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**NOTE:** Engine repair information is not contained within this tractor Repair Manual. For engine repair, refer to publication number 87515682 for the 8.3 & 9.0L 6 Cylinder, 24 Valve CNH Engine with High Pressure Common Rail Fuel System.

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# **Section 00**

## **Chapter 1**




### **STANDARD TORQUE SPECIFICATION**




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## TORQUE SPECIFICATIONS - DECIMAL HARDWARE

Use the torques in this chart when special torques are not given. These torques apply to fasteners with both UNC and UNF threads as received from suppliers dry, or when lubricated with engine oil. Not applicable if special graphites, Molydisulfide greases, or other extreme pressure lubricants are used.


Grade 5 Bolts, Nuts, and Studs		
  		
Size	Pound-Inches	Newton metres
1/4 inch	108 to 132	12 to 15
5/16 inch	204 to 252	23 to 28
3/8 inch	420 to 504	48 to 57
Size	Pound-Feet	Newton metres
7/16 inch	54 to 64	73 to 87
1/2 inch	80 to 96	109 to 130
9/16 inch	110 to 132	149 to 179
5/8 inch	150 to 180	203 to 244
3/4 inch	270 to 324	366 to 439
7/8 inch	400 to 480	542 to 651
1.0 inch	580 to 696	787 to 944
1-1/8 inch	800 to 880	1085 to 1193
1-1/4 inch	1120 to 1240	1519 to 1681
1-3/8 inch	1460 to 1680	1980 to 2278
1-1/2 inch	1940 to 2200	2631 to 2983


Grade 8 Bolts, Nuts, and Studs		
  		
Size	Pound-Inches	Newton metres
1/4 inch	144 to 180	16 to 20
5/16 inch	288 to 348	33 to 39
3/8 inch	540 to 648	61 to 73
Size	Pound-Feet	Newton metres
7/16 inch	70 to 84	95 to 114
1/2 inch	110 to 132	149 to 179
9/16 inch	160 to 192	217 to 260
5/8 inch	220 to 264	298 to 358
3/4 inch	380 to 456	515 to 618
7/8 inch	600 to 720	814 to 976
1.0 inch	900 to 1080	1220 to 1465
1-1/8 inch	1280 to 1440	1736 to 1953
1-1/4 inch	1820 to 2000	2468 to 2712
1-3/8 inch	2380 to 2720	3227 to 3688
1-1/2 inch	3160 to 3560	4285 to 4827
<b>NOTE:</b> Use thick nuts with Grade 8 bolts.		

## TORQUE SPECIFICATIONS - METRIC HARDWARE

Use the following torques when specifications are not given.

These values apply to fasteners with coarse threads as received from supplier, plated or unplated, or when lubricated with engine oil. These values do not apply if graphite or Molydisulfide grease or oil is used.

Grade 8.8 Bolts, Nuts, and Studs		
		
Size	Pound-Inches	Newton metres
M4	24 to 36	3 to 4
M5	60 to 72	7 to 8
M6	96 to 108	11 to 12
M8	228 to 276	26 to 31
M10	456 to 540	52 to 61
Size	Pound-Feet	Newton metres
M12	66 to 79	90 to 107
M14	106 to 127	144 to 172
M16	160 to 200	217 to 271
M20	320 to 380	434 to 515
M24	500 to 600	675 to 815
M30	920 to 1100	1250 to 1500
M36	1600 to 1950	2175 to 2600

Grade 10.9 Bolts, Nuts, and Studs		
		
Size	Pound-Inches	Newton metres
M4	36 to 48	4 to 5
M5	84 to 96	9 to 11
M6	132 to 156	15 to 18
M8	324 to 384	37 to 43
Size	Pound-Feet	Newton metres
M10	54 to 64	73 to 87
M12	93 to 112	125 to 150
M14	149 to 179	200 to 245
M16	230 to 280	310 to 380
M20	450 to 540	610 to 730
M24	780 to 940	1050 to 1275
M30	1470 to 1770	2000 to 2400
M36	2580 to 3090	3500 to 4200

### Grade 12.9 Bolts, Nuts, and Studs



Usually the torque values specified for grade 10.9 fasteners can be used satisfactorily on grade 12.9 fasteners.

## TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS

Tube OD Hose ID	Thread Size	Pound- Inches	Newton metres
<b>37 Degree Flare Fitting</b>			
1/4 inch 6.4 mm	7/16-20	72 to 144	8 to 16
5/16 inch 7.9 mm	1/2-20	96 to 192	11 to 22
3/8 inch 9.5 mm	9/16-18	120 to 300	14 to 34
1/2 inch 12.7 mm	3/4-16	180 to 504	20 to 57
5/8 inch 15.9 mm	7/8-14	300 to 696	34 to 79
Tube OD Hose ID	Thread Size	Pound- Feet	Newton metres
3/4 inch 19.0 mm	1-1/16-12	40 to 80	54 to 108
7/8 inch 22.2 mm	1-3/16-12	60 to 100	81 to 135
1.0 inch 25.4 mm	1-5/16-12	75 to 117	102 to 158
1-1/4 inch 31.8 mm	1-5/8-12	125 to 165	169 to 223
1-1/2 inch 38.1 mm	1-7/8-12	210 to 250	285 to 338

Tube OD Hose ID	Thread Size	Pound- Inches	Newton metres
<b>Straight Threads with O-ring</b>			
1/4 inch 6.4 mm	7/16-20	144 to 228	16 to 26
5/16 inch 7.9 mm	1/2-20	192 to 300	22 to 34
3/8 inch 9.5 mm	9/16-18	300 to 480	34 to 54
1/2 inch 12.7 mm	3/4-16	540 to 804	57 to 91
Tube OD Hose ID	Thread Size	Pound- Feet	Newton metres
5/8 inch 15.9 mm	7/8-14	58 to 92	79 to 124
3/4 inch 19.0 mm	1-1/16-12	80 to 128	108 to 174
7/8 inch 22.2 mm	1-3/16-12	100 to 160	136 to 216
1.0 inch 25.4 mm	1-5/16-12	117 to 187	159 to 253
1-1/4 inch 31.8 mm	1-5/8-12	165 to 264	224 to 357
1-1/2 inch 38.1 mm	1-7/8-12	250 to 400	339 to 542

<b>Split Flange Mounting Bolts</b>		
Size	Pound- Inches	Newton metres
5/16-18	180 to 240	20 to 27
3/8-16	240 to 300	27 to 34
7/16-14	420 to 540	47 to 61
Size	Pound- Feet	Newton metres
1/2-13	55 to 65	74 to 88
5/8-11	140 to 150	190 to 203



**TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS**

Nom. SAE Dash Size	Tube OD	Thread Size	Pound- Inches	Newton metres	Thread Size	Pound- Inches	Newton metres
<b>O-ring Face Seal End</b>					<b>O-ring Boss End Fitting or Lock Nut</b>		
-4	1/4 inch 6.4 mm	9/16-18	120 to 144	14 to 16	7/16-20	204 to 240	23 to 27
-6	3/8 inch 9.5 mm	11/16-16	216 to 240	24 to 27	9/16-18	300 to 360	34 to 41
-8	1/2 inch 12.7 mm	13/16-16	384 to 480	43 to 54	3/4-16	540 to 600	61 to 68
					Thread Size	Pound- Feet	Newton metres
-10	5/8 inch 15.9 mm	1-14	552 to 672	62 to 76	7/8-14	60 to 65	81 to 88
Nom. SAE Dash Size	Tube OD	Thread Size	Pound- Feet	Newton metres	1-1/16-12	85 to 90	115 to 122
					1-3/16-12	95 to 100	129 to 136
-12	3/4 inch 19.0 mm	1-3/16-12	65 to 80	90 to 110	1-5/16-12	115 to 125	156 to 169
-14	7/8 inch 22.2 mm	1-3/16-12	65 to 80	90 to 110	1-5/8-12	150 to 160	203 to 217
-16	1.0 inch 25.4 mm	1-7/16-12	92 to 105	125 to 140	1-7/8-12	190 to 200	258 to 271
-20	1-1/4 inch 31.8 mm	1-11/16-12	125 to 140	170 to 190			
-24	1-1/2 inch 38.1 mm	2-12	150 to 180	200 to 254			

# **Section 00**

## **Chapter 2**

### **SAFETY, GENERAL INFORMATION, MAINTENANCE SCHEDULE**

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## SAFETY



THIS SAFETY ALERT SYMBOL INDICATES IMPORTANT SAFETY MESSAGES IN THIS MANUAL. WHEN YOU SEE THIS SYMBOL, CAREFULLY READ THE MESSAGE THAT FOLLOWS AND BE ALERT TO THE POSSIBILITY OF PERSONAL INJURY OR DEATH.

M171B

To prevent injury always follow the Warning, Caution and Danger notes in this section and throughout the manual.

Put the warning tag shown below on the key for the key switch when servicing or repairing the machine. One warning tag is supplied with each machine. Additional tags are available from your service parts supplier.

Before servicing a machine, park the machine on hard level ground. Turn off the engine, apply the parking brake and remove the key from the key switch. Put blocks in front of and behind either the front or rear wheels.

DO NOT OPERATE

Reason \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Signed by \_\_\_\_\_

DO NOT REMOVE THIS TAG!

See Other Side

Case Part No. \_\_\_\_\_ Printed in U.S.A.

201L95



**WARNING:** Read the operator's manual to familiarize yourself with the correct control functions.

M489



**WARNING:** Operate the machine and equipment controls from the seat position only. Any other method could result in serious injury.

M490



**WARNING:** This machine is for one operator, no riders allowed.

M491A



**WARNING:** Before starting engine study Operator's Manual safety messages. Read all safety signs on machine. Clear the area of other persons. Learn and practice safe use of controls before operating. It is your responsibility to understand and follow manufacturers instructions on machine operation, service, and to observe pertinent laws and regulations. Operator and Repair Manuals may be obtained from your equipment dealer.

M103A



**WARNING:** If you wear clothing that is too loose or do not use the correct safety equipment for your job, you can be injured. Always wear clothing that will not catch on objects. Extra safety equipment that can be required includes hard hat, safety shoes, ear protection, eye or face protection, heavy gloves and reflective clothing.

M492



**WARNING:** When working in the area of the fan belt with the engine running, avoid loose clothing if possible, and use extreme caution.

M493



**WARNING:** When doing checks and tests on the equipment hydraulics, follow the procedures as they are written. DO NOT change the procedure.

M494



**WARNING:** When putting the hydraulic cylinders on this machine through the necessary cycles to check operation or to remove air from a circuit, make sure all people are out of the way.

M495



**WARNING:** Always wear heat protective gloves to prevent burning your hands when handling heated parts.

SM121A



**WARNING:** Lower all attachments to the ground or use stands to safely support the attachments before you do any maintenance or service.

M496



**WARNING:** Hydraulic oil or diesel fuel leaking under pressure can penetrate the skin and cause infection or other injury.

To Prevent Personal Injury:

Relieve all pressure, before disconnecting fluid lines. Before applying pressure, make sure all connections are tight and components are in good condition.

Never use your hand to check for suspected leaks under pressure.

Use a piece of cardboard or wood for this purpose. If injured by leaking fluid, see your doctor immediately.

SM171A



**WARNING:** When removing hardened pins such as a pivot pin, or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and a steel head hammer.

M497



**WARNING:** When using a hammer to remove and install pivot pins or separate parts using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protectors).

M498



**WARNING:** Use suitable floor (service) jacks or chain hoist to raise wheels or tracks off the floor. Always block machine in placed with suitable safety stands.

M499



**WARNING:** When servicing or repairing the machine. Keep the shop floor and operator's compartment and steps free of oil, water, grease, tools, etc. Use an oil absorbing material and or shop cloths as required. Use safe practices at all times.

M500



**WARNING:** Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in the Repair Manual.

M501



**WARNING:** Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust pipe extension. Open the door and get outside air into the area.

M502



**WARNING:** When the battery electrolyte is frozen, the battery can explode if (1), you try to charge the battery, or (2), you try to jump start and run the engine. To prevent the battery electrolyte from freezing, try to keep the battery at full charge. If you do not follow these instructions, you or others in the area can be injured.

M503



**WARNING:** Batteries contain acid and explosive gas. Explosions can result from sparks, flames or wrong cable connections. To connect the jumper cables correctly to the battery of this machine see the Operator's Manual. Failure to follow these instructions can cause serious injury or death.

M504

## GENERAL INFORMATION

### Cleaning

Clean all metal parts except bearings, in mineral spirits or by steam cleaning. Do not use caustic soda for steam cleaning. After cleaning, dry and put oil on all parts. Clean oil passages with compressed air.

### Inspection

Check all parts when the parts are disassembled. Replace all parts that have excessive wear or are damaged. Small scoring or grooves can be removed with a hone or crocus cloth. Complete visual inspection for indications of wear, pitting and the replacement of parts necessary will prevent early failures.

### Bearings

Clean bearings with a good clean solvent and permit to air dry. **DO NOT DRY BEARINGS WITH COMPRESSED AIR.** Check bearings for smooth easy action. If the bearing has a loose fit or rough action, the bearing must be replaced.

### Needle Bearings

Before you press needle bearings into a bore, always remove any metal protrusions in the bore or the edge of the bore. Before you press bearings into position, put petroleum jelly on the inside and outside diameter of the bearing.

### Gears

Check all gears for excessive wear or damage. Replace gears as necessary.

### Oil Seals, O-rings and Gaskets

Always install new oil seals, O-rings and gaskets. Put petroleum jelly on seals and O-rings.

### Shafts

Check all shafts for excessive wear or damage. Check the bearing and oil seal surfaces on the shafts for excessive wear or damage. Replace shafts as necessary.

### Service Parts

Always install genuine New Holland service parts. When ordering refer to the Parts Catalog for the correct part number of the genuine New Holland replacement items. Failures due to the use of other than genuine New Holland replacement parts are not covered by warranty.

### Lubrication

Use only the oils and lubrication specified in the Operator's or Repair Manual. Failures due to the use of non specified oils and lubricants are not covered by warranty.

## LUBRICATION/MAINTENANCE CHART

Service Interval	Maintenance Requirement	Check	Grease	Change	Clean	Drain
<b>When Warning Message Displays</b>	Air Cleaner Element				X	
<b>Every 10 Hours Or Daily</b>	Engine Oil Level	X				
	Transmission Oil Level	X				
	Coolant Reservoir Level	X				
<b>Every 50 Hours</b>	Engine Primary Fuel Filter - Drain Water					X
	Engine Coolant Level – Deaeration Tank	X				
	SuperSteer Axle Linkage Pins		X			
<b>Every 100 Hours</b>	Front Hitch (If Equipped)		X			
<b>Every 300 Hours</b>	Battery Water Level (Note E)	X				
	Engine Air Intake Hoses	X				
	*Engine Oil And Filter			X		
	Front And Rear Wheel Bolt Torques	X				
	Front Weight And Rear Wheel Weight Bolt Torques	X				
	Front Axle And Rear Hitch (Note A)		X			
	Fuel Tank - Drain Water					X
	Differential And Planetary Oil Level (Note B)	X				
	Transmission Oil Pressure	X				
	Reversible 1000 RPM PTO Shaft (Note D)		X			
<b>Every 600 Hours</b>	Engine Coolant Antifreeze Protection	X				
	Engine Coolant Filter			X		
	Engine Coolant Hoses And Clamps	X				
	Engine Fuel Filters			X		
	Changeable PTO Internal Splines		X			
<b>Every 1200 Hours Or Annually</b>	Differential and Planetary Oil			X		
	Engine Primary And Secondary Air Filter			X		
	Engine Air Precleaner				X	
<b>Every 1500 Hours</b>	Transmission Oil, Filter(s) and Breather			X		
<b>Every 2100 Hours</b>	Engine Fuel Injection Nozzles (Note C)	X				
	Engine Coolant And Coolant Conditioner			X		
	Engine Valve Adjustment (Note C)	X				
<b>Every 3000 Hours</b>	Engine Crankshaft Dampener (Note C)	X				
<b>As Required</b>	Cab Air And Recirculation Filters			X	X	
	Cab Air Filter Dust Valve	X				
	Engine Primary Air Filter				X	
	Grill Screens, Radiator, Condenser/Fuel Cooler, Oil Cooler, Air to Air Cooler				X	
	Fan Belt Replacement			X		
	Tire Pressure	X				
	Coupler Spillage Collection Bottle				X	

\* Engine oil change interval may be affected by the sulfur content of the fuel. See Engine Oil Change in this manual.

**Note A** - In severe or wet conditions, interval is every 10 hours or daily.

**Note B** - Perform initial service in first 50 hours of operation.

**Note C** - Dealer must perform this service.

**Note D** - Every 300 PTO hours or twice a year.

**Note E** - If operated in ambient temperatures of 90° F (32° C) or greater, the battery fluid should be checked every 100 hours or once a week, whichever comes first.

## SYSTEM CAPACITIES

SYSTEM	U.S. MEASURE	METRIC MEASURE	IMPERIAL MEASURE
Engine Oil No Filter Change With Filter Change	5 Gal 5-1/2 Gal	19 L 21L	4.2 Gal 4.5 Gal
Cooling System All	7 Gal	26.5 L	5.8 Gal
Trans / Hydraulic System	45-1/2 Gal	172 L	38 Gal
Front Wheel Drive			
<sup>A</sup> 10 Bolt Axle			
Differential – Standard and Suspended FWD	13.0 Qts <sup>B</sup>	12.3 L	21.6 Pints
Differential – SuperSteer FWD	14.0 Qts <sup>C</sup>	13.25 L	23.3 Pints
Planetary - Each	3 Pints	1.4 L	2.5 Pints
<sup>A</sup> 12 Bolt Axle			
Differential – Standard and Suspended FWD	12.5 Qts <sup>D</sup>	11.8 L	20.8 Pints
Differential – SuperSteer FWD	14.0 Qts <sup>C</sup>	13.25 L	23.3 Pints
Planetary - Each	7.0 Pints	3.3 L	5.8 Pints
Fuel Tank All	178 Gal	674L	148 Gal
<sup>A</sup> = Bolt quantity can be determined by observing the wheel ends. <sup>B</sup> = 25 pints New Holland Ambra Hypoide 140 Gear Oil, SAE 85W140, plus 1 pint New Holland Limited Slip Additive (B96606) for 13 quarts total. <sup>C</sup> = 27 pints New Holland Ambra Hypoide 140 Gear Oil, SAE 85W140, plus 1 pint New Holland Limited Slip Additive (B96606) for 14 quarts total. <sup>D</sup> = 24 pints New Holland Ambra Hypoide 140 Gear Oil, SAE 85W140, plus 1 pint New Holland Limited Slip Additive (B96606) for 12.5 quarts total.			



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# **Section 10**

## **Chapter 1**

### **ENGINE REMOVAL AND INSTALLATION**

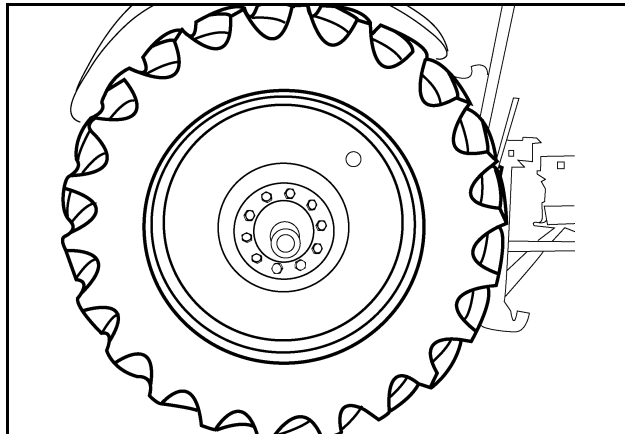
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ENGINE INSTALLATION .....	10-1-10

## ENGINE REMOVAL

**NOTE:** Make note of where any wire harness and hose tie straps are removed during disassembly so they can be properly installed during assembly.

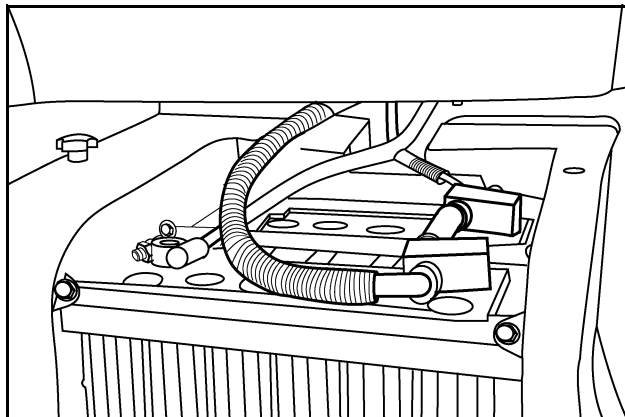
### STEP 1



RD02C070

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Turn off the engine and remove the key. Place blocks in front of and behind the rear wheels.

### STEP 2



RD02E069

Remove the battery cover. Disconnect the negative cable (-) then the positive cable (+).

### STEP 3

Remove the hood. See Hood Removal Section in this Repair Manual.

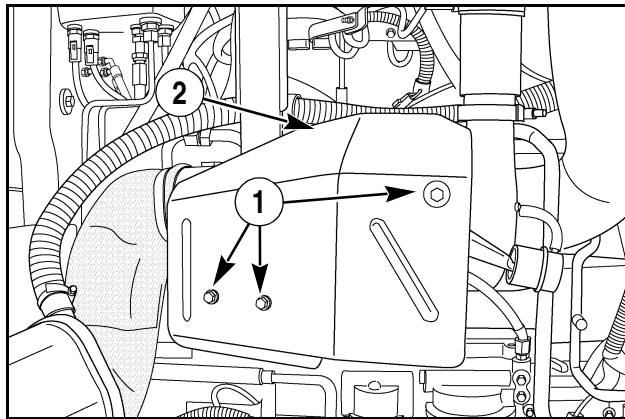
### STEP 4

Evacuate the A/C system. See A/C Service Section in this Repair Manual.

### STEP 5

Remove the cooling module. See Cooling Module Section in this Repair Manual.

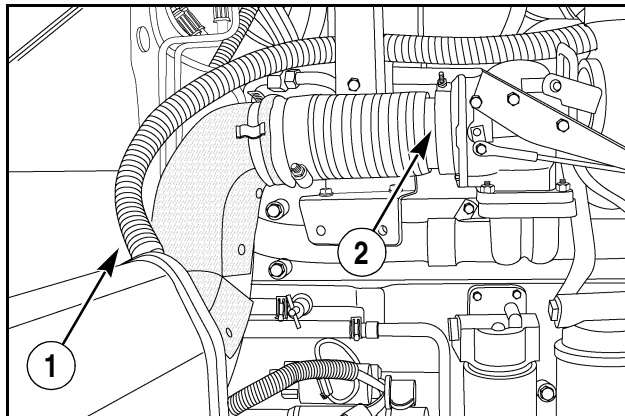
### STEP 6



RD05N100

Remove the exhaust shield mounting hardware (1) and remove the shield (2).

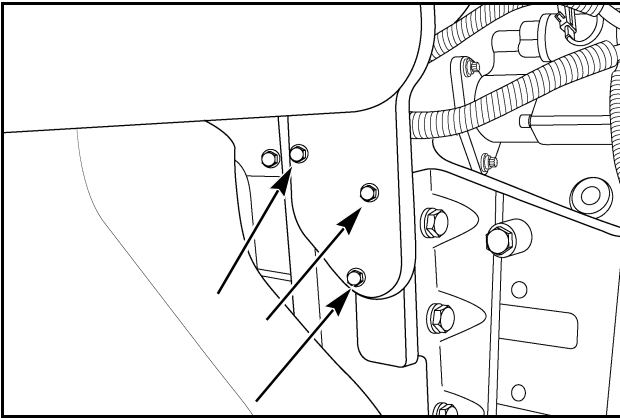
### STEP 7



RD05N101

Remove the air cleaner aspirator hose (1). Disconnect the exhaust pipe at the turbo. (2).

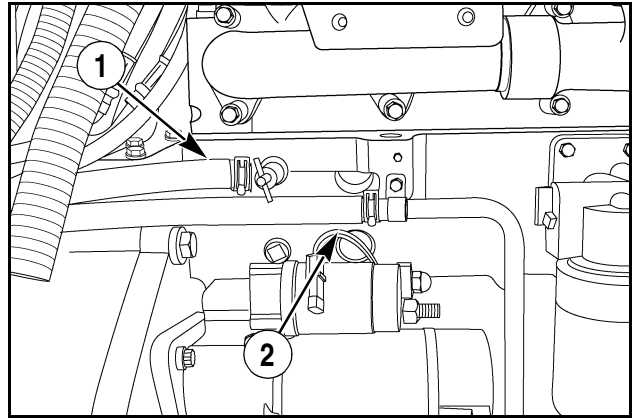
## STEP 8



RD05N102

Properly support the muffler. Remove the mounting hardware and remove the muffler / exhaust elbow assembly.

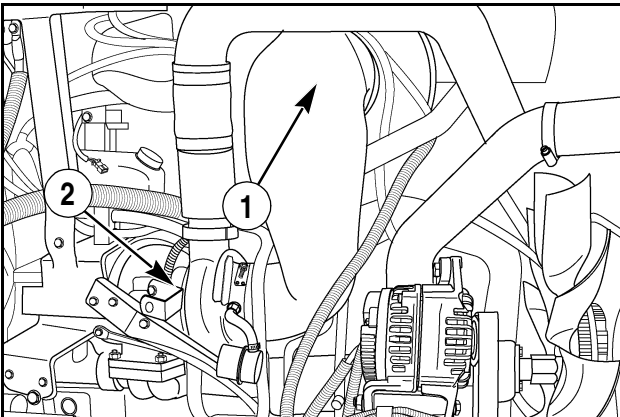
## STEP 11



RD05N105

Tag and remove the heater supply hose (1) and return hose (2).

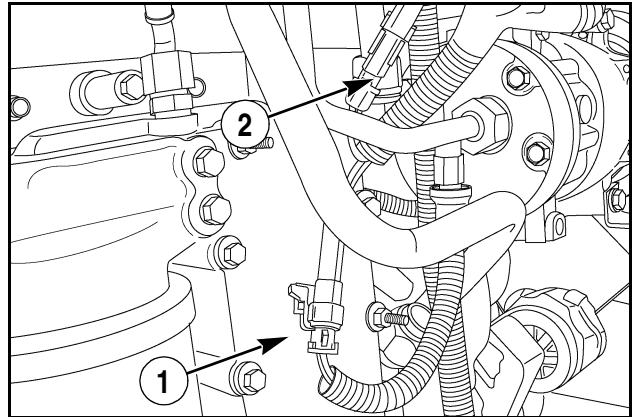
## STEP 9



RD05N103

Disconnect the turbo to charge-air cooler pipe (1) at the turbo (2) and remove.

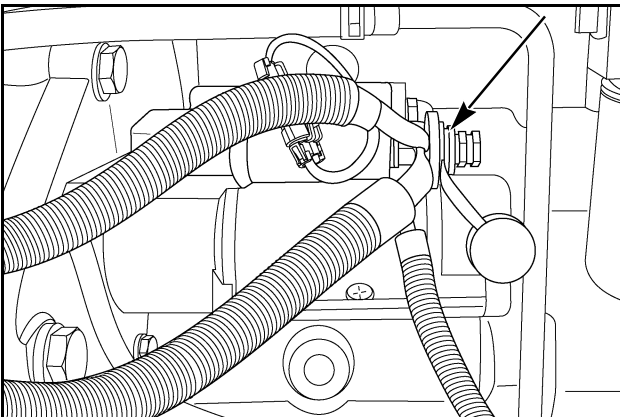
## STEP 12



RD05N106

Disconnect the A/C high pressure switch (1). Disconnect the A/C compressor clutch harness (2).

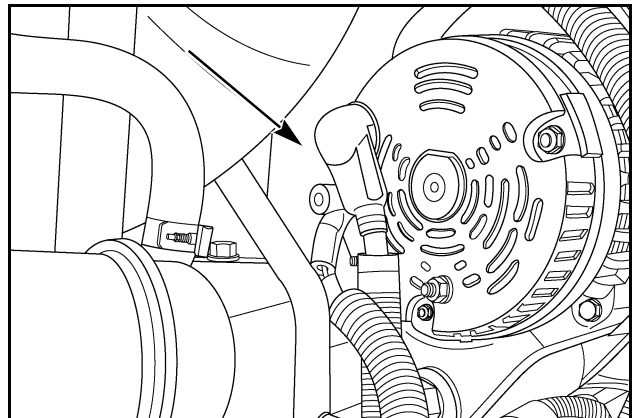
## STEP 10



RD05N104

Remove the starter cables.

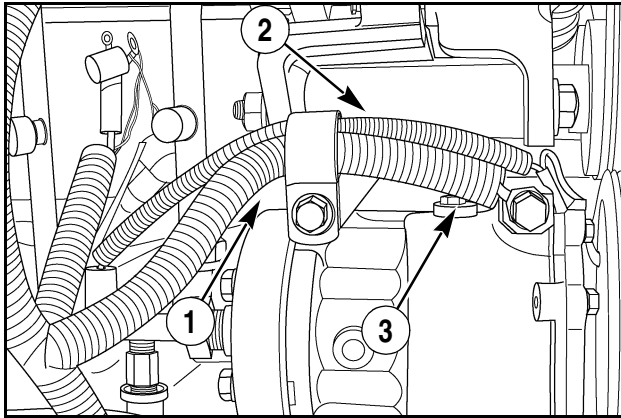
## STEP 13



RD05N107

Remove and tag the alternator harness wires.

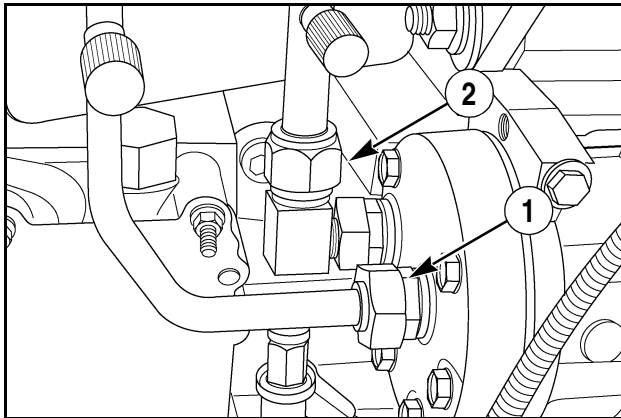
### STEP 14



RD05N108

Remove the harness clamp (1). Remove the compressor clutch harness (2) from the clamp. Reinstall the mounting bolt. Remove the ground wire (3) and reinstall the mounting bolt.

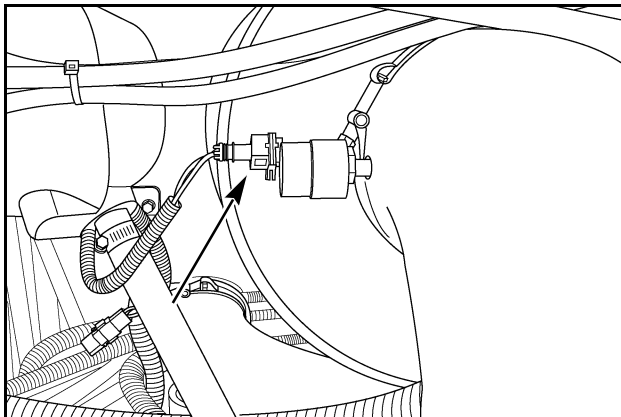
### STEP 15



RD05N109

Remove the high (1) and low (2) pressure A/C line. Discard the O-rings. Cap all fittings.

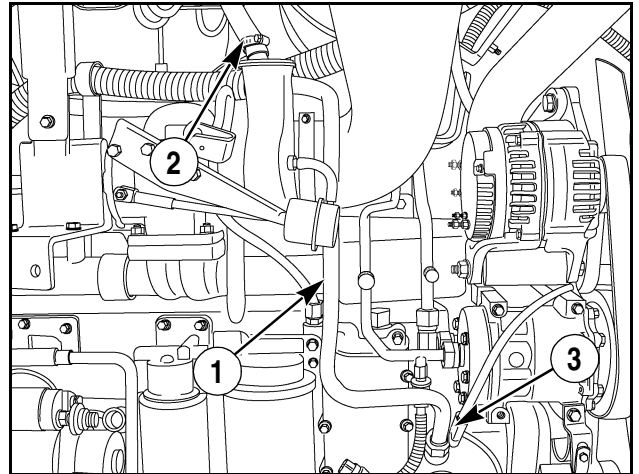
### STEP 16



RD05N110

Remove the air cleaner restriction switch harness.

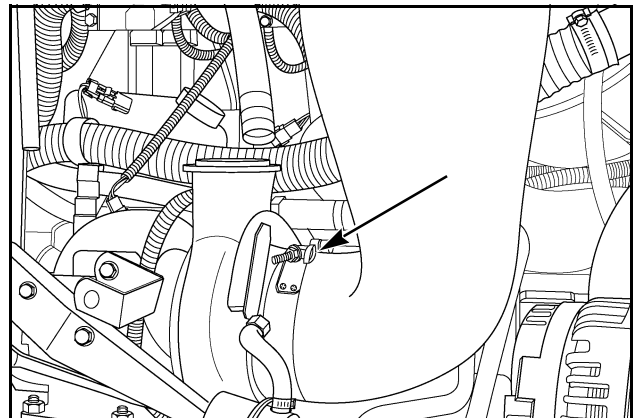
### STEP 17



RD05N136

Disconnect the coolant fill tube (1) at the deaeration tank hose (2) and the engine block (3). Remove the tube.

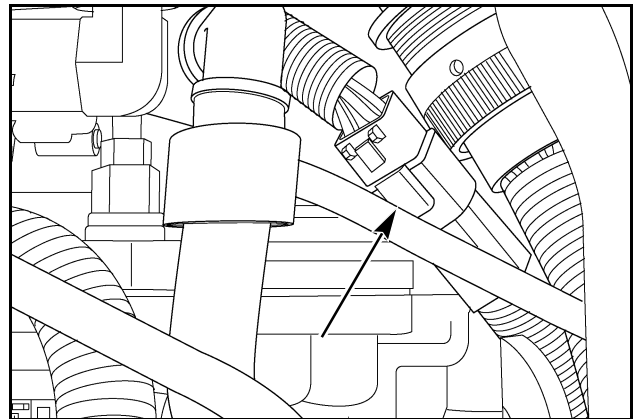
### STEP 18



RD05N111

Loosen the air cleaner to turbo inlet hose clamp.

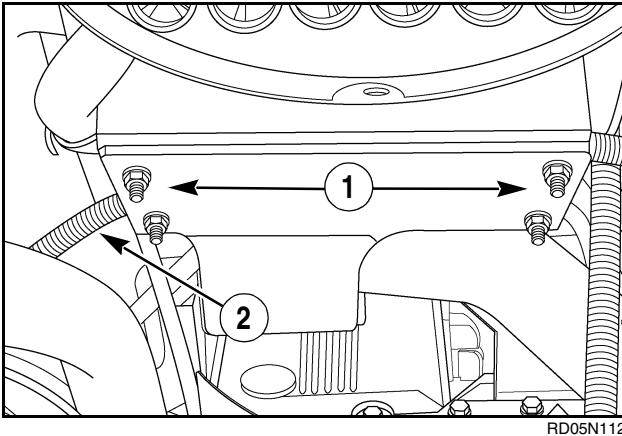
### STEP 19



RD05N117

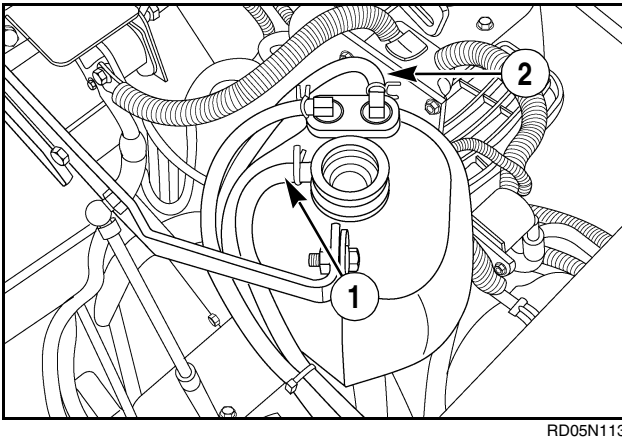
Disconnect the alternator wire harness connector. This connector is located on the left side near the hood support.

## STEP 20



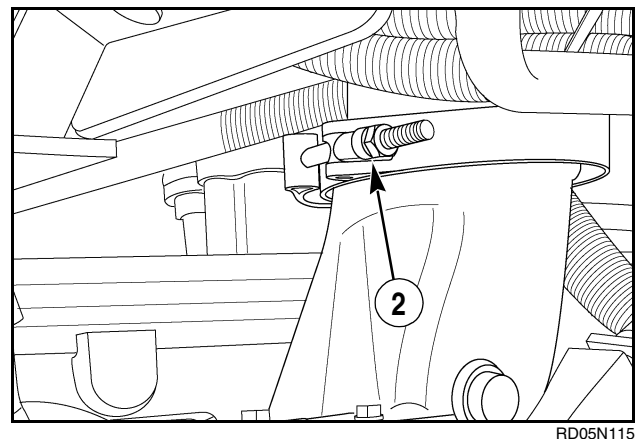
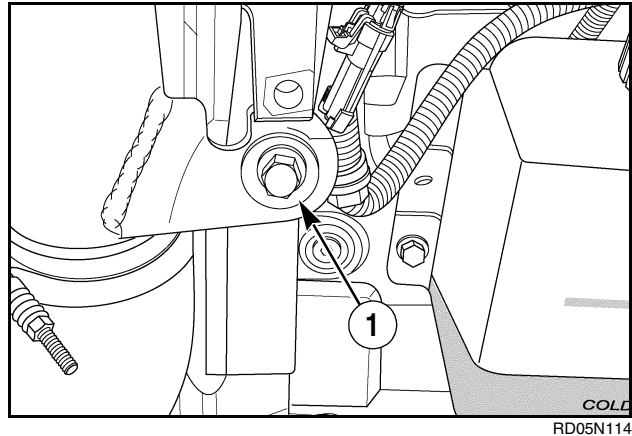
Remove the four air cleaner housing mounting nuts (1). Remove the air cleaner assembly. Remove the alternator wire harness (2) with the air cleaner assembly.

## STEP 21



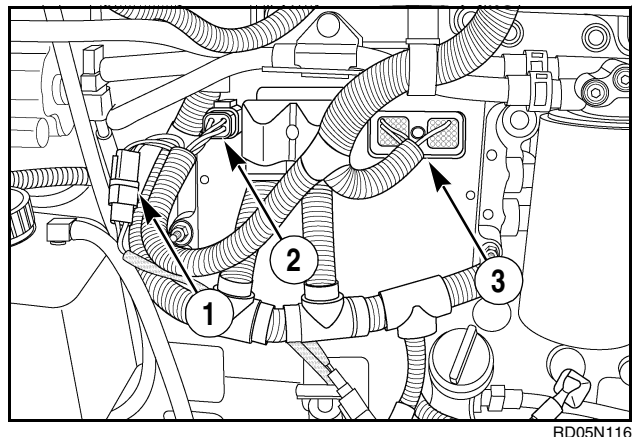
Remove the deaeration tank to recovery bottle hose (1) and engine to deaeration tank air bleed hose (2).

## STEP 22



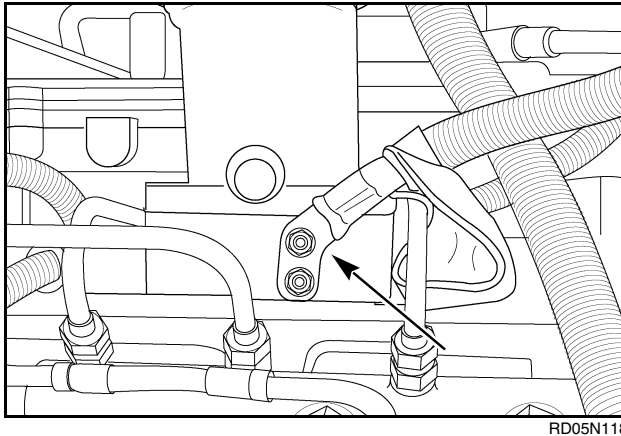
Remove the charge-air cooler to intake manifold tube bushing bolt (1). Remove the charge-air cooler to intake manifold pipe clamp (2). Remove the pipe. Discard the O-ring located at the intake manifold.

## STEP 23



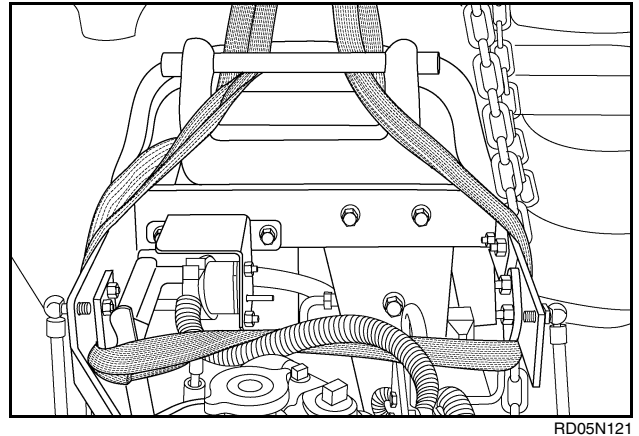
Disconnect the suspended axle position pot harness (1) if equipped. Remove the engine ECM (Electronic Control Module) power connector (2) and the throttle position connector (3).

### STEP 24



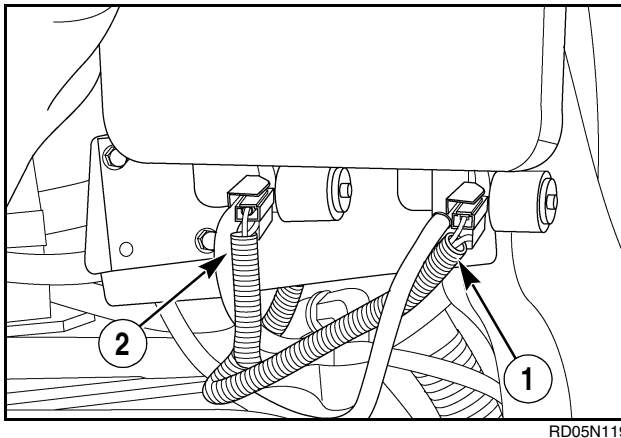
Remove the engine heater grid power cable.

### STEP 27



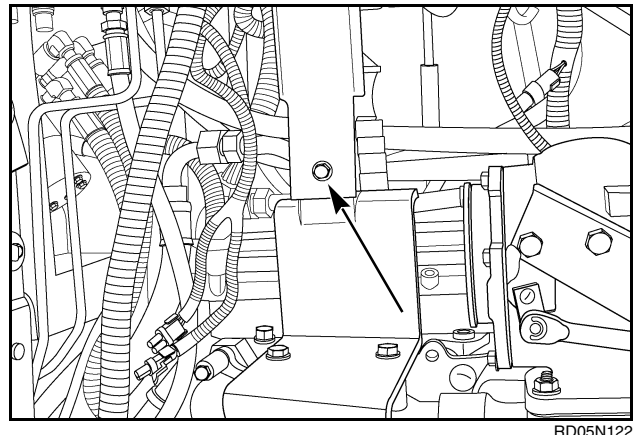
Properly support the hood / deaeration tank mounting assembly.

### STEP 25



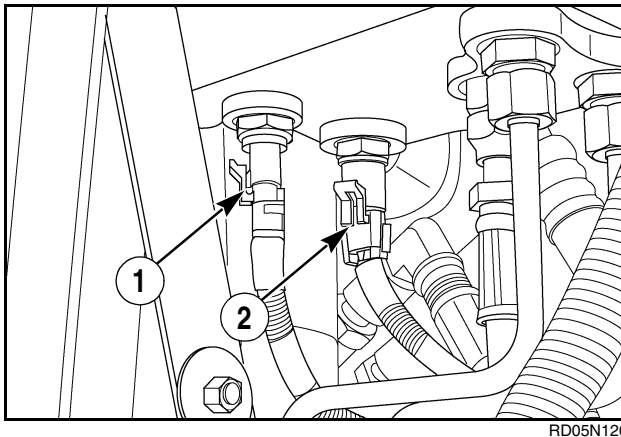
Remove the washer bottle from its mounting bracket. Tag and remove the front washer hose and electrical connector (1). Repeat for the rear (2) if required.

### STEP 28



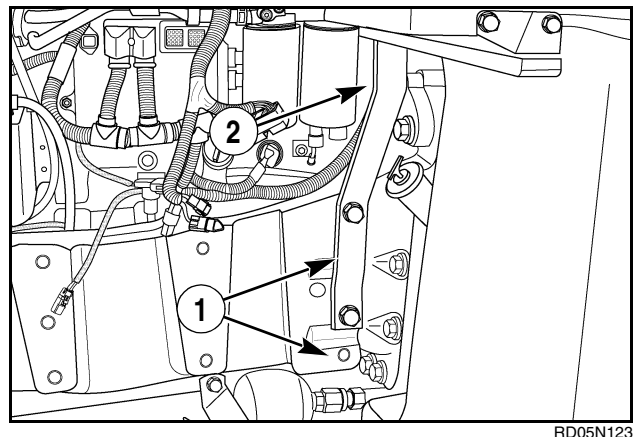
Remove right rear support bracket bolt.

### STEP 26



Tag and remove the right (1) and left (2) brake switch connectors.

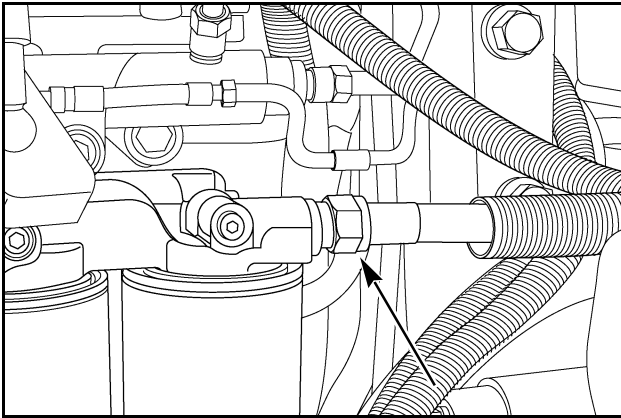
### STEP 29



If installed, remove the windshield step mounting bolts (1) and remove the step (2).

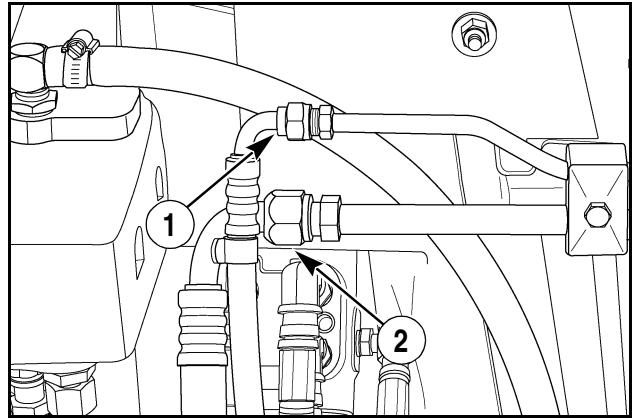


**STEP 30**



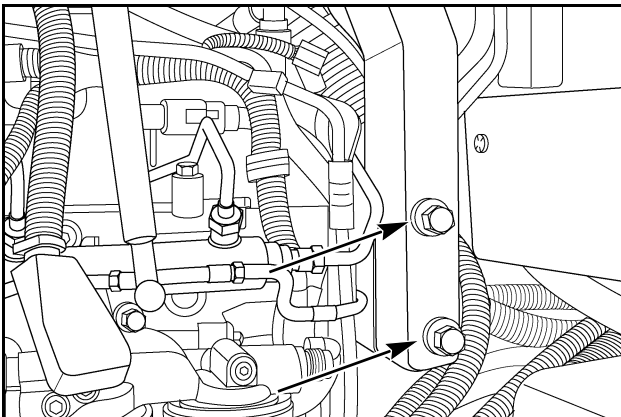
Remove the fuel supply hose.

**STEP 33**



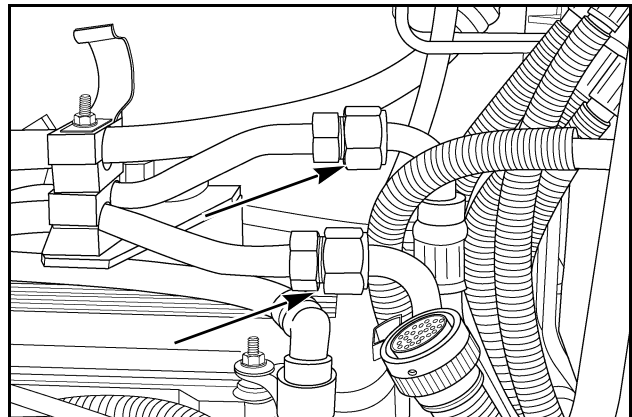
Disconnect the high (1) and low (2) pressure A/C lines.

**STEP 31**



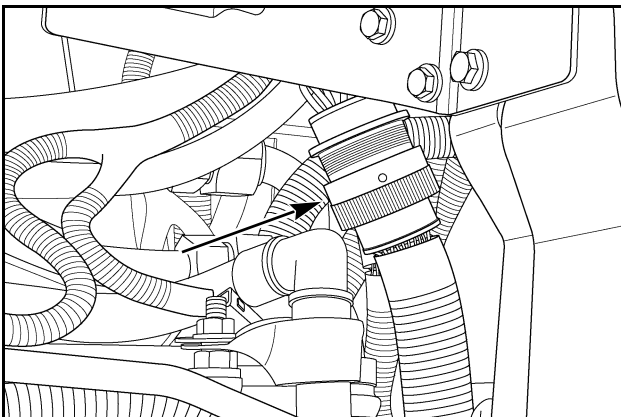
Remove the two support mounting bolts.

**STEP 34**



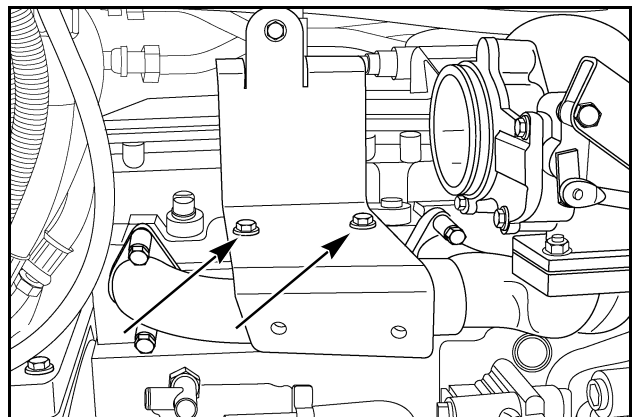
Remove the hydraulic oil cooling lines.

**STEP 32**



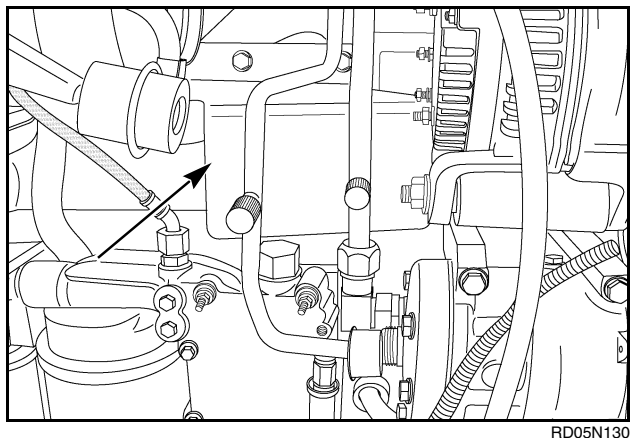
Raise the assembly slightly to gain access to the main engine connector (1) and disconnect. Continue to raise and remove from the engine.

**STEP 35**



Remove the two right rear tube / hose / air cleaner bracket assembly mounting bolts.

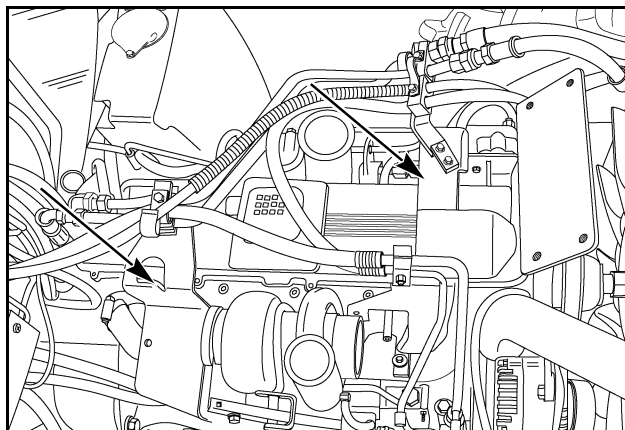
### STEP 36



RD05N130

Remove the A / C tube exhaust shield.

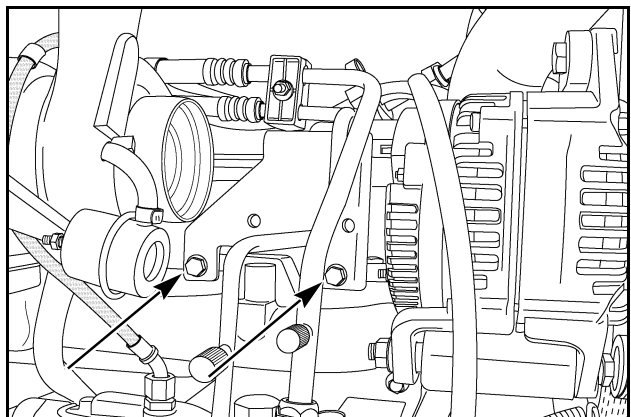
### STEP 39



RD05N133

Properly support the hose / tube / air cleaner support bracket assembly and remove from the engine.

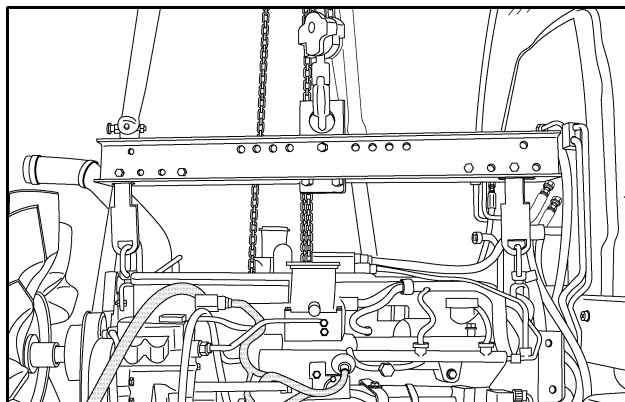
### STEP 37



RD05N131

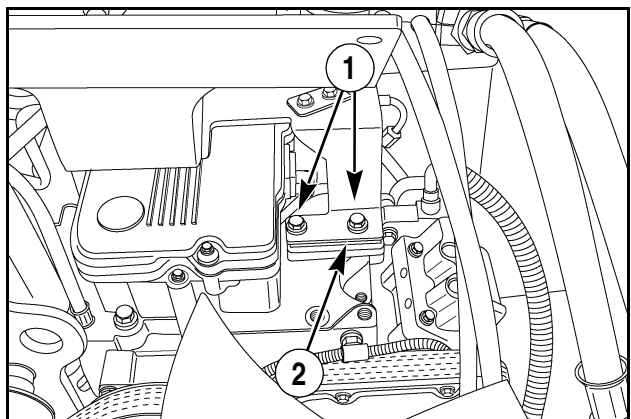
Remove the right front mounting bolts.

### STEP 40



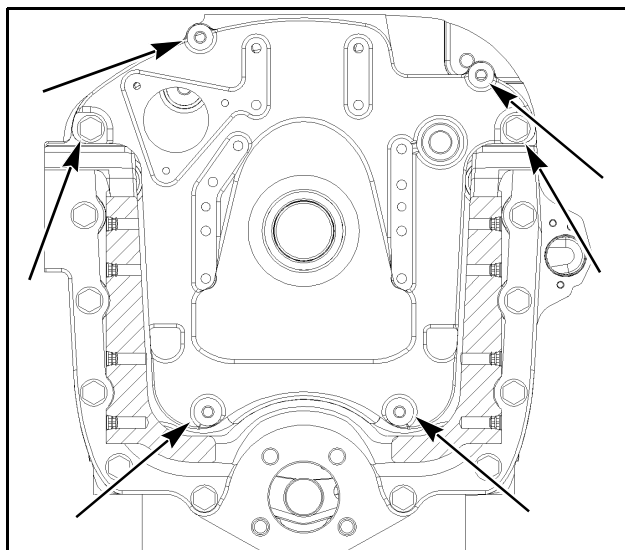
RD05N135

### STEP 38



RD05N132

Remove the left front mounting bolts (1) and spacer (2).

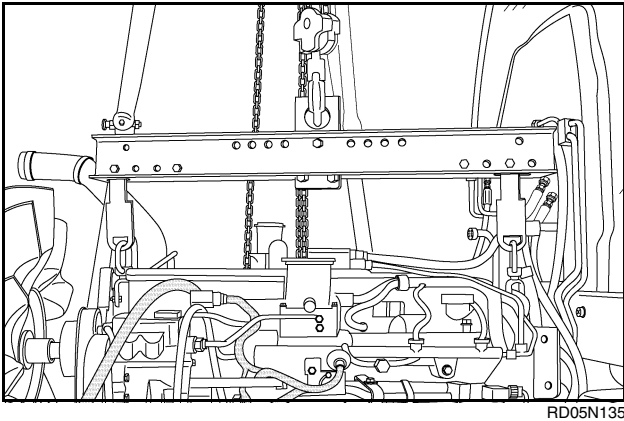


RI02C011

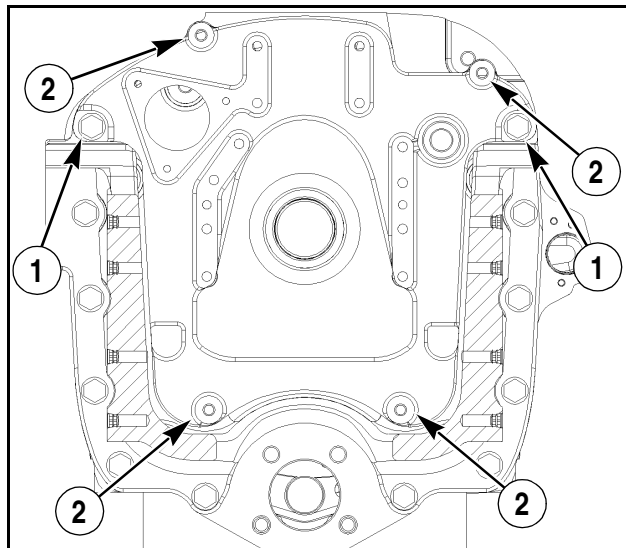
Properly support the engine. Place a small amount of tension on the hoist. Remove the six engine mounting bolts. Move the engine forward to disengage from the transmission. Remove the engine from the front frame.

## ENGINE INSTALLATION

### STEP 41



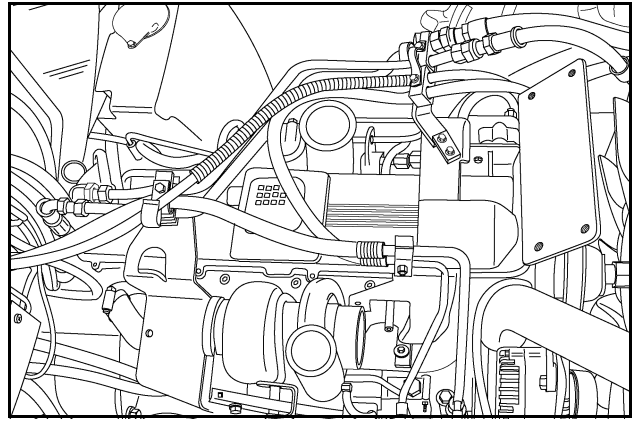
RD05N135



RI02C011

Apply a thin coat of anti seize lubricant to the transmission input shaft splines. Properly support the engine and lift into place. Align the splines on the shaft with the engine flywheel dampener and slide into place. Install the mounting bolts. Tighten the two M20 bolts (1) to a torque of 430 to 485 Nm (315 to 355 lb. ft.) Tighten the four M16 bolts (2) to a torque of 221 to 250 Nm (160 to 180 lb. ft.).

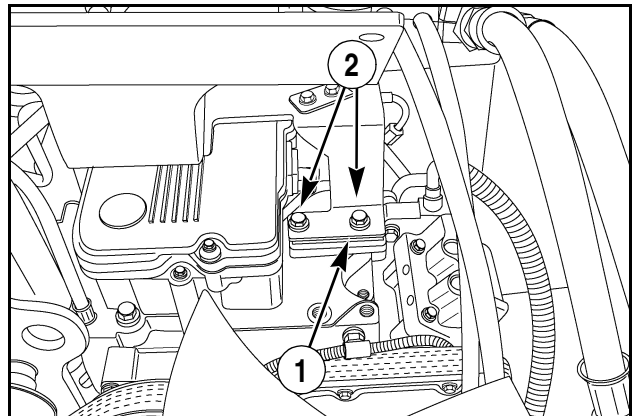
### STEP 42



RD05N133

Set the hose / tube / air cleaner support bracket assembly in place on top of the engine.

### STEP 43

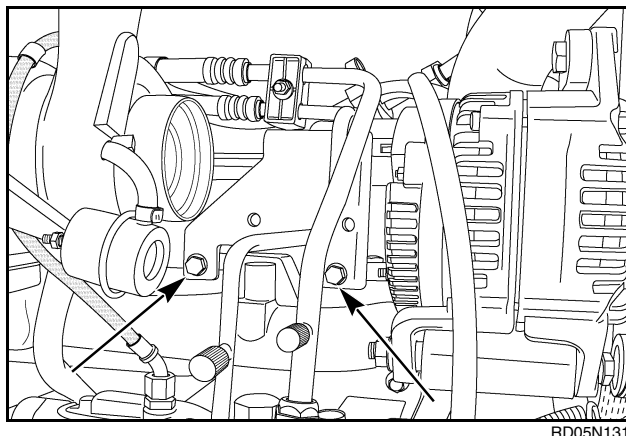


RD05N132

Set the spacer (1) into place and install the mounting bolts (2).

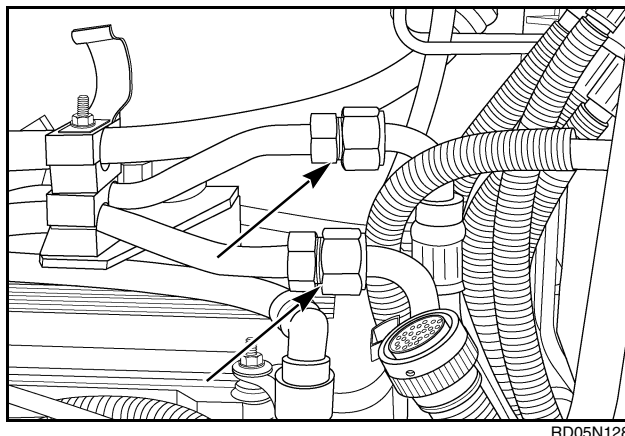
**NOTE:** *DO NOT* tighten the bracket mounting hardware at this time.

### STEP 44



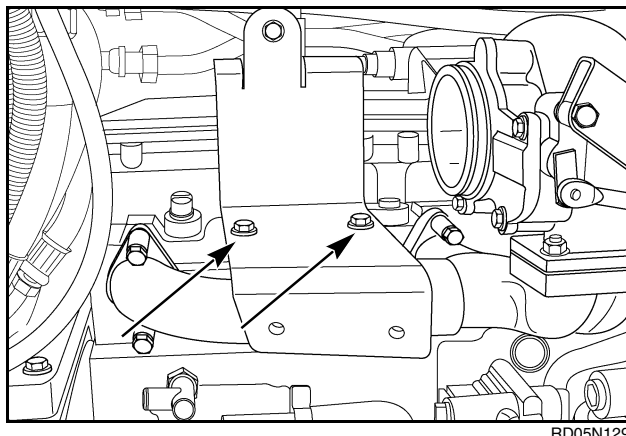
Install the right front mounting bolts.

### STEP 47



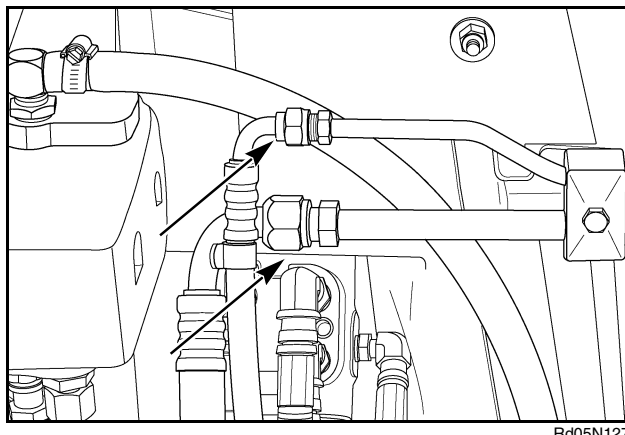
Install new O-rings on the fittings and tighten the hydraulic cooling lines.

### STEP 45



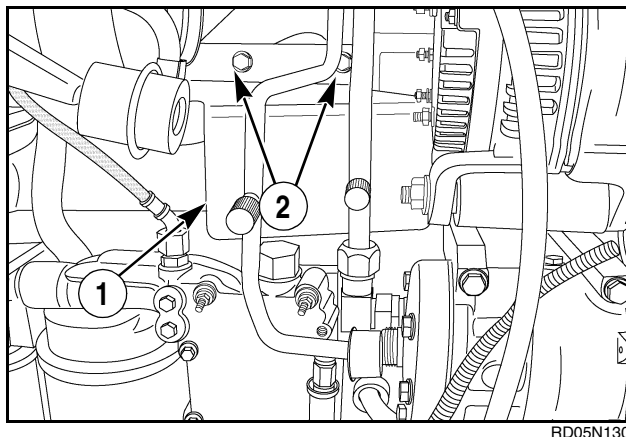
Install the right rear mounting bolts. Tighten ALL bracket mounting bolts at this time.

### STEP 48



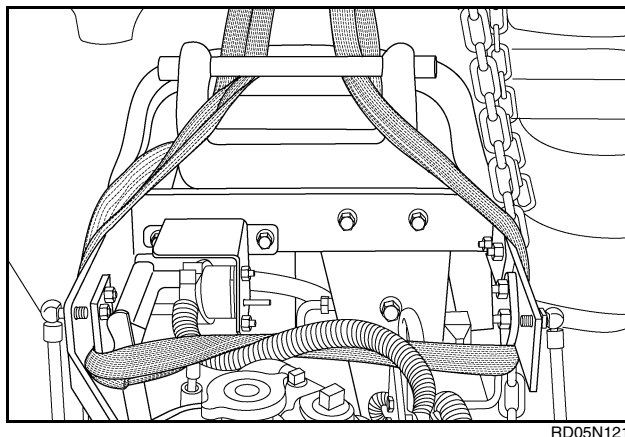
Install new O-rings on the fittings and tighten the A / C lines.

### STEP 46



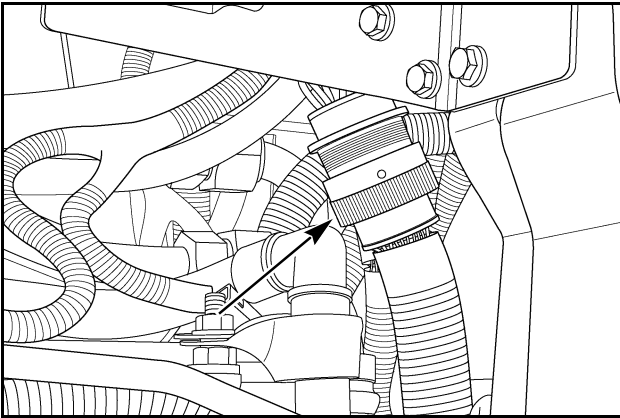
Install the heat shield (1). Install and tighten mounting bolts (2).

### STEP 49



Properly support the hood / deaeration tank mounting assembly and set into place at the rear of the engine.

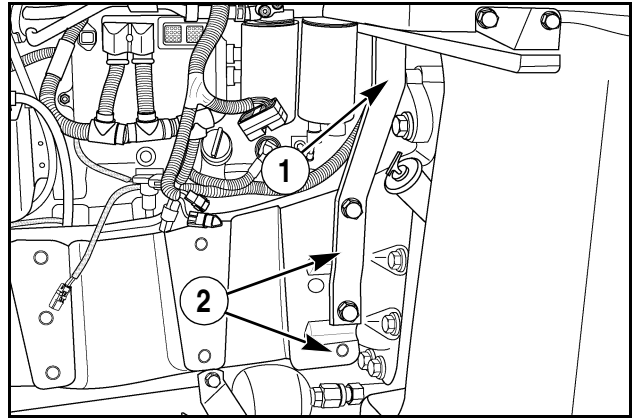
**STEP 50**



RD05N126

Connect the engine wire harness connector.

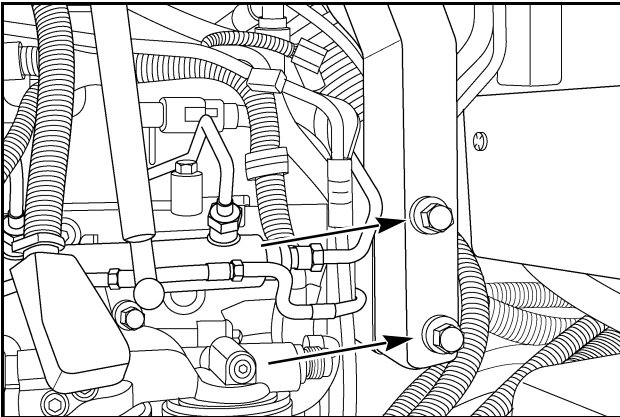
**STEP 53**



RD05N123

If removed, install the windshield step (1) and tighten the bolts (2).

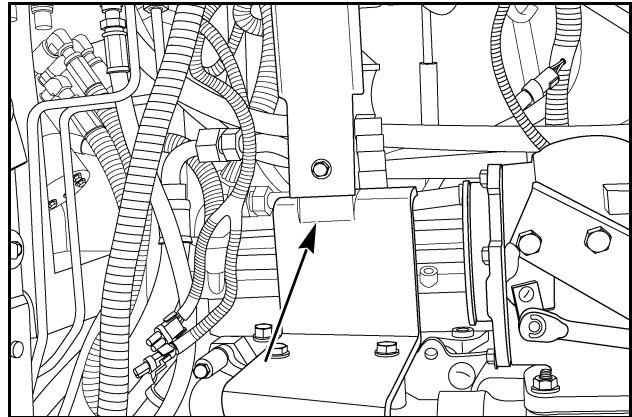
**STEP 51**



RD05N125

Install the support mounting bolts and tighten to a torque of 310 to 380 Nm (230 to 280 lb. ft.).

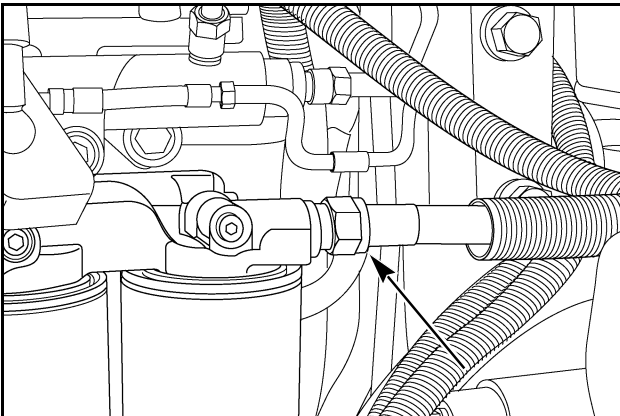
**STEP 54**



RD05N122

Install and tighten the right rear support bolt.

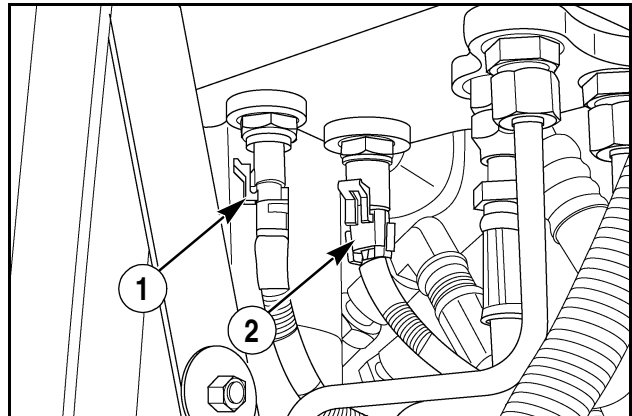
**STEP 52**



RD05N124

Install the fuel supply hose.

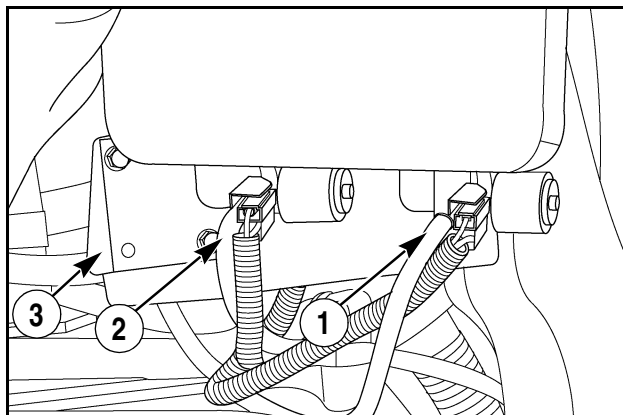
**STEP 55**



RD05N120

Install the right (1) and left (2) brake switch connectors.

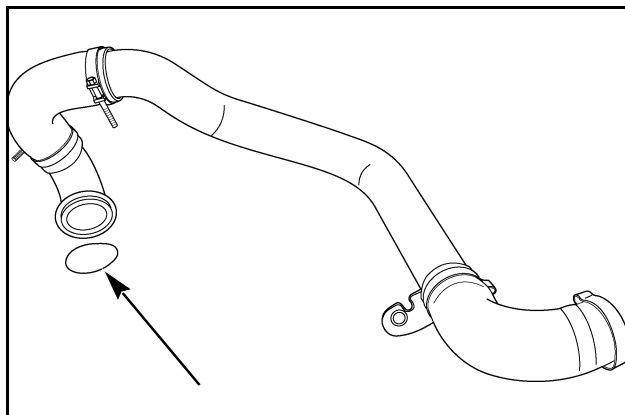
### STEP 56



RD05N119

Install the front washer hose and electrical connector (1) and rear (2) if equipped. Install the bottle onto the bracket (3).

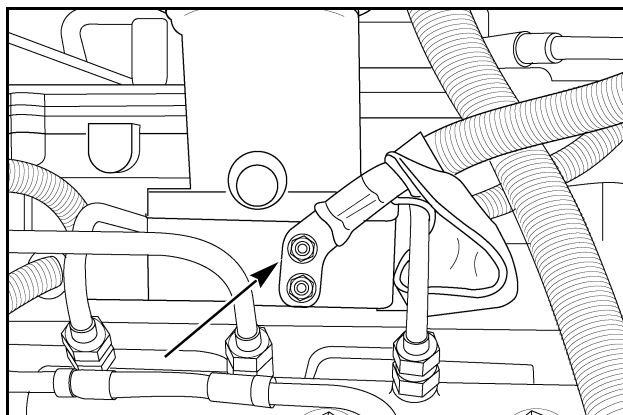
### STEP 59



RD05N134

Install a new O-ring on the charge-air cooler to intake manifold tube assembly. Install the tube.

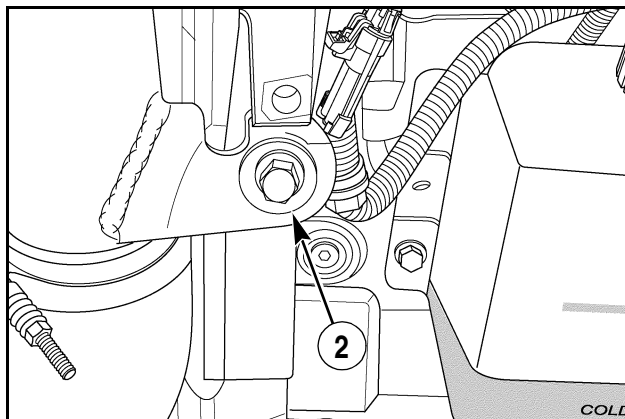
### STEP 57



RD05N118

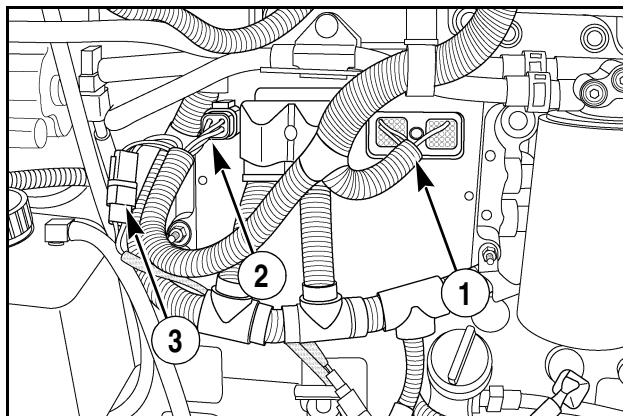
Install the engine grid heater power cable.

### STEP 60



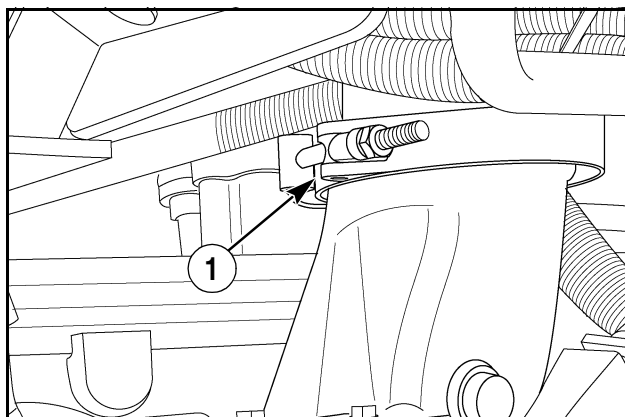
RD05N114

### STEP 58



RD05N116

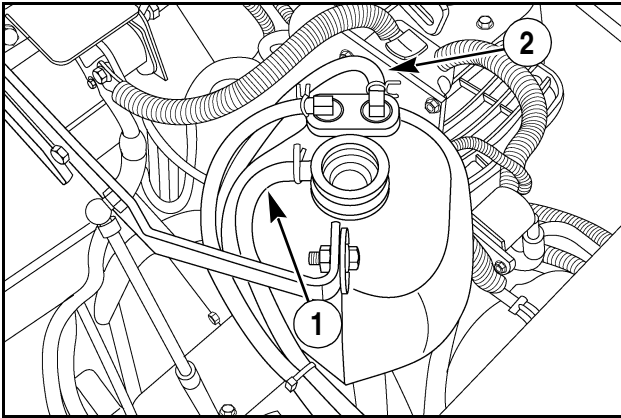
Install the throttle position connector (1) and the ECM power connector (2). If equipped, connect the suspended axle position pot connector (3).



RD05N115

Install the bushing bolt (1). Install the clamp (2). Tighten all hardware.

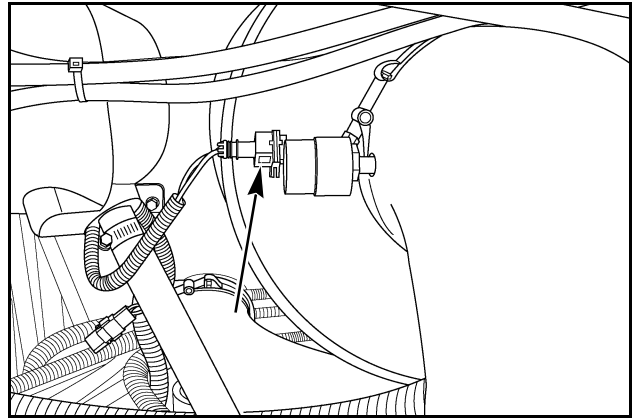
### STEP 61



RD05N113

Install the deaeration tank to coolant recovery bottle hose (1) and engine air bleed line (2).

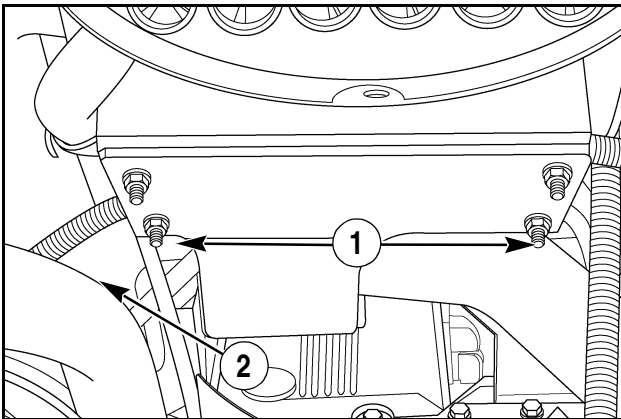
### STEP 64



RD05N110

Install the air cleaner restriction switch connector.

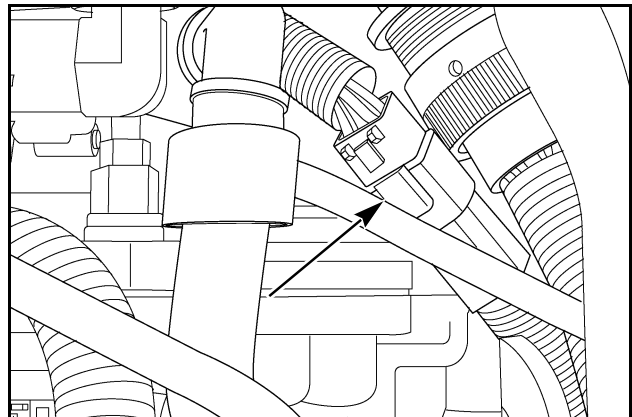
### STEP 62



RD05N112

Install the air cleaner assembly onto the bracket and tighten the mounting nuts. Make sure the alternator wire harness is installed between the air cleaner and mounting brackets.

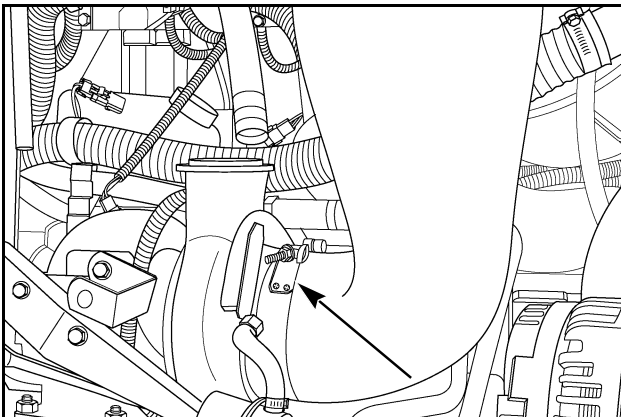
### STEP 65



RD05N117

Connect the alternator harness.

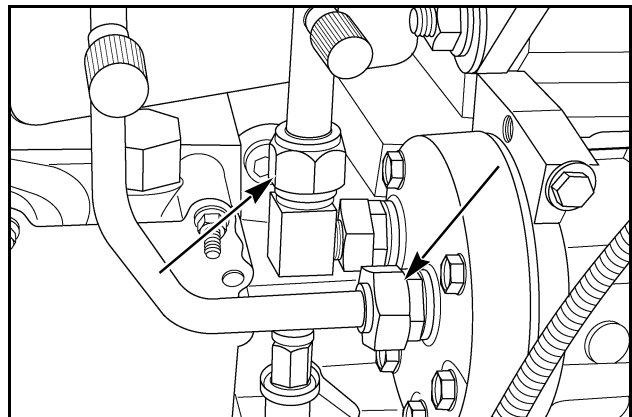
### STEP 63



RD05N111

Tighten the air cleaner to turbo hose clamp

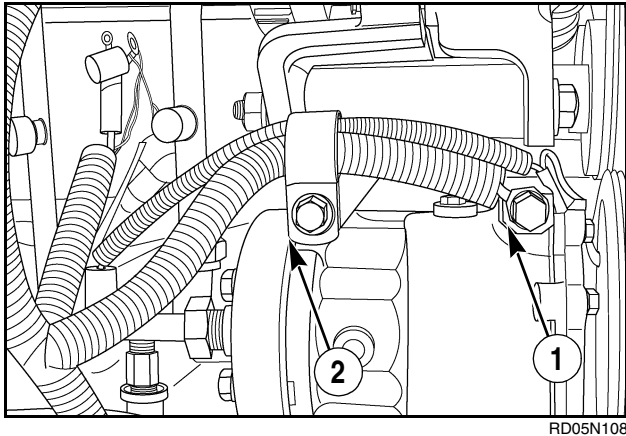
### STEP 66



RD05N109

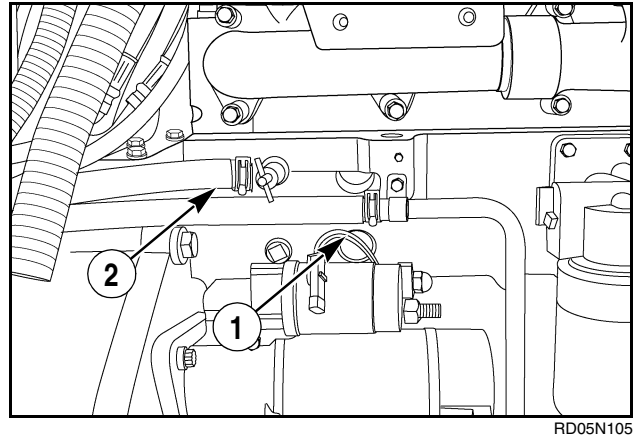
Install new O-rings and tighten the A / C compressor lines.

### STEP 67



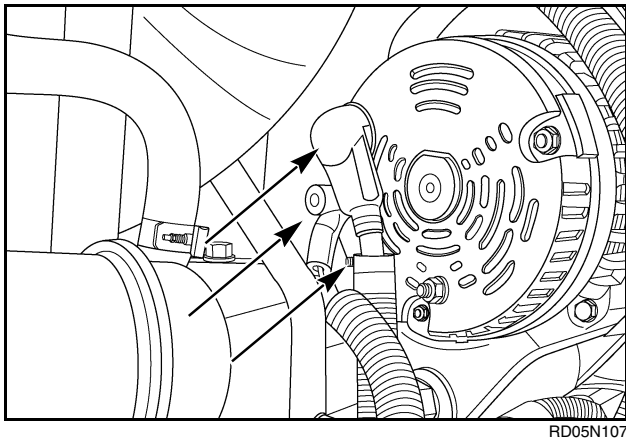
Install the ground wire (1) and the clamp (2).

### STEP 70



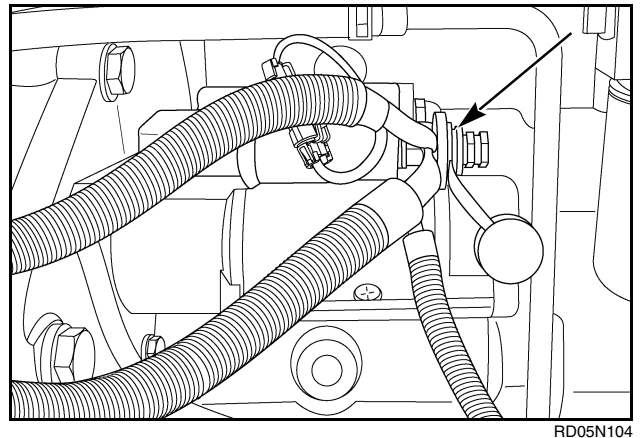
Install the heater out (1) and in (2) hoses.

### STEP 68



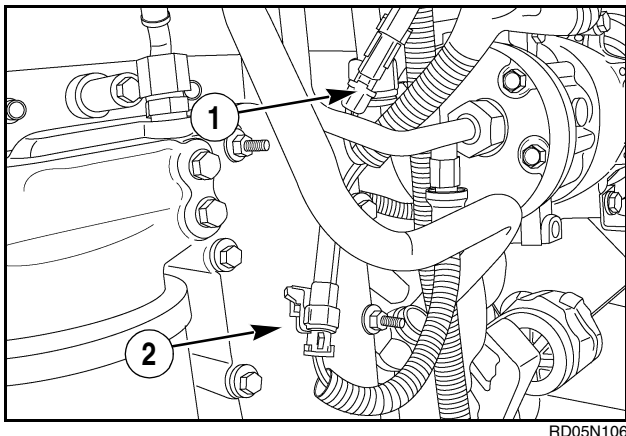
Install the three alternator wires.

### STEP 71



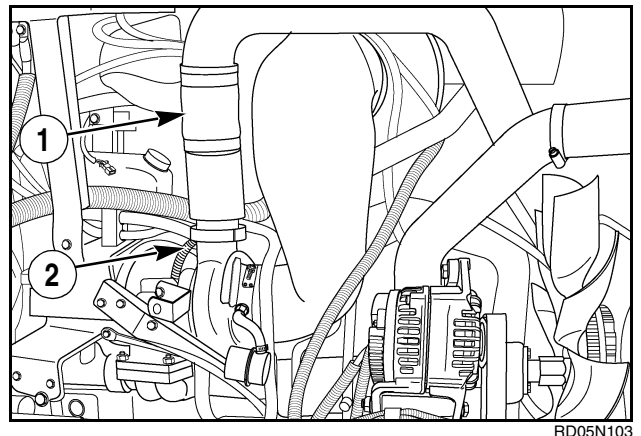
Install the starter cables.

### STEP 69



Connect the A / C compressor clutch (1) and the high pressure switch (2) connectors.

### STEP 72

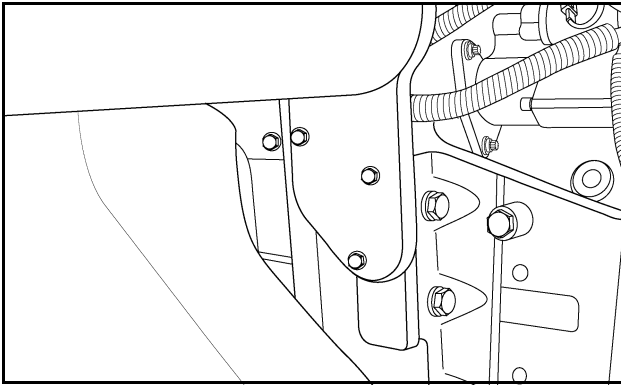


Install the turbo to charge-air cooler pipe assembly (1). Install the clamp (2).

**NOTE:** Do not tighten clamp (2) until the cooling module has been installed. This will allow alignment of the pipe with the charge-air cooler connector.



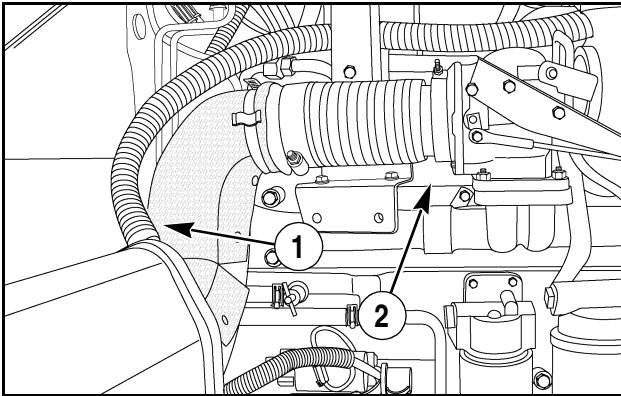
### STEP 73



RD05N102

Properly support the muffler, lift into place and tighten the mounting bolts to a torque of 200 to 245 Nm (149 to 179 lb.ft.).

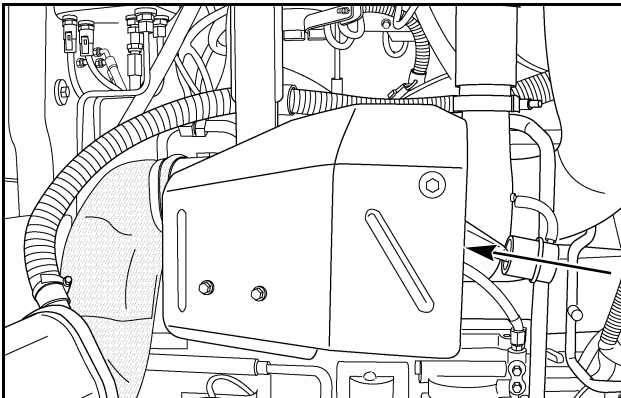
### STEP 74



RD05N101

Install the air cleaner aspirator hose (1). Tighten the exhaust pipe to turbo clamp (2).

### STEP 75



RD05N100

Install the exhaust shield.

### STEP 76

Install the cooling module. See Cooling Module Section in this Repair Manual.

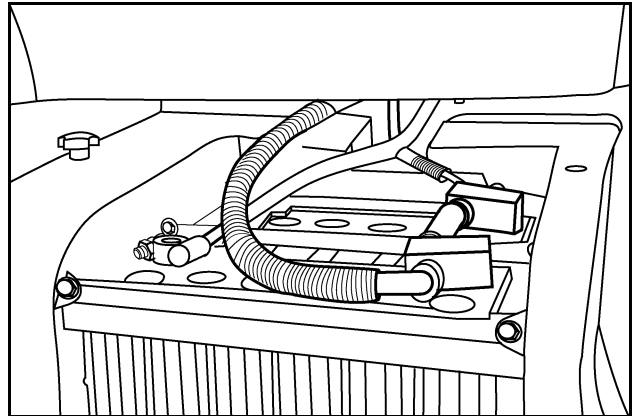
### STEP 77

Recharge the A/C system. See A/C Service Section in this Repair Manual.

### STEP 78

Install the hood. See Hood Removal Section in this Repair Manual.

### STEP 79



RD02E069

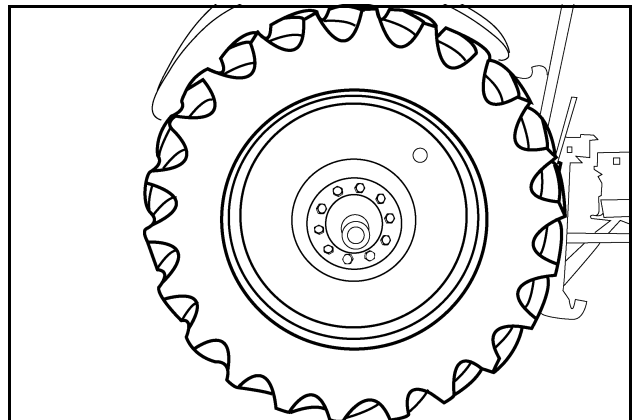
Install the positive cable (+). Install the negative cable (-). Install the battery cover.

**NOTE:** Install all tie straps that were removed during disassembly.

### STEP 80

Start the engine and check for any leaks. Repair as necessary. Top off all fluids. Check A/C for proper operation.

### STEP 81



RD02C070

Remove wheel blocks.

# **Section 10**

## **Chapter 2**

### **FUEL TANK / FUEL SENDER REMOVAL AND INSTALLATION**

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Installation .....	10-2-7
FUEL LEVEL SENDER .....	10-2-10
Removal .....	10-2-10
Installation .....	10-2-11

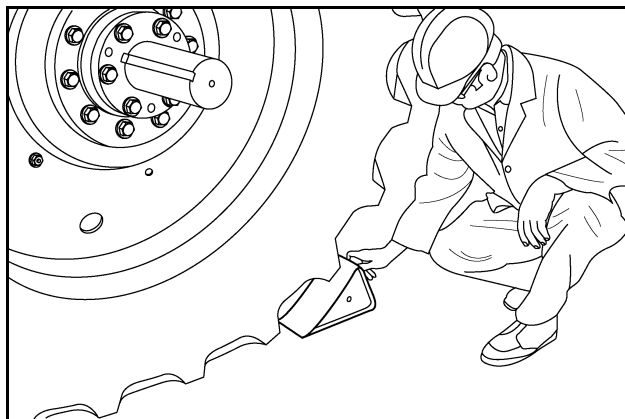
## SPECIAL TORQUES

Bolts on cab steps ..... 37 to 67 Nm (27 to 49 lb. ft.)

## FUEL TANK

### General

#### STEP 1



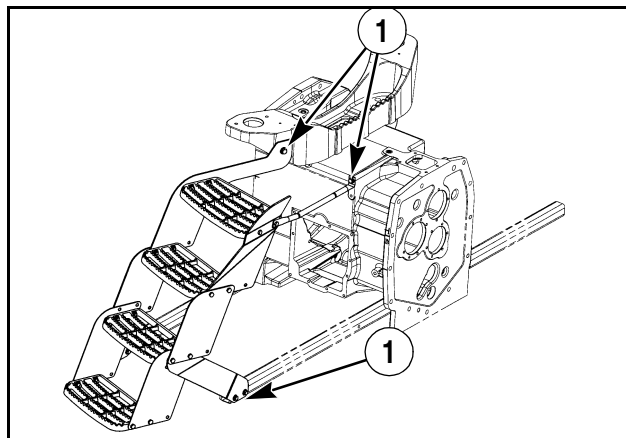
96R-28A

Before removing the fuel tank, do the following:

1. Park the tractor on a hard, level surface.
2. Place the transmission control lever in PARK.
3. Shut off the engine and remove the key.
4. Put blocks in front of and in back of the rear wheels.

### Removal

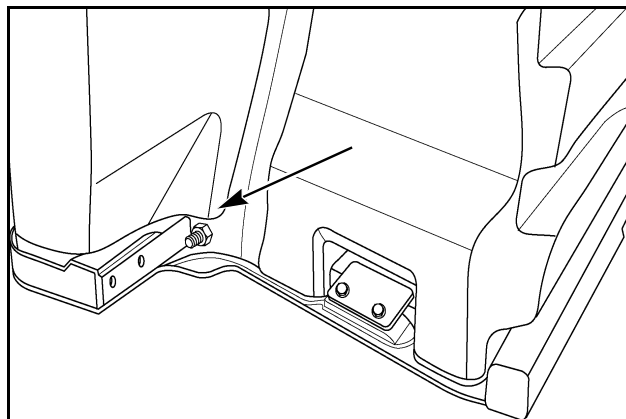
#### STEP 2



95-12

Remove the six step mounting bolts (1). Move the steps away from the tractor.

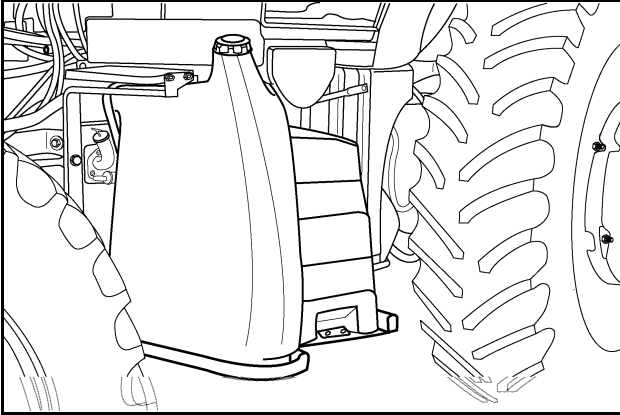
#### STEP 3



4-25F

Drain the fuel tank. Fuel tank capacity is 674 L (178 gal.)

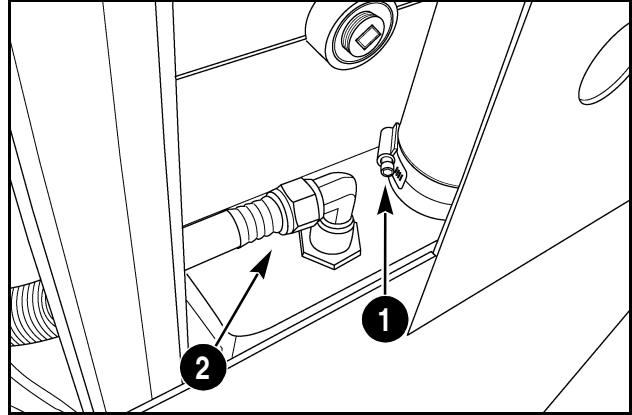
#### STEP 4



50-23F

Move the left rear wheel out on the axle as far as possible to provide clearance when removing the left tank. The wheel can also be removed.

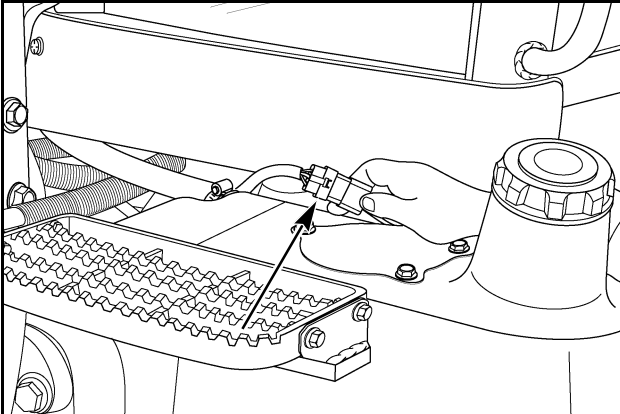
#### STEP 7



RD05K005

Loosen hose clamp (1) on fuel tank balance hose located under the transmission speed housing. Remove the fuel injection system supply hose (2).

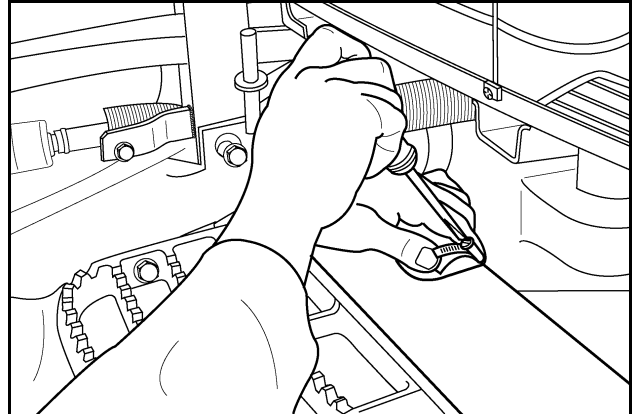
#### STEP 5



RD05J085

Disconnect the fuel level sending unit wire harness.

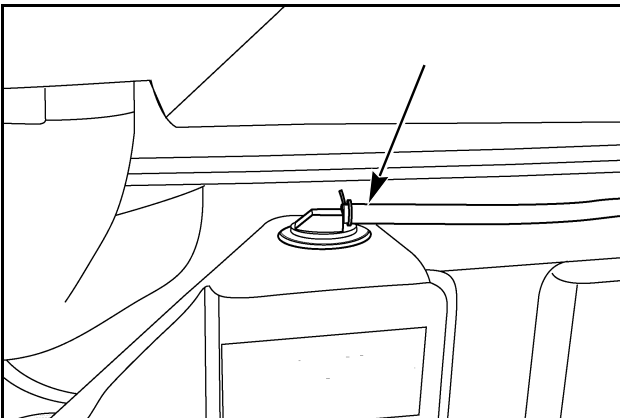
#### STEP 8



95-24-

Remove the pressure equalization hose at the front of the cab from the top left-hand fuel tank.

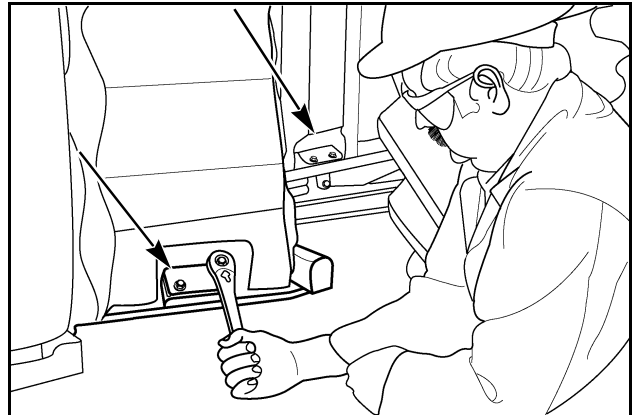
#### STEP 6



RD05K006

Remove the vent hose.

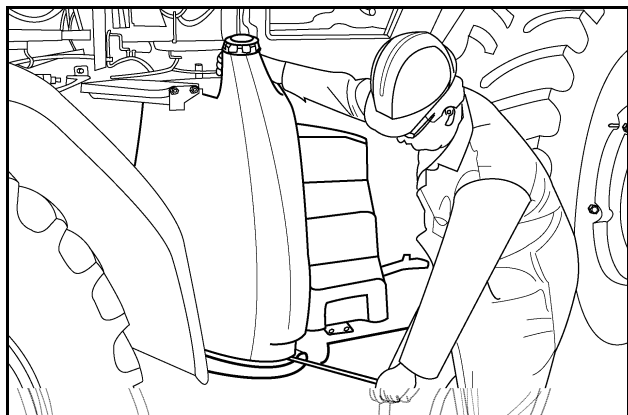
#### STEP 9



95-15R

Remove two bolts from each of the two lockdown plates.

## STEP 10

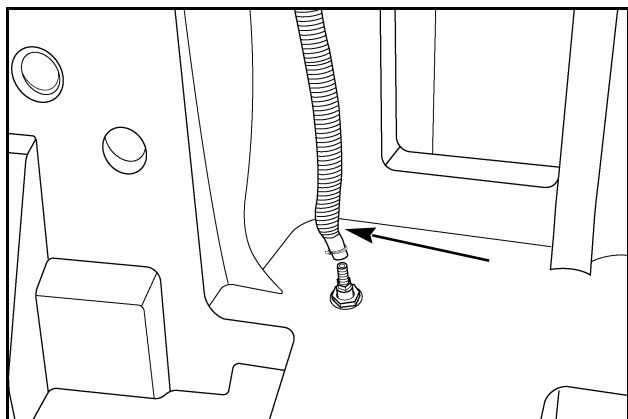


101R-19A

With prybars, lift up on the main tank and move it out a few inches. Insert a plug into the crossover hose as it comes off of the right tank.

**IMPORTANT:** *Be prepared to collect some fuel when the tank is removed. Fuel may spill onto the support bracket.*

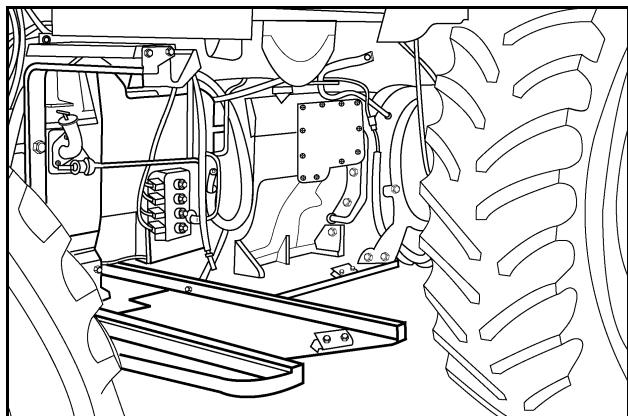
## STEP 11



RD05K008

Disconnect the fuel return line.

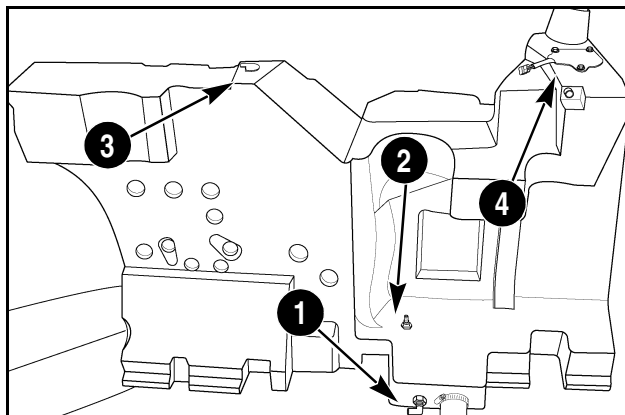
## STEP 12



5-27-3

Remove the left tank.

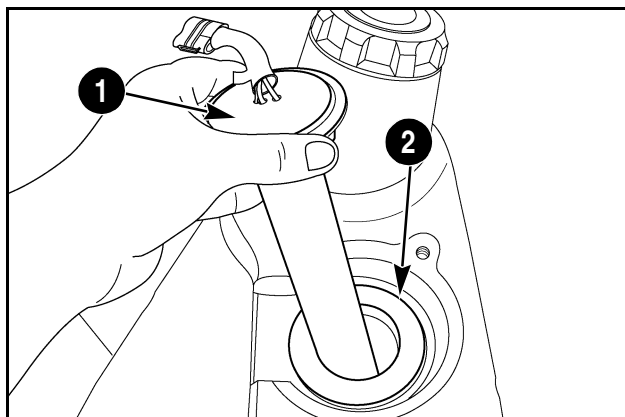
## STEP 13



RD05K007

Remove the fuel supply fitting (1), the fuel return fitting (2), vent fitting (3) and fuel sending unit cover (4).

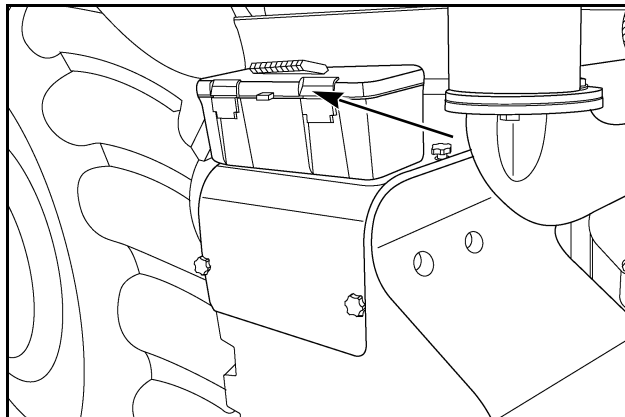
## STEP 14



RD05K003

Remove the fuel sender (1) by placing a screwdriver under the head and prying up. Remove the seal (2). Inspect for damage, replace as necessary.

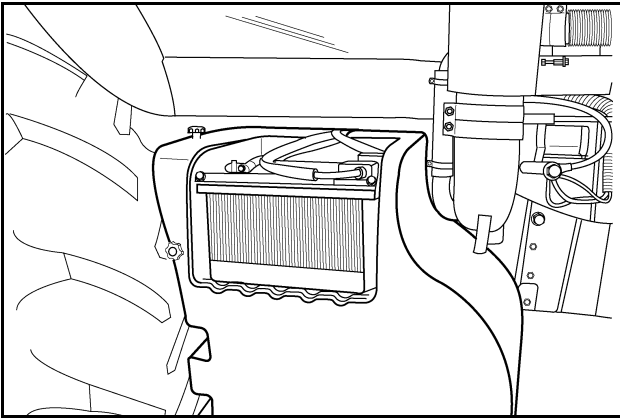
## STEP 15



RD05K002

If the right tank is to be removed, remove the battery cover.

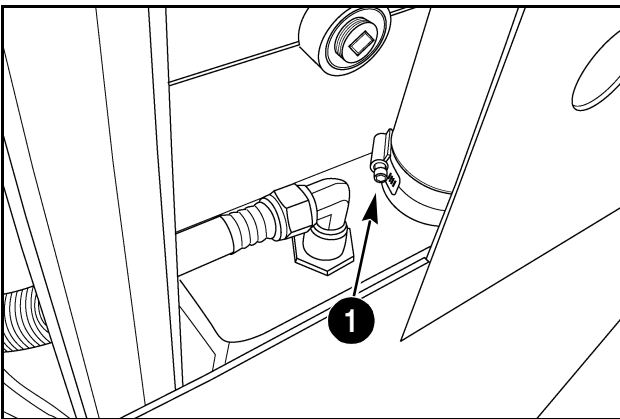
## STEP 16



RD02B106

Remove the battery cables and move to the side. Remove the batteries.

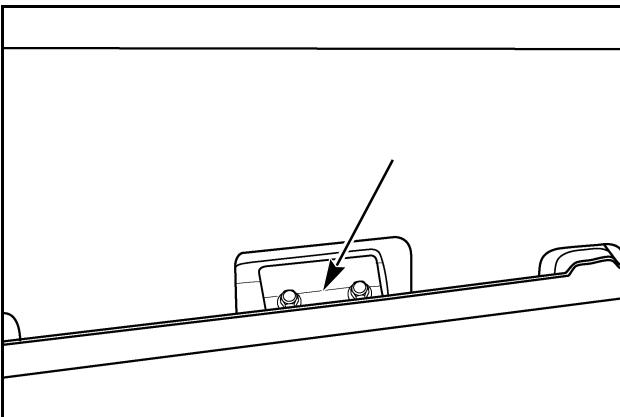
## STEP 17



RD05K005

If not already removed, loosen the clamp (1) on the fuel balance hose located under the transmission speed housing. Slip the hose off the neck leading into tank.

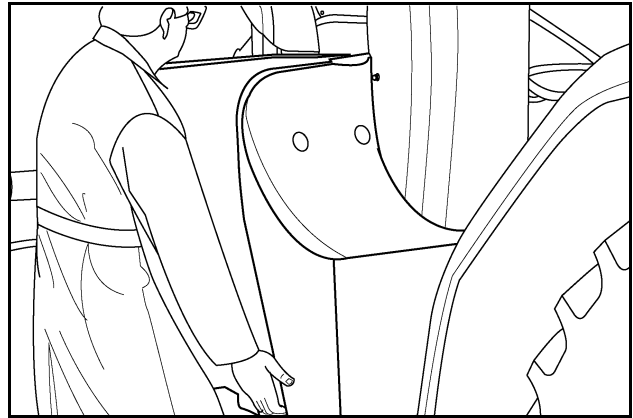
## STEP 18



5-20

Remove the two bolts from the lockdown plate on the right tank.

## STEP 19

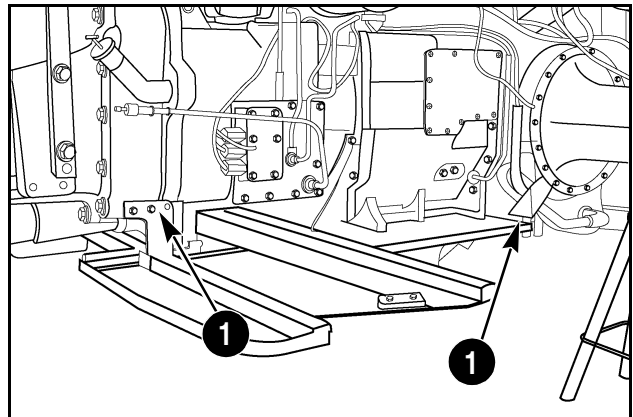


101R-23A

Lift the right tank free of the support bracket and remove the tank.

**IMPORTANT:** Be prepared to collect some fuel when the tank is removed.

## STEP 20



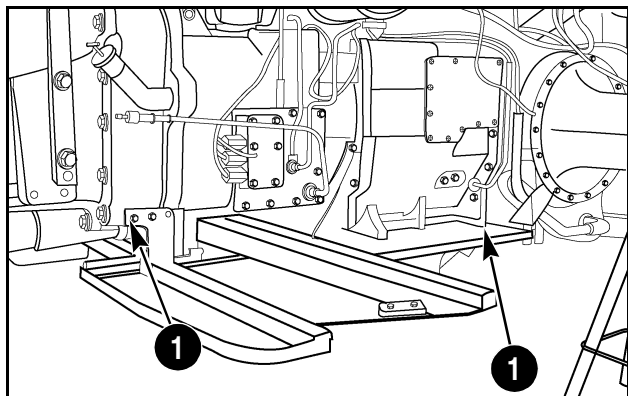
RD02B107

If fuel tank support bracket needs to be removed, properly support the bracket while removing the bolts (1) from the left- and right-hand side of the bracket.

**NOTE:** Bolts are shown on left side.

## Installation

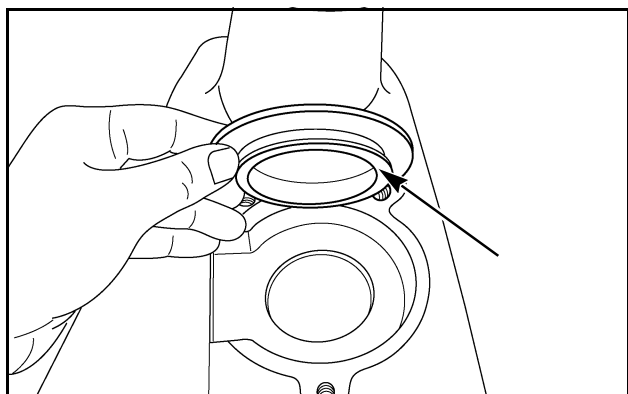
### STEP 21



RD02B107

If the fuel tank support bracket was removed, properly support the bracket and lift into position. Install and tighten all the retaining bolts (1).

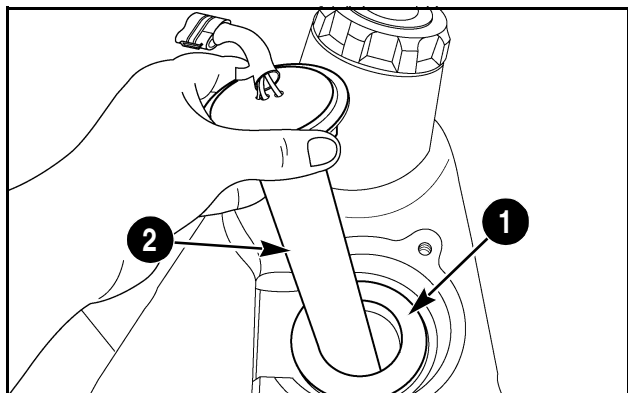
### STEP 22



RD05K004

Lubricate the inside diameter of the seal with soap and install.

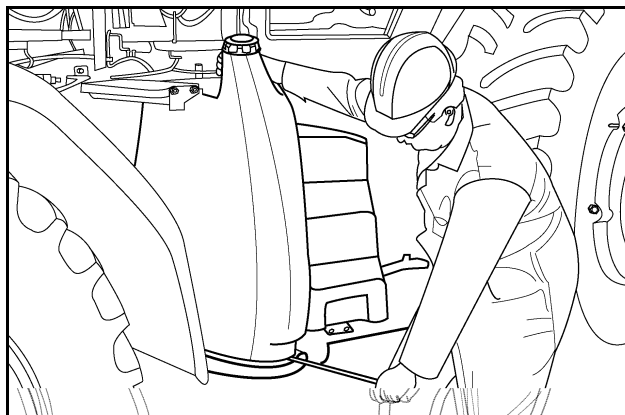
### STEP 23



RD05K003

Lubricate the inside diameter of the seal (1) with soap and install the fuel sender (2).

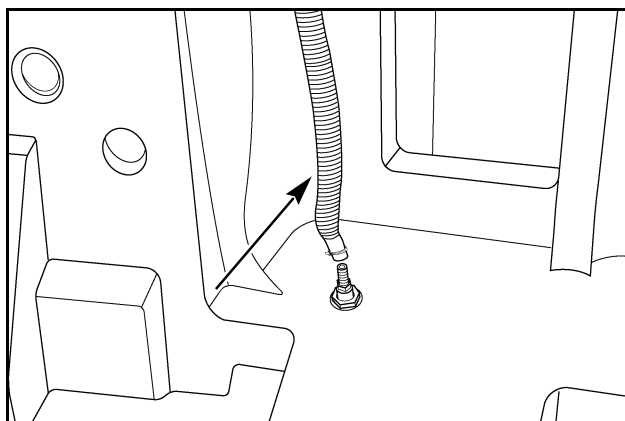
### STEP 24



101R-19A

Install the fuel tank onto the support brackets with enough room to attach fittings.

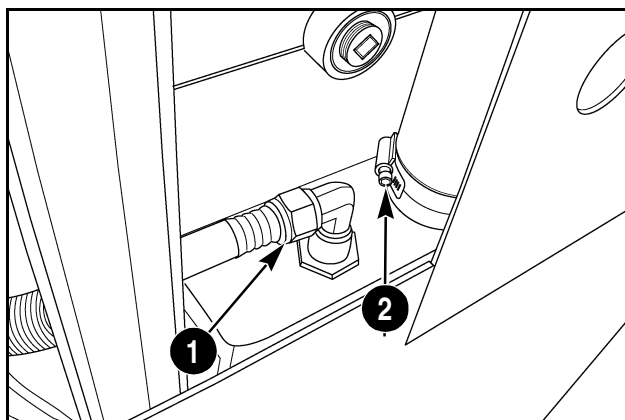
### STEP 25



RD05K008

Install the fuel return line. Push the fuel tank into position.

### STEP 26

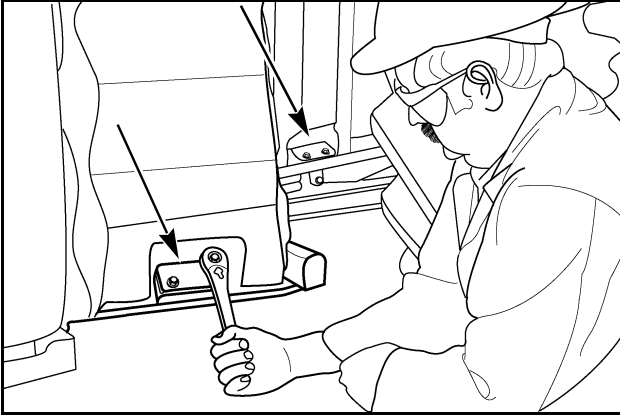


RD05K005

Connect the fuel injection system supply hose (1) and fuel tank balance hose (2). Tighten the fitting and clamp.



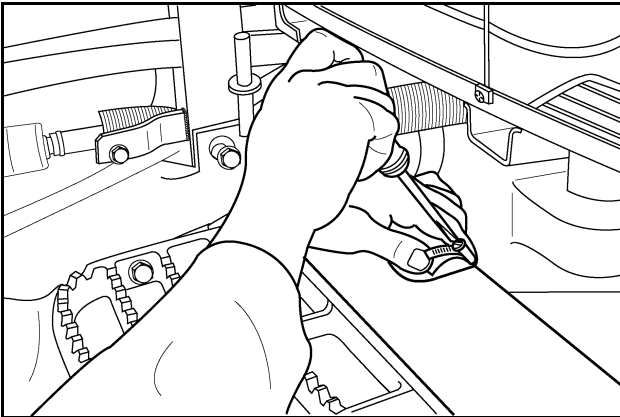
### STEP 27



95-15R

Install and tighten two bolts through each of the two lockdown plates.

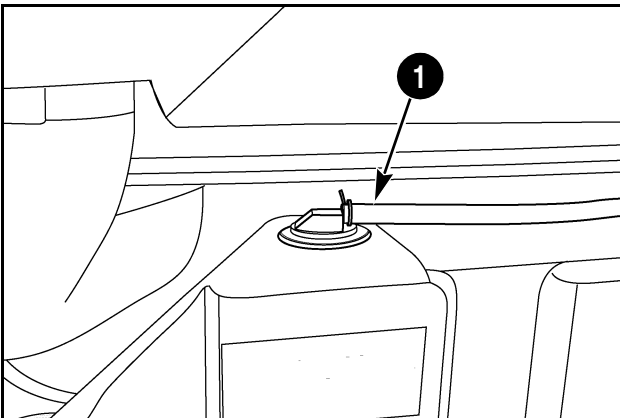
### STEP 28



95-24

Install the pressure equalization hose on the top front of the left tank. Tighten clamp.

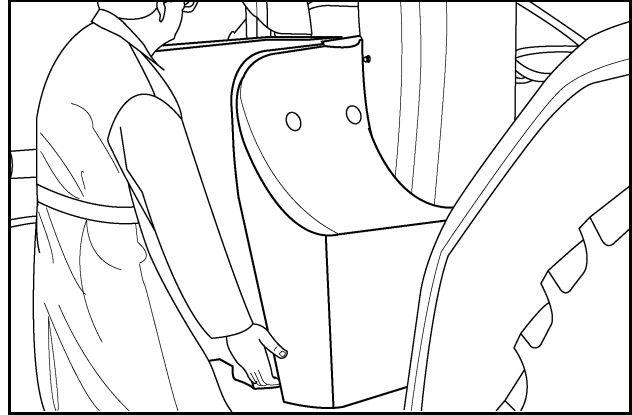
### STEP 29



RD05K006

Install the fuel vent hose (1) and reposition the hose clip.

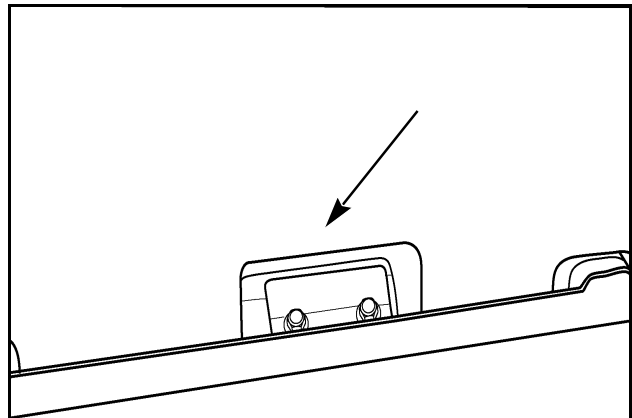
### STEP 30



101R-23A

Move the right tank into position. Connect the balance hose at the bottom of the tank (not shown) and tighten the clamp. Connect the loose end of the pressure equalization hose (not shown) to the top left tank.

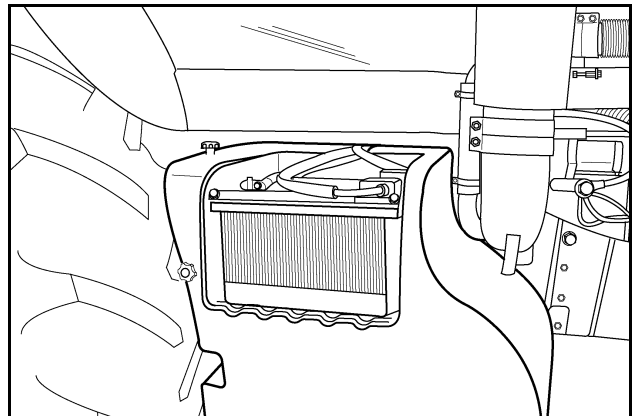
### STEP 31



5-20

Install and tighten the two bolts on the hold-down plate.

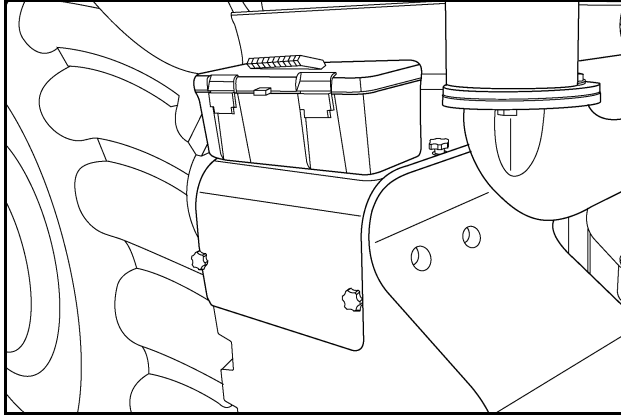
### STEP 32



RD02B106

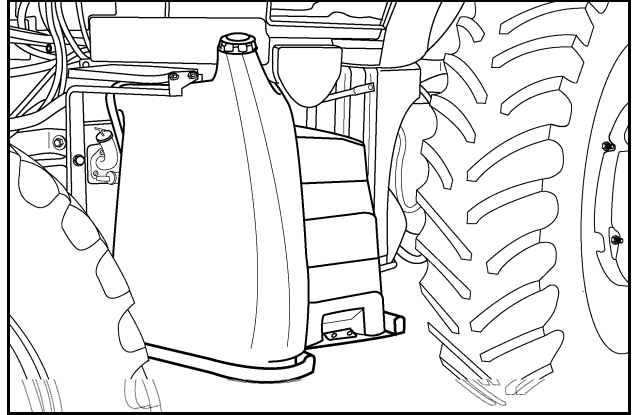
Install the batteries.

### STEP 33



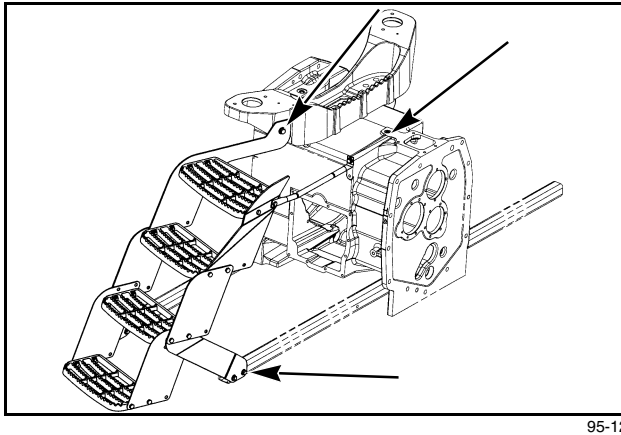
Install battery cover and toolbox.

### STEP 36



Position the wheels to the desired position on the rear axle.

### STEP 34



Move steps into position. Install six bolts and tighten to a torque of 37 to 67 Nm (27 to 49 lb. ft.).

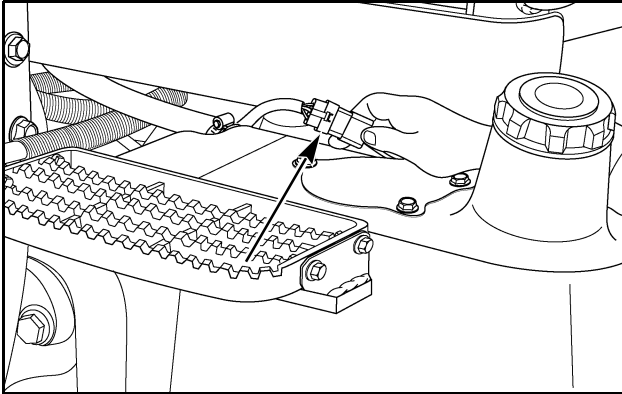
### STEP 35

Install fuel and check for leaks.

## FUEL LEVEL SENDER

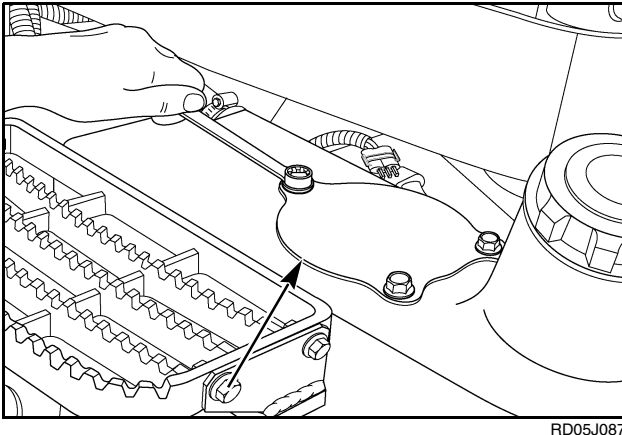
### Removal

#### STEP 37



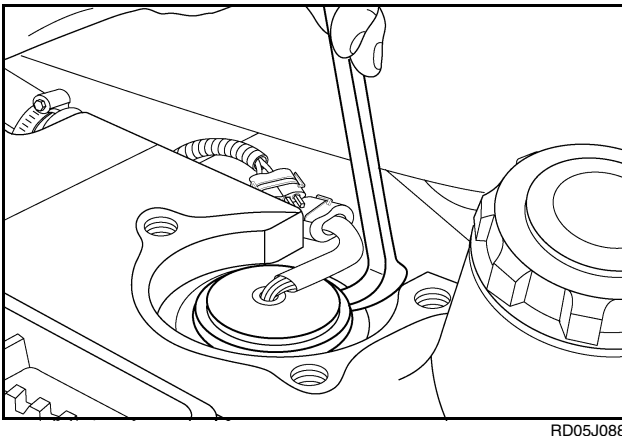
Disconnect the fuel sender wire harness.

#### STEP 38



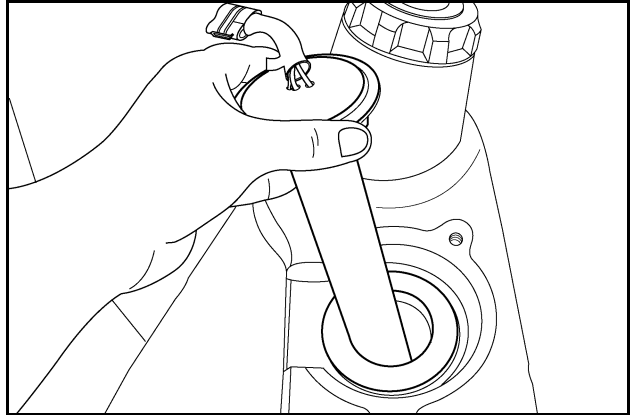
Remove the fuel sender cover bolts.

#### STEP 39



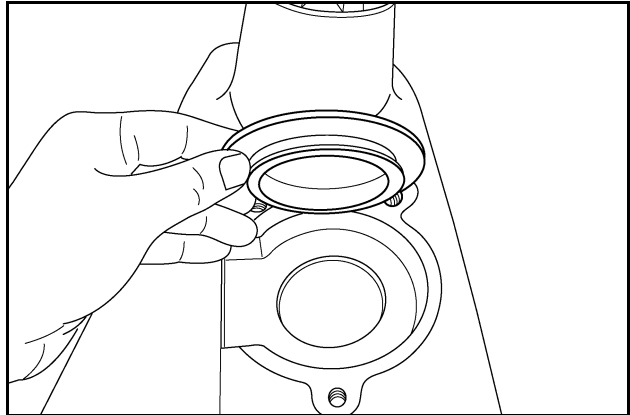
Pry the sender free of the fuel tank.

#### STEP 40



Remove the sender.

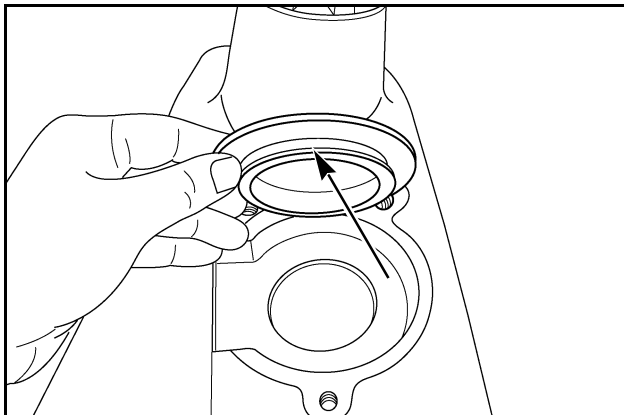
#### STEP 41



Remove the sender seal, inspect for damage and replace if necessary.

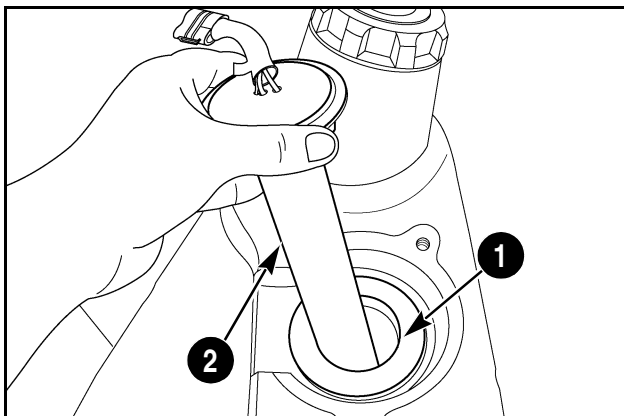
## Installation

### STEP 42



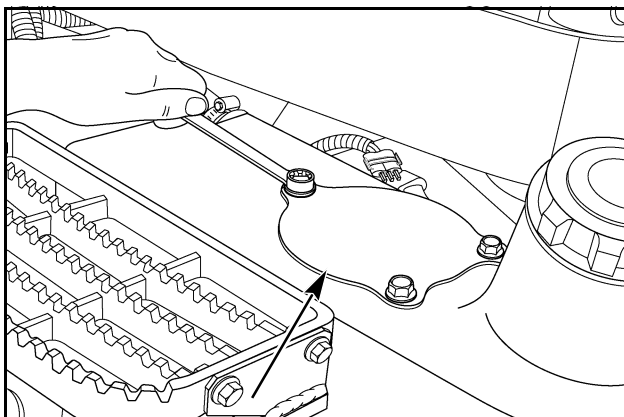
Lubricate the outside diameter of the seal with soap and install.

### STEP 43



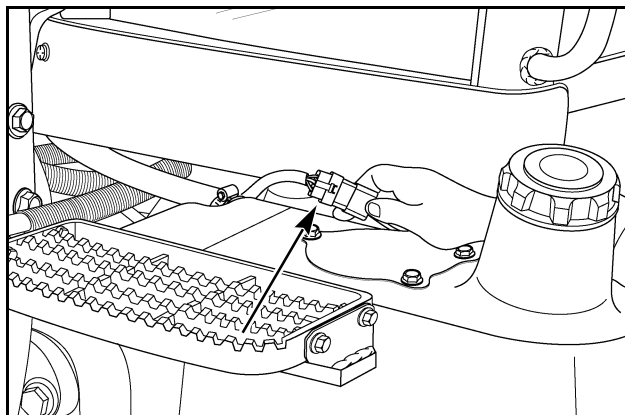
Lubricate the inside diameter of the seal (1) with soap and install the fuel sender (2).

### STEP 44



Install the fuel sender cover.

### STEP 45



Connect the fuel sender wire harness.

### STEP 46

Install fuel and check sender for proper operation.



# **Section 10**

## **Chapter 3**

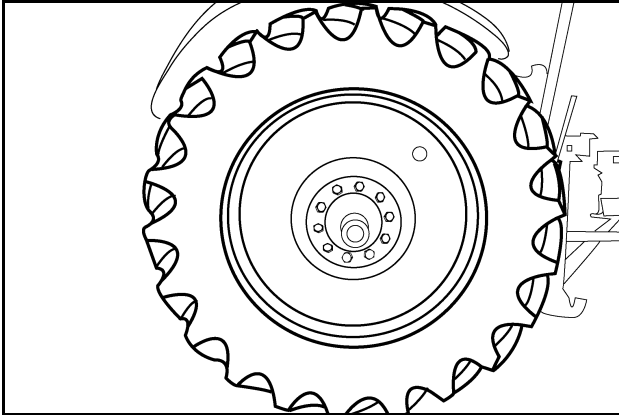
### **HOOD REMOVAL / INSTALLATION**

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HOOD REMOVAL .....	10-3-3
HOOD INSTALLATION .....	10-3-5

## HOOD REMOVAL

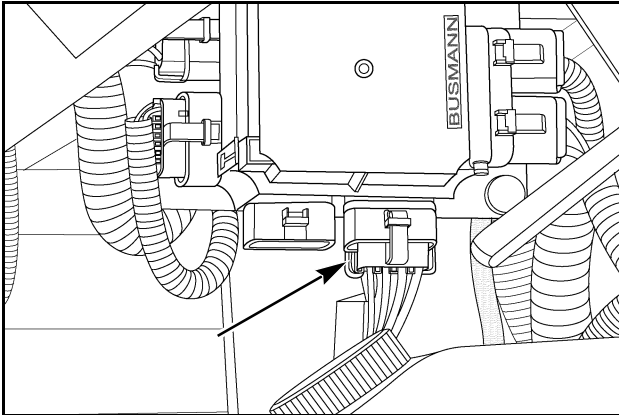
### STEP 1



RD02C070

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Place blocks in front of and behind the rear wheels.

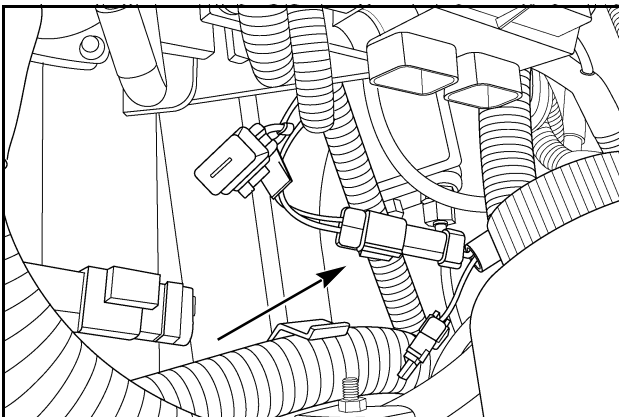
### STEP 2



RD05N001

Disconnect the hood light wire harness.

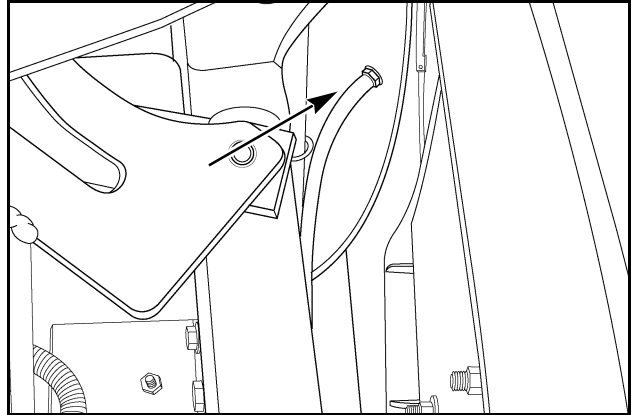
### STEP 3



RD05N002

Disconnect horn wire harness.

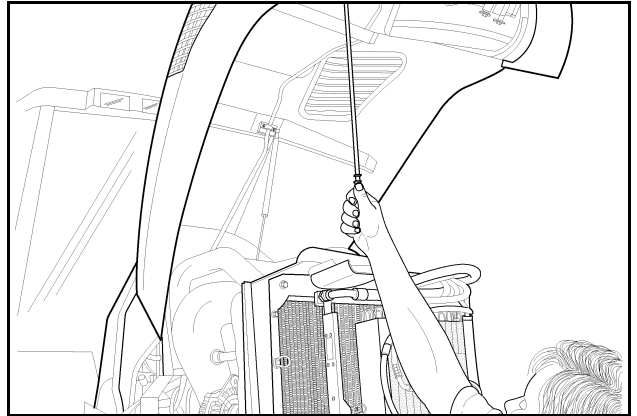
### STEP 4



RD05N003

Remove the windshield washer nozzle hose.

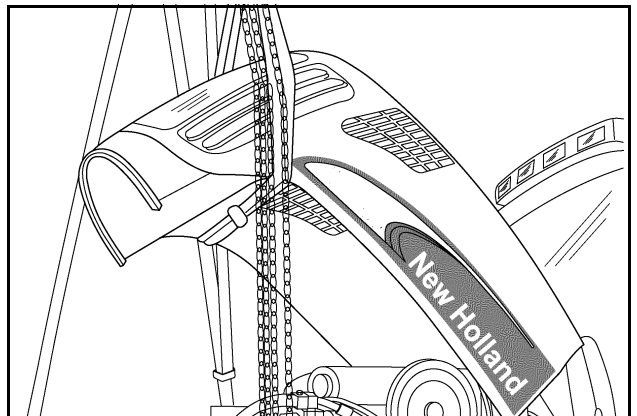
### STEP 5



RD05J075

Remove the hood lanyard and fully raise the hood.

### STEP 6

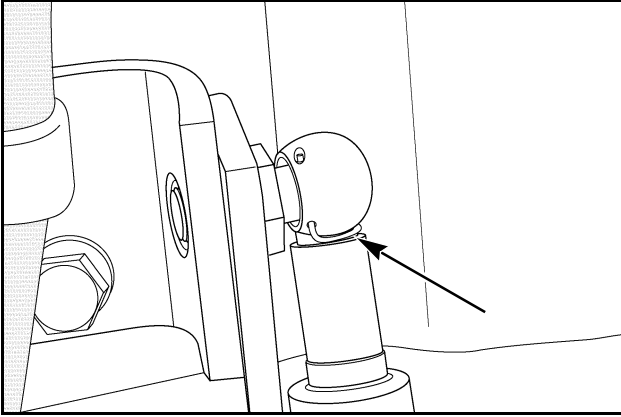


RD05N004

Properly support the hood.

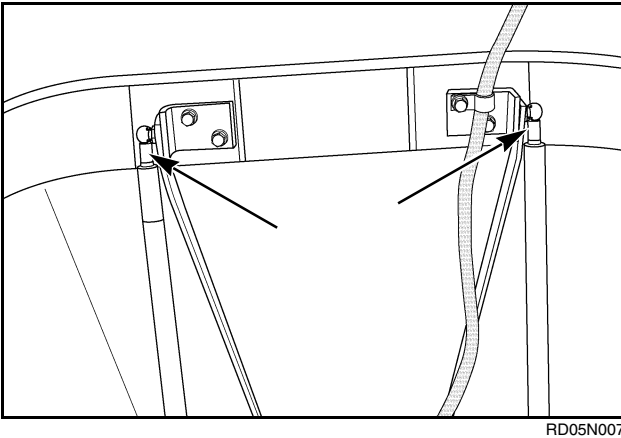


**STEP 7**



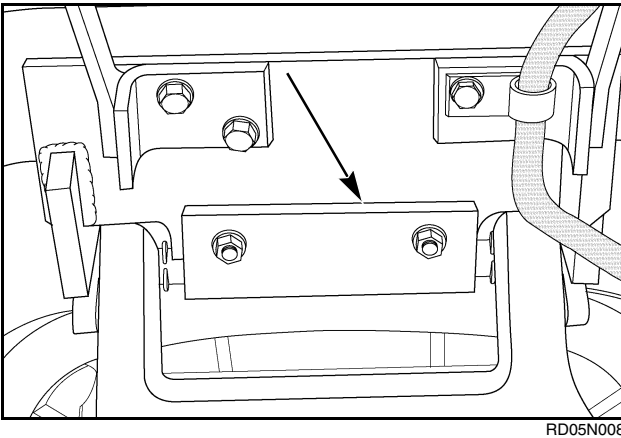
Remove the safety clip from each hood strut.

**STEP 8**



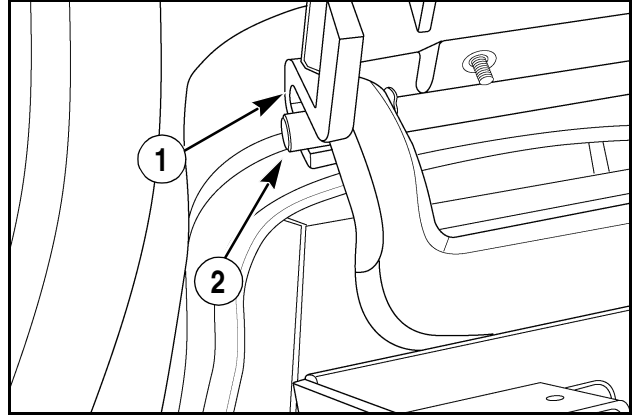
Remove the hood struts.

**STEP 9**



Remove the locking bracket.

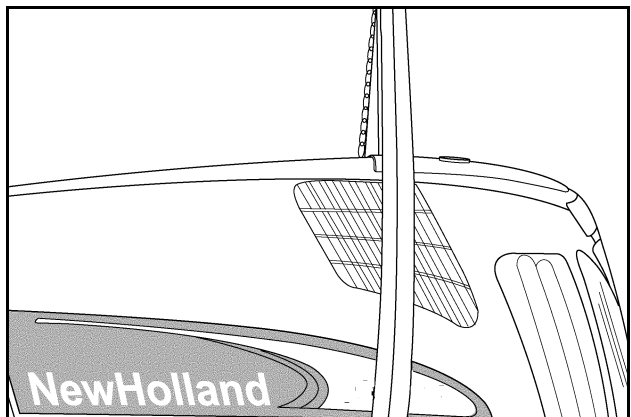
**STEP 10**



Lower the hood and push rearward until the hood bracket (1) is free of the hood support rod (2). While balancing the hood, raise as necessary and remove from the chassis.

## HOOD INSTALLATION

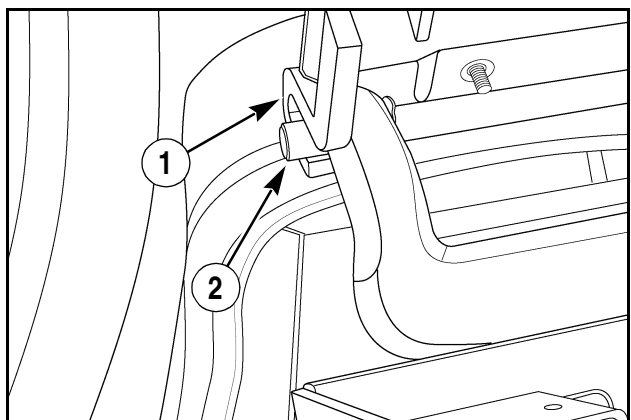
### STEP 11



RD05N005

Properly support the hood. While balancing the hood, raise and set into place.

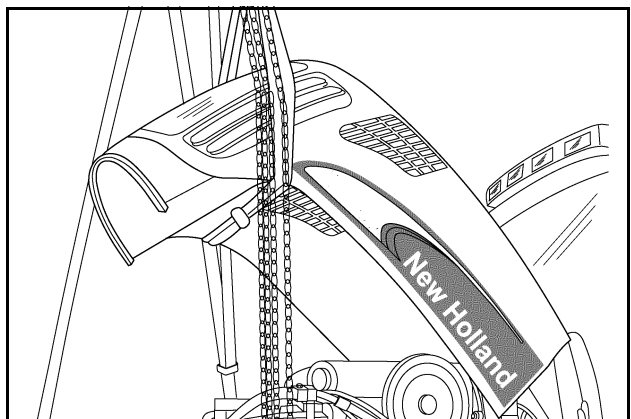
### STEP 12



RD05N009

Align the hood bracket (1) with the hood support rod (2) and slide forward into place.

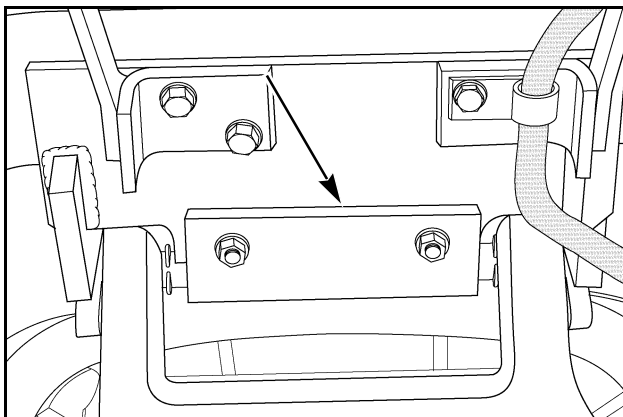
### STEP 13



Rd05N004

Raise the hood.

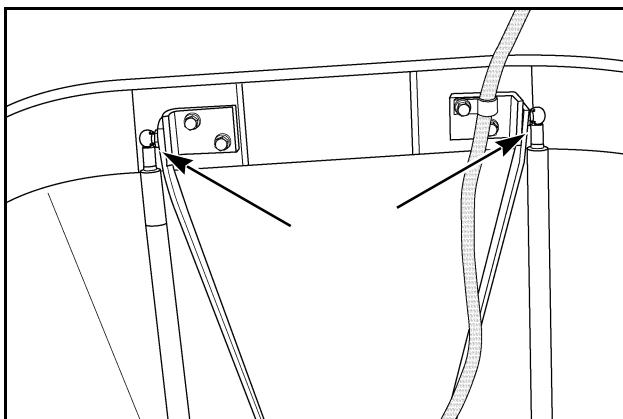
### STEP 14



RD05N008

Install the locking bracket.

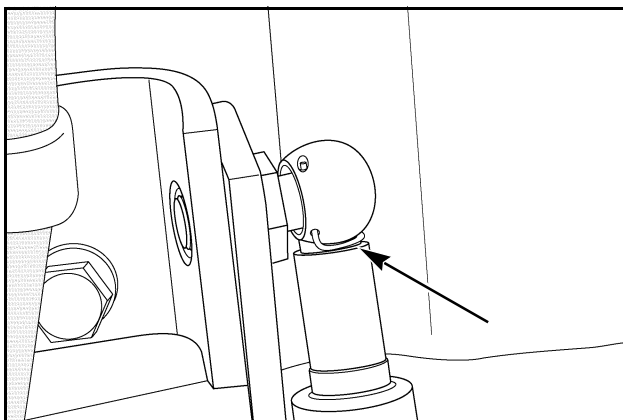
### STEP 15



RD05N007

Install the hood support struts.

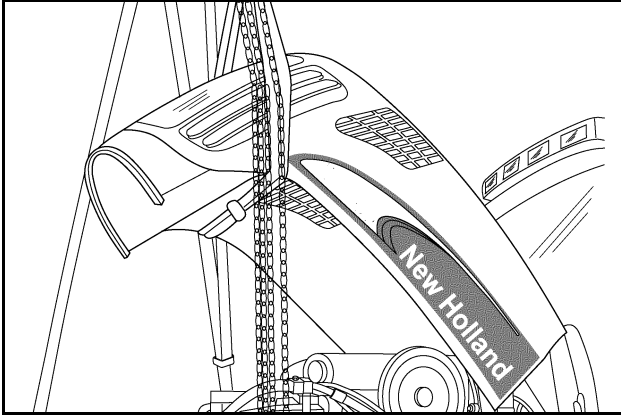
### STEP 16



RD05N006

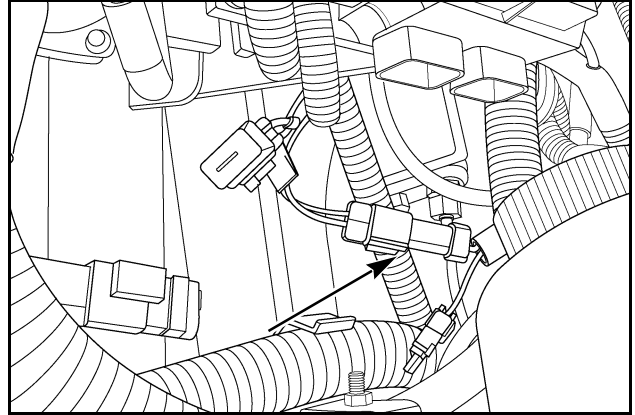
Install the safety pin in each strut and lock in place.

**STEP 17**



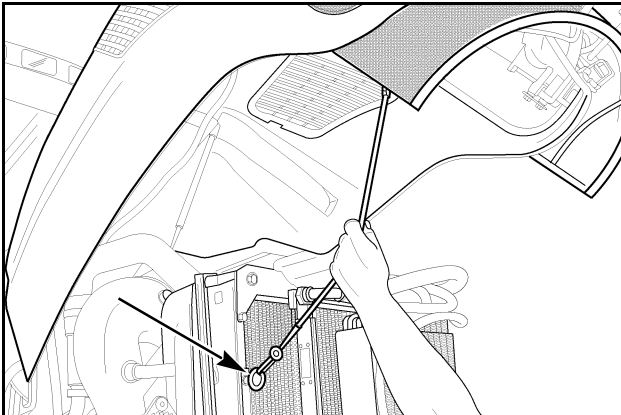
Remove the support from the hood.

**STEP 20**



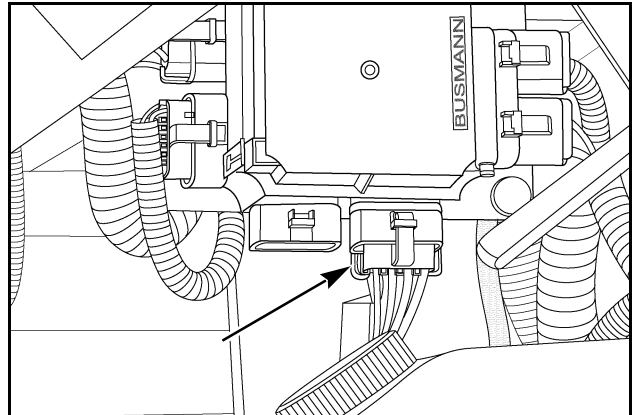
Connect the horn wire harness.

**STEP 18**



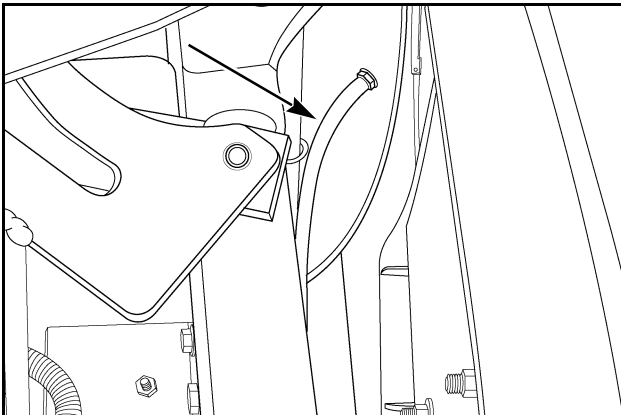
Clip the hood lanyard to the support bracket.

**STEP 21**



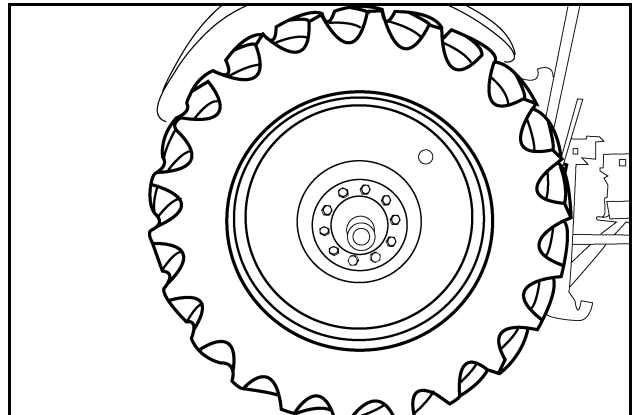
Connect the hood lights wire harness.

**STEP 19**



Install the windshield washer nozzle supply hose.

**STEP 22**



Remove all wheel blocks.

# **Section 10**

## **Chapter 4**

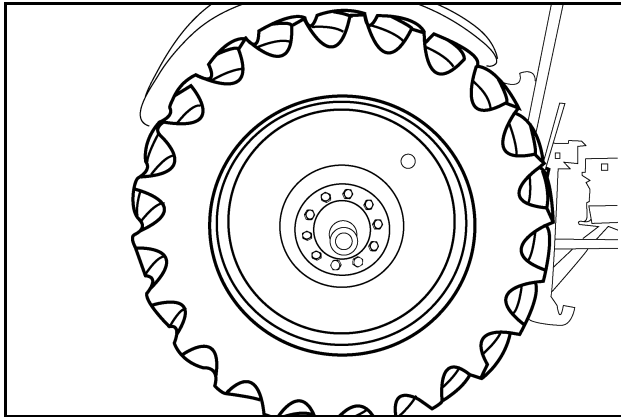
### **COOLING SYSTEM MODULE REMOVAL AND INSTALLATION**

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COOLING MODULE REMOVAL .....	10-4-3
COOLING MODULE INSTALLATION .....	10-4-7

## COOLING MODULE REMOVAL

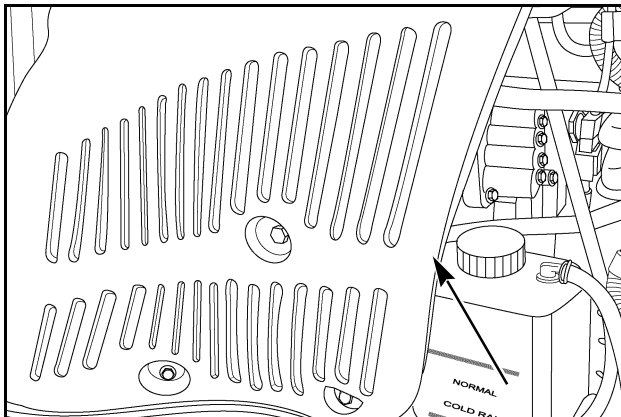
### STEP 1



RD02C070

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Turn off the engine and remove the key. Place blocks in front of and behind the rear wheels.

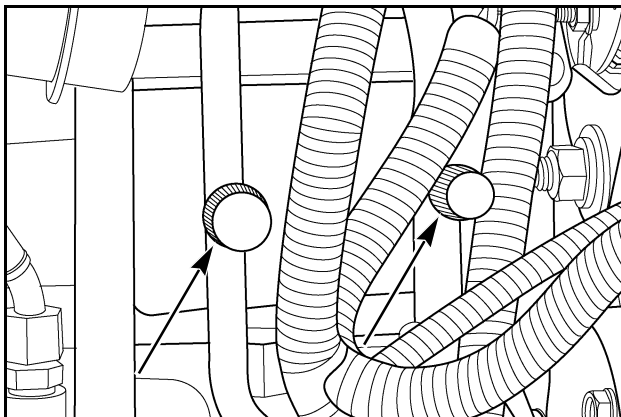
### STEP 2



RD05N011

Remove the left (shown) and right side panels.

### STEP 3

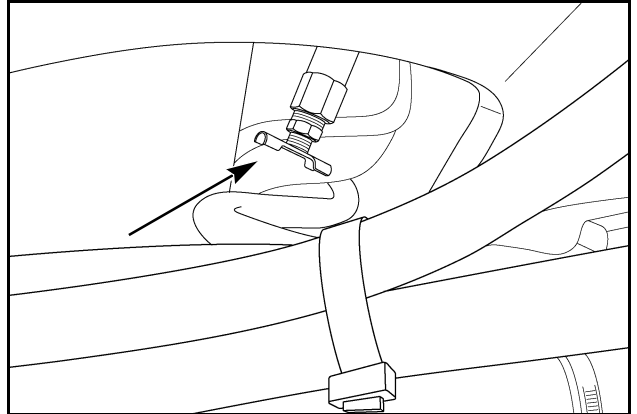


RD05N012

If required, evacuate the A/C system. See A/C Section in this Repair Manual.

**NOTE:** If A/C condenser DOES NOT have to be removed, DO NOT evacuate the system.

### STEP 4



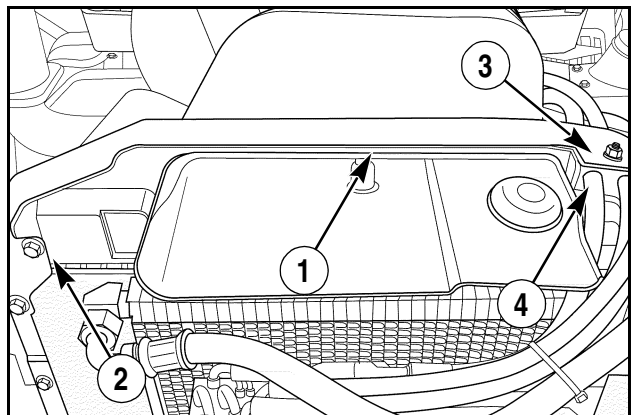
RD05N013

Drain the engine coolant into a suitable clean container. Radiator drain is located on the right side of the front frame.



**WARNING:** Check and service cooling system according to maintenance instructions. Hot coolant can spray out if the deaeration tank cap is removed while system is hot. To remove the deaeration tank cap, let system cool, turn to the first notch, then wait until all the pressure is released. Scalding can result from the fast removal of the deaeration tank cap.

M855

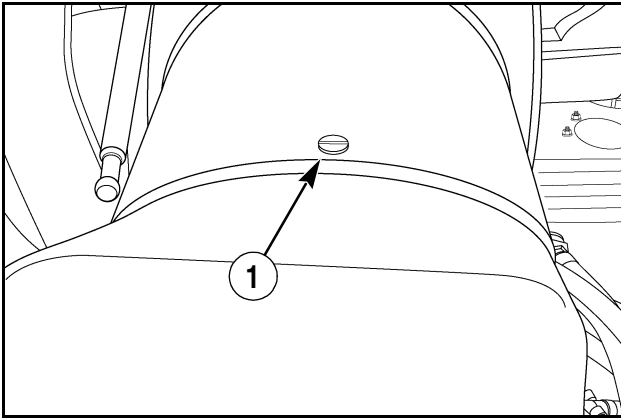


RD05N014

Remove the air scoop / hose bracket (1) mounting bolt (2) and mounting nut (3). Remove the bracket. Remove the hose clamps (4).

**NOTE:** In the following steps, the hood has been removed for photographic purposes.

### STEP 5

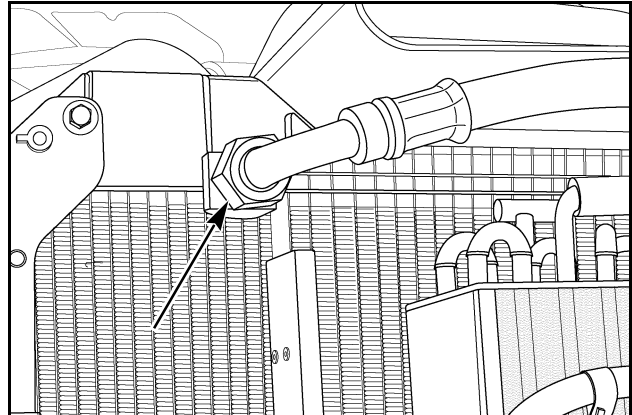


RD05N015

Remove the air scoop upper (shown) (1) and lower plastic fasteners. Remove the air scoop.

Do the following steps if the A/C condenser does not have to be removed.

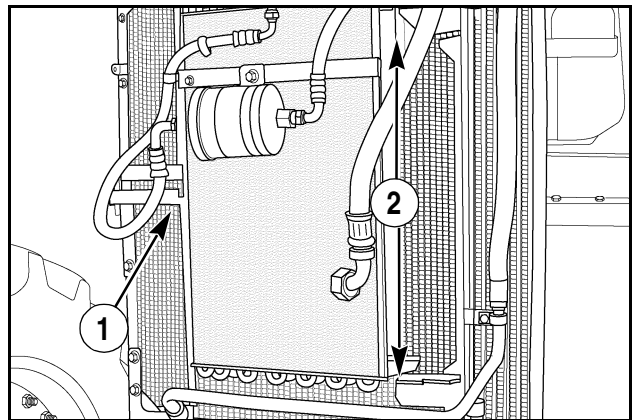
### STEP 6



RD05N016

Remove the upper hydraulic cooling hose. Discard the O-ring. Have a container ready to catch any hydraulic oil that may be in the hose.

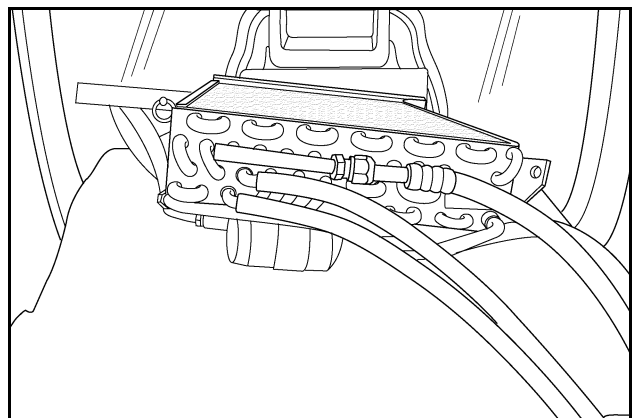
### STEP 7



RD05N017

Remove the swing latch locking pin (1). Remove the mounting lock nuts (2).

### STEP 8

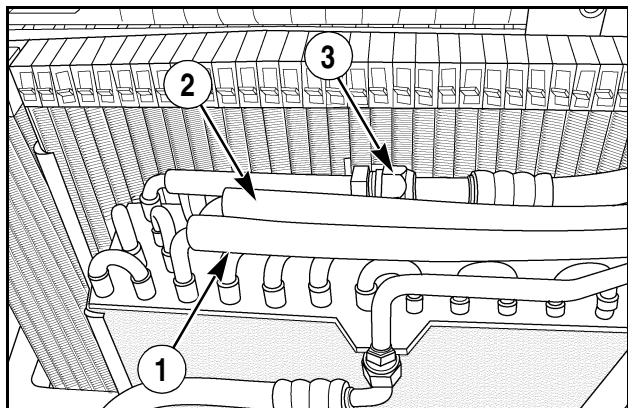


RD05N018

Place a piece of cardboard or other suitable padding on top of the air cleaner. Carefully lift the condenser from its mounting and place it on the padding as show. Continue with cooling module removal.

## Cooling Module Removal with A / C Condenser

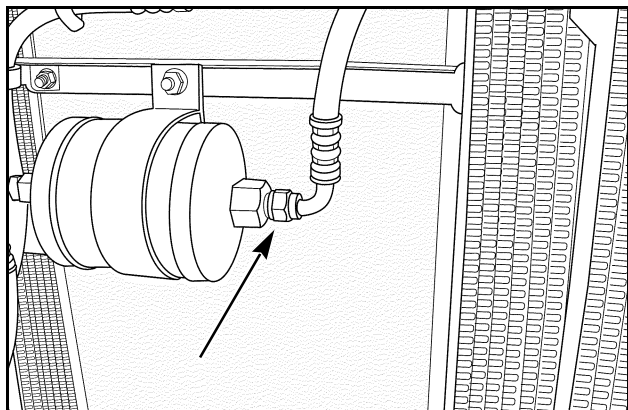
### STEP 9



RD05N019

Remove the fuel cooler inlet (1) and return (2) hoses. Remove the condenser outlet hose (3). Discard the O-ring.

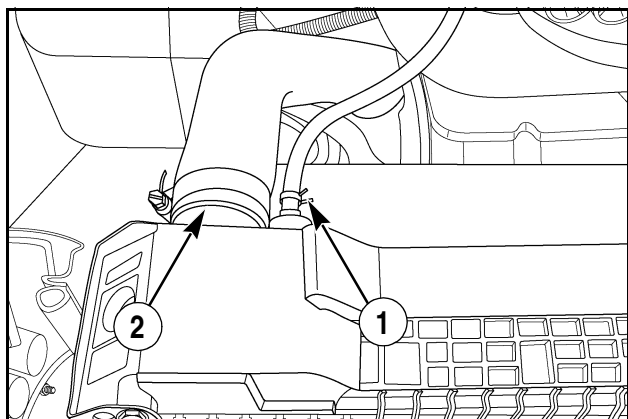
### STEP 10



RD05N020

Remove the A/C dryer inlet hose. Discard the O-ring.

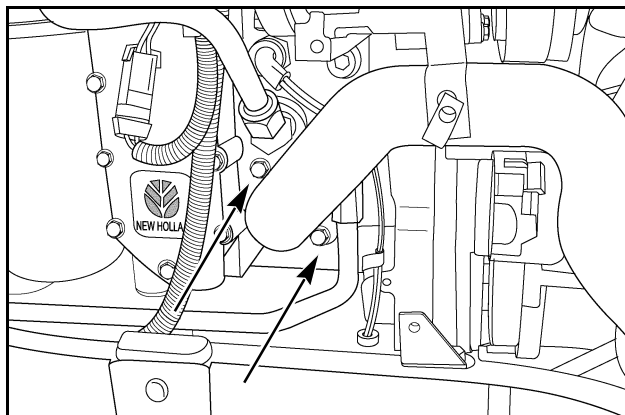
### STEP 11



RD05N021

Remove the air bleed (1) and upper radiator (2) hoses.

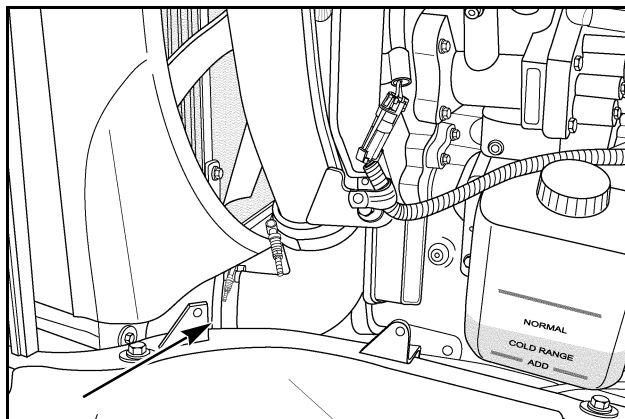
### STEP 12



RD05N022

Remove the radiator outlet (lower) pipe at the engine. Discard the gasket.

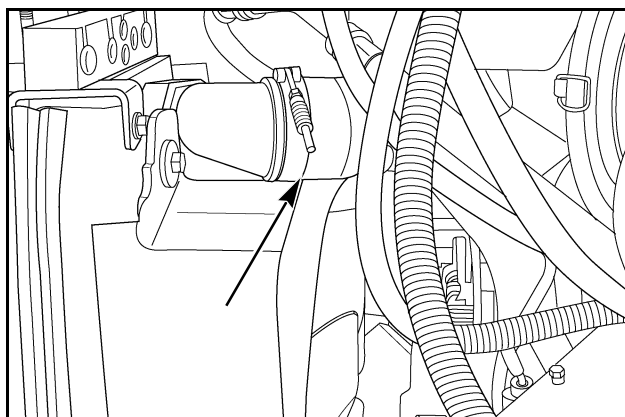
### STEP 13



RD05N023

Remove the lower charge-air cooler hose.

### STEP 14

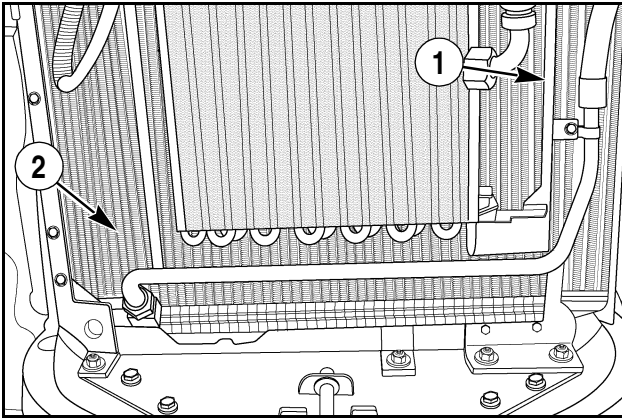


RD05N024

Remove the upper charge-air cooler hose.

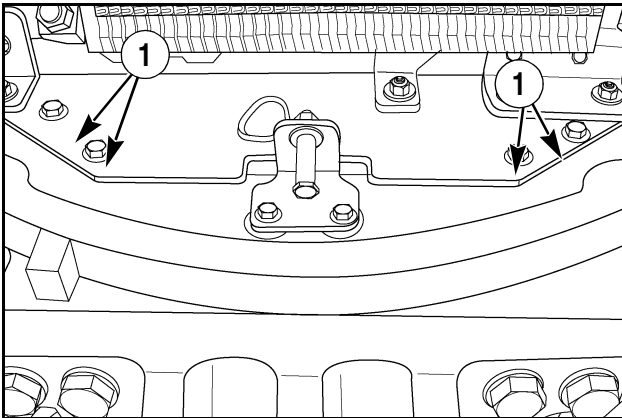


## STEP 15



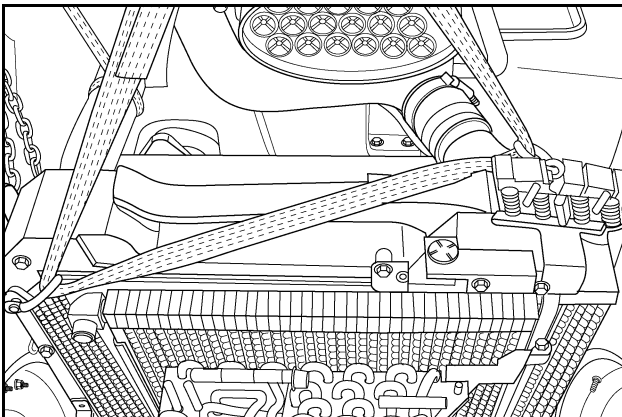
Remove the lower hydraulic oil cooler tube clamp (1) and tube (2). Discard the O-ring. Have a container ready to catch any hydraulic oil that may be in the tube and cooler.

## STEP 16



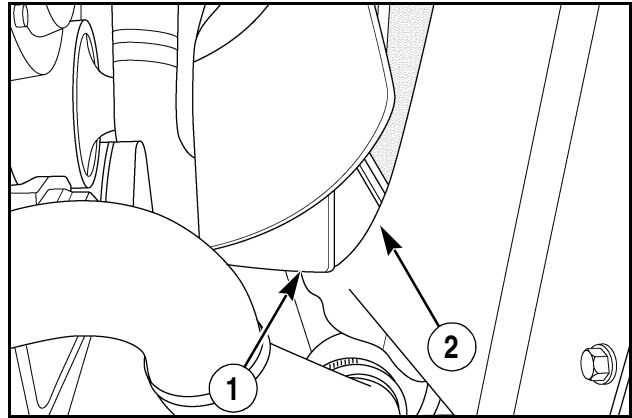
Remove the four cooling assembly mounting bolts (1).

## STEP 17



Properly support the cooling assembly.

## STEP 18

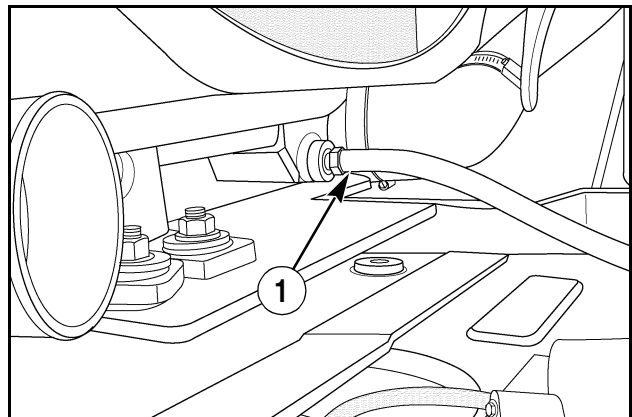


Slowly raise the cooling assembly and pull the lower portion away from the cooling fan (1) to clear the fan shroud (2).

**NOTE:** Fan blades (1) may have to be moved slightly so that they clear the fan shroud.

**IMPORTANT:** DO NOT bend the fan blades too far as damage to the fan may occur.

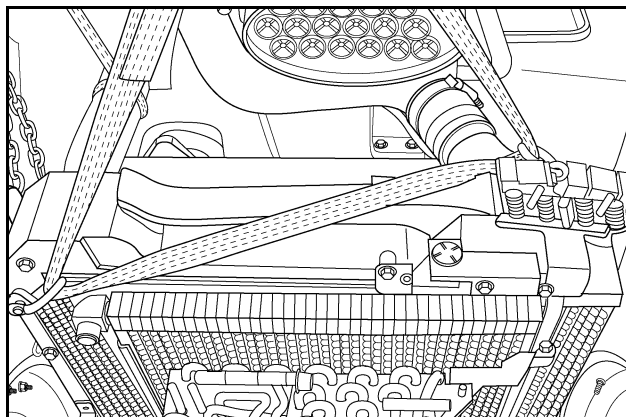
## STEP 19



Move the cooling assembly out far enough to gain excess to the radiator drain hose (1). Remove the hose. Remove the assembly from the frame.

## COOLING MODULE INSTALLATION

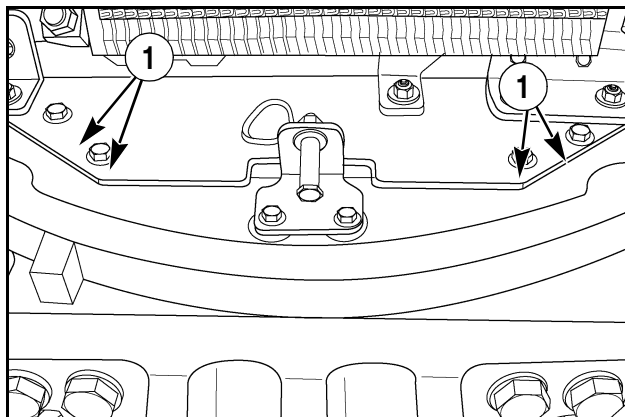
### STEP 20



RD05N026

Properly support the cooling assembly and move into position on the front frame.

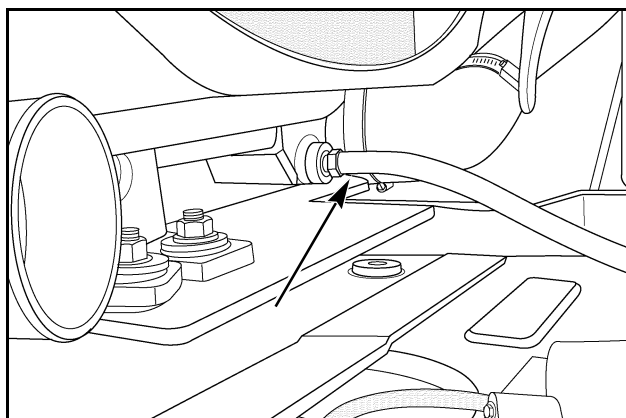
### STEP 23



RD05N027

Install the module mounting bolts (1) and tighten to a torque of 90 to 107 Nm (66 to 79 lb. ft.)

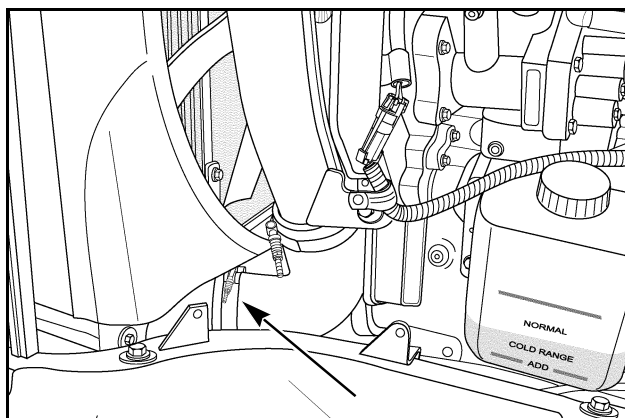
### STEP 21



RD05N029

Install the radiator drain hose.

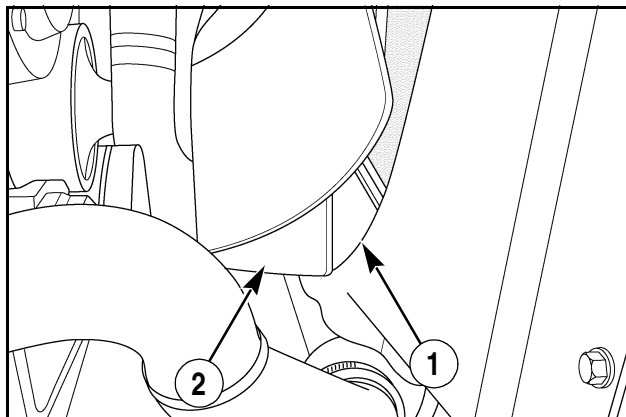
### STEP 24



RD05N023

Install the lower charge-air cooler hose and tighten the clamp.

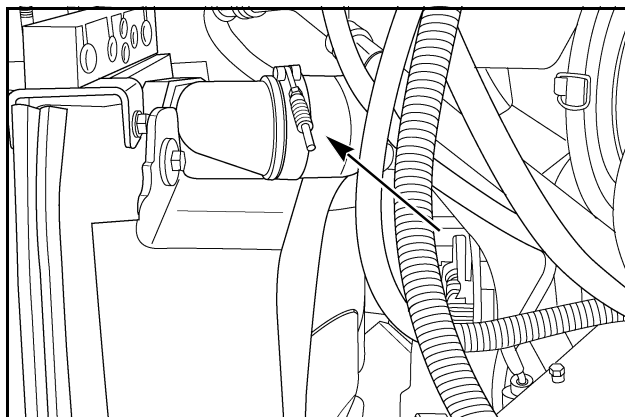
### STEP 22



RD05N028

Lower the assembly into position until the shroud (1) clears the fan (2).

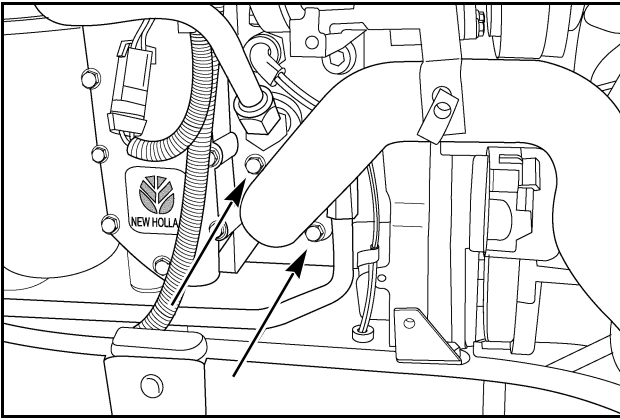
### STEP 25



RD05N024

Install the upper charge-air cooler hose and tighten the clamp.

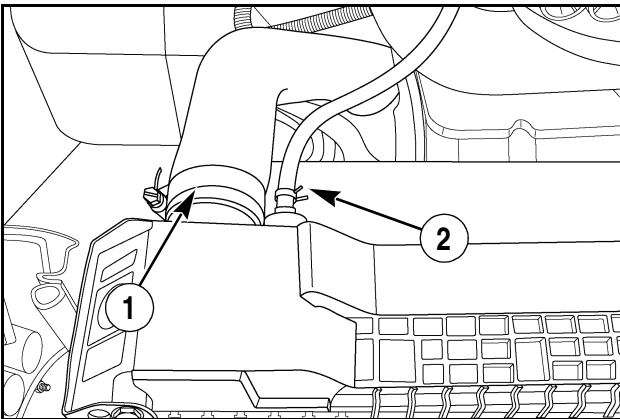
## STEP 26



RD05N022

Install a new gasket and bolt the radiator outlet / engine inlet pipe to the engine coolant inlet port.

## STEP 27

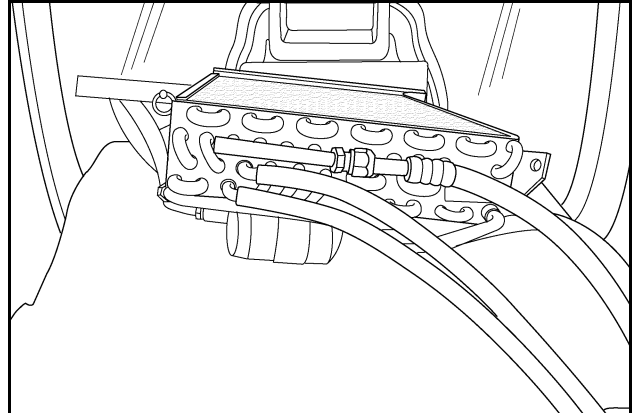


RD05N021

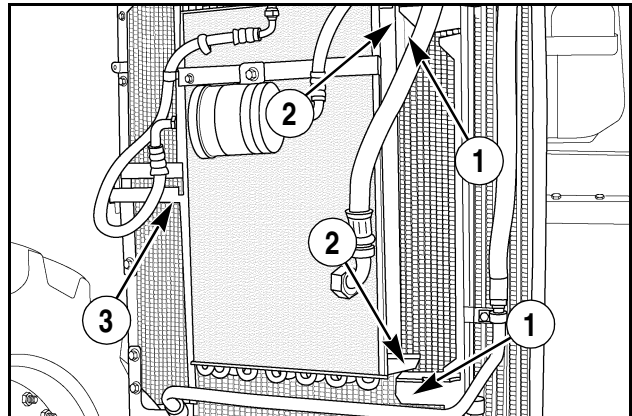
Install the upper radiator hose (1) and tighten the clamp. Install the air bleed hose and clamp (2).

Do the following step if the A/C condenser was not removed.

## STEP 28



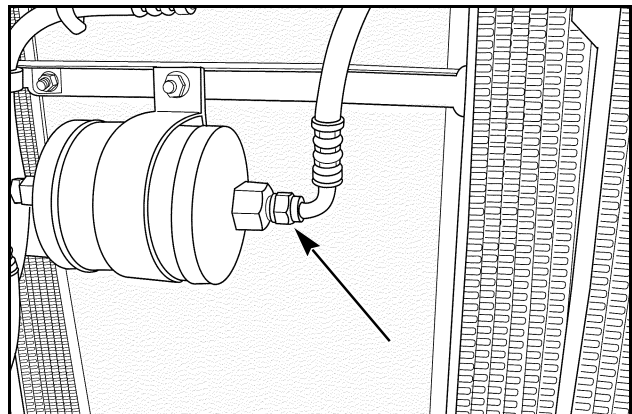
RD05N018



RD05N017

Lift the condenser from the padding and place on the mounting studs (1). Install the locking nuts (2). Do not over tighten the nuts, allow condenser to swing freely. Install the locking pin (3).

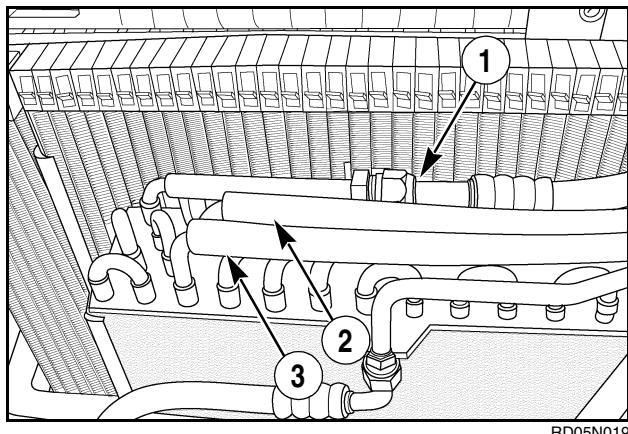
## STEP 29



RD05N020

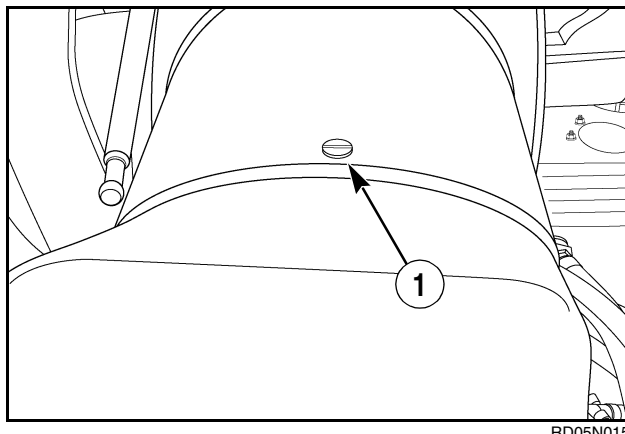
Install a new O-ring on the A/C dryer inlet hose and tighten the fitting.

### STEP 30



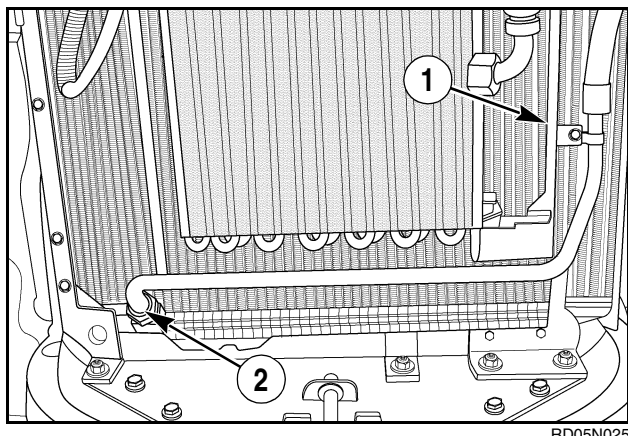
Install a new O-ring on the condenser outlet hose and tighten the fitting (1). Install the fuel cooler outlet hose (2) and inlet hose (3).

### STEP 33



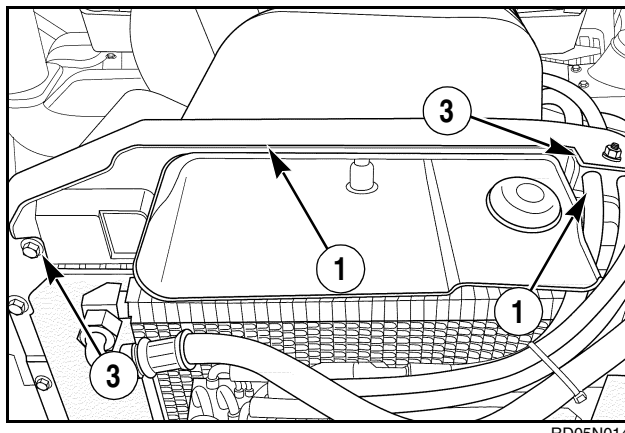
Install the air cleaner scoop and install new plastic fasteners (1). Lower fastener not shown.

### STEP 31



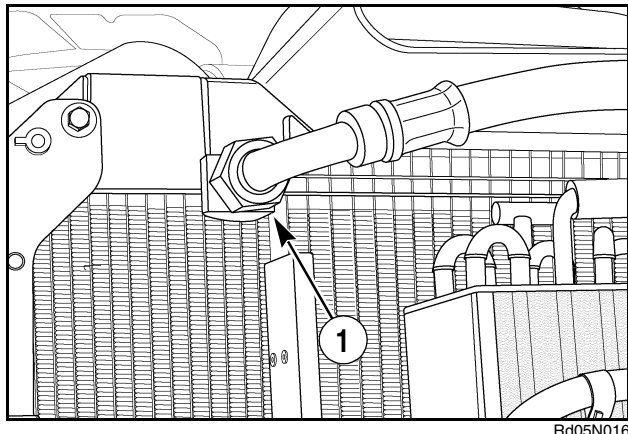
Install a new O-ring on the lower hydraulic cooling line and tighten the fitting (1). Install the support clamp (2).

### STEP 34



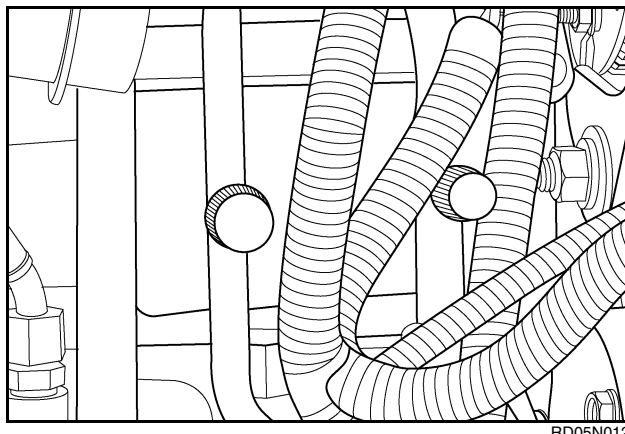
Install hose clamps (1), bracket (2) and mounting hardware (3).

### STEP 32



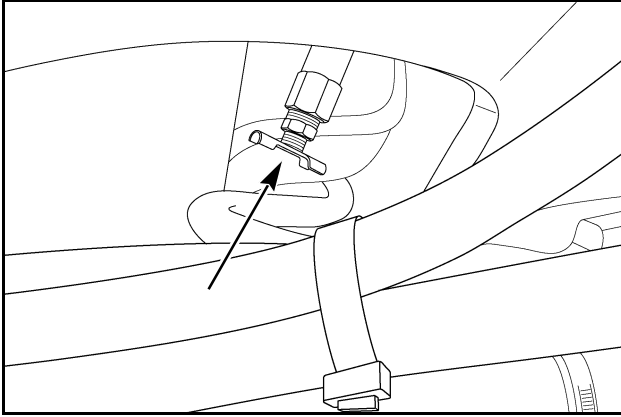
Install a new O-ring on the upper hydraulic cooler hose (1) and tighten the fitting.

### STEP 35



If required, recharge the A/C system. See A/C Section in this Service Manual.

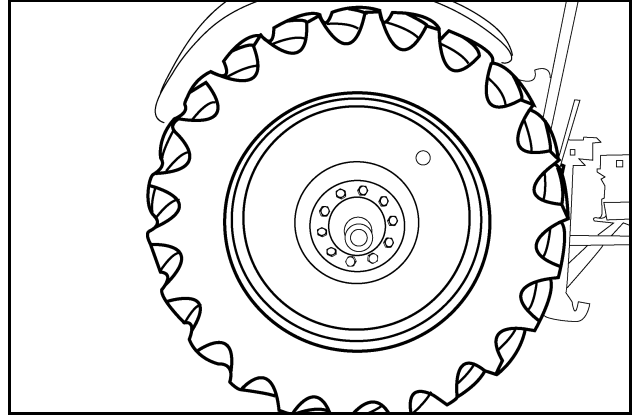
### STEP 36



RD05N013

Close the radiator drain. Refill the cooling system with the proper mix of ethylene glycol. See Operator Manual for coolant capacity. Install the pressure cap on the deaeration tank, start the engine and check for any leaks. Turn off key to shut engine off. Repair as necessary.

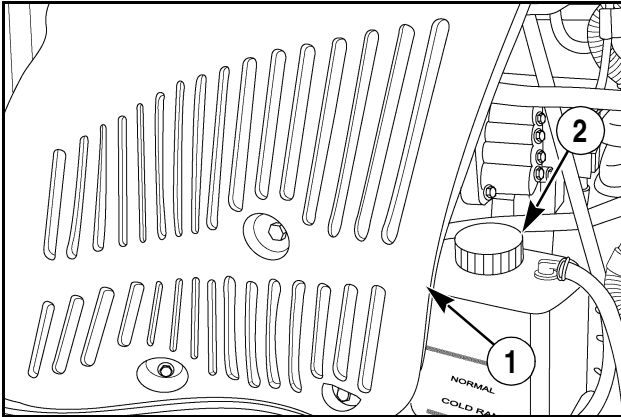
### STEP 38



RD02C070

Remove wheel blocks.

### STEP 37



RD05N011

Install the left (1) and right side panels. If necessary, top off coolant in the recovery bottle (2).

# **Section 10**

## **Chapter 5**

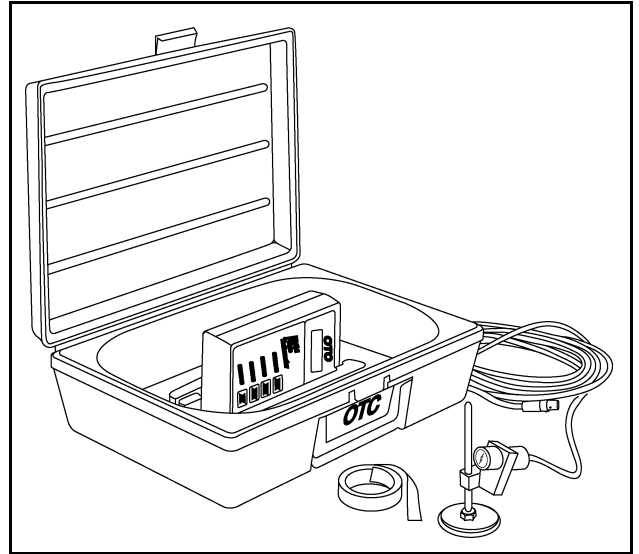
### **VISCOUS FAN DRIVE TEST**

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DIAGNOSTIC PROCEDURE .....	10-5-4
FAN SPEED TEST .....	10-5-7

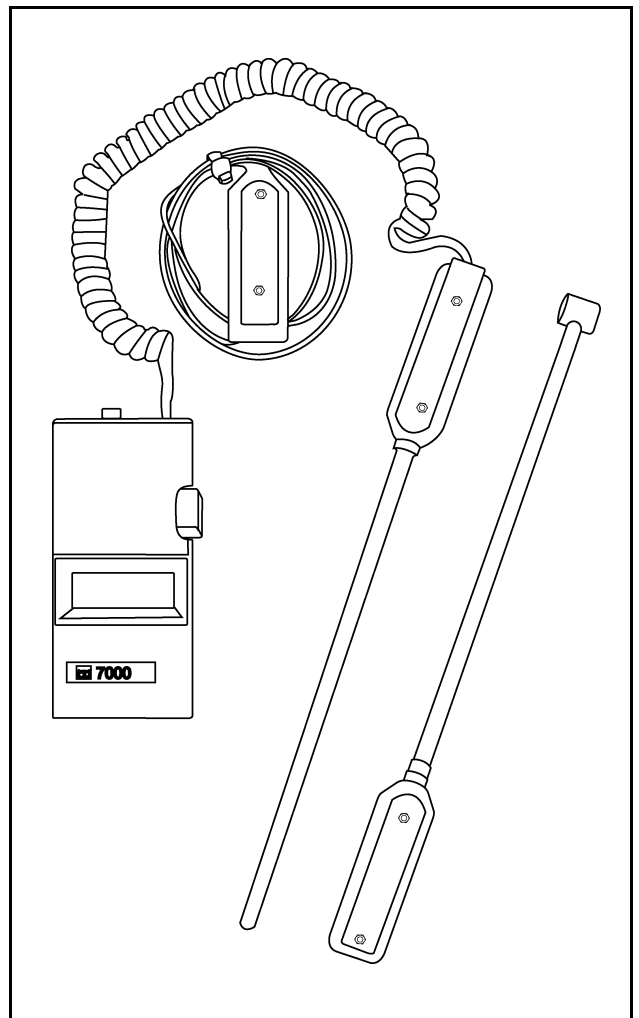
## REQUIRED TOOLS

**Digital Photo Tachometer OEM1057A or Equivalent**



OEM1057A

**Digital Thermometer with Probe (380001301) OR Digital Multimeter with Air Probe Equivalent**



380001301



## DIAGNOSTIC PROCEDURE

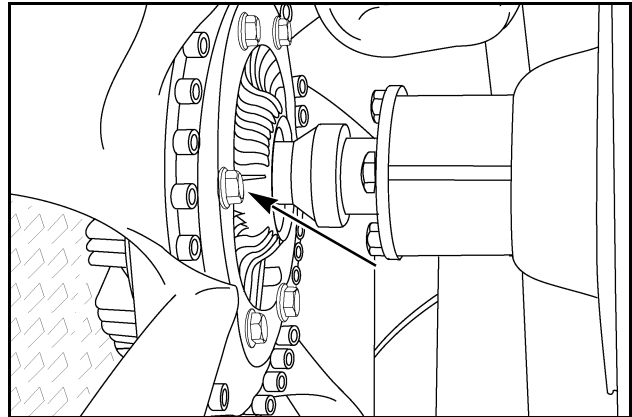
### Physical Check

#### STEP 1

Check the torque of the fan blade mounting bolts.

1. 690 Drive (40KPH Transmission):  
10.3 - 14.8 lb. ft. (14 - 70 Nm).
2. 810 Drive (50 KPH Transmission):  
12.1 - 14.8 lb. ft. (30 - 70 Nm).

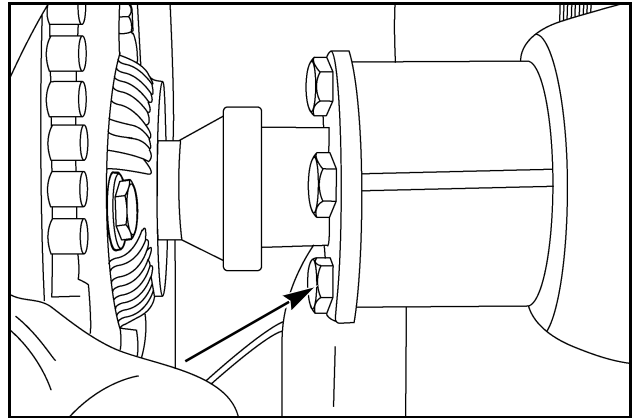
**NOTE:** 810 Fan Drive is installed on all models with 50 KPH transmission. 610 Fan Drive is installed on all other models.



RD03C013

#### STEP 2

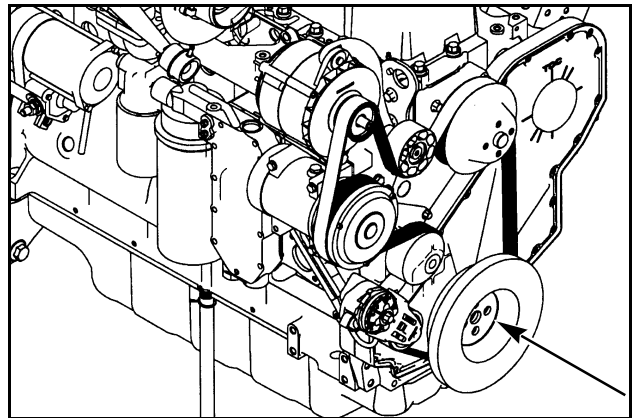
Check the torque of the fan driven pulley bolts –  
20-22 lb. ft. (27-30 Nm).



RD03C014

#### STEP 3

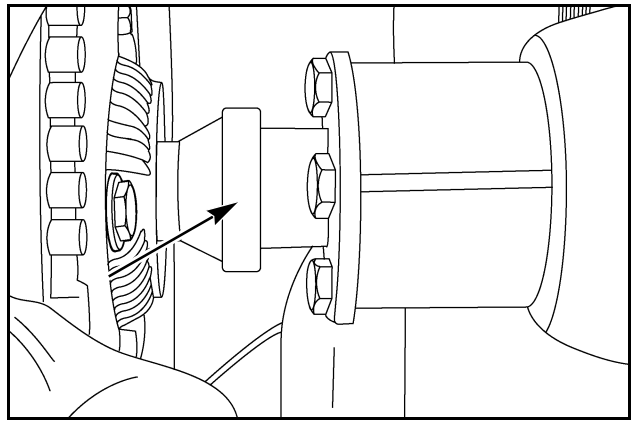
Check the torque of the fan drive pulley –  
148 lb. ft. (200 Nm).



RH02J056

## STEP 4

Check the torque on the drive shaft hub – 66.7 - 82.6 lb. ft. (90 - 112 Nm).



RD03C014

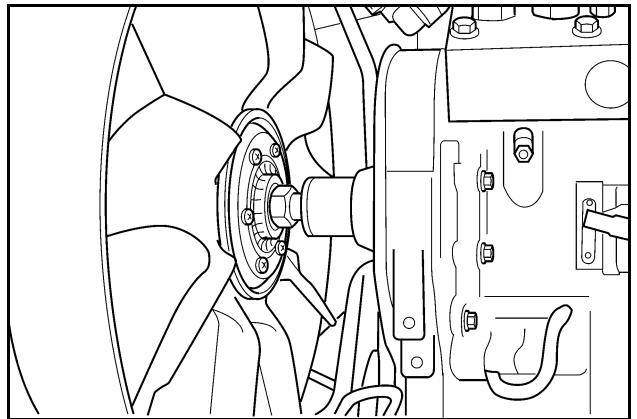
## STEP 5

Check the fan drive, blade assembly, shroud and radiator for signs of interference with rotating parts. If damage is present, locate and repair the problem, replacing defective parts as needed.

## STEP 6

Rotate the fan by hand one complete turn (360°). The fan should turn smoothly with some uniform internal resistance. If the fan rotates with strong or non-uniform resistance, replace the fan drive.

**NOTE:** Fan resistance must result from the internal drive, not from interference with a non-rotating part.

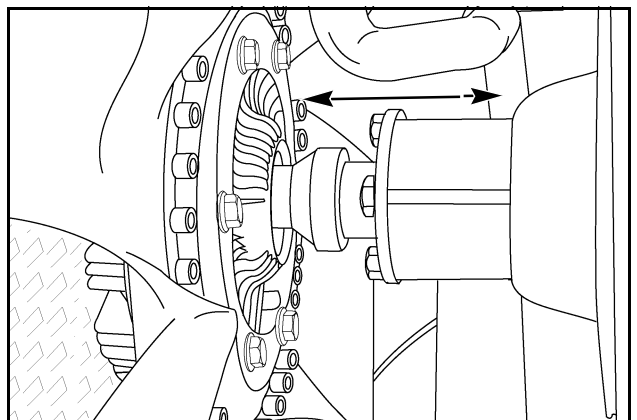


RH02G267

## STEP 7

There should be minimal forward/rearward play in the fan drive. Grasp the center of the blade assembly, and attempt to move the drive forward and rearward. If there is more than 1/16-inch (1.6 mm) play in the drive itself, replace the fan drive.

**NOTE:** This Step checks for internal play within the drive itself, movement which is not the result of loose mounting bolts or pulley bearing wear.

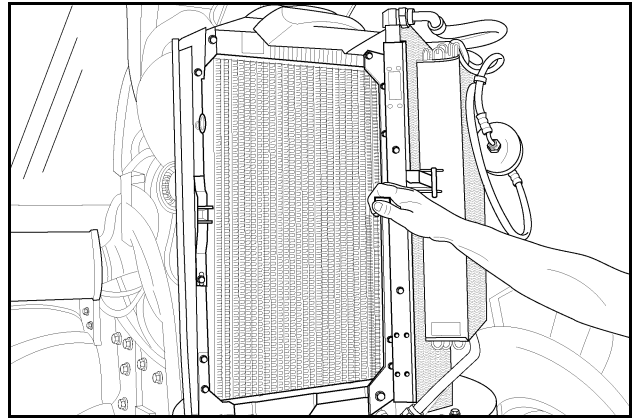


RD03C013

## STEP 8

Check for plugging in the fuel cooler, condenser, air cooler, oil cooler and radiator. Remove crop dust, dirt and debris in the air path to the engine. If necessary, use low pressure power wash or compressed air to clean.

**IMPORTANT:** *Do NOT steam clean or use high pressure jets to clean the fan drive. The high forces used may cause foreign material to be forced past external seals, contaminating the grease or silicone seal. Do NOT aim the low pressure wash directly at the fan bi-metal drive while cleaning.*



RD05J077

## STEP 9

Check that the cooling system is filled to the proper level and with the correct coolant mixture.

## FAN SPEED TEST

### STEP 10

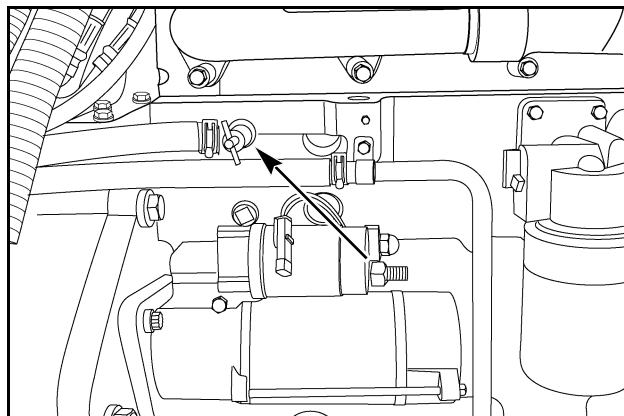
**IMPORTANT:** This test is most effective at an ambient air temperature of 80° F (26.7° C) or higher.

**NOTE:** Reading RPM with the tachometer in bright sunlight may be difficult; if possible, move the tractor to more suitable lighting conditions.

Warm a cold engine to shorten the run time during this procedure:

- A. Turn the air conditioning system OFF.
- B. Close the heater supply valve on the left hand side of the engine.
- C. Start the engine and operate until the thermostat opens; then turn the engine OFF.

**NOTE:** The A/C system and the heater valve should remain closed throughout this test.



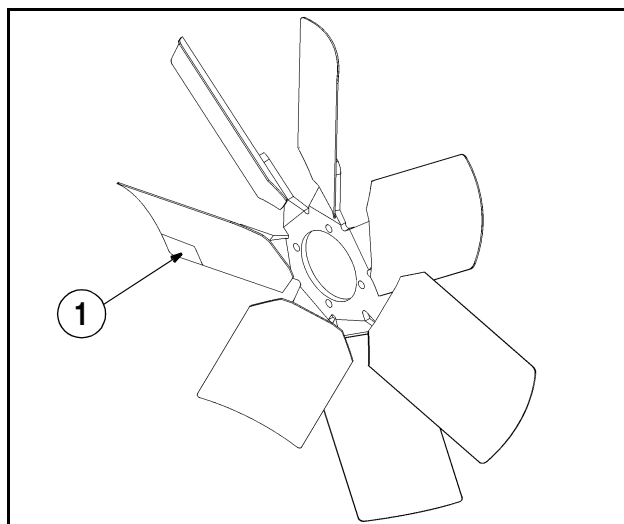
Heater Supply Valve

RD05N105

### STEP 11

Place a piece of reflective tape (1) from the Digital Photo Tachometer Kit on the engine side of the fan blade. Install the tape near the outside edge of the blade, the left corner of the blade as viewed from the left side of the tractor.

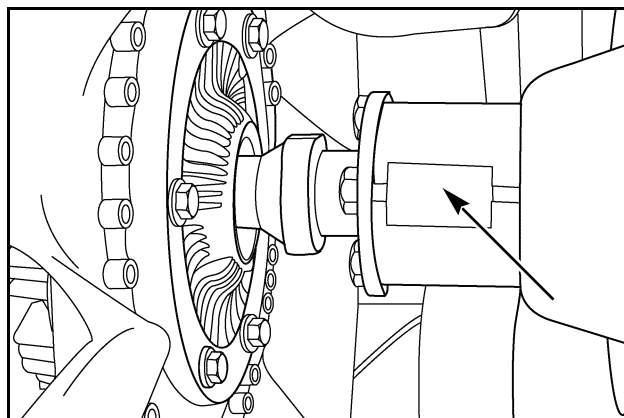
**NOTE:** Fan model shown at the right has seven blades, all present tractor models have eight blades.



RH03C034

### STEP 12

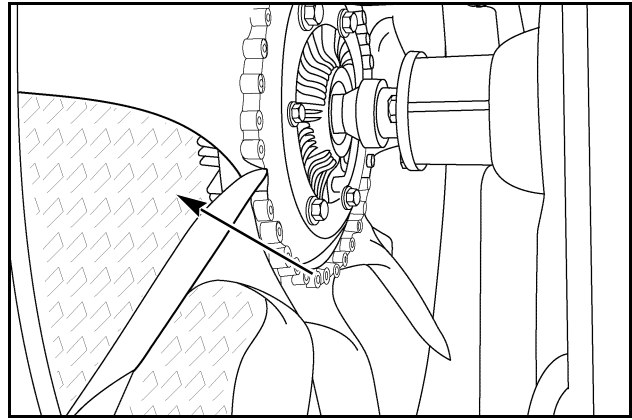
Apply another strip of reflective tape to the fan drive shaft so drive shaft RPM can be read with the photo tachometer.



RD03C020

### STEP 13

Loosen the shroud mounting screws on the left hand side of the fan, and route the temperature probe between the front of the viscous drive and the radiator.

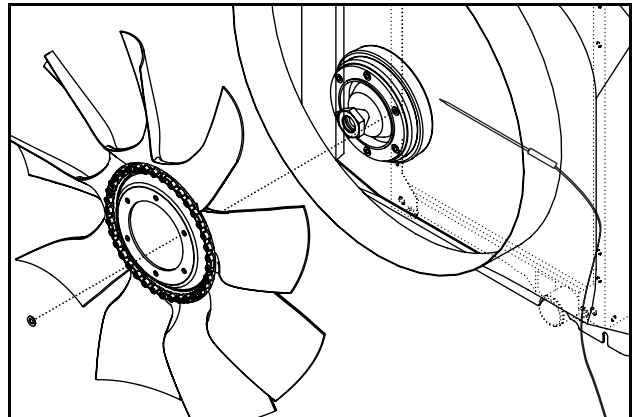


RD03C017

### STEP 14

Secure the temperature probe to the rear of the radiator with wire ties so the sensing probe measures air temperature within 1 inch (25.4 mm) of the center of the fan drive.

Route the electrical lead to the probe so temperature readings can be taken with the hood closed.



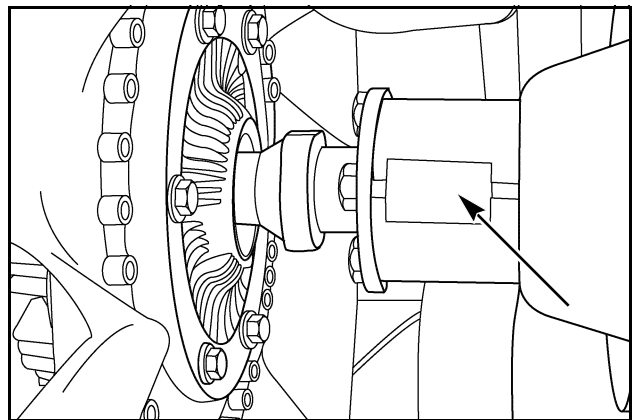
RH03C039

### STEP 15

Start the engine, and turn electrical loads ON (lights and work lamps).

Measure the fan drive shaft speed with the photo tachometer aimed at the reflective tape on the shaft. Increase engine speed until fan drive shaft speed reaches 2200 rpm on all models with 40 KPH transmission or 2500 rpm on all models with 50 KPH transmission.

**NOTE:** Fan drive shaft speed is not the same as engine speed. Fan drive to engine speed ratio is 1.1:1 on all 40 KPH transmission models and 1.25:1 on all 50 KPH models.



RD03C020

Lock the throttle at this RPM. This establishes the fan drive shaft test RPM.

### STEP 16

Install the magnetic base for the photo tachometer on the top of the left hand rail. Install the photo pickup on the base and aim it at the reflective tape on the fan blade. Route the leads to the photo pickup so they will not interfere with any rotating parts with the hood closed.

Reinstall any side panels removed. Close the hood.

Cover the front grille screen. Measure the fan blade speed with the photo tachometer.

**STEP 17**

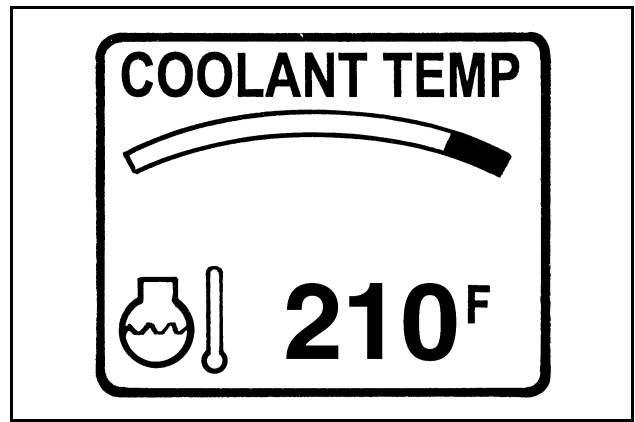
As the engine warms up,

- A. The fan RPM should stabilize between 800-1000 RPM.
- B. When engine coolant reaches 200-220° F (93.3-104.4° C), fan speed should increase to 1870 RPM on all models with 40 KPH transmission or 2125 on all models with 50 KPH transmission.
- C. Air temperature at the fan drive should be 165-195° F (73.9-90.6° C) when the fan engages.

With the fan engaged, record fan RPM, coolant temperature and air temperature at the drive.

With the fan engaged while maintaining the test RPM, fan speed should begin to decrease as temperature decreases. After 2-3 minutes, the fan should slow to the initial fan speed – about 1000 RPM on all models with 50 KPH transmission or 880 RPM on all models with 40 KPH transission.

Repeat this cycle several times while recording temperatures and fan RPM.



RH03C032

**STEP 18**

1. Replace the viscous fan drive if:

**50 KPH Transmissions:** If the fan fails to reach 2125 RPM or higher (at least 85% of the test RPM) at 200-220° F (93.3-104.4° C) coolant temperature AND air temperature at the fan drive exceeds 195° F (90.6° C).

**40 KPH Transmissions:** If the fan fails to reach 1870 RPM or higher (at least 85% of the test RPM) at 200-220° F (93.3-104.4° C) coolant temperature AND air temperature at the fan drive exceeds 195° F (90.6° C).

2. The fan drive is not faulty if the fan fails to reach 85% of the test RPM and the coolant temperature EXCEEDS 220° F (104.4° C) and air temperature at the fan drive does NOT exceed 195° F (90.6° C). Check for the following:
  - A. Air flow restrictions through the air cooler, oil cooler and radiator.
  - B. Internal radiator plugging.
  - C. Faulty thermostat.
  - D. Defective water pump.
3. If fan speed fails to slow down to 800-1000 RPM after the fan drive disengages (with the test RPM maintained), replace the viscous fan drive.

## **STEP 19**

Remove the cover from the front of the radiator. Remove the air temperature probe and photo tachometer. Move the throttle to the low idle position and allow the engine to cool for two minutes before shutting down.

# **Section 21**

## **Chapter 1**

### **POWERSHIFT TRANSMISSION SYSTEM**

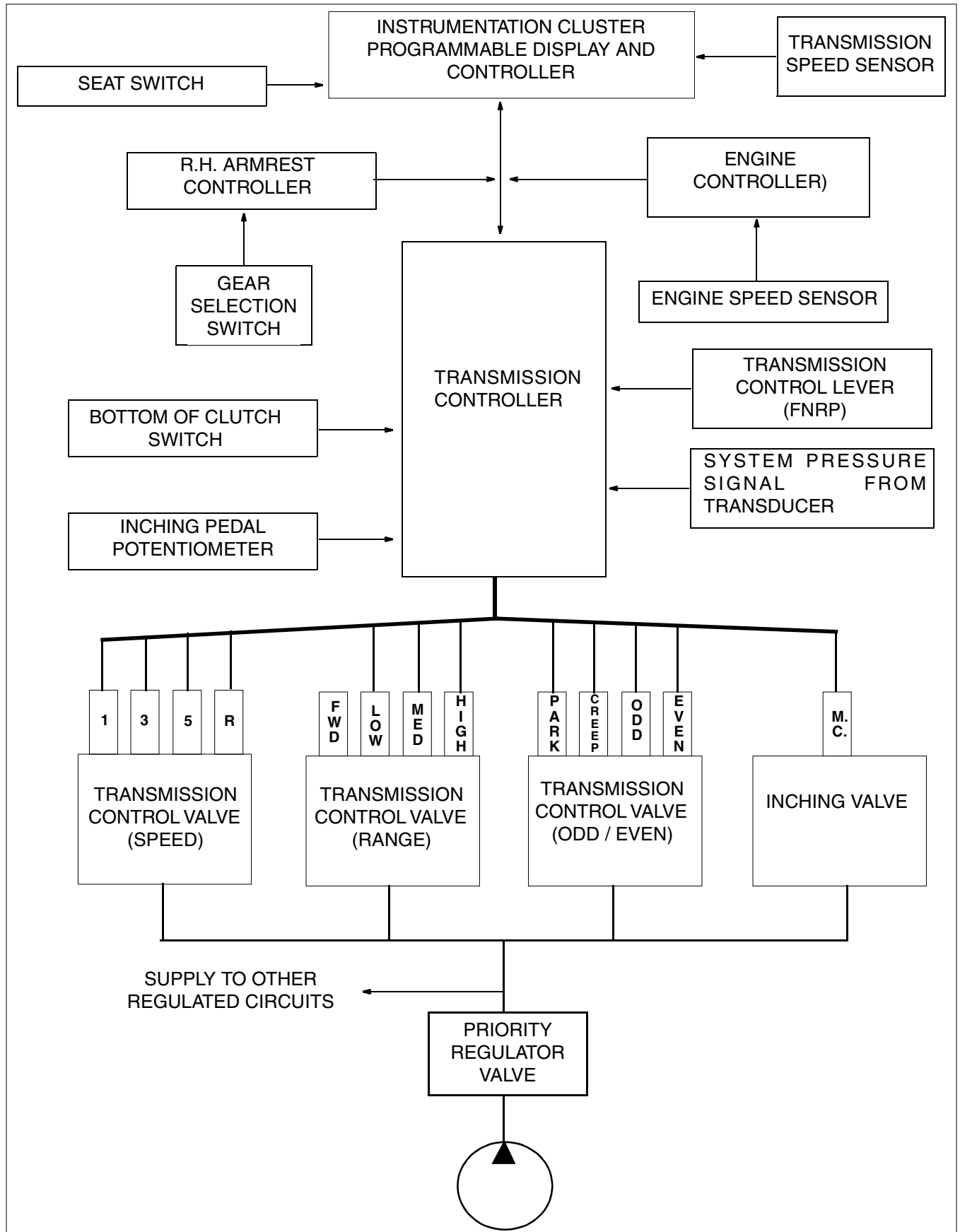
#### **How It Works and Troubleshooting**



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## TRANSMISSION SYSTEM INTRODUCTION



All transmissions are full powershift transmission and controlled by the transmission controller. The standard transmission has 18 forward speeds and 4 reverse speeds. There is an optional transmission with 19 forward speeds and 4 reverse speeds. This transmission has 50Km/h roading capability. The optional creeper transmission has 23 forward speeds and 6 reverse speeds.

It is not necessary to use the inching pedal when shifting between gears or in and out of neutral with a full powershift transmission. The transmission is also equipped with an electro-hydraulically operated park brake mechanism that is applied when power is removed.

The transmission controller either directly or through the Data Bus monitors the state/value of the following items:

Transmission Control Lever

Gear Selection Switch

Bottom of Clutch Switch

Seat Switch


Engine Speed Sensor

Transmission Speed Sensor





The transmission controller will report any problems directly to the instrumentation cluster controller. The instrumentation cluster controller will display any system faults or fault code information through the programmable display.

When a fault occurs, a 3 second continuous audible alarm will sound. The audible alarm will stop after 3 seconds. Once the fault has been corrected, depress the “Reset” button on the programmable display to clear the fault.

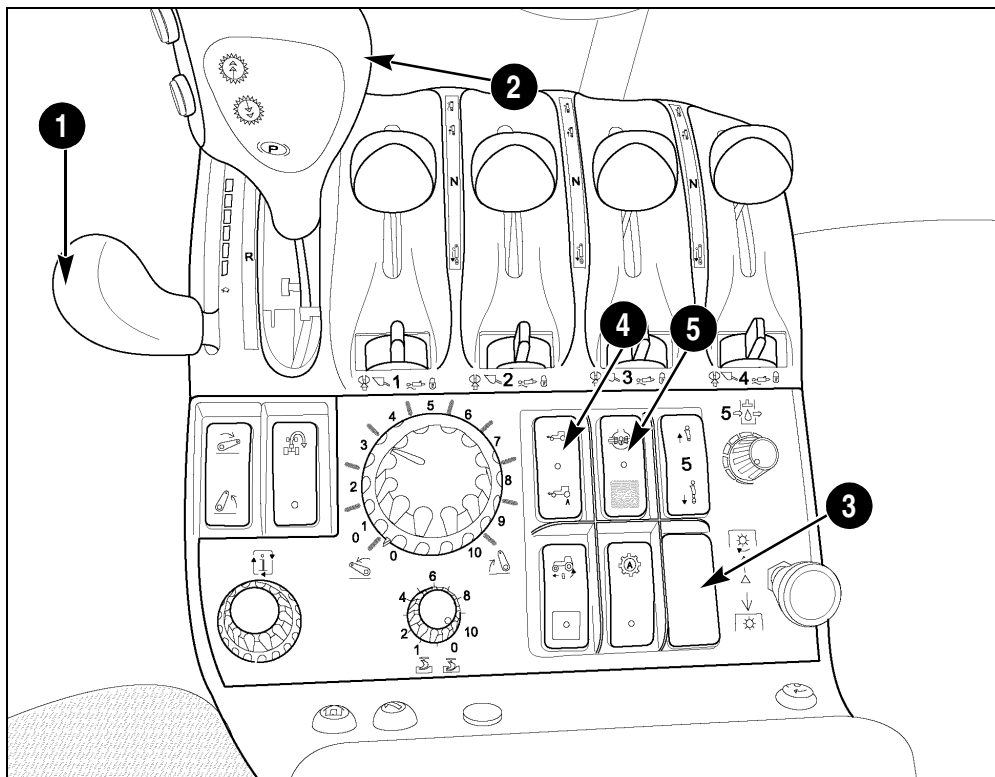
**NOTE:** *The following warning is of a critical nature and the tractor engine should be shut down immediately and the cause of the problem checked. If your tractor is equipped with the Performance Monitor, the tractor will automatically shut down in 30 seconds after the warning is displayed. The warning below cannot be shut off by pushing the reset button.*

Display		Description	Corrective Action
	TRANS OIL TEMP	High transmission oil temperature	Shut the tractor engine OFF immediately and check for cause.

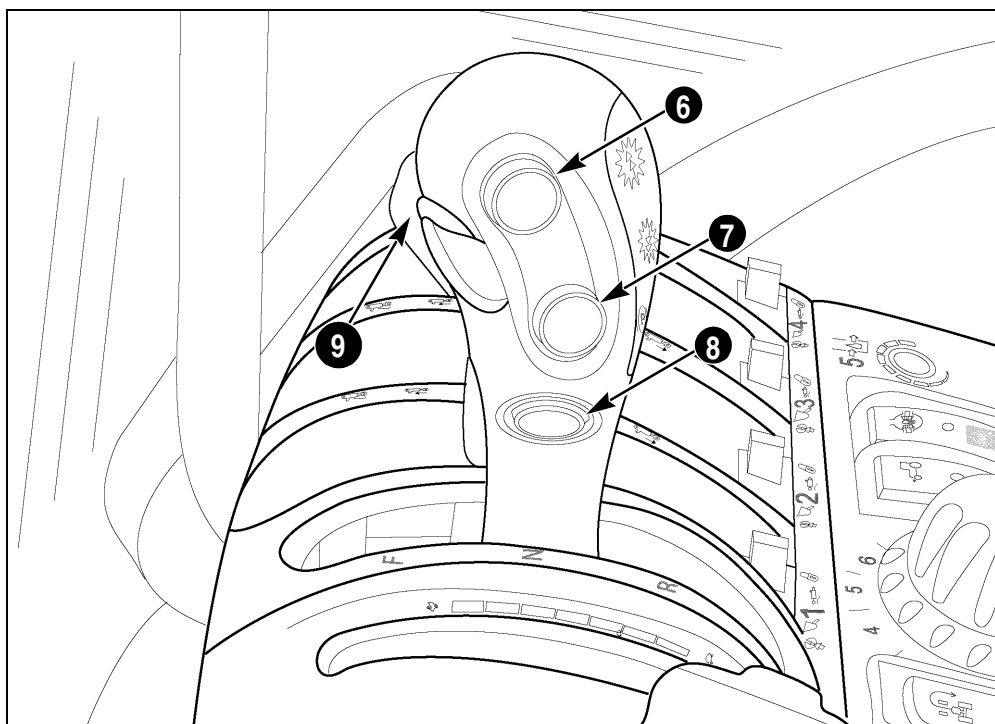
The following faults will not cause immediate damage to the tractor or shut the tractor down, but may make other systems inoperative. Pushing the “Reset” button will clear the fault however, the fault will be displayed again after ten minutes if not corrected.

Display	Description
 TRANS OFF LINE	Transmission Bus Off fault.
 TRANS OFF LINE	Transmission diagnostic fault.
 TRANS CONF/CAL	TRCU - Config/CAL required (bit in system status).
 SIT DOWN	TRCU re-enable required.

## TRANSMISSION SYSTEM CONTROLS



RH05J060

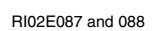


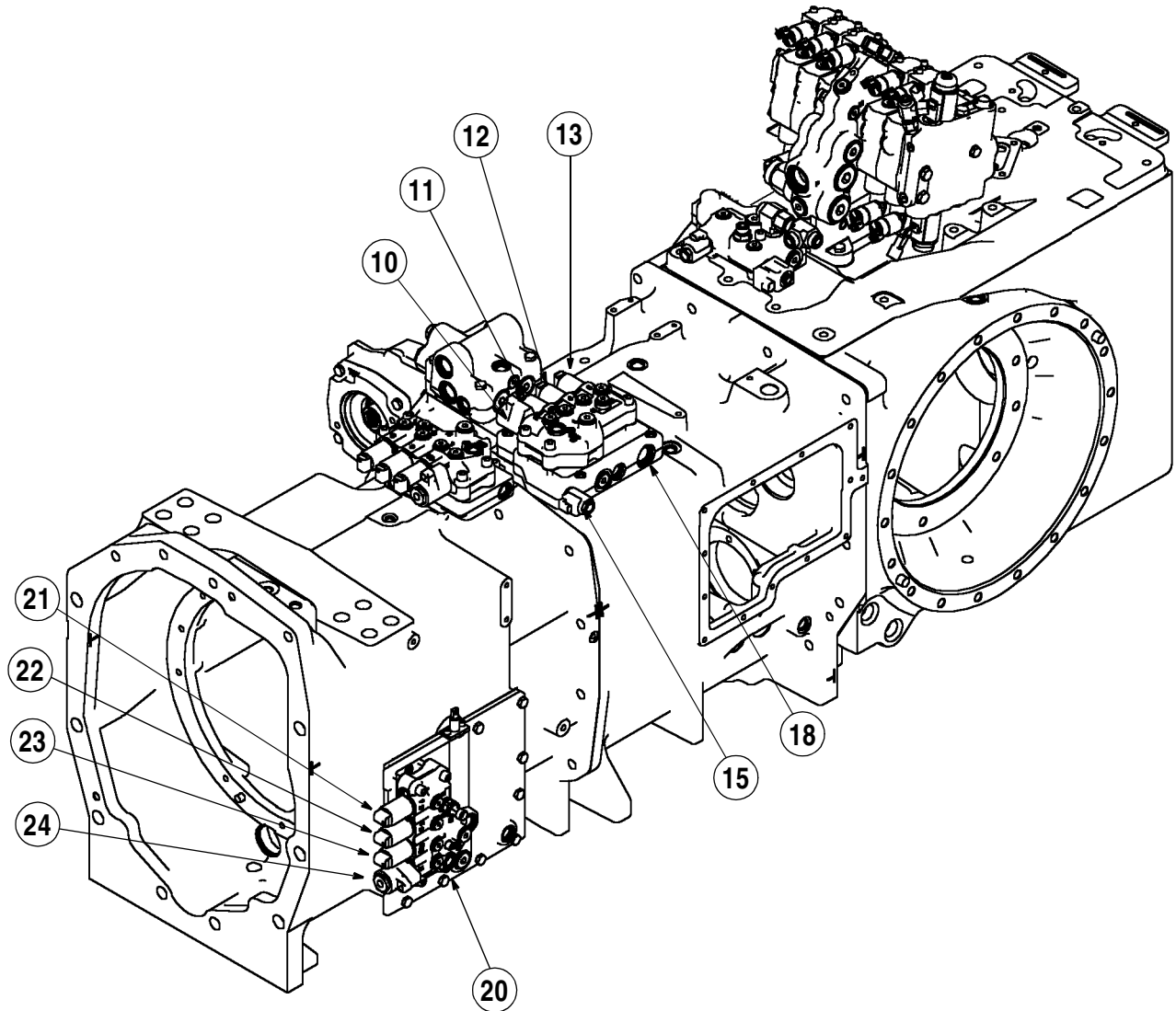
RD05J155

- |   |                                      |
|---|--------------------------------------|
| 1. THROTTLE HAND LEVER                  | 6. GEAR SHIFT UP BUTTON              |
| 2. TRANSMISSION CONTROL LEVER           | 7. GEAR SHIFT DOWN BUTTON            |
| 3. CREEPER CONTROL SWITCH (IF EQUIPPED) | 8. PARK BUTTON (ACTIVATE IN NEUTRAL) |
| 4. FWD CONTROL SWITCH                   | 9. SHUTTLE SHIFT CONTROL BUTTON      |
| 5. DIFF LOCK SWITCH                     |                                      |

This technical drawing shows the rear view of a machine, likely a printing press or similar industrial equipment. The drawing is a line drawing with various components labeled with numbers in circles. The labels are as follows:

- 1: Points to a central horizontal assembly, possibly a roller or a set of rollers.
- 2: Points to a component on the left side, possibly a motor or a drive unit.
- 3: Points to a component on the left side, possibly a motor or a drive unit.
- 4: Points to a component on the left side, possibly a motor or a drive unit.
- 5: Points to a component on the left side, possibly a motor or a drive unit.
- 6: Points to a component on the right side, possibly a motor or a drive unit.
- 7: Points to a component on the right side, possibly a motor or a drive unit.
- 8: Points to a component on the right side, possibly a motor or a drive unit.
- 9: Points to a component on the right side, possibly a motor or a drive unit.
- 10: Points to a component on the right side, possibly a motor or a drive unit.
- 11: Points to a component on the right side, possibly a motor or a drive unit.
- 12: Points to a component on the right side, possibly a motor or a drive unit.
- 13: Points to a component on the right side, possibly a motor or a drive unit.
- 14: Points to a component on the right side, possibly a motor or a drive unit.
- 15: Points to a component on the right side, possibly a motor or a drive unit.
- 16: Points to a component on the right side, possibly a motor or a drive unit.
- 17: Points to a component on the right side, possibly a motor or a drive unit.
- 18: Points to a component on the right side, possibly a motor or a drive unit.
- 19: Points to a component on the right side, possibly a motor or a drive unit.
- 20: Points to a component on the right side, possibly a motor or a drive unit.
- 21: Points to a component on the right side, possibly a motor or a drive unit.
- 22: Points to a component on the right side, possibly a motor or a drive unit.
- 23: Points to a component on the right side, possibly a motor or a drive unit.
- 24: Points to a component on the right side, possibly a motor or a drive unit.
- 25: Points to a component on the right side, possibly a motor or a drive unit.
- 26: Points to a component on the right side, possibly a motor or a drive unit.
- 27: Points to a component on the right side, possibly a motor or a drive unit.
- 28: Points to a component on the right side, possibly a motor or a drive unit.

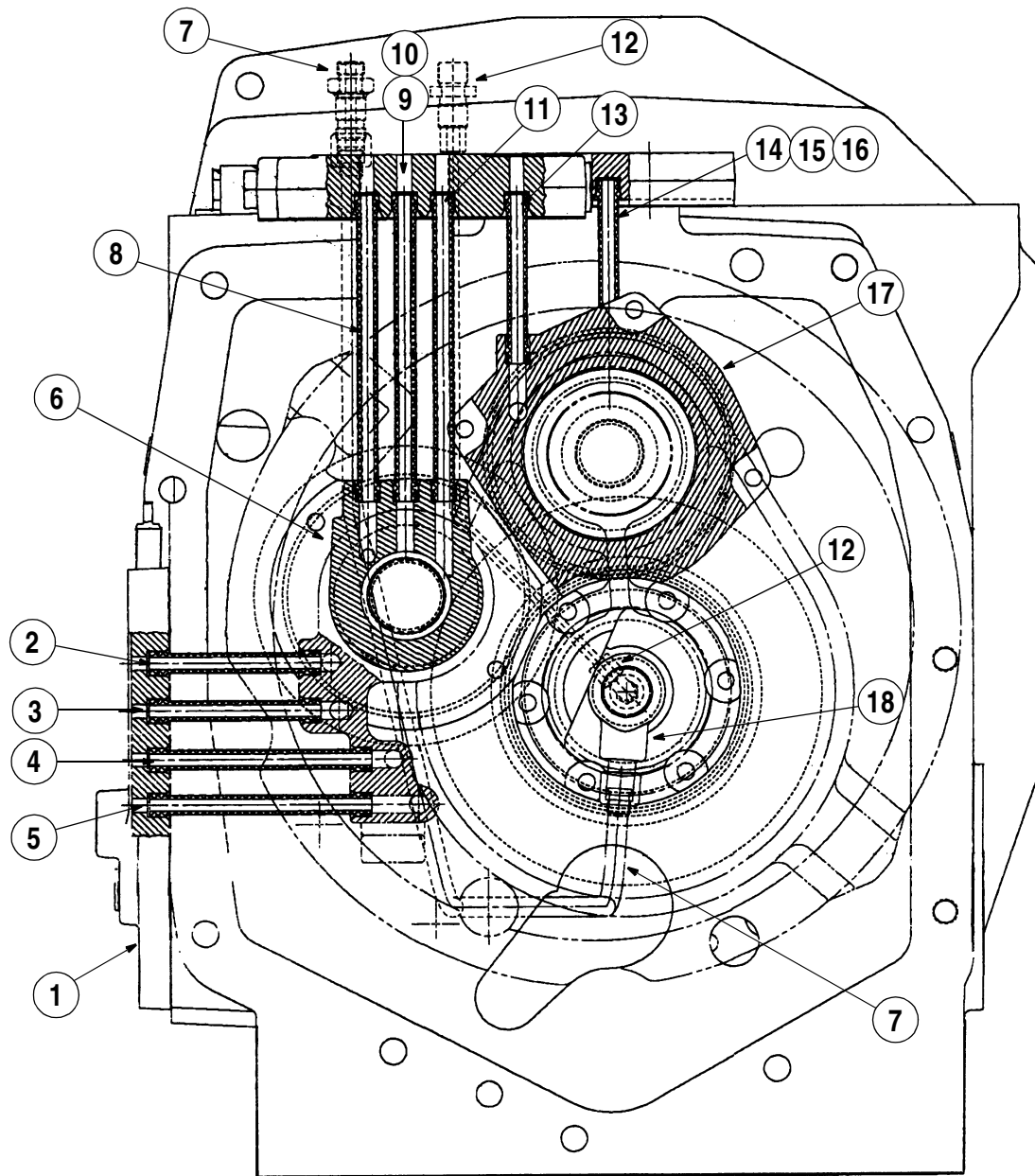




- |  |                                |
|--|--------------------------------|
| 1. POWERSHIFT VALVE ODD/EVEN               | 16. INCHING VALVE              |
| 2. EVEN CLUTCH SOLENOID                    | 17. REGULATED PRESSURE INLET   |
| 3. ODD CLUTCH SOLENOID                     | 18. MASTER CLUTCH LUBE INLET   |
| 4. CREEP CLUTCH SOLENOID                   | 19. MASTER CLUTCH TEST PORT    |
| 5. PARK BRAKE SOLENOID                     | 20. POWERSHIFT VALVE SPEED     |
| 6. PTO/DIFF LOCK VALVE                     | 21. C1 CLUTCH SOLENOID         |
| 7. PRIORITY REGULATOR VALVE                | 22. C3 CLUTCH SOLENOID         |
| 8. REGULATED PRESSURE TO POWERSHIFT VALVES | 23. C5 CLUTCH SOLENOID         |
| 9. POWERSHIFT VALVE RANGE                  | 24. REVERSE SOLENOID           |
| 10. FWD SOLENOID                           | 25. SYSTEM PRESSURE TRANSDUCER |
| 11. LOW CLUTCH SOLENOID                    | 26. TO PARK BRAKE              |
| 12. MID CLUTCH SOLENOID                    | 27. PARK BRAKE PUMP            |
| 13. HIGH CLUTCH SOLENOID                   | 28. DIFF LOCK SOLEBNOID        |
| 14. PTO SOLENOID                           |                                |
| 15. MASTER CLUTCH SOLENOID                 |                                |

RI02E086

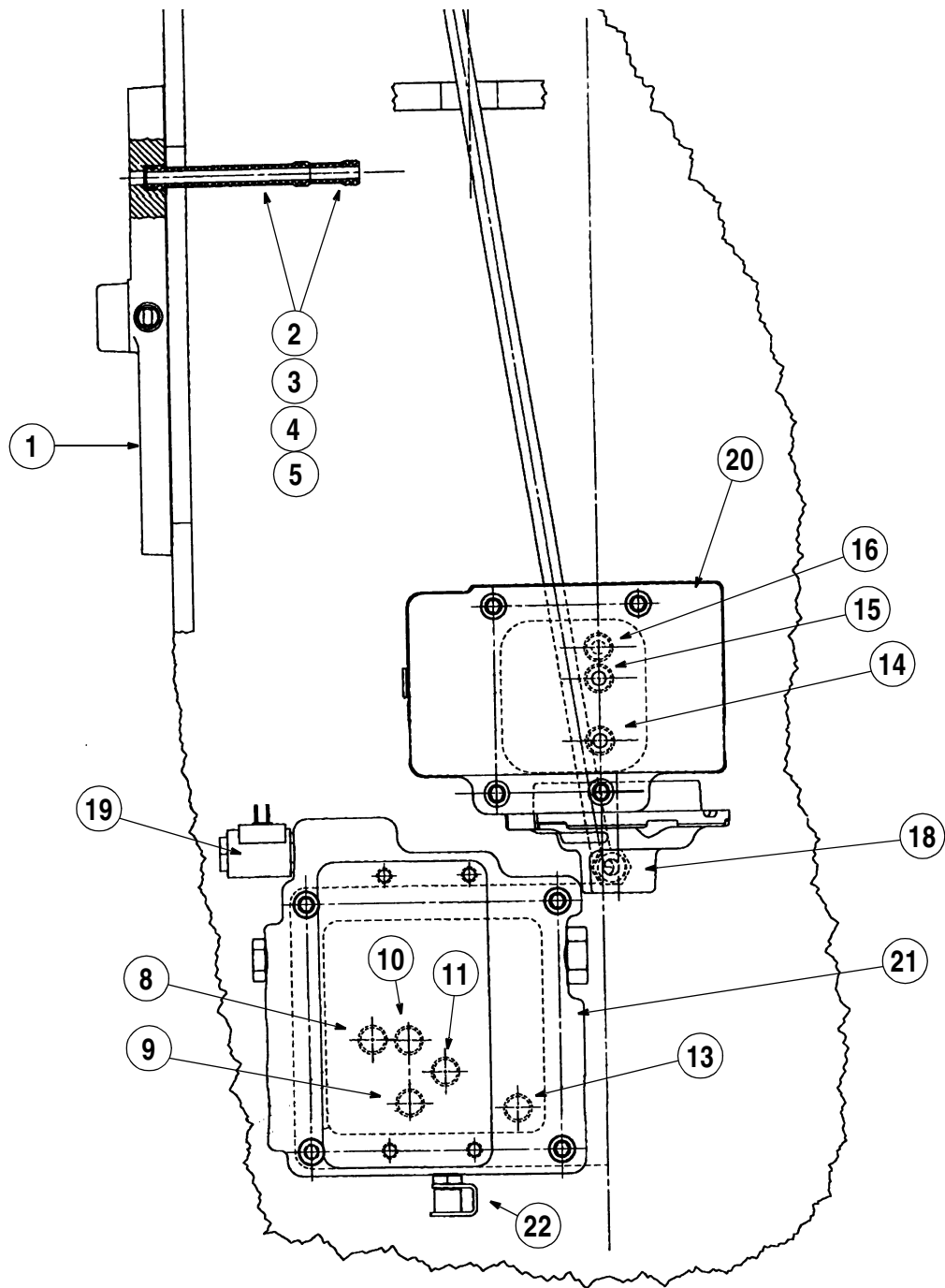
## TRANSMISSION LUBE AND DISTRIBUTION TUBES



RH98C089

**Rear View**

- |  |  |
|--|--|
| 1. SPEED POWERSHIFT VALVE MOUNTING PLATE         | 13. LOW CLUTCH DISTRIBUTION TUBE         |
| 2. SPEED C1 CLUTCH DISTRIBUTION TUBE             | 14. SPEED LUBE DISTRIBUTION TUBE         |
| 3. SPEED C3 CLUTCH DISTRIBUTION TUBE             | 15. ODD CLUTCH DISTRIBUTION TUBE         |
| 4. SPEED C5 CLUTCH DISTRIBUTION TUBE             | 16. EVEN CLUTCH DISTRIBUTION TUBE        |
| 5. SPEED REVERSE CLUTCH DISTRIBUTION TUBE        | 17. SPEED INPUT SHAFT BEARING CAGE       |
| 6. RANGE INPUT SHAFT BEARING CAGE                | 18. SPEED COUNTERSHAFT BEARING CAGE      |
| 7. CREEPER CLUTCH SUPPLY                         | 19. MASTER CLUTCH SOLENOID               |
| 8. MASTER CLUTCH, SPEED OUT AND RANGE INPUT LUBE | 20. ODD / EVEN POWERSHIFT MOUNTING PLATE |
| 9. HIGH CLUTCH DISTRIBUTION TUBE                 | 21. INCHING VALVE MOUNTING PLATE         |
| 10. MID CLUTCH DISTRIBUTION TUBE (BEHIND HIGH)   | 22. MASTER CLUTCH DIAGNOSTIC PORT        |
| 11. MASTER CLUTCH SUPPLY DISTRIBUTION TUBE       |  |
| 12. CREEPER LUBE SUPPLY                          |  |



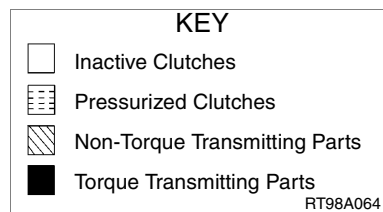
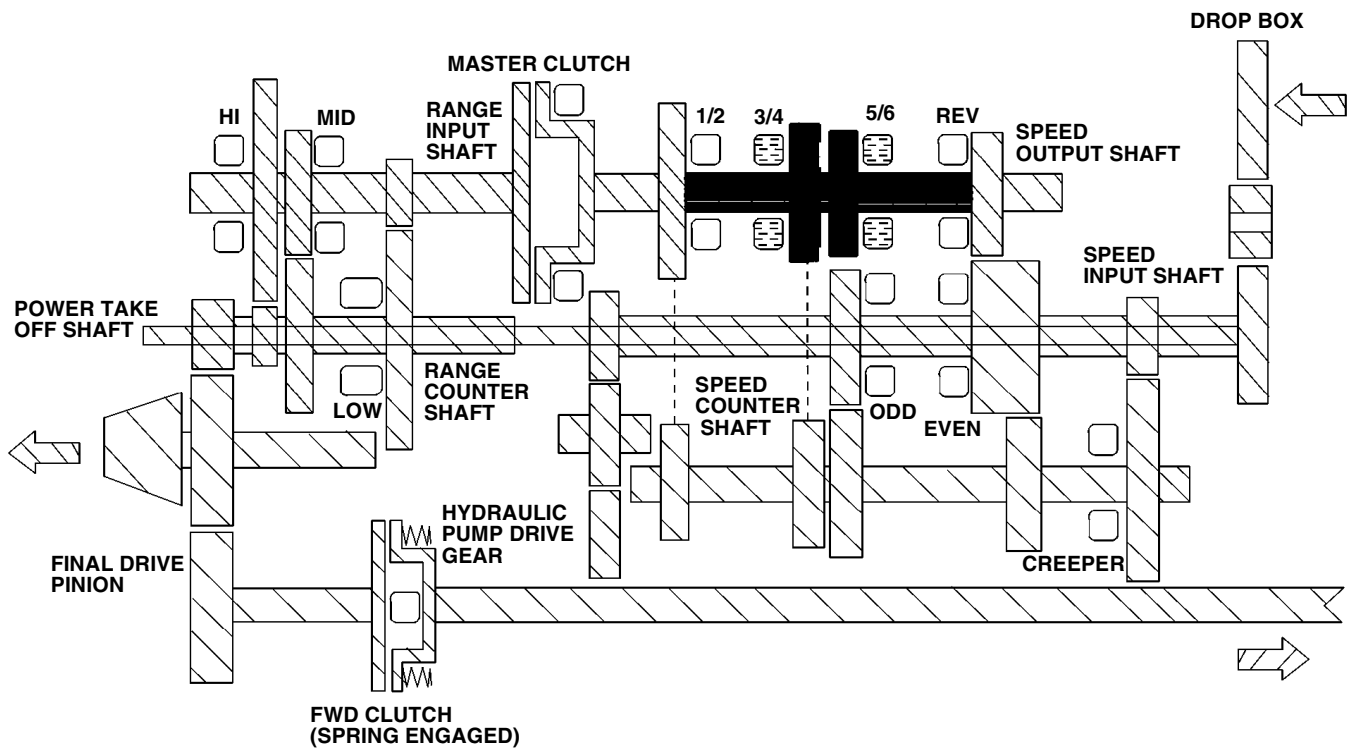
Top Rear View

RH98C089



## POWERSHIFT TRANSMISSION CLUTCH LAYOUT

Neutral



RT98A016

NEUTRAL - In Neutral only C3 and C5 clutches are pressurized.

**POWERSHIFT VALVE CLUTCH ENGAGEMENTS****CLUTCHES**

GEAR	MASTER	ODD	EVEN	1-2	3-4	5-6	LOW	MID	HIGH	REVERSE	CREEP/ OVERDRIVE
NEUTRAL					X	X					
PARK											
1	X	X		X			X				
2	X		X	X			X				
3	X	X			X		X				
4	X		X		X		X				
5	X	X				X	X				
6	X		X			X	X				
7	X	X		X				X			
8	X		X	X				X			
9	X	X			X			X			
10	X		X		X			X			
11	X	X				X		X			
12	X		X			X		X			
13	X	X		X					X		
14	X		X	X					X		
15	X	X			X				X		
16	X		X		X				X		
17	X	X				X			X		
18	X		X			X			X		
19	X					X			X		X
REV-1	X	X					X			X	
REV-2	X		X				X			X	
REV-3	X	X						X		X	
REV-4	X		X					X		X	
CR1	X			X			X				X
CR2	X				X		X				X
CR3	X					X	X				X
CR4	X			X				X			X
CR5	X				X			X			X
CR6	X					X		X			X
RCR-1	X						X			X	X
RCR-2	X							X		X	X

## **POWER FLOW (FORWARD SPEEDS)**

**FIRST GEAR** - As the operator selects first speed, he simultaneously engages the odd speed clutch pack, the first speed clutch pack, and the low range clutch pack through the transmission controller. The power then flows from the drop box, through the input shaft, through the engaged odd-speed clutch pack gear, to the countershaft gear. Since the countershaft gears are in constant mesh with the output shaft gears, power flows from the countershaft gear, to the engaged first-speed clutch pack gear, along the speed output shaft, to the master clutch. With the master clutch engaged, power is transmitted across the range transmission input shaft to the low-range drive gear. Power then flows to the low-range clutch pack gear, across the range countershaft, to the constant mesh gear set. Power flow is delivered to the opinion shaft by this constant mesh gear set in all speeds.

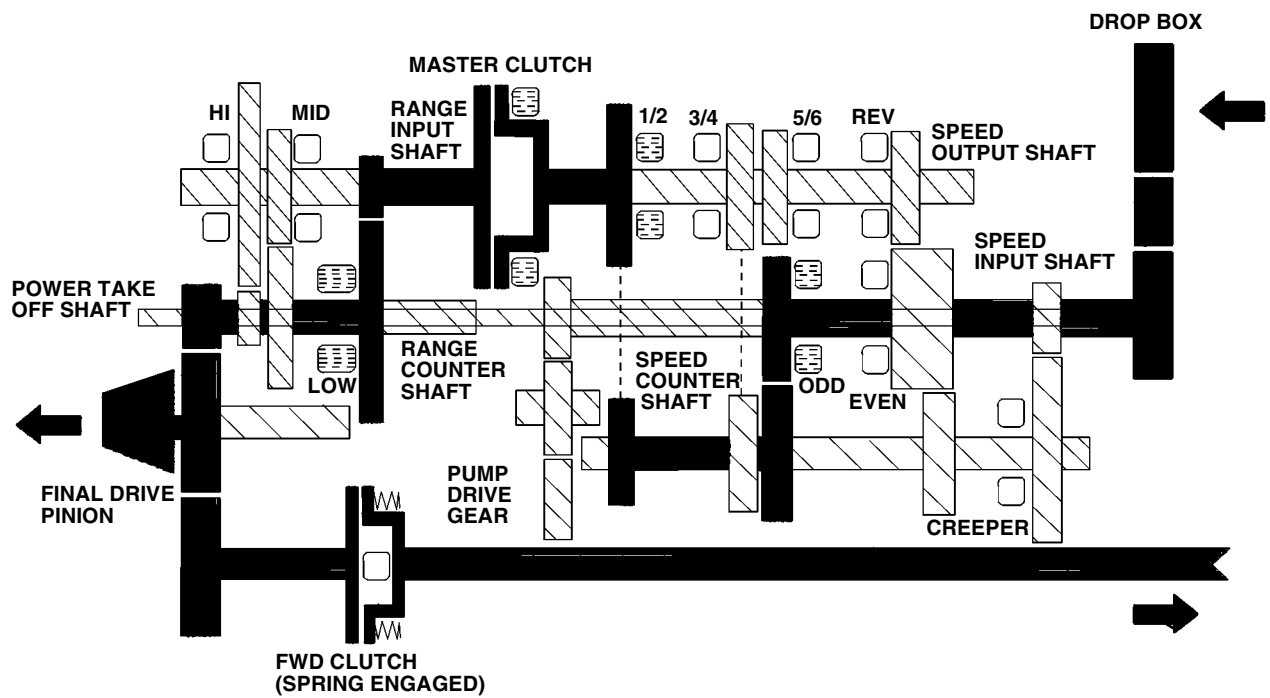
**SECOND GEAR** - As the operator selects second speed with the gear selection switch, the odd-speed clutch is disengaged and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft, through the even-speed clutch gear, the countershaft, the first-speed clutch gear, along the speed output shaft, to the master clutch. Power flow through the range transmission is the same for speeds one through six.

The drive train consists of five separate housings:

- Speed Transmission Housing
- Range Transmission Housing
- Rear Frame Housing
- Two Final Drive Housings

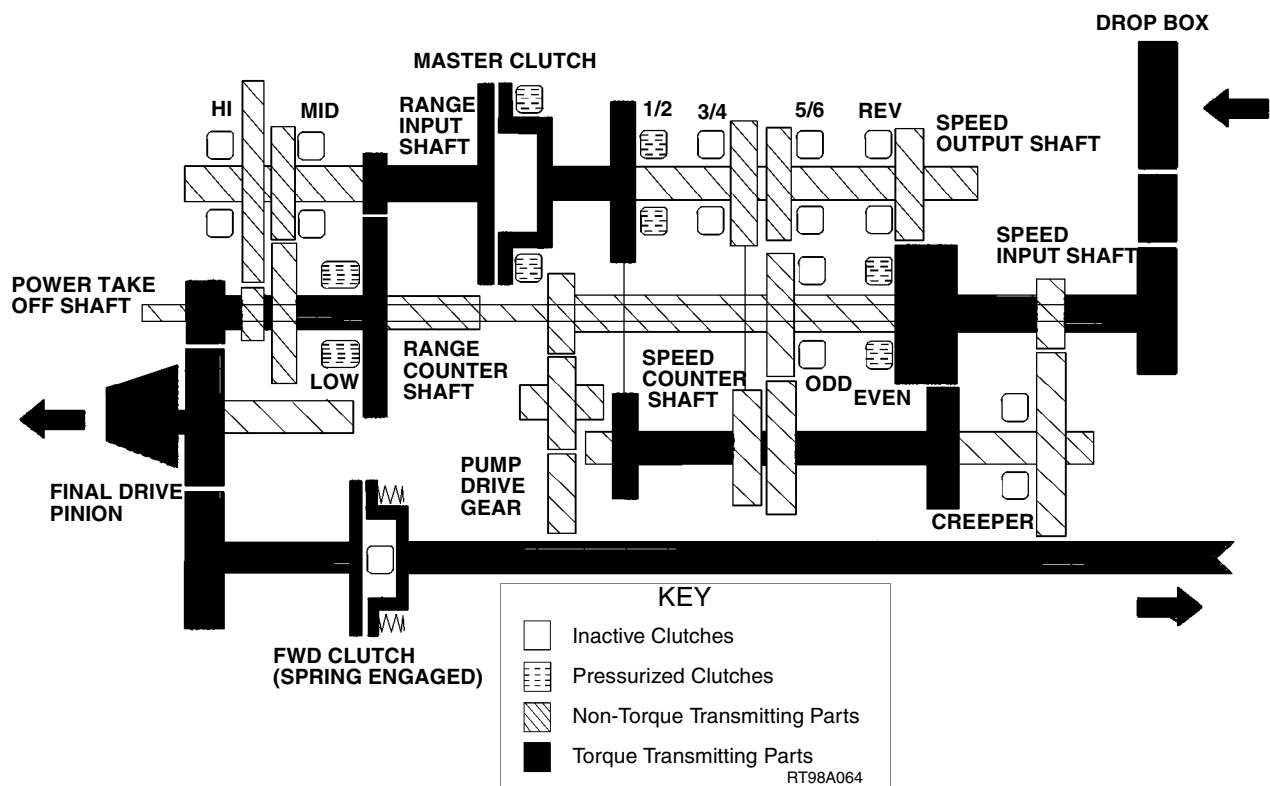
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 1



RT98A017

Gear No. 2



RT98A022

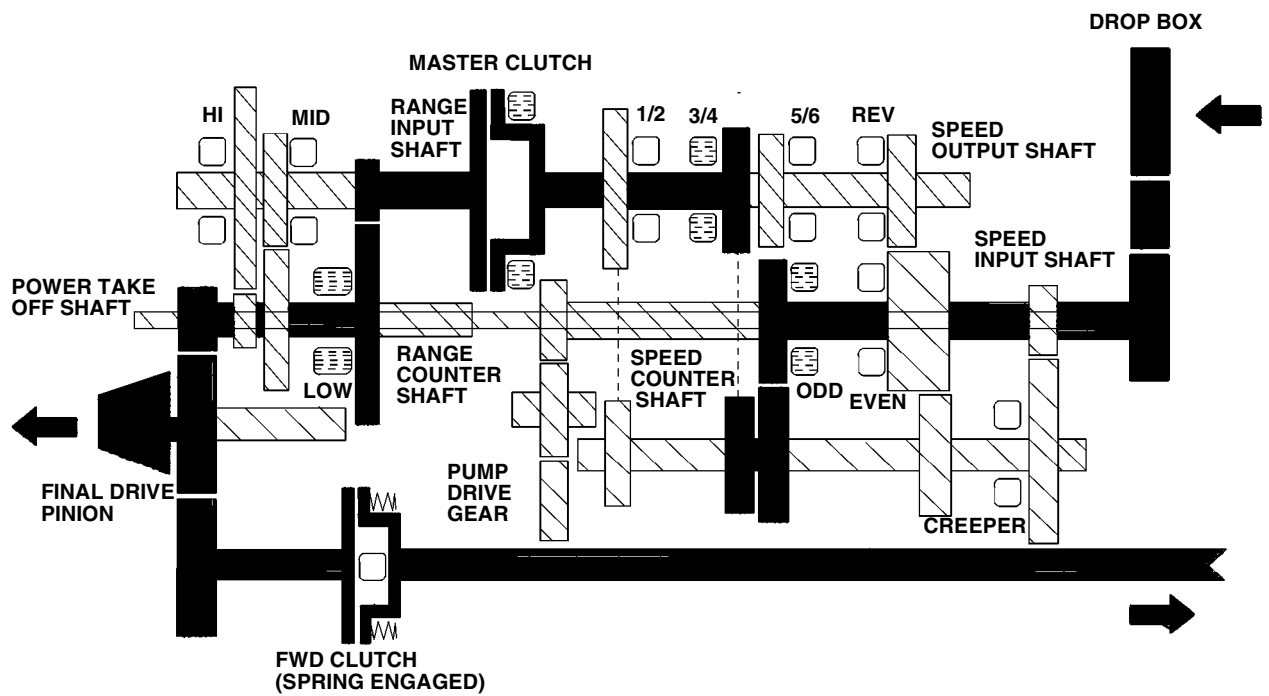
## **POWER FLOW (FORWARD SPEEDS)**

**THIRD GEAR** - As the operator selects third speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the first-speed clutch is disengaged, and the third-speed clutch is engaged. Power then flows from the speed transmission input shaft through the odd speed clutch, the countershaft, the third speed clutch, across the output shaft, to the master clutch. Power flow through the range transmission is the same for speeds one through six.

**FOURTH GEAR** - As the operator selects fourth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft through the even-speed clutch, the countershaft, the third-speed clutch, across the output shaft, to the master clutch. Power flow through the range transmission is the same for speeds one through six.

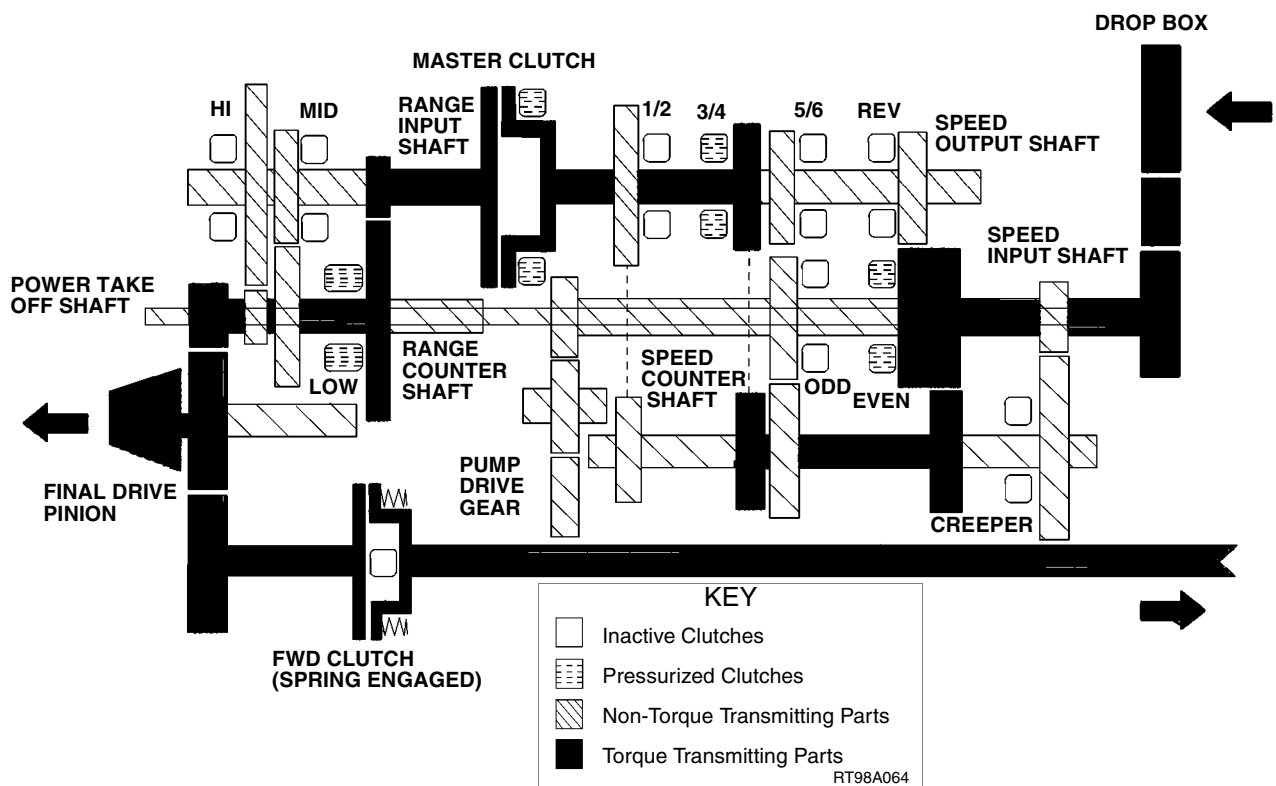
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 3



RT98A026

Gear No. 4



RT98A064

RT98A027

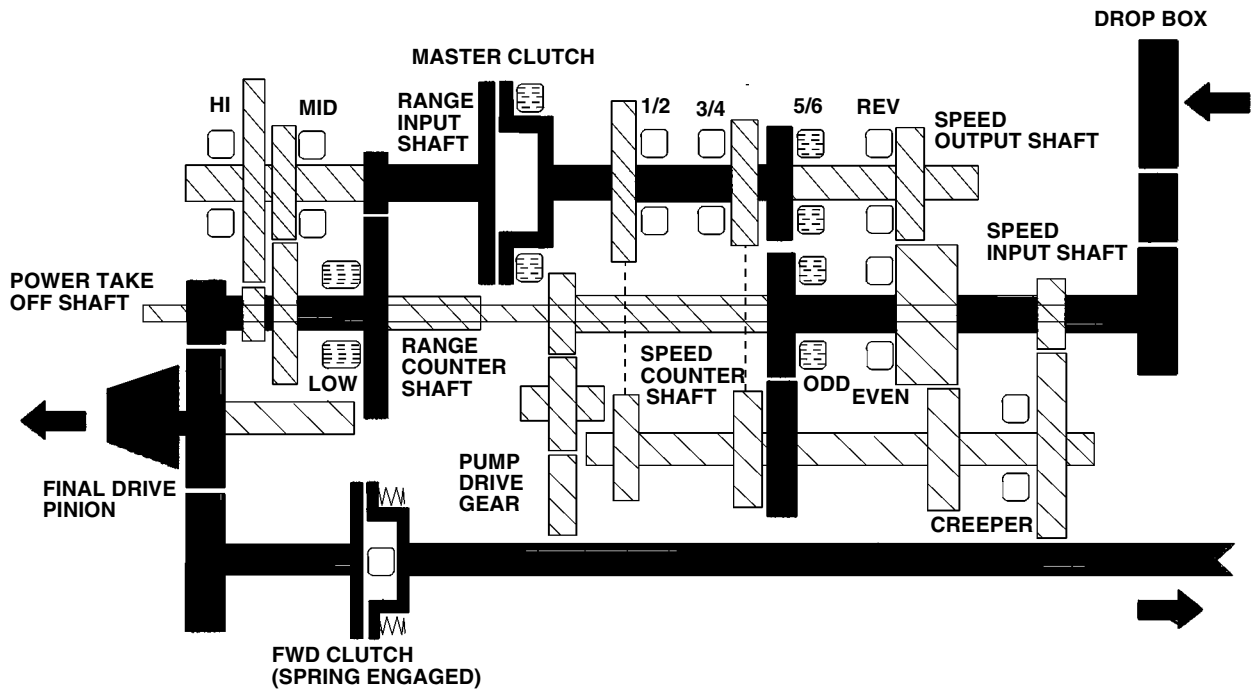
## **POWER FLOW (FORWARD SPEEDS)**

FIFTH GEAR - As the operator selects fifth speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the third-speed clutch is disengaged, and the fifth-speed clutch is engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the fifth speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds one through six.

SIX GEAR - As the operator selects sixth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows, from the speed transmission input shaft through the even-speed clutch, the countershaft, the fifth speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds one through six.

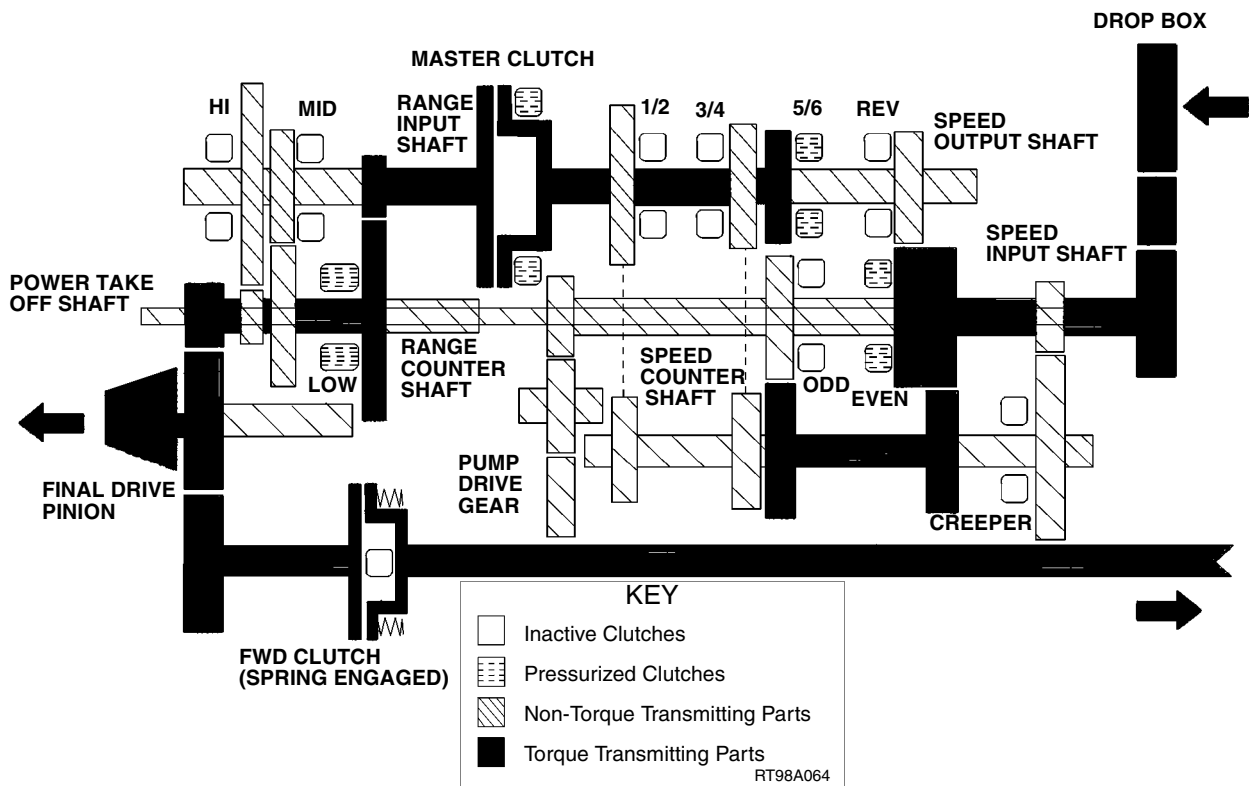
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 5



RT98A028

Gear No. 6



RT98A064

RT98A029



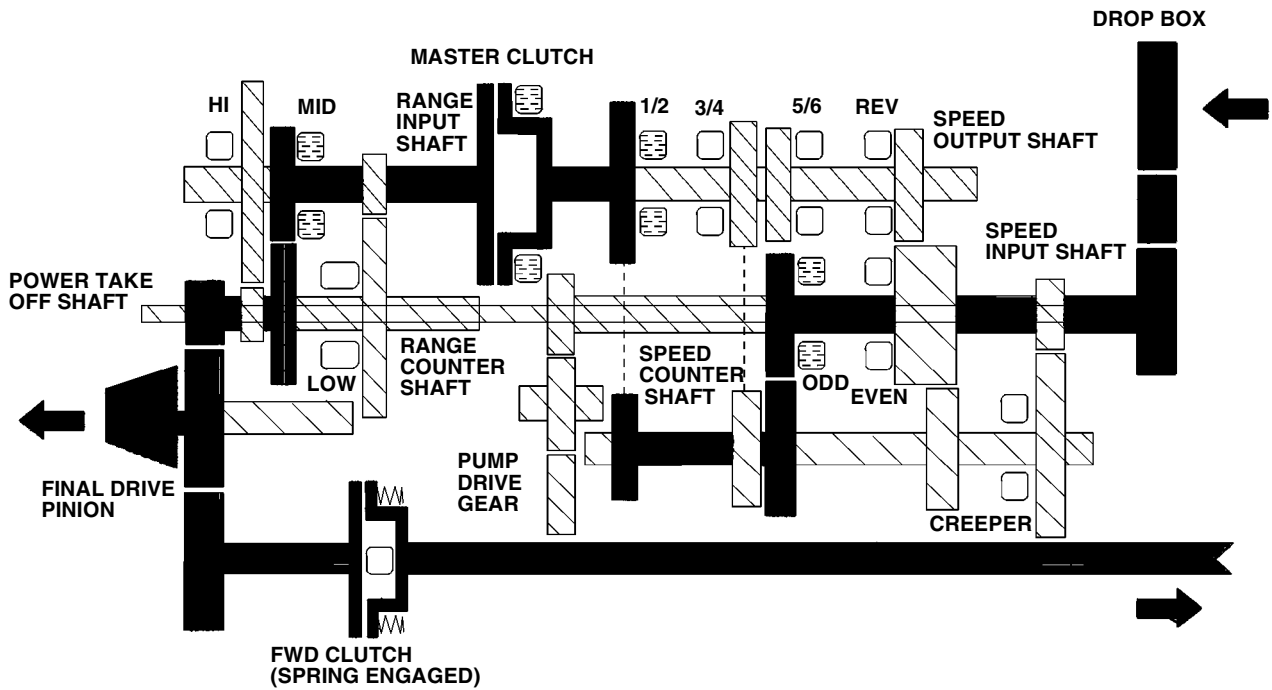
## **POWER FLOW (FORWARD SPEEDS)**

**SEVENTH GEAR** - As the operator selects seventh speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the fifth-speed clutch and the low-range clutch are disengaged, the first speed clutch and medium range clutch are engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the first speed clutch, and across the output shaft to the master clutch. With the master clutch engaged, power is transmitted across the range transmission input shaft to the medium-range clutch. Power then flows to the range countershaft driven gear across the countershaft to the constant mesh gear set. Power flow is delivered to the pinion shaft by the constant mesh gear set in all speeds.

**EIGHTH GEAR** - As the operator selects eighth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows, from the speed transmission input shaft through the even-speed clutch, the countershaft, the first speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds seven through twelve.

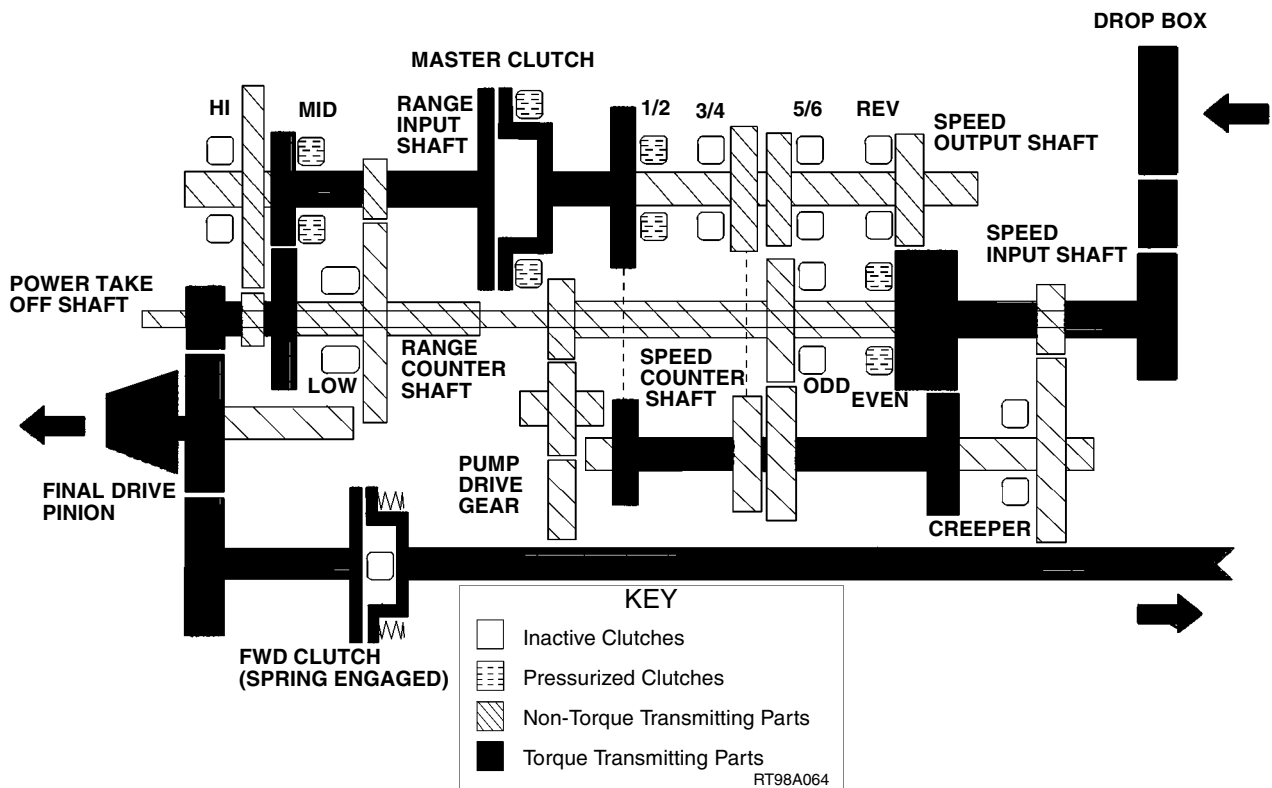
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 7



RT98A030

Gear No. 8



RT98A031

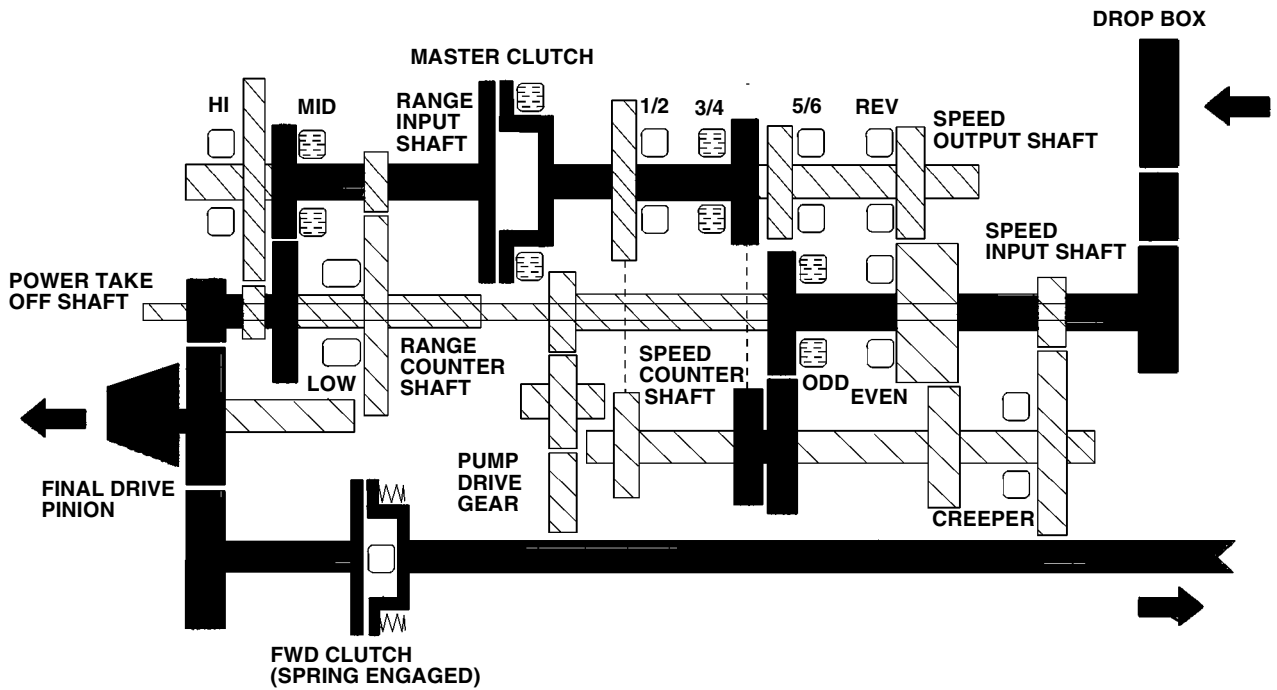
## **POWER FLOW (FORWARD SPEEDS)**

**NINTH GEAR** - As the operator selects ninth speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the first-speed clutch is disengaged, and the third-speed clutch is engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the third speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds seven through twelve.

**TENTH GEAR** - As the operator selects tenth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft through the even-speed clutch, the countershaft, the third speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds seven through twelve.

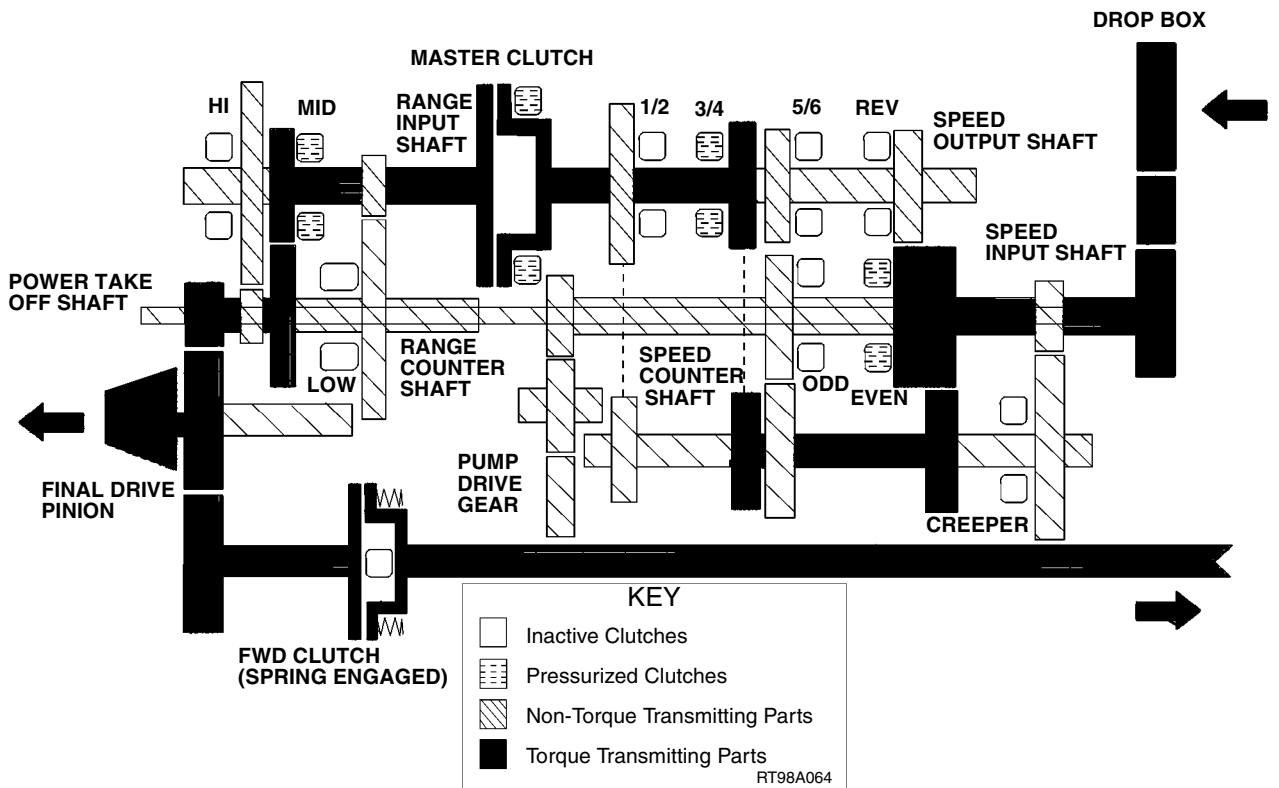
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 9



RT98A032

Gear No. 10



RT98A033

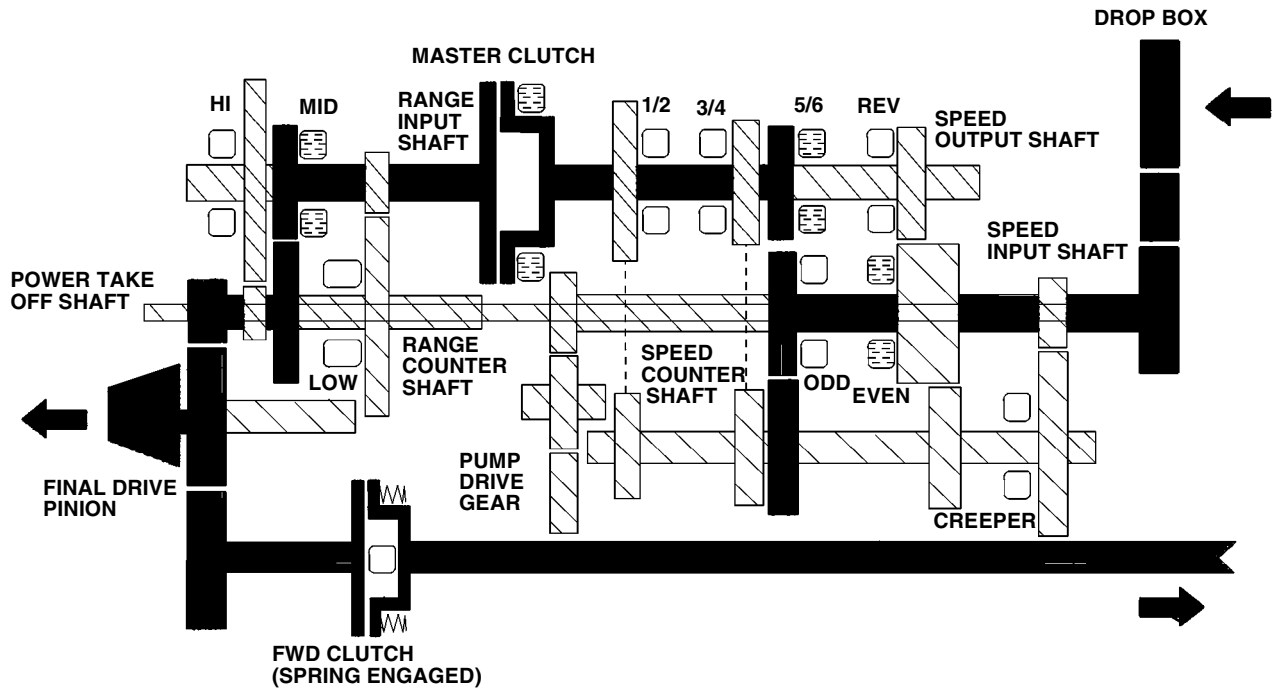
## **POWER FLOW (FORWARD SPEEDS)**

**ELEVENTH GEAR** - As the operator selects eleventh speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the third-speed clutch is disengaged, the fifth-speed clutch is engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the fifth speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds seven through twelve.

**TWELFTH GEAR** - As the operator selects twelfth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft through the even-speed clutch, and the countershaft, the fifth speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds seven through twelve.

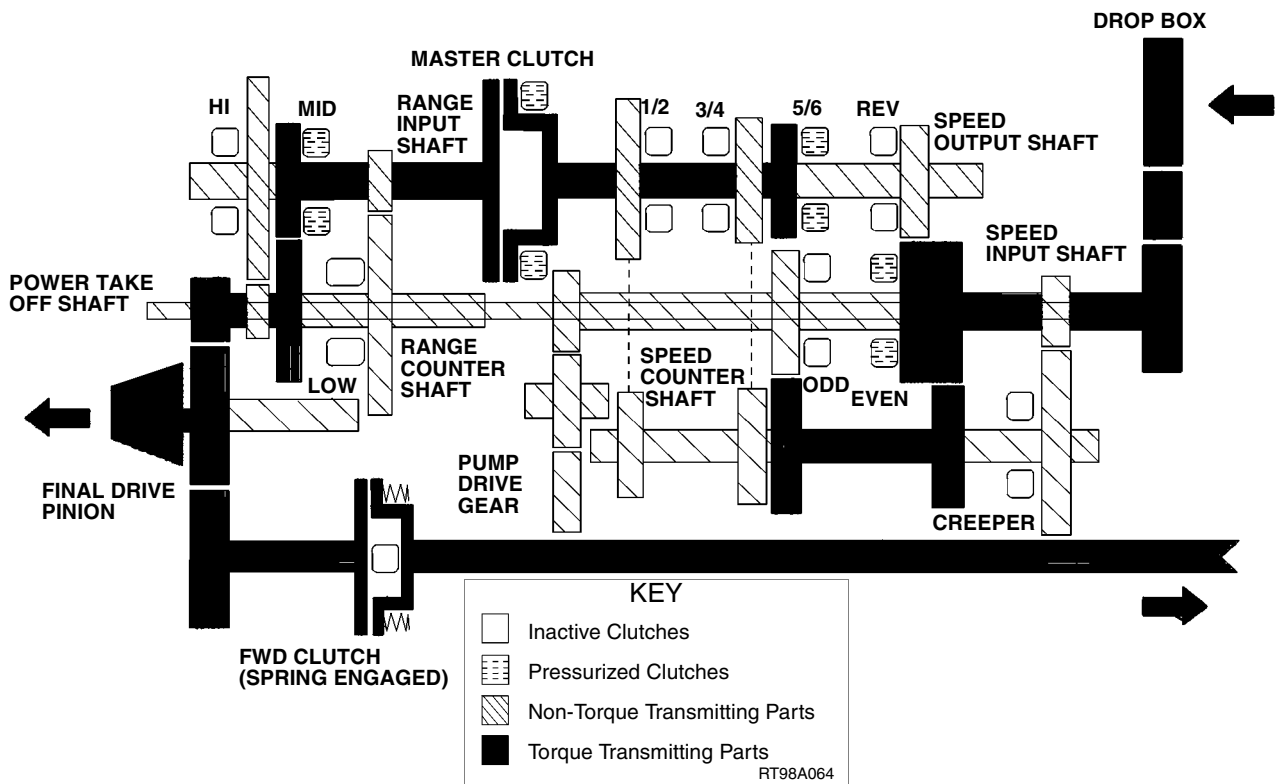
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 11



RT98A034

Gear No. 12



RT98A035

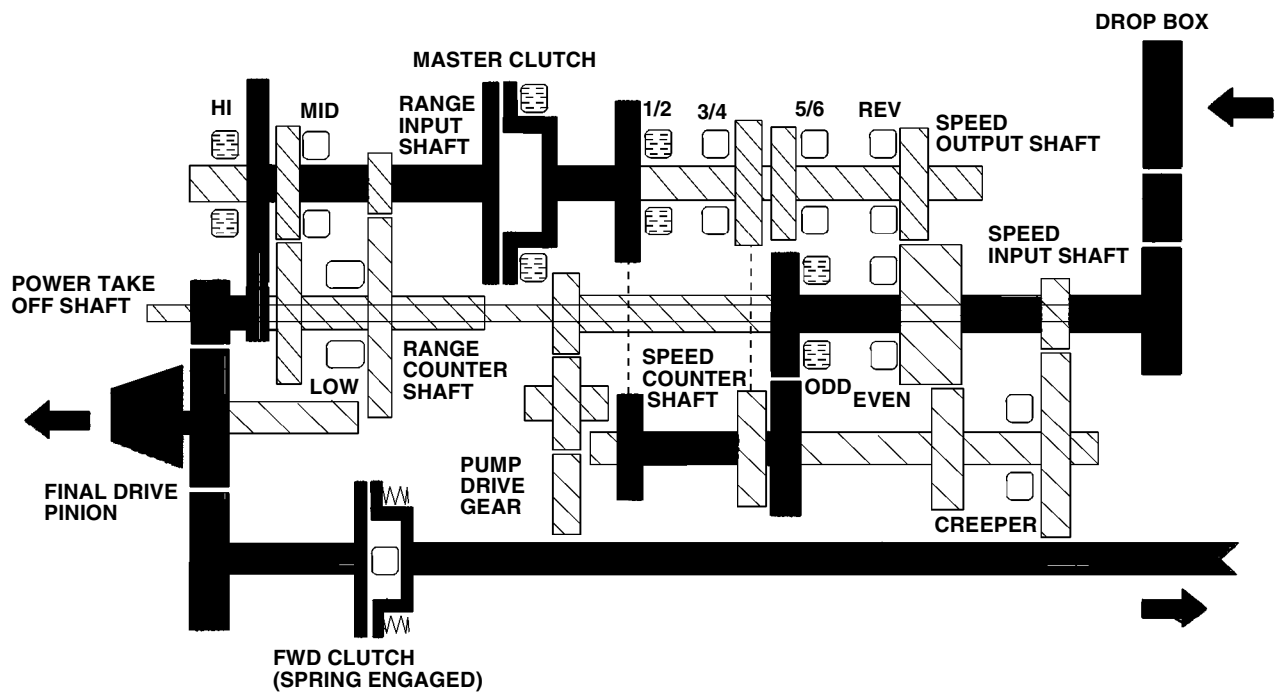
## **POWER FLOW (FORWARD SPEEDS)**

**THIRTEENTH GEAR** - As the operator selects thirteenth speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the fifth-speed clutch and the medium-range clutch are disengaged, the first-speed clutch and the high-range clutch are engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the first speed clutch, and across the output shaft to the master clutch. With the master clutch engaged, power is transmitted across the range transmission input shaft to the high-range clutch. Power then flows to the range countershaft driven gear across the countershaft to the constant mesh gear set. Power flow is delivered to the pinion shaft by the constant mesh gear set in all speeds.

**FOURTEENTH GEAR** - As the operator selects fourteenth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft through the even-speed clutch, the countershaft, the first speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds thirteen through eighteen.

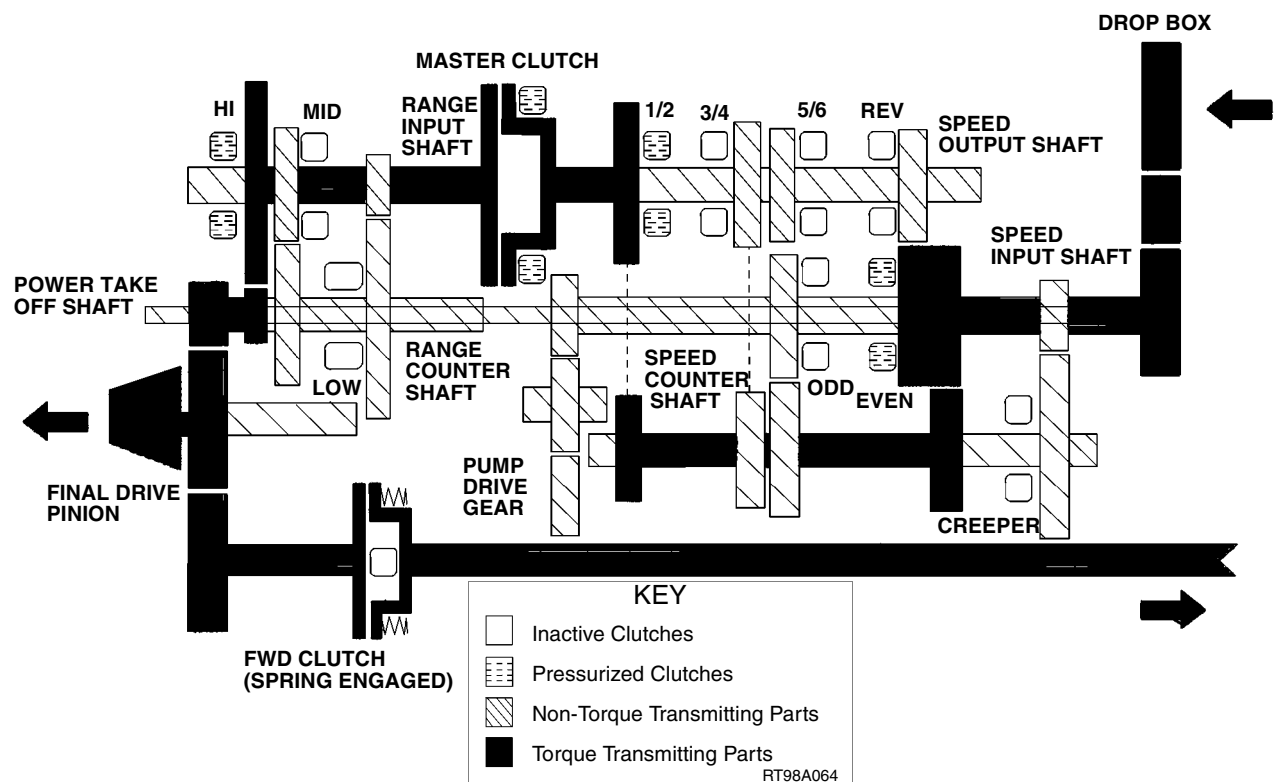
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 13



RT98A043

Gear No. 14



RT98A044



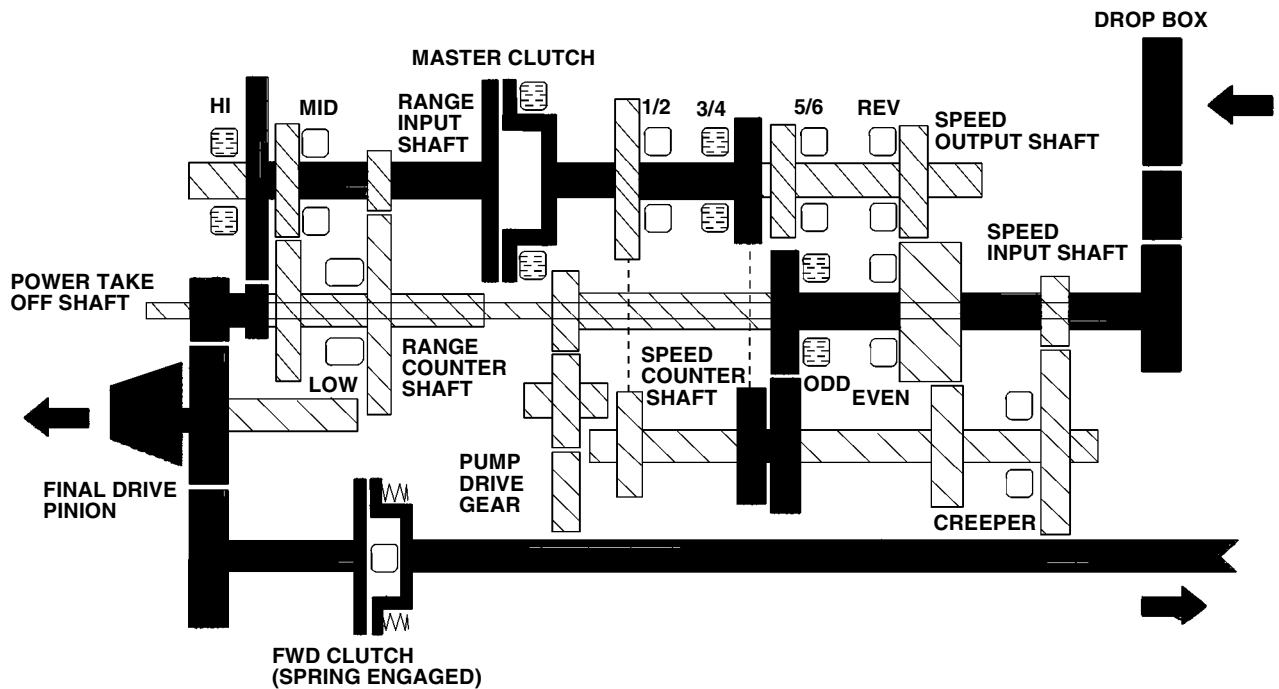
## **POWER FLOW (FORWARD SPEEDS)**

**FIFTEENTH GEAR** - As the operator selects fifteenth speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the first-speed clutch is disengaged, and the third-speed clutch is engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the third speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds thirteen through twelve.

**SIXTEENTH GEAR** - As the operator selects sixteenth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft through the even-speed clutch, the countershaft, the third speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds thirteen through eighteen.

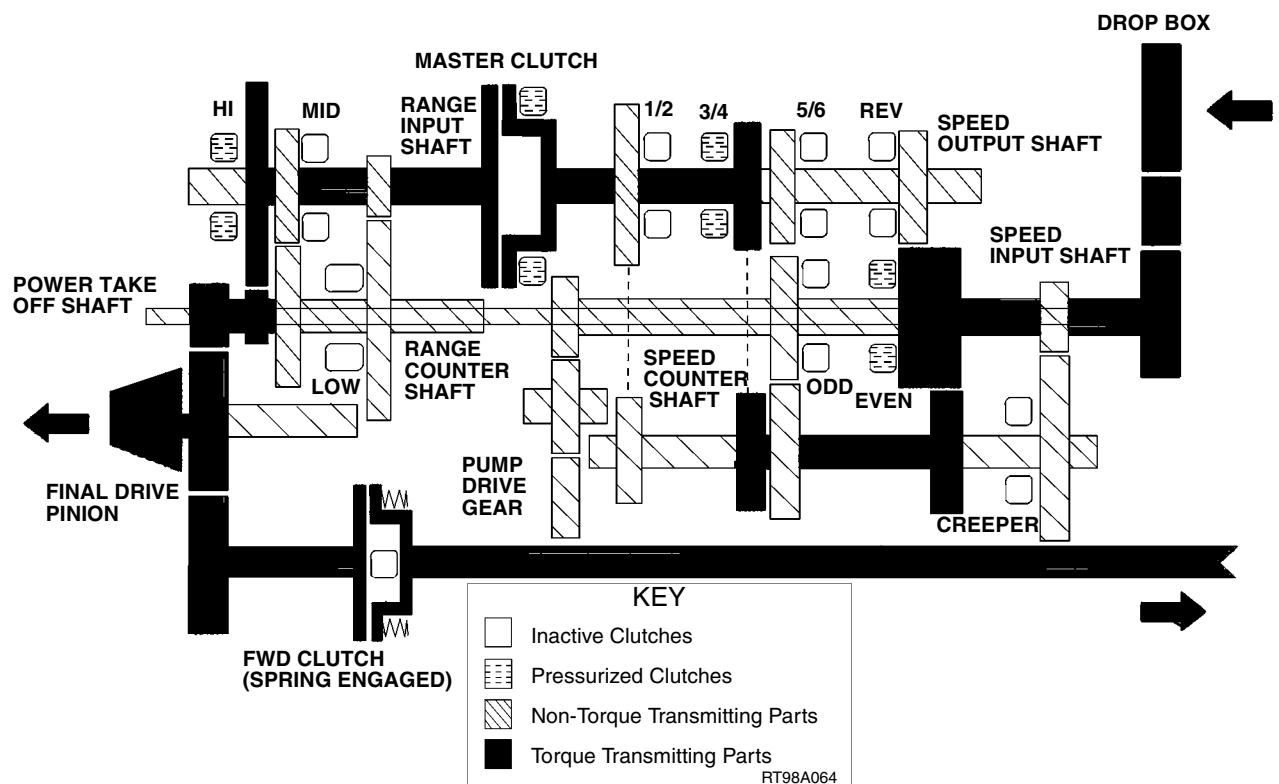
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 15



RT98A045

Gear No. 16



RT98A046

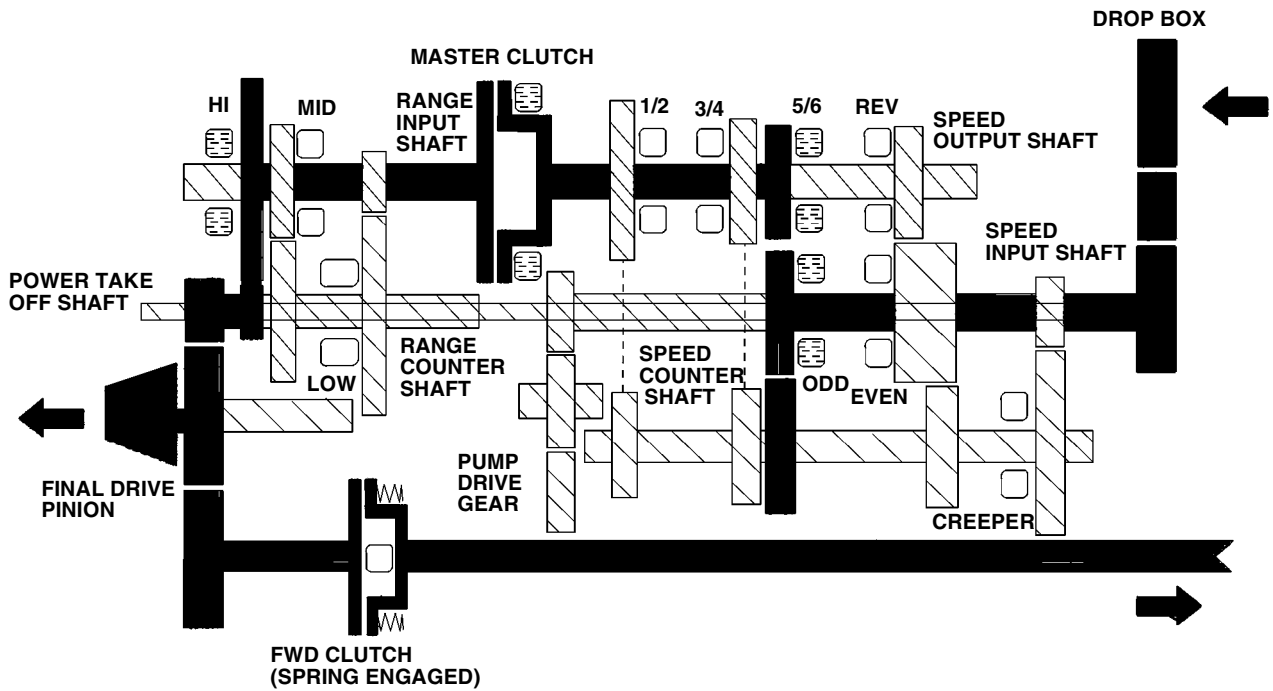
## **POWER FLOW (FORWARD SPEEDS)**

**SEVENTEENTH GEAR** - As the operator selects seventeenth speed, the even-speed clutch is disengaged, and the odd-speed clutch is engaged. At the same time, the third-speed clutch is disengaged, the fifth-speed clutch is engaged. Power then flows from the speed transmission input shaft through the odd-speed clutch, the countershaft, the third speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds thirteen through eighteen.

**EIGHTEENTH GEAR** - As the operator selects eighteenth speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft through the even-speed clutch, the countershaft, the fifth-speed clutch, and across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds thirteen through eighteen.

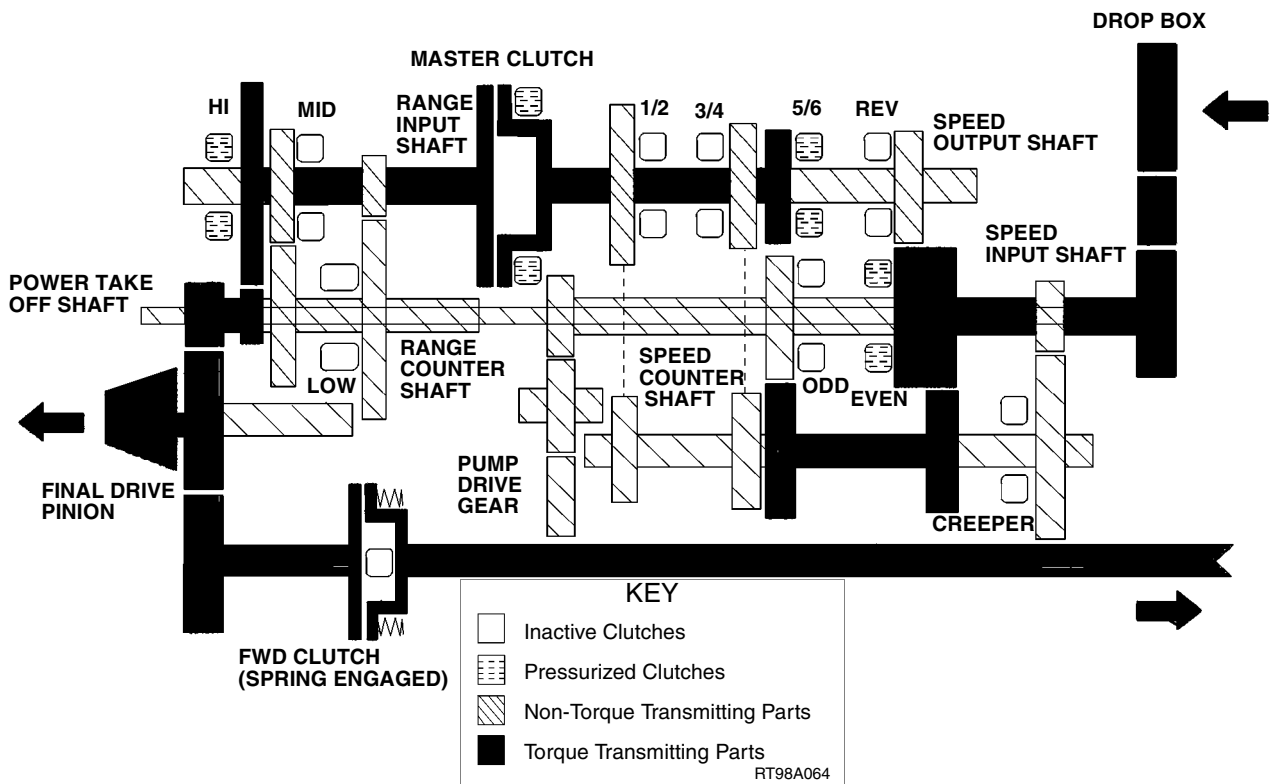
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Gear No. 17



RT98A047

Gear No. 18



RT98A0048

## **POWER FLOW (REVERSE SPEEDS)**

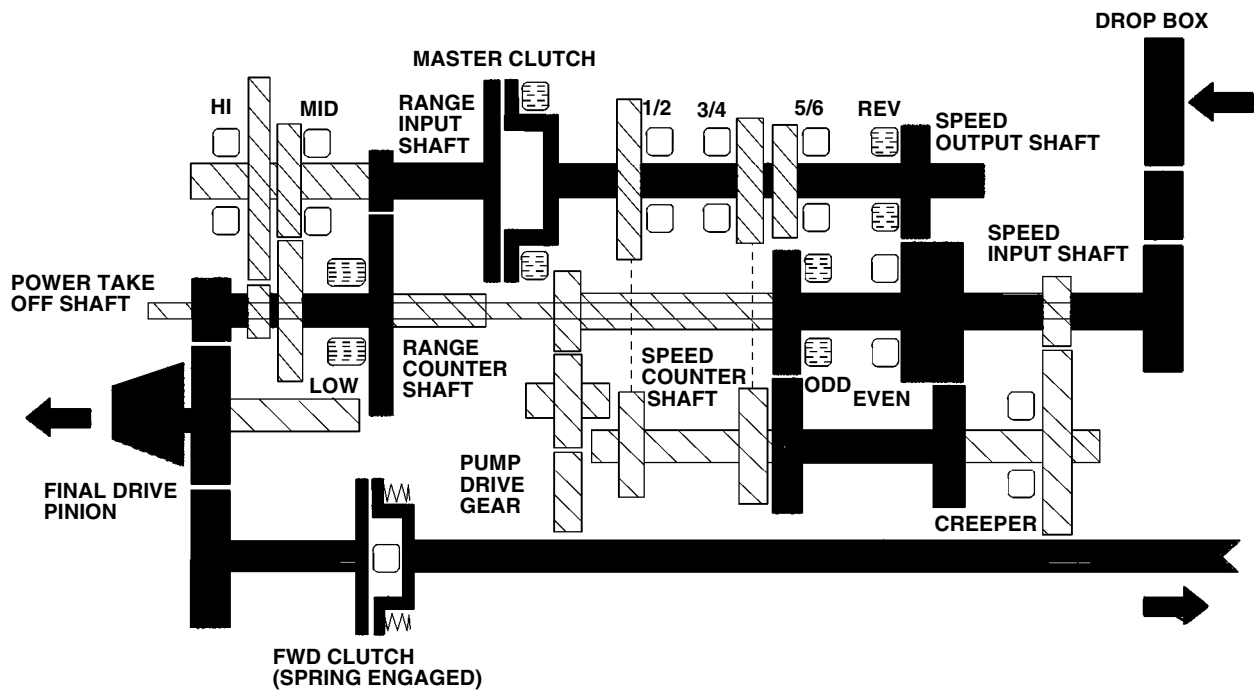
**FIRST REVERSE GEAR** - As the operator selects first reverse speed, he simultaneously engages the odd-speed clutch pack, the reverse-speed clutch pack and the low-range clutch pack through the transmission controller. The power then flows from the drop box, through the input shaft, the engaged odd-speed clutch pack gear, to the countershaft gear. Since the countershaft gears are in constant mesh with the output shaft gears, power flows forward from the countershaft, through the even-speed driven gear to even-speed drive gear (idler gear), to the engaged reverse-speed clutch pack. Power is then directed across the output shaft to the master clutch. The addition of an idler gear for first-reverse and creeper-reverse 1 (creeper option) speeds causes the speed output shaft and everything rearward of the pinion shaft to reverse rotation compared to the forward gear rotation. With the master clutch engaged, power is transmitted across the range transmission input shaft to the low range drive gear. Power then flows to the low range clutch pack gear and across the range countershaft to the constant mesh gear set. Power flow is delivered to the pinion shaft by this constant mesh gear set in all speeds.

**SECOND REVERSE GEAR** - As the operator selects second reverse speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft, through the even-speed clutch, directly to the reverse-speed clutch. Since the countershaft is not used to transmit power in second reverse, the direction of rotation provided to the speed output shaft is opposite that which occurs in the forward speeds.

With the master clutch engaged, power is transmitted across the range transmission input shaft to the low range drive gear. Power then flows to the low range clutch pack gear and across the range countershaft to the constant mesh gear set, driving the pinion shaft.

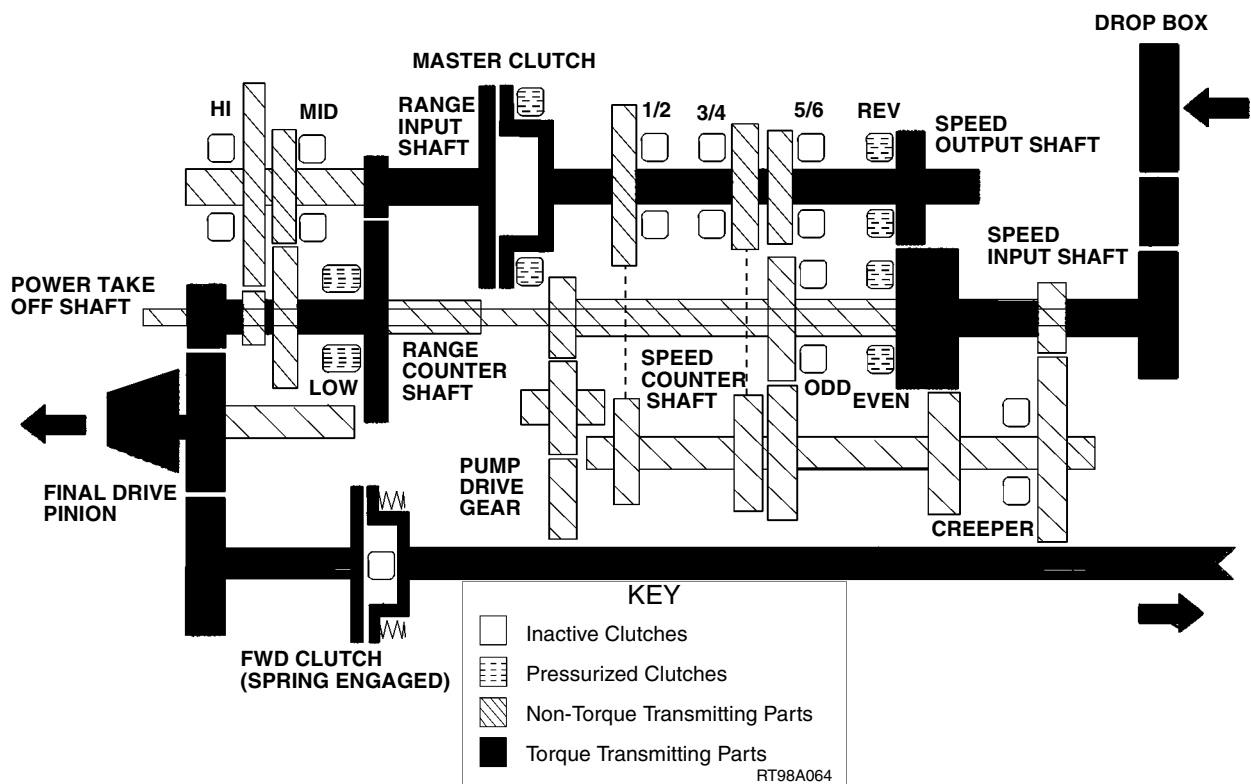
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Reverse No. 1



RT98A049

Reverse No. 2



RT98A050

## POWER FLOW (REVERSE SPEEDS)

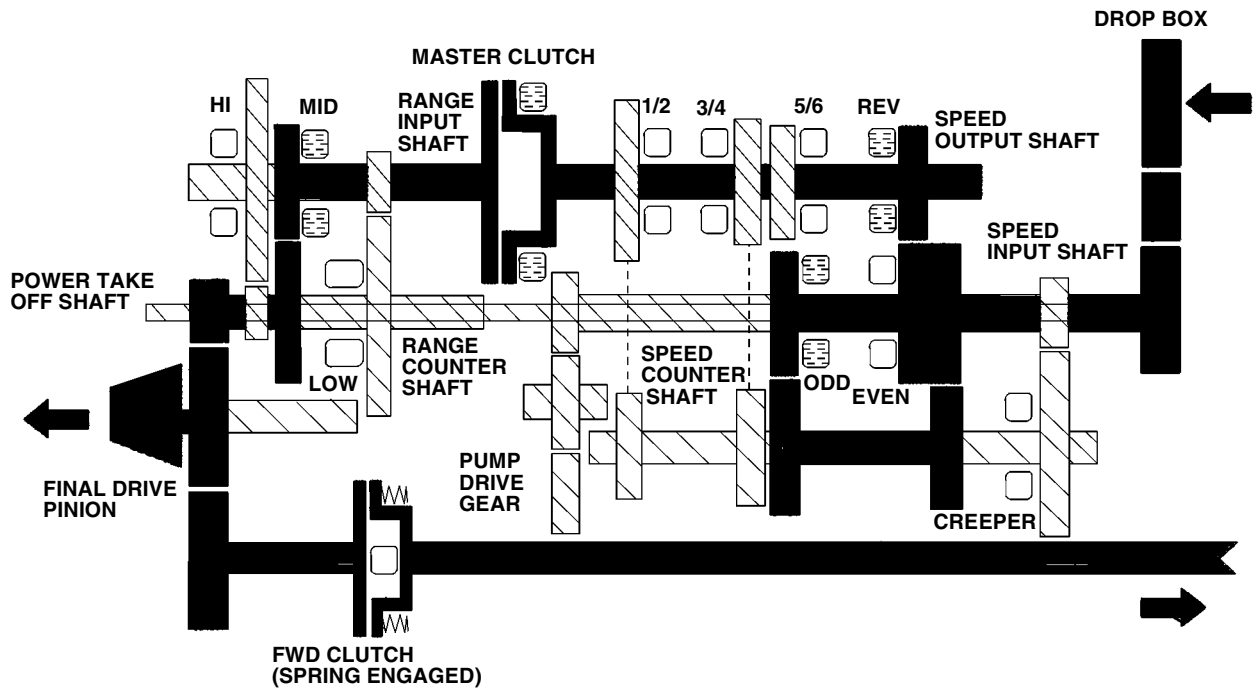
THIRD REVERSE GEAR - As the operator selects third reverse speed, he simultaneously engages the odd-speed clutch, reverse-speed clutch pack and the medium-range clutch pack through the transmission controller. The power then flows from the drop box, through the input shaft, the engaged odd-speed clutch pack, to the countershaft gear. Since the countershaft gears are in constant mesh with the output shaft gears, power flows forward from the countershaft, to the even-speed drive gear (idler gear), to the engaged reverse-speed clutch pack. Power is then directed across the output shaft to the master clutch. The addition of an idler gear for third-reverse causes the speed output shaft, and everything rearward of the pinion shaft, to reverse rotation in contrast to the forward gear rotation. With the master clutch engaged, power is transmitted across the range transmission input shaft to the medium range clutch pack. Power then flows to the medium-range driven gear on the range countershaft, across to the constant mesh gear set driving the pinion shaft.

FOURTH REVERSE GEAR - As the operator selects fourth reverse speed, the odd-speed clutch is disengaged, and the even-speed clutch is engaged. Power then flows from the speed transmission input shaft, through the even speed clutch, directly to the reverse-speed clutch. Since the countershaft is not used to transmit power in fourth reverse, the direction of rotation provided to the speed output shaft is opposite that which occurs in the forward speeds. Power flows through the range transmission in the same manner as third reverse.

**NOTE:** *HIGH RANGE CLUTCH PACK IS NOT USED FOR REVERSE SPEEDS.*

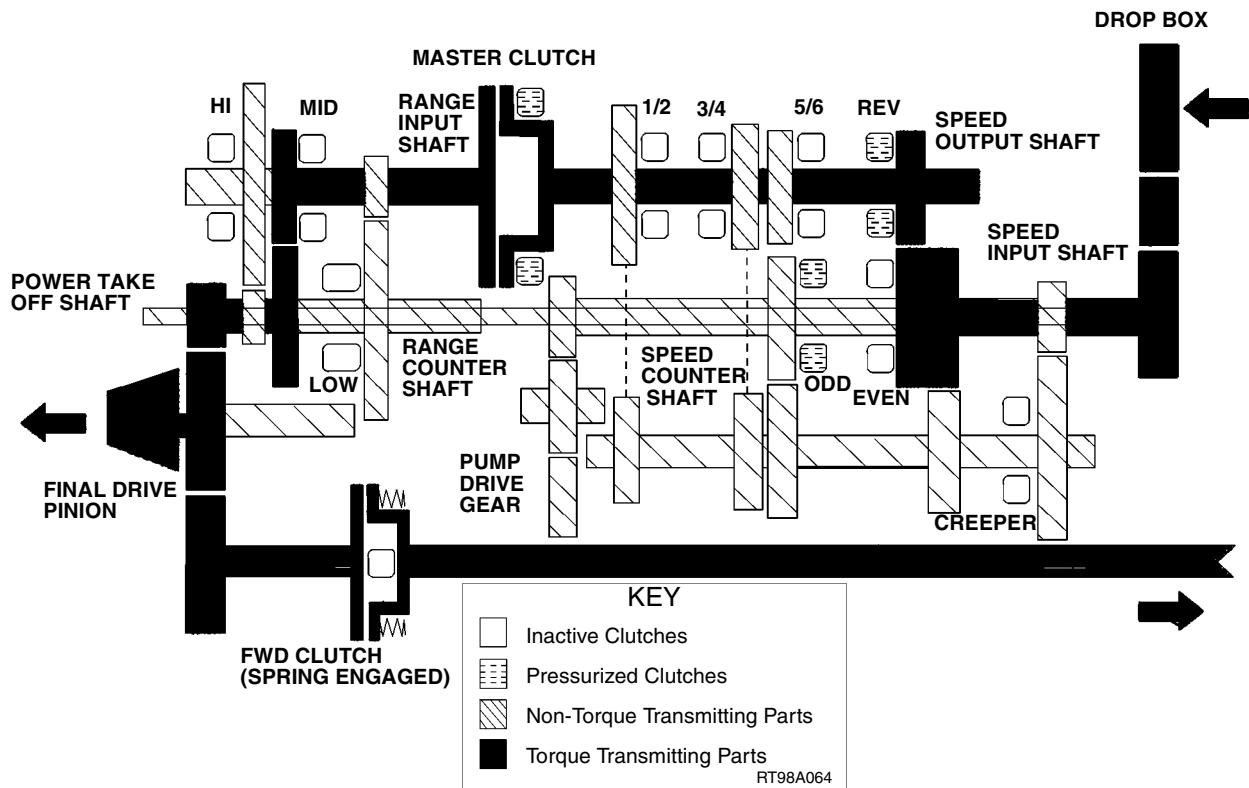
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Reverse No. 3



RT98A051

Reverse No. 4



RT98A052



## **POWER FLOW (FORWARD CREEPER DRIVE SPEEDS)**

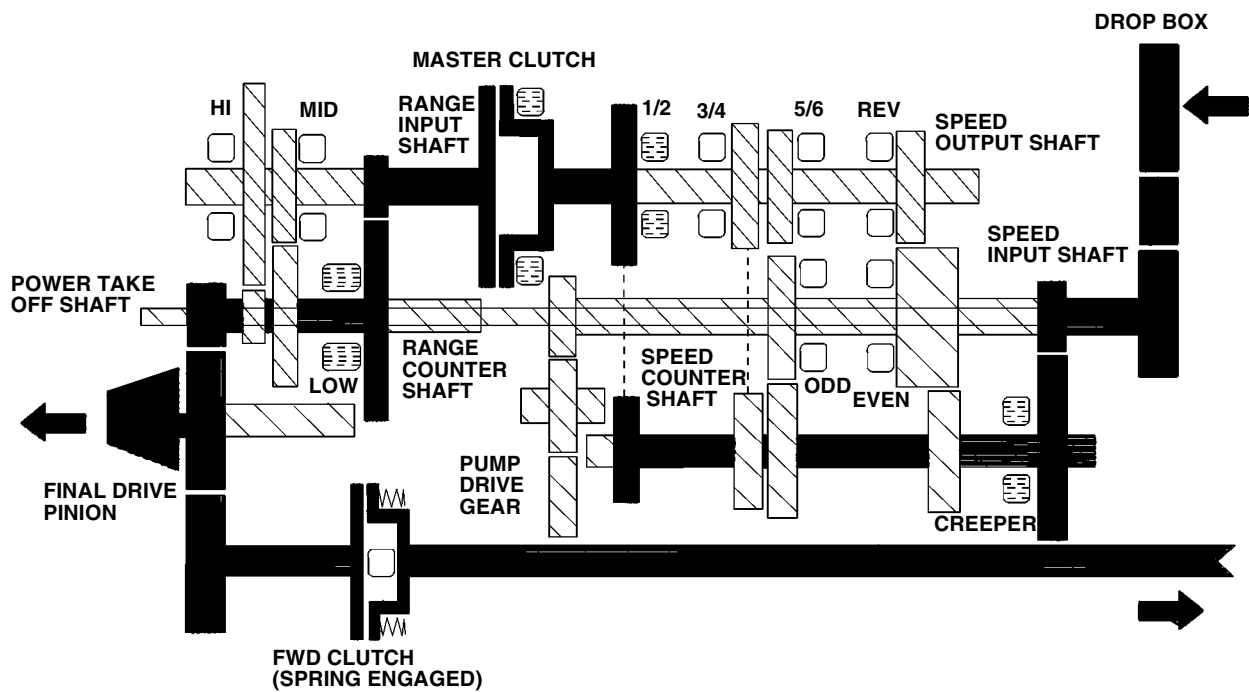
**FIRST CREEP GEAR** - As the operator selects first creep speed, he simultaneously disengages and locks out the odd-speed clutch pack and the even-speed clutch pack. He also engages the creep speed clutch pack, the first speed clutch pack and the low range clutch pack. This is accomplished through the transmission controller. Power then flows from the speed transmission input shaft creep speed drive gear through the creep-speed clutch, and across the countershaft to the first-speed clutch drive gear. Power is then directed through the first speed constant mesh gear set and the clutch pack, across the output shaft to the master clutch.

With the master clutch engaged, power is transmitted across the range transmission input shaft to the low-range drive gear. Power then flows to the low-range clutch pack gear and across the range countershaft to the constant mesh gear set. Power flow is delivered to the pinion shaft by this constant mesh gear set in all speeds.

**SECOND CREEP GEAR** - As the operator selects second creep speed, he simultaneously disengages the first speed clutch and engages the third speed clutch. Power then flows from the speed transmission input shaft through the creep-speed clutch on the countershaft, to the third-speed clutch on the output shaft then the master clutch. Power flow through the range transmission is the same for speeds first creep through third creep.

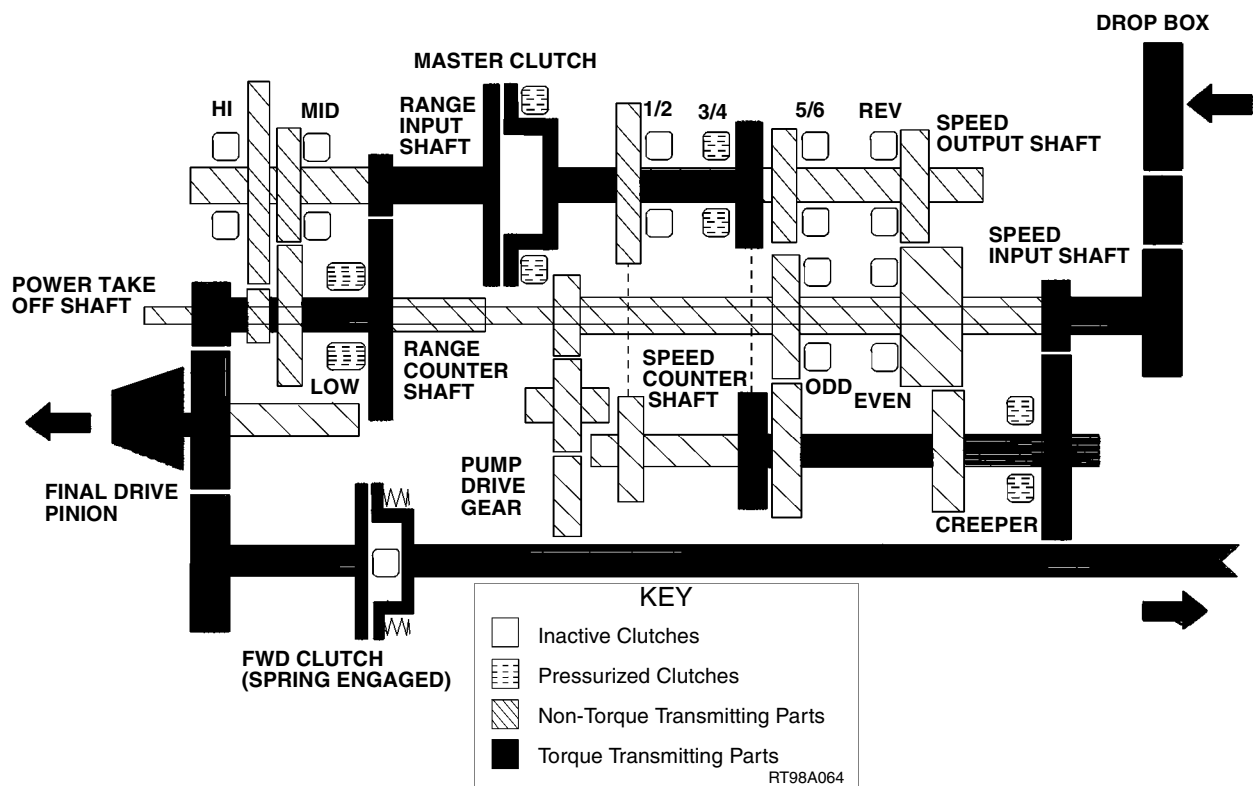
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Creeper Gear No. 1



RT98A053

Creeper Gear No. 2



RT98A054

## **POWER FLOW (FORWARD CREEPER DRIVE SPEEDS)**

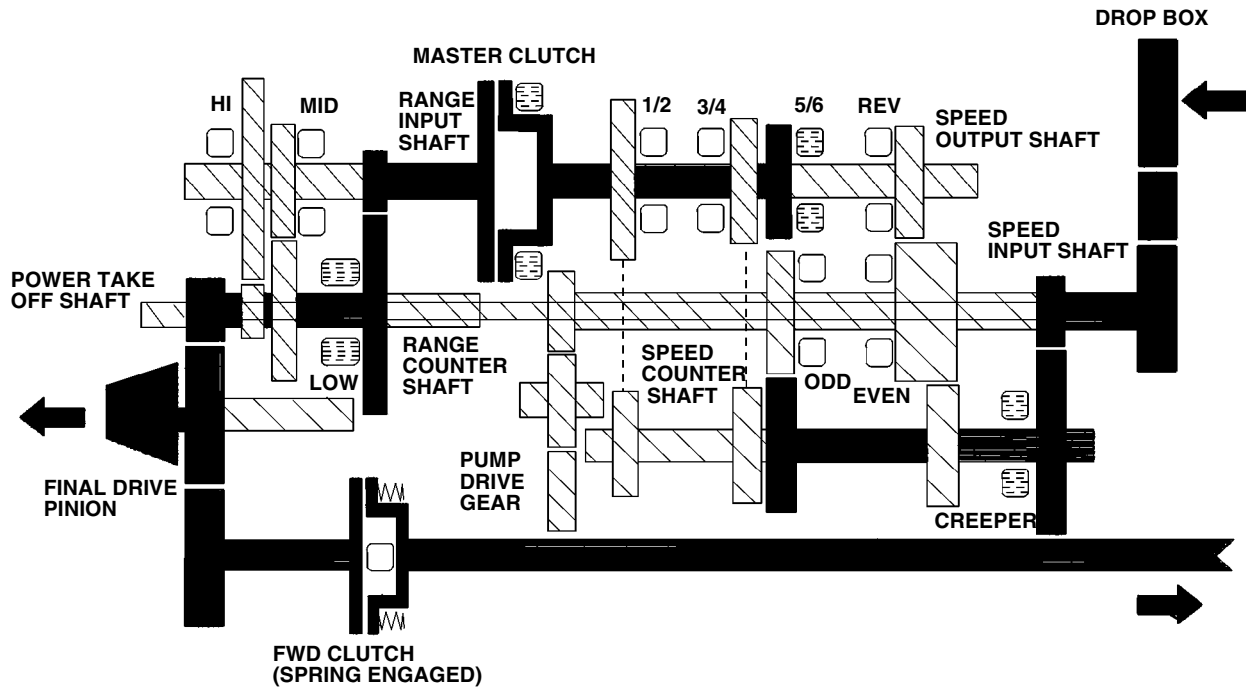
**THIRD CREEP GEAR** - As the operator selects third-creep speed, he simultaneously disengages the third-speed clutch and engages the fifth-speed clutch. Power then flows from the speed transmission input shaft through the creep-speed clutch on the countershaft, to the fifth-speed clutch, across the output shaft to the master clutch. Power flow through the range transmission is the same for speeds first creep through third creep.

**FOURTH CREEP GEAR** - As the operator selects fourth-creep speed, he simultaneously disengages the fifth-speed clutch and the low-range clutch, and engages the first speed clutch and the medium-range clutch. Power then flows from the speed transmission input shaft through the creep speed clutch on the countershaft, to the first speed clutch on the output shaft across the master clutch.

With the master clutch engaged, power is transmitted across the range transmission input shaft to the medium-range clutch. Power then flows to the range countershaft driven gear, across the countershaft, to the constant mesh gear set. Power flow is delivered to the pinion shaft by this constant mesh gear set in all speeds.

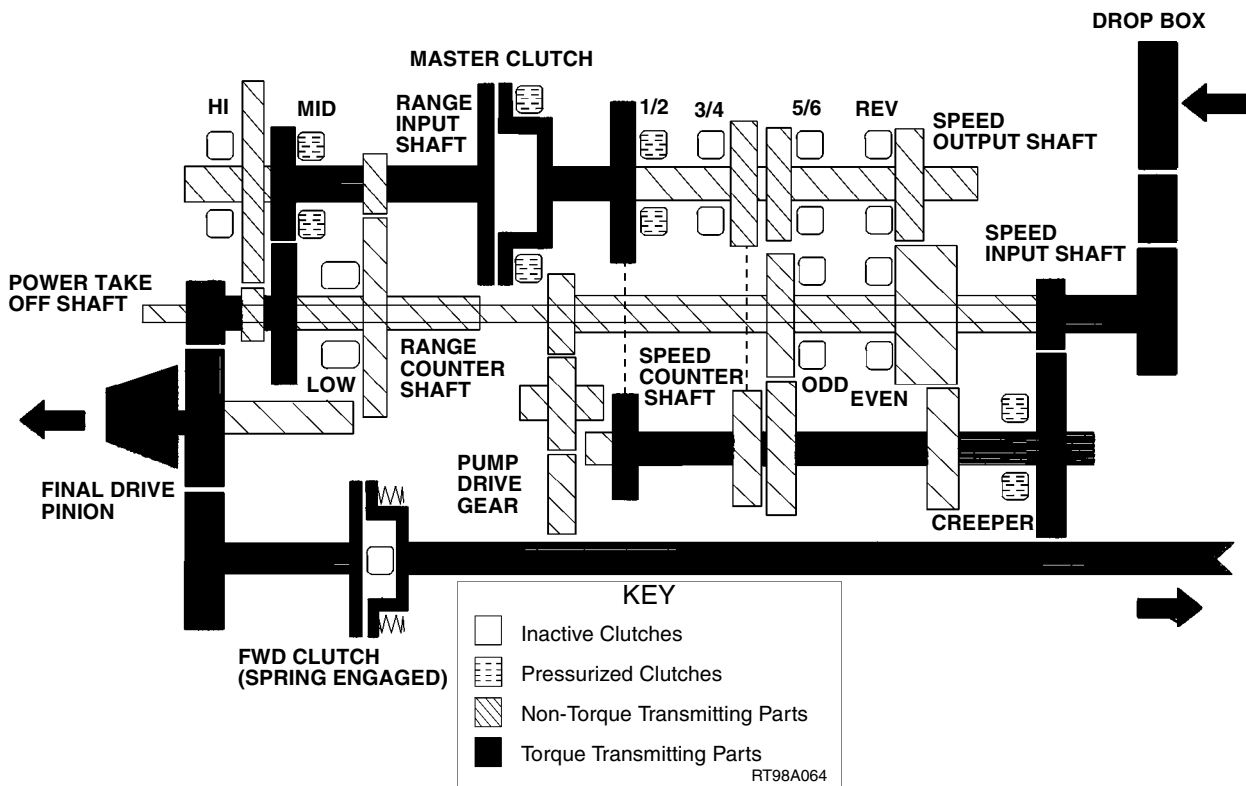
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Creeper Gear No. 3



RT98A055

Creeper Gear No. 4



RT98A056

## **POWER FLOW (FORWARD CREEPER DRIVE SPEEDS)**

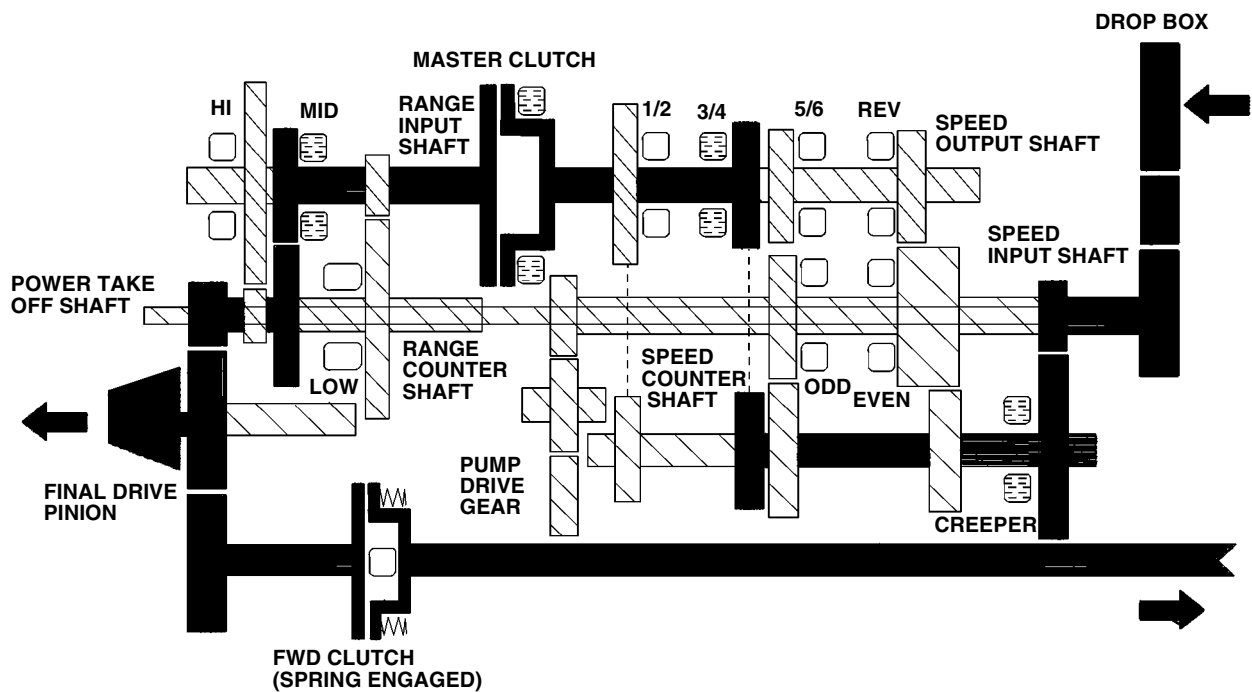
**FIFTH CREEP GEAR** - As the operator selects fifth creep speed, he simultaneously disengages the first-speed clutch and engages the third-speed clutch. Power then flows from the speed transmission input shaft, through the creep-speed clutch on the countershaft, to the third-speed clutch on the output shaft, across to the master clutch. Power flow through the range transmission is the same for speeds fourth creep through sixth creep.

**SIXTH CREEP GEAR** - As the operator selects sixth creep speed, he simultaneously disengages the third-speed clutch and engages the fifth-speed clutch. Power then flows from the speed transmission input shaft, through the creep-speed clutch on the countershaft, to the fifth-speed clutch on the output shaft, across to the master clutch. Power flow through the range transmission is the same for speeds fourth creep through sixth creep.

**NOTE:** *High range clutch pack is not used for the creeper speeds.*

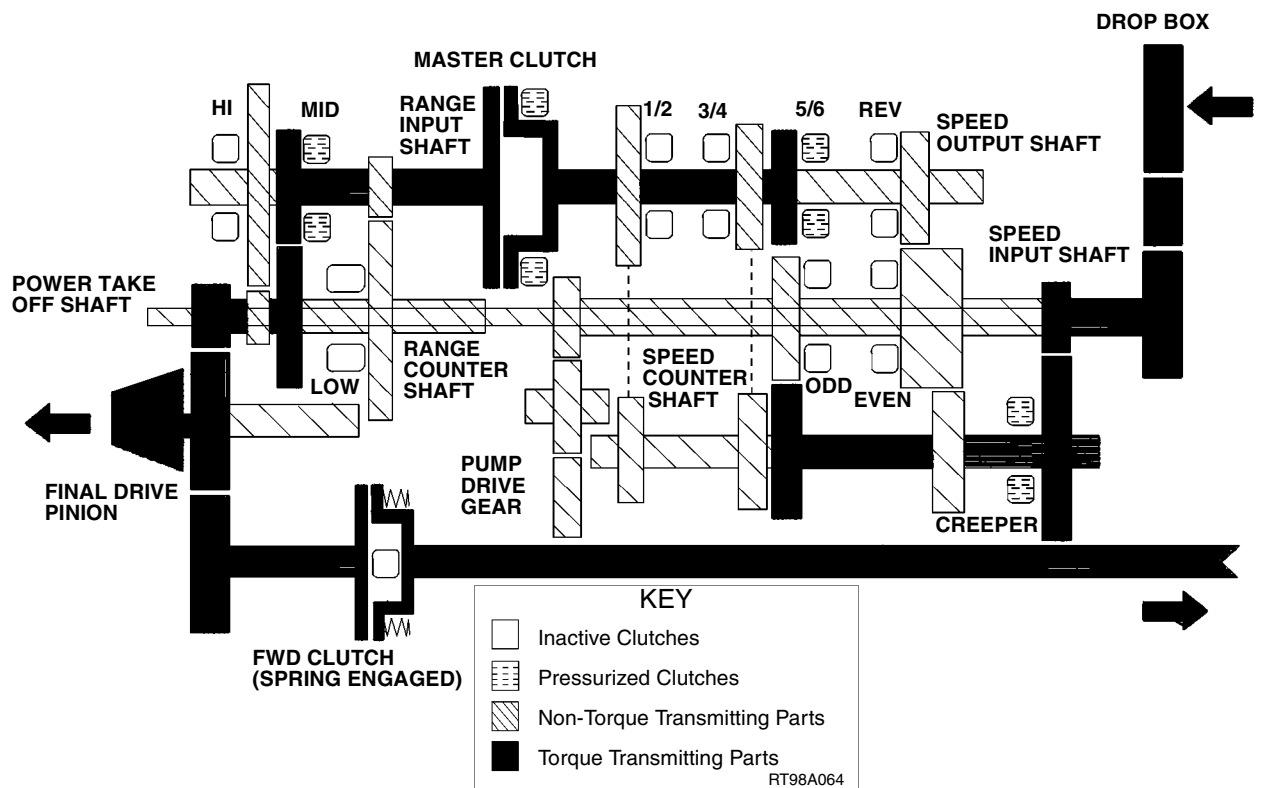
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Creeper Gear No. 5



RT98A057

Creeper Gear No. 6



RT98A064

RT98A058

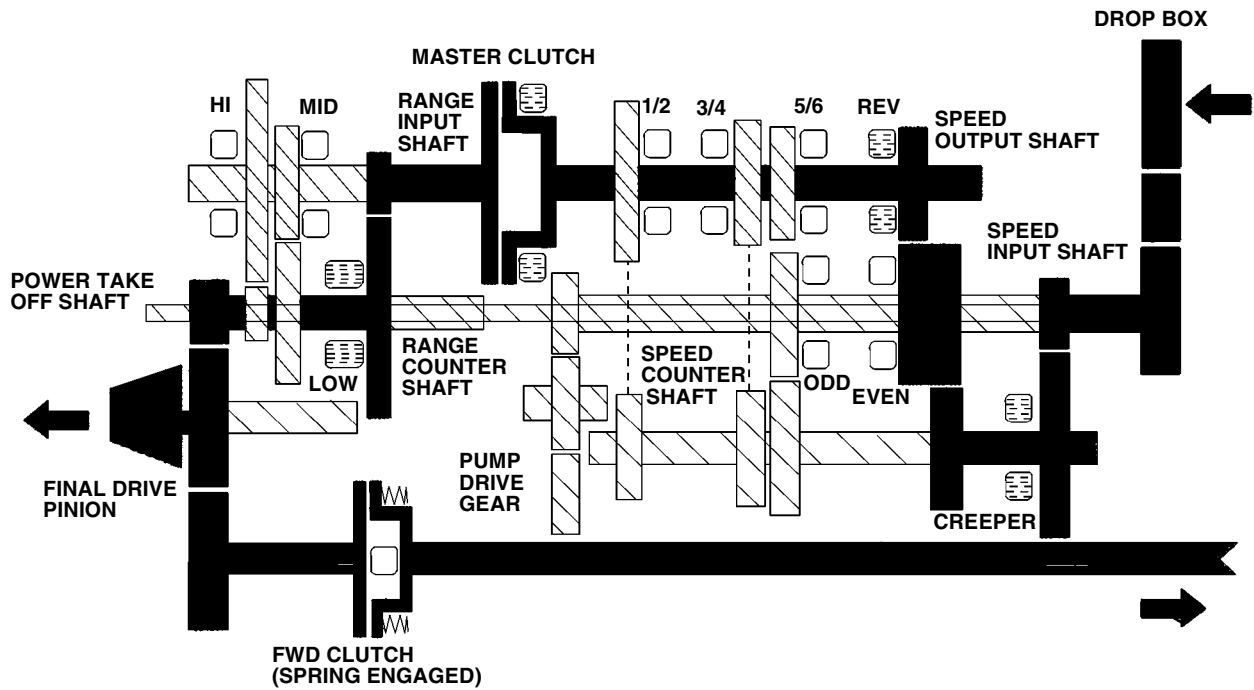
## **POWER FLOW (REVERSE CREEPER DRIVE SPEEDS)**

**CREEPER REVERSE FIRST GEAR (CR1)** - As the operator selects creeper first-reverse speed, he simultaneously disengages and locks out the odd-speed clutch pack and the even-speed clutch pack. He also engages the creep-speed clutch pack, the reverse-speed clutch pack, and the low-range clutch pack. This is accomplished through the transmission controller. Power then flows from the speed transmission input shaft creeper speed drive gear, through the creeper speed clutch, to the countershaft. The countershaft drive gear transmits power through the even drive gear (idler gear), through the engaged reverse clutch, to the output shaft. The addition of an idler gear for reverse speed causes the speed output shaft, and everything rearward of the pinion shaft, to reverse rotation compared to the forward gear rotation. Power is transmitted across the output shaft and engaged master clutch, to the range input shaft. From the range input shaft, power is transmitted through the low-range drive gear, low-range driven gear, and clutch, to the constant mesh gear set and pinion shaft.

**CREEPER REVERSE SECOND GEAR (CR2)** - As the operator selects creeper second-reverse speed, he simultaneously disengages and locks out the odd/even speed clutch packs. He also engages the creep speed clutch pack, the reverse clutch pack and medium clutch pack. Power then flows from the speed input shaft creeper speed drive gear, through the creeper speed clutch, to the countershaft. The countershaft drive gear transmits power through the even-speed drive gear (idler gear), through the engaged reverse clutch, to the output shaft. The addition of the idler gear for reverse speed causes the speed output shaft and everything rearward of the pinion shaft to reverse rotation compared to the forward rotation. Power is transmitted across the output shaft and the engaged master clutch to the range transmission input shaft. From the range input shaft, power is transmitted through the medium-range clutch, the medium-range drive gear, to the medium-range driven gear on the countershaft. The power is then transmitted across the countershaft to the constant mesh gear set and the pinion shaft.

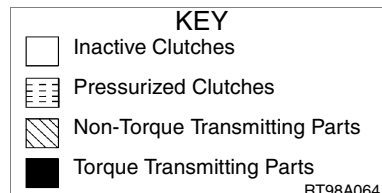
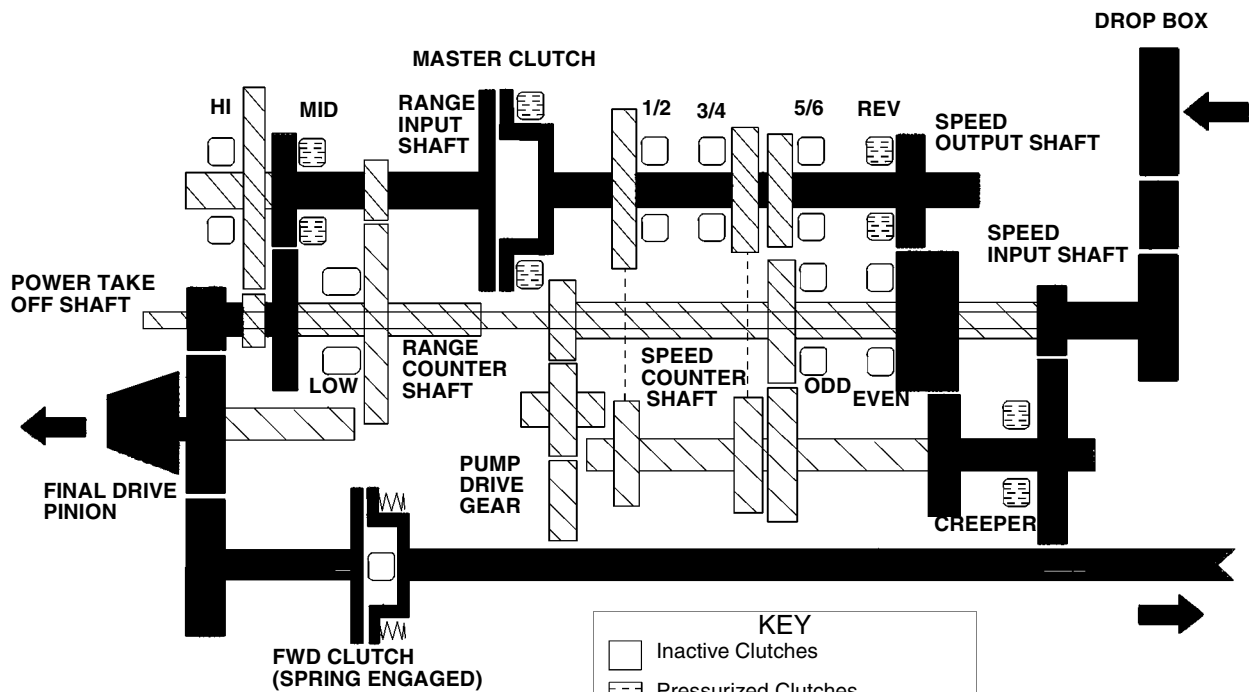
# Powershift Transmission Clutch Layout with Pump Drive, PTO, FWD, and Creeper Drive

Creeper Reverse Gear No. 1



RT98A059

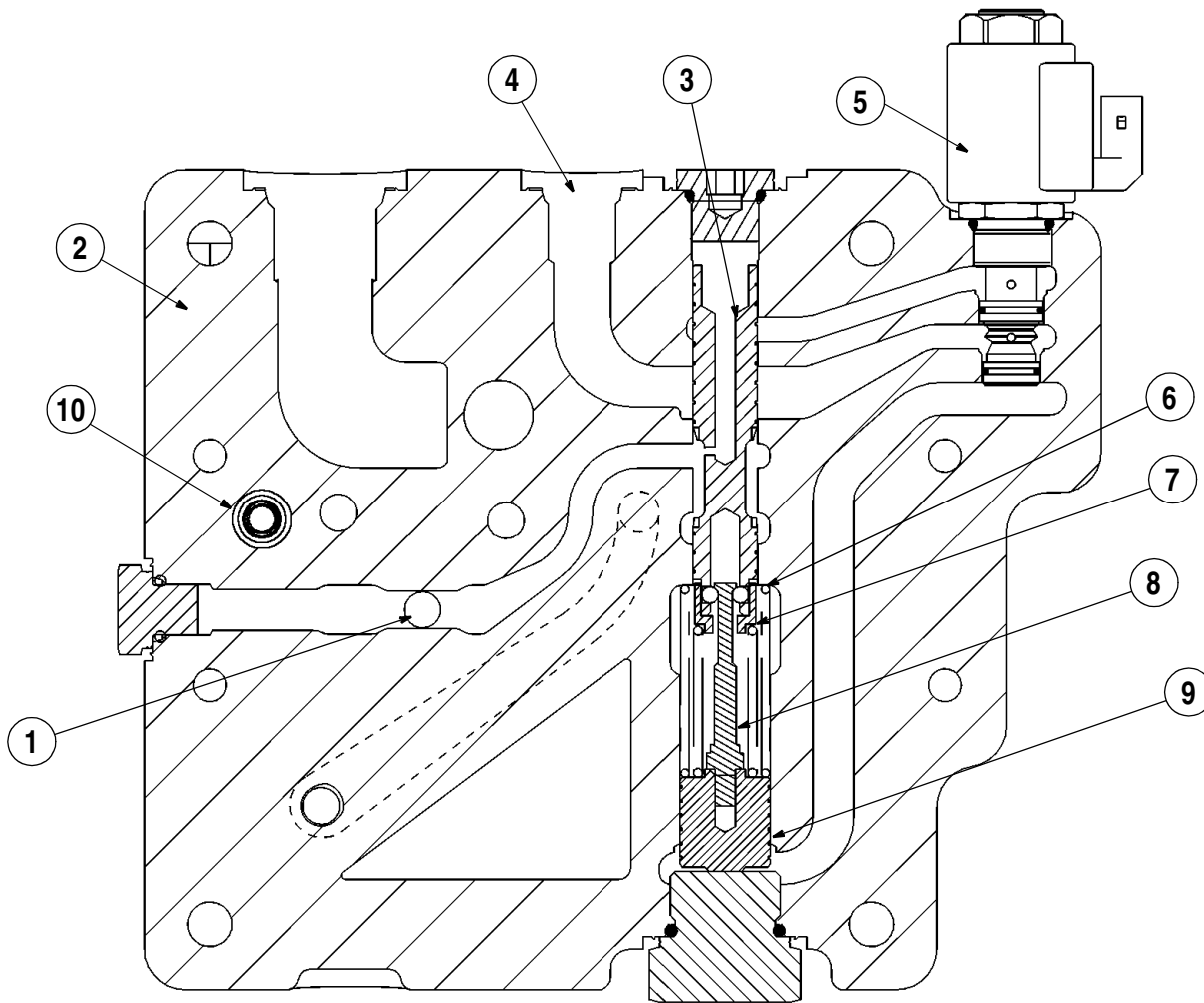
Creeper Reverse Gear No. 2



RT98A060



## INCHING VALVE OPERATION



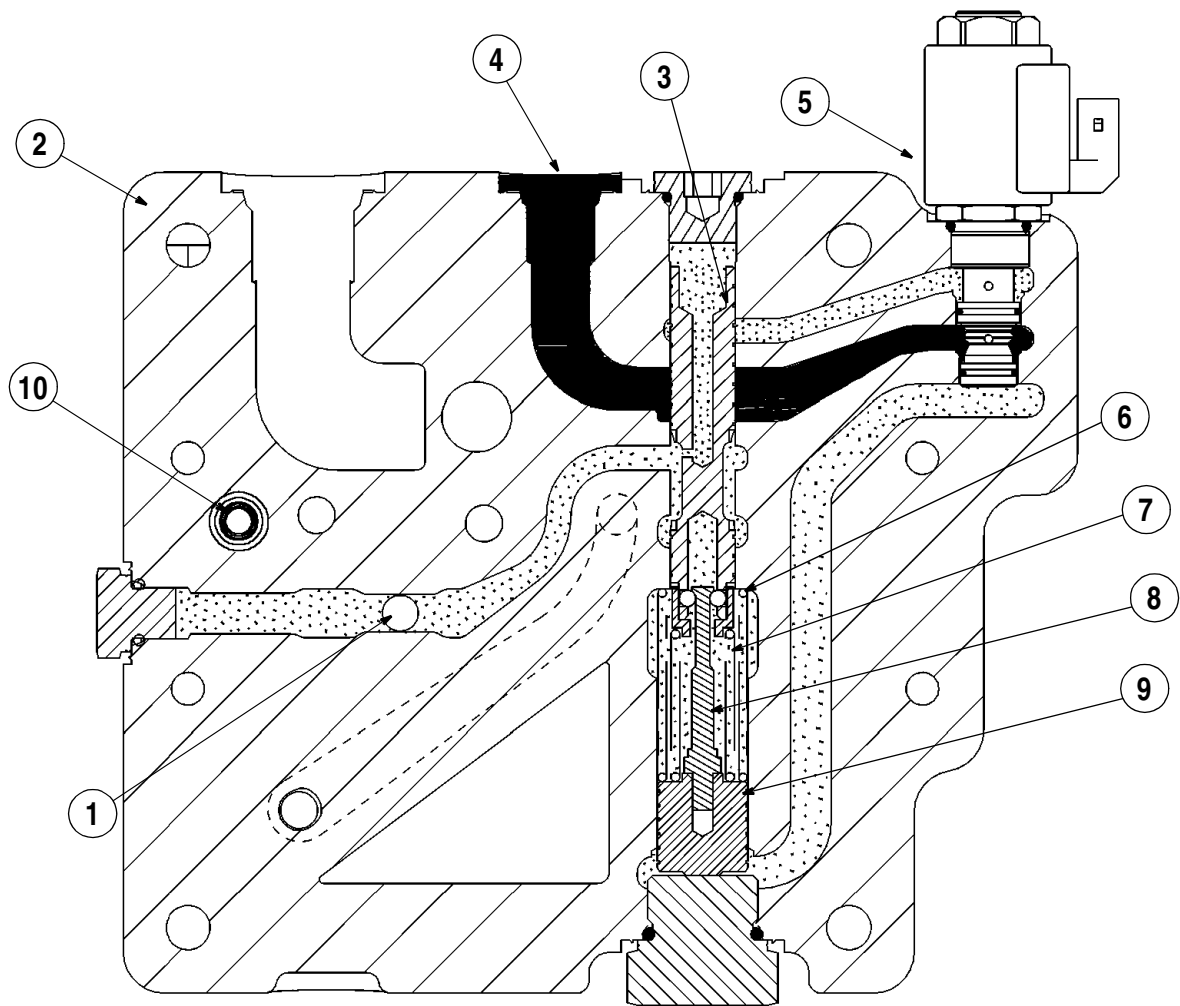
RH02F070

- |  |                              |
|--|------------------------------|
| 1. PORTING TO MASTER CLUTCH              | 6. PRELOAD SPRING            |
| 2. INCHING VALVE BODY                    | 7. INNER MODULATOR SPRING    |
| 3. MODULATOR SPOOL                       | 8. PISTON CENTER PIN         |
| 4. REGULATED PRESSURE SUPPLY             | 9. MODULATOR PISTON ASSEMBLY |
| 5. PROPORTIONAL CURRENT CONTROL SOLENOID | 10. CHECK VALVE              |

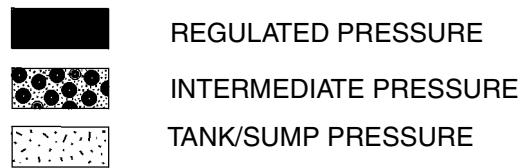
The transmission controller has to be run through the “Trans Setup” Procedure whenever a transmission component is replaced: clutch pedal switch, inching valve, transmission controller, or replacement of the master clutch.

TRANS SETUP consists of: Cal Pedal - Used to calibrate the operating range of the clutch pedal.

Cal Valve - Used to calibrate the fill current of the master clutch and detect the presence of the optional creeper transmission. The fill current is the current required to just fill the clutch with oil without conducting torque through the clutch.



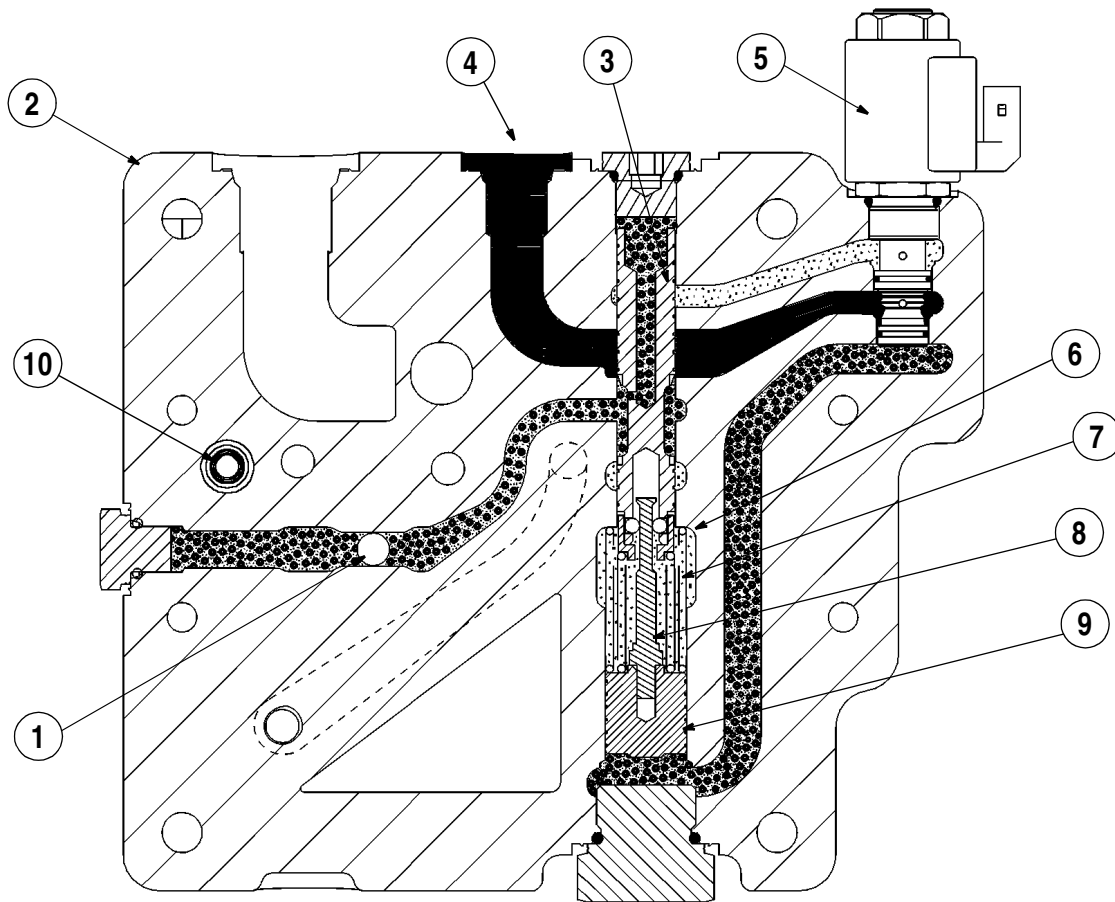
RH02F071



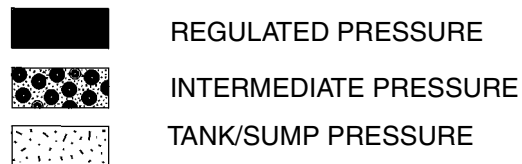
RT98F015

- |  |                              |
|--|------------------------------|
| 1. PORTING TO MASTER CLUTCH              | 6. PRELOAD SPRING            |
| 2. INCHING VALVE BODY                    | 7. INNER MODULATOR SPRING    |
| 3. MODULATOR SPOOL                       | 8. PISTON CENTER PIN         |
| 4. REGULATED PRESSURE SUPPLY             | 9. MODULATOR PISTON ASSEMBLY |
| 5. PROPORTIONAL CURRENT CONTROL SOLENOID | 10. CHECK VALVE              |

The inching valve is shown with the engine running and the inching pedal fully depressed. The position of the inching pedal controls the current value supplied to the inching valve PCC solenoid. When the inching pedal is fully depressed there is no current supplied to the inching valve PCC solenoid.



RH02F072



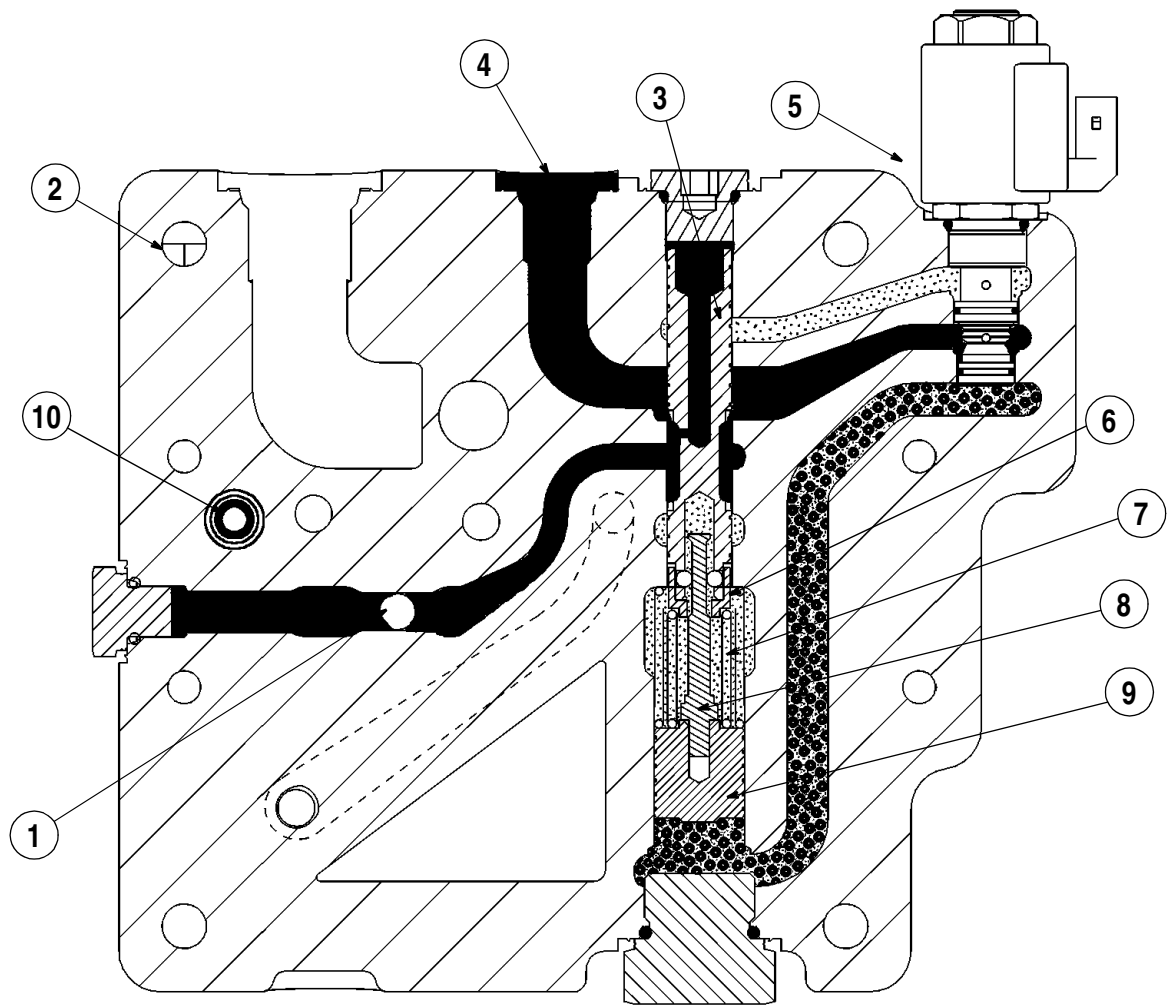
RT98F015

- |  |                              |
|--|------------------------------|
| 1. PORTING TO MASTER CLUTCH              | 6. PRELOAD SPRING            |
| 2. INCHING VALVE BODY                    | 7. INNER MODULATOR SPRING    |
| 3. MODULATOR SPOOL                       | 8. PISTON CENTER PIN         |
| 4. REGULATED PRESSURE SUPPLY             | 9. MODULATOR PISTON ASSEMBLY |
| 5. PROPORTIONAL CURRENT CONTROL SOLENOID | 10. CHECK VALVE              |

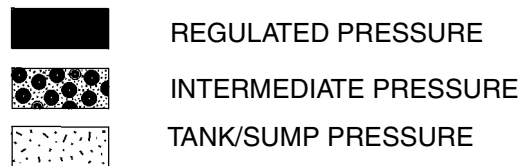
As the inching pedal is let up, the transmission controller sends a current signal to the inching valve PCC solenoid. The current value is based on the inching pedal position. The solenoid spool shifts, metering oil through the center of the spool assembly down to the bottom of the modulator piston assembly.

As the pressure builds the modulator piston assembly begins to move up, against the force of both the inner modulator and preload springs. As the modulator piston assembly moves up, the center pin of the modulator piston assembly moves into the bore of the modulator spool. The modulator piston assembly does not directly shift the modulator spool. The inner modulator spring force begins to shift the modulator spool.

As the modulator spool shifts upward it simultaneously blocks the master clutch return and opens the master clutch supply to the inlet regulated supply. At the same time the inlet regulated supply is also ported through a cross drilled and end drilled holes to the top of the modulator spool. The balance between the increasing inner modulator spring force and pressure against the increasing clutch pressure at the top of the modulator spool causes the master clutch pressure to gradually build.



RH02F073



RT98F015

- |  |                              |
|--|------------------------------|
| 1. PORTING TO MASTER CLUTCH              | 6. PRELOAD SPRING            |
| 2. INCHING VALVE BODY                    | 7. INNER MODULATOR SPRING    |
| 3. MODULATOR SPOOL                       | 8. PISTON CENTER PIN         |
| 4. REGULATED PRESSURE SUPPLY             | 9. MODULATOR PISTON ASSEMBLY |
| 5. PROPORTIONAL CURRENT CONTROL SOLENOID | 10. CHECK VALVE              |

As the inching pedal is brought fully up the current supplied to the inching valve solenoid is at the maximum.

With the inching pedal fully up the modulator piston moves up and fully shifts the modulator spool. The modulator spool is no longer being moved by the inner spring, but through direct contact from the ramp area on the modulator piston assembly.

The modulator spool has now moved far enough to allow full regulated pressure from the valve inlet to be applied to the master clutch.

## INSTRUMENTATION CLUSTER - TRANSMISSION LEAKAGE CHECK

The regulated circuit pump is the front section of the tandem gear pump. The pump draws oil from the system reservoir through a 100 mesh suction screen. The pump flow passes through the regulated circuit filter housing and into the priority regulator valve. The priority regulator valve maintains the regulated pressure circuit at 22.4 to 24.5 bar (325 to 355 PSI). The regulated pump flow supplies the PTO/ Diff lock valve, transmission control valves and brake valve. Both the remote and hitch valves are also supplied with pilot pressure.

Once these circuits are satisfied the excess regulated pump flow is directed through the oil coolers and joins up with the charge pump flow at the downstream side of the main filter head.

The 27 GPM tandem gear pump is a fixed displacement pump, therefore the output flow will decrease as the engine speed is lowered. At low engine speeds, leaks in the regulated and transmission circuits are more noticeable.

### BACKGROUND INFORMATION:

The transmission controller monitors the pressure through the system pressure transducer. The manifold pressure can be read from the display through the TRANS SYS PRESSURE screen.

- Start and run the engine.
- Press the INCR or DECR key on the programmable instrumentation until TRANS OIL TEMP screen is reached.

**NOTE:** *Screen order is set by the operator. The TRANS OIL TEMP and TRANS SYS PRESURE screens could or could not be together depending on setup.*

- Operate the engine at 1500 RPM until the transmission temperature displayed on the instrumentation reads at least 49° C (120° F).
- Press the INCR as required to display the TRANS SYS PRESSURE screen.
- With the engine at 1500 RPM, record the transmission system pressure with all hydraulic systems OFF, PTO and Diff Lock in the OFF position and the FWD switch in the ON position.
- Increase engine speed to 2000 RPM. Record the range powershift manifold pressure. Decrease engine speed.

- **The Powershift System Manifold Pressure\_\_\_\_\_ kPa at 2000 RPM**

- A. If the pressure reading is greater than 310 PSI (2240 kPa) go to the regulated system leakage test. (Complete the regulated system leakage test before adjusting regulated pressure. See Hydraulic System How It Works And Troubleshooting)
- B. If the pressure reading is less than 310 PSI (2240 kPa) go to the regulated pump flow test (See Hydraulic System How It Works And Troubleshooting)..

**NOTE:** *Transducer Pressure Range: 2240 to 2250 kPa (325 to 355 PSI) at 2000 RPM and 120°F (49°C). To convert kPa to bar, move the decimal place over two places to left, i.e. 2240 kPa equals 22.4 bar.*

Fault codes will be generated if a problem is detected with the following components:

- System pressure transducer failure.
- Wire failed, or shorted between sensor and controller.
- Low regulated supply pressure to powershift valves.
- Low powershift manifold pressure due to leaking clutch.
- Wire failed, or shorted between powershift valve solenoid and controller.

## STEP 1 - Record Clutch Pressures in each Gear with Tractor Instrumentation

**NOTE:** *Clutch pack leaks can be identified through the tractor instrumentation pressure readings.*

**IMPORTANT:** *The tractor must be driven to perform this test. Perform this test in an open outdoor location free of obstacles and people.*

-- Start and run the engine with the transmission control lever in the PARK position.

- Press the INCR or DECR key on the programmable instrumentation until TRANS OIL TEMP screen is reached.

**NOTE:** *Screen order is set by the operator. The TRANS OIL TEMP and TRANS SYS PRESURE screens could or could not be together depending on setup.*

- Operate the engine at 1500 RPM until the transmission temperature displayed on the instrumentation reads at least 49° **C (120° F)**.

- Press the INCR as required to display the TRANS SYS PRESSURE screen.

- With the engine at 1500 RPM, record the transmission system pressure with all hydraulic systems OFF, PTO and Diff Lock in the OFF position and the FWD switch in the ON position.

- Select 1st gear with the Gear selection switch.

Move the transmission control lever to forward. Release the inching pedal. Shift through the gears and record the valve manifold pressures below.

**NOTE:** *Valve manifold pressures will momentarily drop and quickly recover pressure as each shift is completed.*

GEAR 1 _____	GEAR 7 _____	GEAR 13 _____
GEAR 2 _____	GEAR 8 _____	GEAR 14 _____
GEAR 3 _____	GEAR 9 _____	GEAR 15 _____
GEAR 4 _____	GEAR 10 _____	GEAR 16 _____
GEAR 5 _____	GEAR 11 _____	GEAR 17 _____
GEAR 6 _____	GEAR 12 _____	GEAR 18 _____

Shift back to 1st gear and move the transmission control lever to reverse. Shift through the reverse speeds and record the pressures.

REVERSE 1 _____
REVERSE 2 _____
REVERSE 3 _____
REVERSE 4 _____

The “PresS” system pressure will be noticeably lower in the following gears if there is significant clutch leakage:

Low pressure for Speeds R1, R2, R3 and R4 ----- Indicates Reverse Clutch Leakage.

Low pressure for Speeds 1, 2, 7, 8, 13 and 14 ----- Indicates 1st Speed Clutch Leakage.

Low pressure for Speeds 3, 4, 9, 10, 15 and 16-----Indicates 3rd Speed Clutch Leakage.

Low pressure for Speeds 5, 6,11,12, 17 and 18 -----Indicates 5th Speed Clutch Leakage.

Low pressure for Speeds 1, 3, 5, 7, 9, 11, 13, 15, 17, R1 and R3 ----- Indicates Odd Clutch Leakage.

Low pressure for Speeds 2, 4, 6, 8, 10, 12, 14, 16, 18, R2 and R4 -----Indicates Even Clutch Leakage.

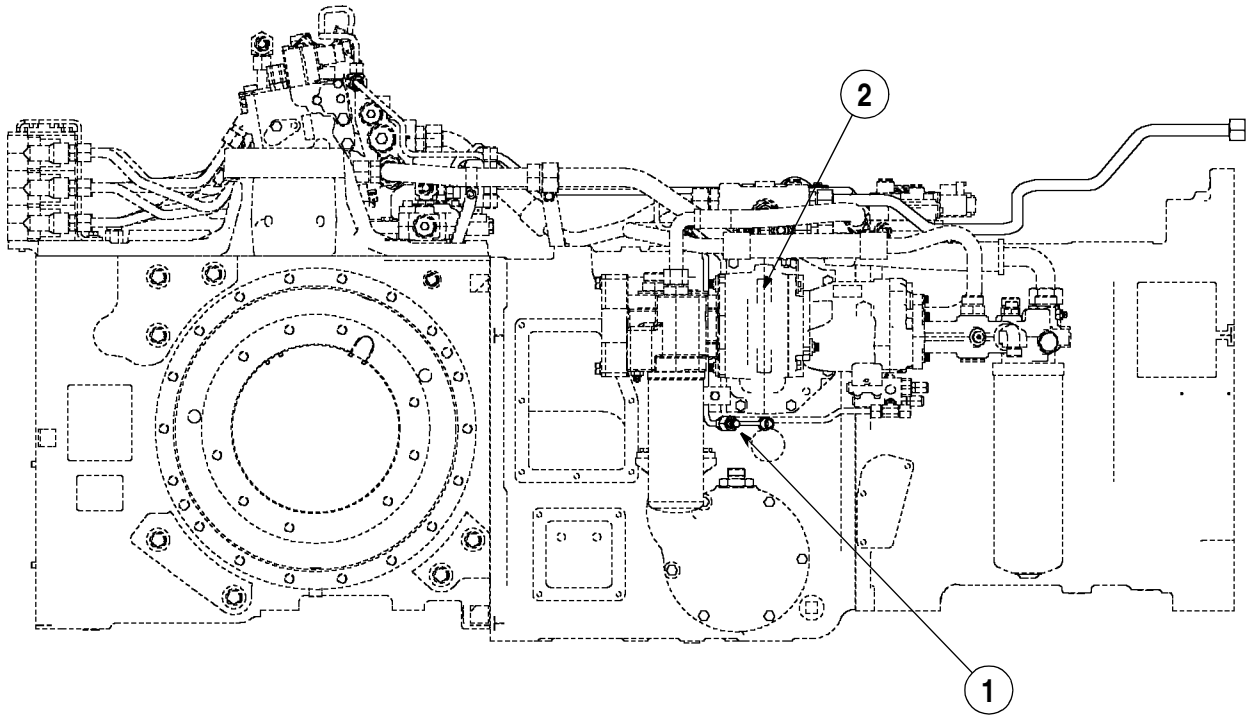
Low pressure for Speeds 1, 2, 3, 4, 5, 6, R1 and R2 ----- Indicates Low Range Clutch Leakage.

Low pressure for Speeds 7, 8, 9, 10, 11, 12, R3 and R4 ----- Indicates Mid Range Clutch Leakage.

Low pressure for Speeds 13, 14, 15, 16, 17 and 18-----Indicates High Range Clutch Leakage.

Low pressure in all creep gears -----Indicates Creep Clutch Leakage.

## MASTER CLUTCH PRESSURE CHECK



1. DIAGNOSTIC TEST PORT

2. PUMP DRIVE GEAR HOUSING

RH98F161

The master clutch pressure diagnostic test port is located on the right hand side of the transmission below the pump drive gear housing.

### Test Fitting and Tool Requirements:

- 400 PSI (28 bar) pressure gauge with extension hose long enough to reach into cab.

**IMPORTANT:** *The tractor must be driven to perform this test. Perform this test in an open outdoor location free of obstacles and people.*

- Connect the gauge/extension hose to the diagnostic port.
- Turn the Differential Lock OFF.
- Start and run the tractor at low idle.
- Using the gear selection switch select gear number 1.
- Press and hold the inching pedal to the floor.

- Place the transmission control lever in forward.
- As the inching pedal is slowly let up the gauge reading should gradually increase.
- Once the pedal is fully up and the tractor is moving forward the gauge reading should be 325 to 355 PSI (22.4 to 24.4 bar).
- A. If the master clutch pressure reading is low, perform the Regulated System Pressure Test described in the Hydraulic System How It Works section of this manual.
- B. If the regulated pressure is also low (matches master clutch) continue with the procedure described.
- C. If the regulated pressure is within specification check for the following:
  - Check for fault code in Transmission Controller Calibration and Fault Codes section of this manual.



- Inspect the inching valve modulator spool and modulator piston. Both must move freely within the valve bore. See Inching Valve Operation in this section and the Transmission Control Valves and Inching Valve section of this manual for disassembly.
- Master clutch is leaking - see Range Transmission including FWD Clutch/ Park Brake section of this manual.

# **Section 21**

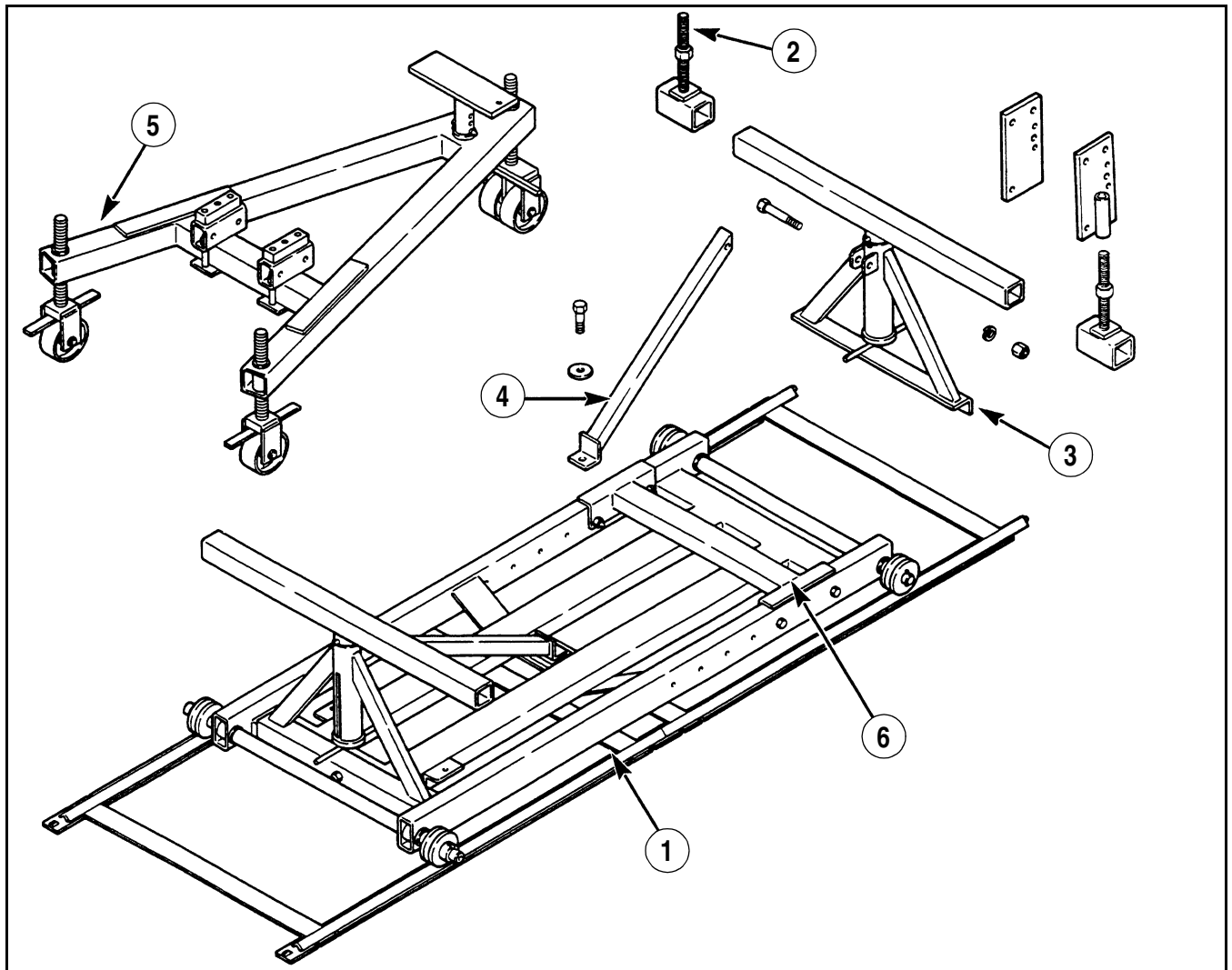
## **Chapter 2**

**FRONT FRAME TO SPEED TRANSMISSION SPLIT**

## TABLE OF CONTENTS

SPECIAL TOOLS .....	21-2-3
SPECIAL TORQUES .....	21-2-3
FRONT FRAME TO SPEED TRANSMISSION SPLIT .....	21-2-4

## SPECIAL TOOLS



0507TL5R

- 1. SPLITTING STAND 17-526A
- 2. ADAPTER PLATES CAS-2604
- 3. SUPPORT BRACE 17-526-14

- 4. SUPPORT ASSEMBLY 17-526-4A
- 5. REAR HOUSING HANDLER 17-527
- 6. ADAPTER BRIDGE 17-526-7

## SPECIAL TORQUES

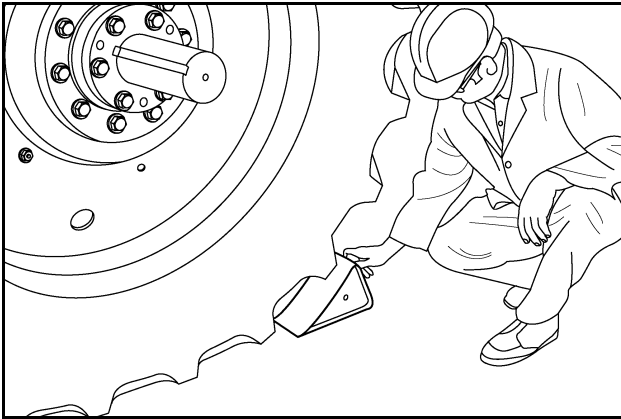
Front Frame To Speed Transmission Front End Housing

M16 Bolts.....	251 to 280 Nm (185 to 205 lb. ft.)
M20 Bolts.....	430 to 485 Nm (315 to 355 lb. ft.)

## FRONT FRAME TO SPEED TRANSMISSION SPLIT

### Disassembly

#### STEP 1



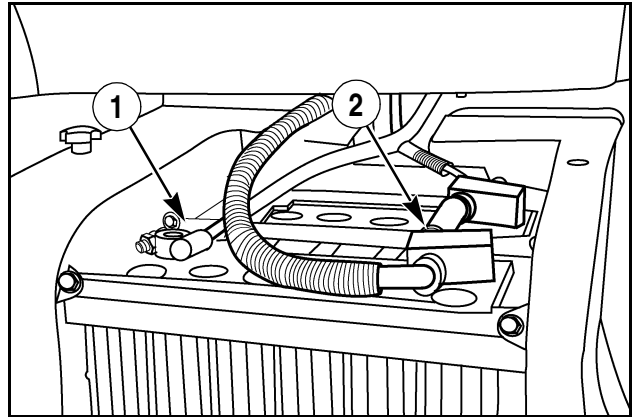
96RS28A

Prepare for disassembly as follows:

1. Park the tractor on a hard level surface.
2. Put the transmission control lever in PARK.
3. Fully lower the three point hitch.
4. Stop the engine and remove the key.
5. Put blocks behind and in front of the rear wheels.
6. Remove the front weights and weight bracket.
7. Evacuate the A/C system. See A/C Section in this Service Manual.
8. See the FWD drive shaft removal information and remove the FWD drive shaft.
9. Drain the engine cooling system into a clean container.

**NOTE:** Cooling capacity is approximately 24.7 liters (6.5 gallons).

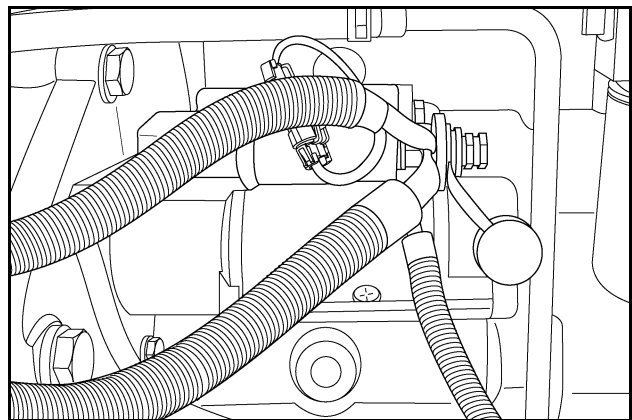
#### STEP 2



RD02E069

Disconnect the negative (1) and positive (2) battery cables.

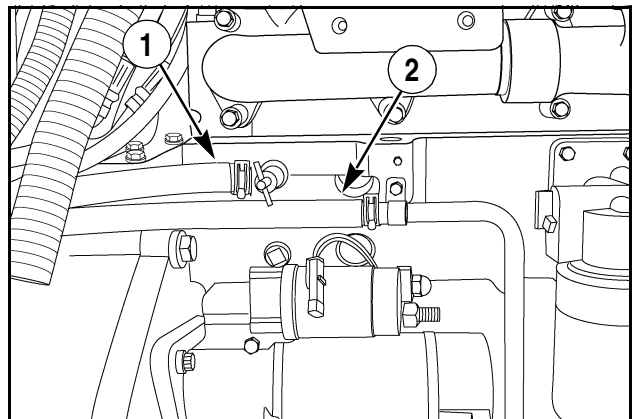
#### STEP 3



RD05N104

Disconnect the battery cables at the starter.

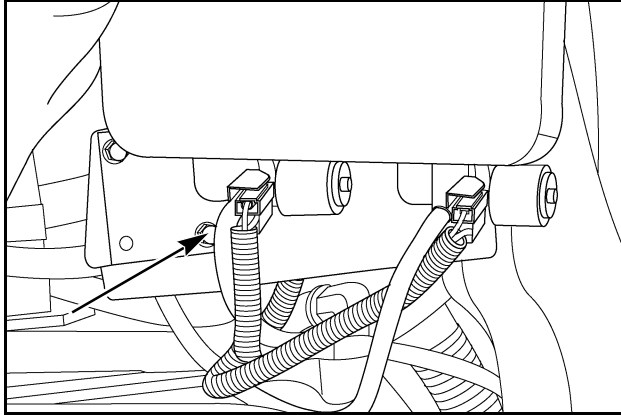
#### STEP 4



RD05N105

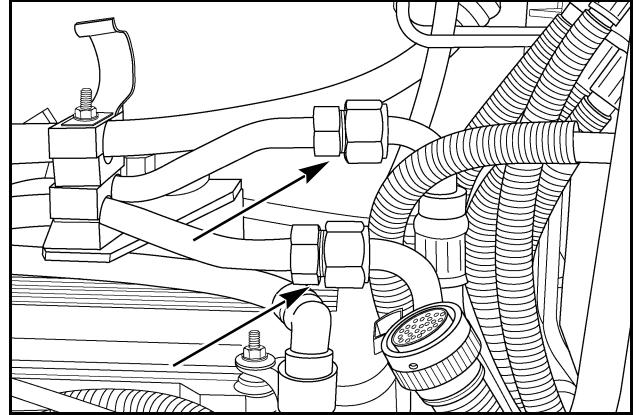
Tag and remove the supply (1) and return (2) heater hoses.

### STEP 5



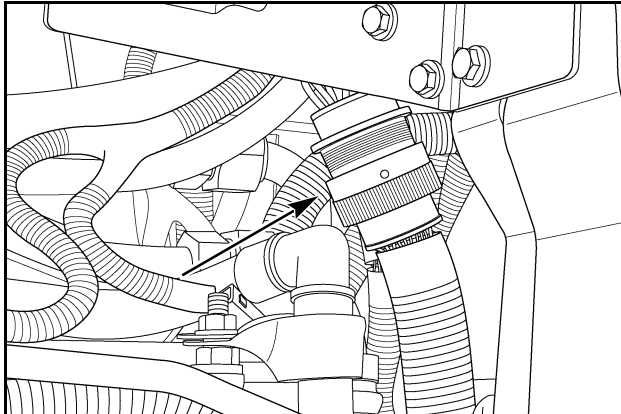
If equipped, remove the rear windshield washer hose.

### STEP 8



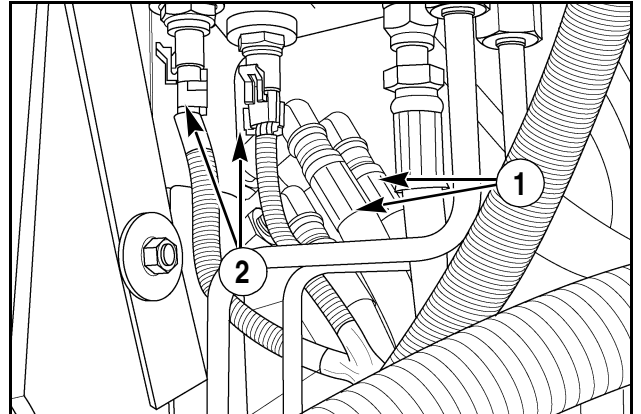
Disconnect the hydraulic cooling lines at the fittings located at the rear of the engine.

### STEP 6



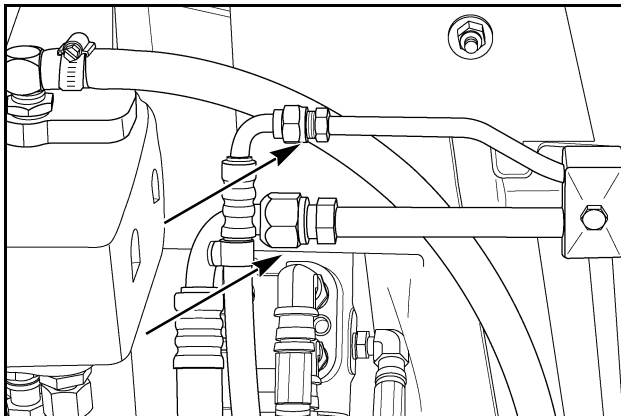
Disconnect the main electrical connector.

### STEP 9



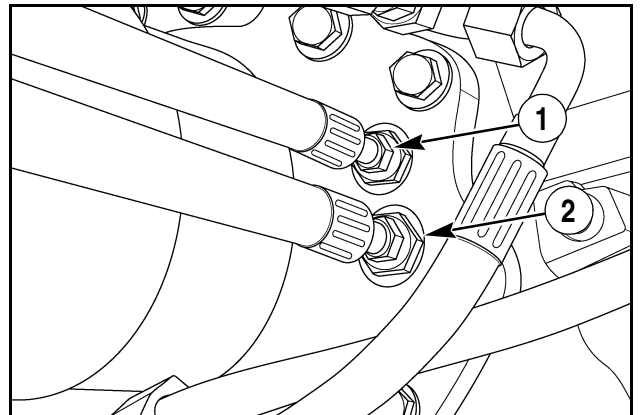
Tag and remove the steering return hoses (1) and brake switch connectors (2).

### STEP 7



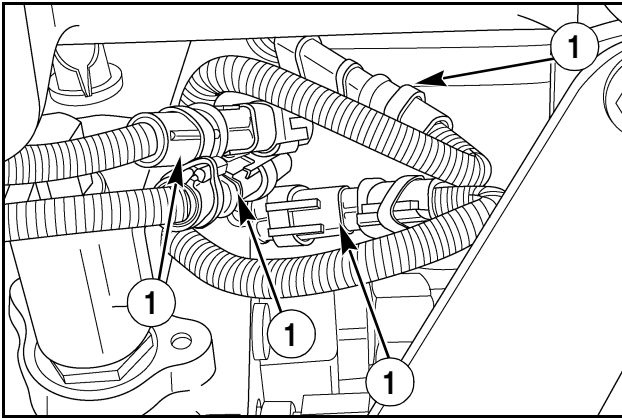
Disconnect the A/C lines at the firewall and cap the fittings.

### STEP 10

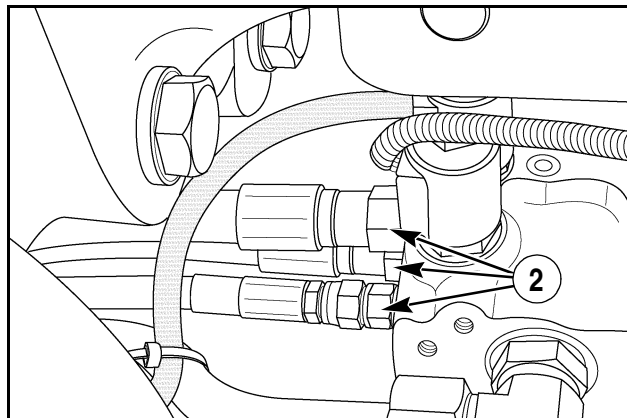


If equipped, remove and cap the FWD differential lock hydraulic supply (1) and return line (2).

### STEP 11



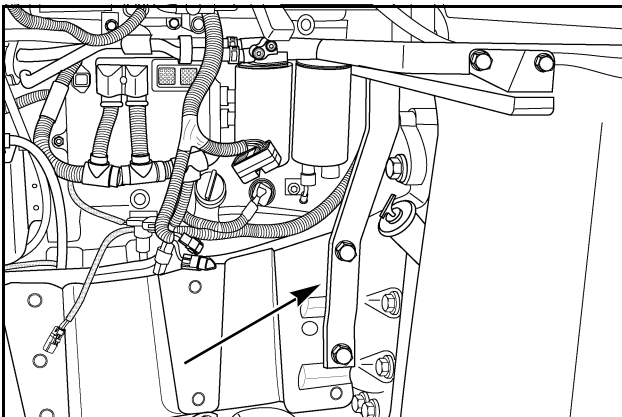
RD06A168



RD06A169

If equipped, tag and disconnect the four suspended front axle solenoid connectors (1) and remove the suspended axle valve hydraulic hoses (2).

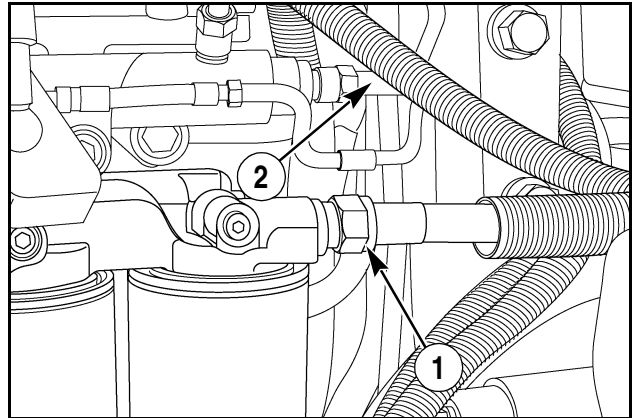
### STEP 12



RD05N128

If required, remove the windshield step.

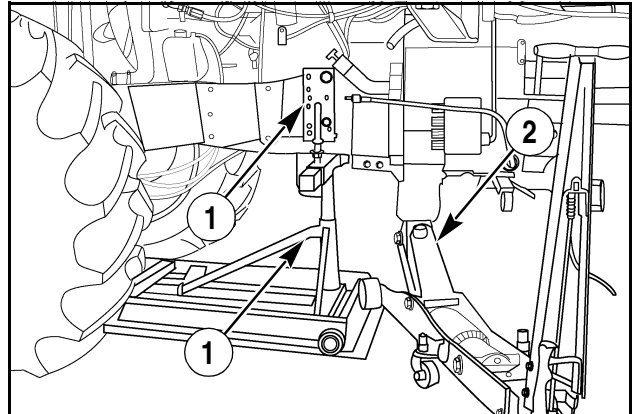
### STEP 13



RD05N124

Remove the fuel supply (1) and return (2) hoses. Remove the return hose at the fuel cooler.

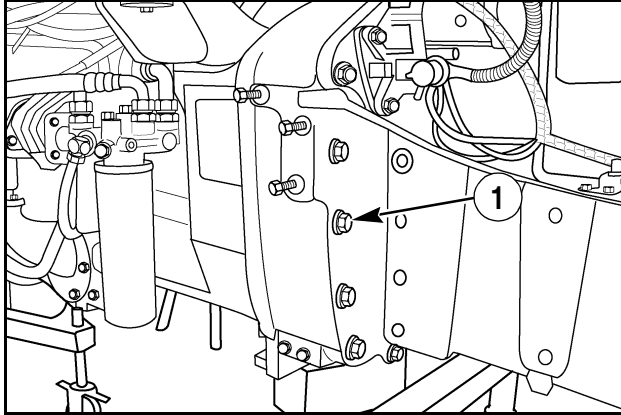
### STEP 14



RD02C175

Position the front splitting stand 17 - 526A (1) as shown. Properly support the transmission speed housing with jack (2). Place jack stands (not shown) under the speed housing for added support and safety.

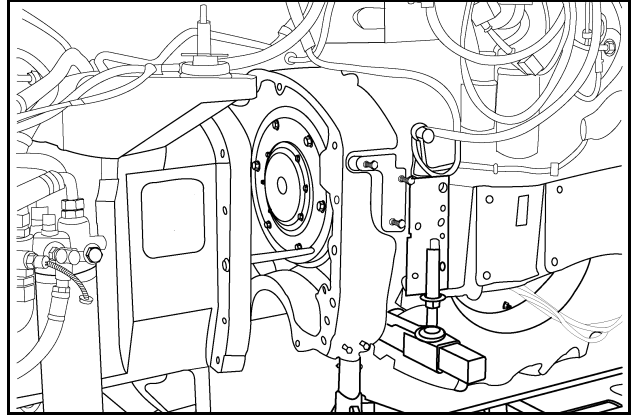
### STEP 15



RD02C173

Remove bolt (1) on the left and right hand sides. Install an alignment dowel on each side. Remove the remaining five bolts on each side.

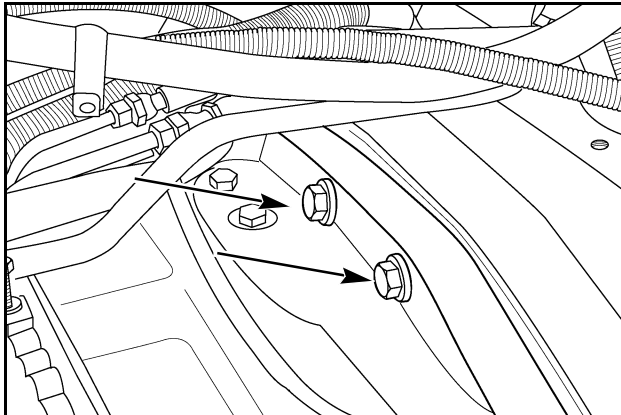
### STEP 17



RD02C177

Push on the front wheels to move the front frame forward a few inches. Check to be sure there are no lines connected across the split. Continue to separate the tractor.

### STEP 16



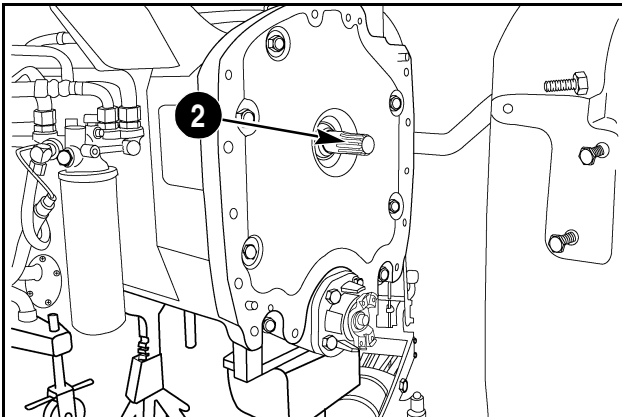
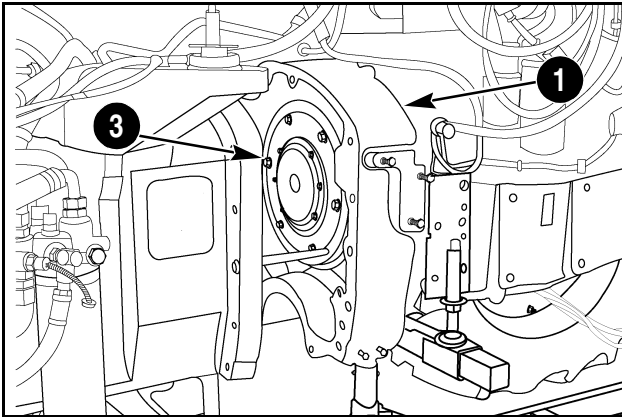
RD02C174

Remove the two top inside bolts.



## Assembly

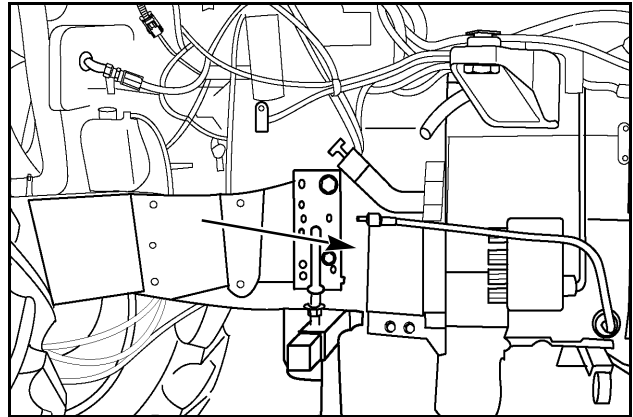
### STEP 18



With alignment dowels installed on both sides of the transmission, move the front frame (1) rearward until the input shaft (2) engages the flywheel (3).

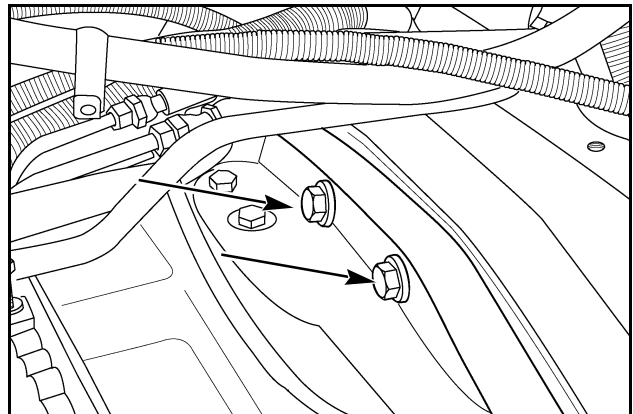
**NOTE:** It may be necessary to rotate the flywheel by turning the engine crankshaft dampener to align the flywheel splines with the input shaft.

### STEP 19

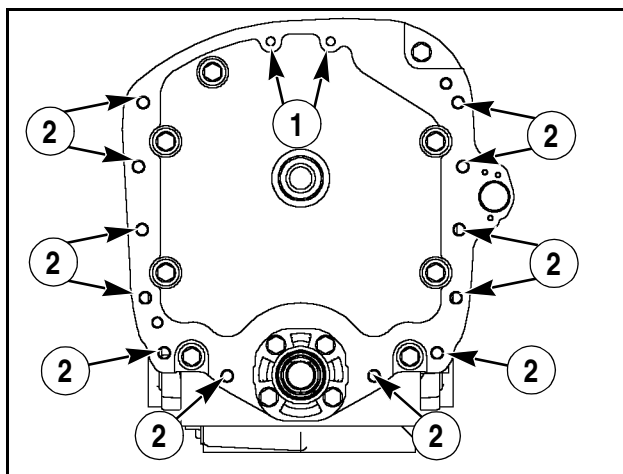


Install a bolt on both sides. Evenly tighten the bolts until the adapter plate and front frame flanges contact. Install and tighten all the side bolts except those blocked by the frame brackets. Remove the alignment dowels.

### STEP 20



Install the two top bolts.

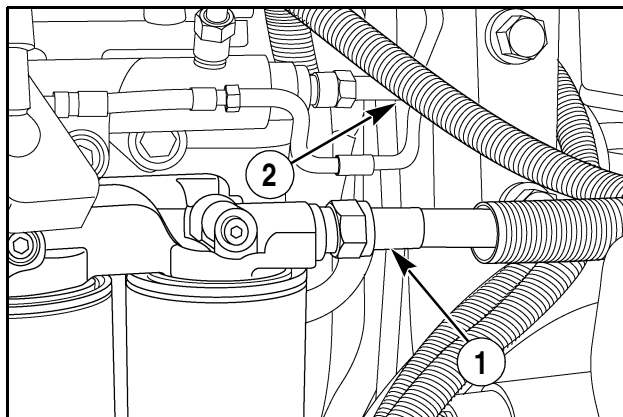


RI02D004

- 1..... 251 to 280 Nm (185 to 205 lb. ft.)  
 2..... 430 to 485 Nm (315 to 355 lb. ft.)

Remove the frame support brackets to make clearance for a torque wrench. Tighten all the bolts to the values shown.

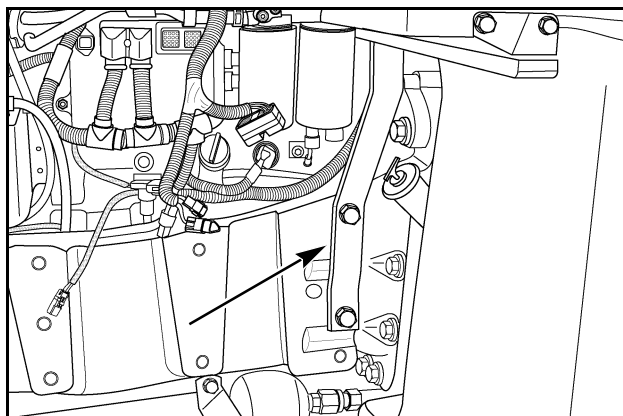
### STEP 21



RD05N124

Install the fuel supply (1) and return (2) lines.

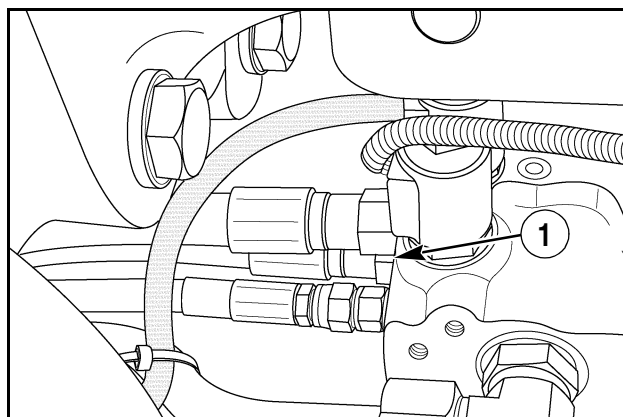
### STEP 22



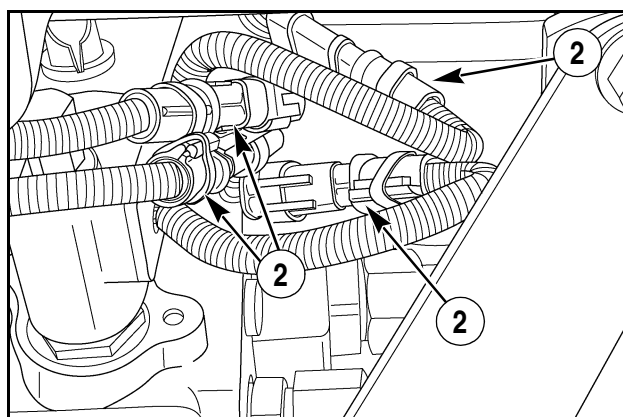
RD05N123

If required, install the windshield step.

### STEP 23



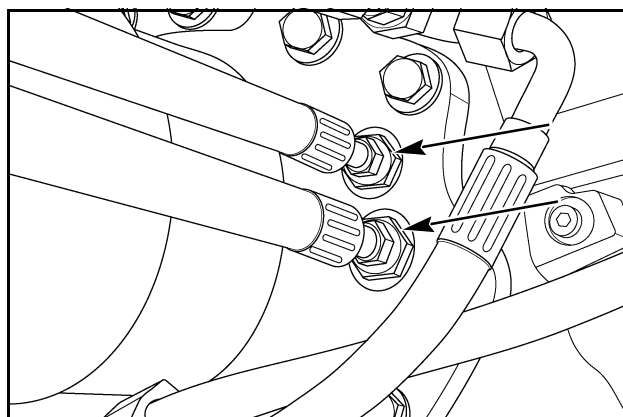
RD06A169



RD06A168

If equipped, install the suspended front axle hydraulic fittings (1) and electrical connectors (2).

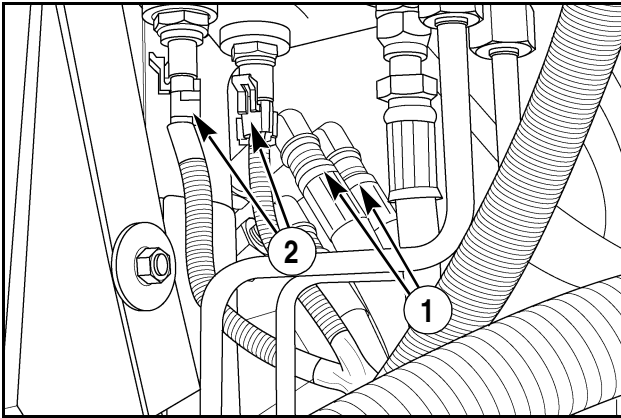
### STEP 24



RD06A167

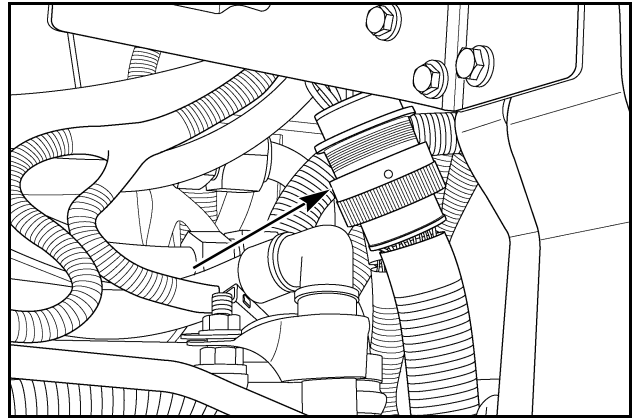
If equipped, install the FWD differential lock hydraulic hoses. Replace O-rings as needed.

### STEP 25



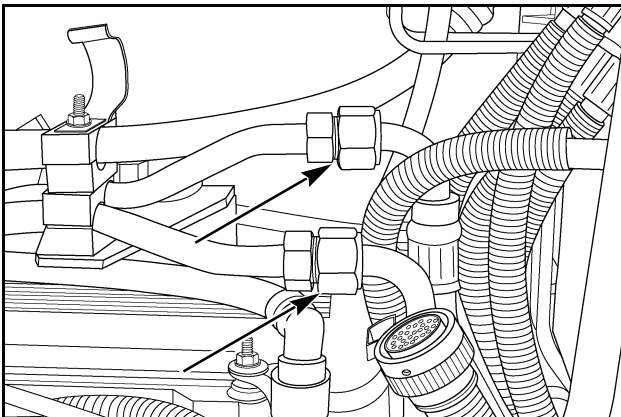
Install the steering hoses (1) and brake switch connectors (2).

### STEP 28



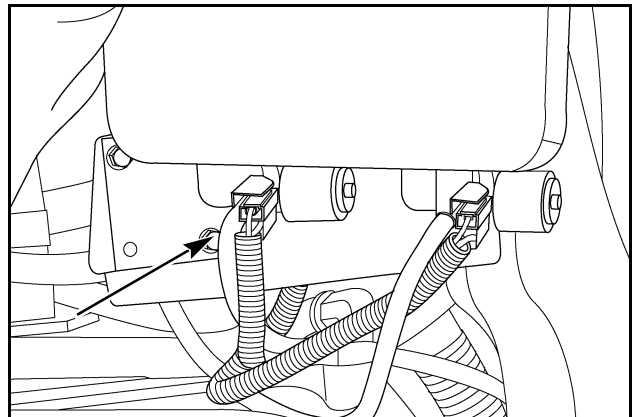
Connect the main electrical connector.

### STEP 26



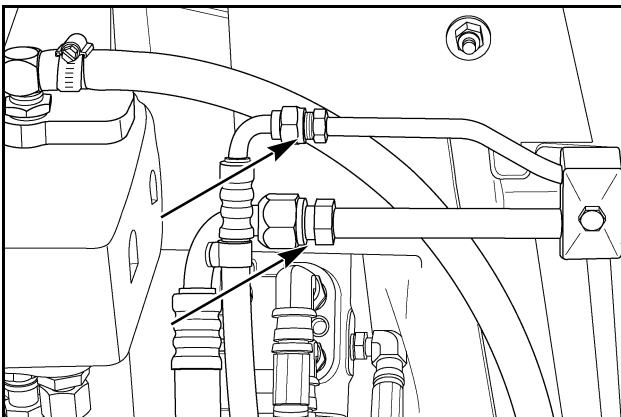
Install new O-ring and install the hydraulic cooling hoses.

### STEP 29



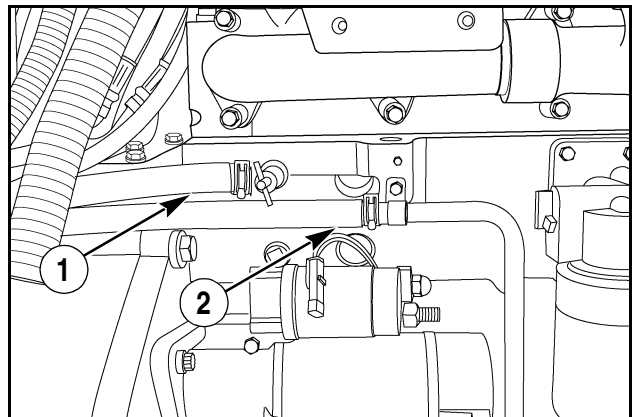
If equipped, install the rear windshield washer hose.

### STEP 27



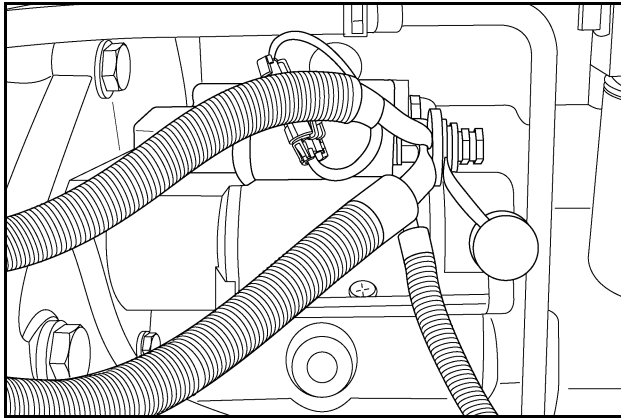
Install new O-ring and install the A/C lines.

### STEP 30



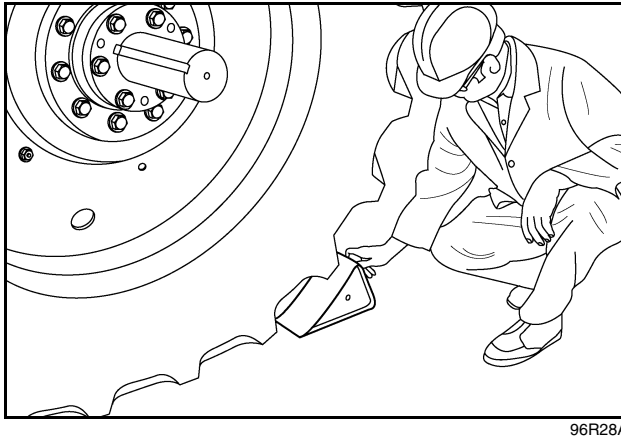
Install the heater supply (1) and return (2) hoses.

### STEP 31



Connect the battery cables at the starter.

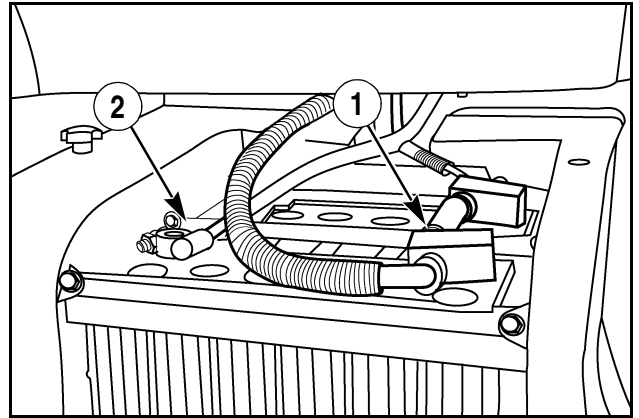
### STEP 32



Complete installation as follows:

1. Remove the jack stands, jack and front splitting stand.
2. Install the FWD drives shaft. See FWD drive shaft removal and installation information.
3. Recharge the A/C system. See A/C Section in this Service Manual.
4. If required, install the front weight bracket and weights.
5. Remove the blocks from the wheels.

### STEP 33



Connect the positive (1) negative (2) and battery cables.

### STEP 34

When tractor assembly is complete, run the tractor and check for hydraulic leaks.

Check the fluid level in the transmission and add as required.

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# **Section 21**

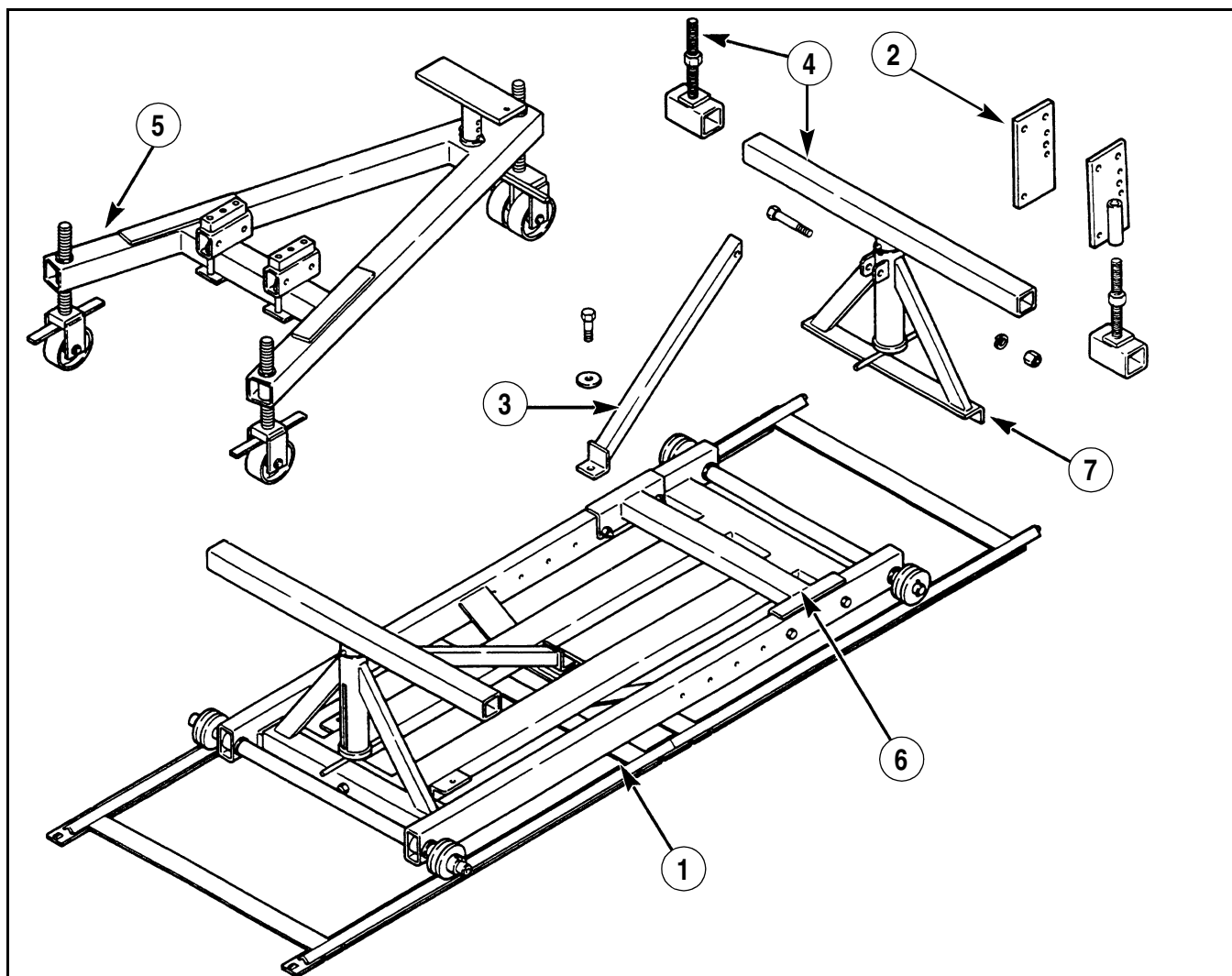
## **Chapter 3**

**SPEED TO RANGE TRANSMISSION SPLIT**

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SPECIAL TOOLS .....	21-3-3
SPECIAL TORQUES .....	21-3-3
SPEED TO RANGE TRANSMISSION SPLIT .....	21-3-4
Removal .....	21-3-4
Installation .....	21-3-7

## SPECIAL TOOLS



0507TLR

1. SPLITTING STAND 17-526A
2. ADAPTER PLATES CAS-2604
3. SUPPORT BRACE 17-526-14
4. SUPPORT ASSEMBLY 17-526-4A

5. REAR HOUSING HANDLER 17-527
6. ADAPTER BRIDGE 17-526-7
7. SUPPORT ASSEMBLY 17-526-5

## SPECIAL TORQUES

### Speed to Range Transmission Bolts

20 mm .....	232 to 262 Nm (171 to 193 lb. ft.)
20 mm X 80 mm (3.15 in.) .....	220 to 250 Nm (162 to 184 lb. ft.)
24 mm .....	430 to 486 Nm (317 to 358 lb. ft.)



## SPEED TO RANGE TRANSMISSION SPLIT

### Removal

#### STEP 1

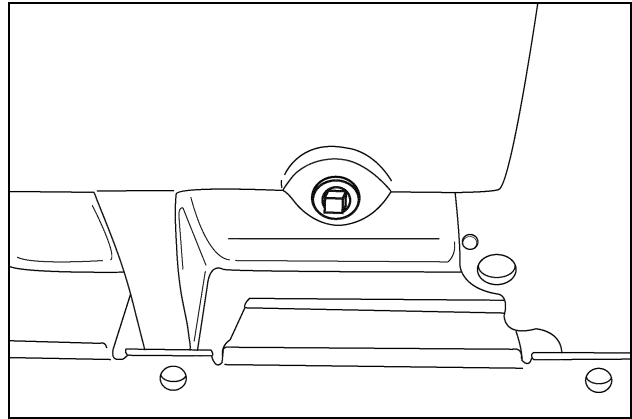


96RS28A

Prepare for removal as follows:

1. Park the tractor on a hard, level surface.
2. Put the shift control lever in PARK.
3. Fully lower the rear three-point hitch.
4. Stop the engine and remove the key.
5. Put blocks behind and in front of the rear wheels.
6. Remove the hood, following the procedure in the Tilt and Fixed Hoods section of this manual.
7. Remove the cab, following the procedure in the Cab Raise/Removal and Installation section of this manual.
8. Remove the fuel tanks, following the procedure in the Fuel Tank/Fuel Sender Removal and Installation section of this manual.
9. Remove the MFD drive shaft, following the procedure in the MFD Drive Shaft section of this manual.

#### STEP 2

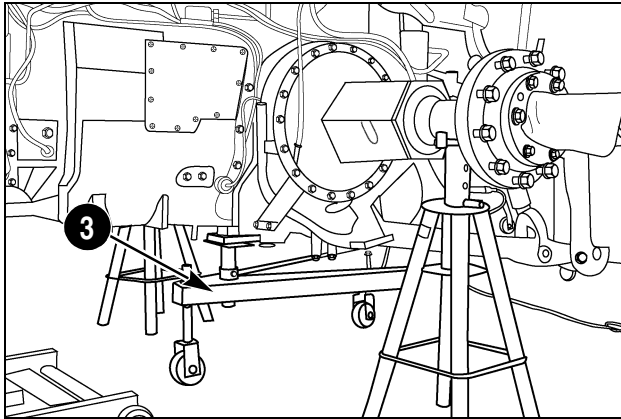
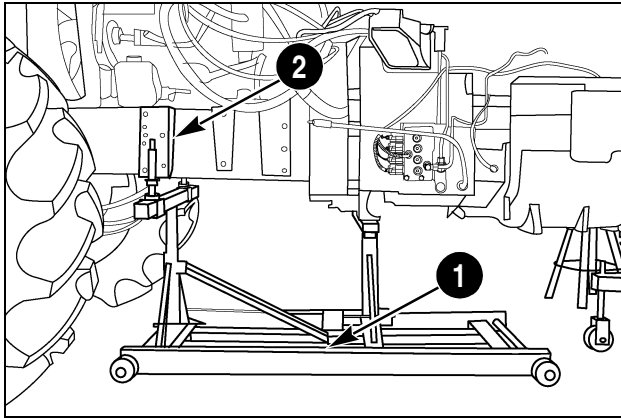


91S17

Drain the transmission fluids from the range, speed, and rear frame. Drain fluid into clean drain pans.

**NOTE:** *The transmission capacity is approximately 172 liters (45 gallons).*

### STEP 3



Position the front splitting stand 17-526A (1) and attach the adapter plates (2) on both sides.

Position the rear housing handler 17-527 (3) and adjust it to support the rear frame and range transmission without lifting up on them.

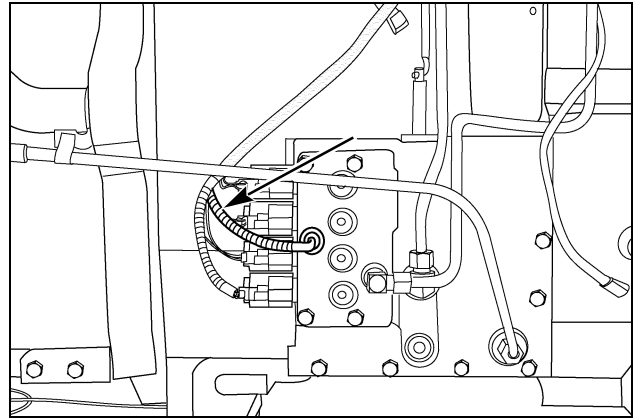
Be sure that the transmission is as level as possible and that the front wheels are as straight as possible. This will aid in shaft alignment on assembly.

**NOTE:** The exhaust stack does not have to be removed for this split, but removal does simplify the task.

**NOTE:** Rear wheels removed for photographic purposes.

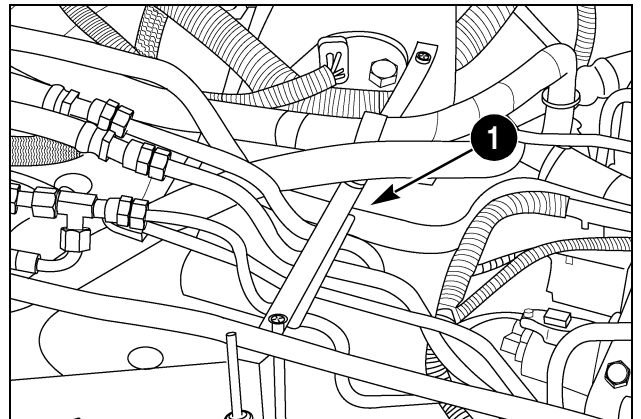
**NOTE:** Tag and identify all lines before removing them throughout this procedure.

### STEP 4



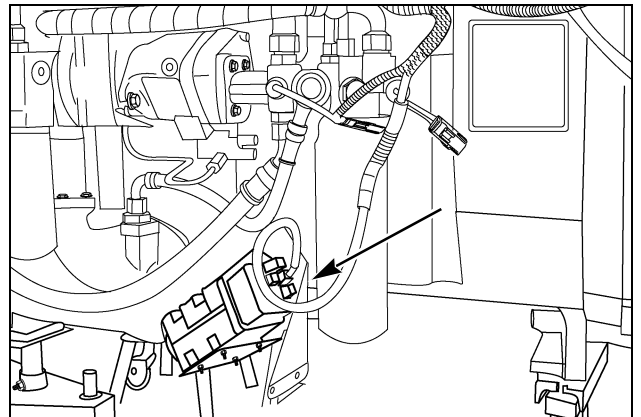
Disconnect the wire harness from the speed powershift valve solenoids.

### STEP 5



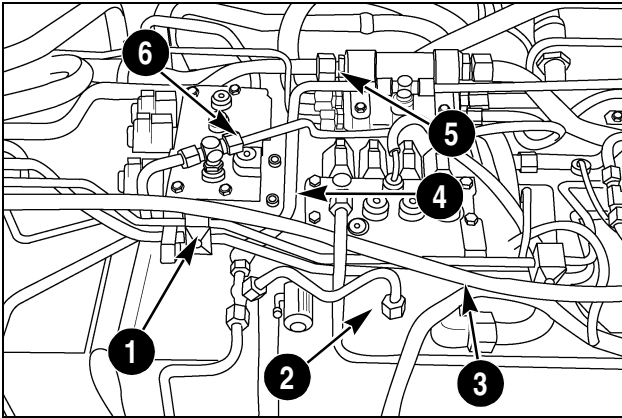
Remove the clamp bar (1) over the hydraulic lines on top of the speed transmission. Tag and remove the lines.

### STEP 6



If equipped, disconnect the true ground speed radar from the wire harness and remove the radar and mounting bracket from the speed transmission housing.

## STEP 7

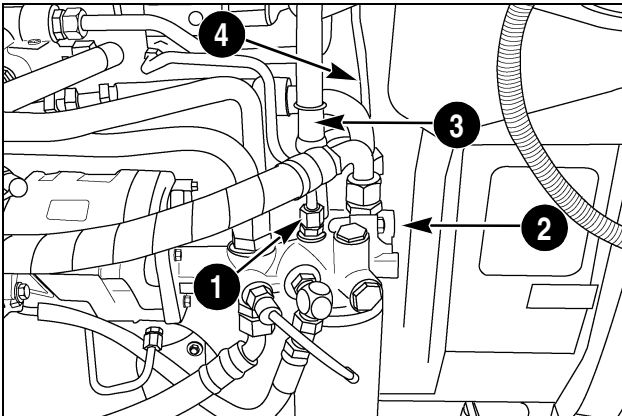


RD02C167

- |   |                                      |
|---|--------------------------------------|
| 1. STEERING SENSING<br>AND SUPPLY LINES | 4. REGULATED PRESSURE<br>SUPPLY LINE |
| 2. REGULATED SUPPLY<br>JUMPER TUBE      | 5. OIL COOLER RETURN<br>LINE         |
| 3. MFD/DIFF LOCK SUPPLY<br>LINE         | 6. PARK LOCK RELEASE<br>SUPPLY LINE  |

Disconnect these lines from the top of the transmission

## STEP 8



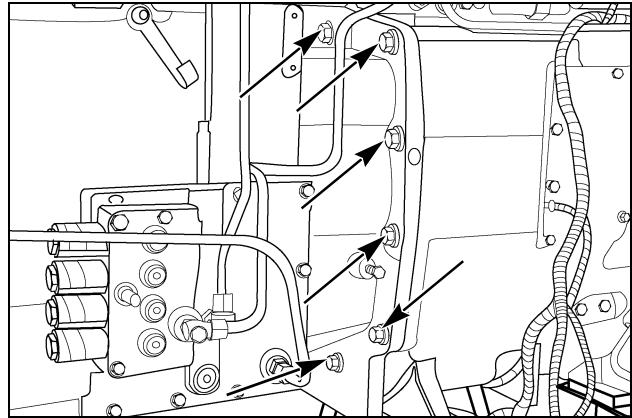
RD02C169

- |                                  |                              |
|----------------------------------|------------------------------|
| 1. ODD EVEN VALVE<br>RETURN LINE | 3. OIL COOLER SUPPLY<br>LINE |
| 2. FILTER TEMP SENDING<br>WIRE   | 4. STEERING RETURN LINE      |

Remove these lines from the hydraulic filter head. Disconnect the filter temperature sender wire.

Move the transmission wire harness back out of the way.

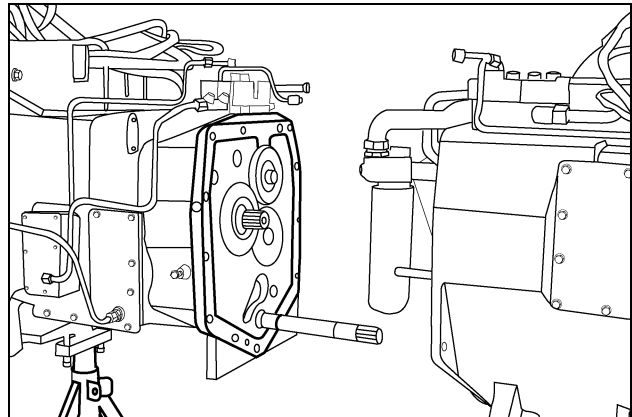
## STEP 9



RD02C170

Remove the 10 bolts attaching the speed transmission to the range transmission and install a guide stud on each side.

## STEP 10

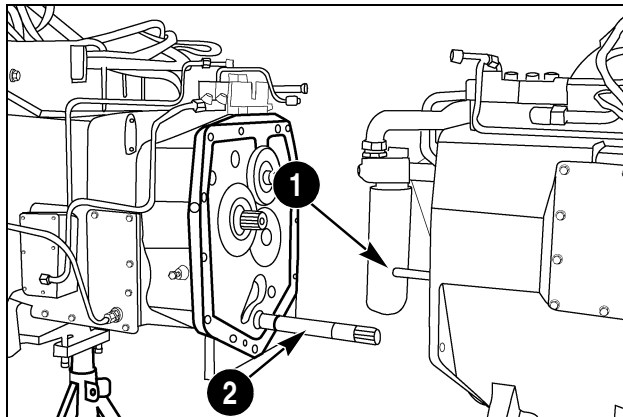


RD02C171

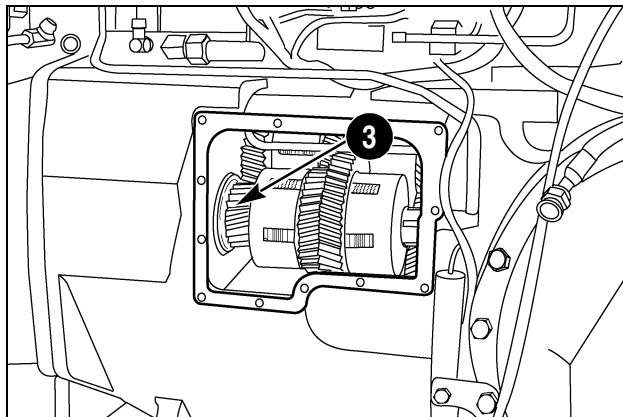
Move the speed and range transmissions apart a few inches. Check to be sure no lines are connected across the split. Push on the front wheels and continue to move the speed and range transmissions apart.

## Installation

### STEP 11



RD02C171



RD02C172

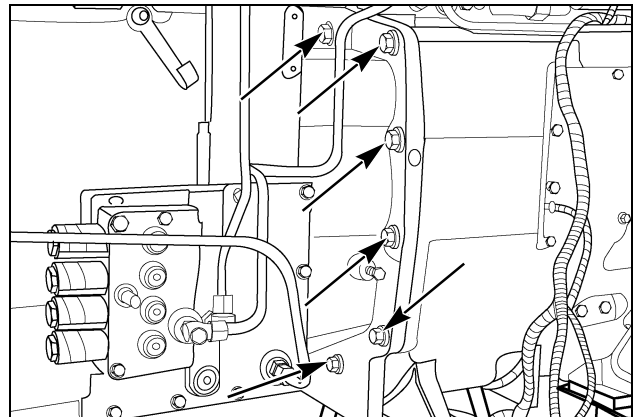
With the range transmission supported by the rear housing handler 17-527 and speed transmission supported by the splitting stand 17-526A, install guide studs

(1). Install a new gasket onto the range housing. Push on the front wheels to move the transmissions together. The three shaft splines must align and engage. It may be necessary to rotate the drive shaft yoke end of the MFD shaft

(2), rotate the engine crankshaft dampener (not shown) and to remove the side cover plate and rotate the gear

(3) to align all the shaft splines.

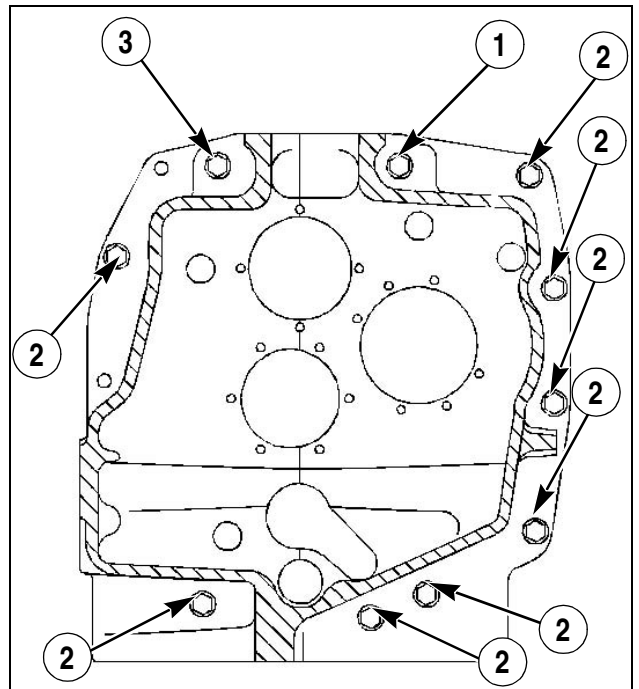
### STEP 12



Rd02C170

Install and partially tighten the 10 bolts.

### STEP 13



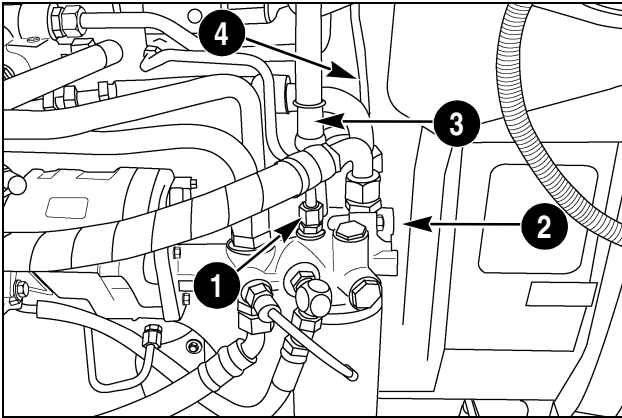
BOLTPAT4

- |         |                                    |
|---------|------------------------------------|
| 1 ..... | 220 to 250 Nm (162 to 184 lb. ft.) |
|         | 80 mm (3.15 in.) long bolt         |
| 2 ..... | 232 to 262 Nm (171 to 193 lb. ft.) |
| 3 ..... | 430 to 486 Nm (317 to 358 lb. ft.) |

Tighten the bolts according to the torque values shown above.

**IMPORTANT:** Failure to properly torque the bolts could lead to failure of the bolts and housings.

## STEP 14



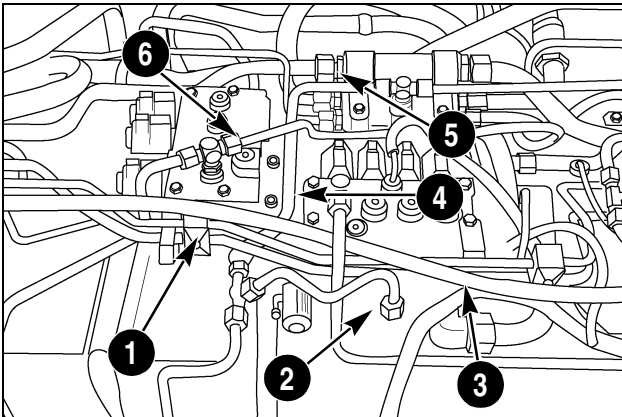
RD02C169

- |                                  |                                 |
|----------------------------------|---------------------------------|
| 1. ODD EVEN VALVE<br>RETURN LINE | 3. OIL COOLER SUPPLY<br>LINE    |
| 2. FILTER TEMP SENDING<br>WIRE   | 4. STEERING RETURN LINE<br>WIRE |

Move the transmission wire harness into position over the speed transmission housing.

Connect filter temperature sender wire to the hydraulic filter head. Connect the hydraulic lines to the filter head.

## STEP 15

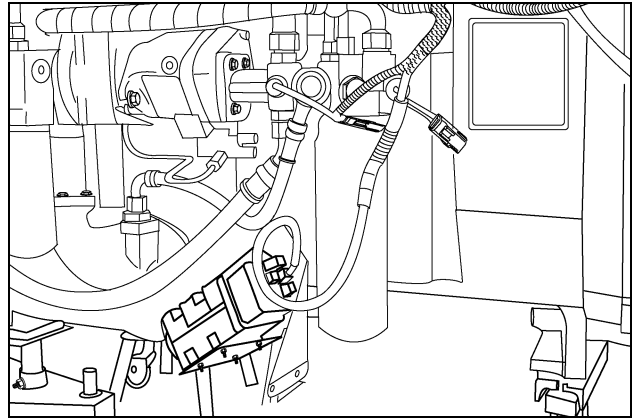


RD02C167

- |   |                                      |
|---|--------------------------------------|
| 1. STEERING SENSING<br>AND SUPPLY LINES | 4. REGULATED PRESSURE<br>SUPPLY LINE |
| 2. REGULATED SUPPLY<br>JUMPER TUBE      | 5. OIL COOLER RETURN<br>LINE         |
| 3. MFD/DIFF LOCK SUPPLY<br>LINE         | 6. PARK LOCK RELEASE<br>SUPPLY LINE  |

Connect these lines on the top of the transmission

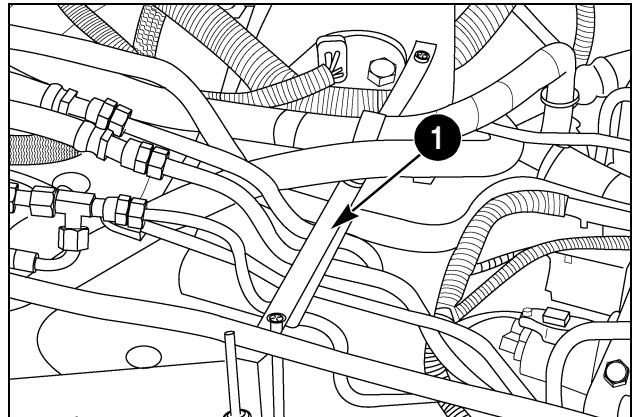
## STEP 16



RD02C168

If equipped, install the true ground speed radar on to the transmission housing and connect to the wire harness.

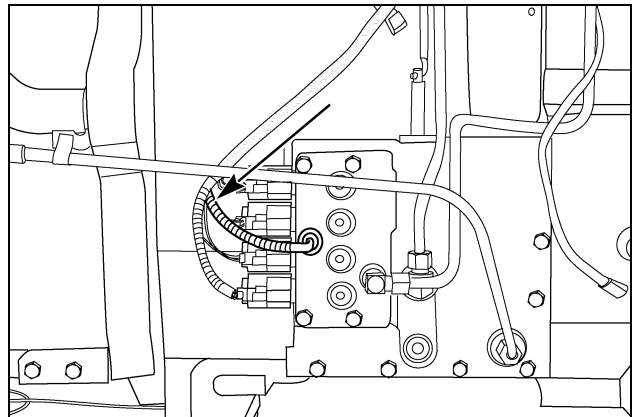
## STEP 17



RD02C166

Connect the removed tagged lines. Position the lines in the retaining bracket and install the clamp bar (1).

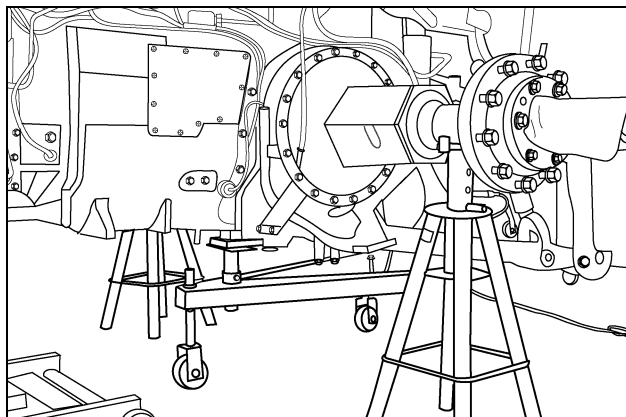
## STEP 18



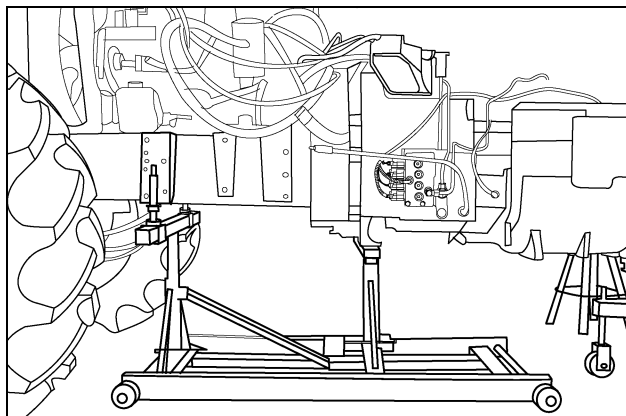
RD02C165

Connect the wire harness to the speed powershift valve solenoids.

### STEP 19



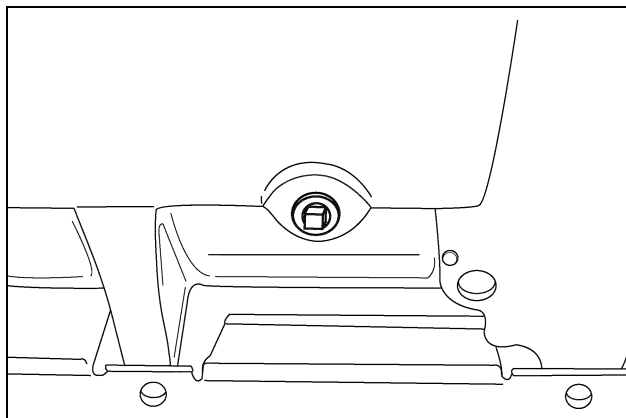
RD02C164



RD02C163

Remove the rear handler and front splitting stand.

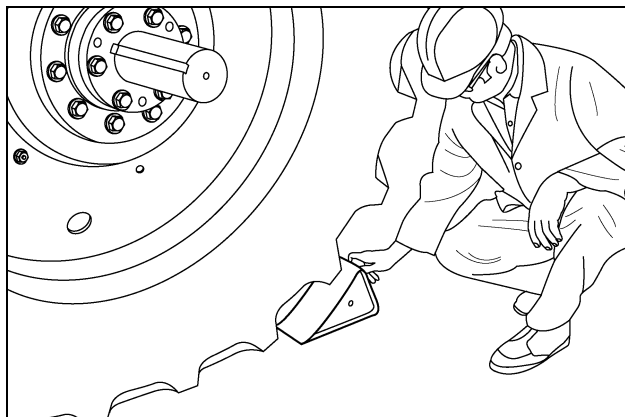
### STEP 20



91S17

Install the plugs for range, speed, and final drive transmission housings.

### STEP 21



96R28A

Complete installation as follows:

1. Install the MFD driveshaft. See MFD Driveshaft information.
2. Install the fuel tanks. See Fuel Tank Removal and Installation information.
3. Install the cab. See Cab Raise/Removal and Installation information.
4. Install the hood. See Hood Removal information.
5. Install transmission fluid.
6. Install transmission fluid.
7. Remove the blocks from the wheels.

### STEP 22

When tractor assembly is complete, run the tractor and check for hydraulic leaks.

Check the fluid level in the transmission and add as required.

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# **Section 21**

## **Chapter 4**

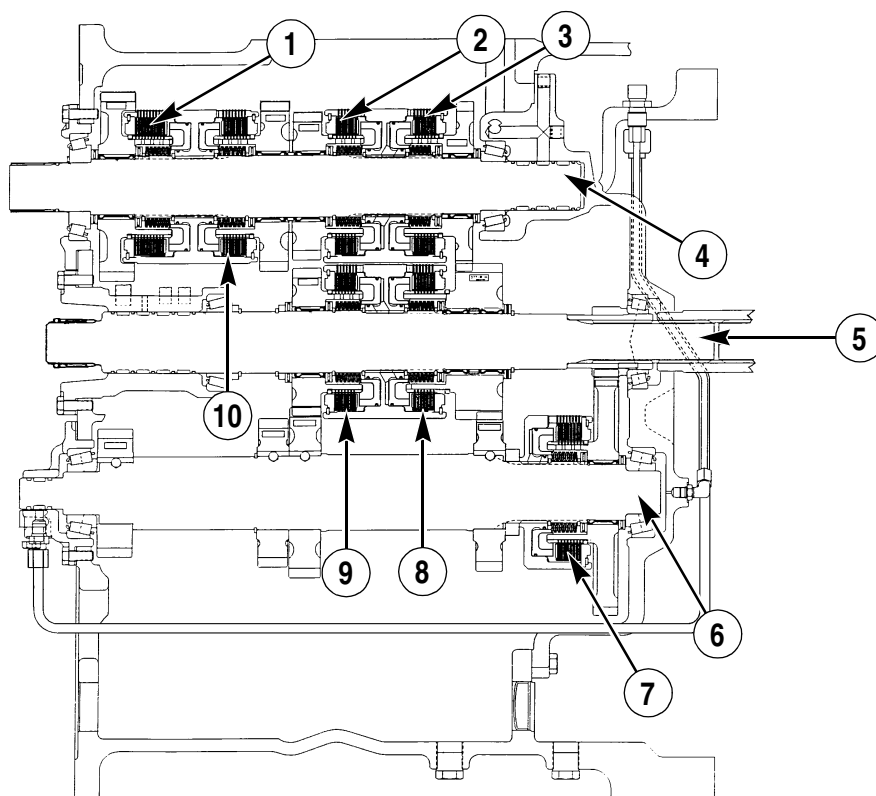
### **SPEED TRANSMISSION**



## TABLE OF CONTENTS

SPECIFICATIONS .....	21-4-4
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ASSEMBLING THE COUNTERSHAFT WITH CREEPER SPEED CLUTCH .....	21-4-14
TRANSMISSION ASSEMBLY WITH CREEP OPTION .....	21-4-78
TRANSMISSION ASSEMBLY WITHOUT CREEP OPTION .....	21-4-80

## PICTORIAL INDEX - SPEED TRANSMISSION



1. 1ST SPEED CLUTCH  
2. 5TH SPEED CLUTCH  
3. REVERSE SPEED CLUTCH

4. OUTPUT SHAFT  
5. INPUT SHAFT  
6. COUNTERSHAFT

7. CREEPER SPEED  
CLUTCH  
8. EVEN SPEED CLUTCH

85L94A

9. ODD SPEED CLUTCH  
10. 3RD SPEED CLUTCH

## SPECIFICATIONS

End Play for Installed Speed Transmission Countershaft,  
 Input Shaft and Output Shaft..... 0.03 to 0.13 mm (0.0012 to 0.0051 inch)  
 Clutch Pack Oil Leakage ..... 0.5 L/min (0.13 gpm) Maximum

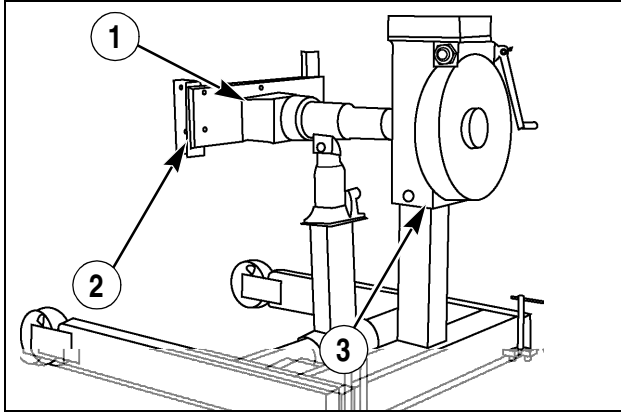
## SPECIAL TORQUES

Mounting Bolts for Front Bearing Support Cover on  
 Speed Transmission Housing ..... 94 to 106 Nm (69 to 78 lb. ft.)  
 Mounting Bolts for Rear Bearing Cages on  
 Speed Transmission Housing ..... 54 to 61 Nm (40 to 45 lb. ft.)  
 Mounting Bolts for Speed Transmission Housing  
 Through Speed Housing Front Flange into Drop Box  
 16 mm (grade 8.8, plain) ..... 234 to 260 Nm (173 to 192 lb. ft.)  
 Through Speed Housing Rear Flange into Range Housing  
 16 mm (grade 10.9, plated) ..... 220 to 250 Nm (162 to 185 lb. ft.)  
 16 mm (grade 8.8, plain) ..... 232 to 262 Nm (171 to 193 lb. ft.)  
 20 mm (grade 10.9, plated) ..... 430 to 486 Nm (317 to 359 lb. ft.)

## TROUBLESHOOTING AFTER SPEED TRANSMISSION REPAIR

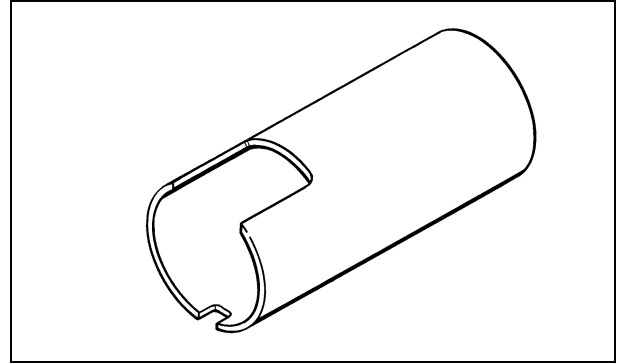
Problem	Probable Cause
Tractor moves in reverse when shifted into 5th, 6th 11th and 12th gear.	The Reverse/5th clutch hub is installed backward on shaft.
Odd gears are even and even gears are odd.	The odd/even clutch pack is installed backward.

## SPECIAL TOOLS



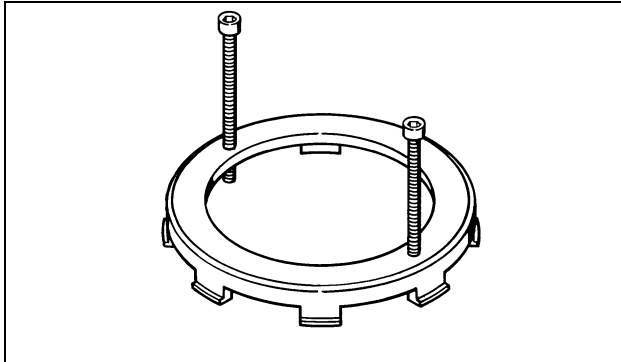
T98826

1. Mounting Plate 17-52-14
2. Mounting Brackets 17-52-16 (set of two)
3. Engine Mounting Stand CAS10431



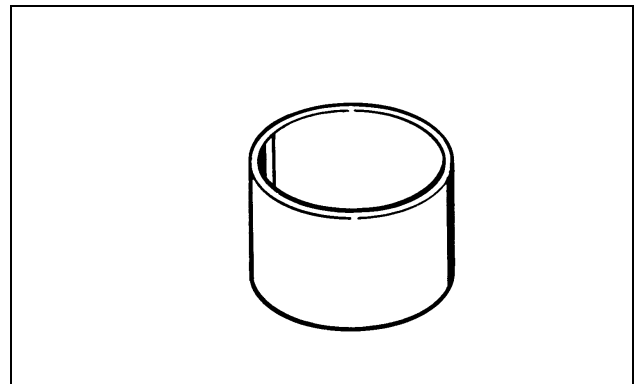
T98826

Compression Sleeve with Notch CAS1903-3  
(first used on Page 10).



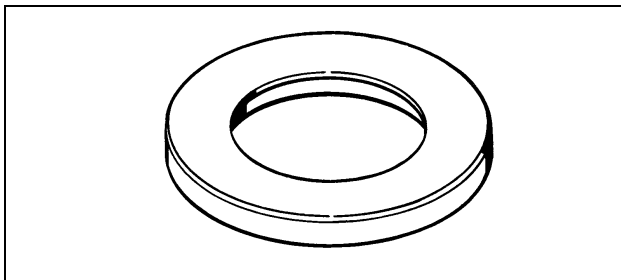
CAS19031

Compression Plate with 6 Tangs and 2 Capscrews  
CAS1903-1 (first used on Page 12).



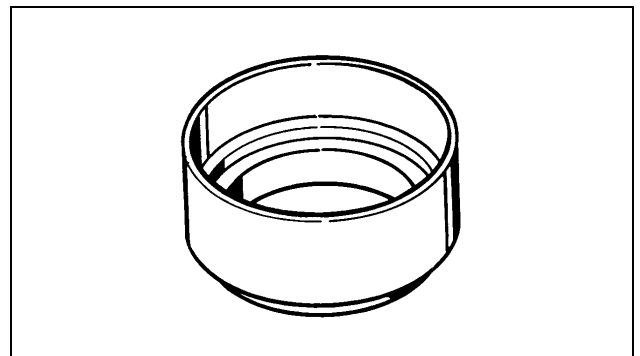
CAS1903-4

Centering Sleeve CAS1903-4 (first used on Page 52).



CAS 1903-2

Compression Plate CAS 1903-2 (first used on Page 12).

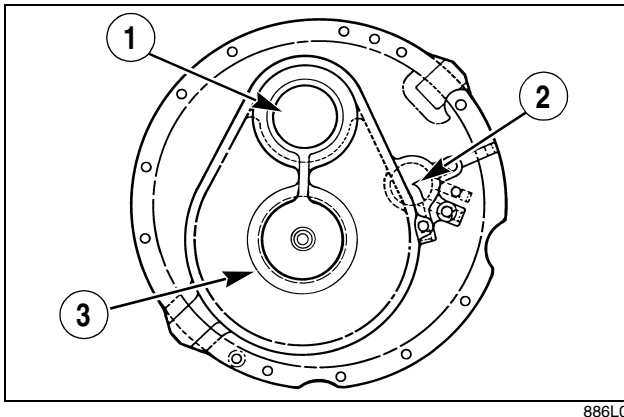


CAS1903-5

Compression Sleeve CAS 1903-5 (first used on Page 37).

## SPEED TRANSMISSION WITH CREEP OPTION

### STEP 1

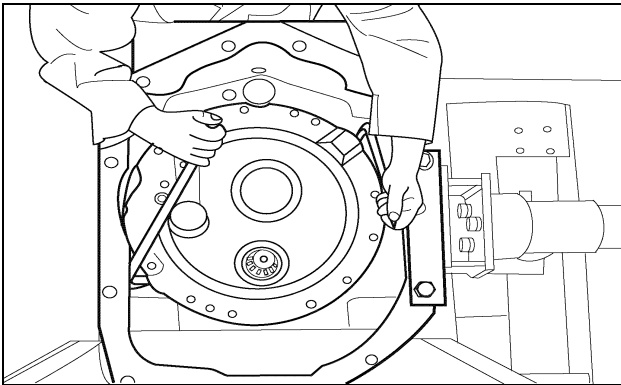


886L0

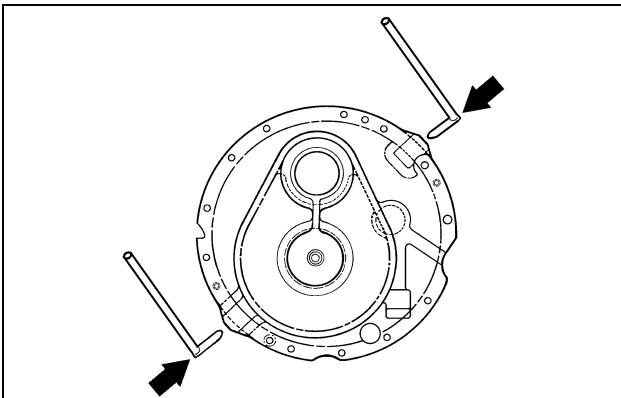
1. INPUT SHAFT
2. OUTPUT SHAFT
3. COUNTERSHAFT

Remove the mounting bolts from the front bearing support cover.

### STEP 2



25-35

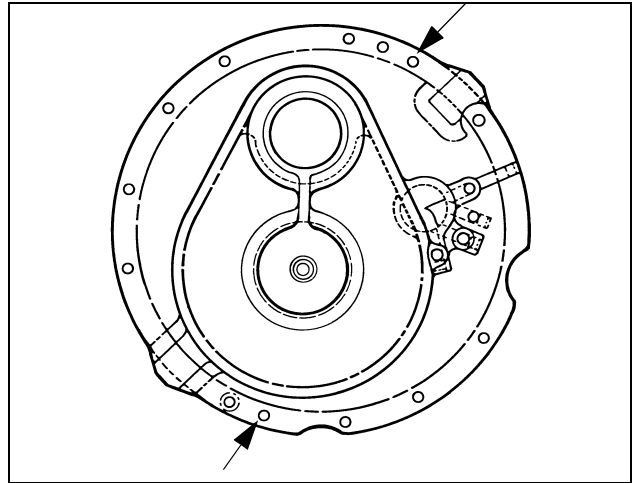


886L0P

Use prybars under the two lift areas in the front bearing support cover and loosen the cover.

**NOTE:** Cover is shown without creep option. Prybars must be in same lift areas for covers with or without creep option.

### STEP 3

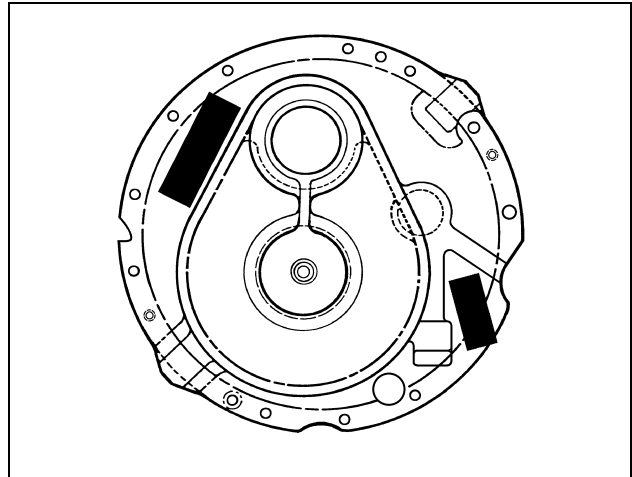


886L0

Remove any remaining seal material from the bolt hole threads. Install two bolts in the bearing support cover at the 1 and 7 o'clock position (front view shown). Tighten bolts only finger-tight.

**NOTE:** Use Steps 4 through 6 for transmission equipped with the creep option. Use Steps 8 through 11 for transmissions without the creep option.

### STEP 4



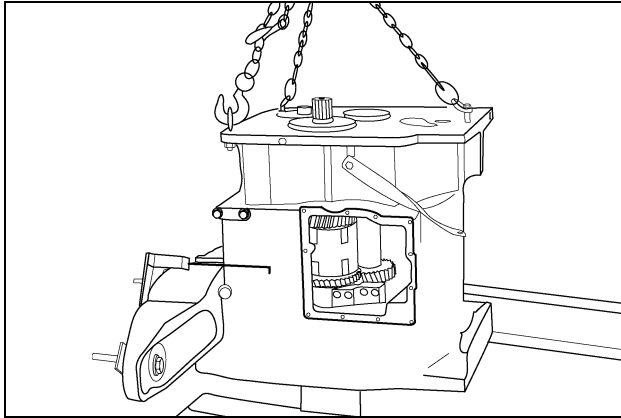
51L91

Make support blocks as follows:

1. Use suitable material to make two support blocks that will hold at least 400 lb (181 kg).
2. One block must be 14 inch H x 10 inch L x 2-3/4 inch W.
3. The other block must be 14 inch H x 4-1/2 inch L x 2-1/4 W.

## Countershaft, Input Shaft, And Output Shaft Removal For Transmissions With Creep Option

### STEP 5



18-8

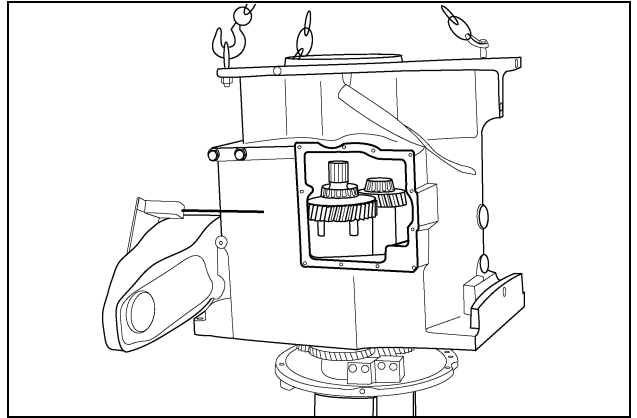
Remove housing as follows:

1. Connect a chain to the rear of the speed housing (shown with cab mounting bracket attached).
2. Use a suitable hoist to remove the housing from the engine stand.
3. Raise the housing up enough to put the support blocks in position under the bearing support cover as shown above.
4. Slowly lower the transmission housing until the bearing support cover is fully seated on the support blocks.

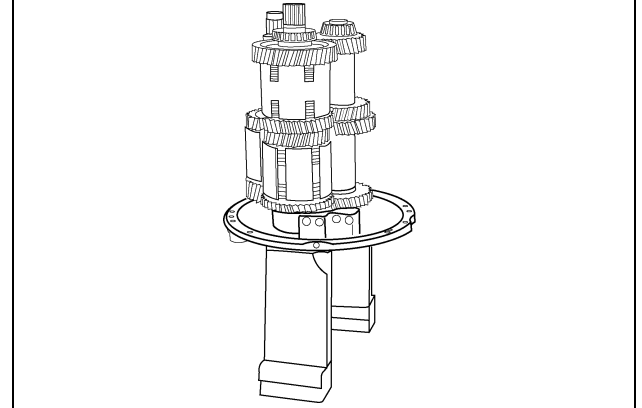
**NOTE:** *Be sure the blocks are in the correct position on the support cover.*

5. Reach under the housing and remove the two remaining support cover retaining bolts that were tightened only finger tight.

### STEP 6



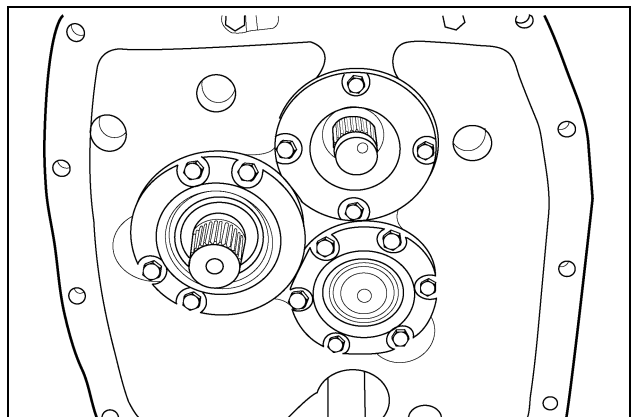
18-11



18-14

Slowly raise the transmission housing leaving the bearing support cover and three shaft assemblies on the support blocks.

### STEP 7



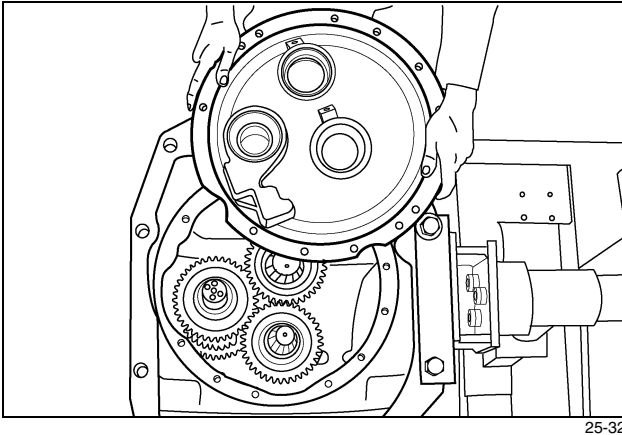
18-2

Remove the mounting bolts from the three bearing cages. Remove the bearing cages and shims.

**NOTE:** *Keep the shims together with the bearing cage as the cages are removed.*

## Countershaft, Input Shaft, and Output Shaft Removal for Transmissions without Creep

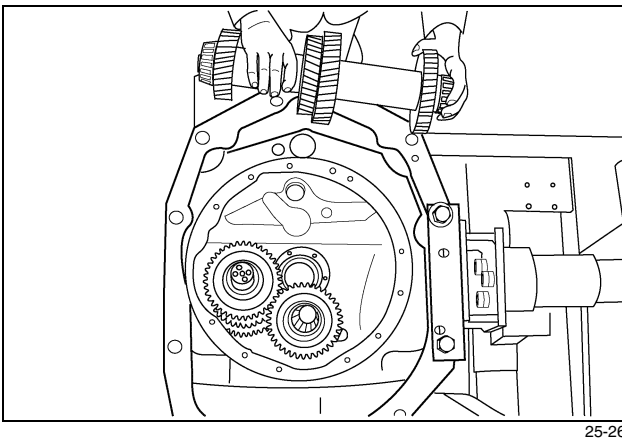
### STEP 8



Remove transmission housing cover as follows:

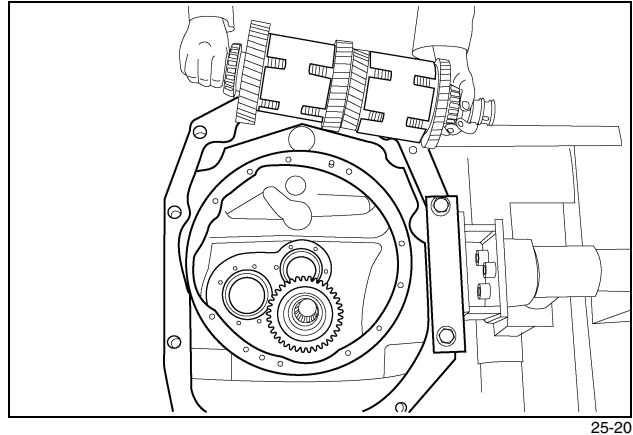
1. With the transmission housing on the engine stand, turn the housing so the cover is in the upright position.
2. Remove the mounting bolts from the front bearing support.
3. Loosen and raise the transmission housing cover using prybars under the two lift areas.

### STEP 9



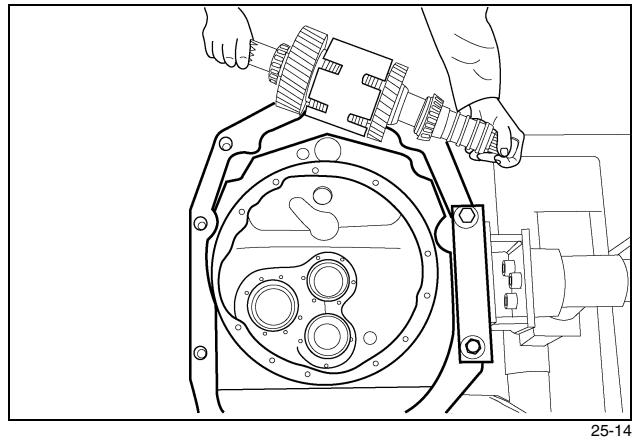
Place strap around input shaft. Raise input shaft and remove countershaft.

### STEP 10



Remove output shaft.

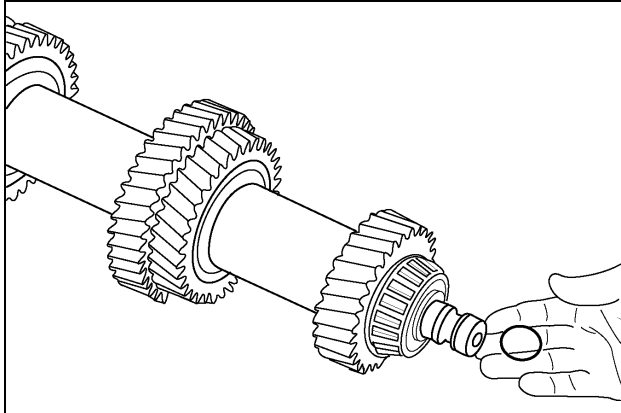
### STEP 11



Remove input shaft.

## Disassembling the Countershaft with Creeper Speed Clutch

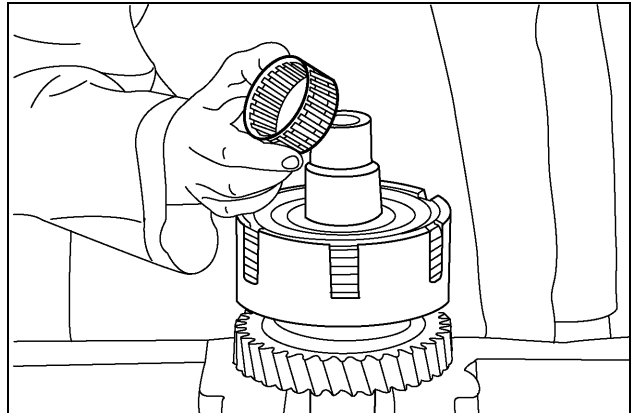
### STEP 12



T95237

Remove the two seal rings from the shaft.

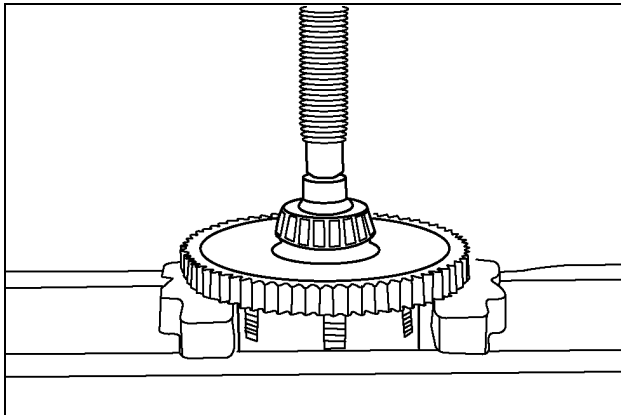
### STEP 14



T95239

Remove the caged needle bearing.

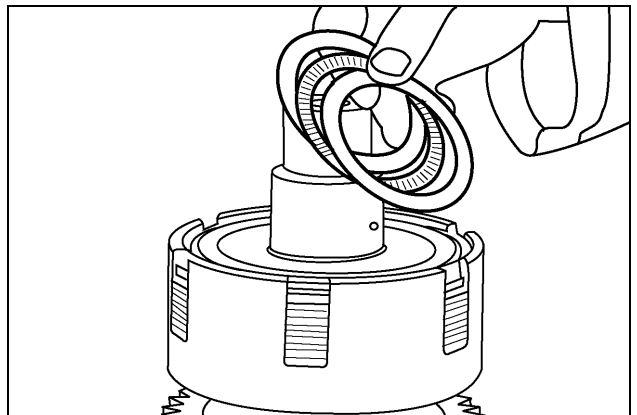
### STEP 13



T95238

Use a hydraulic press to remove the front bearing cone and the creeper driven gear.

### STEP 15



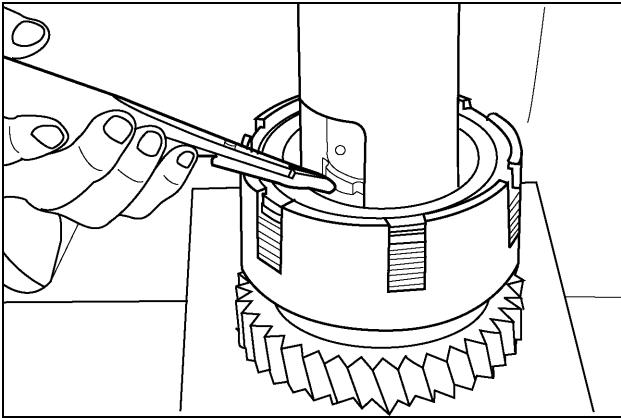
A11511

Remove the rear needle thrust bearing and the two bearing thrust washers.

**NOTE:** The front needle thrust bearing and two bearing thrust washers will come off with the front bearing cone.



## STEP 16



A11501

Remove snap ring as follows:

1. Install the compression sleeve CAS1903-3 with the notch over the piston return Belleville washers (see the Special Tools page in this section).
2. The opening in the special tool must be over the ends of the snap ring.
3. Compress the Belleville washers with a hydraulic press and remove the snap ring.

**NOTE:** See Steps 27 through 30 for an alternative method for removing the snap ring.

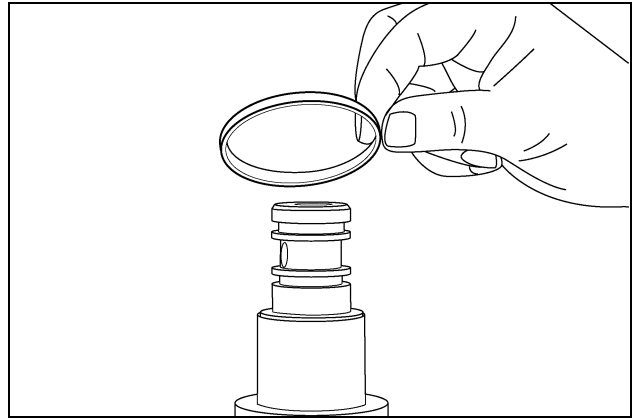
## STEP 17



RD05M015

Remove eight Belleville washers. Note the orientation of the washers for later installation.

## STEP 18



RD05M014

Remove the lube management ring.

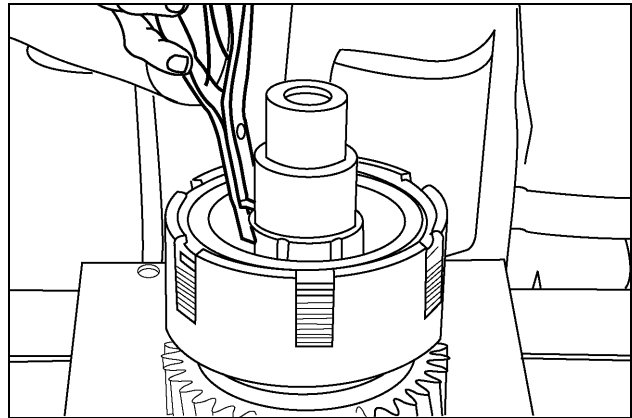
## STEP 19



RD05M013

Remove the last Belleville washer. Note orientation for later installation.

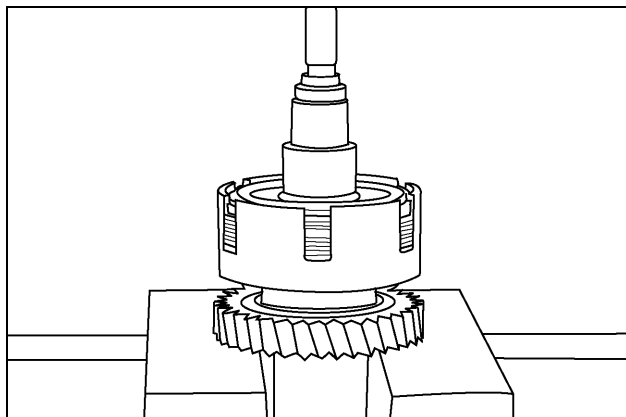
## STEP 20



A11503

Remove the snap ring.

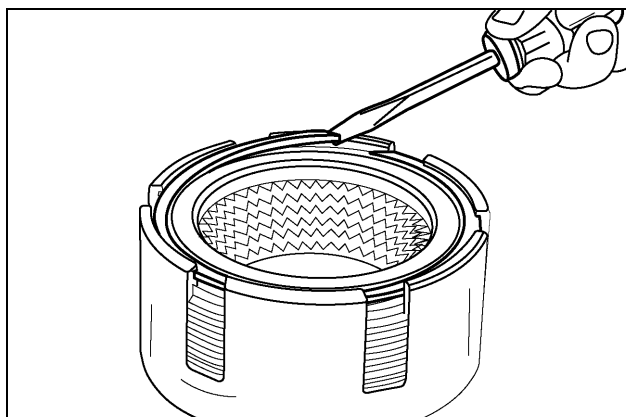
### STEP 21



A11515

Use a hydraulic press to move the shaft through the clutch plate carrier, spacer and the (2nd-4th-6th) speed driven gear.

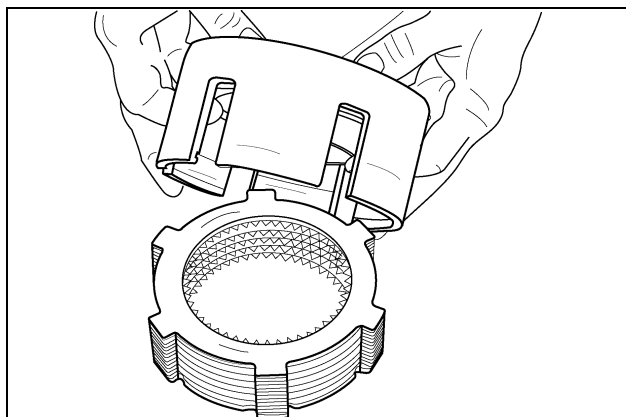
### STEP 22



A10871

Remove the snap ring from inside the clutch plate carrier.

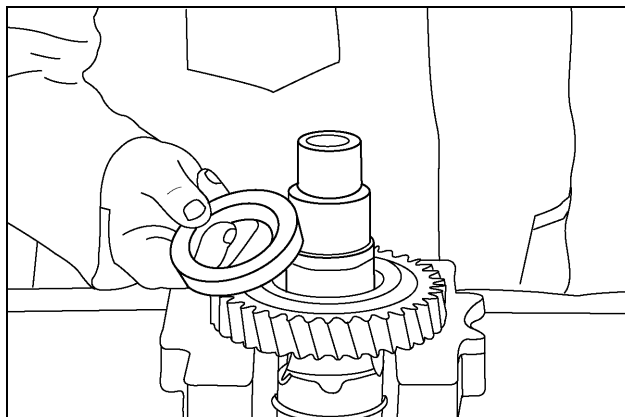
### STEP 23



40-33

Remove the backing plate, friction plates, separator plates and reaction plate (thicker than separator plate) from the clutch carrier.

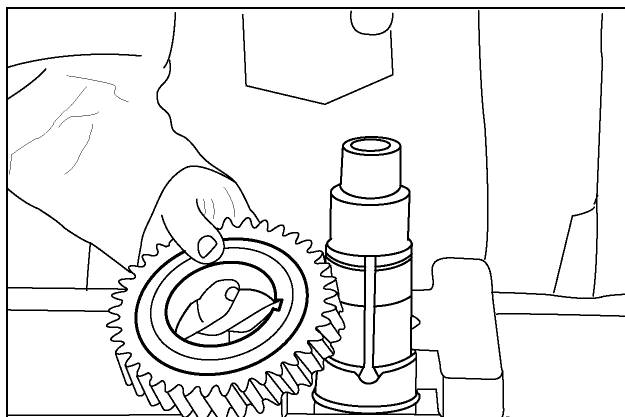
### STEP 24



T95251

Remove the spacer.

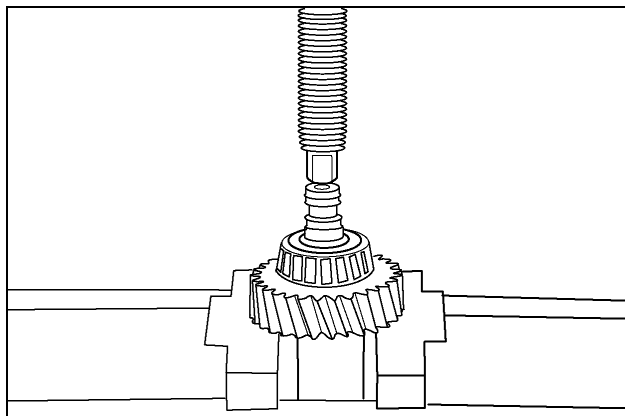
### STEP 25



T95252

Remove the (2nd-4th-6th) speed driven gear and steel ball.

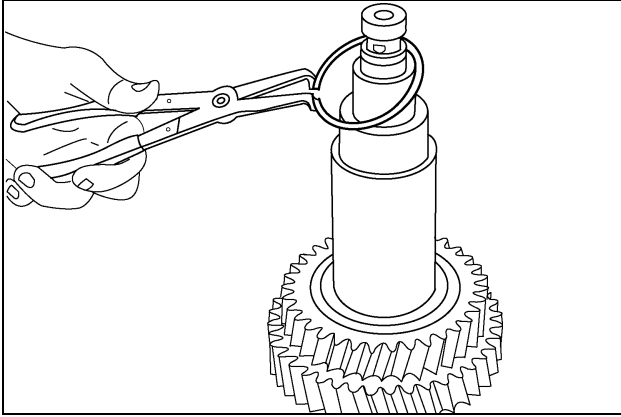
### STEP 26



T95256

Turn the shaft over and use a hydraulic press to remove the rear bearing cone (1st-2nd) speed driver gear and steel ball.

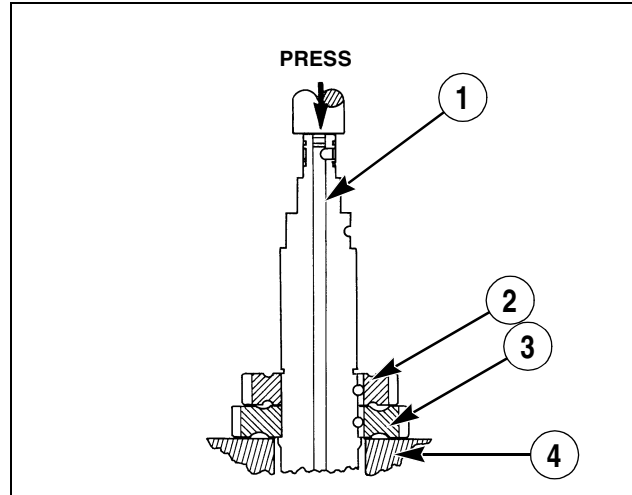
### STEP 27



T95267

Remove the snap ring.

### STEP 28



DBR01

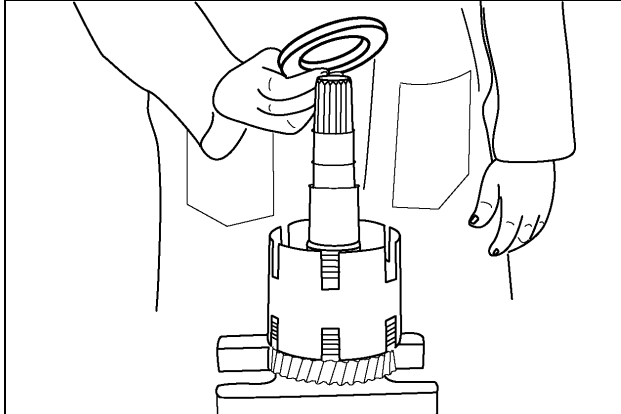
- |                        |                            |
|------------------------|----------------------------|
| 1. COUNTERSHAFT        | 3. 1ST-3RD-5TH DRIVEN GEAR |
| 2. 3RD-4TH DRIVER GEAR | 4. SUPPORT                 |

Turn the shaft over and use a hydraulic press to remove the (3rd-4th) speed driver gear and the (1st-3rd-5th) speed driven gear. Remove the two steel balls.

## Alternative Method for Snap Ring Removal

**NOTE:** This method can be used on any clutch carrier. The large snap ring, backing plate, friction plates, separator plates and reaction plate must be removed first.

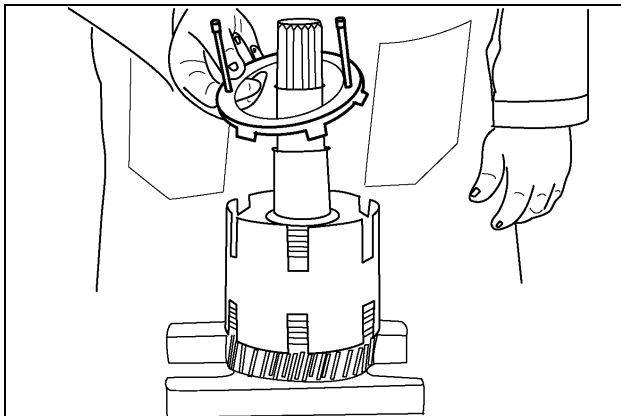
### STEP 29



T95545

Install the compression plate (CAS 1903-2) over the piston return Belleville washers. The counterbore of the plate must go over the Belleville washers.

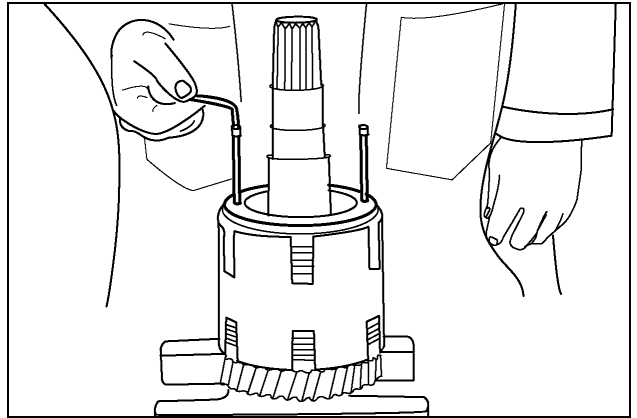
### STEP 30



T95546

Install the compression plate (CAS 1903-1) with the two cap screws and six tangs inside the clutch carrier. The tangs on the plate must engage the snap ring groove inside the carrier.

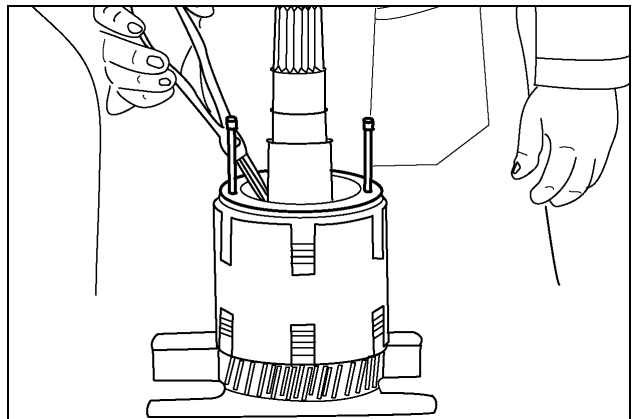
### STEP 31



T95547

Compress the Belleville washers by tightening the cap screws in the tool.

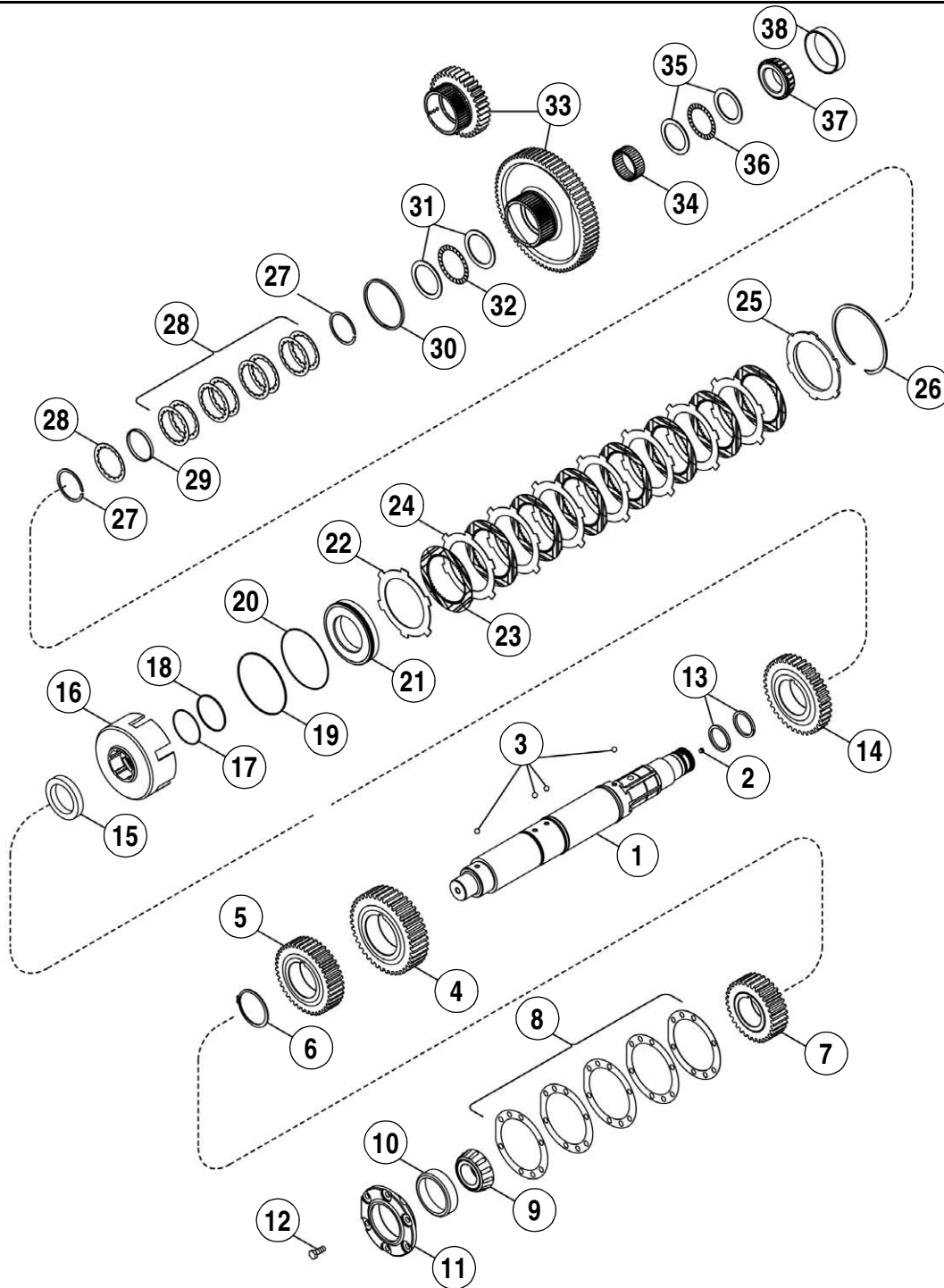
### STEP 32



T95548

Remove the snap ring.

## ASSEMBLING THE COUNTERSHAFT WITH CREEPER SPEED CLUTCH

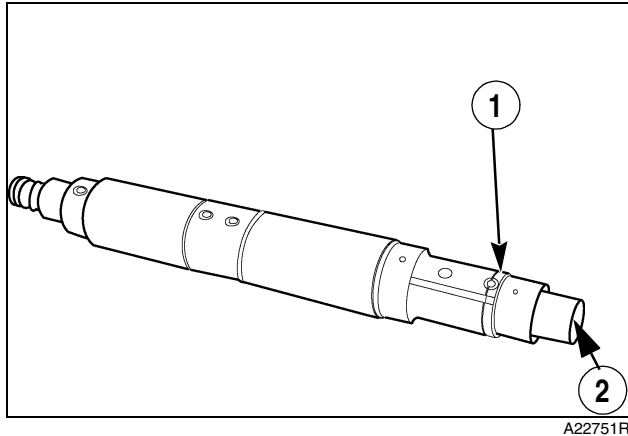


RI05M091M

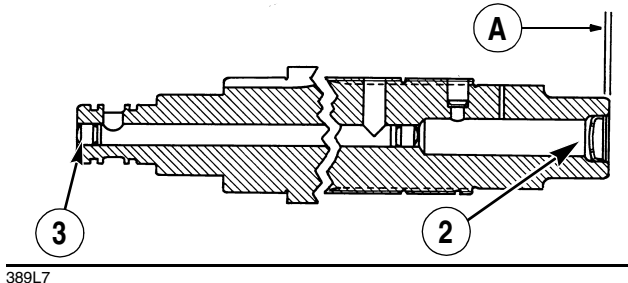
- |                           |                            |                       |                    |
|---------------------------|----------------------------|-----------------------|--------------------|
| 1. SHAFT                  | 11. CAGE                   | 21. PISTON            | 31. THRUST WASHER  |
| 2. PLUG                   | 12. BOLT M10 X 25          | 22. SEPERATOR DISC    | 32. THRUST BEARING |
| 3. STEEL BALL             | 13. SEAL RING              | 23. FRICTION DESC     | 33. GEAR           |
| 4. PINION GEAR DRIVEN 39T | 14. PINION GEAR DRIVEN 37T | 24. SEPERATOR DISC    | 34. NEEDLE BEARING |
| 5. PINION GEAR DRIVE 34TP | 15. SPACER                 | 25. CLUTCH DISC       | 35. THRUST WASHER  |
| 6. SNAP RING              | 16. CARRIER                | 26. SNAP RING         | 36. THRUST BEARING |
| 7. PINION GEAR DRIVE 29T  | 17. SEAL RING              | 27. CIRCLIP           | 37. BEARING        |
| 8. SHIM                   | 18. O-RING                 | 28. BELLEVILLE SPRING | 38. BEARING CONE   |
| 9. BEARING                | 19. SEAL RING              | 29. LUBE RING         |                    |
| 10. BEARING CONE          | 20. O-RING                 | 30. SEAL RING         |                    |

**NOTE:** If any clutch pack is disassembled, new friction plates must be installed.

### STEP 33



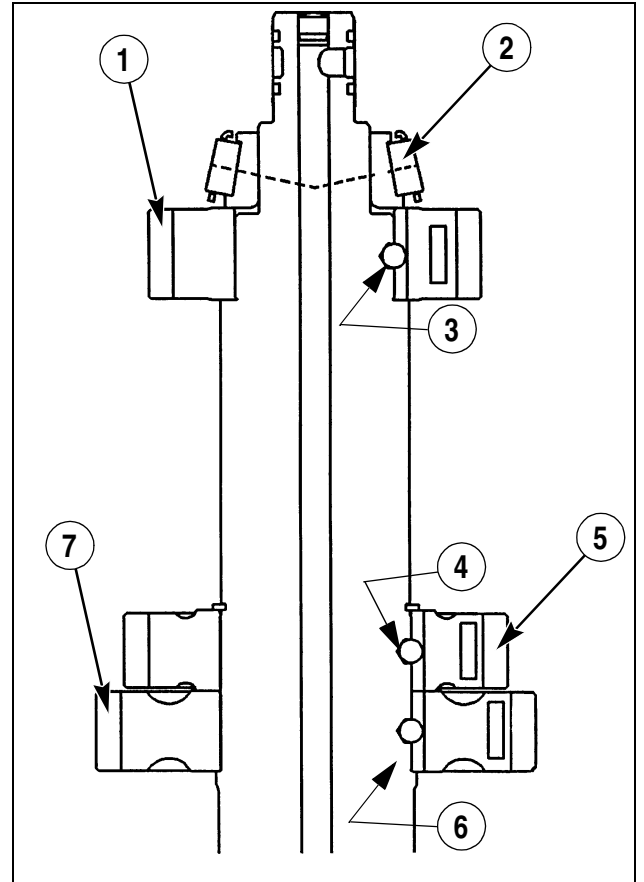
#### DIMENSION



Install countershaft components as follows:

1. Install the plug (2) and press in place as shown; 3 mm (0.118 in.) (A) beyond the face of the shaft.
2. Install the dowel pin (3) and press in flush as shown.

### STEP 34



- |                       |                            |
|-----------------------|----------------------------|
| 1. 1ST-2ND DRIVERGEAR | 5. 3RD-4TH DRIVER GEAR     |
| 2. REAR BEARING CONE  | 6. 1ST STEEL BALL          |
| 3. 3RD STEEL BALL     | 7. 1ST-3RD-5TH DRIVEN GEAR |
| 4. 2ND STEEL BALL     |                            |

Install steel balls as follows:

1. Apply petroleum jelly to the first steel ball (6) and install ball into hole in shaft for (1st-3rd-5th) driven gear (7).
2. Heat the (1st-3rd-5th) speed driven gear in a bearing oven for 3 to 4 hours at a temperature of 350 to 370° F (177 to 187° C).



**WARNING:** Always wear heat protective gloves to prevent burning your hands when handling heated parts.

SM121A

**NOTE:** Do not heat the gear beyond a temperature of 375° F (190° C).

3. Install the gear over the shaft, engaging the ball and seat against the shaft shoulder.
4. Apply petroleum jelly to the second steel ball (4) and install into the shaft hole for (3rd-4th) speed driver gear.

5. Heat the (3rd-4th) speed drive gear (5) in a bearing oven for 3 to 4 hours at a temperature of 350 to 370° F (177-187° C).

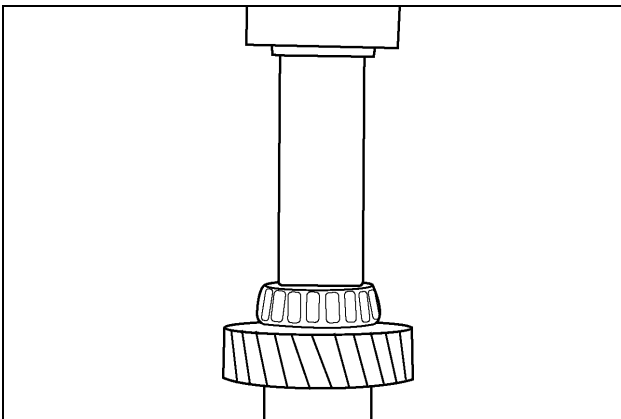
**NOTE:** Do not heat the gear beyond a temperature of 375° F (190° C).

6. Install the gear (5) over the shaft, engaging the ball and seat against the (1st-3rd-5th) speed driven gear.
7. Install the snap ring. The flat side of the snap ring must face away from the gear.
8. Apply petroleum jelly to the third steel ball (3) and install into the shaft hole for (1st-2nd) speed driver gear.
9. Heat the (1st-2nd) speed driver gear (1) in a bearing oven for 3 to 4 hours at a temperature of 350 to 370° F (177 to 187° C).

**NOTE:** Do not heat the gear beyond a temperature of 375° F (190° C).

10. Install the gear (1) over the shaft, engaging the ball and seat against the shaft shoulder.

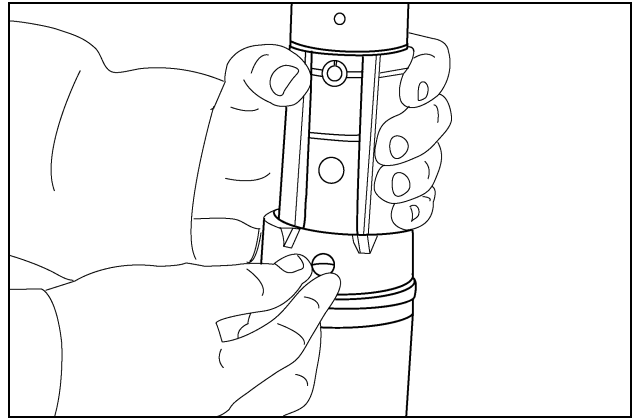
### STEP 35



A11504

Install the bearing cone over the shaft with the larger OD end of the bearing seated against the gear. Press the bearing on the inner race to properly seat the bearing on the shaft.

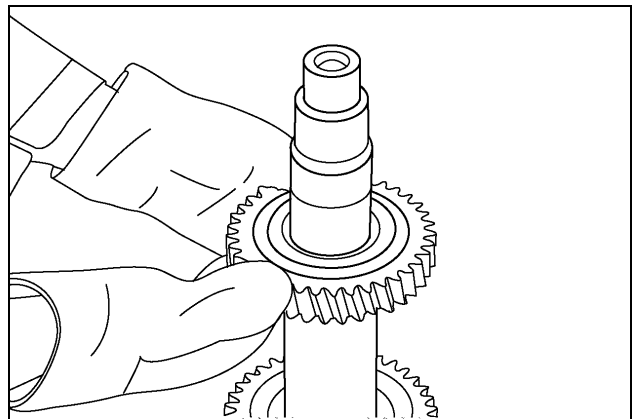
### STEP 36



A22753

Apply petroleum jelly to the steel ball and install in the shaft hole.

### STEP 37



T95275

Heat the (2nd-4th-6th) speed driven gear in a bearing oven for 3 to 4 hours at a temperature of 350° to 370°F (177° to 187°C).

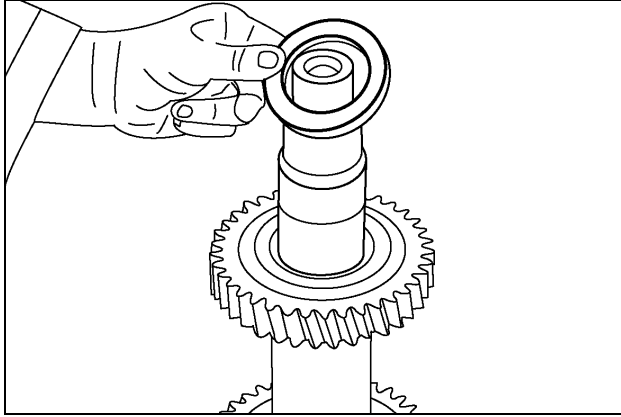
**NOTE:** Do not heat the gear beyond a temperature of 375°F (190°C).



**WARNING:** Always wear heat protective gloves to prevent burning your hands when handling heated parts.

SM121A

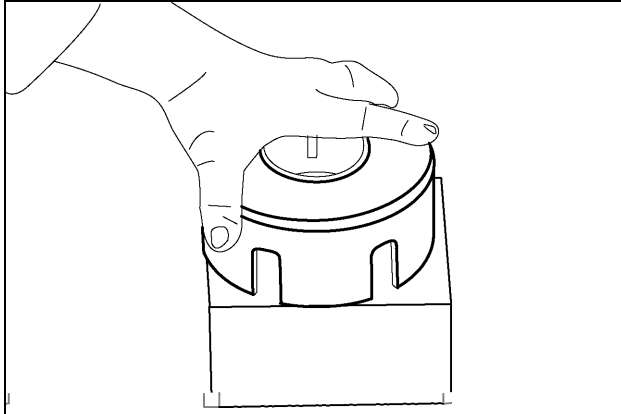
### STEP 38



T95276A

Install the spacer.

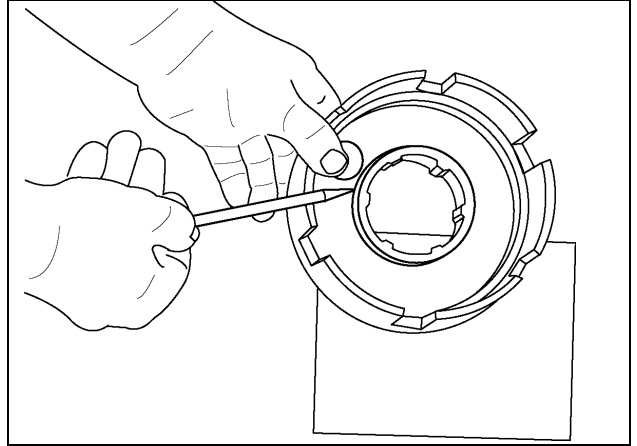
### STEP 39



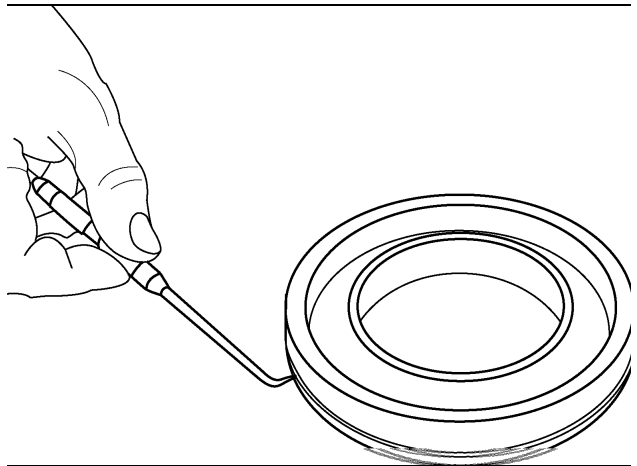
T95277

Hit the clutch plate carrier against a wood block to remove the clutch piston.

### STEP 40



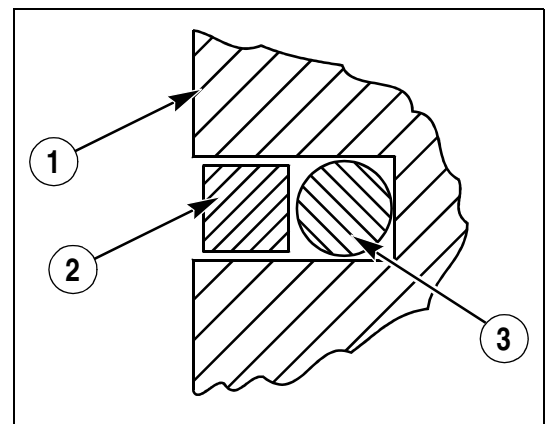
T95278



40-35

Remove and replace teflon ring and O-ring as follows:

1. Replace the teflon ring and the O-ring on the carrier and piston.
2. Install the O-ring in the groove. Install the teflon ring over the O-ring as shown below.

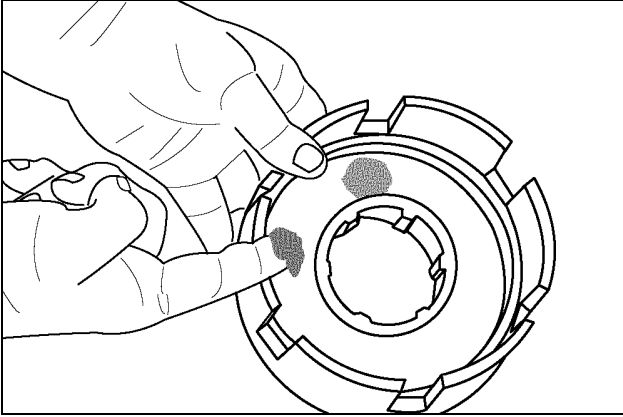


detail\_b

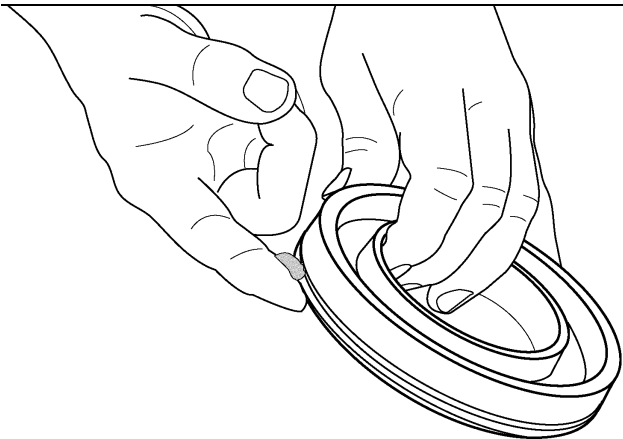
1. PISTON
2. TEFLON RING
3. O-RING



### STEP 41



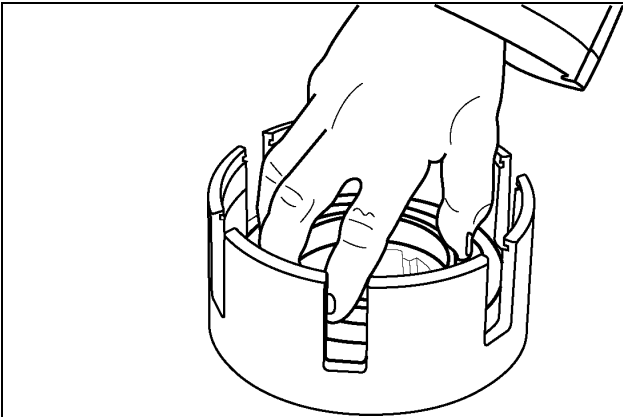
T95280



41-3

Apply petroleum jelly to the teflon rings.

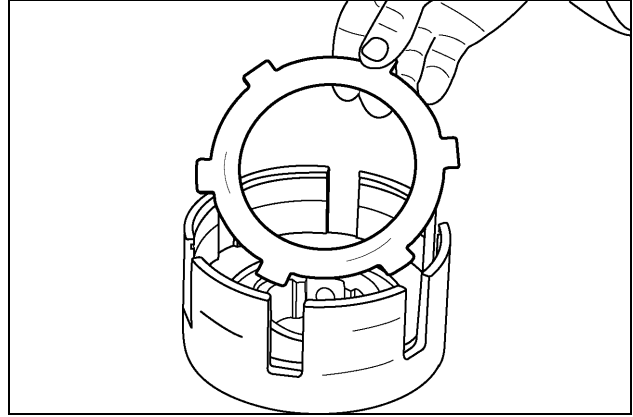
### STEP 42



A10873

Install the clutch piston into the carrier with the flat side of the piston facing down. Push the piston into the carrier by hand.

### STEP 43

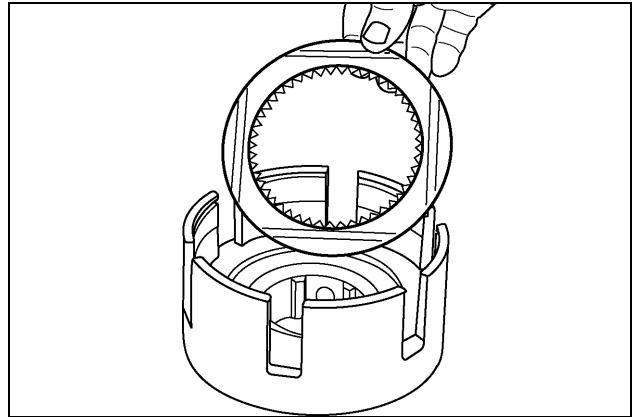


A10875

Install the reaction plate (thicker than separator plate).

**NOTE:** The reaction plate is similar to a separator plate except that it is thicker.

### STEP 44

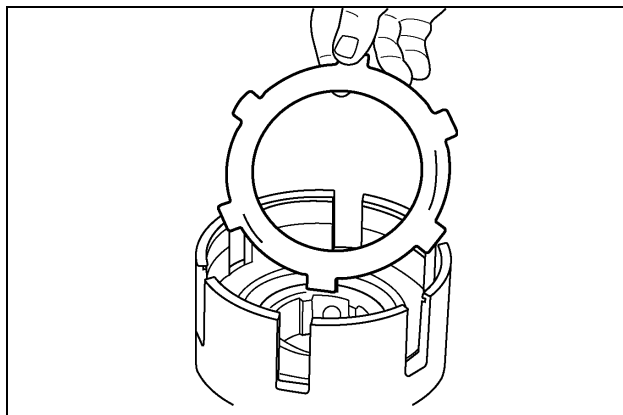


A10876

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

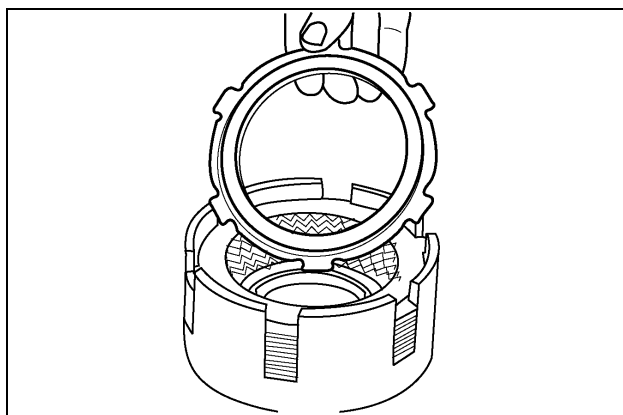
### STEP 45



A10877

Install a separator plate. Install the remaining seven new friction plates and six separator plates, alternating the plates.

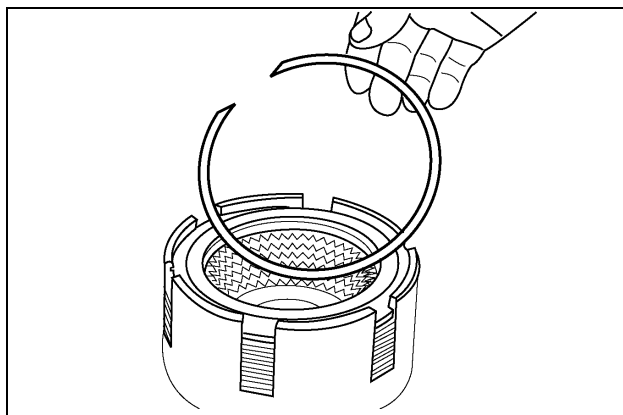
### STEP 46



A10878

Install the backing plate. The flat side of the plate must be facing down.

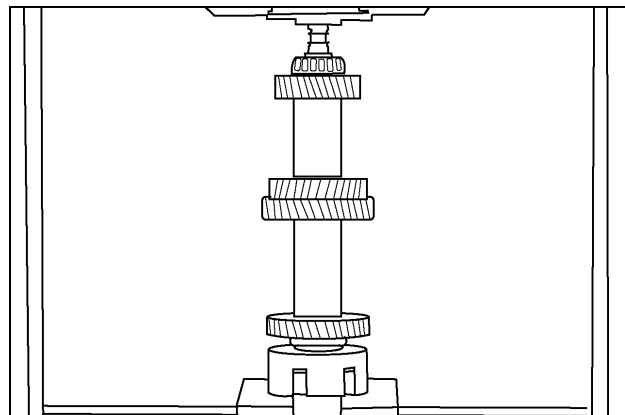
### STEP 47



A10879

Install the snap ring.

### STEP 48

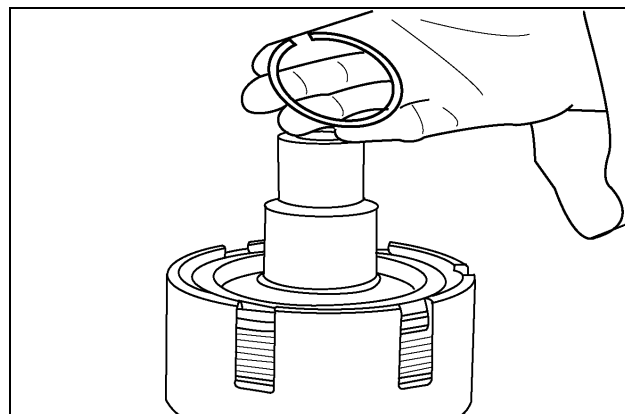


AA11505

Put the carrier assembly in a press. Align the oil hole in the carrier with the oil gallery hole in the shaft. Press the shaft into the carrier until fully seated.

**NOTE:** Be sure the oil holes in the shaft and carrier are aligned before proceeding.

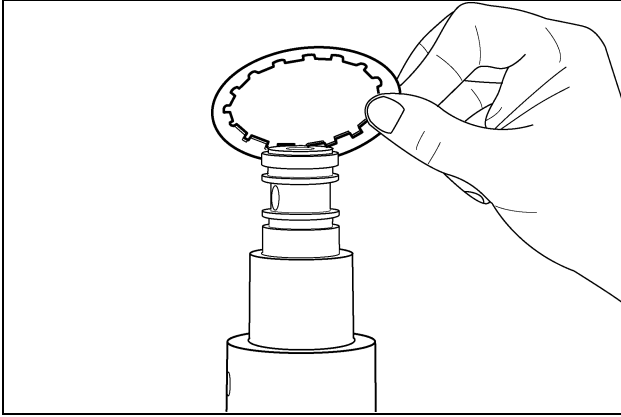
### STEP 49



A11507

Install the carrier retaining snap ring.

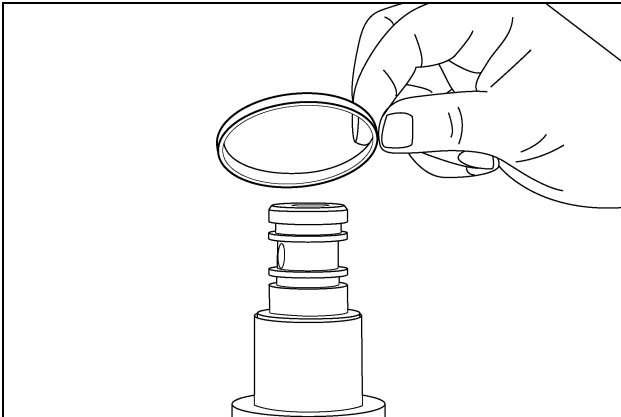
## STEP 50



RD05M013

Install the first piston-return Belleville washer. The concave side of the washer must be facing down.

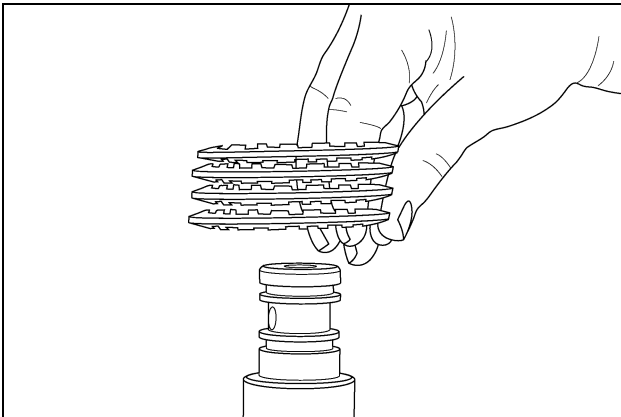
## STEP 51



RD05M014

Install the lube management ring.

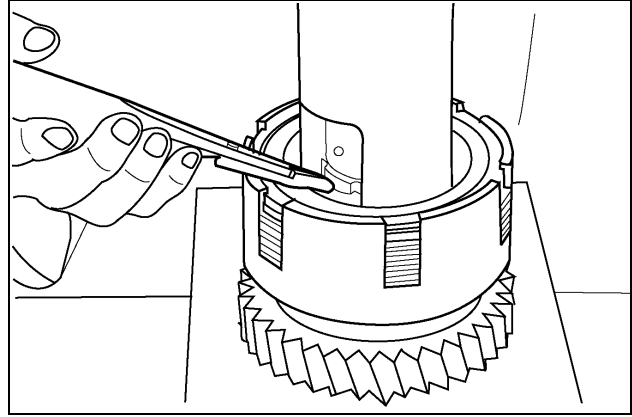
## STEP 52



RD05M015

Install the remaining eight Belleville washers.

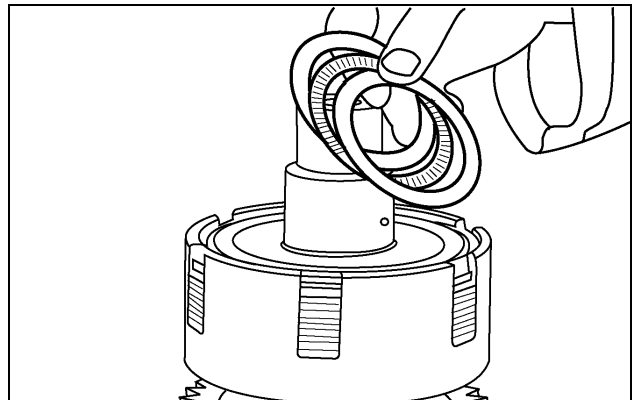
## STEP 53



A11501

1. Install the snap ring on the shaft.
2. Install the compression sleeve CAS1903-3 with the notch over the shaft.
3. Use a hydraulic press to compress the Belleville washers.
4. Install the snap ring in the groove.

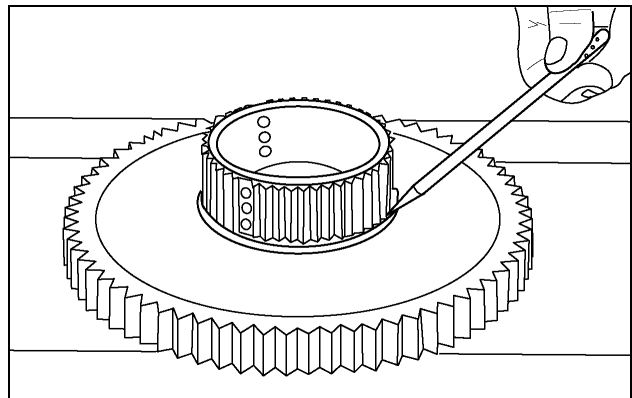
## STEP 54



A11511

Install the needle thrust bearing and the two bearing thrust washers. The needle thrust bearing must be between the two bearing thrust washers.

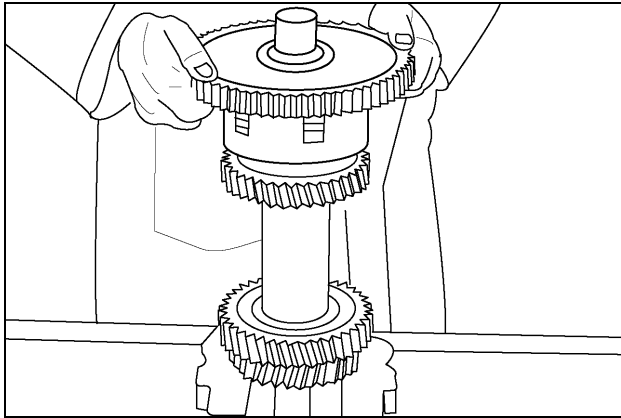
## STEP 55



T95295

Install a new seal ring on the creeper driven gear.

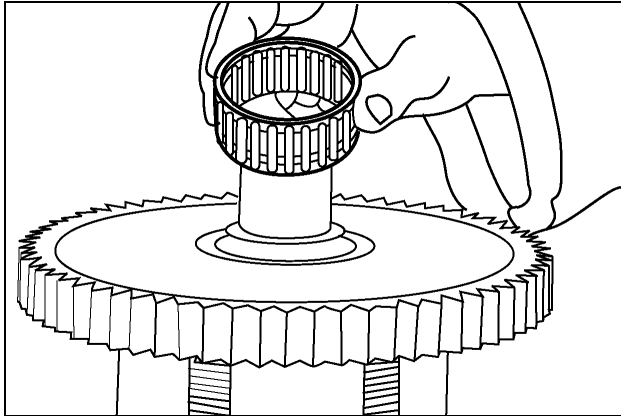
### STEP 56



T95296

Align the friction plate teeth. Install the creeper driven gear into the clutch carrier assembly. Slight oscillation of the gear will help with the installation. The splined hub of the gear must engage all the friction plates.

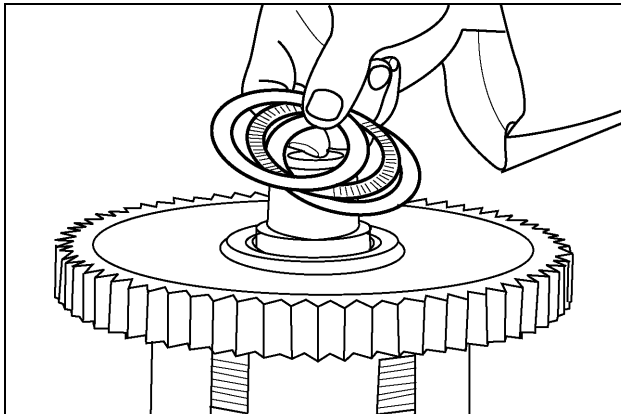
### STEP 57



A11512

Install the caged needle bearing. The top of the needle bearing cage will be aligned with the top of the gear hub when all the friction plates are engaged on the hub.

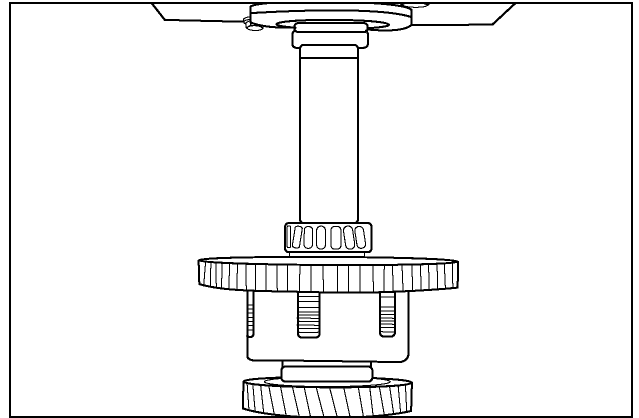
### STEP 58



A11513

Install the needle thrust bearing and the two bearing thrust washers. The needle thrust bearing must be between the two bearing thrust washers.

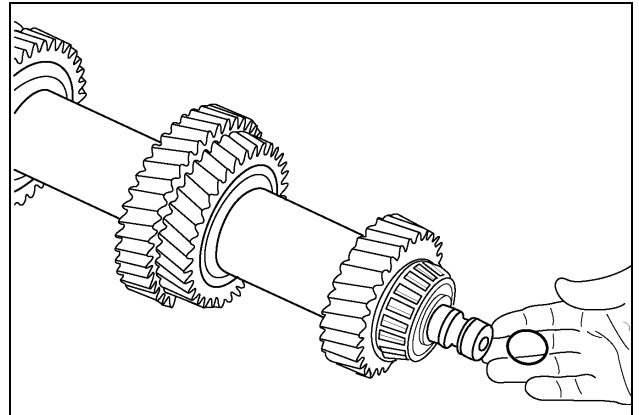
### STEP 59



A11514

Install the bearing cone with the larger OD bearing end facing down. Press the bearing on the inner race to properly seat the bearing on the shaft.

### STEP 60



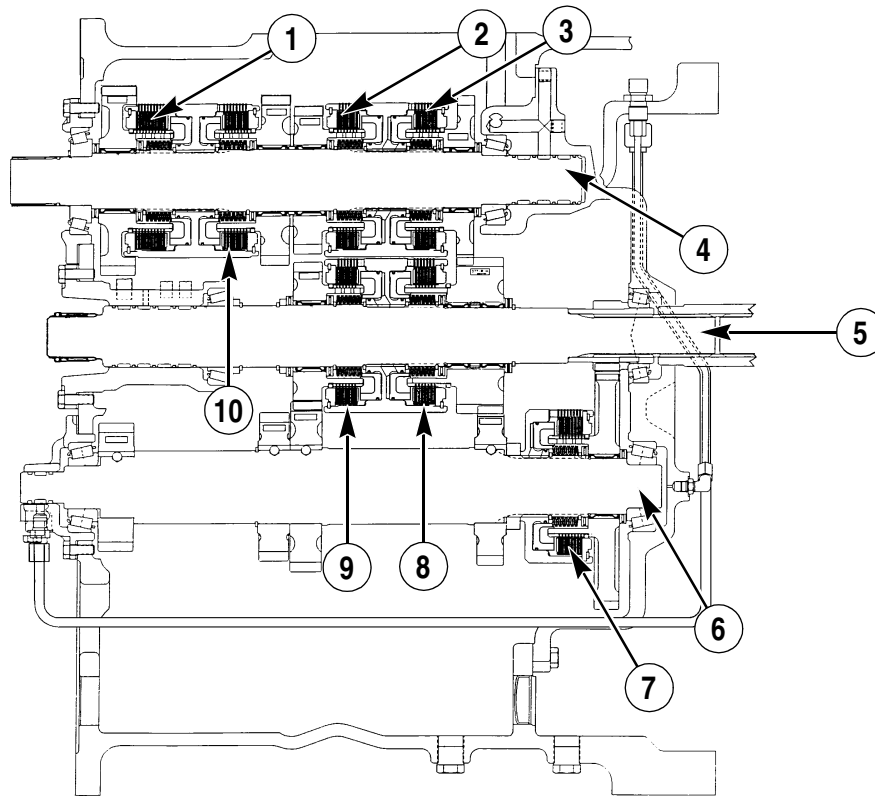
T95237

Install two new seal rings on the rear of the shaft.

### STEP 61

Disassemble and assemble the countershaft using the illustrations provided. For disassembly, follow Steps 23 to 26. For assembly, follow Steps 32 to 36.

## Countershaft with Creep



- 1. 1ST SPEED CLUTCH
- 2. 5TH SPEED CLUTCH
- 3. REVERSE SPEED CLUTCH

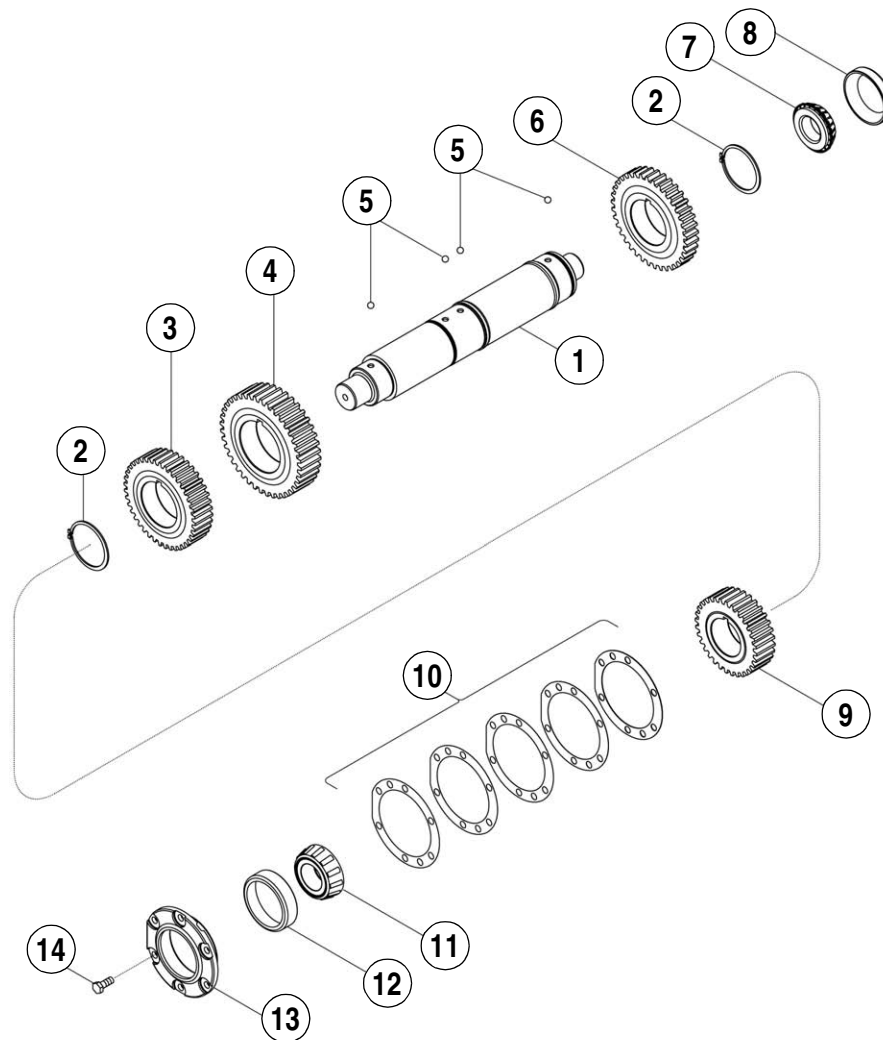
- 4. OUTPUT SHAFT
- 5. INPUT SHAFT
- 6. COUNTERSHAFT

- 7. CREEPER SPEED CLUTCH
- 8. EVEN SPEED CLUTCH

- 9. ODD SPEED CLUTCH
- 10. 3RD SPEED CLUTCH

85L94A

## Disassembly and Assembly of Countershaft without Creep



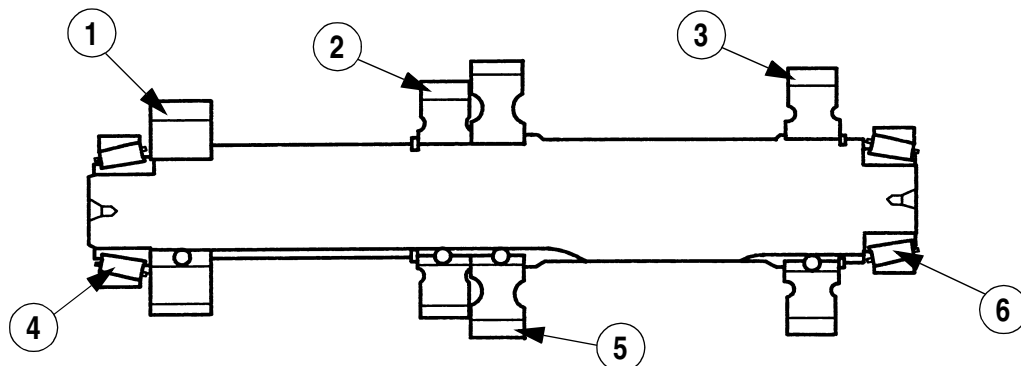
- 1. SHAFT
- 2. SNAP RING
- 3. PINION DRIVE GEAR 34T
- 4. PINION DRIVEN GR 37T

- 5. STEEL BALL
- 6. PINION DRIVEN GR. 37T
- 7. BEARING
- 8. BEARING CONE

- 9. PINION DRIVE GEAR 29T
- 10. SHIM
- 11. BEARING
- 12. BEARING CONE

- 13. CAGE
- 14. BOLT M10 X 25

RD05N030M



- 1. 1ST-2ND SPEED DRIVER GEAR
- 2. 3RD-4TH SPEED DRIVER GEAR

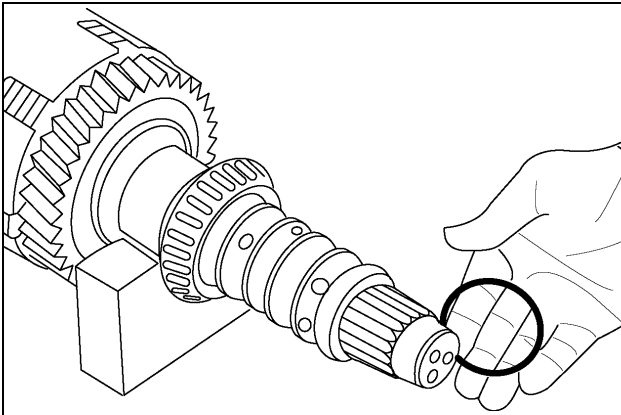
- 3. 2ND-4TH-6TH SPEED DRIVEN GEAR
- 4. REAR BEARING CONE

- 5. 1ST-3RD-5TH SPEED DRIVEN GEAR
- 6. FRONT BEARING CONE

87L94

## Disassembling the Speed Input Shaft

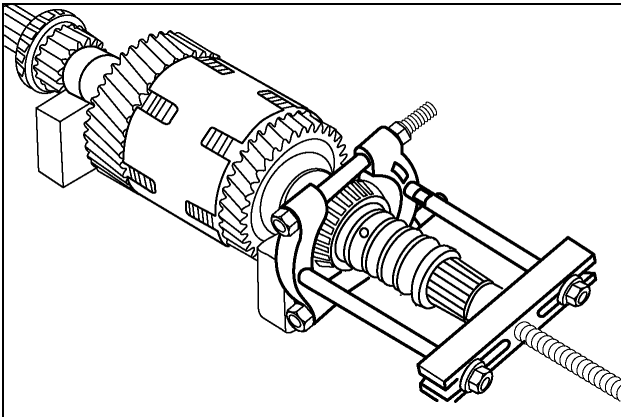
### STEP 62



T95300a

Remove the five seal rings from the speed input shaft.

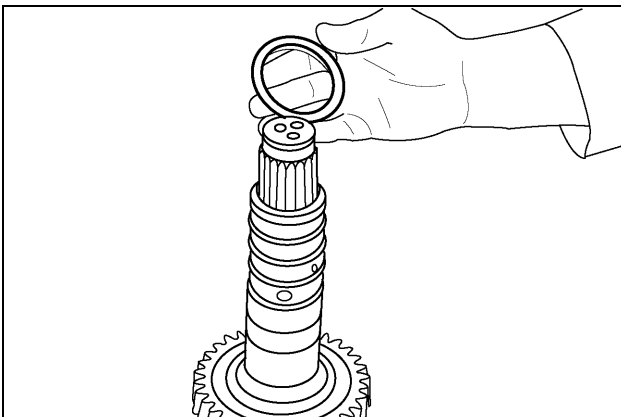
### STEP 63



T95301a

Use a bearing puller to remove the rear bearing cone.

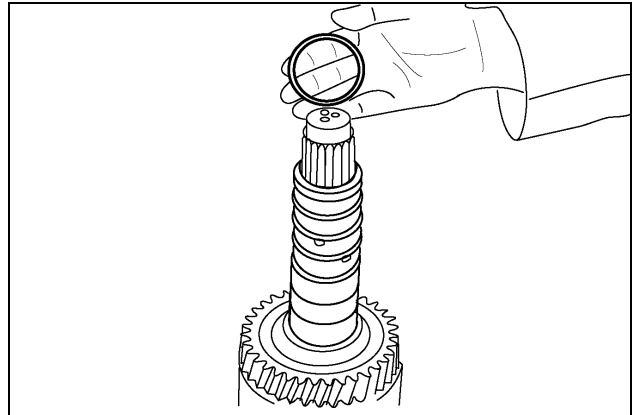
### STEP 64



T95303a

Remove the spacer.

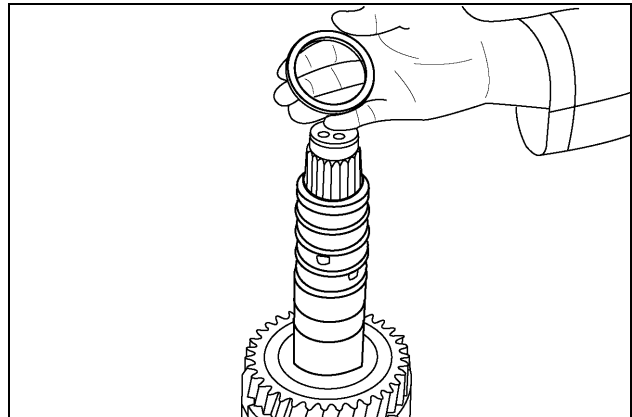
### STEP 65



T95305a

Remove the two snap rings.

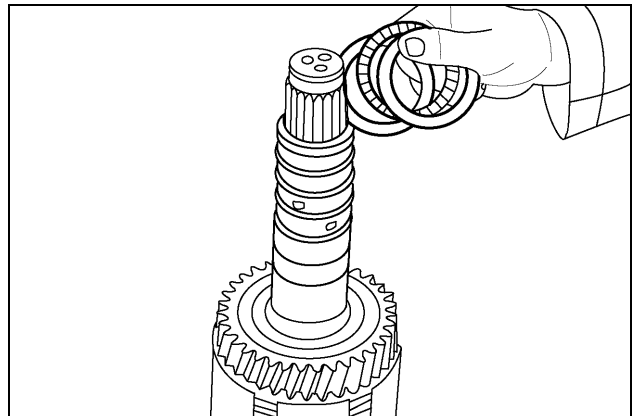
### STEP 66



T95306a

Remove the spacer.

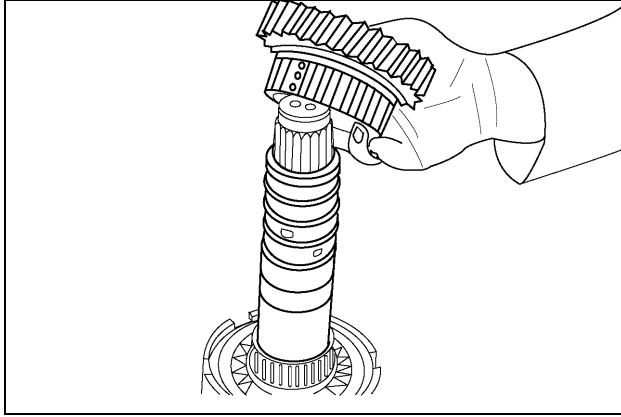
### STEP 67



T95307a

Remove the two bearing thrust washers and the needle thrust bearing.

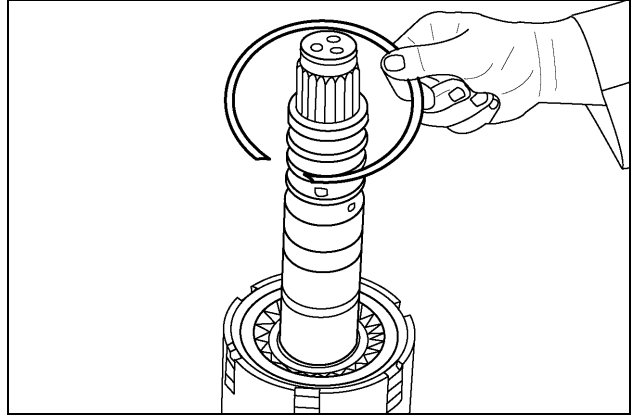
**STEP 68**



T95308a

Remove the (1st-3rd-5th) speed drive gear.

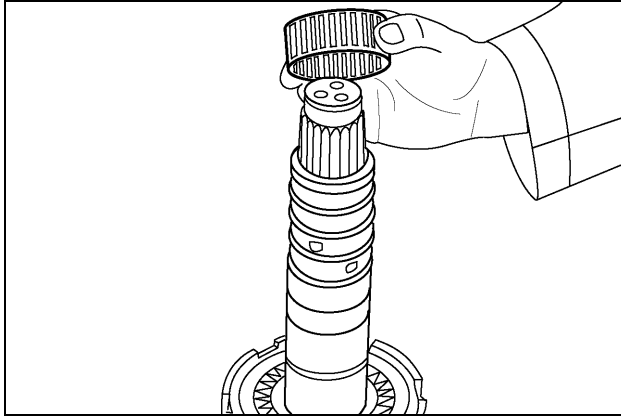
**STEP 71**



T95311a

Remove the snap ring.

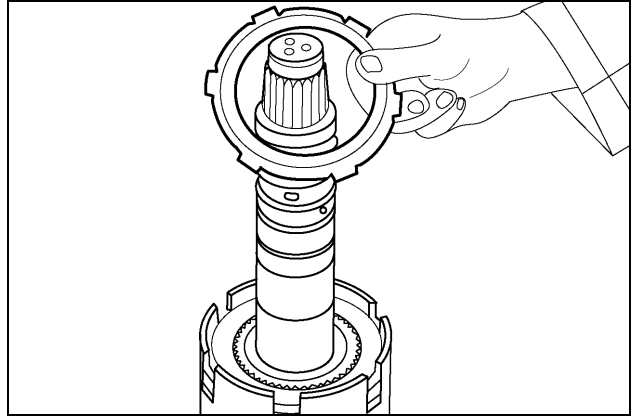
**STEP 69**



T95309a

Remove the caged needle bearing.

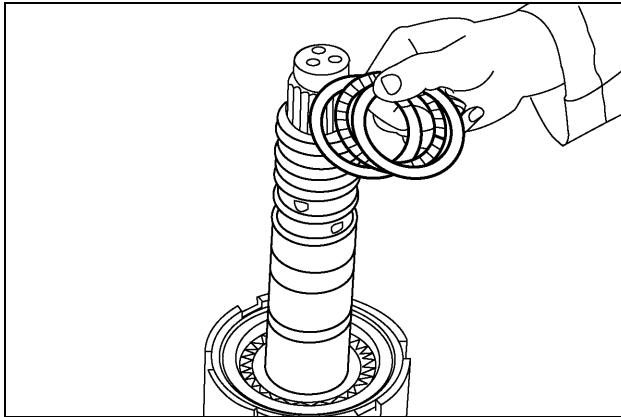
**STEP 72**



T95312a

Remove the backing plate.

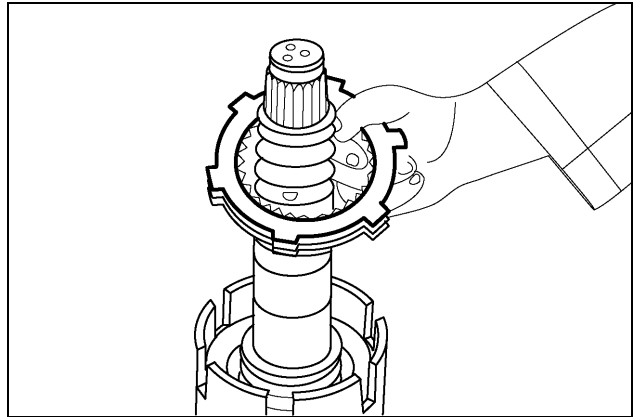
**STEP 70**



T95310a

Remove the two bearing thrust washers and the needle thrust bearing.

**STEP 73**

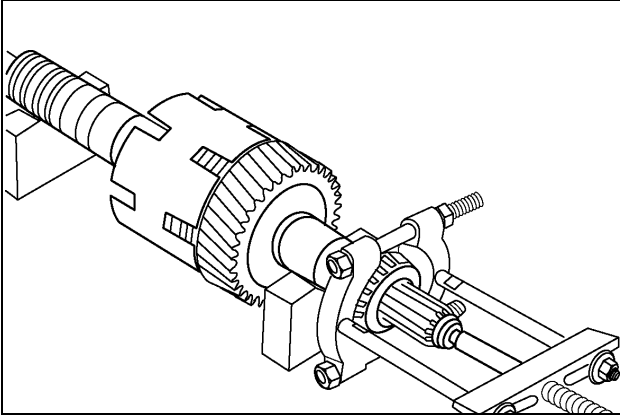


T95313a

Remove the friction plates, separator plates and the reaction plate (thicker than separator plate).

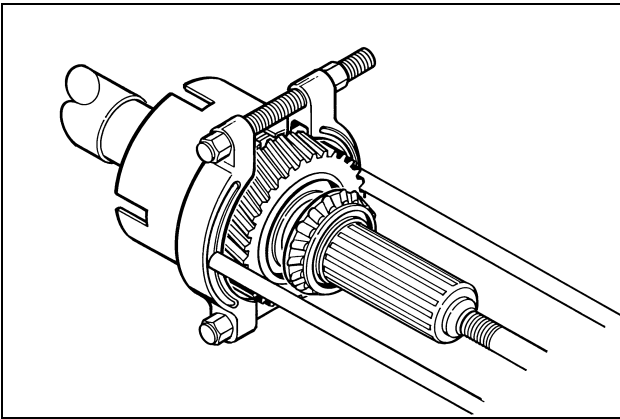


### STEP 74



Use a bearing puller to remove the front bearing cone.

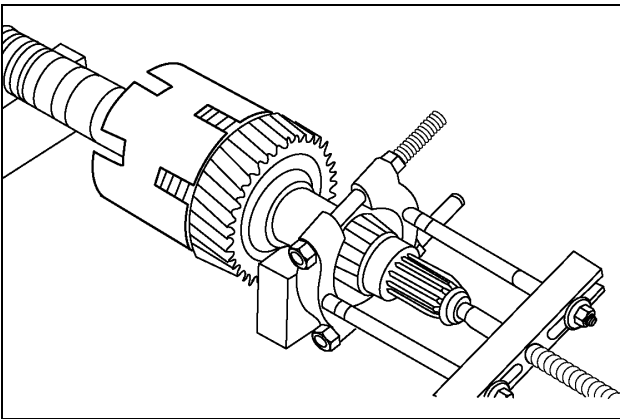
### STEP 75



#### Non Creep Transmission

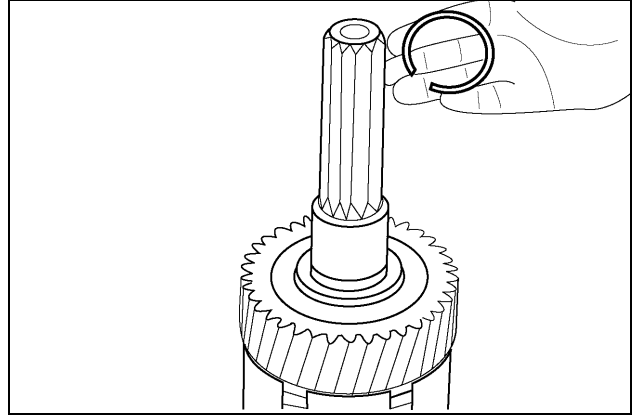
Use a bearing puller to remove the gear and front bearing cone.

### STEP 76



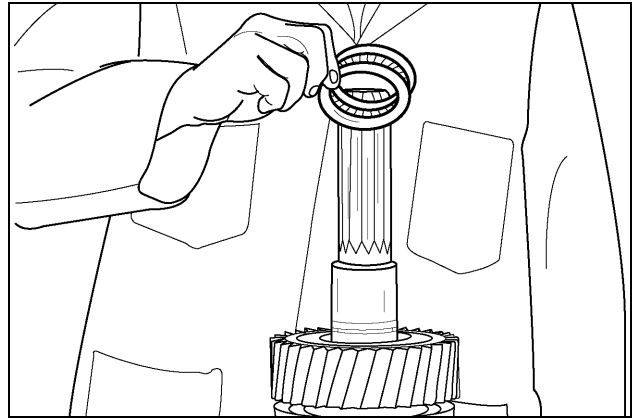
Use a bearing puller to remove the creeper gear, if equipped.

### STEP 77



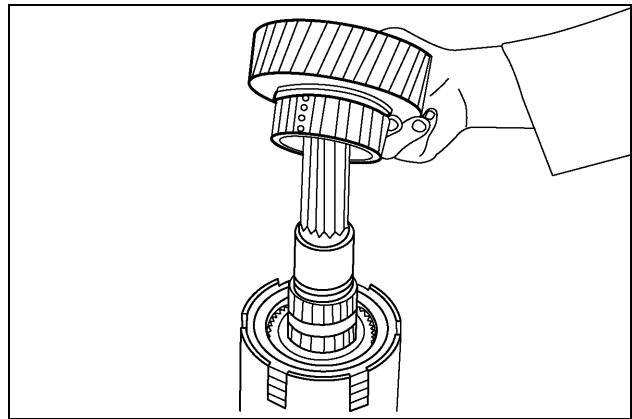
Remove the snap ring.

### STEP 78



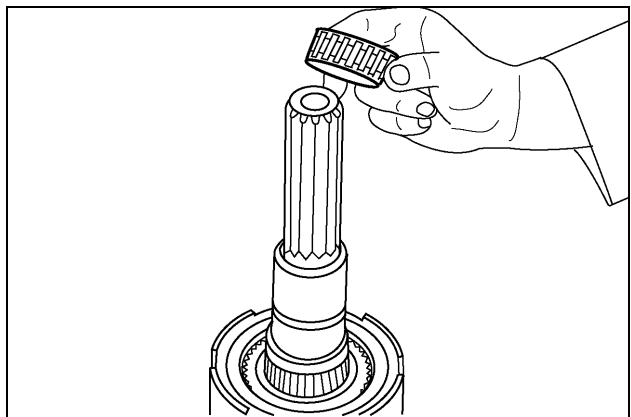
Remove the two bearing thrust washers and the needle thrust bearing.

### STEP 79



Remove the (2nd-4th-6th) speed drive gear.

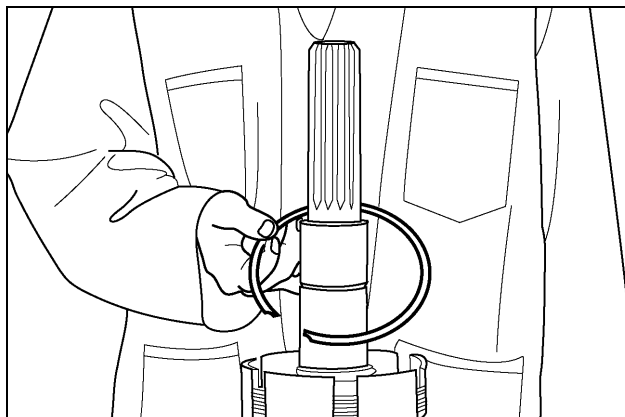
**STEP 80**



T95320

Remove the caged needle bearing.

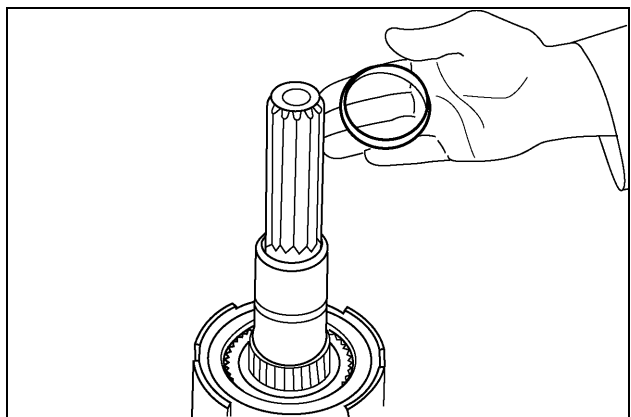
**STEP 83**



A11532

Remove the snap ring.

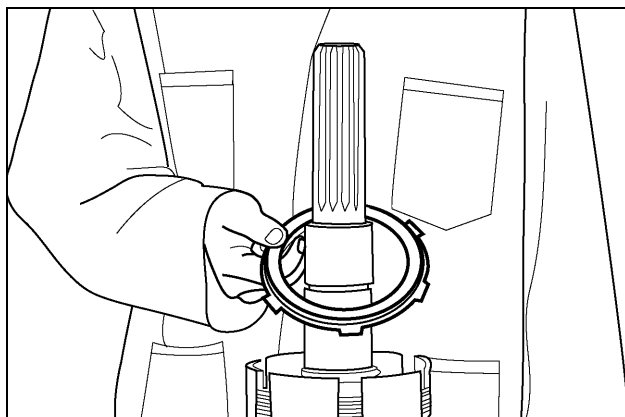
**STEP 81**



T95321

Remove the spacer.

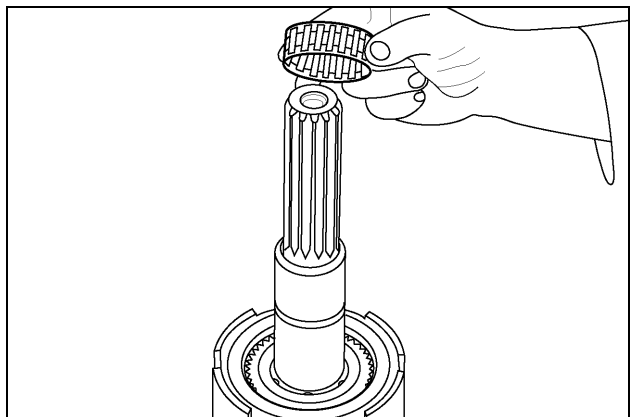
**STEP 84**



A11531

Remove the backing plate.

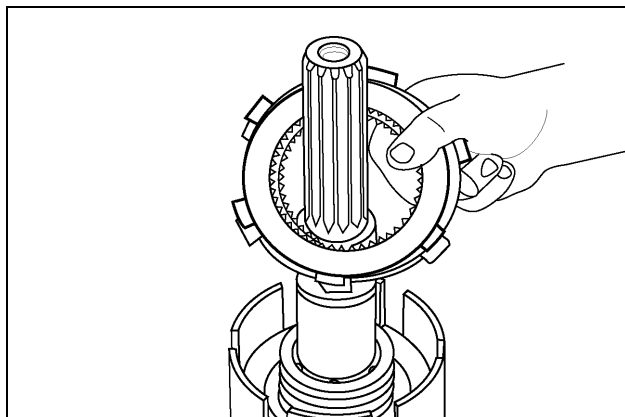
**STEP 82**



T95322

Remove the second caged needle bearing.

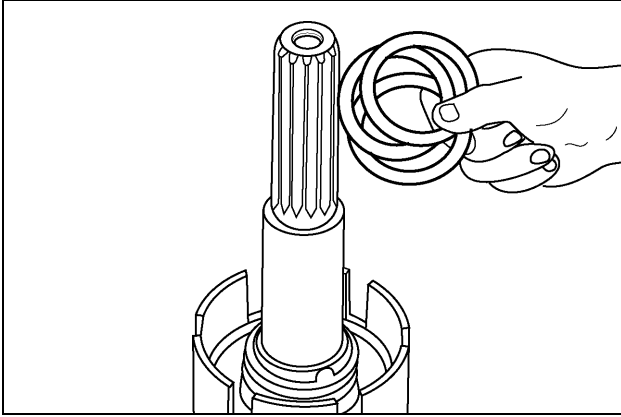
**STEP 85**



T95325

Remove the friction plates, separator plates and the reaction plate (thicker than separator plate).

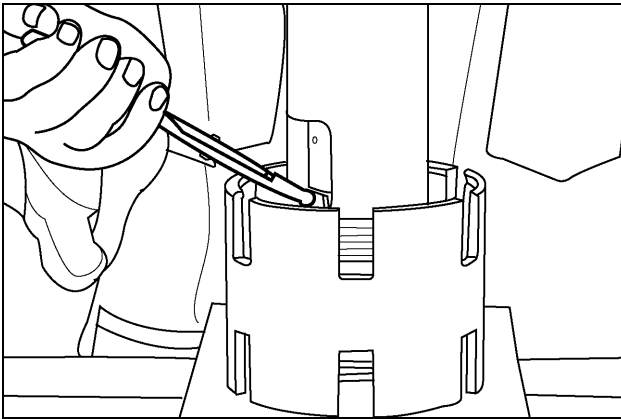
### STEP 86



T95327

Remove the two bearing thrust washers and the needle thrust bearing.

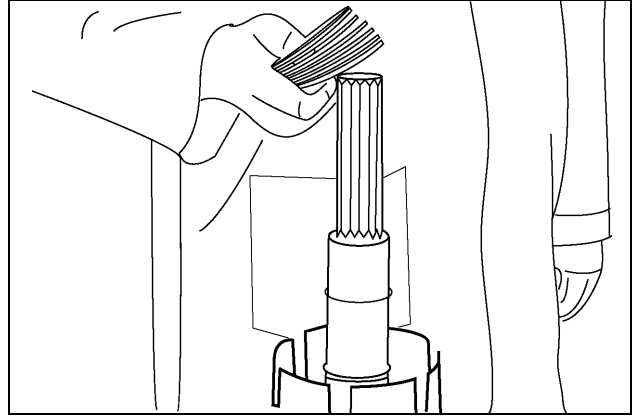
### STEP 87



A11518

Install the compression sleeve CAS1903-3 with the notch over the piston return Belleville washer. The opening in the sleeve must be over the ends of the snap ring. Compress the Belleville washers with a hydraulic press and remove the snap ring from both sides of the clutch plate carrier.

### STEP 88

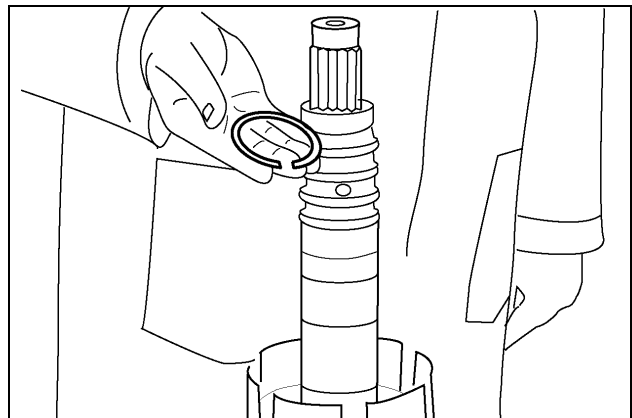


T95331

Remove the piston return Belleville washers and lube management ring from each side of the clutch plate carrier.

**IMPORTANT:** Note orientation of Belleville washers and lube management ring for later installation.

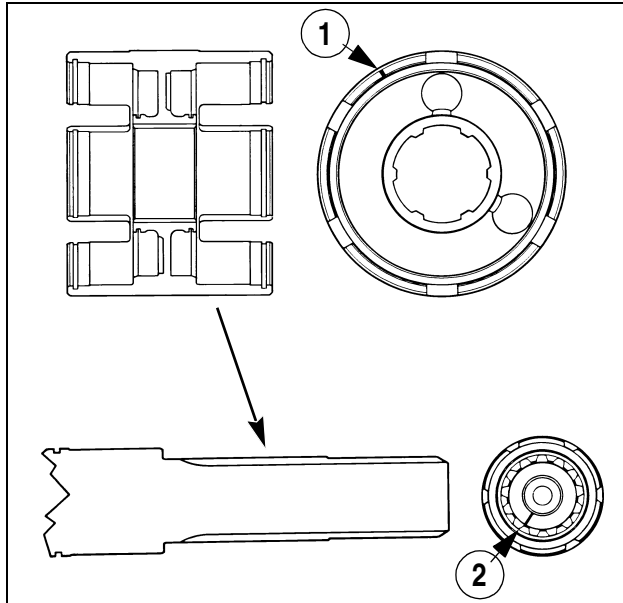
### STEP 89



T95332a

Remove the carrier retaining snap ring from each side of the clutch plate carrier.

## STEP 90



468L72

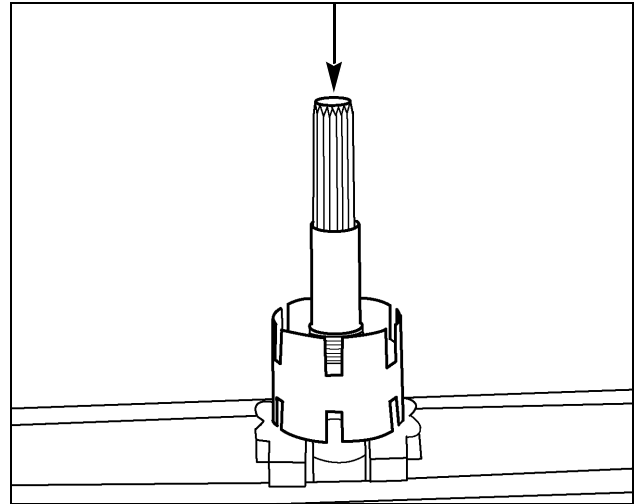
1. MARK ON FACE OF  
CARRIER

2. MARK ON FRONT END OF  
SHAFT

Make an appropriate mark with scratch awl, prick punch, etc., on the front end of the carrier. Make a similar mark on the same end of the shaft. Make sure that these marks are aligned. These marks will be used to align the carrier on the shaft during assembly.

**NOTE:** *If a new part replaces an old part, make a mark on the new part that is in the same position as the mark for the old part.*

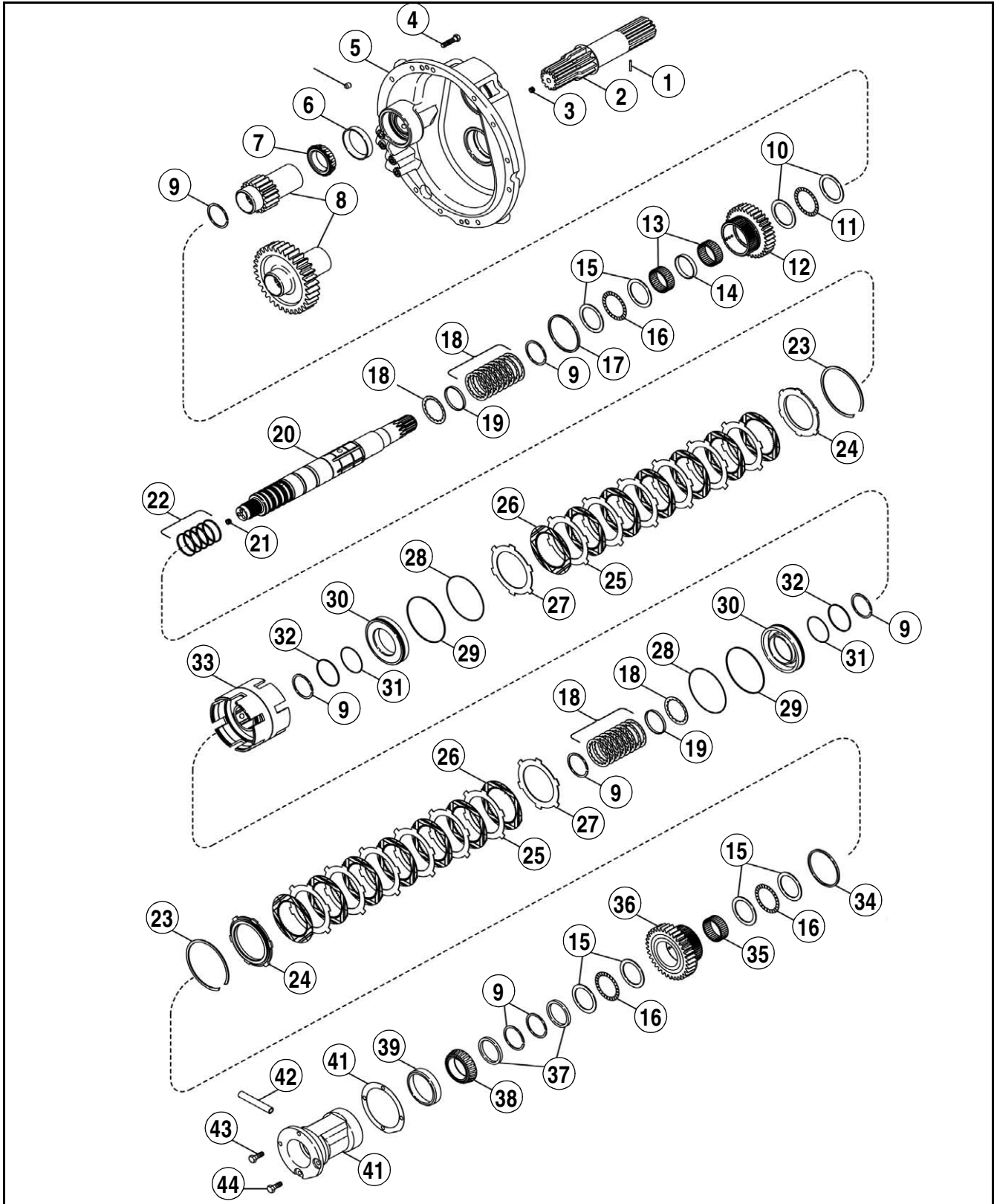
## STEP 91



T95333

Press the splined front end of the shaft so that the shaft moves through the clutch plate carrier.

# Speed Input Shaft Assembly With Creep Speed Or 50 KPH Transmission



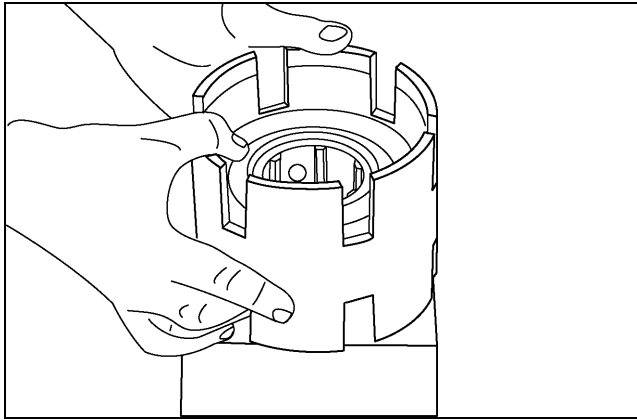
RI05M069M

- |                                 |                     |                    |                    |                   |
|---------------------------------|---------------------|--------------------|--------------------|-------------------|
| 1. COIL PIN                     | 10. THRUST WASHER   | 19. LUBE RING      | 28. SEAL           | 37. SPACER        |
| 2. SHAFT                        | 11. THRUST BEARING  | 20. SHAFT          | 29. O-RING         | 38. BEARING       |
| 3. BOLT M10 X 10                | 12. PINION GEAR 37T | 21. PLUG           | 30. PISTON         | 39. BEARING CUP   |
| 4. BOLT M12 X 40                | 13. NEEDLE BEARING  | 22. SEAL           | 31. SEAL           | 40. SHIM          |
| 5. CARRIER                      | 14. SPACER          | 23. SNAP RING      | 32. O-RING         | 41. CAGE          |
| 6. BEARING CUP                  | 15. THRUST WASHER   | 24. CLUTCH DISC    | 33. CARRIER        | 42. TUBE          |
| 7. BEARING                      | 16. THRUST BEARING  | 25. SEPARATOR DISC | 34. SEAL           | 43. BOLT M10 X 30 |
| 8. GEAR, CREEP/ GEAR DRVN 50KPH | 17. SEAL RING       | 26. FRICTION DESC  | 35. NEEDLE BEARING | 44. BOLT M10 X 25 |
| 9. CIRCLIP                      | 18. BELLEVILLE WSH  | 27. DISC           | 36. WHEEL GEAR 34T |                   |

**NOTE:** If any clutch pack is disassembled, new friction plates must be installed.

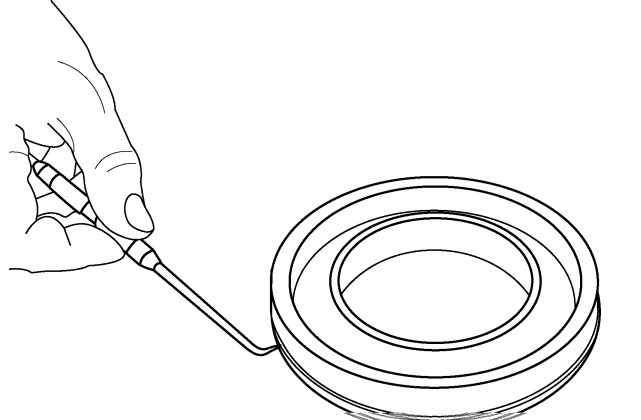
## Assembly of the Speed Input Shaft

### STEP 92



T95336

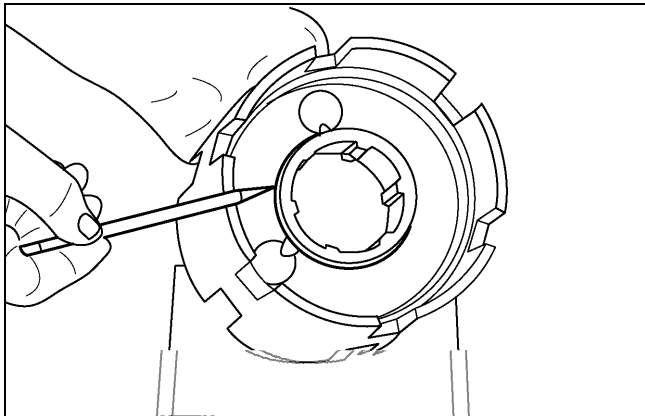
Hit the clutch plate carrier against a wood block to remove the clutch piston from each side of the carrier.



40-35

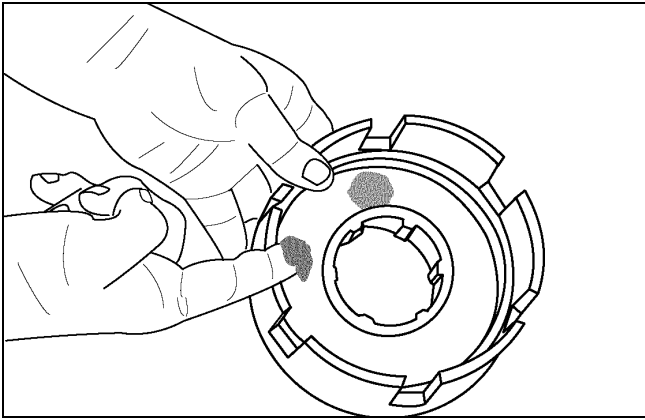
Replace the teflon ring and O-ring on the carrier and piston. Install the O-ring in the groove. Install the teflon ring over the O-ring.

### STEP 93

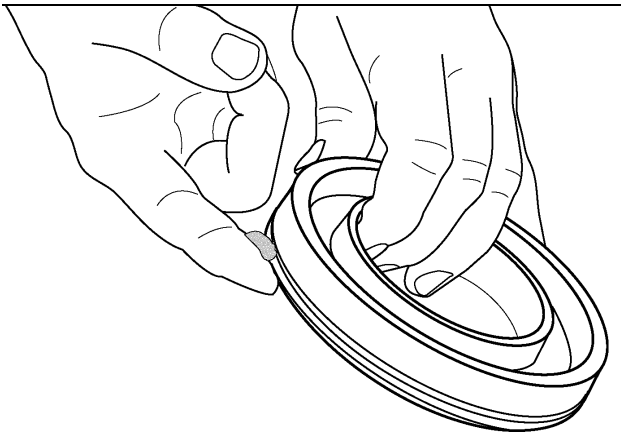


T95337

## STEP 94



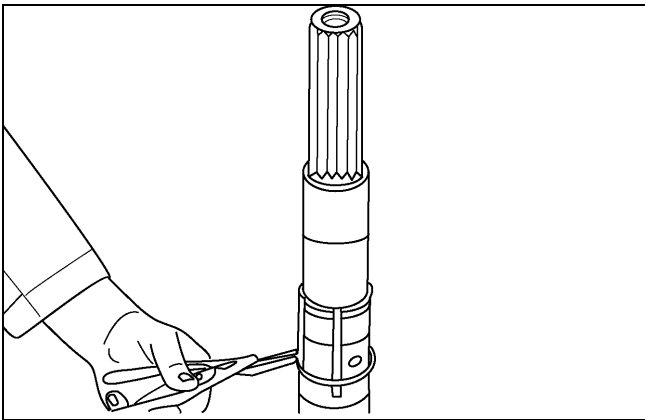
T95280



41-3

Apply petroleum jelly to the teflon rings

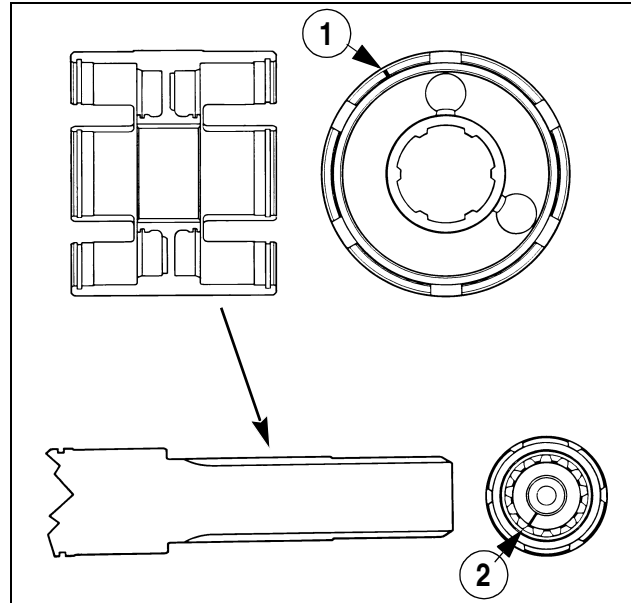
## STEP 95



T95339

Install the snap ring on the shaft in the third groove from the front to retain the rear side of the clutch plate carrier.

## STEP 96



468L72

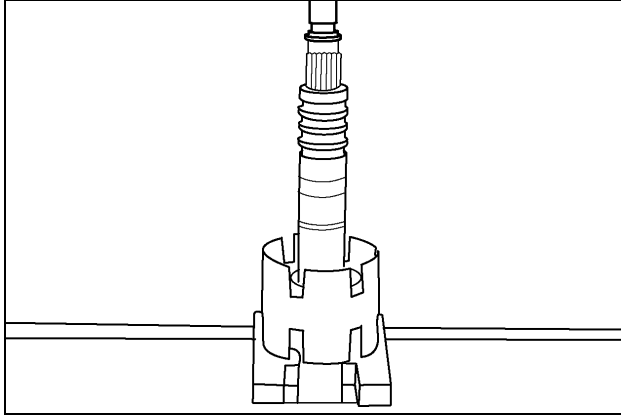
1. MARK ON FACE OF  
CARRIER

2. MARK ON FRONT END  
OF SHAFT

Before pressing the shaft through the clutch plate carrier, find the mark on the end of the shaft (2) and on the face of the carrier (1).

**NOTE:** If a new part replaces an old part, make a mark on the new part that is in the same position as the mark for the old part.

### STEP 97



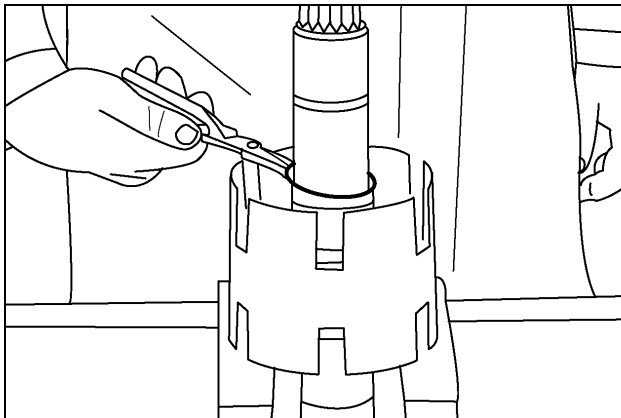
T95340a

Install the shaft on the carrier as follows:

1. Align the mark on the front end of the shaft with the mark on the face of the clutch plate carrier before pressing the shaft through the carrier. Aligning the marks will align the oil holes in the shaft with the oil holes in the carrier.
2. Press the front end of the shaft through the carrier until the carrier is seated against the snap ring.
3. Check to be sure that all the oil holes in the shaft and carrier are aligned.

**NOTE:** *Be sure marks are properly aligned for correct timing.*

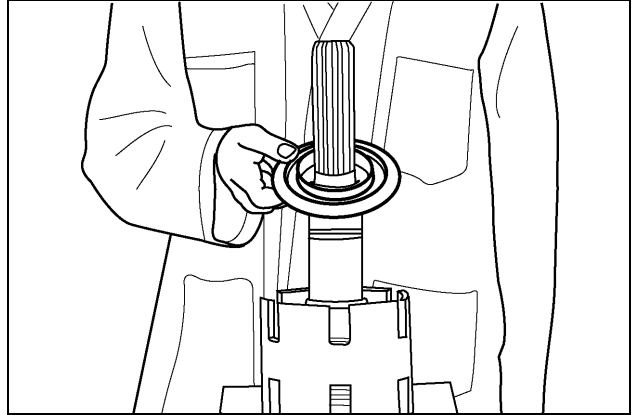
### STEP 98



T95341

Turn the shaft over and install the carrier retaining ring.

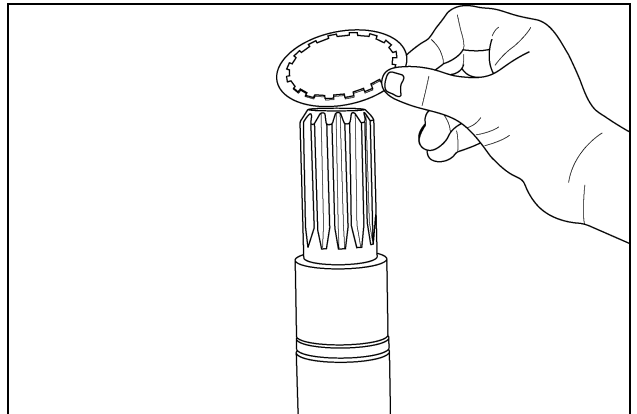
### STEP 99



A11519

Install a clutch piston into each side of the carrier. The flat side of the piston must be down. Push the piston into the carrier by hand.

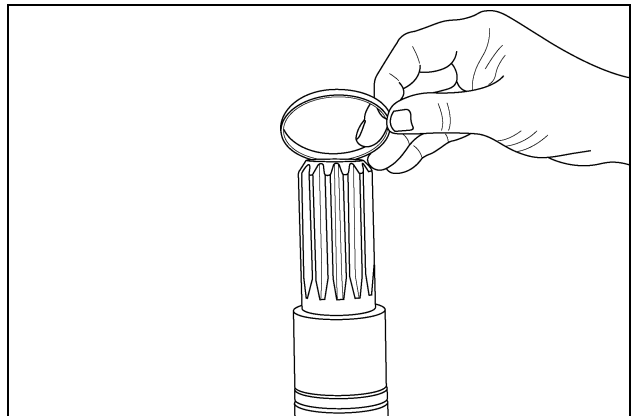
### STEP 100



RD05M001

Install the first piston return Belleville washer. The concave side of the washer must be facing down.

### STEP 101

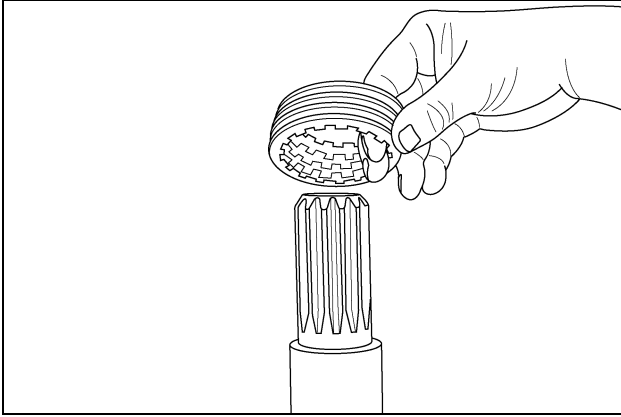


RD05M002

Install the lube management ring.



## STEP 102

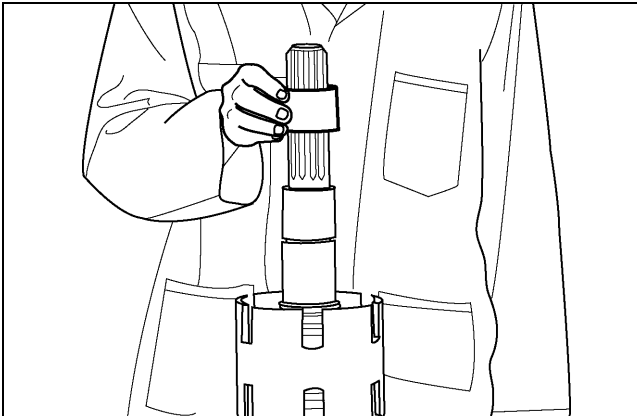


RD05M003

Install the remaining Belleville washers as follows:

1. Install the second Belleville washer. The concave side of the washer must be facing up.
2. Install the remaining seven Belleville washers, alternating the position of the washers until the last washer with the concave side is facing down.

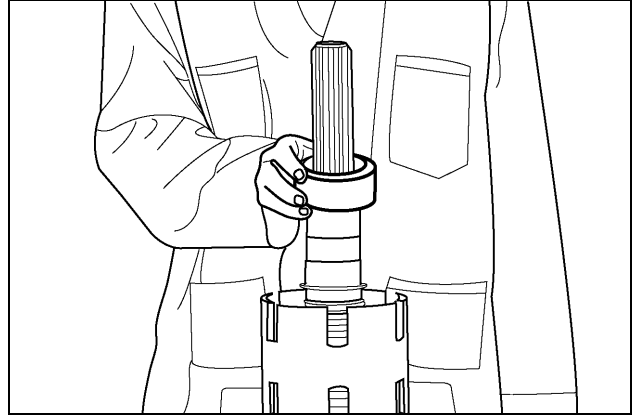
## STEP 103



A11523

Install the centering sleeve CAS 1903-4 over the shaft.

## STEP 104



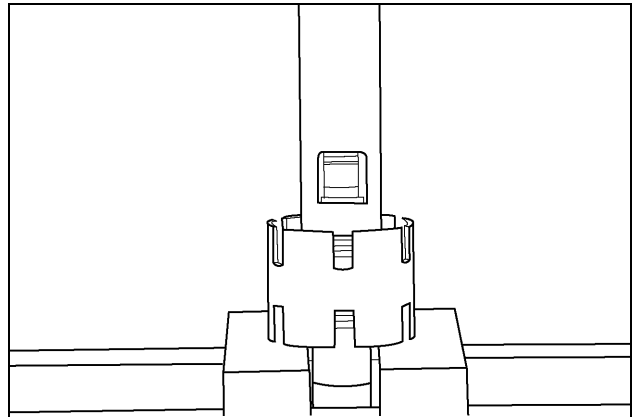
A11525

Install the snap ring as follows:

1. Install the snap ring over the centering sleeve.
2. Install the Belleville washer compression sleeve over the shaft and centering sleeve CAS 1903-5 and on top of the snap ring.

**NOTE:** The smaller OD side of the sleeve must be facing up.

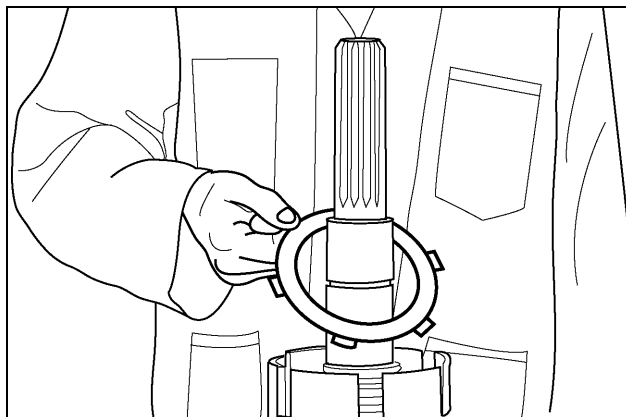
## STEP 105



A11526

Install the compression sleeve CAS1903-3 with the notch over the shaft. Use a hydraulic press to press the sleeves down. The snap ring will be pushed into position in the groove with the pin between the snap ring ends. Verify that the snap ring is properly seated in the groove.

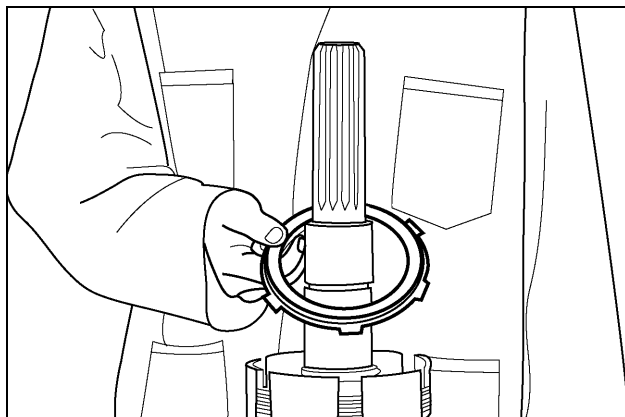
### STEP 106



A11528

Install the reaction plate (thicker separator plate).

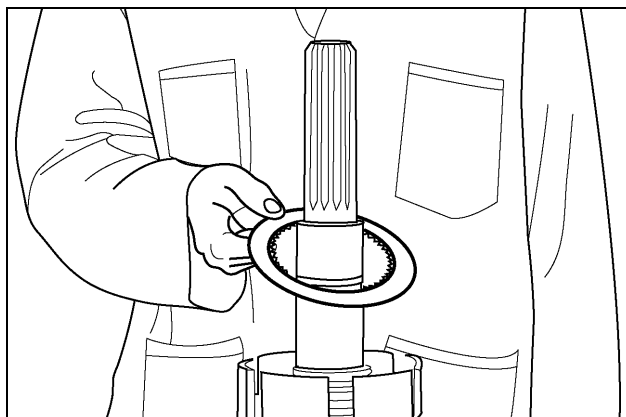
### STEP 109



A11531

Install the backing plate. The flat side of the plate must face down.

### STEP 107

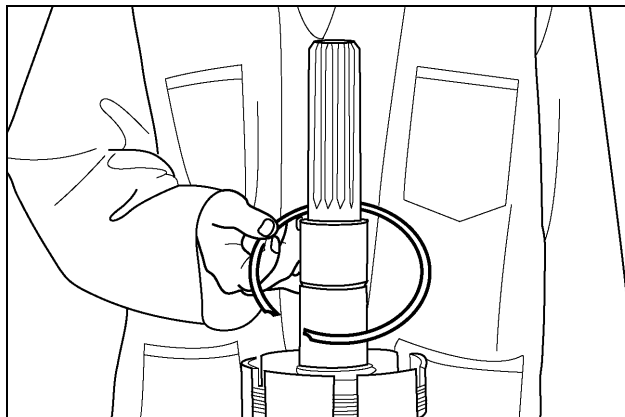


A11529

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

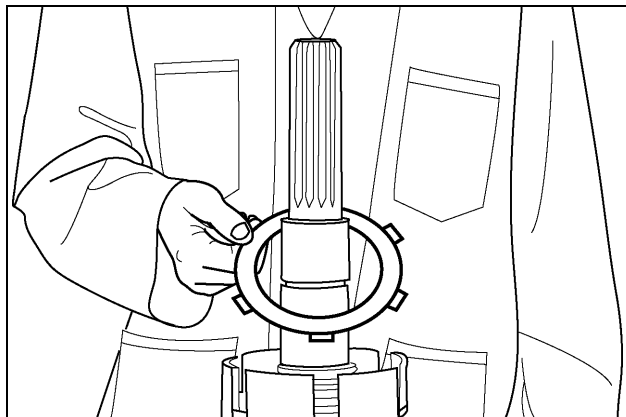
### STEP 110



A11532

Install the snap ring.

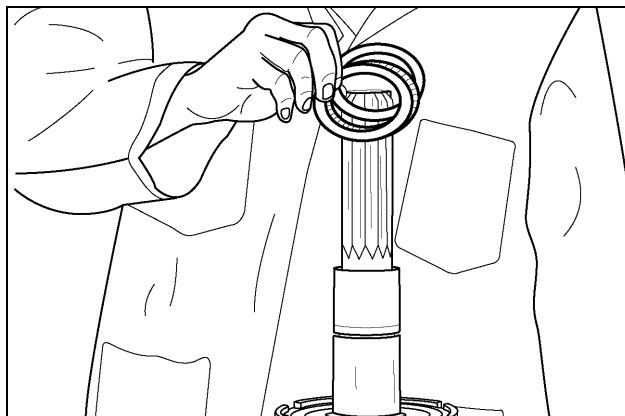
### STEP 108



A11530

Install a separator plate. Install the remaining six new friction plates and five separator plates, alternating the plates.

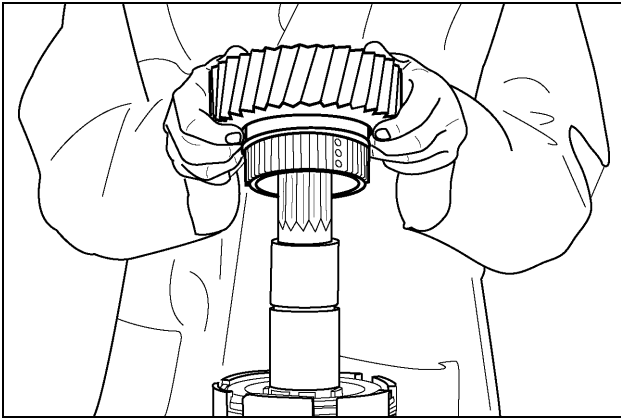
### STEP 111



A11537

Install the two bearing thrust washers and the needle thrust bearing. The needle thrust bearing must be between the two thrust washers.

## STEP 112

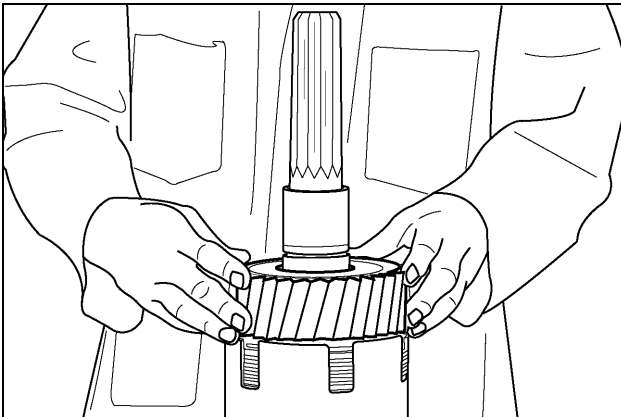


A11533

### 1. SEAL

Install a new seal ring on the (2nd-4th-6th) speed drive gear at location shown by arrow. Align the friction plate teeth. Install the gear into the clutch pack. The splined hub of the gear must be facing down.

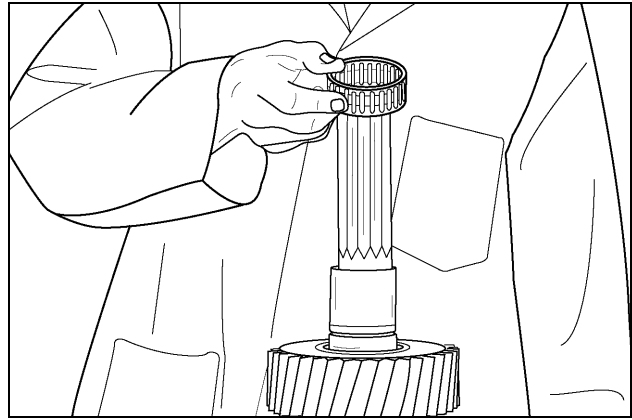
## STEP 113



A11534

Slight oscillation of the gear will help with the installation. The splined hub of the gear must engage all the friction plates.

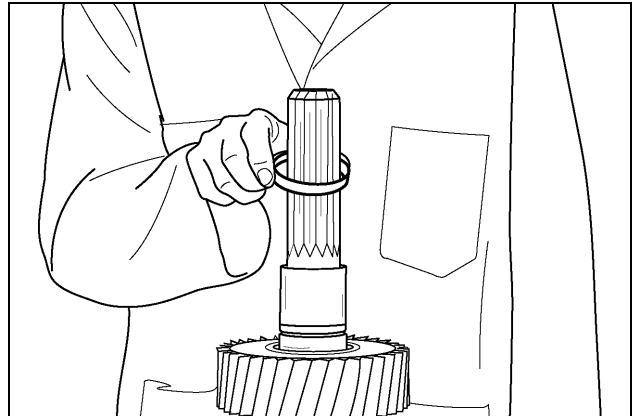
## STEP 114



A11535

Install a caged needle bearing into the gear hub.

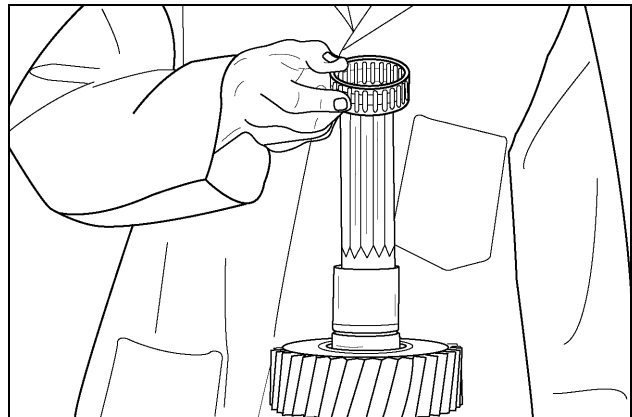
## STEP 115



A11536

Install a spacer into the gear hub.

## STEP 116

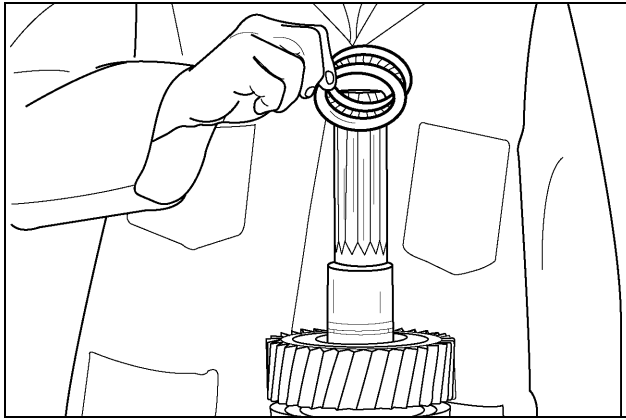


A11535

Install another caged needle bearing into the gear hub.

**NOTE:** The top of the second needle bearing cage will be aligned with the top of the gear hub when all the friction plates are engaged with the splined hub of the gear.

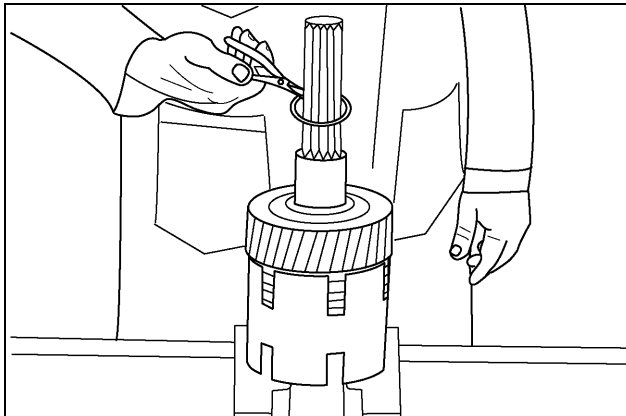
### STEP 117



A11538

Install the two bearing thrust washers and the needle thrust bearing. The needle thrust bearing must be between the two bearing thrust washers.

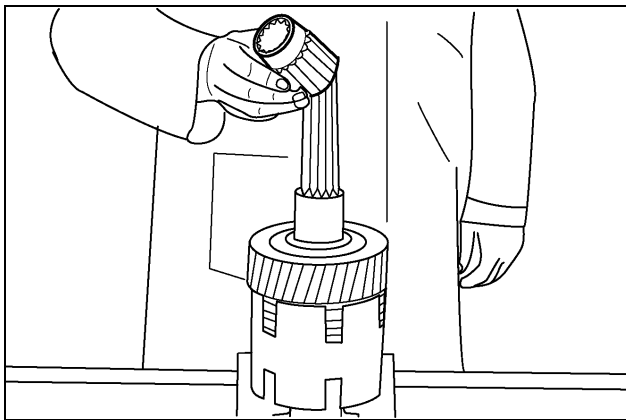
### STEP 118



T95361

If the transmission has the creep option, install the snap ring against the bearing thrust washer.

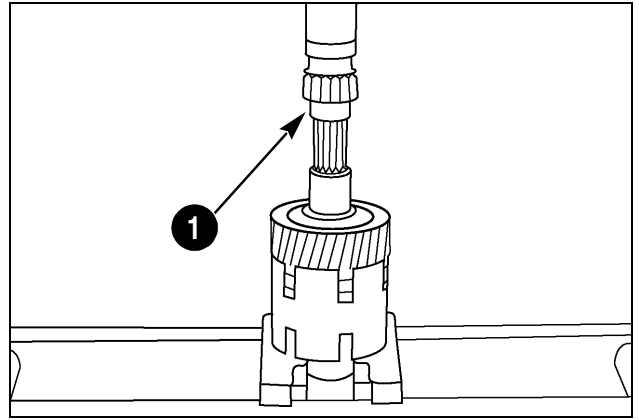
### STEP 119



T95362

Install the creeper speed gear (if equipped). The longer hub of the gear must face down.

### STEP 120

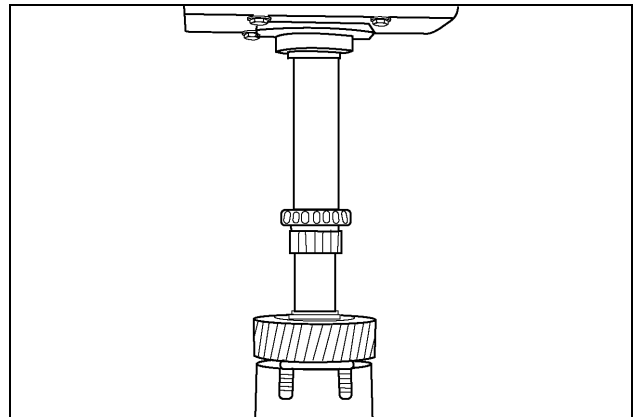


T95363

1. LONGER HUB

Press the creeper speed gear into position.

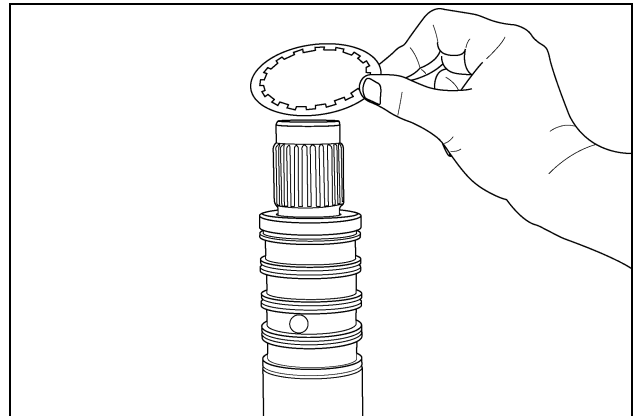
### STEP 121



A11516

Install the bearing cone on the shaft. The larger OD end of the bearing cone must face down. Press the bearing on the inner race to properly seat the bearing on the shaft.

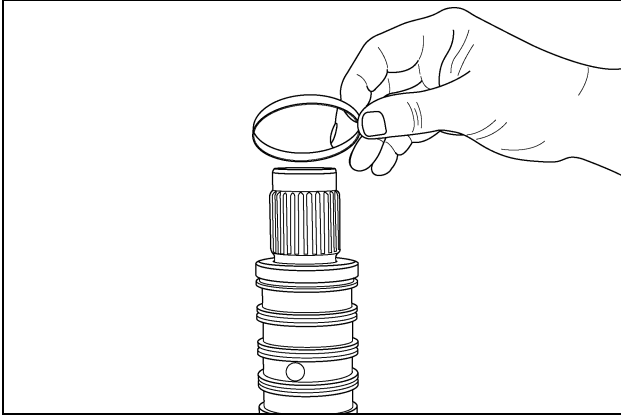
### STEP 122



RD05M004

Turn the shaft over and install the first piston return Belleville washer. The concave side of the washer must be facing down.

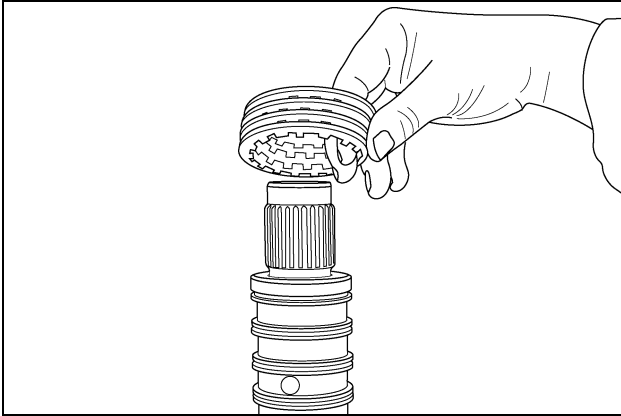
### STEP 123



RD05M005

Install the lube management ring.

### STEP 124



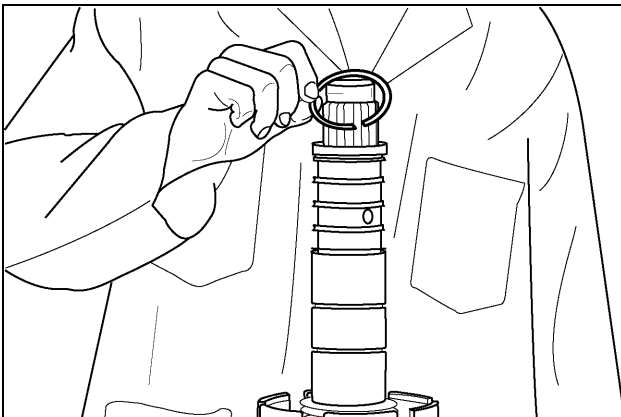
RD05M006

Install the remaining Belleville washers as follows:

1. Install the second Belleville washer. The concave side of the washer must be facing up.

Install the remaining seven Belleville washers, alternating the position of the washers until the last washer with the concave side is facing down.

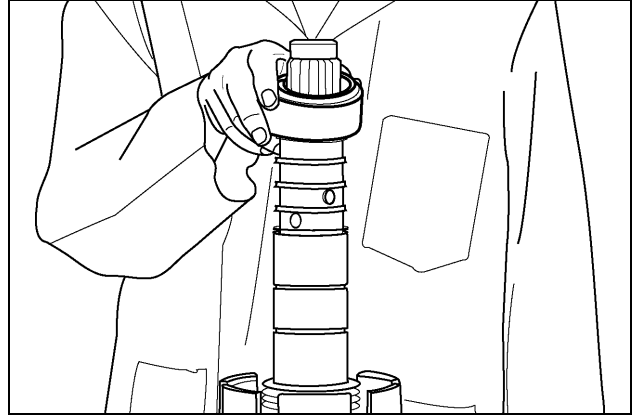
### STEP 125



A11540a

Install the snap ring over the shaft.

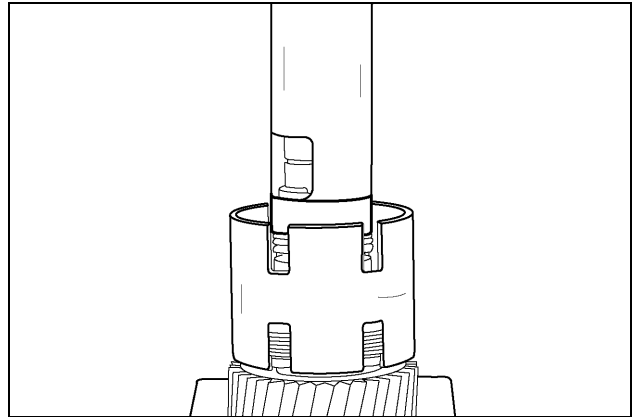
### STEP 126



A11541a

Install the Belleville washer compression sleeve CAS1903-5 over the shaft and on top of the snap ring. The smaller OD side of the sleeve must be facing up.

### STEP 127

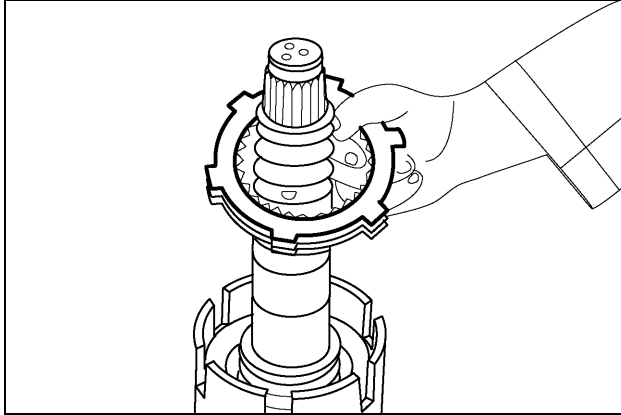


A11542

Install snap ring as follows:

1. Install the compression sleeve CAS1903-3 with the notch over the shaft.
2. Use a hydraulic press to press the sleeve down. The snap ring will be pushed into position in the groove with the pin between the snap ring ends.
3. Verify that the snap ring is seated properly in the groove.

### STEP 128

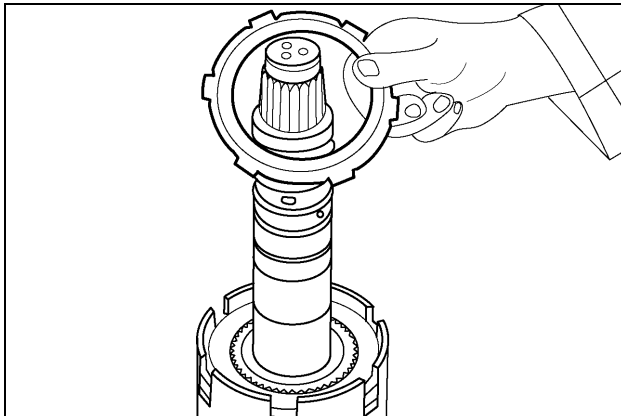


T95313a

Install the reaction plate, friction plates, and separator plates as follows:

1. Install the reaction plate (thicker separator plate).
2. Install the seven new friction plates and six separator plates, alternating the plates.

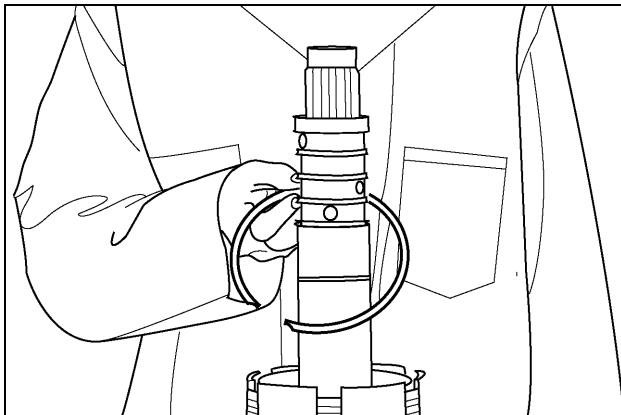
### STEP 129



T95312a

Install the backing plate. The flat side of the plate must face down.

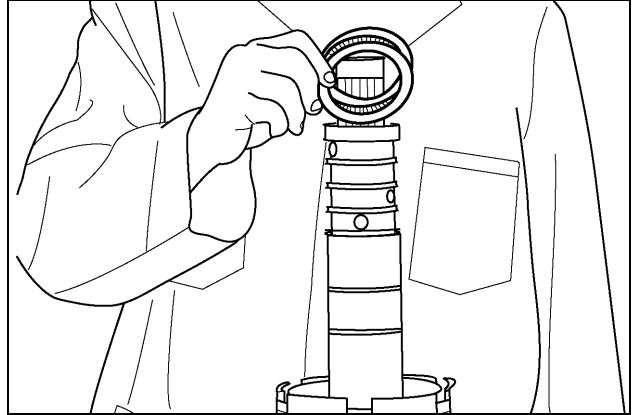
### STEP 130



A11543

Install the snap ring.

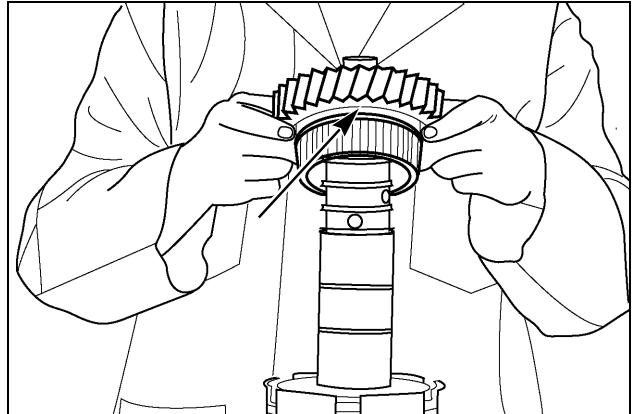
### STEP 131



A11544

Install the two bearing thrust washers and the needle thrust bearing. The needle thrust bearing must be between the two thrust washers.

### STEP 132

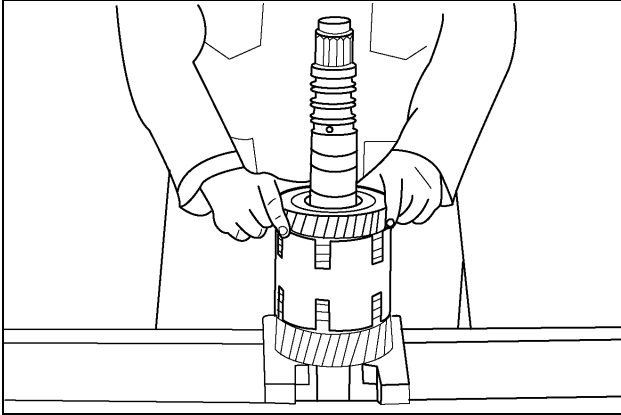


A11545

1. SEAL

Install a new seal ring on the (1st-3rd-5th speed) drive gear. Align the friction plate teeth. Install the gear over the shaft. The splined hub of the gear must be facing down.

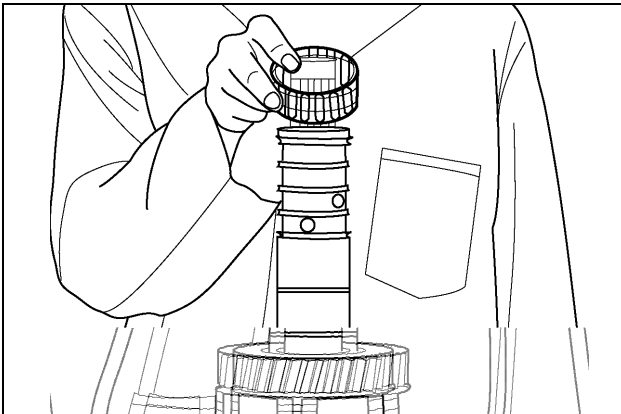
### STEP 133



T95379

Slight oscillation of the gear will help with the installation. The splined hub of the gear must engage all the friction plates.

### STEP 134

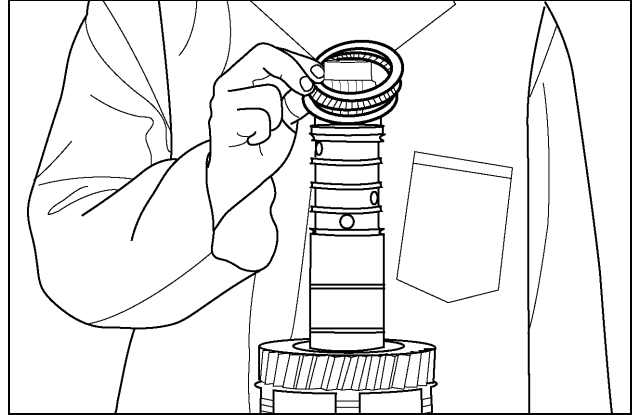


A11546

Install a caged needle bearing into the gear hub.

**NOTE:** The top of the needle bearing cage will be aligned with the top of the gear hub when all the friction plates are engaged with the splined hub of the gear.

### STEP 135

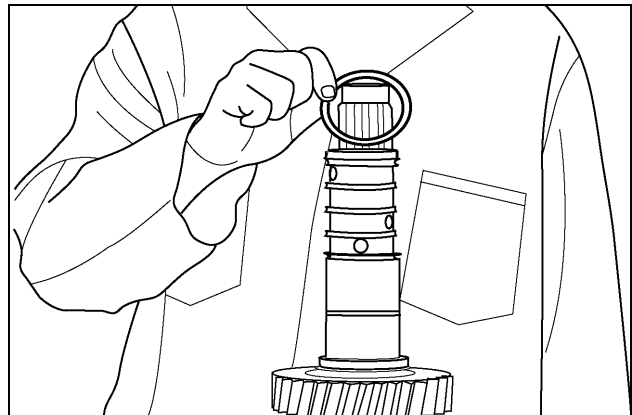


A11547a

Install the two bearing thrust washers and the needle thrust bearing.

**NOTE:** The needle thrust bearing must be between the two bearing thrust washers.

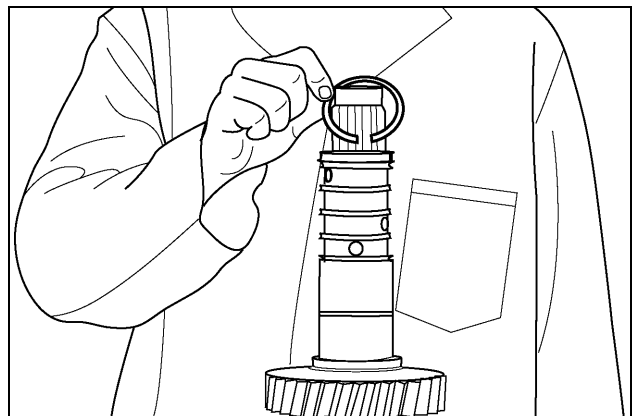
### STEP 136



A11551A

Install the first spacer.

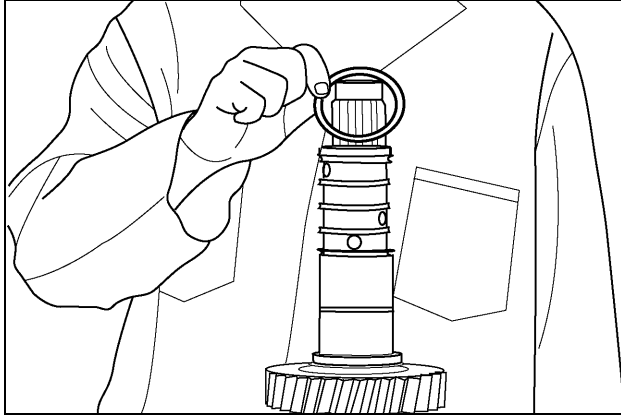
### STEP 137



A11550

Install the two snap rings.

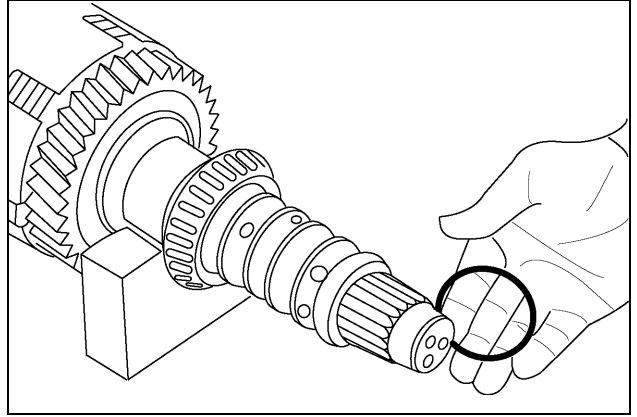
**STEP 138**



A11551

Install the second spacer.

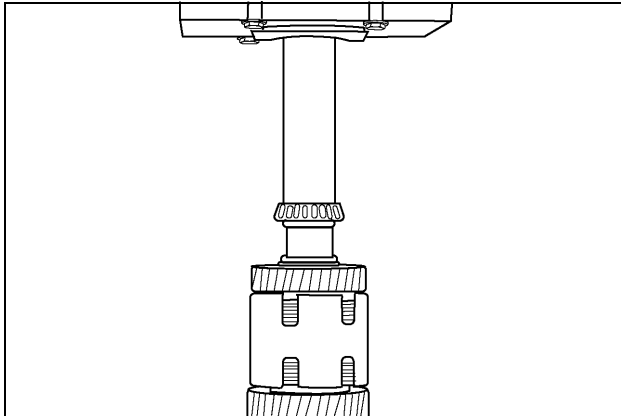
**STEP 140**



T95300a

Install five new seal rings on the end of the input shaft.

**STEP 139**

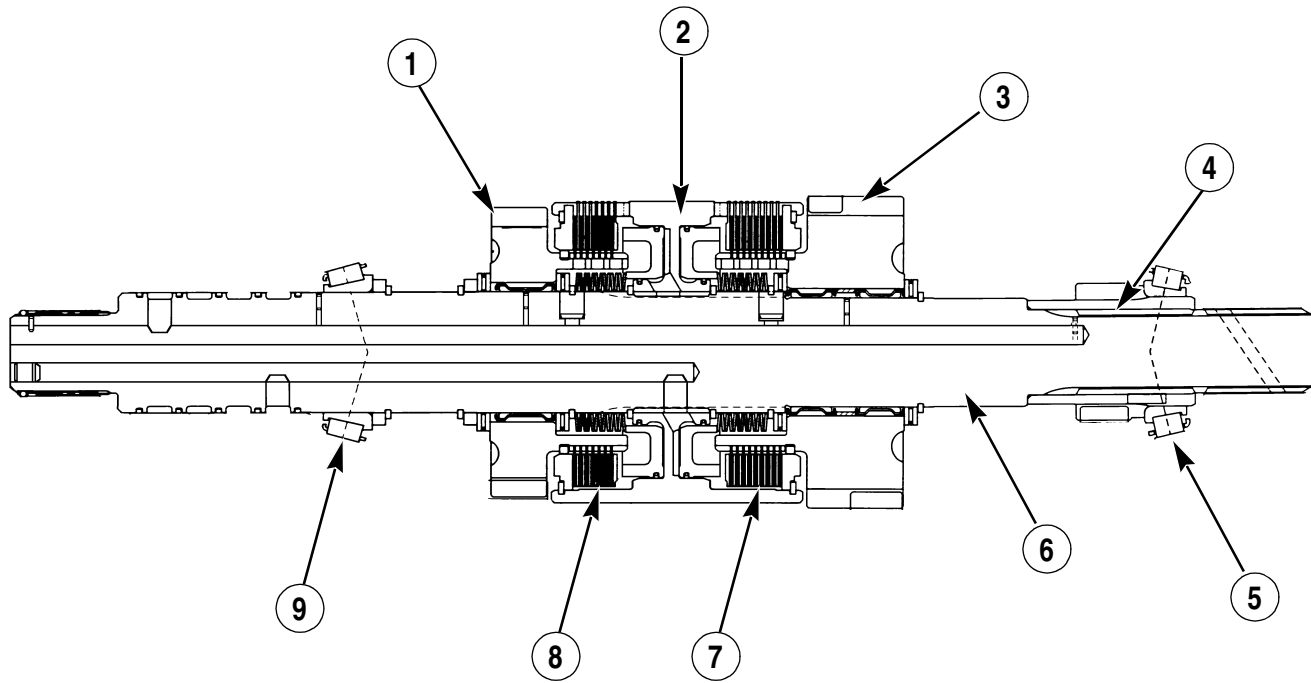


A11517

Install the bearing cone on the shaft. The larger OD end of the bearing must be facing down. Press the bearing on the inner race to properly seat the bearing on the shaft.



## Speed Input Shaft

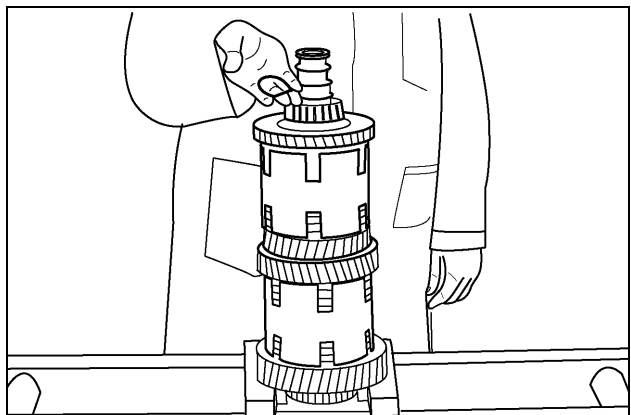


385L7

- |                                   |                                     |                           |
|-----------------------------------|-------------------------------------|---------------------------|
| 1. (1st-3rd-5th) SPEED DRIVE GEAR | 4. CREEPER SPEED GEAR (IF EQUIPPED) | 7. EVEN SPEED CLUTCH PACK |
| 2. CLUTCH PLATE CARRIER           | 5. FRONT BEARING CONE               | 8. ODD SPEED CLUTCH PACK  |
| 3. (2ND-4TH-6TH) SPEED DRIVE GEAR | 6. INPUT SHAFT                      | 9. REAR BEARING CONE      |

## Disassembling the Speed Output Shaft

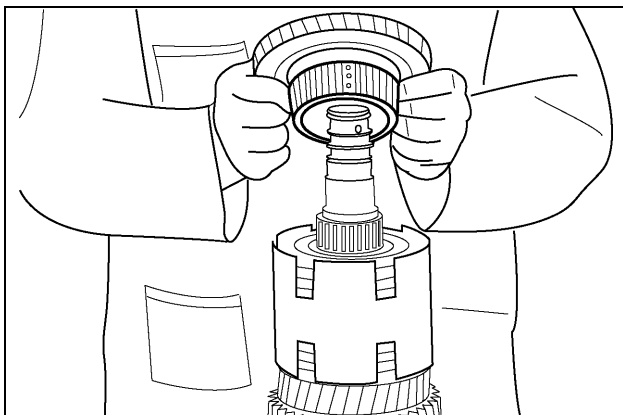
### STEP 141



T95386

Remove the four seal rings.

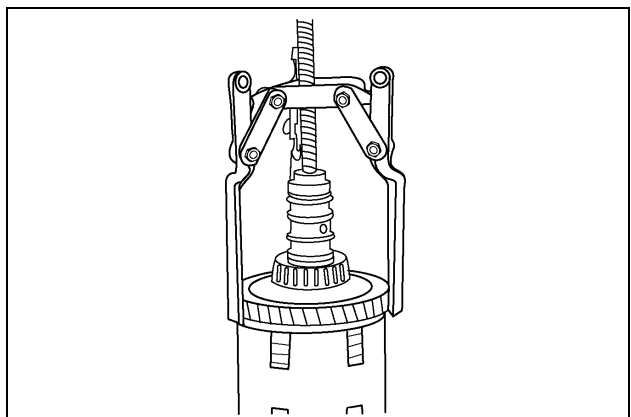
### STEP 144



T95391

Remove the reverse driven gear.

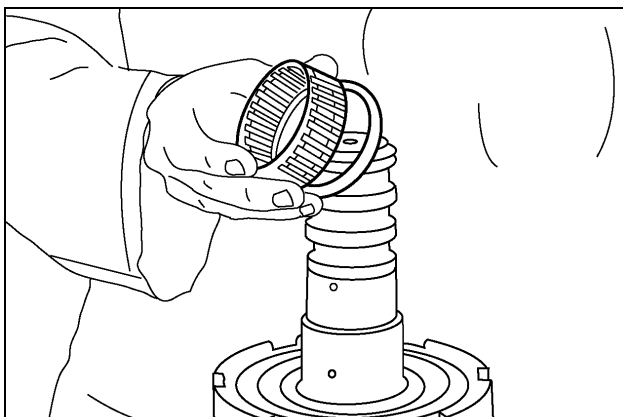
### STEP 142



T95387

Use a bearing puller to remove the front bearing cone and the reverse driven gear from the shaft.

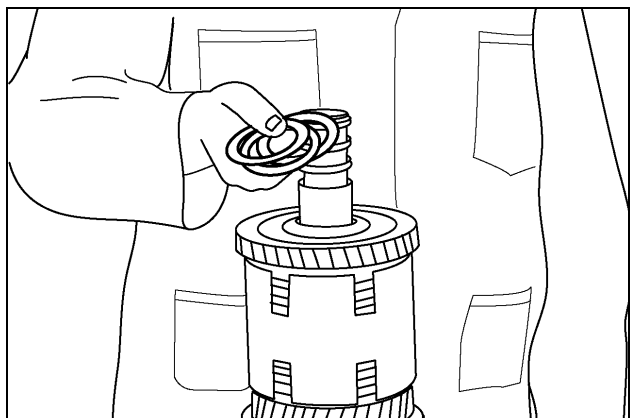
### STEP 145



A11638

Remove the caged needle bearing and nylon spacer.

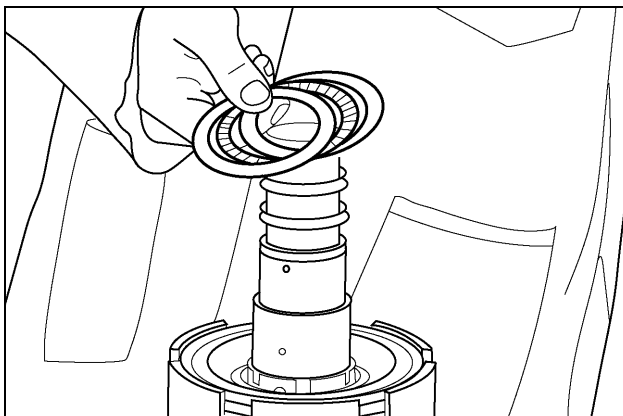
### STEP 143



T95389

Remove the two bearing thrust washers and the needle thrust bearing.

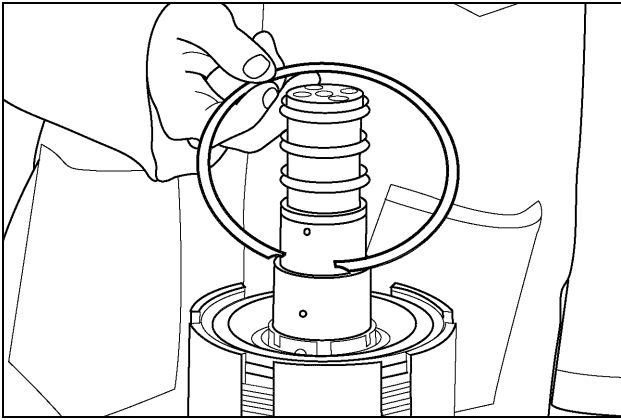
### STEP 146



A11555

Remove the two bearing thrust washers and the needle thrust bearing.

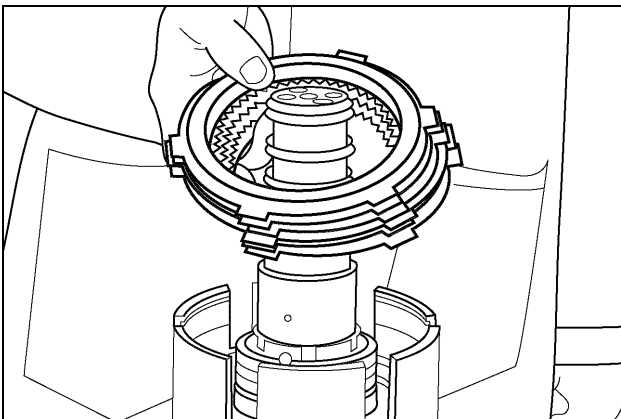
### STEP 147



A11556

Remove the snap ring from inside the clutch plate carrier.

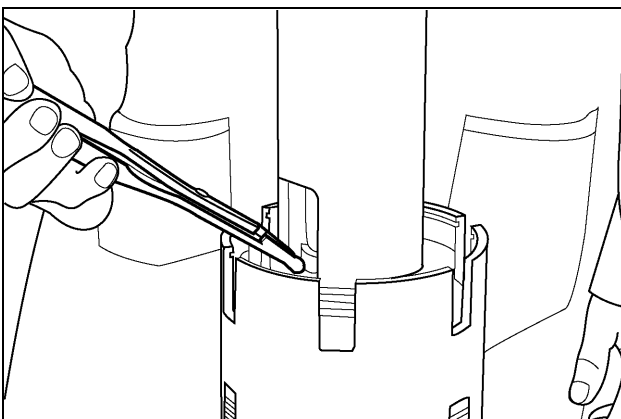
### STEP 148



A11557

Remove the backing plate, friction plates, separator plates, and reaction plate (thicker separator plate).

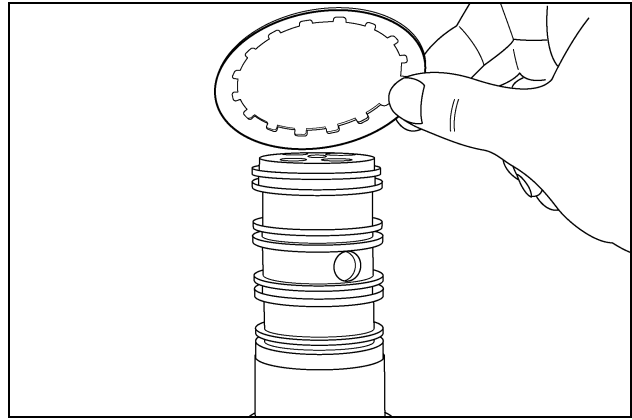
### STEP 149



A11558

Install the compression sleeve CAS1903-3 with the notch over the piston return Belleville washers. The opening in the sleeve must be over the ends of the snap ring. Compress the Belleville washers with a hydraulic press and remove the snap ring.

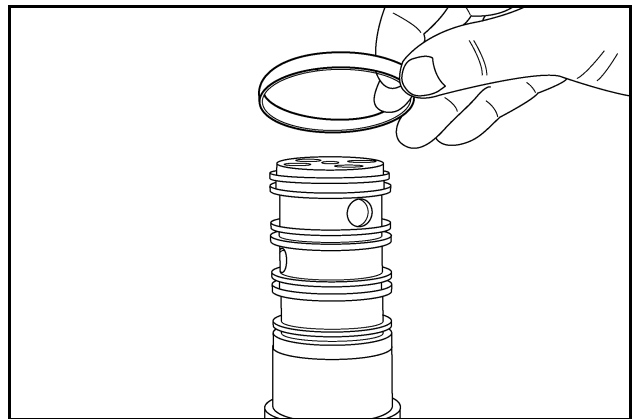
### STEP 150



RD05M010

Remove one piston return Belleville washers.

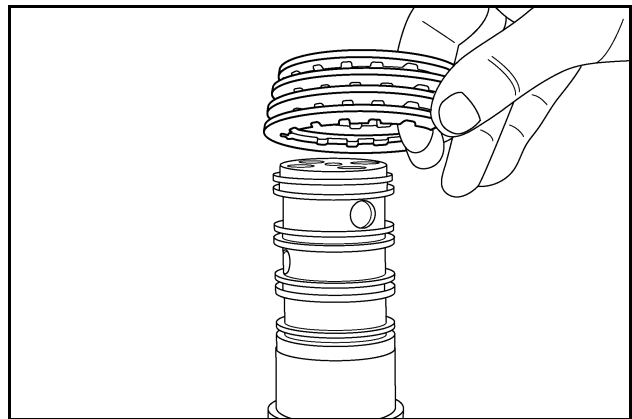
### STEP 151



RD05M011

Remove the lube management ring.

### STEP 152

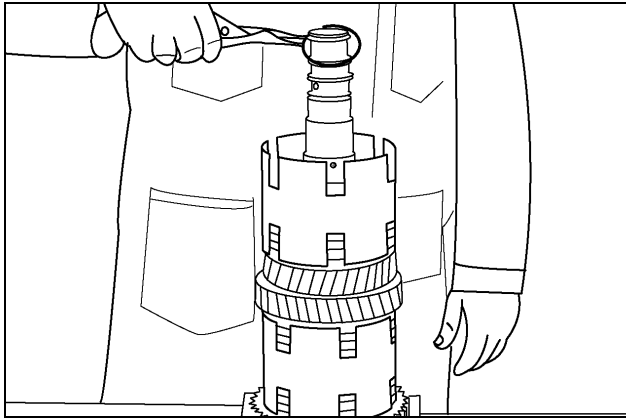


RD05M012

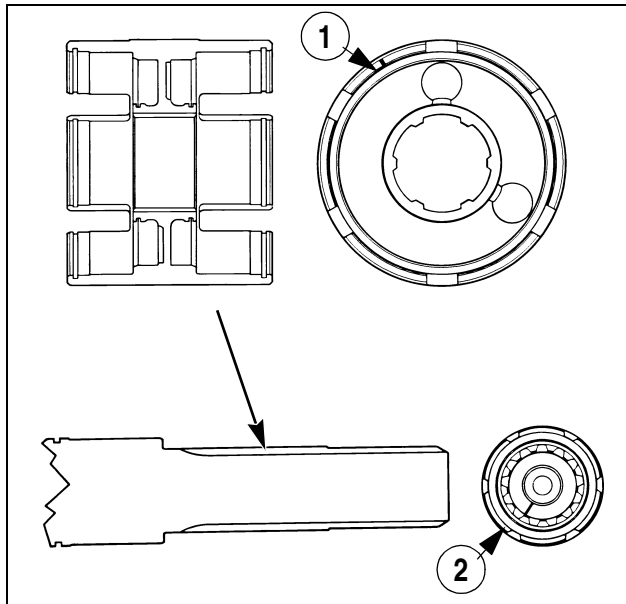
Remove eight Belleville washers.

**NOTE:** Record orientation of Belleville washers and lube management ring for reassembly. It is important that washers and ring are properly reinstalled.

### STEP 153



T95410



468L72

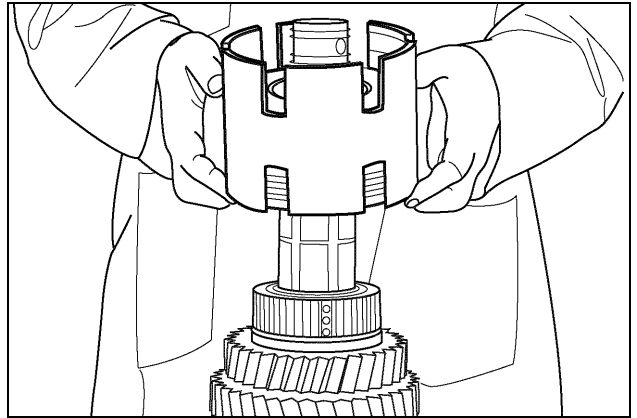
1. MARK ON FACE OF CARRIER

2. MARK ON FRONT END OF SHAFT

Remove the snap ring. Make a mark on the carrier face that will align with the mark on the end of the shaft. These marks will be used to align the carrier on the shaft during assembly.

**NOTE:** If a new part replaces an old part, make a mark on the new part that is in the same position as the mark for the old part.

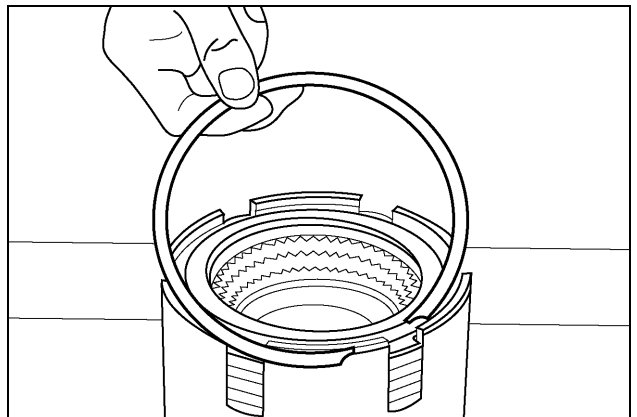
### STEP 154



A11559

Remove the clutch plate carrier from the shaft.

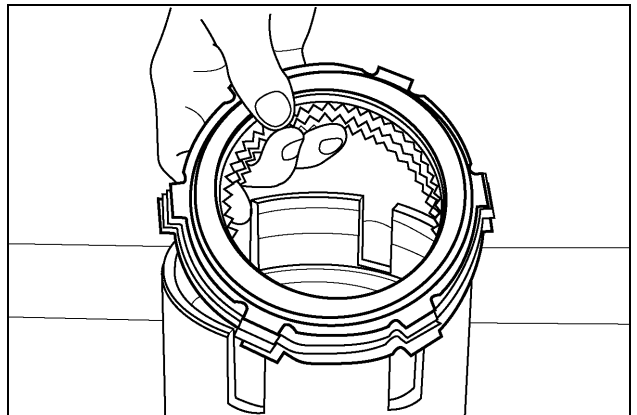
### STEP 155



A11560

Remove the snap ring from the clutch plate carrier.

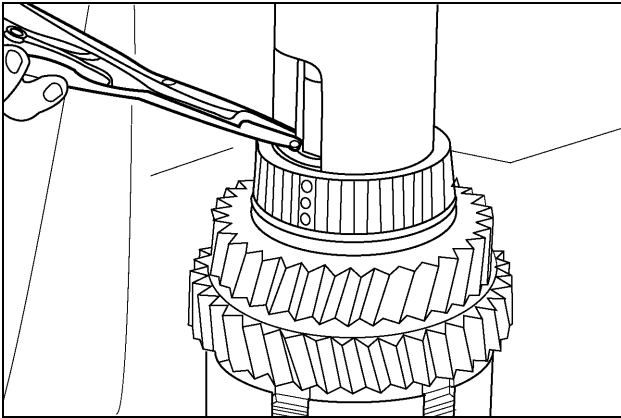
### STEP 156



A11561

Remove the backing plate, friction plates, separator plates and reaction plate.

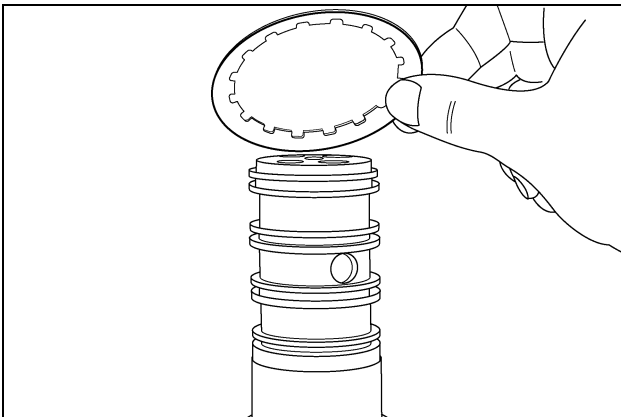
### STEP 157



A11562

Install the compression sleeve CAS1903-3 with the notch over the piston return Belleville washers. The opening in the sleeve must be over the ends of the snap ring. Compress the Belleville washers with a hydraulic press and remove the snap ring.

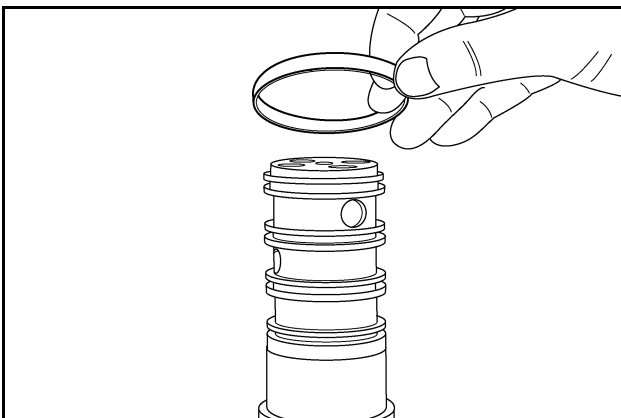
### STEP 158



RD05M010

Remove one piston return Belleville washer.

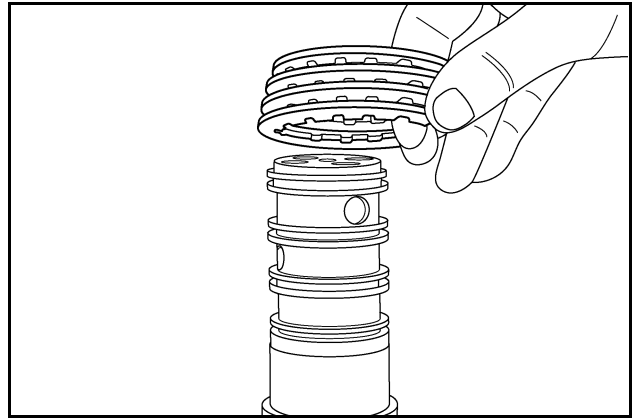
### STEP 159



RD05M011

Remove the lube management ring.

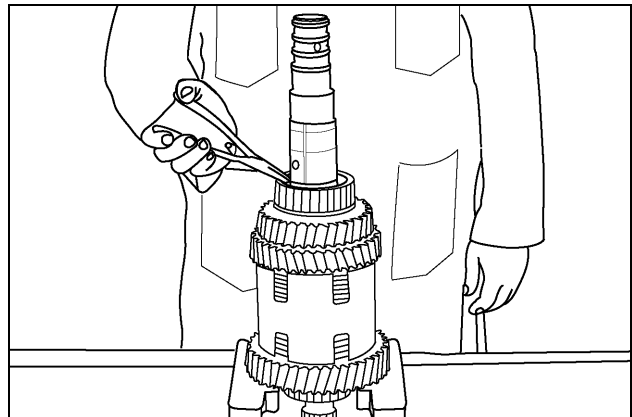
### STEP 160



RD05M012

Remove eight Belleville washers.

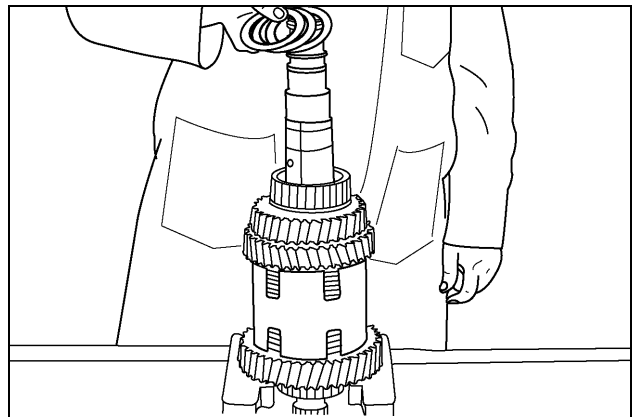
### STEP 161



T95429

Remove the snap ring.

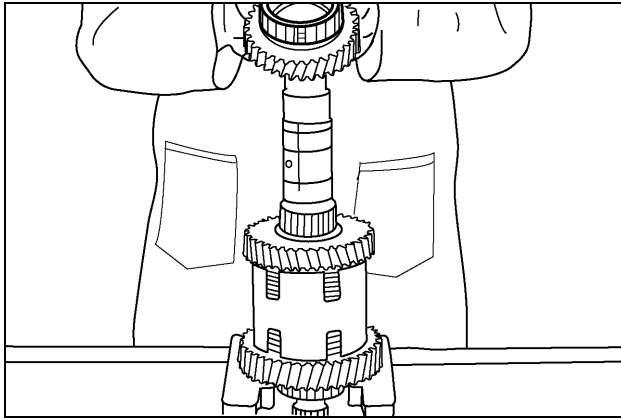
### STEP 162



T95430

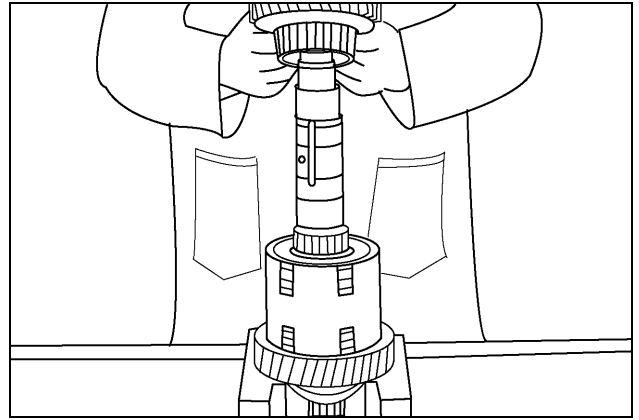
Remove the two bearing thrust washers and the needle thrust bearing.

**STEP 163**



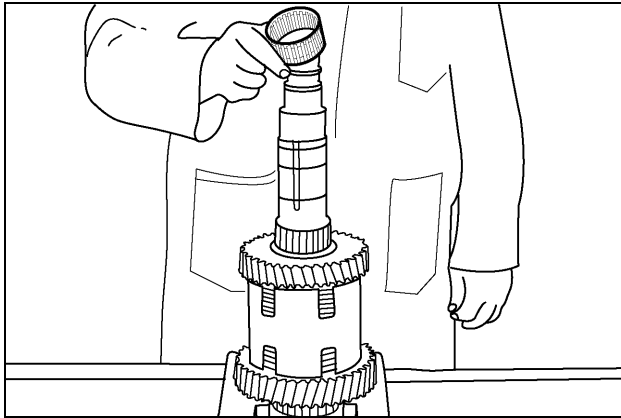
Remove the (5th-6th speed) driven gear.

**STEP 166**



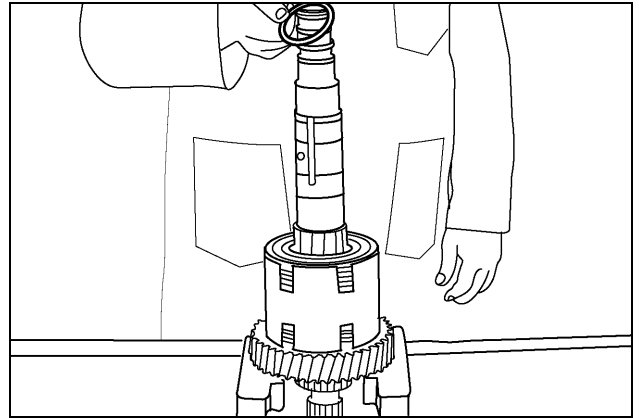
Remove the (3rd-4th speed) driven gear.

**STEP 164**



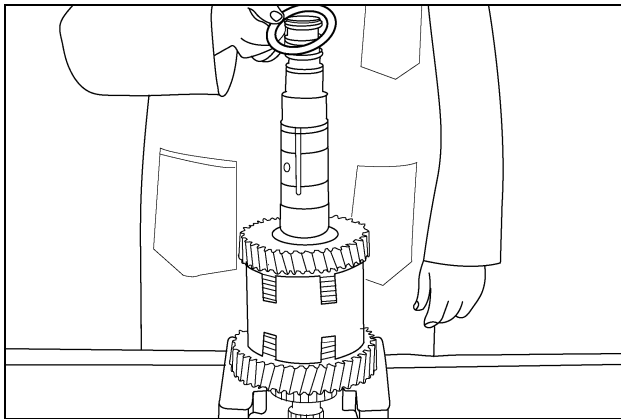
Remove the caged needle bearing.

**STEP 167**



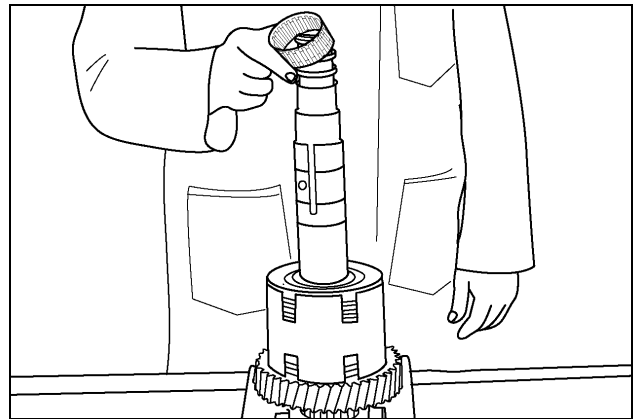
Remove the thrust washer spacer.

**STEP 165**



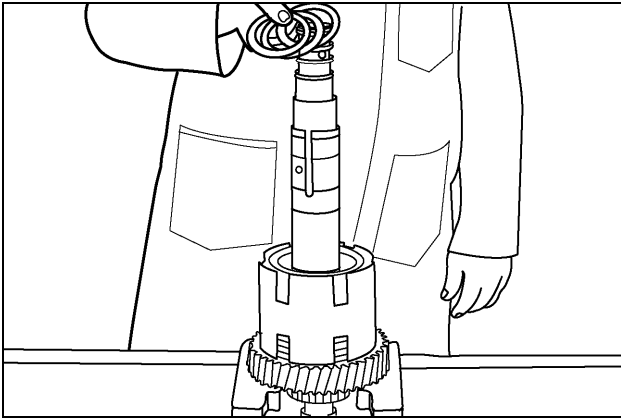
Remove the thrust washer.

**STEP 168**



Remove the caged needle bearing.

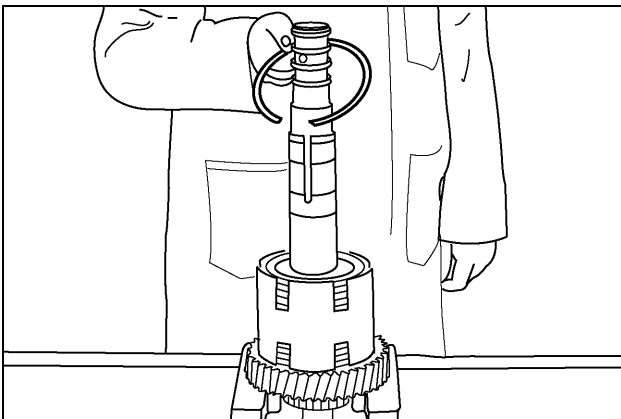
### STEP 169



T95437

Remove the two bearing thrust washers and the needle thrust bearing.

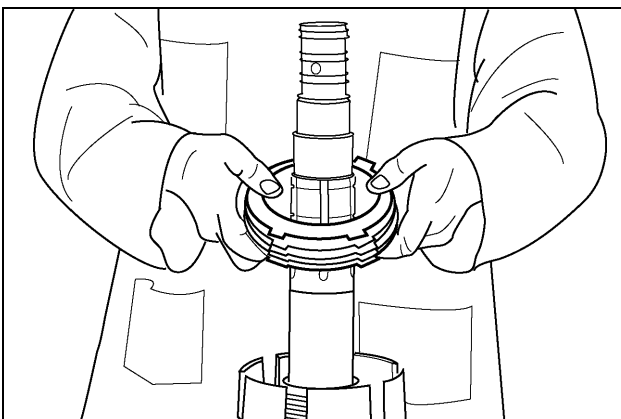
### STEP 170



T95438

Remove the snap ring from inside the clutch plate carrier.

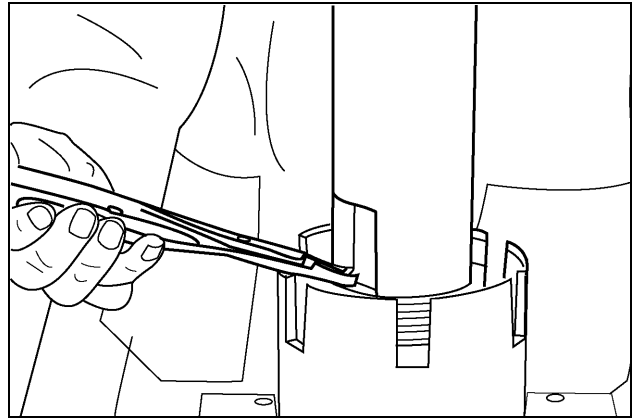
### STEP 171



A11563

Remove the backing plate, friction plates and separator plates.

### STEP 172

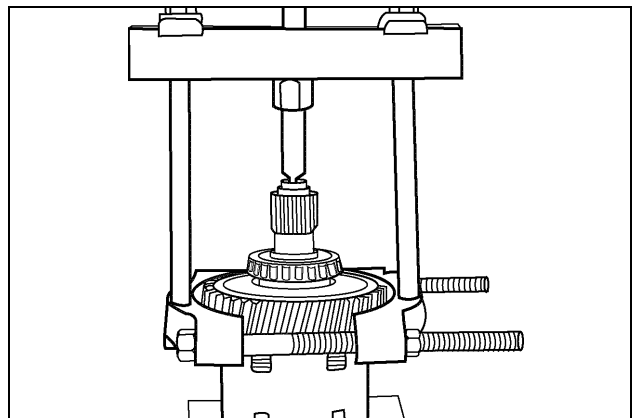


A11564

Remove Belleville washers as follows:

1. Install the compression sleeve with the notch CAS1903-3 over the piston return Belleville washers. The opening in the sleeve must be over the ends of the snap ring.
2. Compress the Belleville washers with a hydraulic press and remove the snap ring.
3. Remove the Belleville washers and lube management ring.
4. Note orientation of Belleville washers and lube management ring for later installation.

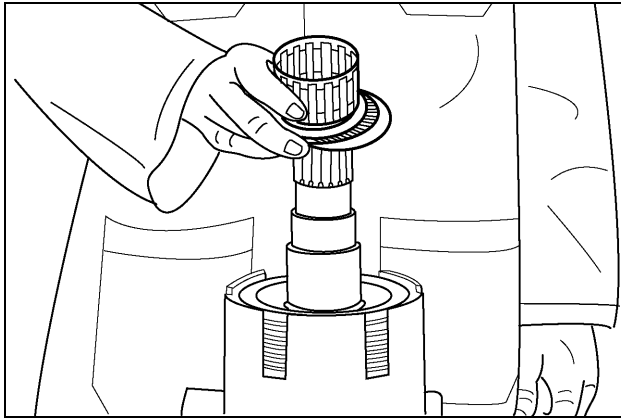
### STEP 173



A11565

Turn the shaft over. Use a bearing puller to remove the (1st-2nd) driven gear, two bearing thrust washers, needle thrust bearing and the rear bearing cone.

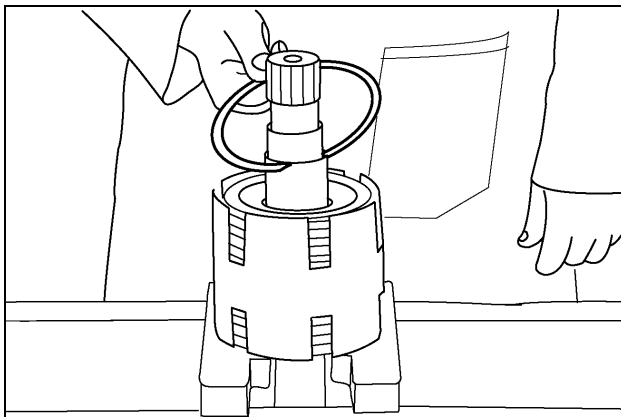
### STEP 174



A11566

Remove the caged needle bearing and the two bearing thrust washers and needle thrust bearing.

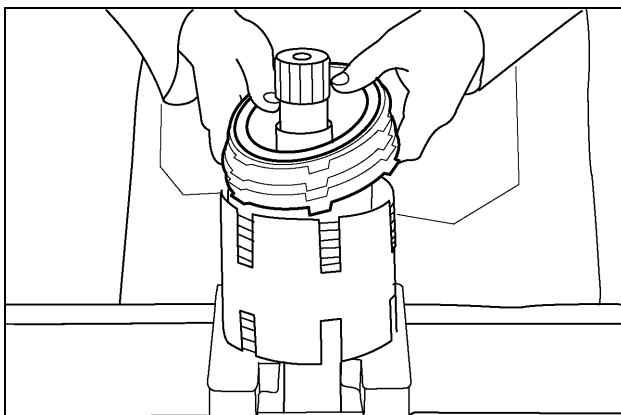
### STEP 175



T95460

Remove the snap ring from inside the clutch plate carrier.

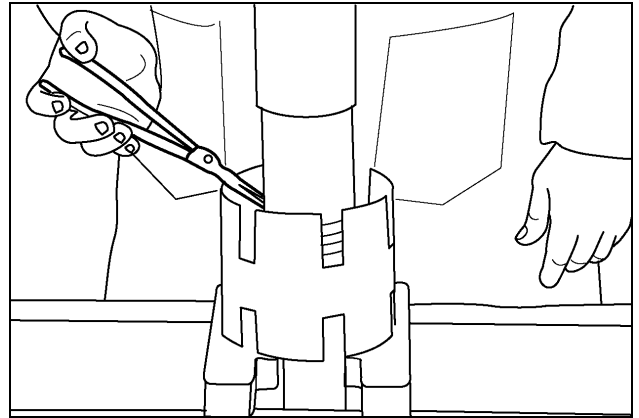
### STEP 176



T95461

Remove the backing plate, friction plates and separator plates.

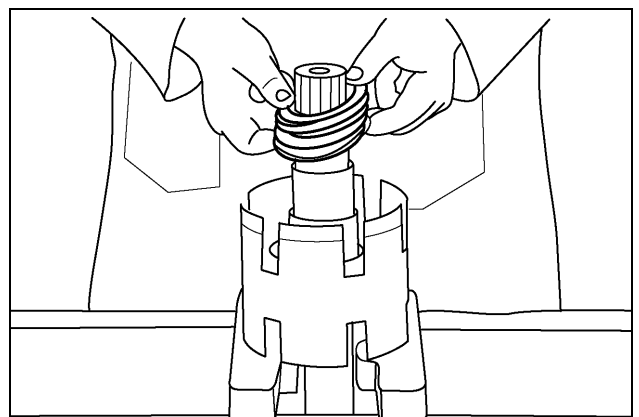
### STEP 177



T95469

Install the compression sleeve CAS1903-3 with the notch over the piston return Belleville washers. The opening in the sleeve must be over the ends of the snap ring. Compress the Belleville washers with a hydraulic press and remove the snap ring.

### STEP 178

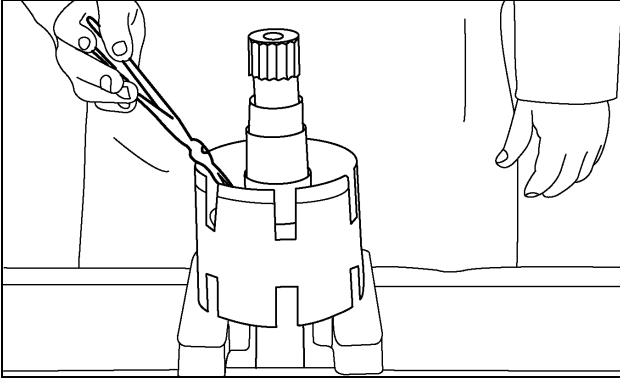


T95471

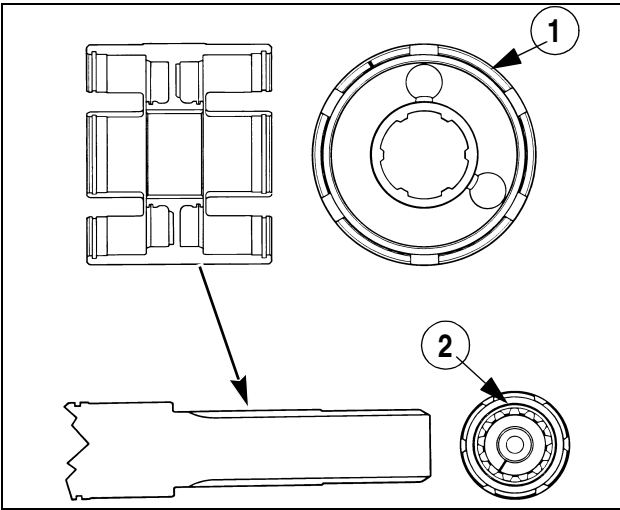
Remove the piston return Belleville washers and lube management ring. Note orientation for later installation.



## STEP 179



T95474



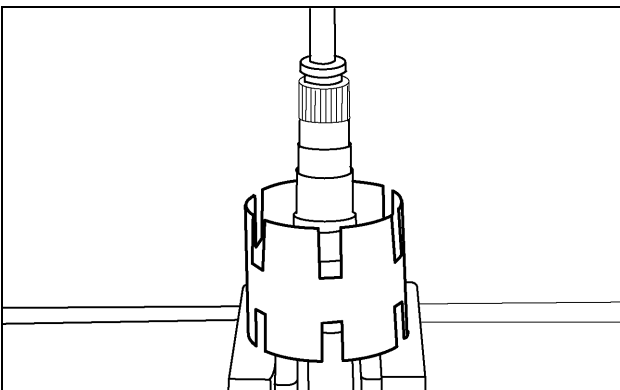
468L72

1. MARK ON CARRIER FACE    2. MARK ON SHAFT FRONT

Remove snap ring. Make a mark on carrier face that will align with mark on the end of shaft. This mark will help align carrier on the shaft during assembly.

**NOTE:** If a new part replaces an old part, make a mark on the new part that is in the same position as the mark for the old part.

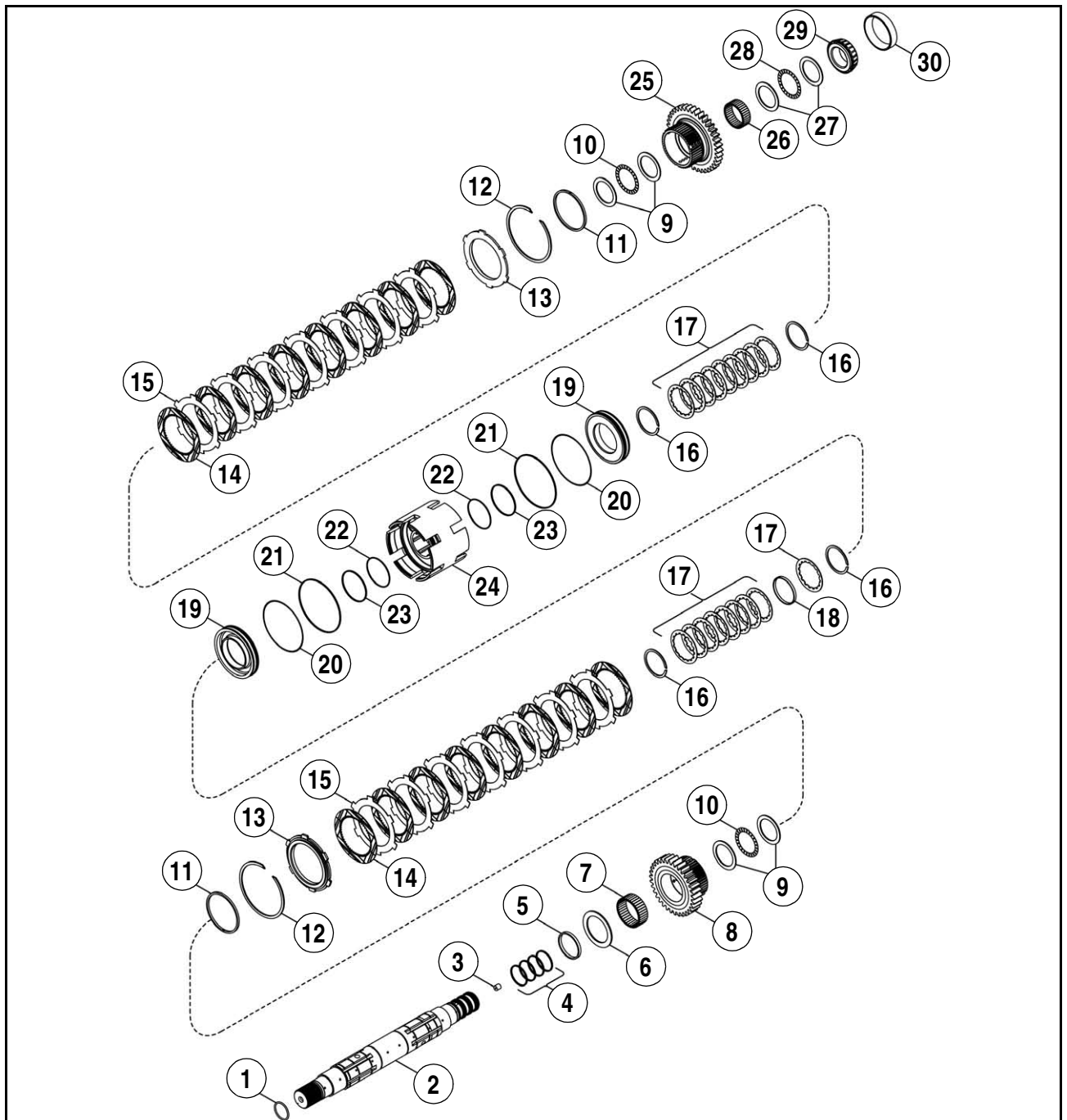
## STEP 180



T95476

Press the splined rear end of the shaft so the shaft moves through the clutch plate carrier.

# Speed Output Shaft Front Clutch Assembly

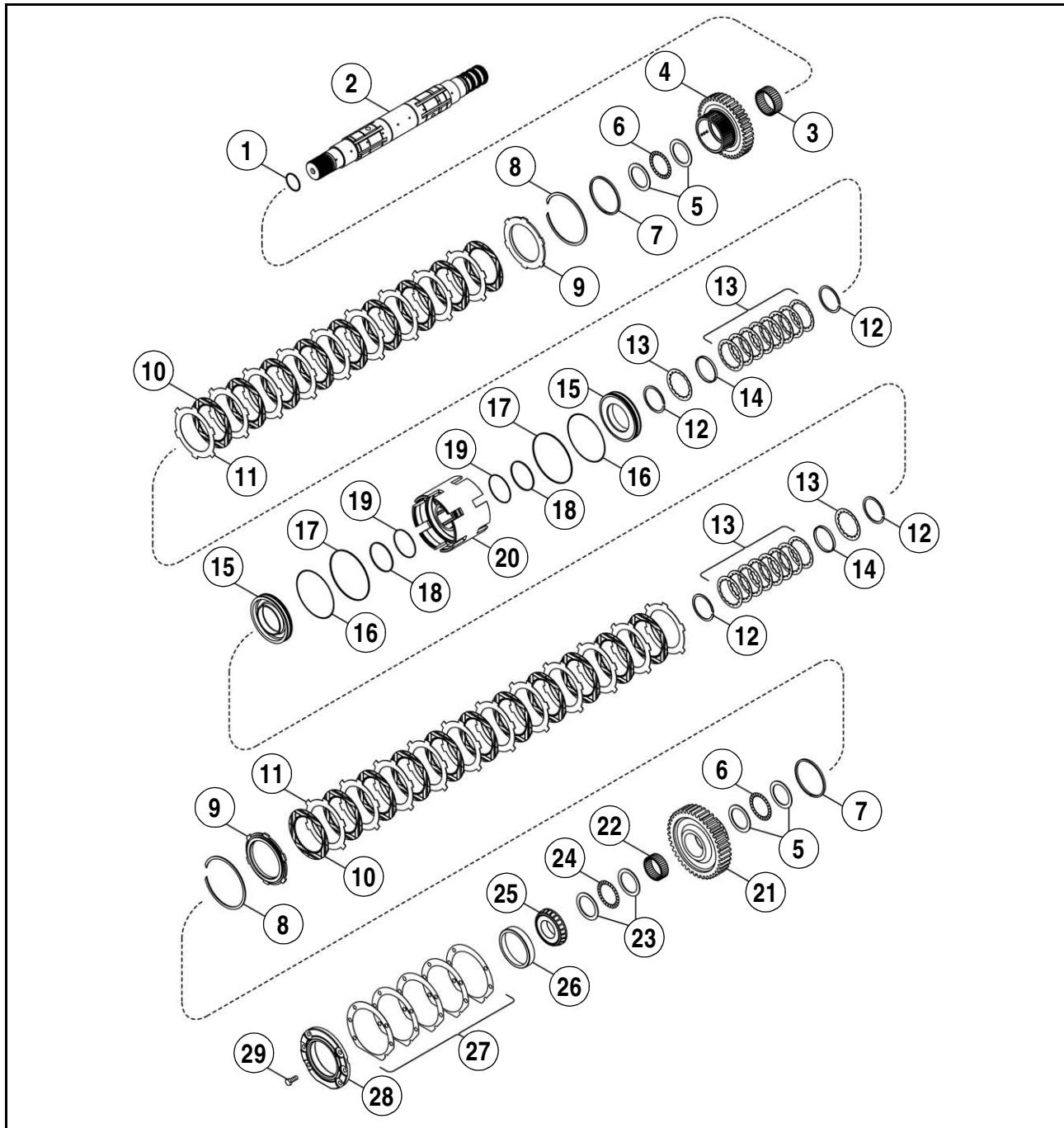


RI05N028M

**NOTE:** If any clutch pack is disassembled, new friction plates must be installed.

- |                   |                     |                       |                    |
|-------------------|---------------------|-----------------------|--------------------|
| 1. O-RING         | 9. THRUST WASHER    | 17. BELLEVILLE SPRING | 25. PINION 39T     |
| 2. SHAFT          | 10. THRUST BEARING  | 18. LUBE RING         | 26. NEEDLE BEARING |
| 3. PLUG           | 11. RING            | 19. PISTON            | 27. THRUST WASHER  |
| 4. SEAL           | 12. RETAINER RING   | 20. O-RING            | 28. THRUST BEARING |
| 5. RING           | 13. CLUTCH DISC     | 21. SEAL              | 29. BEARING CONE   |
| 6. THRUST WASHER  | 14. FRICTION PLATE  | 22. O-RING            | 30. BEARING CUP    |
| 7. NEEDLE BEARING | 15. SEPERATOR PLATE | 23. SEAL              |                    |
| 8. GEAR 34T       | 16. RETAINER RING   | 24. CARRIER           |                    |

## Speed Output Shaft Rear Clutch Assembly

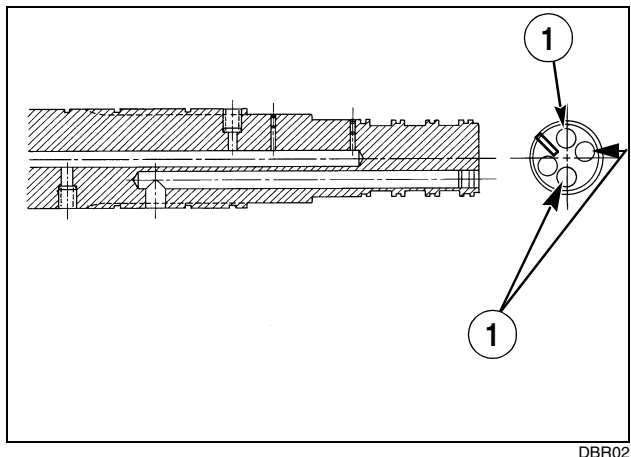


RI05N028M

**NOTE:** If any clutch pack is disassembled, new friction plates must be installed.

- |                   |                       |                    |                    |
|-------------------|-----------------------|--------------------|--------------------|
| 1. O-RING         | 9. CLUTCH DISC        | 17. SEAL RING      | 25. BEARING CONE   |
| 2. SHAFT          | 10. FRICTION DISC     | 18. SEAL RING      | 26. BEARING CUP    |
| 3. NEEDLE BEARING | 11. SEPARATOR DISC    | 19. O-RING         | 27. SHIM           |
| 4. PINION 39T     | 12. RETAINER RING     | 20. CARRIER        | 28. CAGE           |
| 5. THRUST WASHER  | 13. BELLEVILLE SPRING | 21. PINION 44T     | 29. BOLT M10 X25MM |
| 6. THRUST BEARING | 14. LUBE RING         | 22. NEEDLE BEARING |                    |
| 7. RING           | 15. PISTON            | 23. THRUST WASHER  |                    |
| 8. RETAINER RING  | 16. O-RING            | 24. THRUST BEARING |                    |

### STEP 181

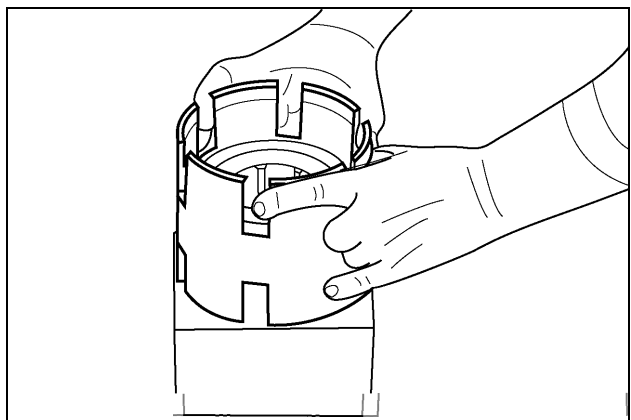


1. PLUG

DBR02

1. Install the plug (2) flush to the surface, as shown.
2. Make sure that all the oil passages in the shaft are clean and open.

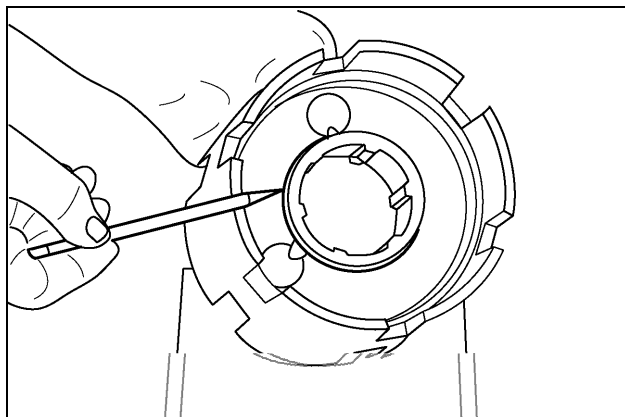
### STEP 182



T95479

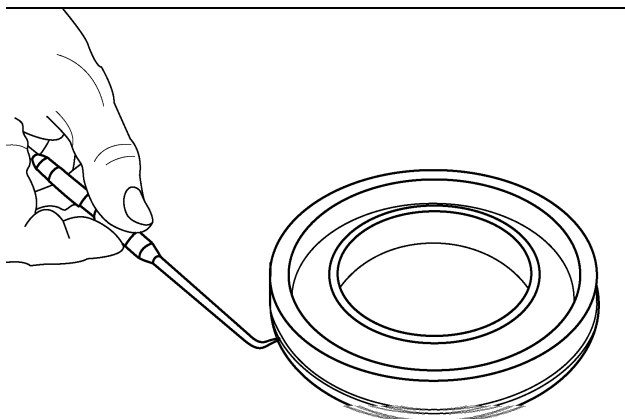
Hit the clutch carrier against a wood block to remove the clutch pistons.

### STEP 183



T95337

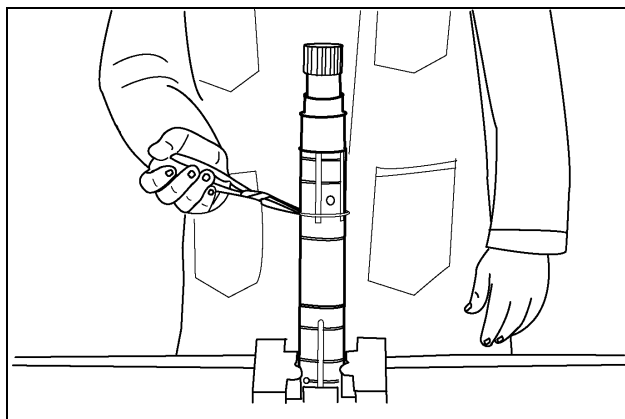
Replace the teflon ring and O-ring on the piston and carrier as follows:



40-35

1. Install the O-ring in the groove.
2. Install the teflon ring over the O-ring.

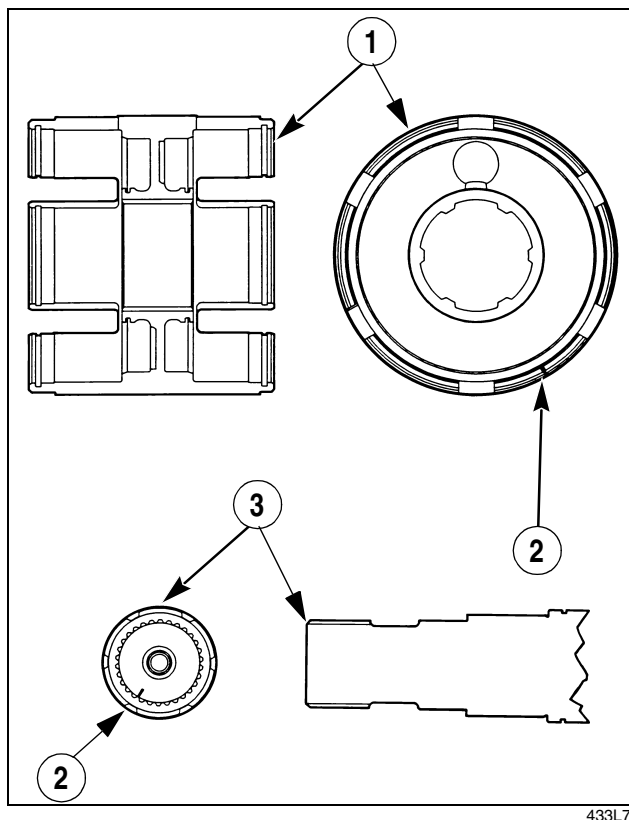
### STEP 184



T95497

Install the snap ring into the third groove in the shaft, down from the rear end of the shaft.

## STEP 185



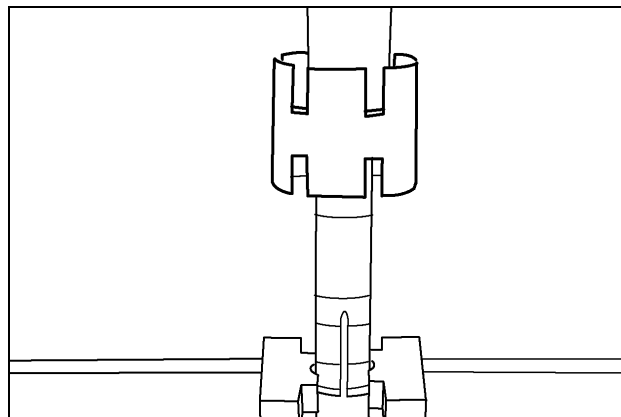
1. FRONT FACE OF CARRIER
2. MARK
3. REAR END OF SHAFT

433L7

Before pressing the shaft through the clutch plate carrier, find the etch mark that was made in Step 170 on the rear end of the shaft and on the front face of the rear clutch plate carrier.

**NOTE:** If a new part replaces an old part, make a mark on the part that is in the same position as the mark for the old part.

## STEP 186

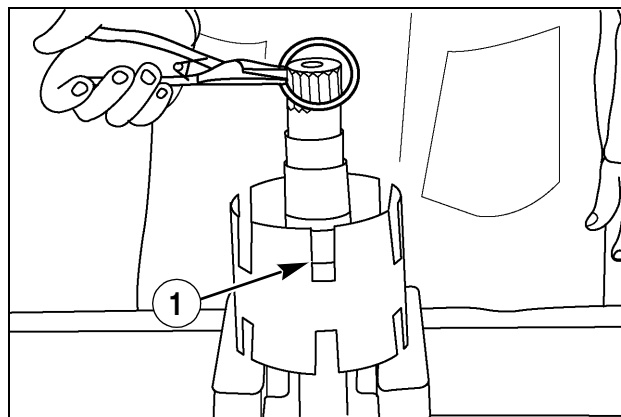


T95498

Assemble the clutch plate carrier as follows:

1. Install the front end of the rear clutch plate carrier over the rear end of the shaft.
2. Align the mark on the rear end of the shaft with the mark on the front face of the rear clutch plate carrier before pressing the carrier over the shaft, aligning the marks will align the oil holes in the shaft with the oil holes in the carrier.
3. Press the carrier down on the shaft until the carrier is against the snap ring.
4. Check to be sure that all the oil holes in the shaft and carrier are aligned.

## STEP 187

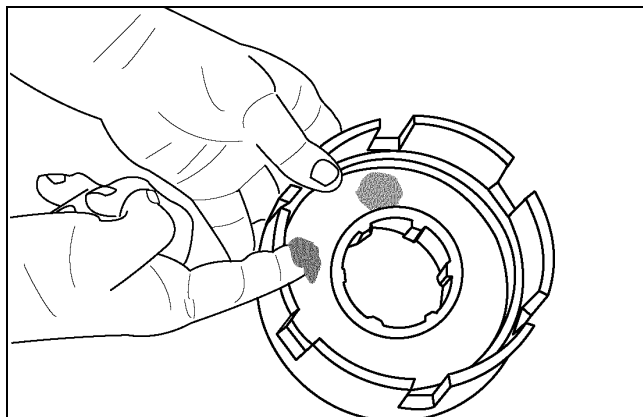


T95475

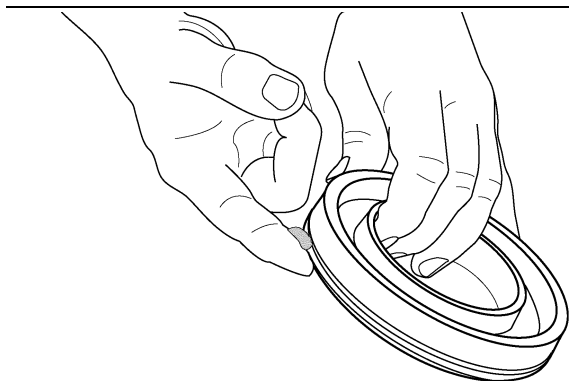
1. CARRIER RETAINING RING SLOT

Install the carrier retaining ring.

### STEP 188



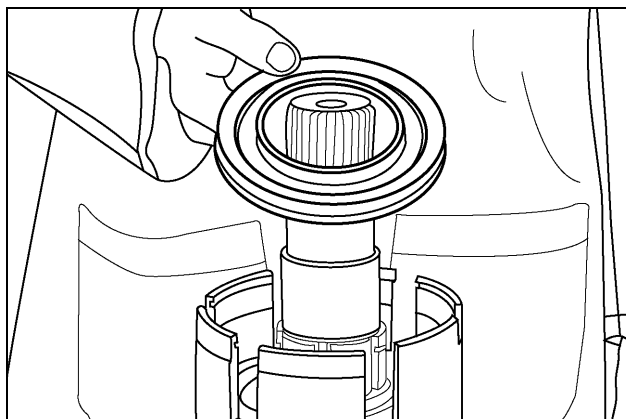
T95280



41-3

Apply petroleum jelly to the teflon rings.

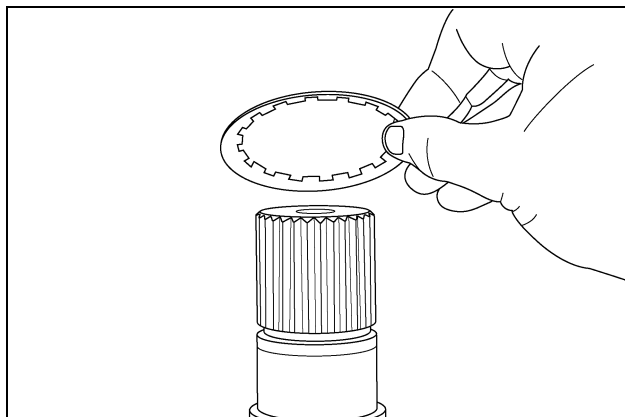
### STEP 189



A11568

Install a piston in each side of the clutch carrier with the flat side toward the inside.

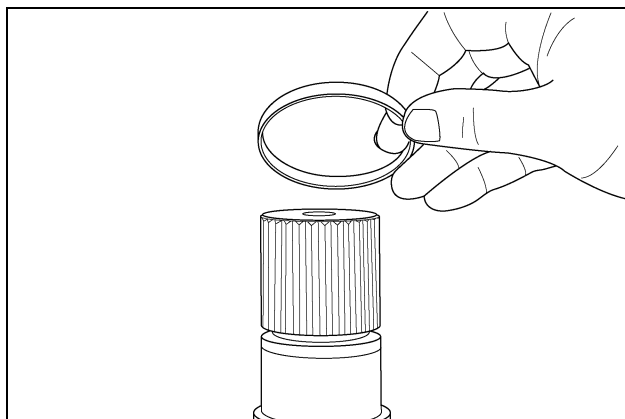
### STEP 190



Rd05M007

Install the first piston return Belleville washer. The concave side of the washer must be facing down.

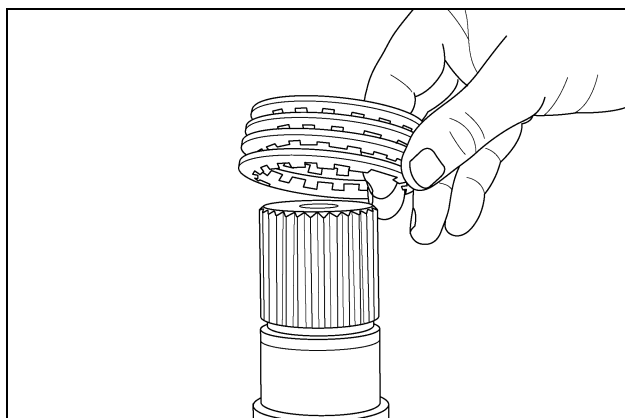
### STEP 191



Rd05M008

Install the lube management ring.

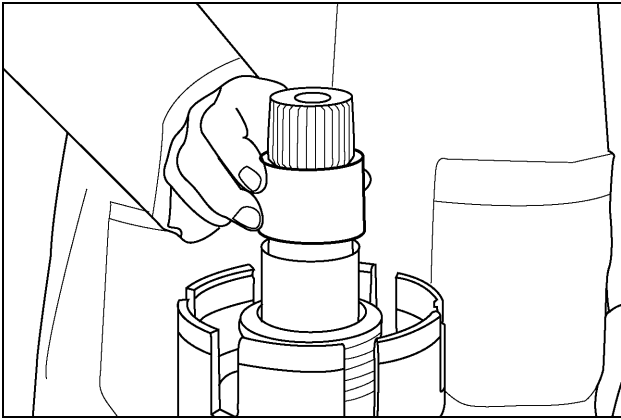
### STEP 192



RD05M009

Install the second Belleville washer. The concave side of the washer must be facing up. Install the remaining seven Belleville washers, alternating the position of the washers until the last washer with the concave side facing down.

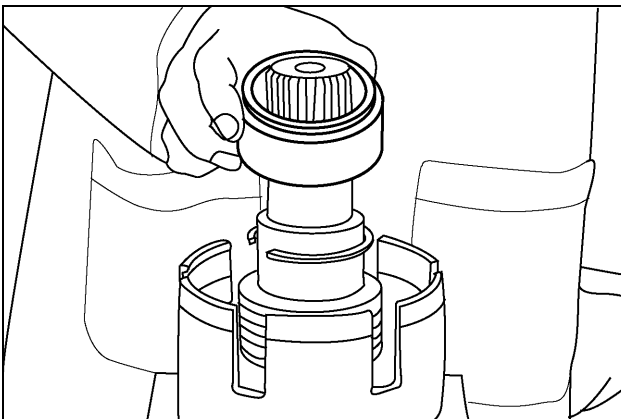
### STEP 193



A11571

Install the centering sleeve CAS1903-4 over the shaft.

### STEP 194



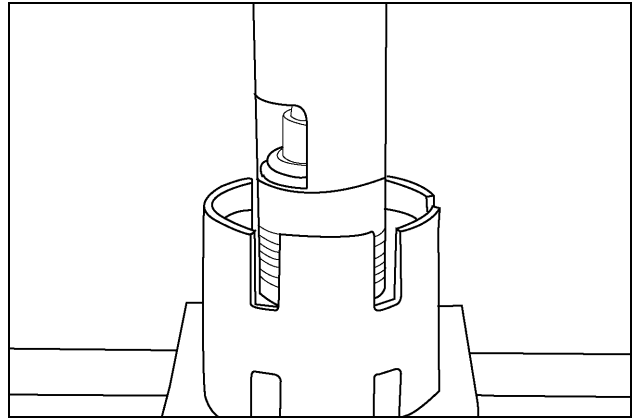
A11573

Install snap ring as follows:

1. Install the snap ring over the centering sleeve.
2. Install the Belleville washer compression sleeve CAS1903-5 over the shaft and centering sleeve. The compression sleeve will rest on top of the snap ring.

**NOTE:** The smaller OD side of the sleeve must be facing up.

### STEP 195

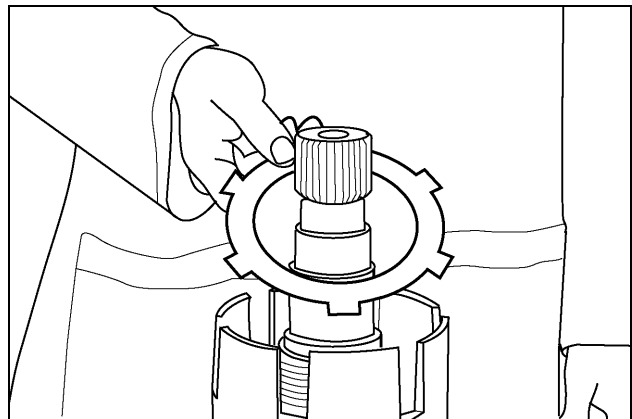


A11574

Install the sleeves and snap ring as follows:

1. Install the compression sleeve with the notch over the shaft.
2. Use a hydraulic press to press the sleeves down. The snap ring will be pushed into position in the groove with the pin between the snap ring ends.
3. Verify that the snap ring is properly seated in the groove.

### STEP 196

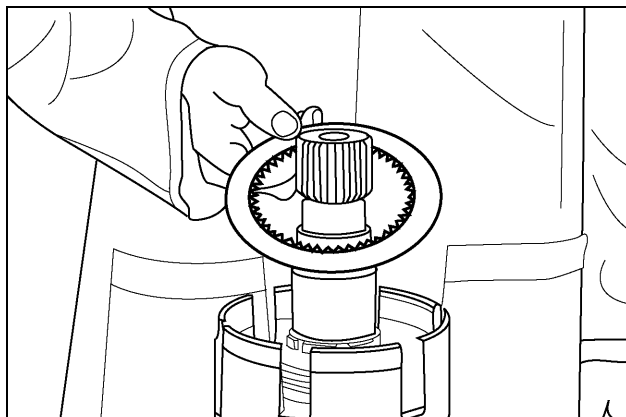


A11576

Install a separator plate.

**NOTE:** 1st and 3rd clutch does not use a reaction plate (thicker than separator plate).

### STEP 197

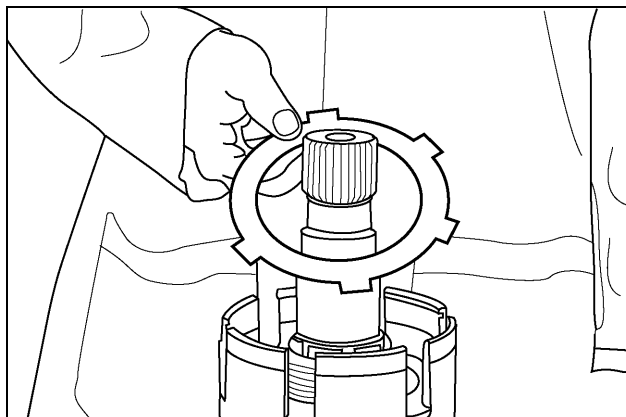


A11577

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

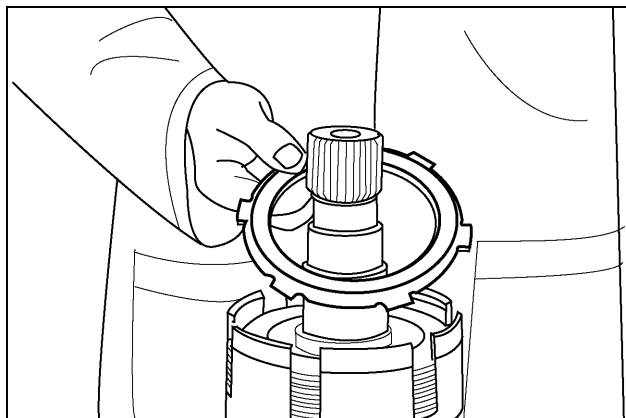
### STEP 198



A11578

Install the remaining 10 separator plates and 10 friction plates, alternating the plates.

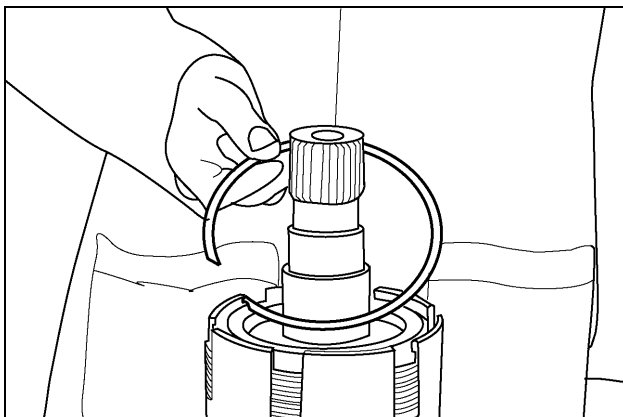
### STEP 199



A11579

Install the backing plate. The flat side of the plate must face down.

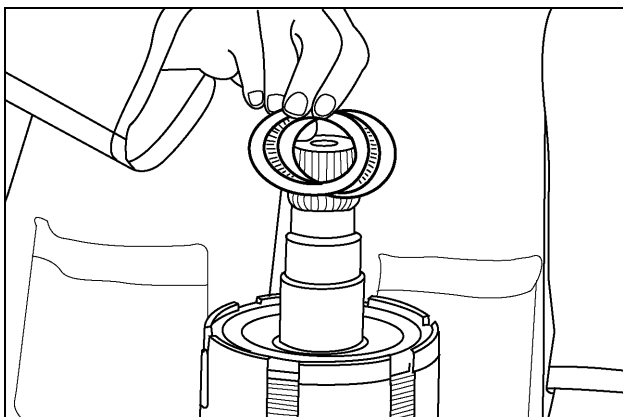
### STEP 200



A11580

Install the snap ring.

### STEP 201

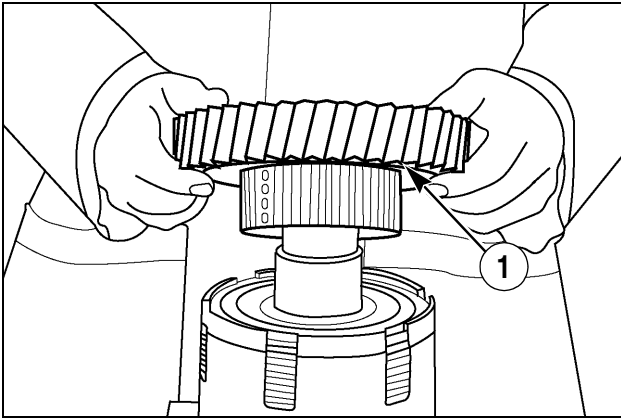


A11581

Install the needle thrust bearing and the two bearing thrust washers. The needle thrust bearing must be between the two bearing thrust washers.



## STEP 202



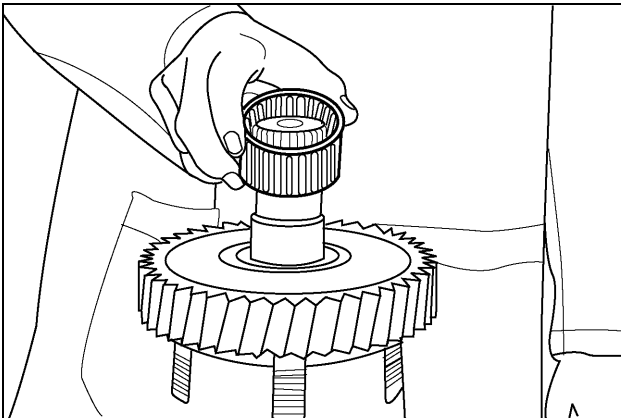
A11582

### 1. SEAL

Install 1st-2nd speed driven gear as follows:

1. Install a new seal ring on the (1st-2nd speed) driven gear.
2. Align the friction plate teeth. Install the gear into the clutch pack. The splined hub of the gear must be facing down.
3. Slight oscillation of the gear will help with the installation. The splined hub of the gear must engage all the friction plates.

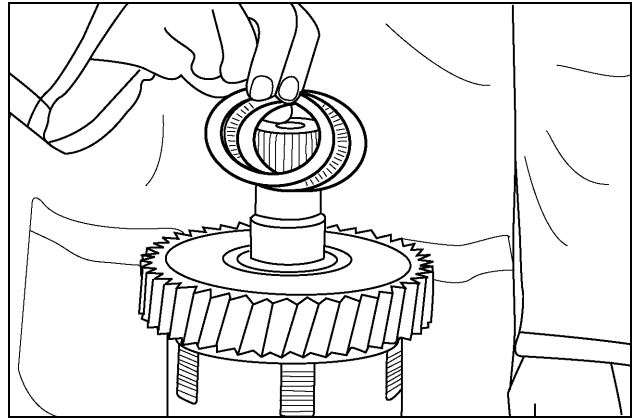
## STEP 203



A11583

Install a caged needle bearing into the gear hub.

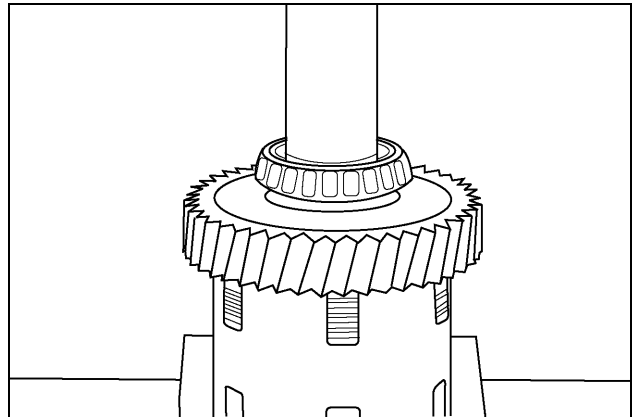
## STEP 204



A11584

Install the two bearing thrust washers and the needle thrust bearing. The needle thrust bearing must be between the two bearing thrust washers.

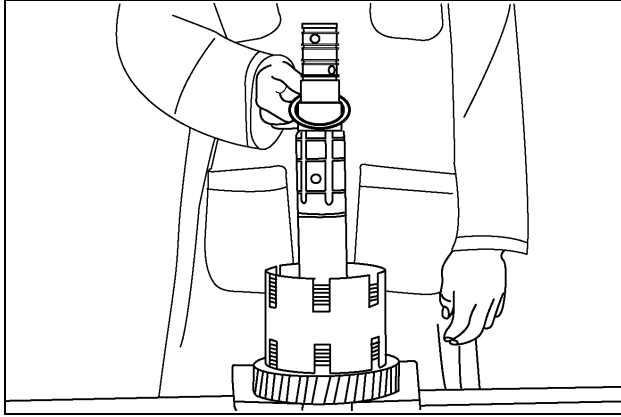
## STEP 205



A11585

Install the bearing on the shaft with larger OD side of the bearing cone facing down. Press the bearing on the inner race to properly seat the bearing on the shaft.

### STEP 206

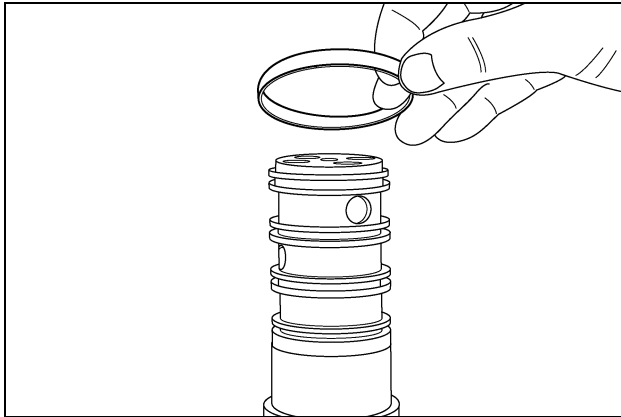


A11592

Turn the shaft over and install the first piston return Belleville washer.

**NOTE:** *The concave side of the washer must be facing down.*

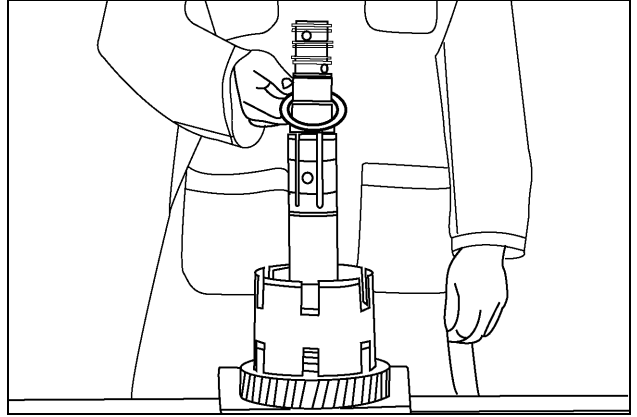
### STEP 207



Rd05M011

Install the lube management ring.

### STEP 208



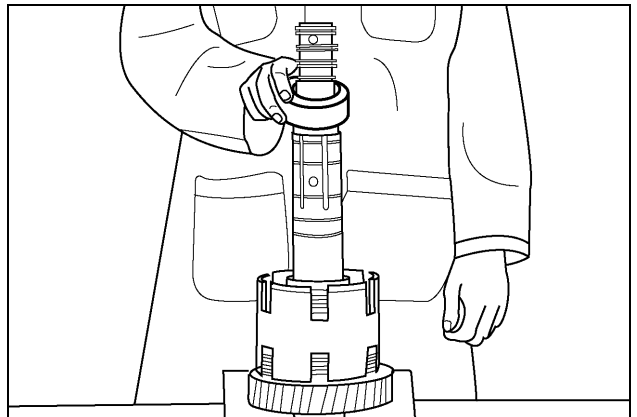
A11593

Install the second Belleville washer.

**NOTE:** *The concave side of the washer must be facing up.*

Install the remaining seven Belleville washers, alternating the position of the washers until the last washer has the concave side facing down.

### STEP 209



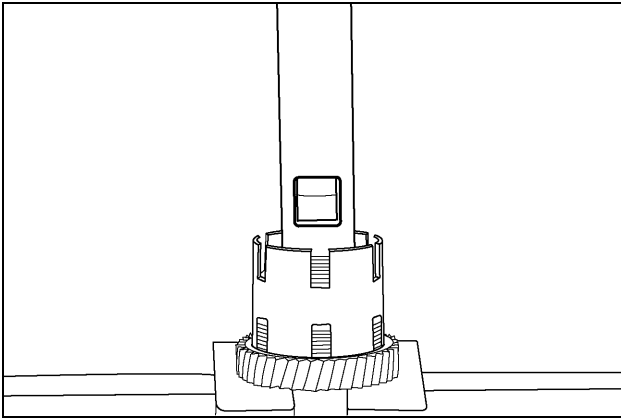
A11595

1. Install the snap ring over the shaft.

2. Install the Belleville washer compression sleeve CAS1903-5 over the shaft and on top of the snap ring.

**NOTE:** *The smaller OD side of the sleeve must be facing up.*

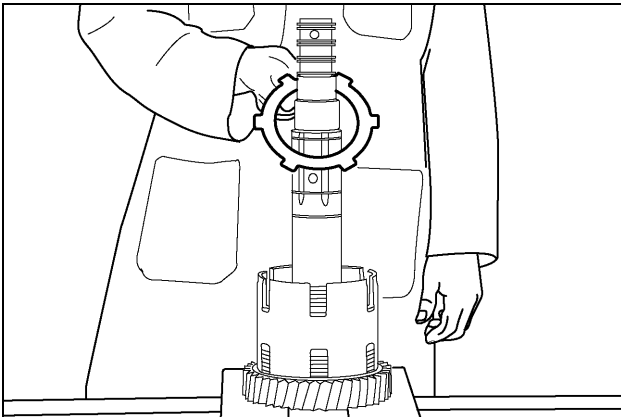
## STEP 210



A11596

1. Install the compression sleeve CAS1903-3 with the notch over the shaft.
2. Use a hydraulic press to press the sleeves down. The snap ring will be pushed into position in the groove.
3. Verify that the snap ring is seated properly in the groove.

## STEP 211

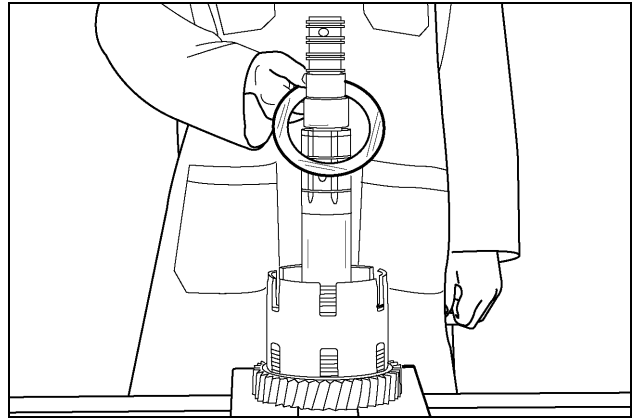


A11598

Install a separator plate.

**NOTE:** 1st and 3rd clutch does not use a reaction plate (thicker than separator plate).

## STEP 212

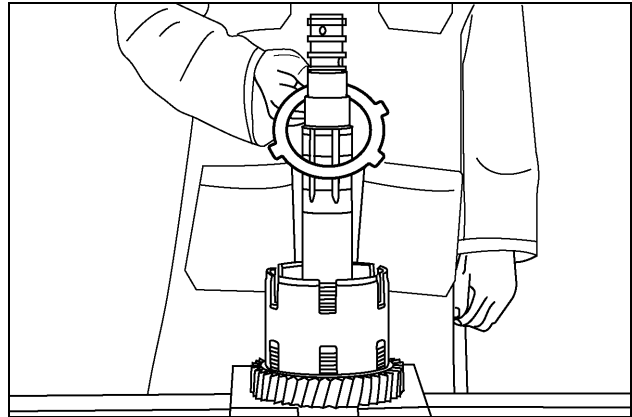


A11599

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

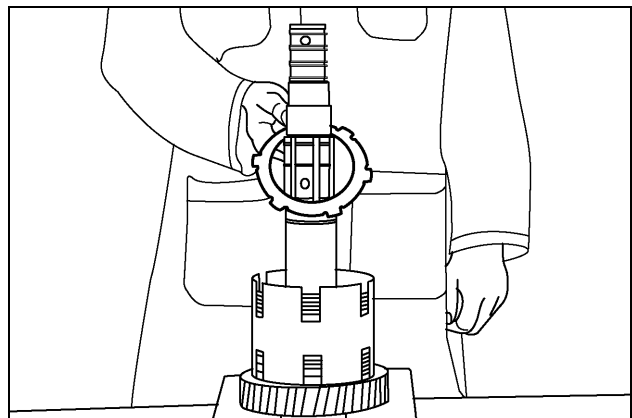
## STEP 213



A11600

Install the remaining 8 separator plates and 8 friction plates, alternating the plates.

## STEP 214

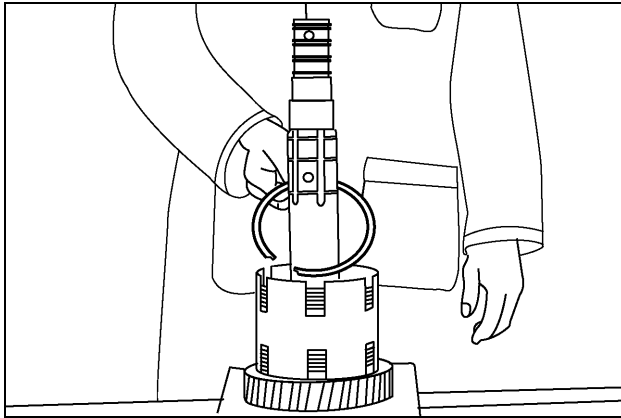


A11590

Install the backing plate.

**NOTE:** The flat side of the plate must face down.

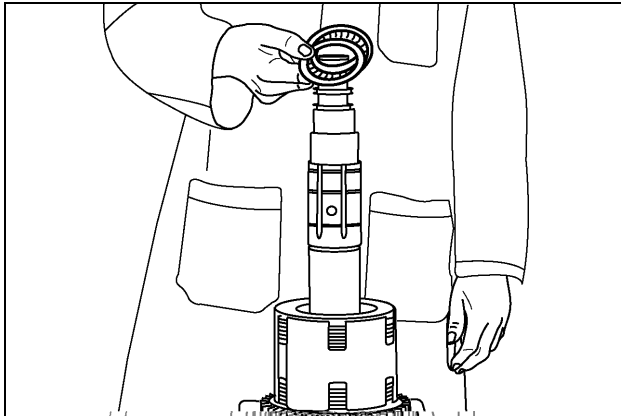
### STEP 215



A11591

Install the snap ring.

### STEP 216

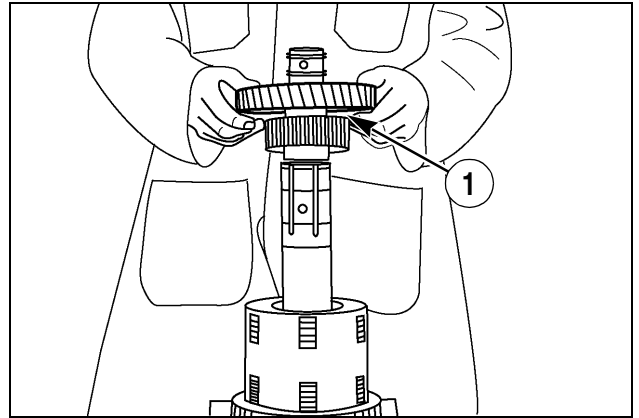


A11601

Install the two bearing thrust washers and the needle thrust bearing.

**NOTE:** *The needle thrust bearing must be between the two bearing thrust washers.*

### STEP 217



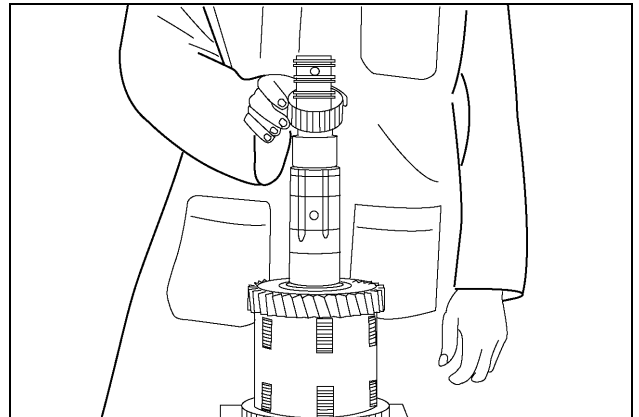
A11602

1. SEAL

Install the 3rd-4th speed driven gear as follows:

1. Install a new seal ring on the (3rd - 4th speed) driven gear.
2. Align the friction plate teeth. Install the gear into the clutch pack. The splined hub of the gear must be facing down.
3. Slight oscillation of the gear will help with the installation.
4. The splined hub of the gear must engage all the friction plates.

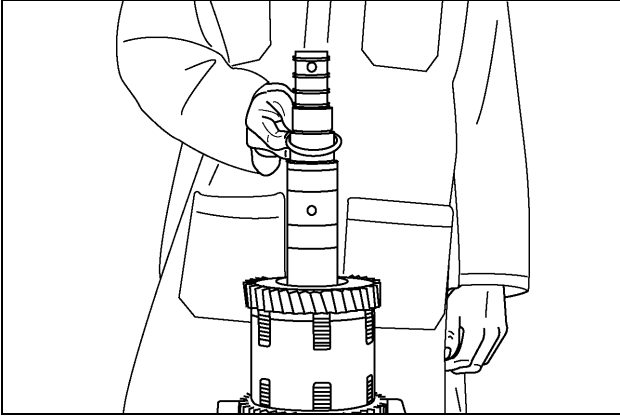
### STEP 218



A11603

Install the caged needle bearing.

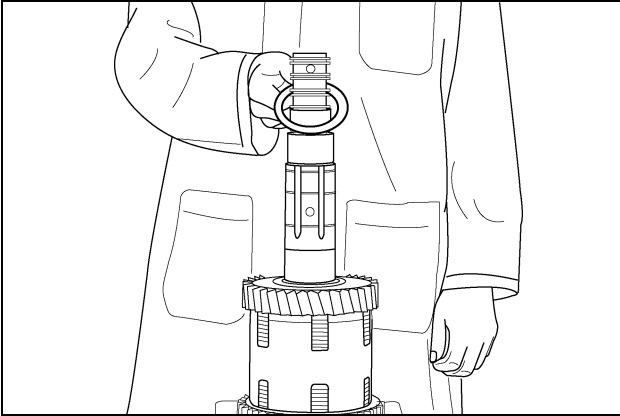
### STEP 219



A11604

Install the spacer.

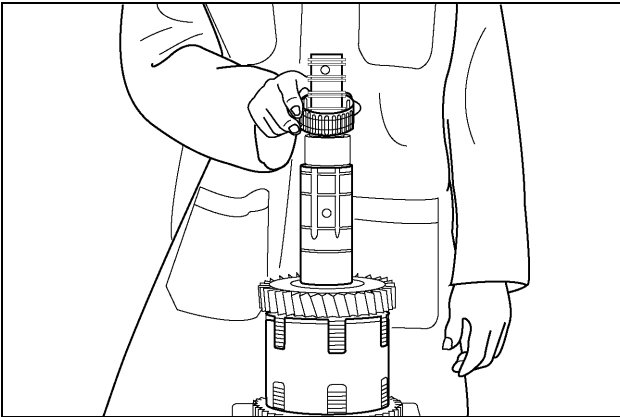
### STEP 220



A11605

Install the fiber thrust washer on the spacer ring.

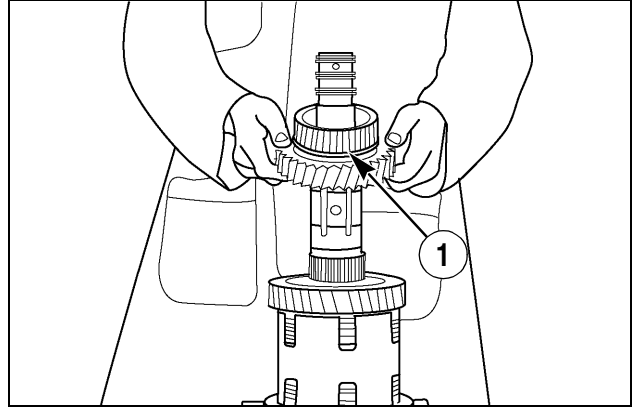
### STEP 221



A11606

Install another caged needle bearing.

### STEP 222

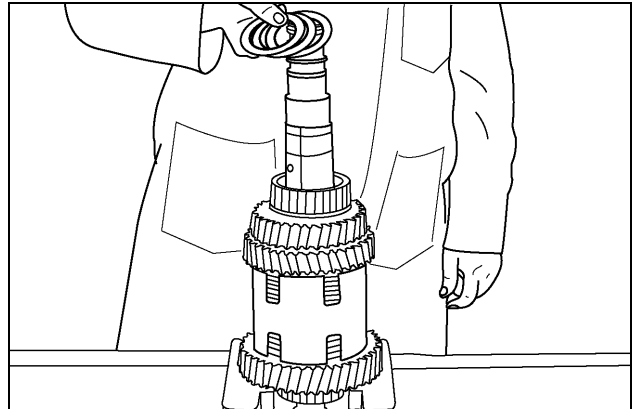


A11607

Install a new seal ring on the (5th-6th speed) gear.  
Install the gear on the shaft.

**NOTE:** *The splined hub of the gear must be facing up.*

### STEP 223

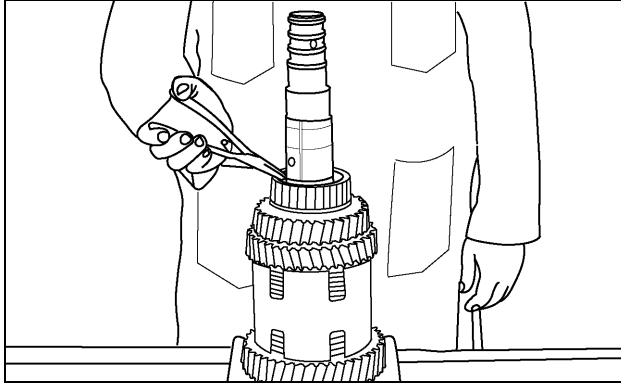


T95430

Install the two bearing thrust washers and the needle thrust bearing.

**NOTE:** *The needle thrust bearing must be between the two bearing thrust washers.*

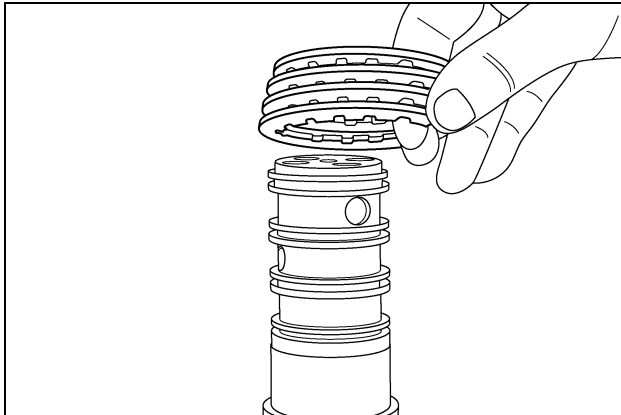
### STEP 224



T95429

Install the retaining ring for the piston return Belleville washers on the shaft.

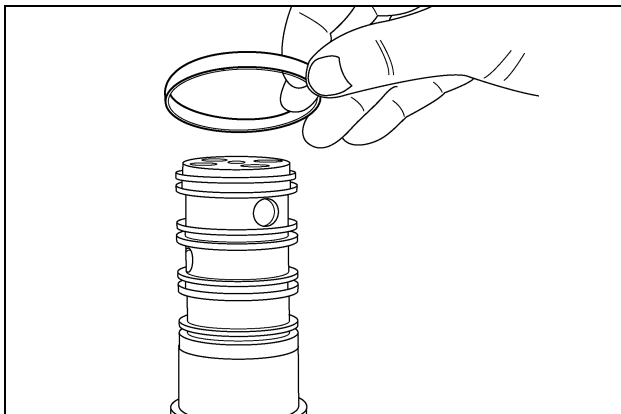
### STEP 225



RD05M012

1. Install the first washer with the concave side facing up.
2. Install the second washer with the concave side facing down.
3. Install the next six washers, alternating the position of the washers until the last washer concave side is facing up.

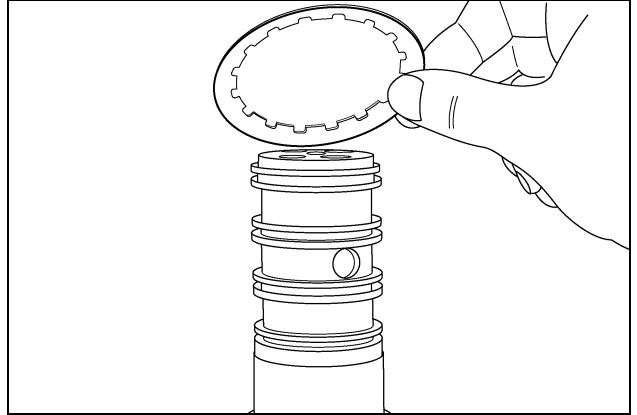
### STEP 226



RD05M011

Install the lube management ring.

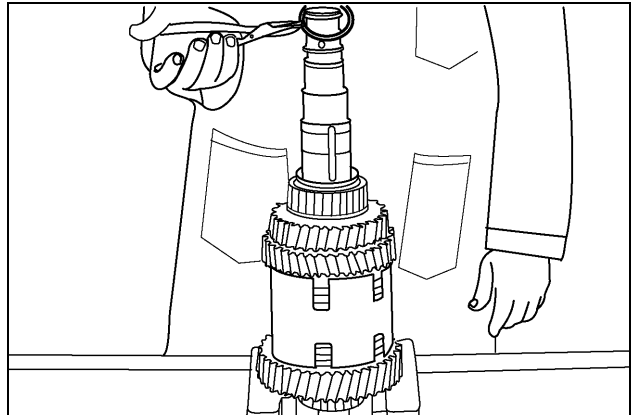
### STEP 227



RD05M010

Install final washer with concave facing upward.

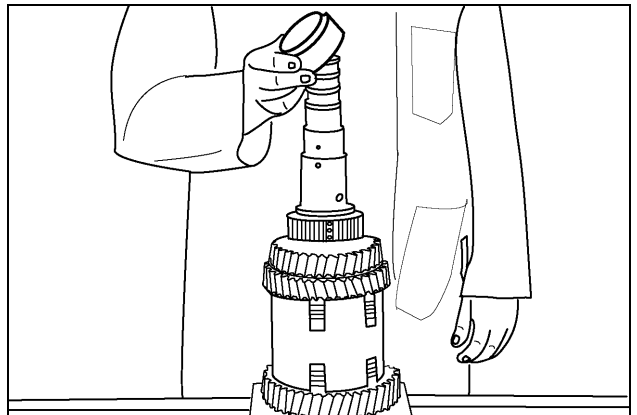
### STEP 228



T95424

Install the snap ring on the shaft and let the snap ring lie on top of the last piston return Belleville washer that was installed.

### STEP 229

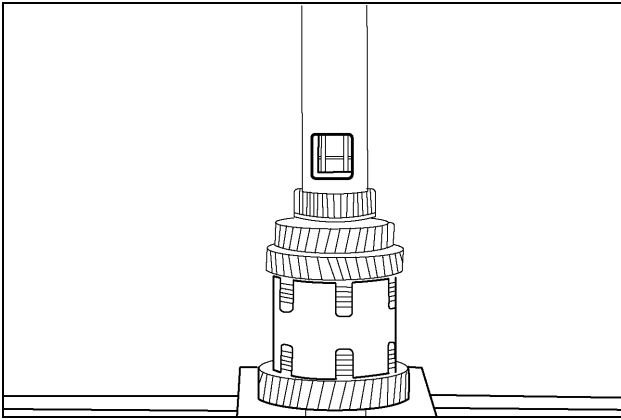


T95499

Install the Belleville washer compression sleeve CAS1903-5 on the shaft and over the piston return Belleville washers.

**NOTE:** The smaller OD end of the sleeve must be facing up.

### STEP 230

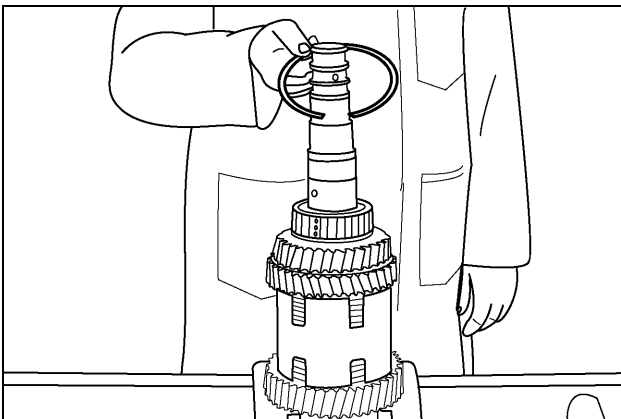


A11608

Install the snap ring as follows:

1. Install the compression sleeve CAS1903-3 with the notch over the shaft.
2. Use a hydraulic press to press the sleeves down. The snap ring will be pushed into position in the groove.
3. Verify that the snap ring is seated properly in the groove.

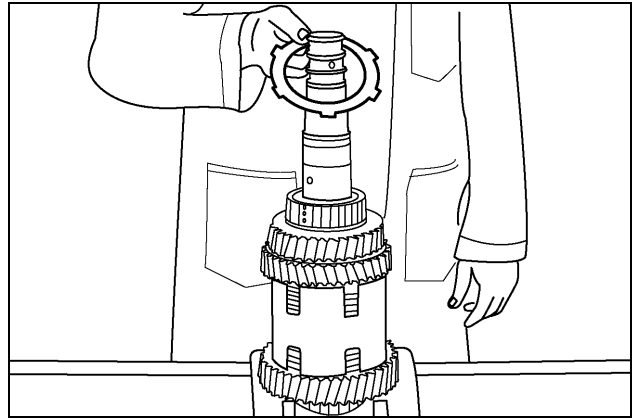
### STEP 231



T95415

Put the clutch pack retaining ring on top of the gear.

### STEP 232

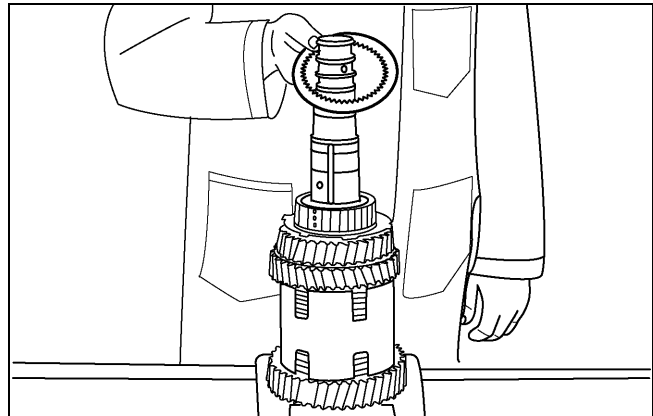


T95416

Install the backing plate over the gear.

**NOTE:** The flat side of the place must be facing up.

### STEP 233

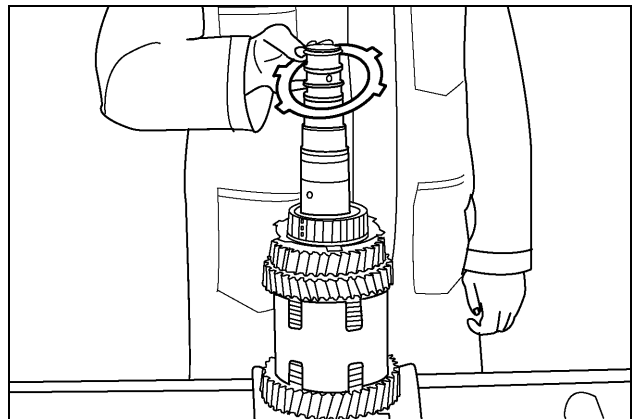


T95417

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

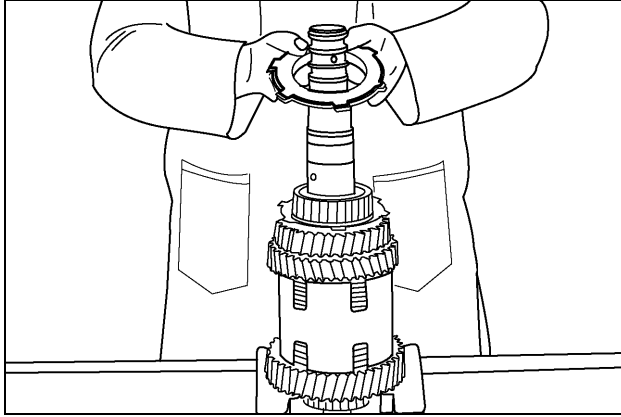
### STEP 234



T95418

Install a separator plate.

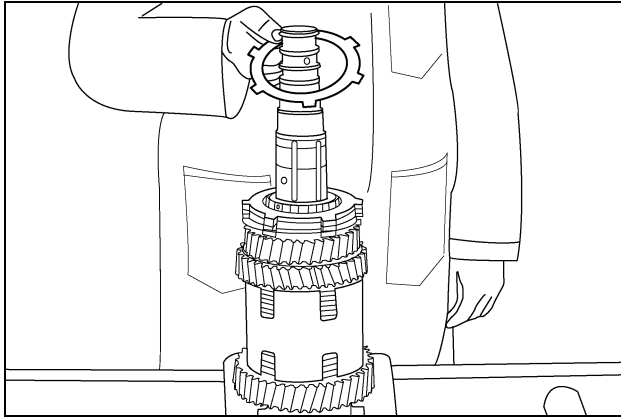
### STEP 235



T95419

Install the remaining six new friction plates and five separator plates, alternating the plates.

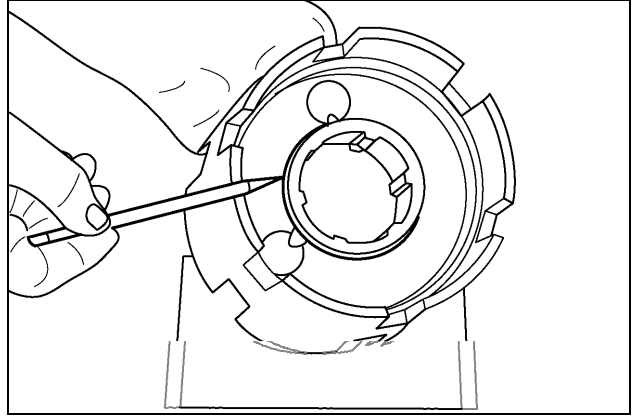
### STEP 236



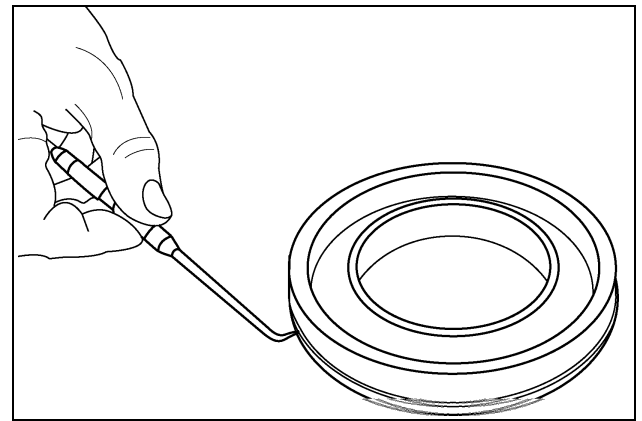
T95420

Install the reaction plate (thicker separator plate) over the gear.

### STEP 237



T95337

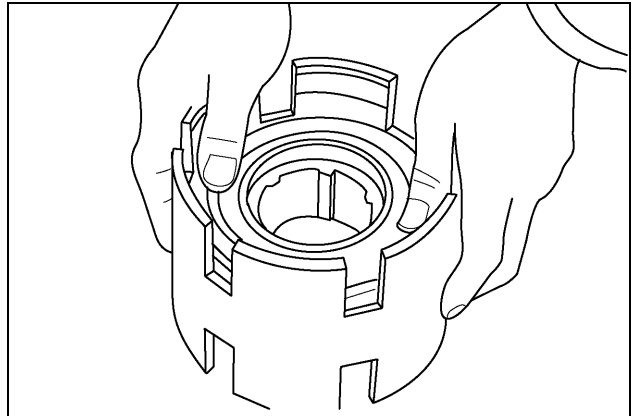


40-35

Install the teflon and O-rings as follows:

1. Hit the clutch carrier against a wood block to remove the clutch pistons.
2. Replace the teflon ring and O-ring on the carrier and piston.
3. Install the O-ring in the groove.
4. Install the teflon ring over the O-ring.

### STEP 238

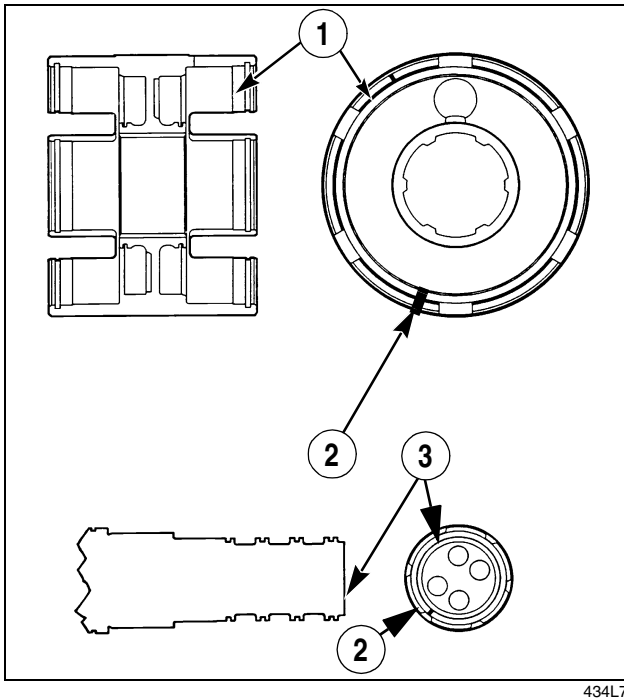


A11609

Apply petroleum jelly to the teflon rings and install the 5th clutch piston into the carrier.



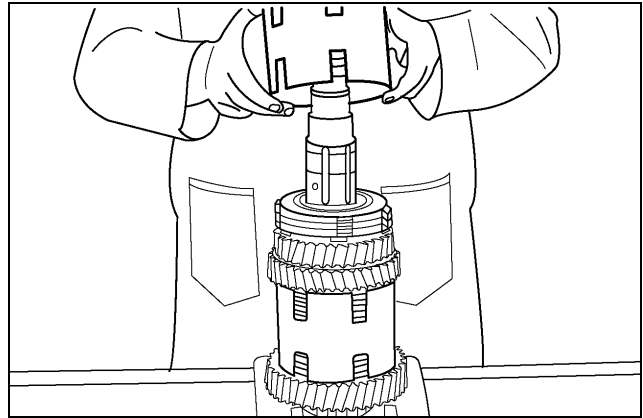
## STEP 239



1. FRONT FACE OF CARRIER
2. MARK
3. FRONT FACE OF SHAFT

Before installing the front clutch plate carrier on the shaft, find the mark made in Step 146 on the front face of the carrier and on the front end of the shaft.

## STEP 240



T95413

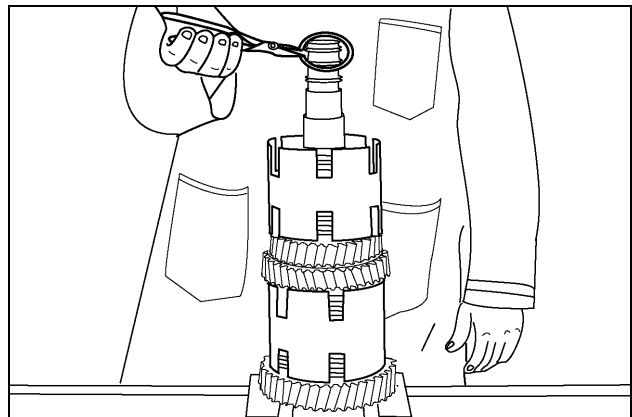
Install carrier as follows:

1. Install the rear face of the carrier over the front end of the shaft.
2. Align the marks on the carrier and the shaft before pushing the carrier down on the shaft.

**NOTE:** Aligning the marks will align the oil holes in the shaft with the oil holes in the carrier.

3. Align the separator plate tabs with the slots in the carrier.
4. Use a press if necessary to carefully push the carrier down on the shaft.
5. Check to be sure that the oil holes in the shaft and carrier are aligned. Look through the oil hole in the carrier and almost a full hole in the shaft should be visible.

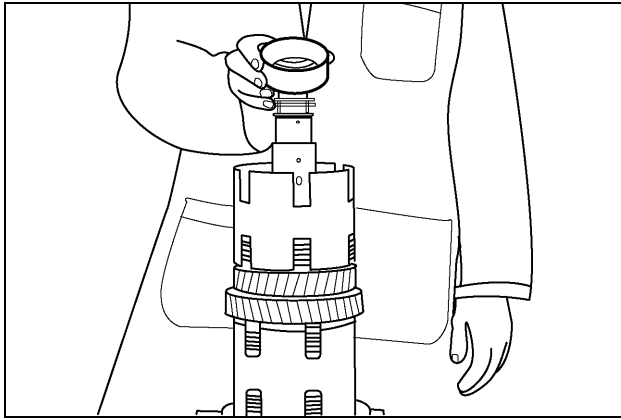
## STEP 241



T95503

Install the carrier snap ring over the shaft.

### STEP 242

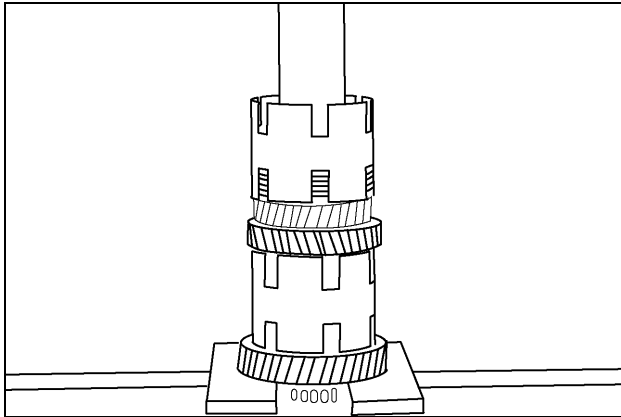


A11610

Install the compression sleeve CAS1903-5 over the shaft.

**NOTE:** *The large OD end of the sleeve must be up.*

### STEP 243

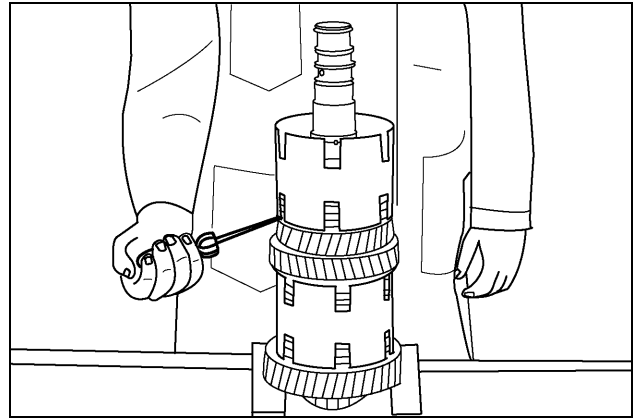


A11611

Install snap ring as follows:

1. Insert a tubular pressing tool that is smaller in diameter than the larger ID of the compression tool, but not so small that it goes through the hole in the compression tool.
2. Use a hydraulic press to press the carrier snap ring into the groove.
3. Verify that the snap ring is seated properly in the groove.

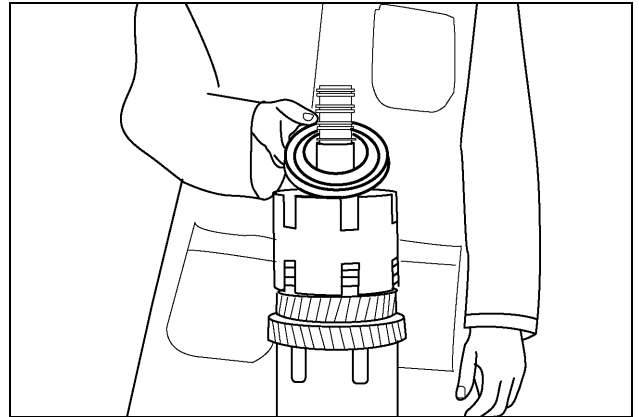
### STEP 244



T95411

Use a screwdriver to install the snap ring that was installed on top of the gear (Step 219), into the inside groove in the carrier. Air check the clutch using the procedure in Step 252.

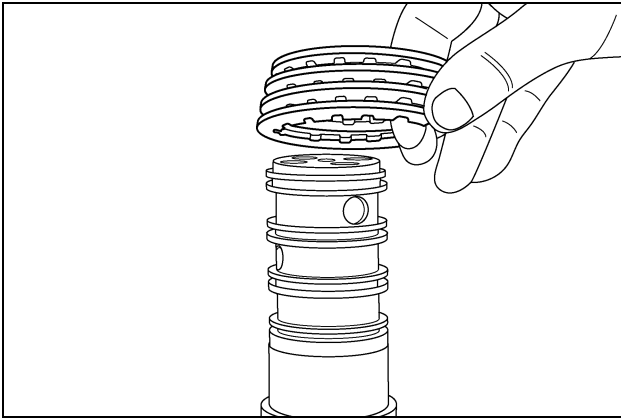
### STEP 245



A11612

Apply petroleum jelly to the teflon rings and install the reverse clutch piston into the carrier with the flat side facing down.

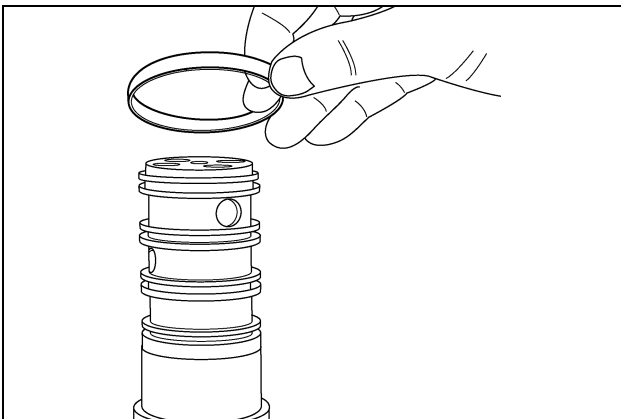
## STEP 246



RD05M012

1. Install the first washer with the concave side facing up.
2. Install the second washer with the concave side facing down.
3. Install the next six washers, alternating the position of the washers until the last washer concave side is facing up.

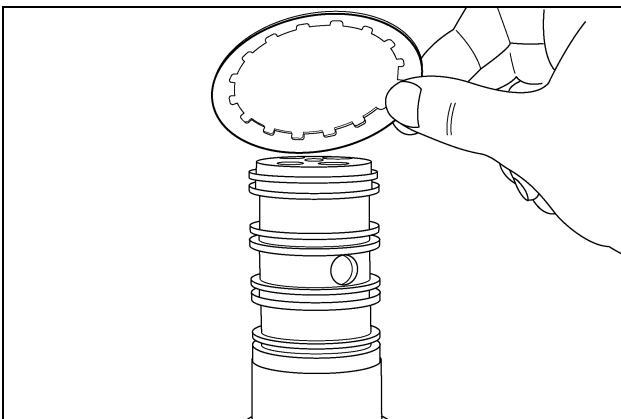
## STEP 247



RD05M011

Install the lube management ring.

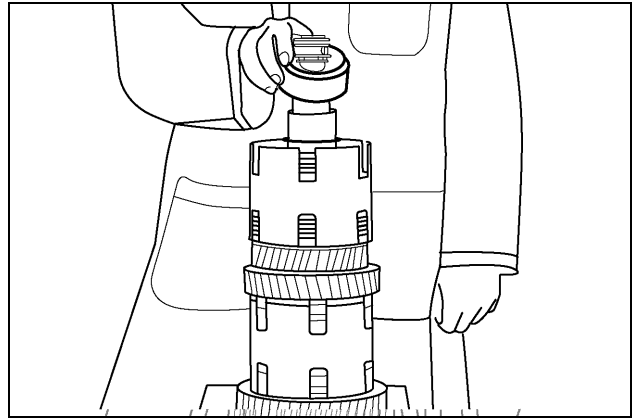
## STEP 248



RD05M010

Install final washer with concave facing upward.

## STEP 249

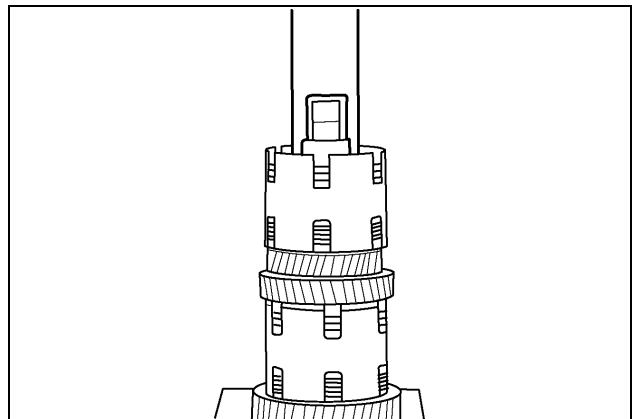


A11614

Install snap ring and Belleville washer compression sleeve as follows:

1. Install a centering sleeve CAS1903-4 over the shaft.
2. Install the snap ring over the centering sleeve.
3. Install the Belleville washer compression sleeve CAS1903-5 on top of the snap ring.

## STEP 250

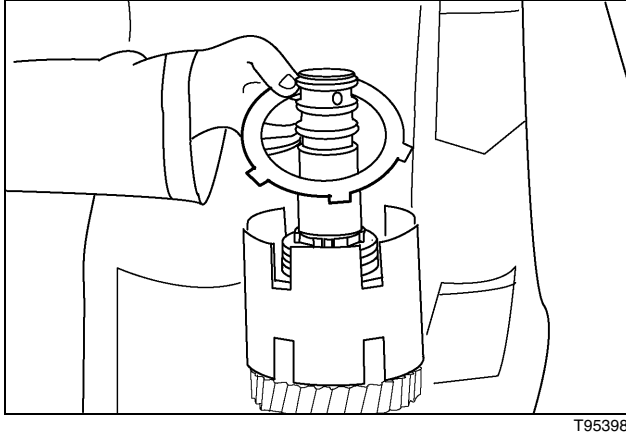


A11615

Install snap ring as follows:

1. Install the compression sleeve CAS1903-3 with the notch over the shaft.
2. Use a hydraulic press to push the sleeves down. The snap ring will be pushed into position in the groove with the pin between the snap ring ends.
3. Verify that the snap ring is seated properly in the groove.

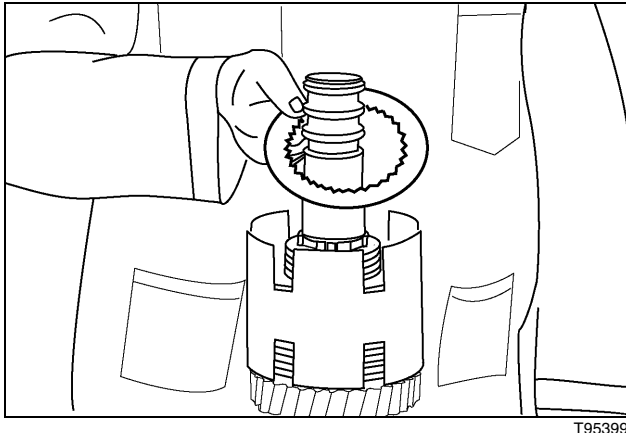
### STEP 251



T95398

Install the reaction plate (thicker separator plate).

### STEP 252

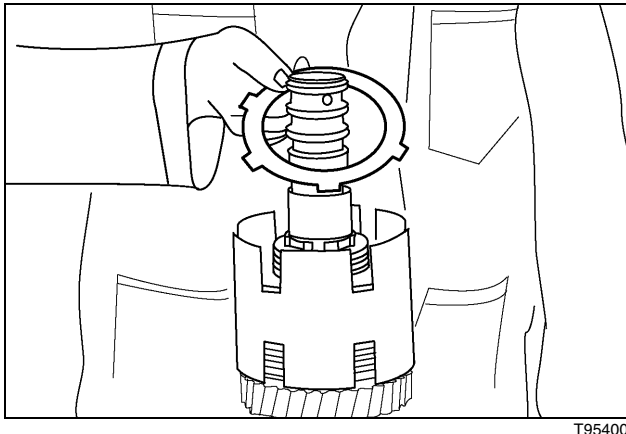


T95399

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

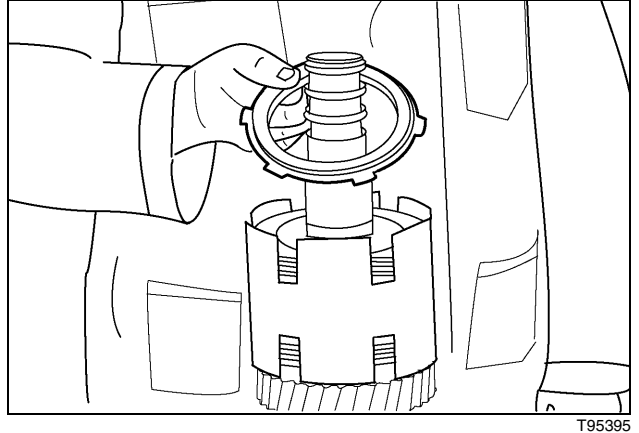
### STEP 253



T95400

Install a separator plate. Install the remaining 6 new friction plates and 5 separator plates, alternating the plates and plates.

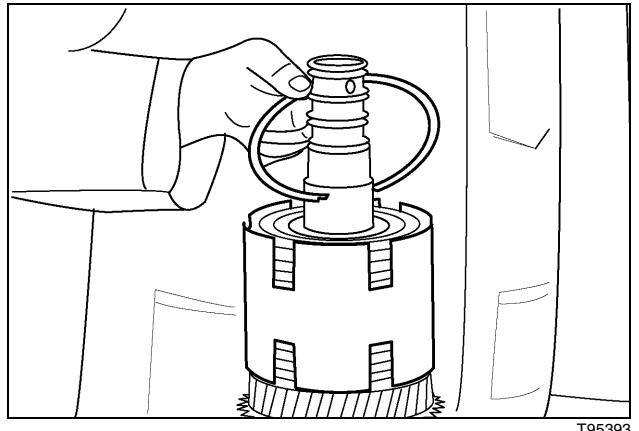
### STEP 254



T95395

Install the backing plate. The flat side must be facing down.

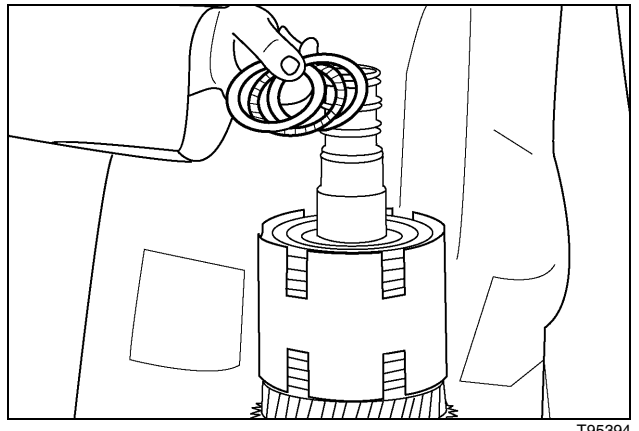
### STEP 255



T95393

Install the snap ring.

### STEP 256

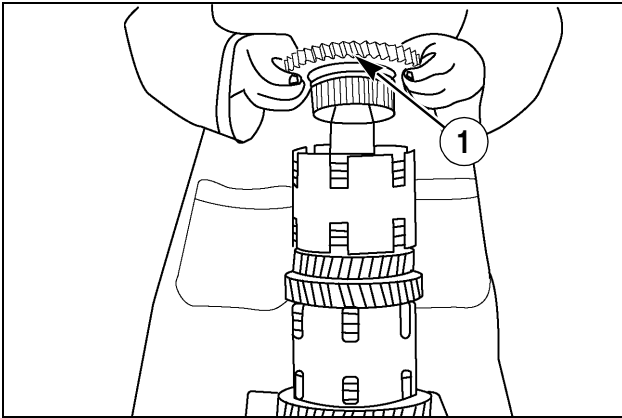


T95394

Install the needle thrust bearing and the two bearing thrust washers.

**NOTE:** The needle thrust bearing must be between the two bearing thrust washers.

## STEP 257



A11616

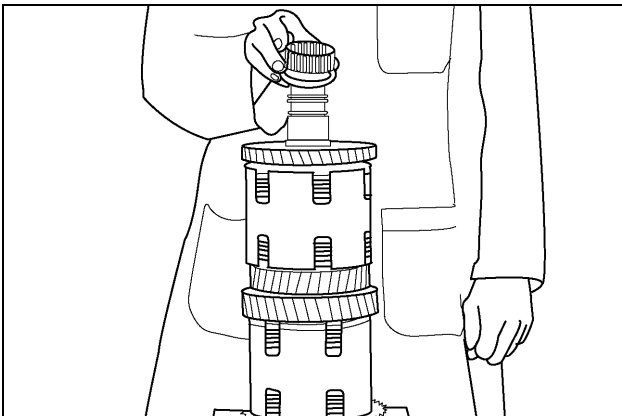
1. SEAL

Install the reverse speed driven gear as follows:

1. Install a new seal ring on the reverse speed driven gear.
2. Align the friction plate teeth.
3. Install the reverse speed driven gear into the clutch pack. The splined hub of the gear must be facing down. Slight oscillation of the gear will help with the installation.

**NOTE:** The splined hub of the gear must engage all the friction plates.

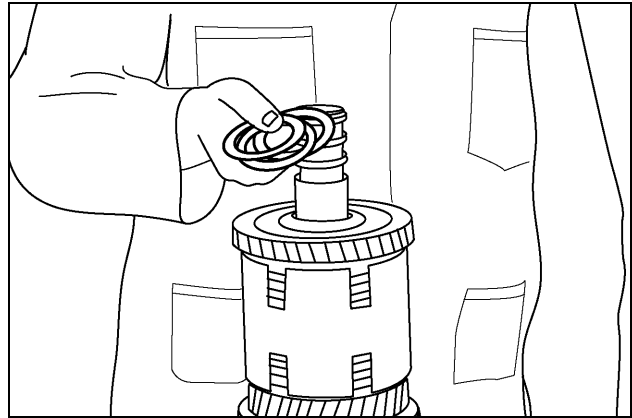
## STEP 258



A11617

Install the spacer in the gear hub. Install the caged needle bearing into the gear hub.

## STEP 259

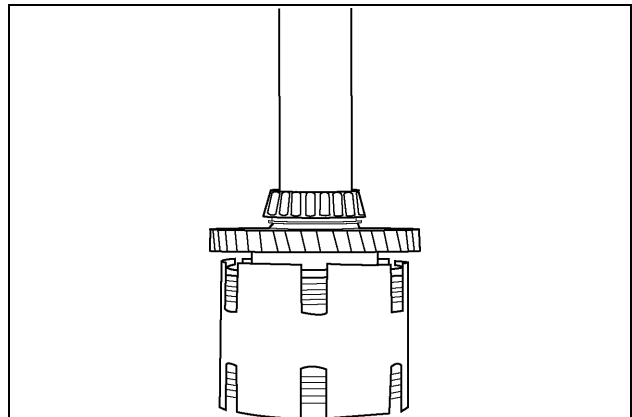


T95389

Install the needle thrust bearing and the two bearing thrust washers.

**NOTE:** The needle thrust bearing must be between the two bearing thrust washers.

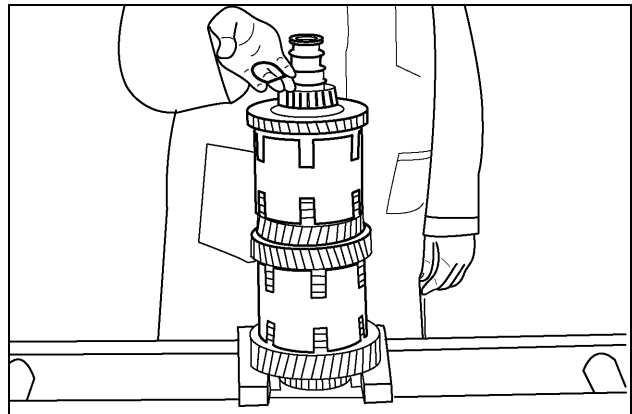
## STEP 260



A11552

Install the front bearing cone with the smaller OD end of the bearing cone facing up. Press the bearing on the inner race to properly seat the bearing on the shaft.

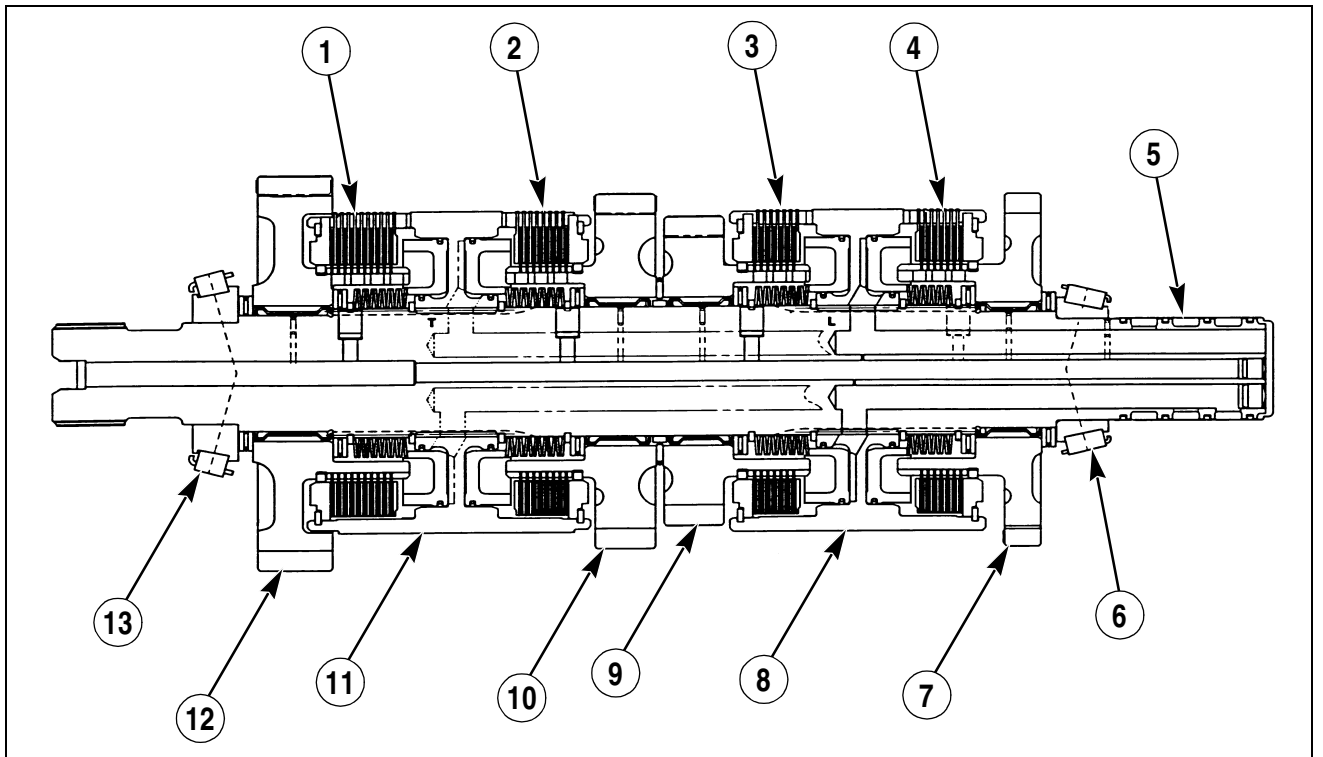
## STEP 261



T95386

Install four new seal rings on the shaft.

## Cross-Section View of Output Shaft

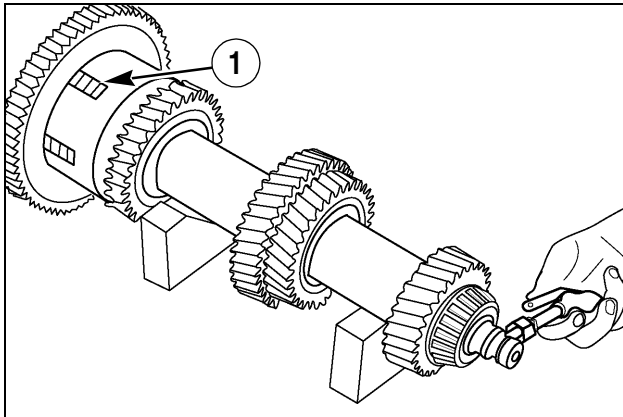


73194

- |                              |                                 |
|------------------------------|---------------------------------|
| 1. 1ST SPEED CLUTCH PACK     | 8. FRONT CLUTCH PLATE CARRIER   |
| 2. 3RD SPEED CLUTCH PACK     | 9. (5TH-6TH) SPEED DRIVEN GEAR  |
| 3. 5TH SPEED CLUTCH PACK     | 10. (3RD-4TH) SPEED DRIVEN GEAR |
| 4. REVERSE SPEED CLUTCH PACK | 11. REAR CLUTCH PLATE CARRIER   |
| 5. OUTPUT SHAFT              | 12. (1ST-2ND) SPEED DRIVEN GEAR |
| 6. FRONT BEARING CONE        | 13. REAR BEARING CONE           |
| 7. REVERSE SPEED DRIVEN GEAR |                                 |

## Air Check for Speed Transmission Clutch Piston Operation

### STEP 262



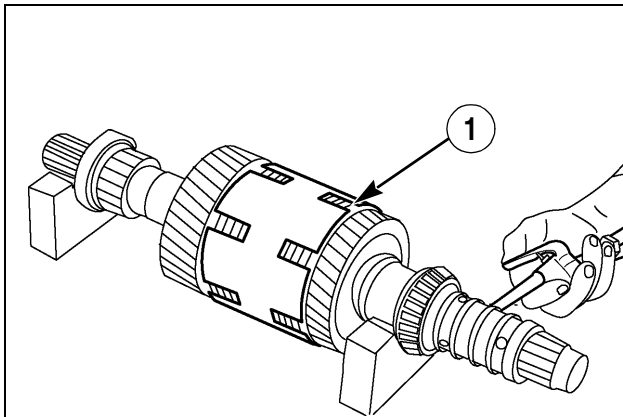
T95508

1. CREEPER CLUTCH PLATES

Use an air gun to check the movement of the crawler clutch piston, if equipped, as follows:

1. Install the tip of the air gun into the oil hole at the rear end of the countershaft. The air pressure will move the clutch plates on the crawler clutch.
2. Replace the seal rings on the piston if the clutch plates do not move.

### STEP 263



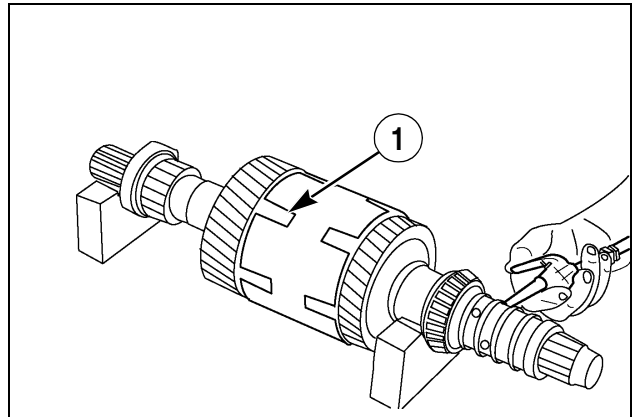
T95509A

1. ODD CLUTCH PLATES

Check the odd gear clutch piston operation as follows:

1. Install the tip of the air gun into the hole in the third groove from the rear of the input shaft.
2. The air pressure will move the clutch plates in the odd gear clutch.
3. Replace the seal rings on the clutch piston if the clutch plates do not move.

### STEP 264



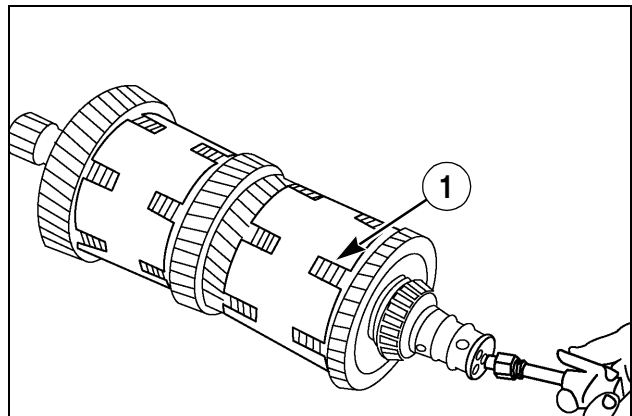
T95510A

1. EVEN CLUTCH PLATES

Check the even gear clutch piston operation as follows:

1. Install the tip of the air gun into the hole in the fourth groove from the rear of the input shaft.
2. The air pressure will move the clutch plates in the even gear clutch.
3. Replace the seal rings on the clutch piston if the clutch plates do not move.

### STEP 265



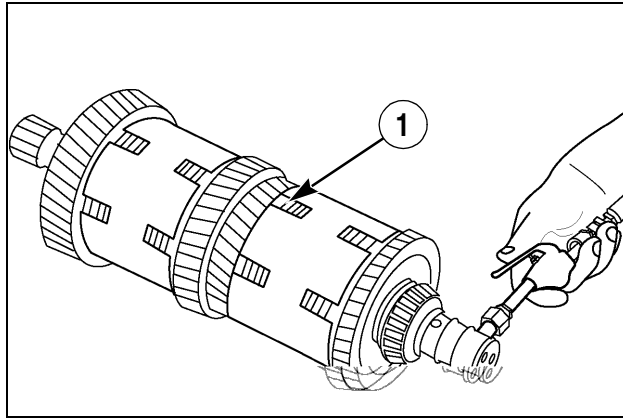
T95511

1. REVERSE CLUTCH PLATES

Check reverse gear drive clutch as follows:

1. Install the tip of the air gun into the oil hole in the end of the output shaft. The air pressure will move the clutch plates in the reverse gear drive clutch.
2. Replace the seal rings on the clutch piston if the clutch plates do not move.

## STEP 266



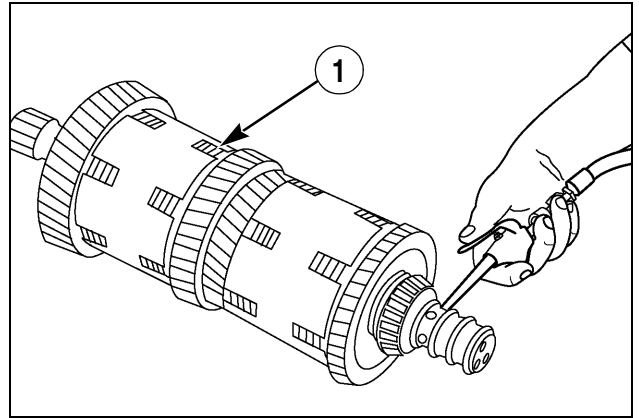
T95512

1. 5TH CLUTCH PLATES

Check 5th gear clutch piston operation as follows:

1. Install the tip of the air gun into the oil hole in the first groove from the rear of the output shaft. The air pressure will move the clutch plates in the 5th gear clutch.
2. Replace the seals on the clutch piston if the clutch plates do not move.

## STEP 268



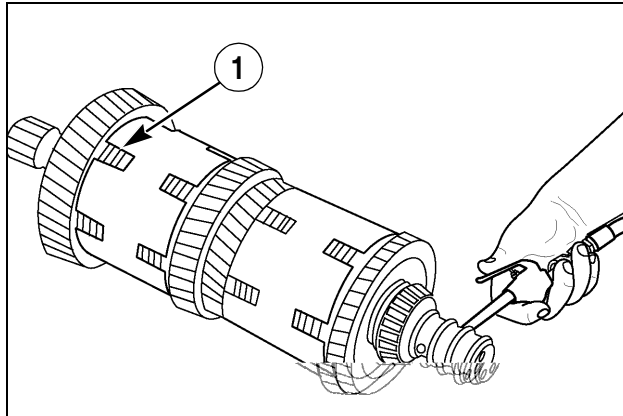
T95514

1. 3RD CLUTCH PLATES

Check 3rd gear clutch piston operation as follows:

1. Install the tip of the air gun into the oil hole in the third groove from the rear of the output shaft. The air pressure will move the clutch plates in the 3rd gear clutch.
2. Replace the seal rings on the clutch piston if the clutch plates do not move.

## STEP 267



T95513

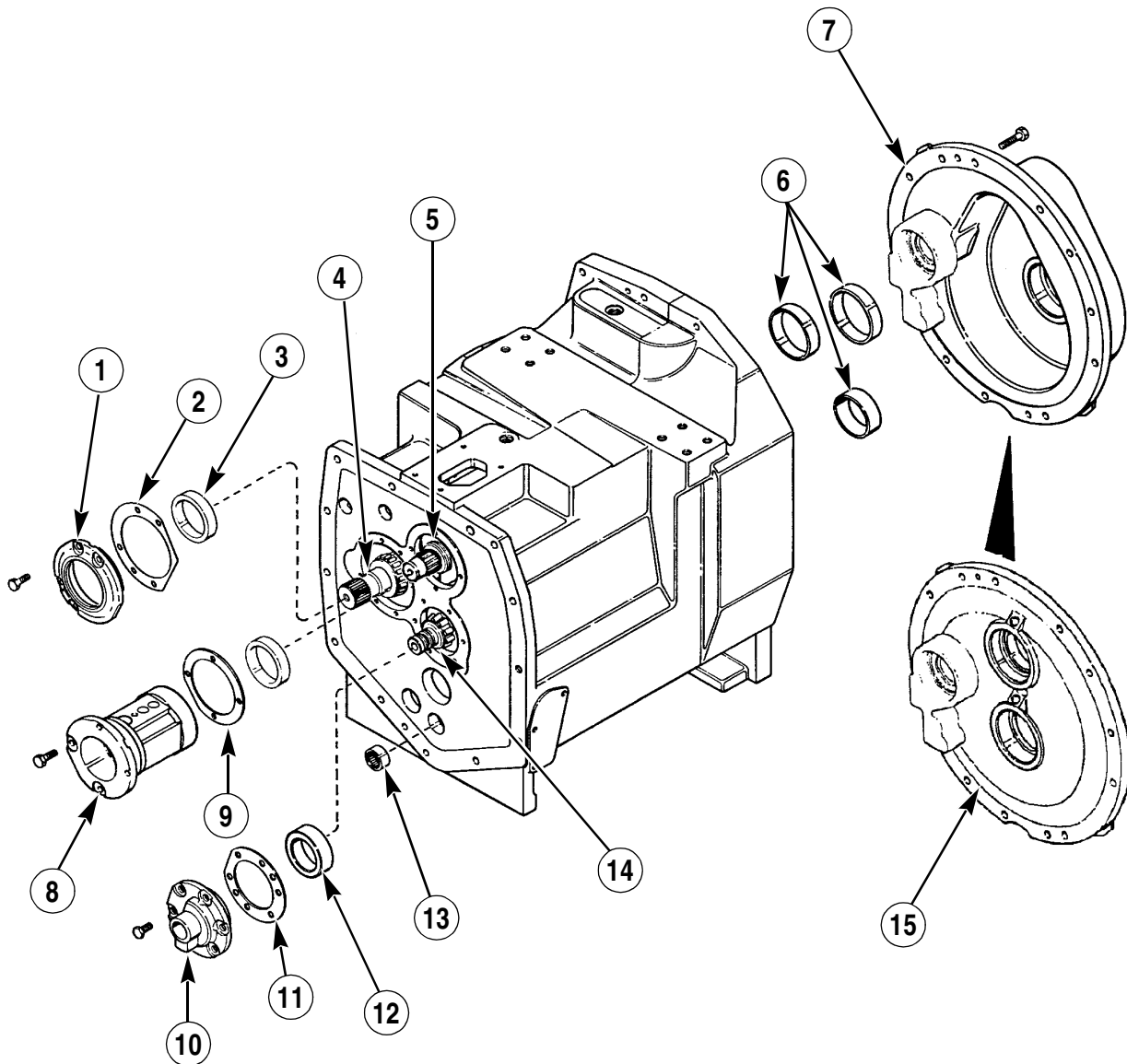
1. 1ST CLUTCH PLATES

Check 1st gear clutch piston operation as follows:

1. Install the tip of the air gun into the oil hole in the second groove from the rear of the output shaft. The air pressure will move the clutch plates in the 1st gear clutch.
2. Replace the seals on the clutch piston if the clutch plates do not move.



## Countershaft, Input Shaft, and Output Shaft Installation - Exploded View

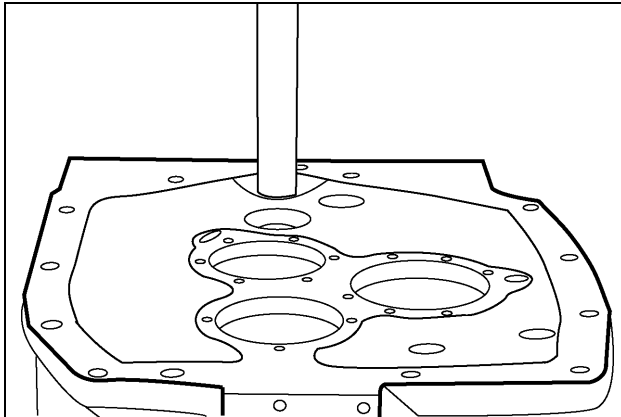


73L94AR

- |  |  |
|--|--|
| 1. OUTPUT SHAFT REAR BEARING CAGE        | 9. SHIM                                      |
| 2. SHIM                                  | 10. COUNTERSHAFT REAR BEARING CAGE           |
| 3. BEARING CUP                           | 11. SHIM                                     |
| 4. OUTPUT SHAFT ASSEMBLY                 | 12. BEARING CUP                              |
| 5. INPUT SHAFT ASSEMBLY                  | 13. MFD NEEDLE BEARING                       |
| 6. BEARING CUPS                          | 14. COUNTERSHAFT ASSEMBLY                    |
| 7. FRONT BEARING CAGE (WITH CREEP SPEED) | 15. FRONT BEARING CAGE (WITHOUT CREEP SPEED) |
| 8. INPUT SHAFT REAR BEARING CAGE         |  |

## Bearing Removal and Replacement

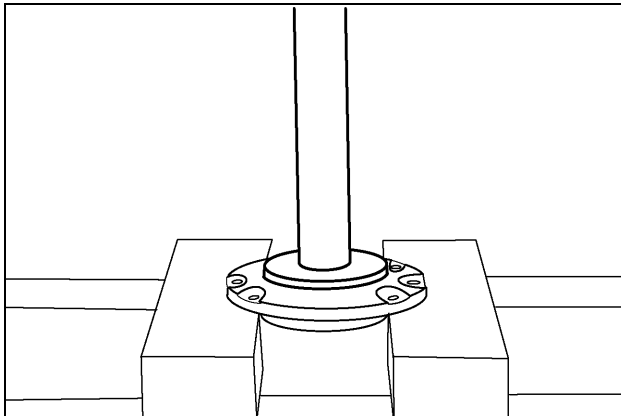
### STEP 269



A11623

If the MFD shaft bearing must be replaced, press the old bearing out of the housing. Press a new bearing assembly into the housing until the bearing is flush with the rear housing surface.

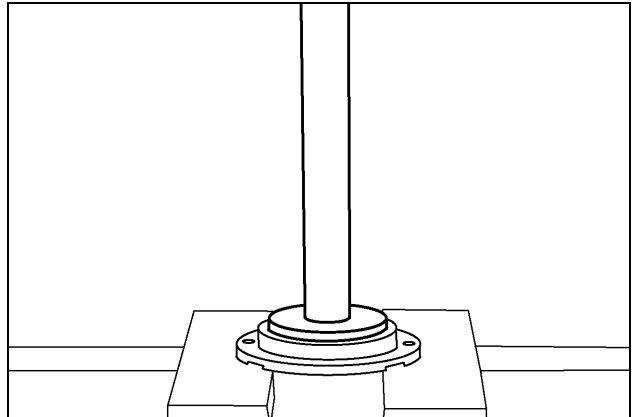
### STEP 270



A11622

Press the bearing cup out of the rear output shaft bearing cage if the bearing cone on the output shaft has been replaced.

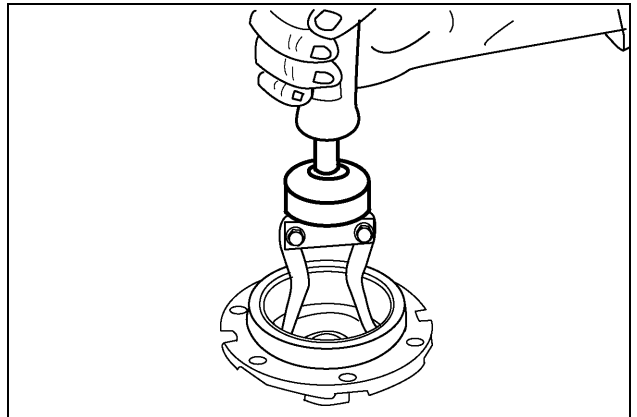
### STEP 271



A11621

Press a new bearing cup into the cage until the cup is fully seated.

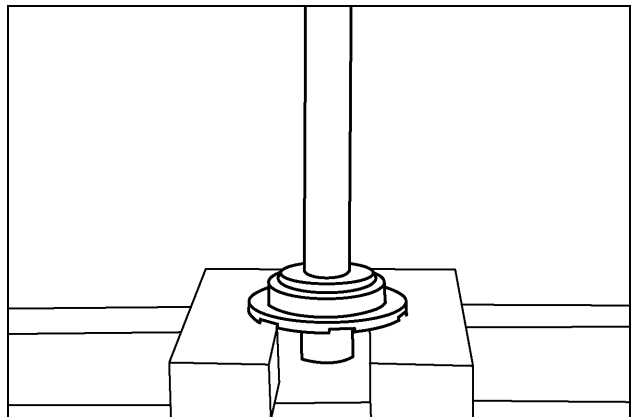
### STEP 272



T95482

Use a puller to remove the bearing cup from the rear countershaft bearing cage if the bearing cone on the countershaft has been replaced.

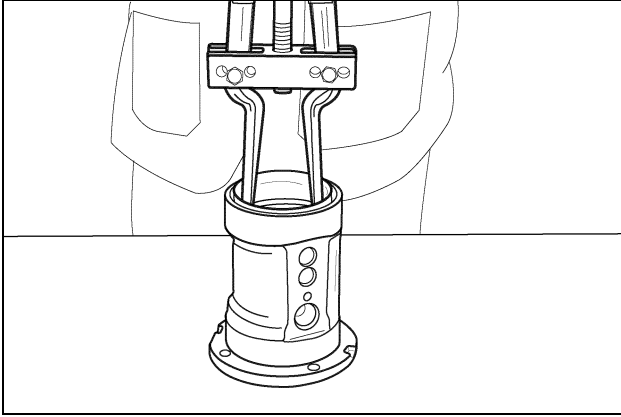
### STEP 273



A11620

Press a new bearing cup into the cage until the cup is fully seated.

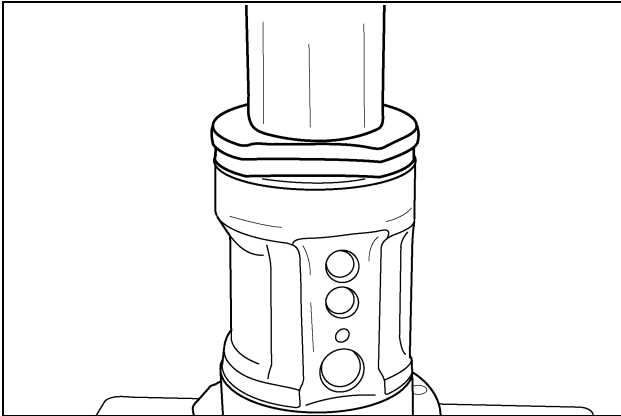
### STEP 274



41-13

Use a bearing puller to remove the bearing cup from the rear input shaft cage if the bearing cone on the input shaft has been replaced.

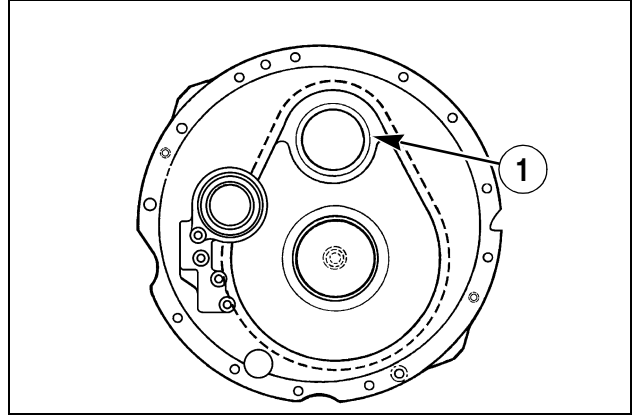
### STEP 275



41-16

Press a new bearing cup into the cage until the cup is fully seated.

### STEP 276



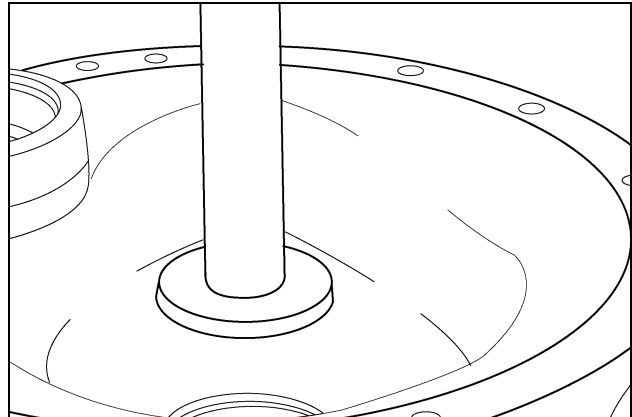
CVR901

1. BEARING CUP

Remove all foreign material from the rear surface of the front bearing support cover. Use a puller to remove any bearing cup from the support cover (input shaft bearing cup shown) if the bearing cone of that set was replaced.

**NOTE:** *Support cover shown for creep option.*

### STEP 277

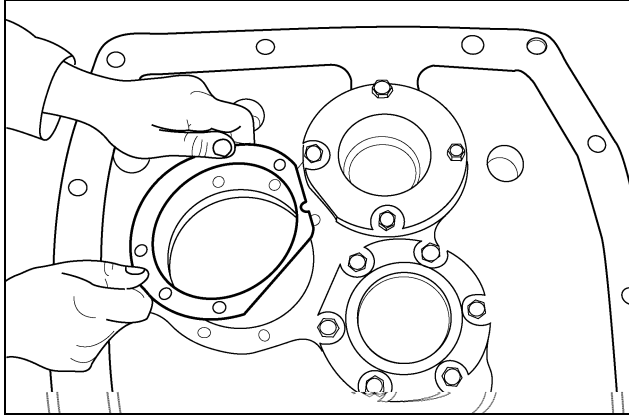


A11618

Press the new cup into the bearing support until the cup is fully seated.

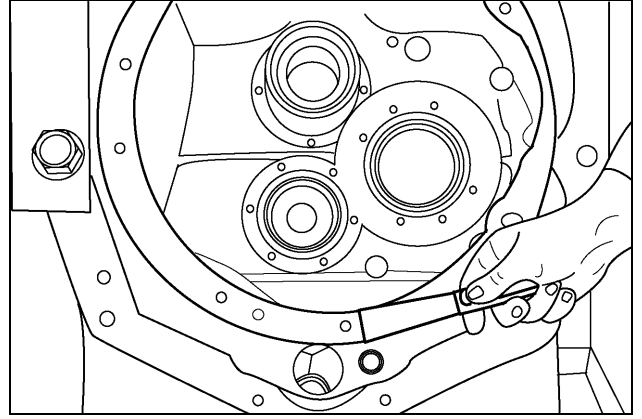
**NOTE:** *Replacement of bearing cups in non-creeper bearing support cover is similar.*

**STEP 278**



Install the rear bearing shim packs that were removed during disassembly, and the rear bearing cages. Do not fully tighten the bolts.

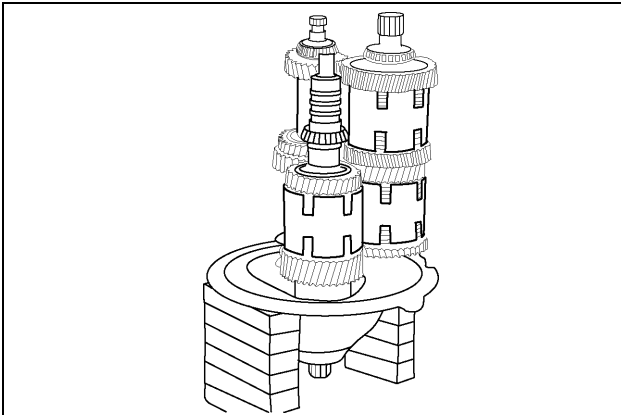
**STEP 279**



Remove all foreign material from the speed transmission housing front flange.

## TRANSMISSION ASSEMBLY WITH CREEP OPTION

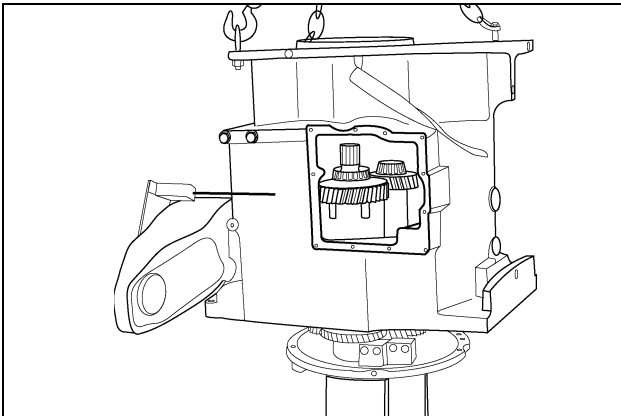
### STEP 280



A11624

Put the bearing support cover on support blocks as shown in Step 4 in this section. Apply petroleum jelly to the seal rings. Install the three shaft assemblies in the cover.

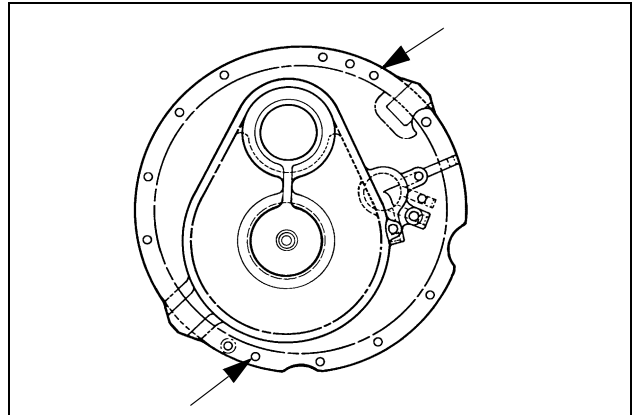
### STEP 281



18-11

Connect a chain to the rear of the speed housing. Use a suitable hoist and slowly and carefully lower the housing over the shaft assemblies until the shaft bearing cones are seated in the cups.

### STEP 282

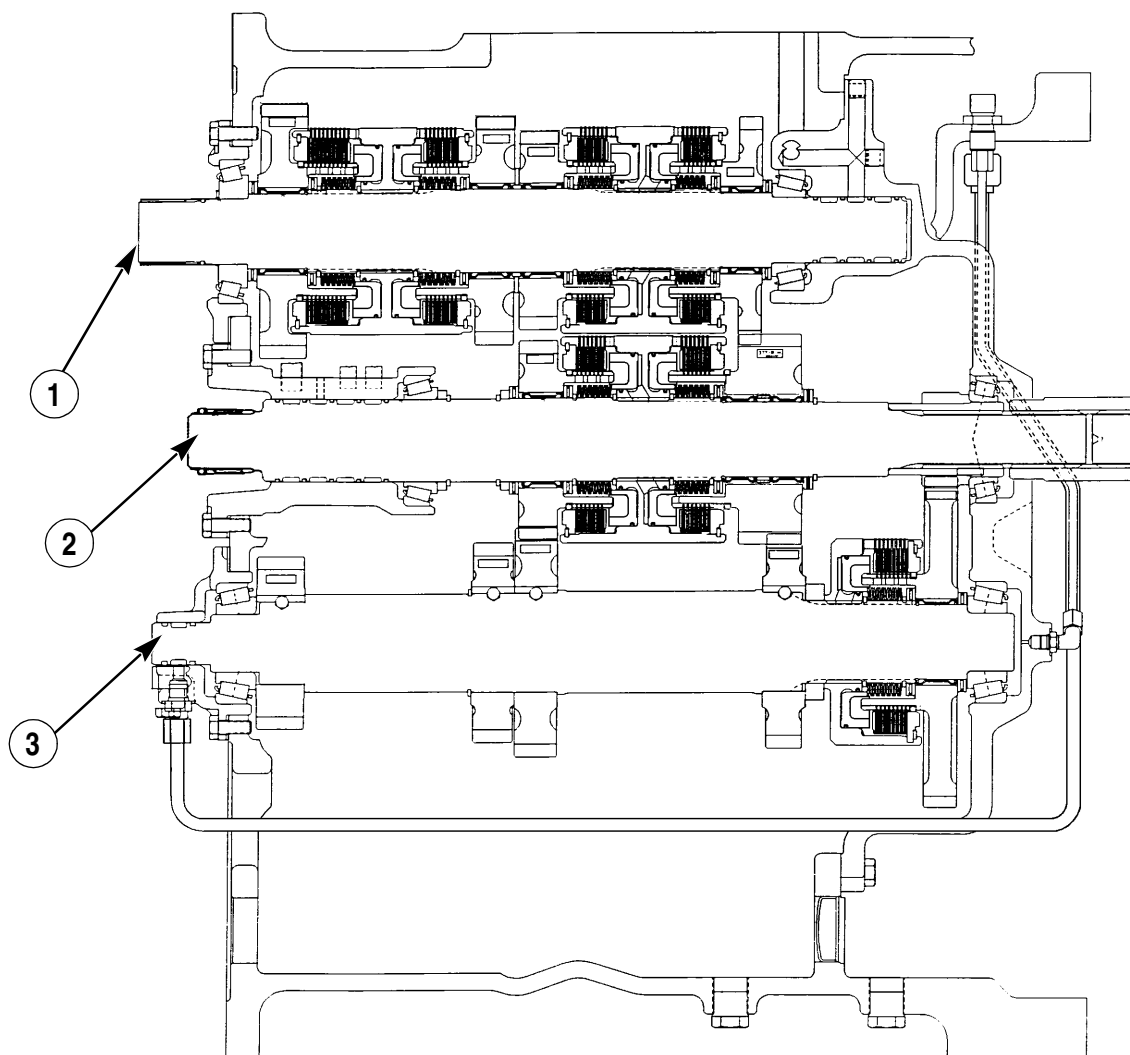


886L0

Install and tighten a bolt in the bearing support cover at the 1 and 7 o'clock position. Install bearing support cover as follows:

1. Mount the speed housing to the engine stand.
2. Turn the housing up right and install the remaining bolts into the bearing support cover.
3. Tighten the bolts to a torque of 94 to 106 Nm (69 to 78 lb. ft).

## Shafts in Speed Transmission

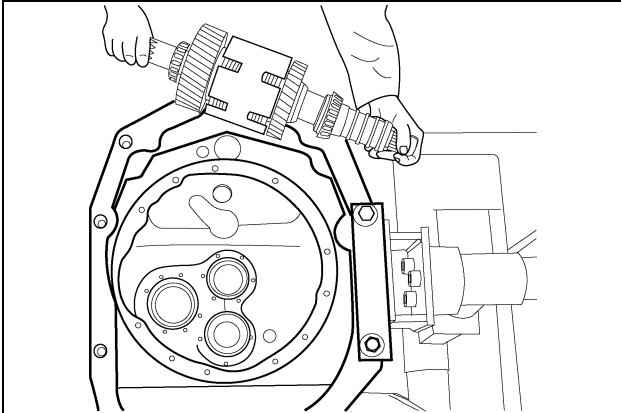


85L94

- 1. OUTPUT SHAFT ASSEMBLY
- 2. INPUT SHAFT ASSEMBLY
- 3. COUNTERSHAFT ASSEMBLY

## TRANSMISSION ASSEMBLY WITHOUT CREEP OPTION

### STEP 283

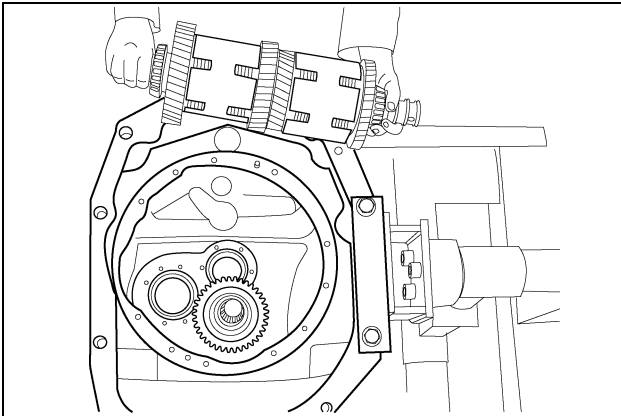


25-14

Install input shaft as follows:

1. Mount the transmission housing in the engine stand.
2. Apply petroleum jelly to the seal rings on the shafts.
3. Install the input shaft.

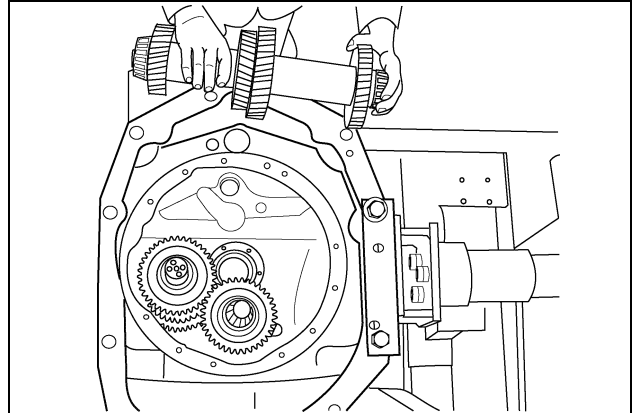
### STEP 284



25-20

Install the output shaft.

### STEP 285

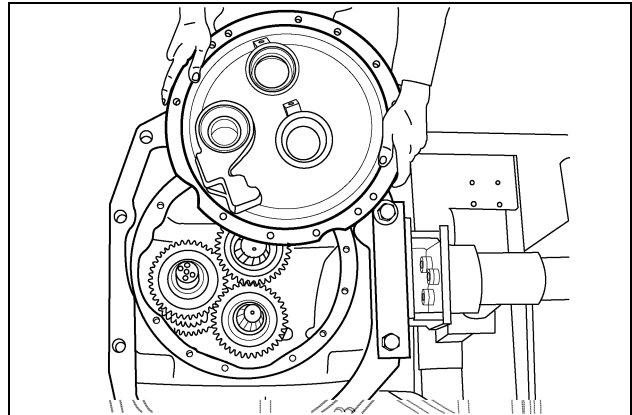


25-26

Install the countershaft as follows:

1. Raise the input shaft approximately 44 mm (1-3/4 inches.)
2. Install the countershaft until the gears of the countershaft are in mesh with the gears of the input shaft.
3. Lower both the countershaft and input shaft into position.

### STEP 286

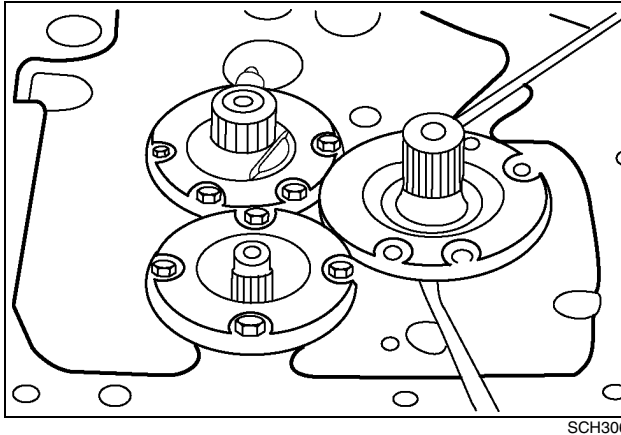


25-32

Install the bearing support cover and bolts. Tighten the bolts to a torque of 94 to 106 Nm (69 to 78 lb. ft.).

## Setting the End Play of the Speed Transmission Countershaft, Input Shaft, and Output Shaft

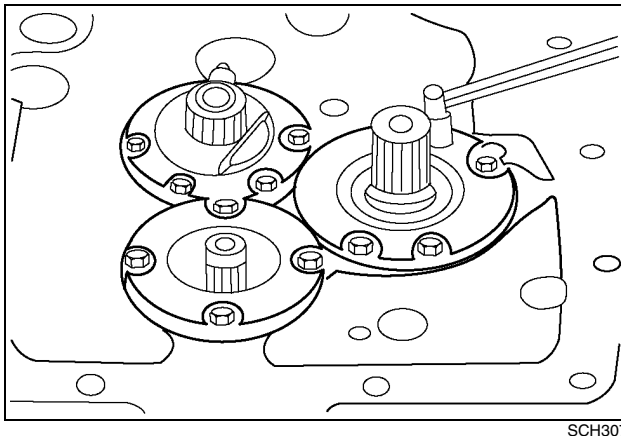
### STEP 287



**NOTE:** End play of each shaft must be checked if any of the following parts were replaced: shaft, rear bearing cage, front bearing cage, bearing cups, and bearing cones. This procedure is an adjustable bearing set-up to provide an end play of 0.03 to 0.13 mm (0.001 to 0.005 inch) for each shaft assembly. Check one shaft at a time for end play.

Remove the rear bearing cage and remove all the shims.

### STEP 288

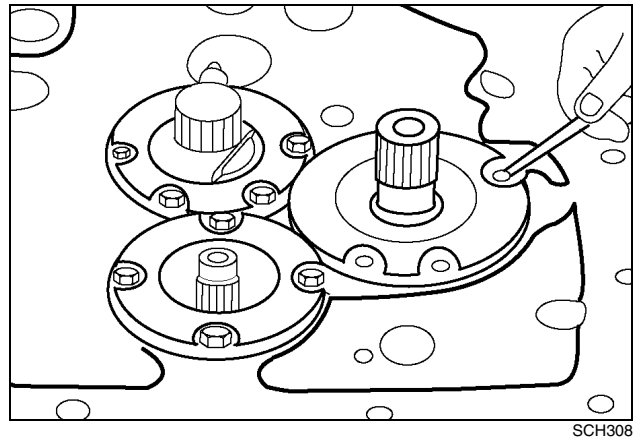


Install a rear bearing cage (with no shims) for the appropriate shaft (output shaft shown) as follows:

1. Install the rear bearing cage.
2. Install the bolts into the rear bearing cage. The bolts must be loose.
3. Rotate the shaft a minimum of 12 revolutions while tightening the bolts.

4. Tighten two opposite bolts, alternately, in three increments until the bolts are tightened to a torque of 5.6 Nm (50 lb in).
5. To get a correct end play, rotate the shaft until the bolts torques do not change.

### STEP 289

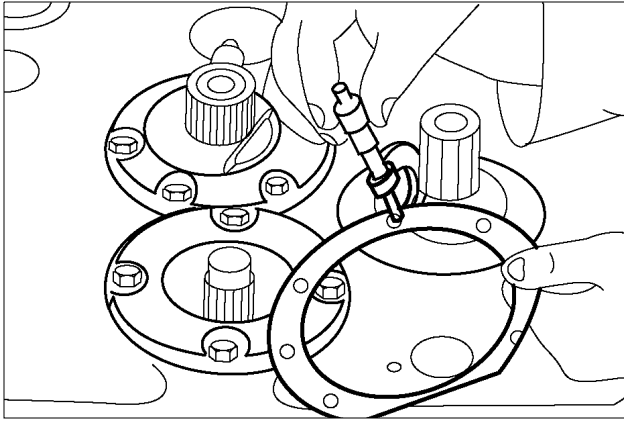


Do the following:

1. Measure the shim gap clearance between the rear bearing cage and the housing. Measure at two locations next to the two bolts that were tightened.
2. Use a tapered feeler gauge.
3. If the difference between the two measurements is 0.254 mm (0.010 inch) or less, take an average of the two readings to the nearest 0.025 mm (0.001 inch).
4. If the difference is greater than 0.25 mm (0.010 inch), loosen the two bolts and check for correct bearing seating, burrs, or foreign material.
5. Do the procedure again until a range of 0.25 mm (0.010 inch) or less is obtained. Take an average of the two readings.



## STEP 290



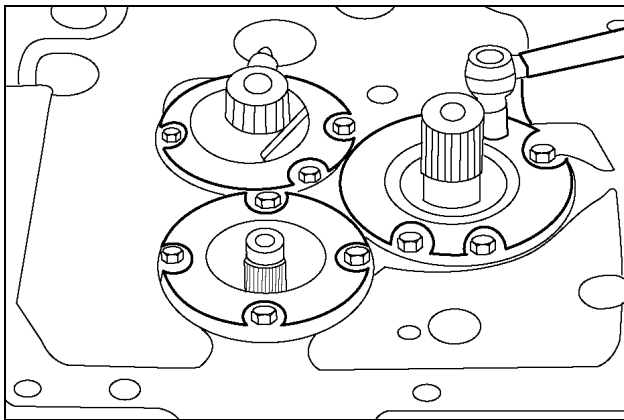
SCH309

Remove the rear bearing cage. Take the average measurement from Step 275. To this average measurement, add the following amount of shims thickness:

Input Shaft without Creep Drive	0.009 in. (0.229 mm)
Input Shaft with Creep Drive.....	0.008 in. (0.203 mm)
Countershaft without Creep Drive .....	0.014 inch (0.356 mm)
Countershaft with Creep Drive .....	0.008 inch (0.203 mm)
Output Shaft .....	0.014 in. (0.356 mm)

The result is the correct shim pack thickness. Select a measured shim pack having a thickness within 0.001 inch (0.025 mm) of the desired value.

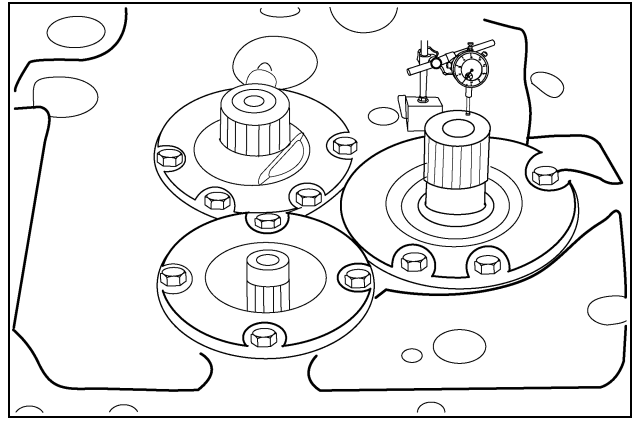
## STEP 291



SCH310

Install the measured shim pack and the rear bearing cage. Tighten the bolts to a torque of 54 to 61 Nm (40 to 45 lb. ft).

## STEP 292



SCH311

Do the following:

1. Rotate the shaft a minimum of 12 revolutions.
2. Use a dial indicator to measure the end play.
3. Use a pry bar inside the speed transmission housing to lift a gear on the shaft.
4. The end play must be 0.001 to 0.005 inch (0.03 to 0.13 mm).
5. Add or remove shims to get a correct reading.

**NOTE:** Measure the end play of all three shafts following the procedure in Steps 273 through 278. Check one shaft at a time.

# **Section 21**

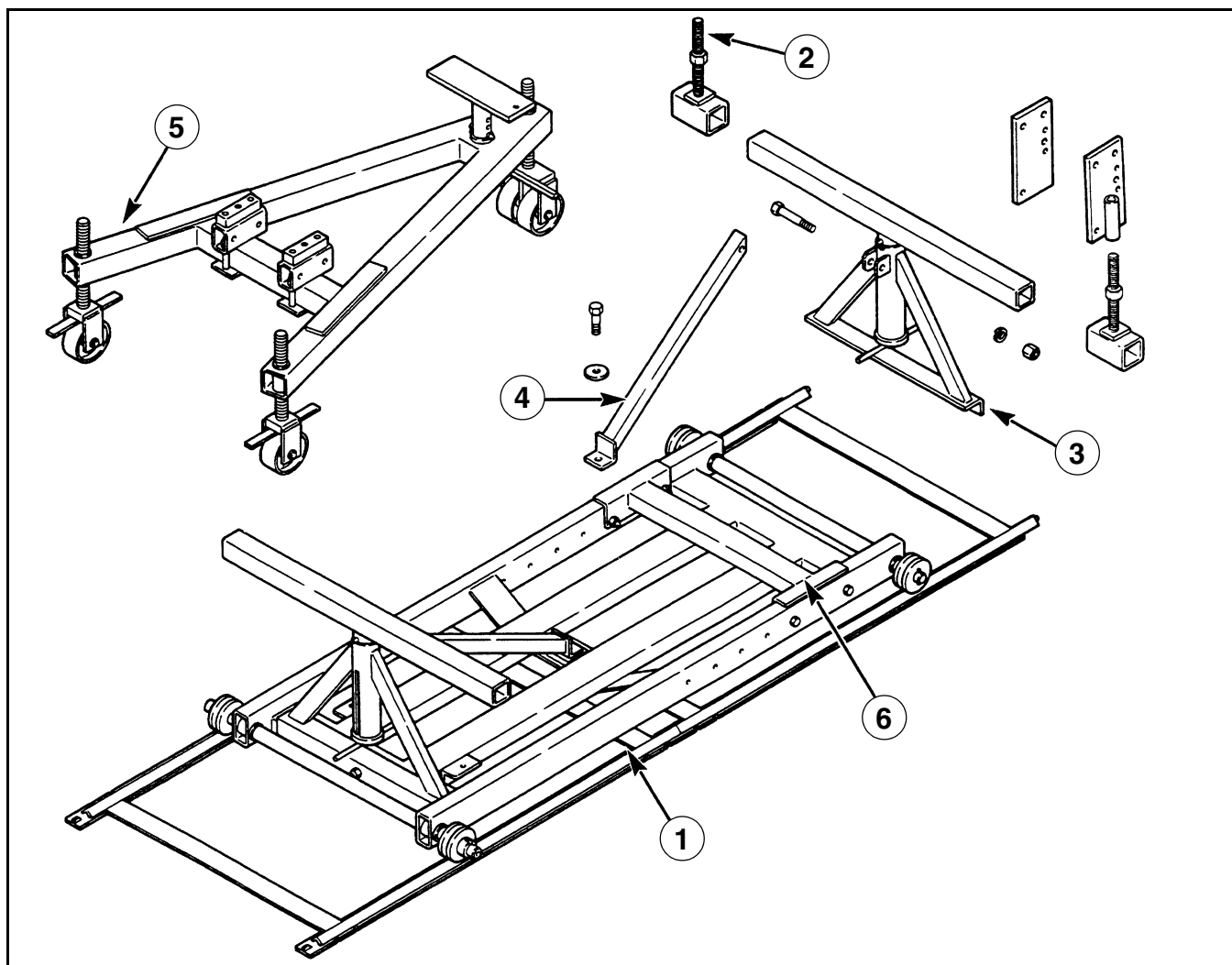
## **Chapter 5**

**RANGE TRANSMISSION TO REAR FRAME SPLIT**

## TABLE OF CONTENTS

SPECIAL TOOLS .....	21-5-3
SPECIAL TORQUES .....	21-5-3
RANGE TRANSMISSION TO REAR FRAME SPLIT .....	21-5-4
Disassembly .....	21-5-4
Assembly .....	21-5-7

## SPECIAL TOOLS



0507TL5R

- |                            |                                |
|----------------------------|--------------------------------|
| 1. SPLITTING STAND 17-526A | 4. SUPPORT ASSEMBLY 17-526-4A  |
| 2. ADAPTER PLATES CAS-2604 | 5. REAR HOUSING HANDLER 17-527 |
| 3. SUPPORT BRACE 17-526-14 | 6. ADAPTER BRIGE 17-526-7      |

## SPECIAL TORQUES

Range Transmission to Rear Frame Bolts

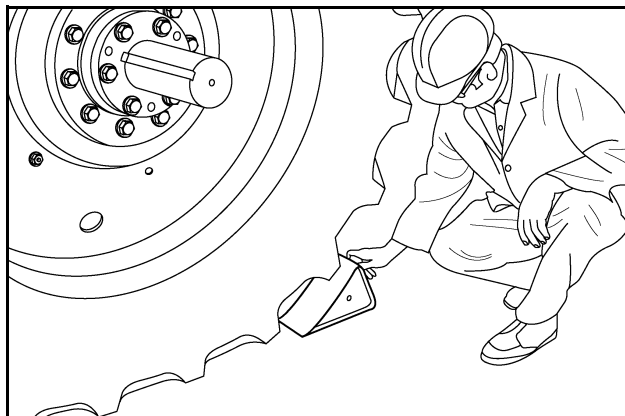
M16 x 60 mm.....	232 to 262 Nm (171 to 193 lb. ft.)
M16 x 80 mm.....	220 to 250 Nm (162 to 184 lb. ft.)
M16 x 110 mm.....	220 to 250 Nm (162 to 184 lb. ft.)

## RANGE TRANSMISSION TO REAR FRAME SPLIT

### Disassembly

**NOTE:** Clean the entire transmission housing before beginning this procedure.

#### STEP 1



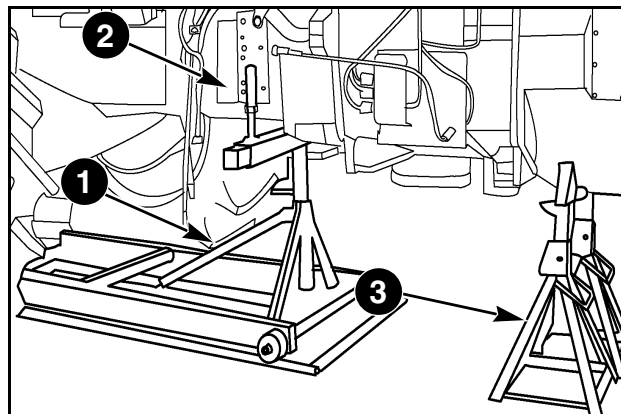
96R-28A

Before starting the procedure, do the following:

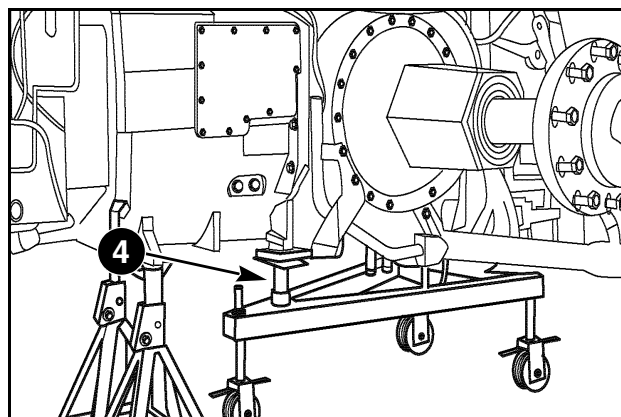
1. Park the tractor on a hard, level surface.
2. Put the gear shift control lever in PARK.
3. Fully lower the rear three-point hitch.
4. Turn the engine off and remove the key.
5. Put blocks behind and in front of the rear wheels.
6. See the cab removal information and remove the cab.
7. See the fuel tank removal information and remove the fuel tank.
8. Drain the transmission fluid into a clean container.

**NOTE:** The transmission capacity is approximately 172 liters (45 gallons).

#### STEP 2



RD02C181



RD02C180

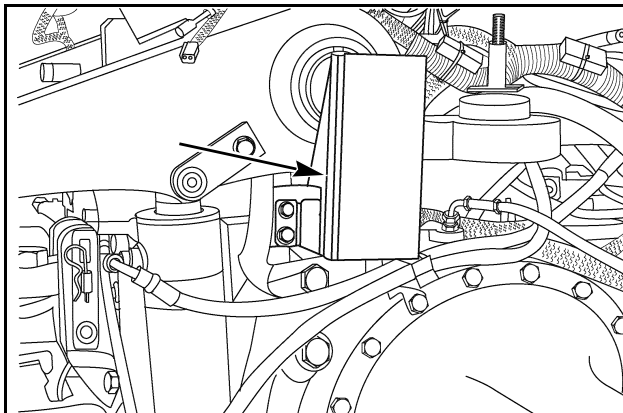
Position the splitting stand 17-526A (1), adapter plates (2), and jack stands (3) as shown above.

Position rear housing handler 17-527 (4) and adjust it to support the rear frame without lifting up on it.

Be sure that the transmission is as level as possible and the rear handler wheels are straight. This will aid in shaft alignment on assembly.

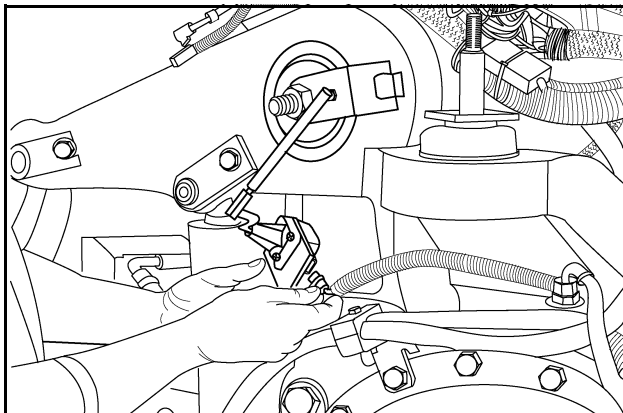
**NOTE:** Rear wheels removed for photographic purposes.

**STEP 3**



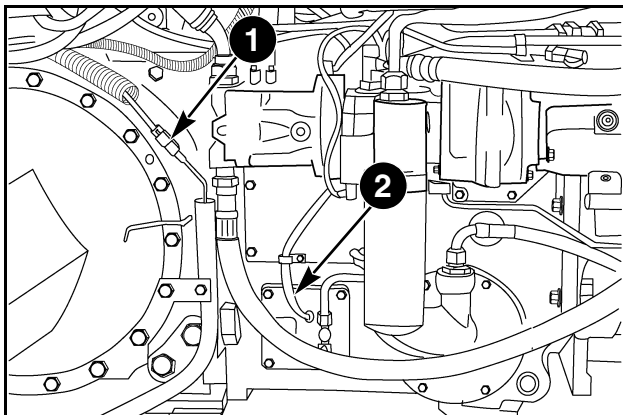
Remove the hitch position sensor cover.

**STEP 4**



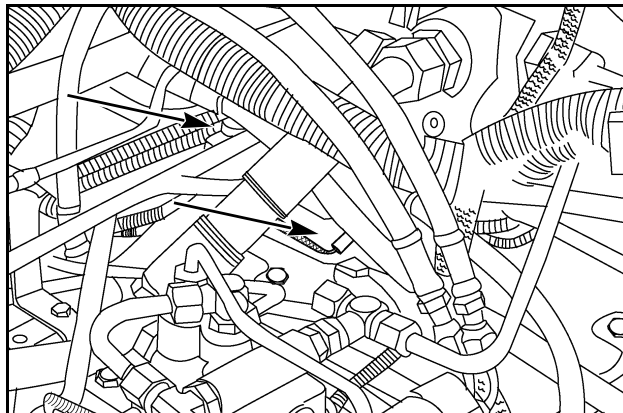
Disconnect the hitch position sensor connector.

**STEP 5**



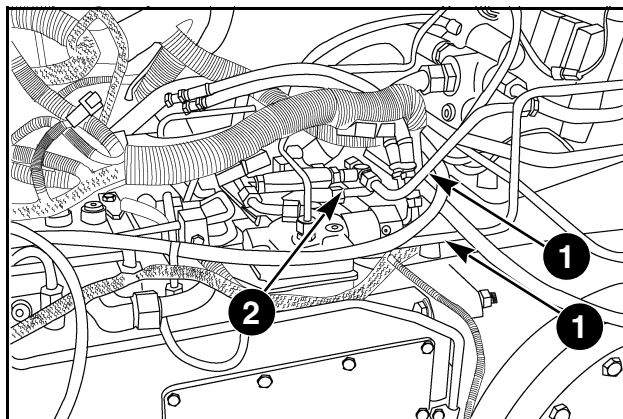
Disconnect the draft pin connector (1 - LH and RH side) and the transmission sump temperature sender connector (2).

**STEP 6**



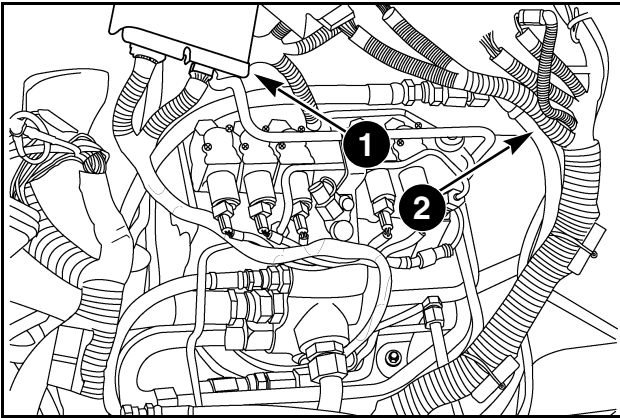
Disconnect the wire harness from the PTO (1) and MFD (2) solenoids.

**STEP 7**



Remove the two lines (1) from the trailer brake valve (if equipped). Remove the two lines (2) from the steering priority valve.

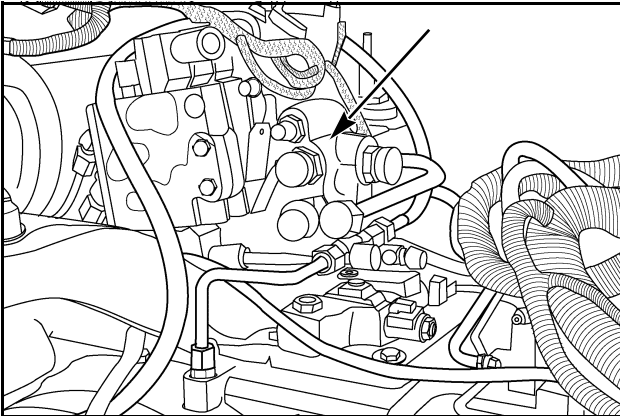
## STEP 8



RD02C197

Disconnect the remote auxiliary controller (1) from the wire harness. Move the remaining controllers and wire harness (2) forward until the harness is on the front side of the rear housing/range housing seam.

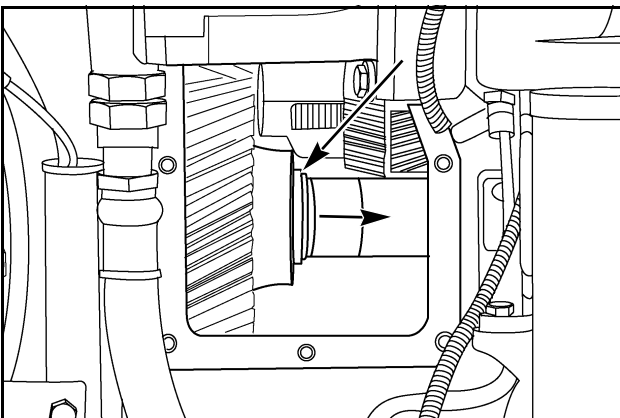
## STEP 9



RD02C188

Tag and remove the hydraulic lines from the remote valve. Cap all lines and fittings.

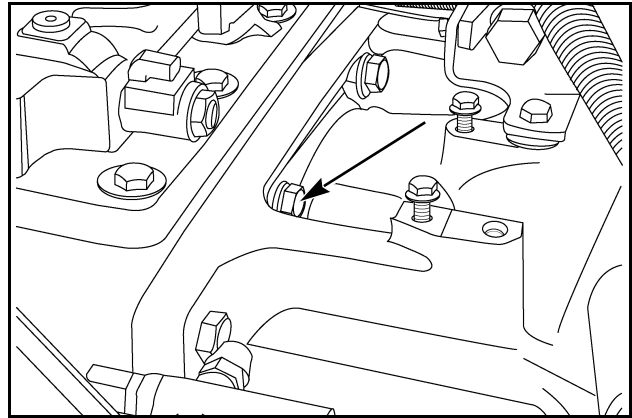
## STEP 10



RD02C192

Remove the cover from the RH side of the range transmission. Move the snap ring out of the groove and forward on the shaft.

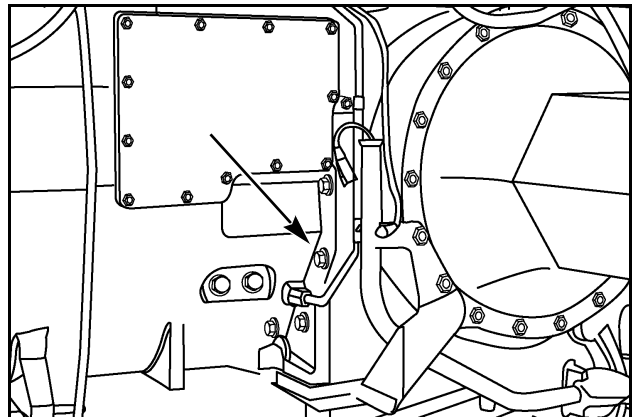
## STEP 11



RD02C193

Remove the top bolts.

## STEP 12

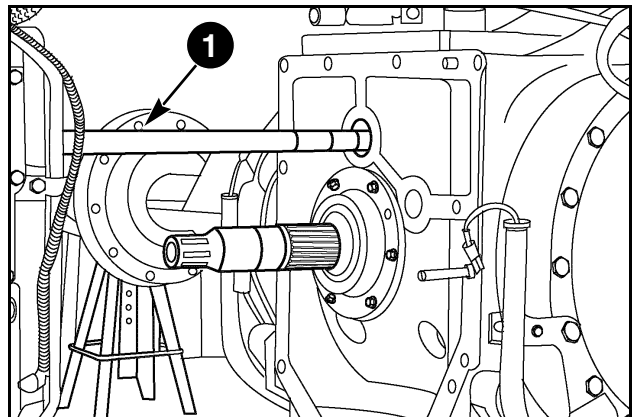


RD02C194

Remove the five bolts on each side of the housing. Install alignment dowels on each side.

**NOTE:** Two bolts on the bottom are removed from the rear.

## STEP 13



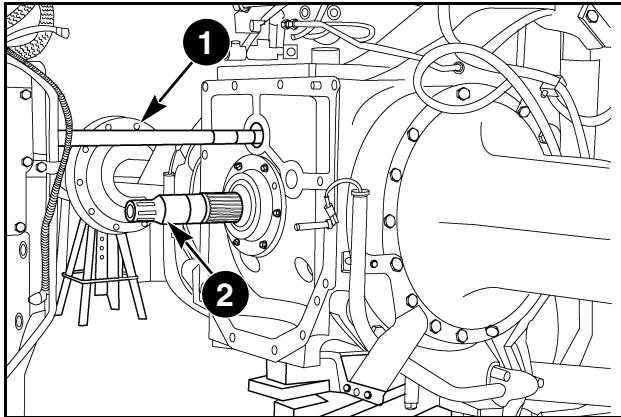
RD02C196

Separate the rear housing from the range housing. As the rear housing is moved rearward, move the snap ring and gear forward on the shaft. There is also a spacer between the snap ring and gear. Be sure to capture the snap ring, spacer and gear before they reach the end of the shaft.

**NOTE:** Be sure that the PTO input shaft (1) stays with the rear housing.

## Assembly

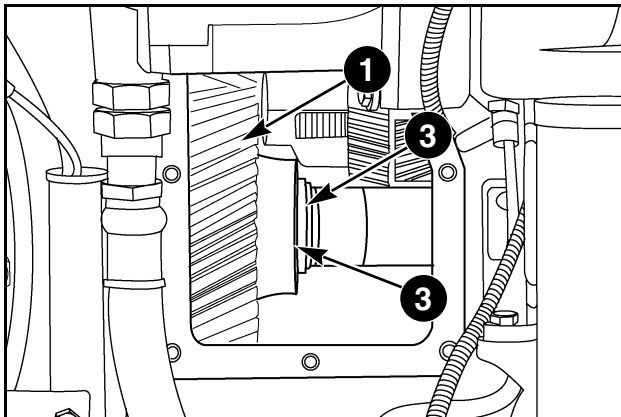
### STEP 14



RD02C196

Clean off all old gasket material in the flange area. Install alignment dowels and a new gasket. Move the rear housing forward until the PTO shaft (1) and the bevel pinion shaft (2) are started in the range housing.

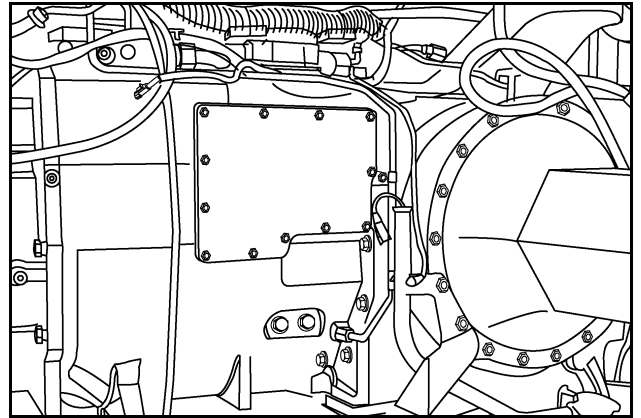
### STEP 15



RD02C192

When the bevel pinion shaft is far enough into the range housing, install the constant mesh gear (1), spacer (2) and snap ring (3) onto the shaft. Continue to move the rear housing forward while moving the snap ring along the shaft until it is seated in the groove in the shaft.

### STEP 16

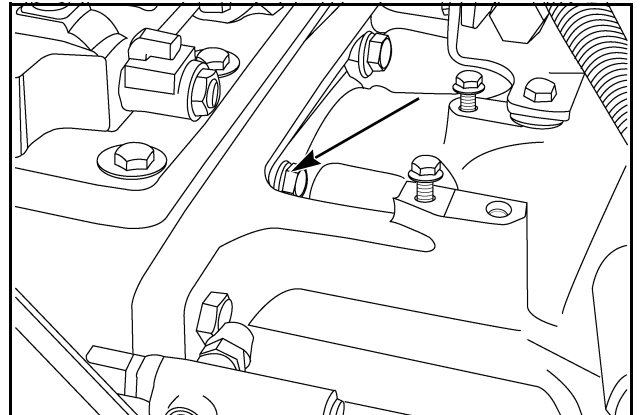


RD02C194

Using a bolt on both sides, draw the rear frame and range transmission together evenly. Remove guide studs when two bolts are drawn tight and replace with the bolts. Check to be sure the snap ring is fully seated in the shaft groove.

**NOTE:** It may be necessary to rotate the PTO output shaft to align splines.

### STEP 17

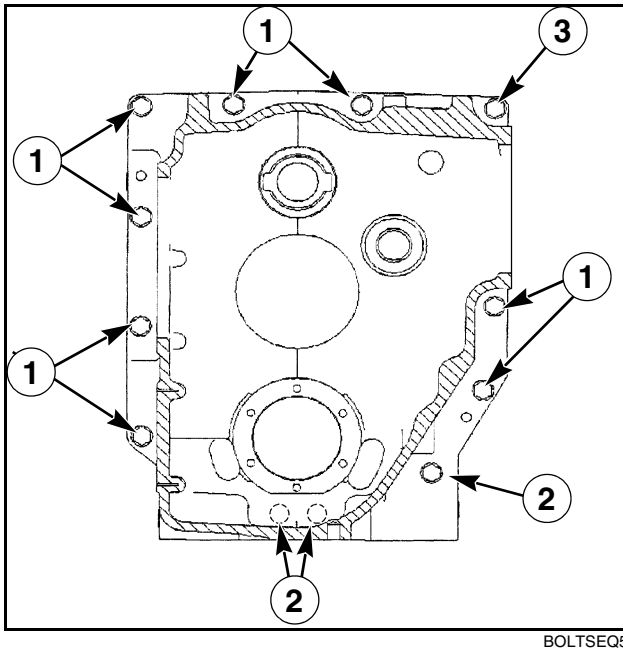


RD02C193

Install the top bolts.



## STEP 18



BOLTSEQ5

Tighten the bolts to the following torques:

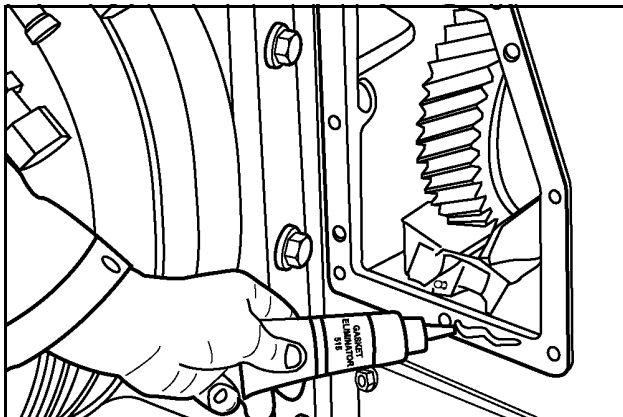
M16 x 60mm..... 232 to 262 Nm (171 to 193 lb. ft.)

M16 x 80mm..... 220 to 250 Nm (162 to 184 lb. ft.)

M16 x 110mm..... 220 to 250 Nm (162 to 184 lb. ft.)

**IMPORTANT:** Failure to correctly tighten bolts could lead to failure of the bolts and housing.

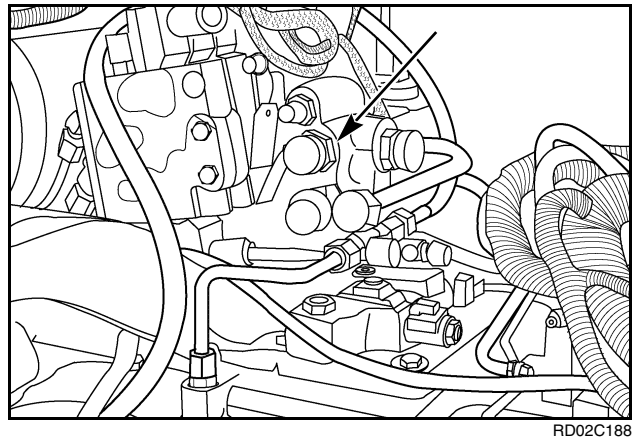
## STEP 19



T95616

Remove all foreign material from the cover and cover mounting flange. Apply a bead of Loctite Gasket Eliminator 515 down the center of the flange and around each bolt hole. Install the cover and seven bolts. Tighten all bolts to a torque of 54 to 61 Nm (40 to 45 lb. ft.).

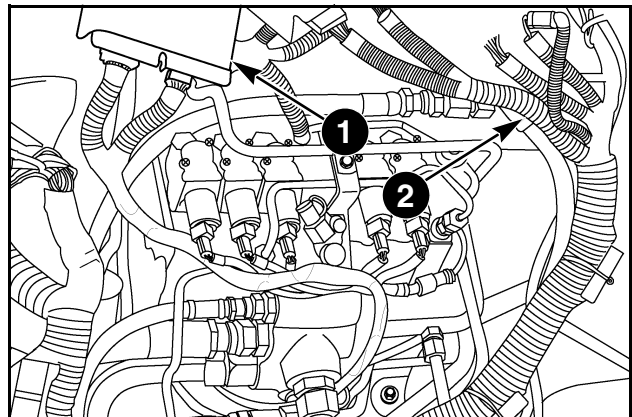
## STEP 20



RD02C188

Install tube removed from the remote valve.

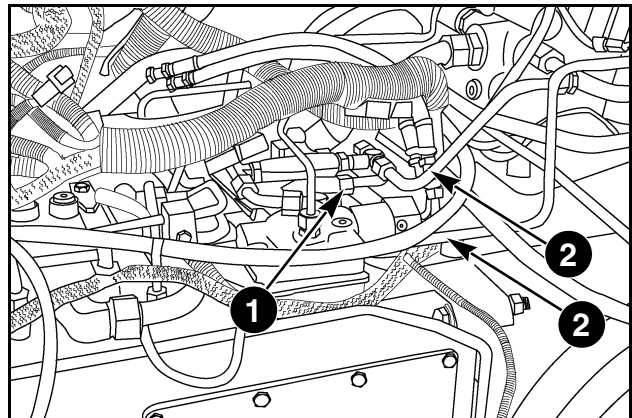
## STEP 21



RD02C197

Move the wire harness (1) and controllers back in position. Connect the remote auxiliary controller (2) to the wire harness.

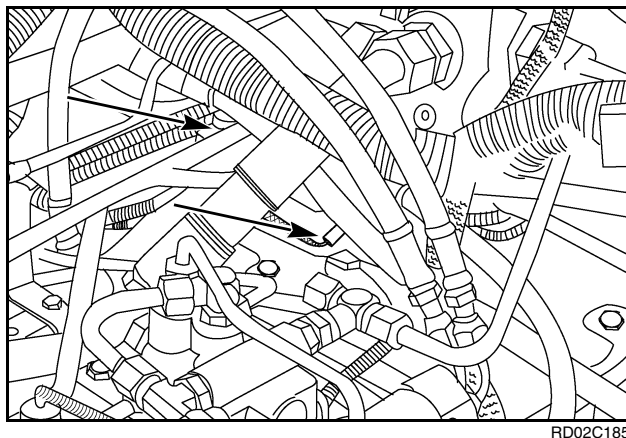
## STEP 22



RD02C186

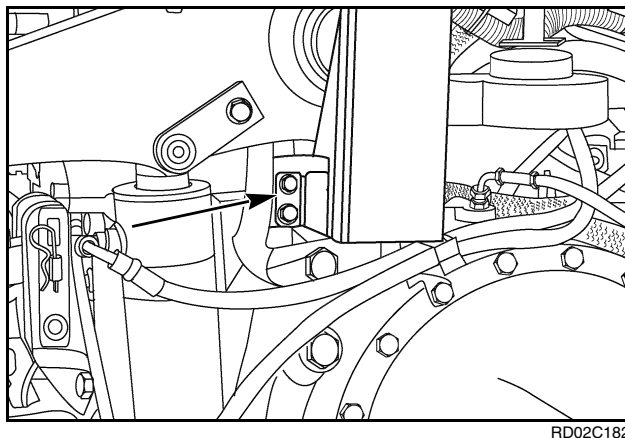
Install the two steering priority lines (1) and the two lines (2) for the trailer brake valve (if equipped).

### STEP 23



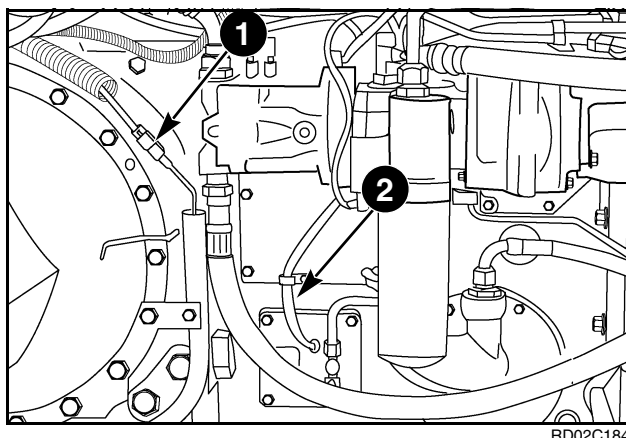
Connect the wire harness to the MFD and PTO solenoids.

### STEP 26



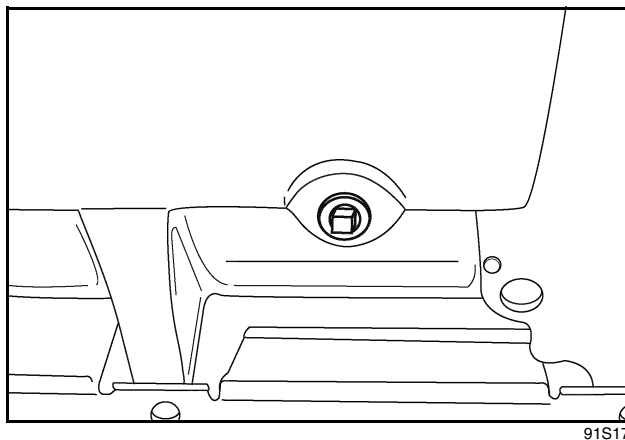
Install the hitch position sensor cover and tighten the bolts.

### STEP 24



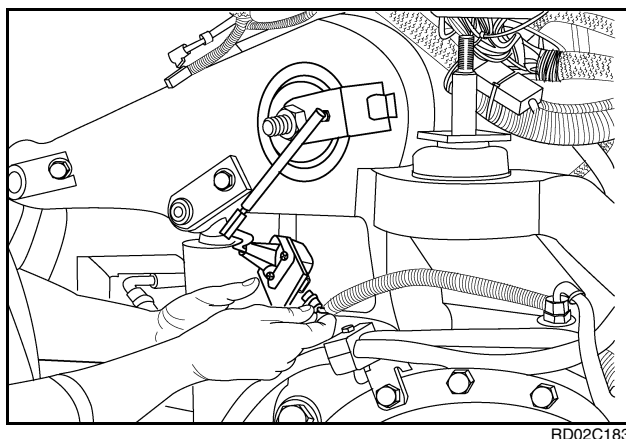
Connect the draft pin connector (1 - LH and RH side) and the transmission sump temperature sender connector (2) to the wire harness.

### STEP 27



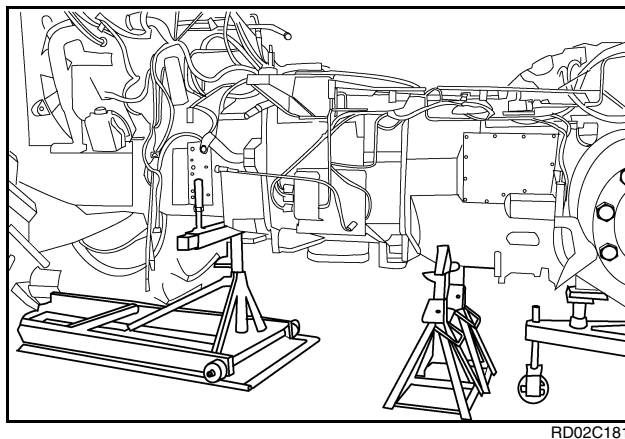
If not already done, install all removed drain plugs in the transmission.

### STEP 25



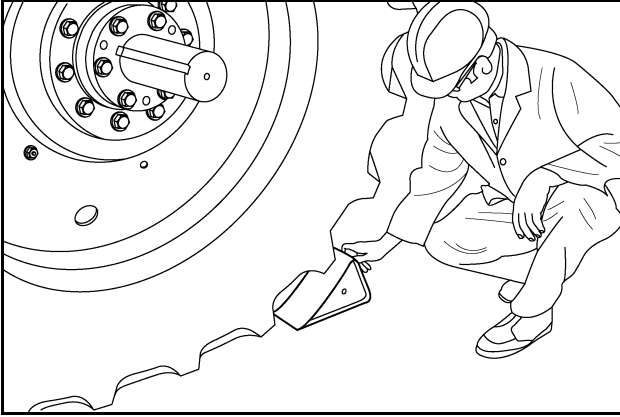
Connect the hitch position sensor to the wire harness.

### STEP 28



Remove the rear handler, front splitting stand and jack stands.

## STEP 29



96R28A

Complete the installation as follows:

1. Install the fuel tanks. See Fuel Tank Removal and Installation information.
2. Install the cab. See Cab Raise/Removal and Installation information.
3. Fill the transmission with fluid.
4. Remove the blocks from the wheels.

## STEP 30

When tractor assembly is complete, run the tractor and check for hydraulic leaks.

Check the fluid level in the transmission and add as required.

# **Section 21**

## **Chapter 6**

**RANGE TRANSMISSION**

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Installing the Range Input Master Clutch .....	21-6-75

## SPECIFICATIONS

Range Input Shaft Master Clutch Spring:

Free Length .....	35.82 mm (1.41 inches)
Compress to 30.99 mm (1.220 inches) .....	42.26 N (9.5 lb.)
FWD Clutch Pack Oil Leakage .....	0.40 L/min max (0.10 gpm max)
FWD Input Shaft Bearing End Play .....	0.025 to 0.153 mm (0.001 to 0.006 inch)
End Play for Installed Range Transmission Countershaft.....	0.013 to 0.100 mm (0.0005 to 0.004 inch)
End Play for Installed Range Transmission Input Shaft.....	0.03 to 0.13 mm (0.001 to 0.005 inch)
Clutch Pack Oil Leakage .....	0.5 L/min (0.13 gpm) maximum

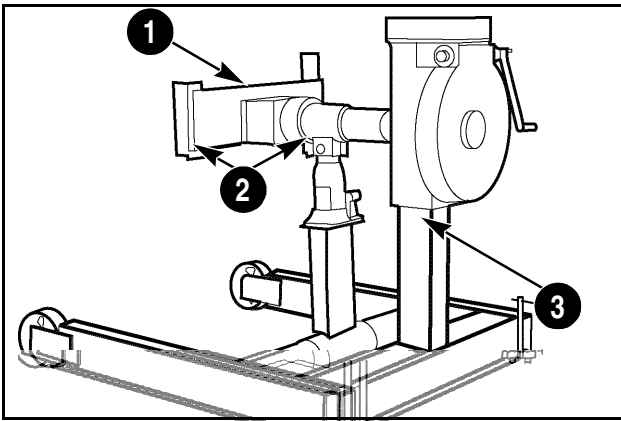
## TROUBLESHOOTING AFTER RANGE TRANSMISSION REPAIR

Problem	Probable Cause
Tractor has three sets of 1st-6th gear shift speeds.	Medium/high clutch pack is incorrectly indexed on the shaft.
Tractor will not move after the Master clutch repair (with the Master clutch pressure within specifications).	Master clutch pack is incorrectly indexed on the shaft.
Loss of Low range clutch pressure after repair (within first 200 hours).	Bearing on range countershaft not installed correctly (the Belleville spring was not compressed during installation).
	Check distributor hub and seal ring area for damage when repairing.

## SPECIAL TORQUES

FWD/Park Brake Assembly to Range Housing Mounting Bolts.....	106 to 113 Nm (78 to 84 lb. ft.)
Range Transmission Housing Front Bearing Support Cover Mounting Bolts .....	90 to 107 Nm (66 to 79 lb. ft.)
Range Transmission Housing to Rear Frame Mounting Bolts .....	232 to 262 Nm (171 to 194 lb. ft.)
Range Transmission Access Cover Mounting Bolts .....	54 to 61 Nm (40 to 45 lb. ft.)
Lubrication Manifold Mounting Bolts.....	52 to 61 Nm (38 to 45 lb. ft.)
Hydraulic Pump Assembly Mounting Bolts .....	52 to 61 Nm (38 to 45 lb. ft.)

## SPECIAL TOOLS

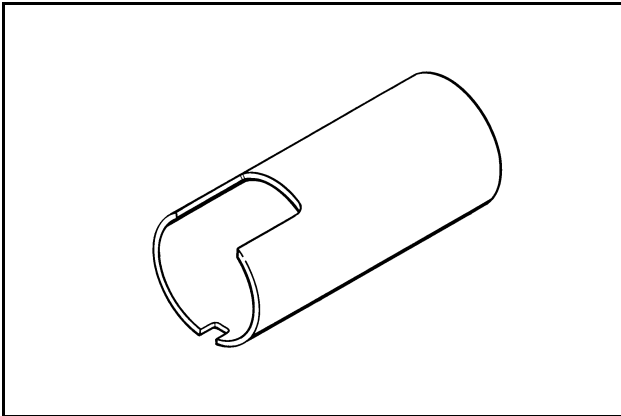


T95952

1. 17-52-14 MOUNTING PLATE
2. 17-52-16 MOUNTING BRACKETS (SET OF 2)

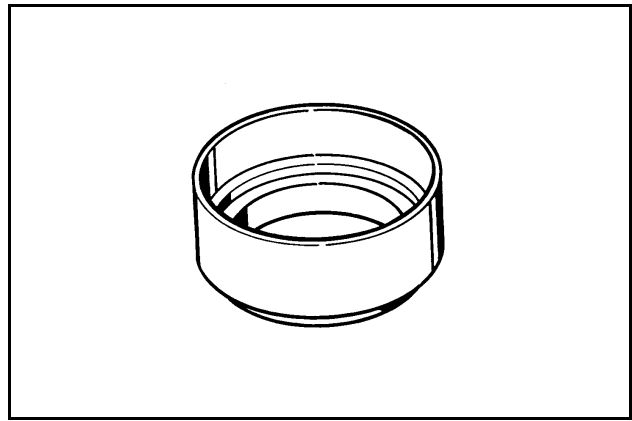
3. CAS 10431 ENGINE MOUNTING STAND

Engine Mounting Stand CAS10431, Mounting Brackets 17-52-16, and Mounting Plate 17-52-14



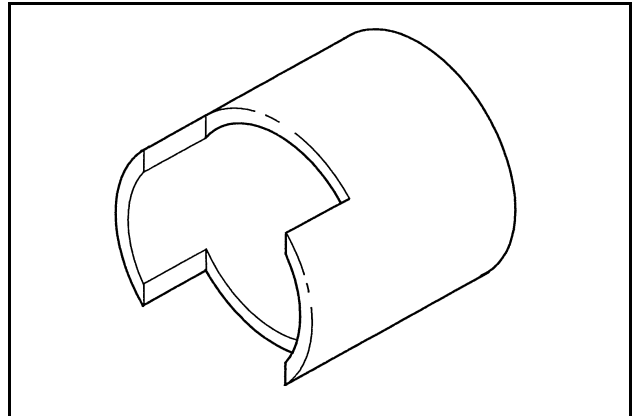
C1903H3

Compression Sleeve with notch CAS1903-3



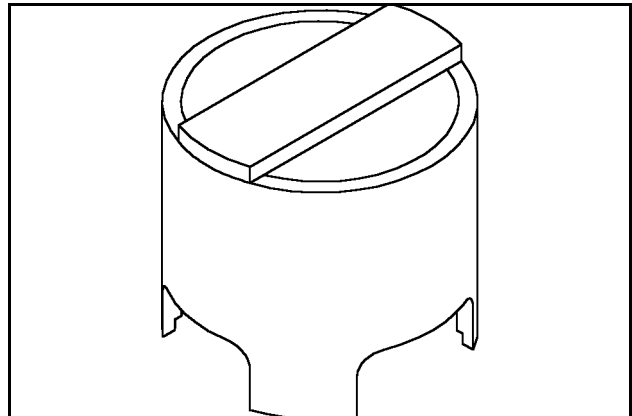
C1903H5

Compression Sleeve without notch CAS1903-5



CAS 2358

Compression Sleeve with notch CAS2602



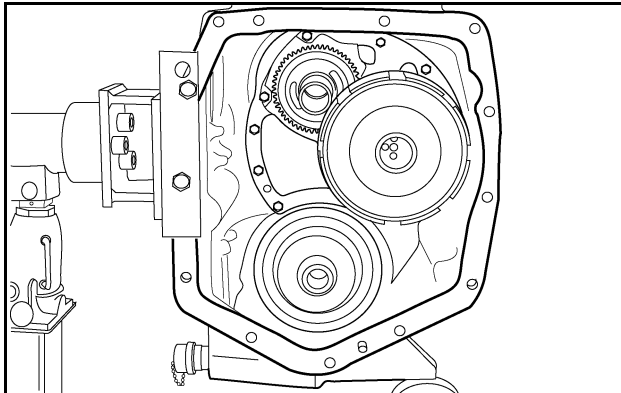
RI05f022

Compression Sleeve with notches 380002454

## RANGE TRANSMISSION

### Removing the Shaft Master Clutch

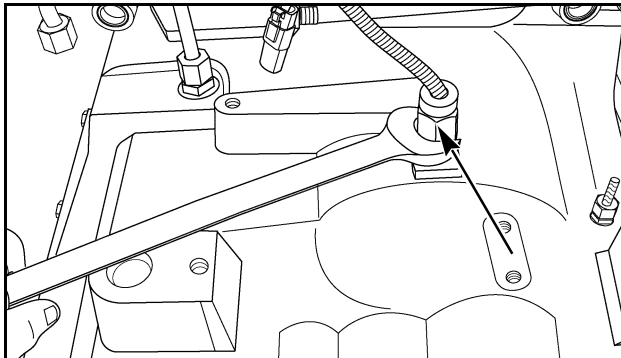
#### STEP 1



15S1R

After completing the procedures outlined in the Speed to Range Transmission Split Section and the Range Transmission to Differential Split Section of this Service Manual, the range transmission is ready for service. Mount the transmission on an engine stand CAS10431.

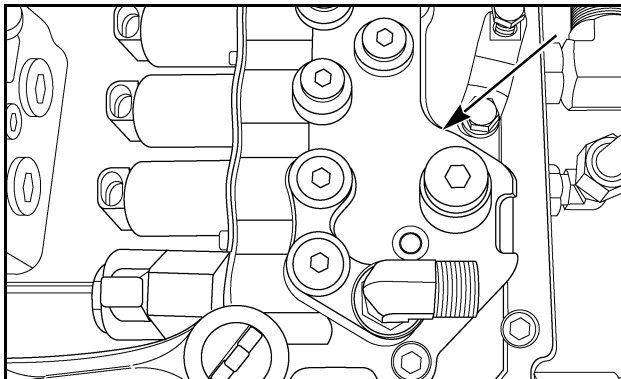
#### STEP 2



RD05K013

Remove the speed sensor.

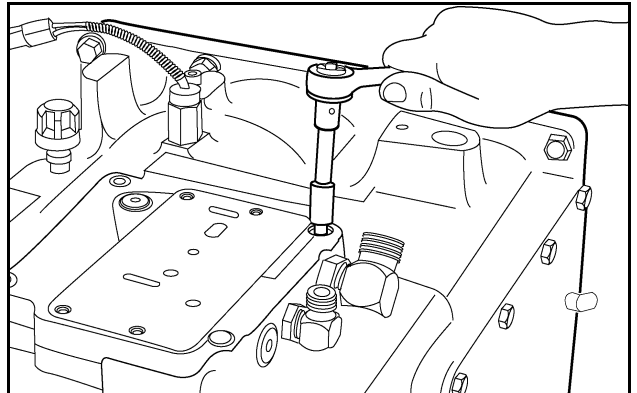
#### STEP 3



RD05K015

Remove range valve body.

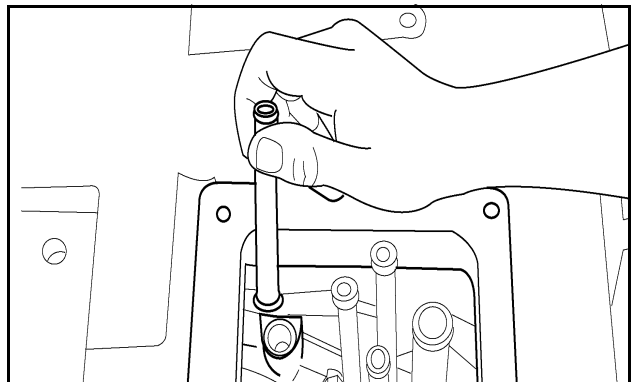
#### STEP 4



12S9CUR4

Remove valve body plate.

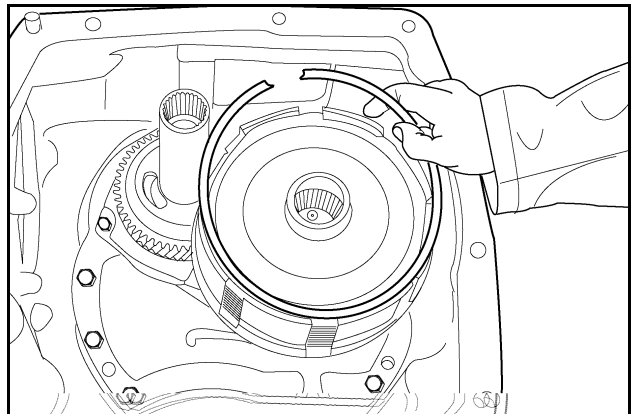
#### STEP 5



12S15

Remove feeder tubes.

#### STEP 6

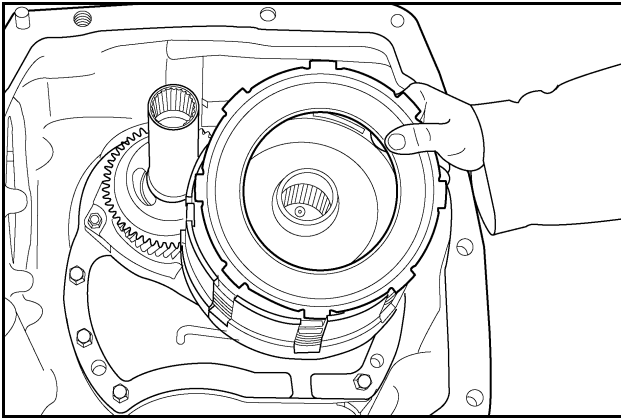


15S18

Remove the large, internal snap ring from the master clutch.



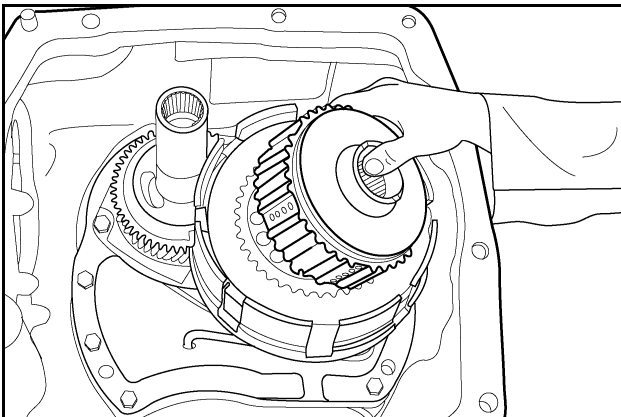
## STEP 7



15S21

Remove the clutch backing plates.

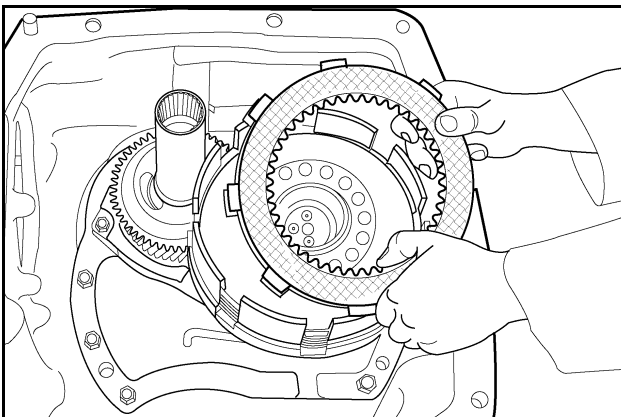
## STEP 8



15S24

Remove the clutch hub.

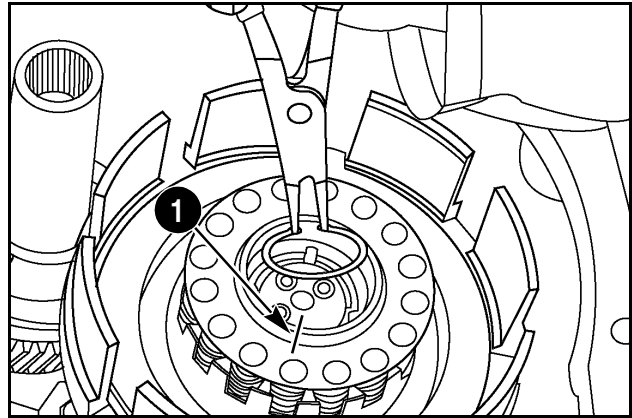
## STEP 9



15S27

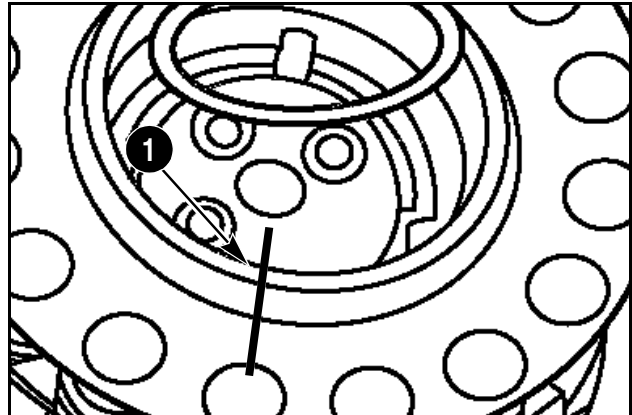
Remove 9 friction plates and 9 separator plates.

## STEP 10



A22306

Enlarged View:



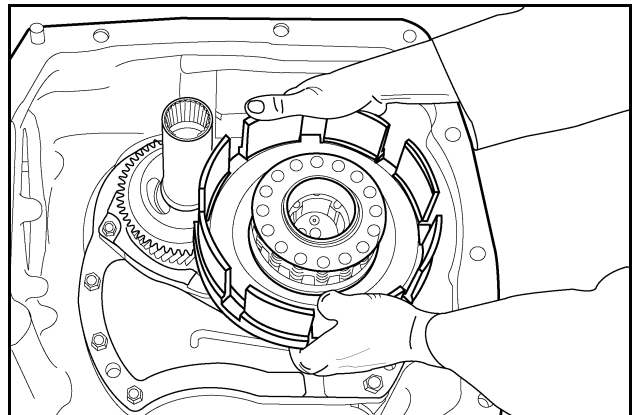
A22306CU

1. ALIGNMENT MARK

Mark the master clutch for reassembly. Remove the snap ring that fastens the master clutch to the range input shaft.

**IMPORTANT:** *The master clutch must be aligned properly with the input shaft.*

## STEP 11

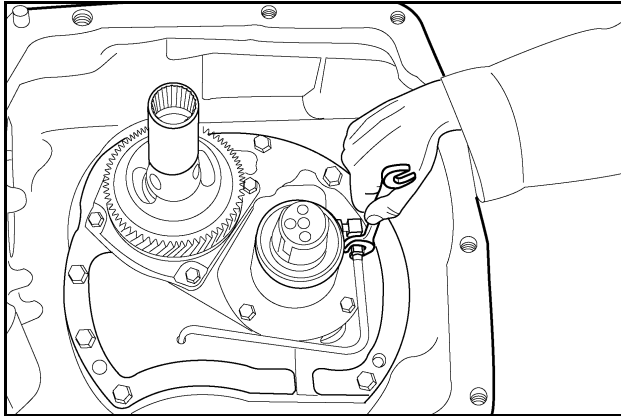


15S30

Remove the master clutch carrier assembly, including master clutch piston and return springs.

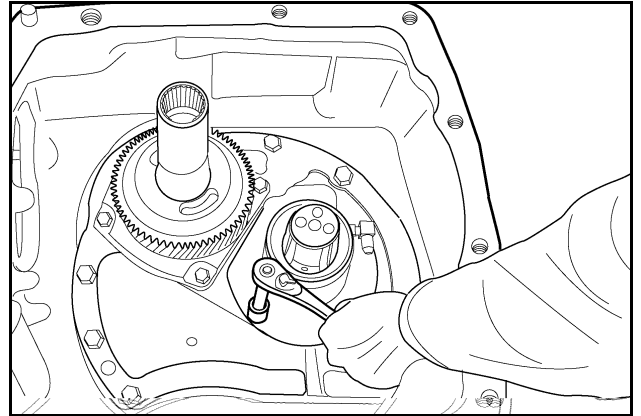
## Removing the Input Shaft, Countershaft and Mechanical Front Drive (FWD) / Park Brake Assembly

### STEP 12



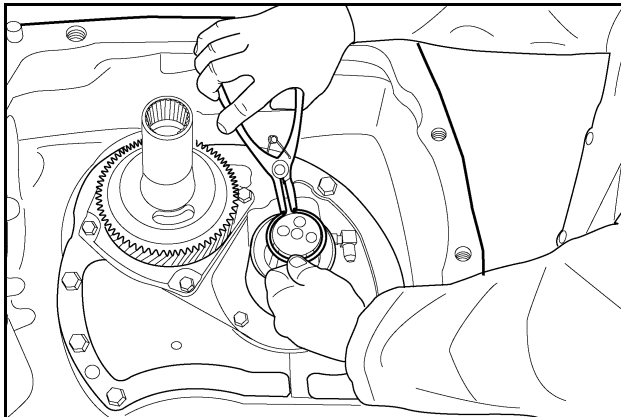
Remove the lubrication tube from the input shaft bearing cage.

### STEP 14



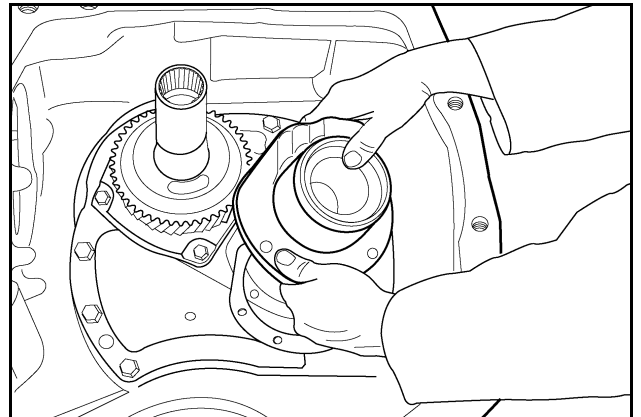
Remove the mounting bolts from the input shaft bearing cage.

### STEP 13



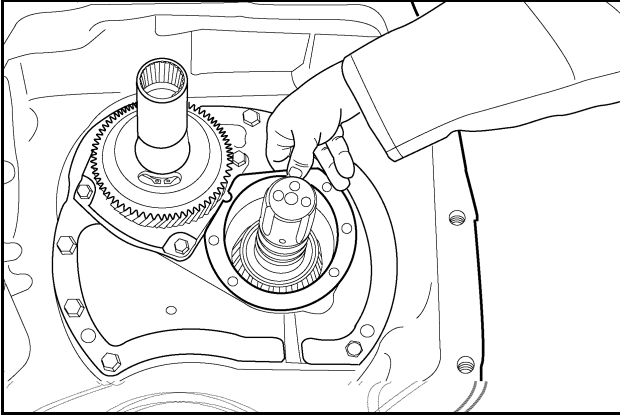
Remove the master clutch carrier rear retaining ring from the input shaft.

### STEP 15



Remove the input shaft bearing cage.

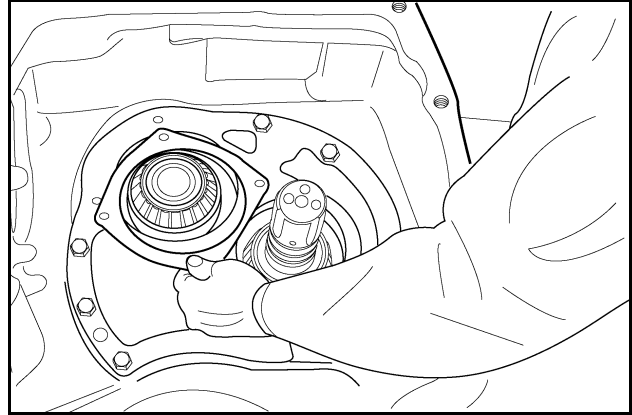
### STEP 16



16S12

Remove the shims for the input shaft bearing cage. Keep the shims together with the bearing cage. The shims will be used again during assembly.

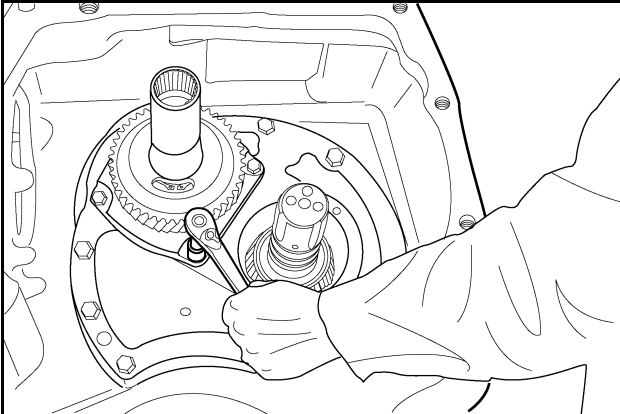
### STEP 19



16S21

Remove the shims for the countershaft bearing cage. Keep the shims together with the bearing cage.

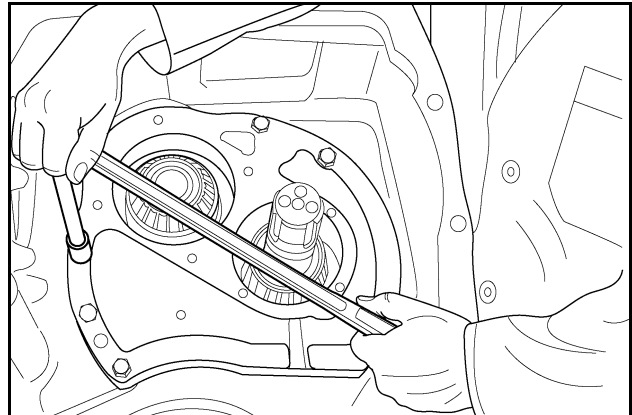
### STEP 17



16S15

Remove the mounting bolts from the countershaft bearing cage.

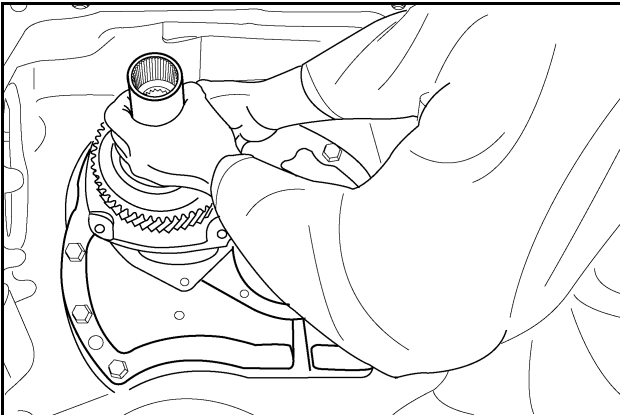
### STEP 20



16S24

Remove the mounting bolts from the front bearing support cover.

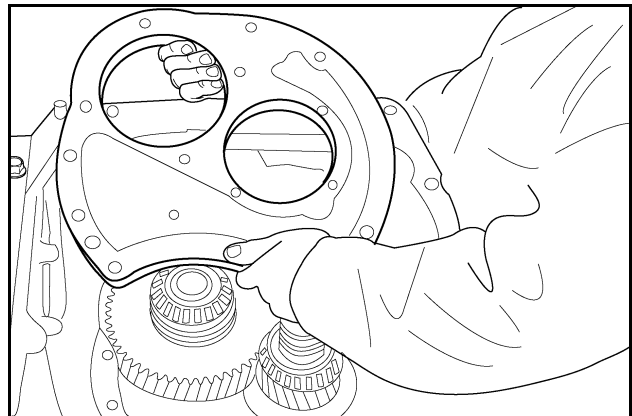
### STEP 18



16S18

Remove the countershaft bearing cage and pump drive gear assembly.

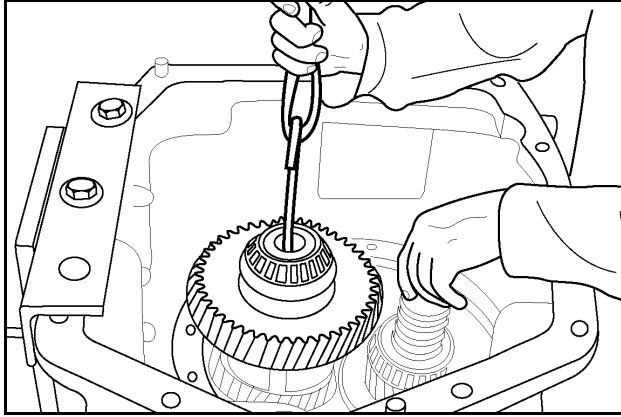
### STEP 21



16S27

Remove the front bearing support cover.

## STEP 22



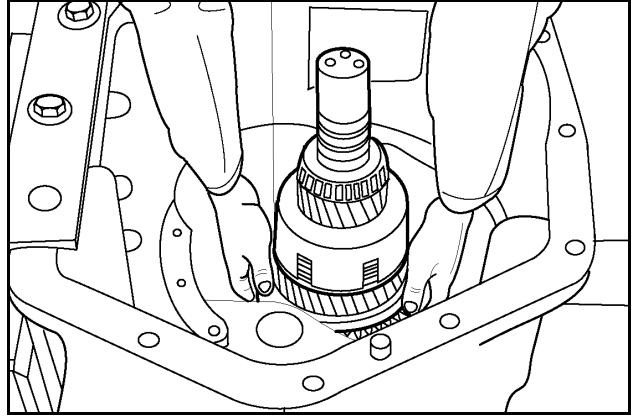
A22319

**NOTE:** *If only the FWD/Emergency Brake Assembly needs to be removed, the range input and counter shafts DO NOT have to be removed.*

Remove the countershaft as follows:

1. Move the input shaft over to the side for clearance.
2. A threaded rod with a washer slightly larger than the countershaft diameter may be used to lift the shaft assembly.
3. Use a hoist to remove the countershaft.

## STEP 23

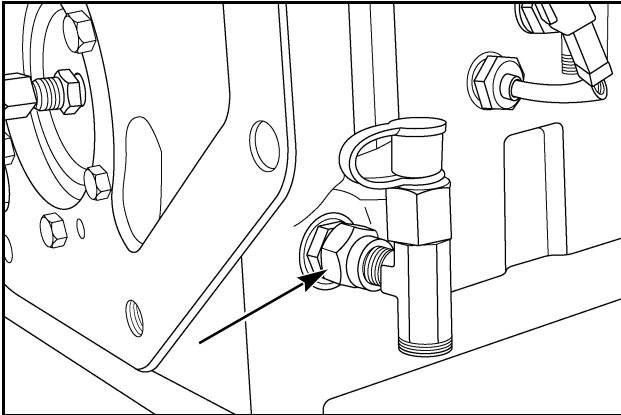


A22321

Remove the input shaft.

## FWD/Emergency Brake Removal

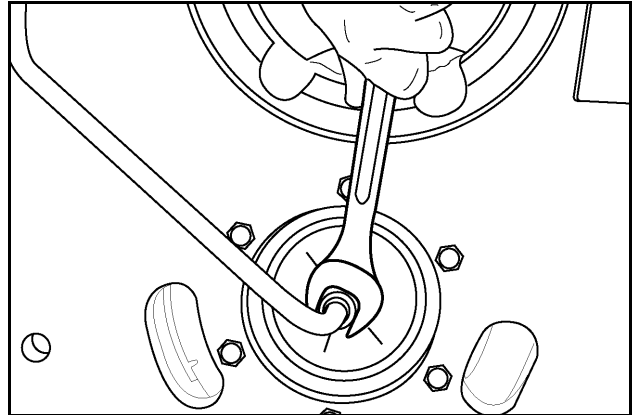
### STEP 24



RD05K011

Remove the emergency brake supply fitting.

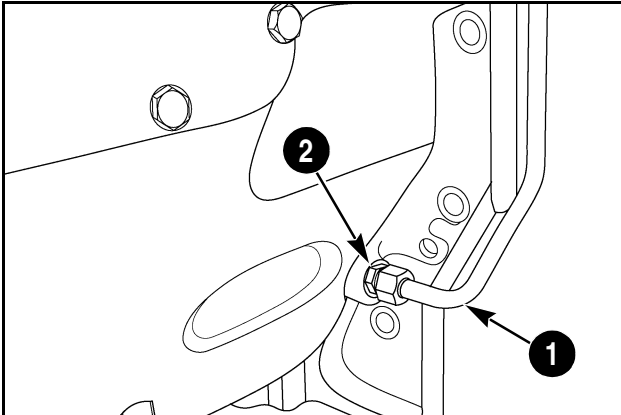
### STEP 27



A22326

Remove the FWD lube supply tube from the rear of the FWD / emergency brake input shaft.

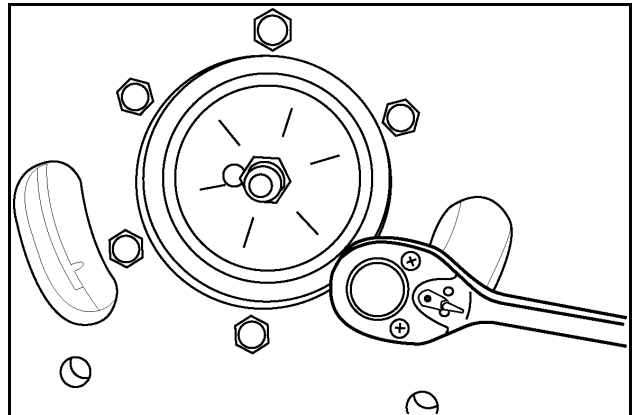
### STEP 25



RD05K012

Remove the supply tube (1) and fitting (2) for the FWD clutch pack.

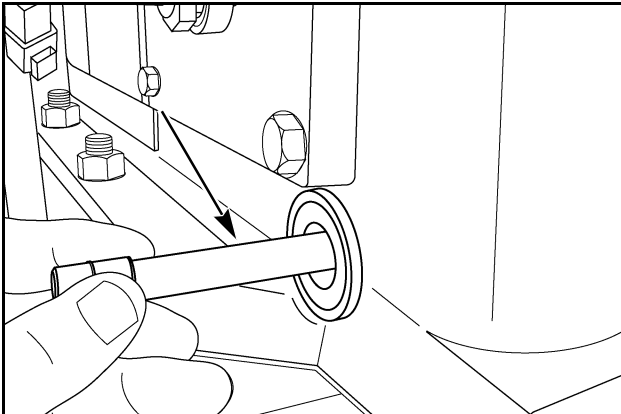
### STEP 28



A22328

Remove the six FWD / emergency brake rear flange mounting bolts.

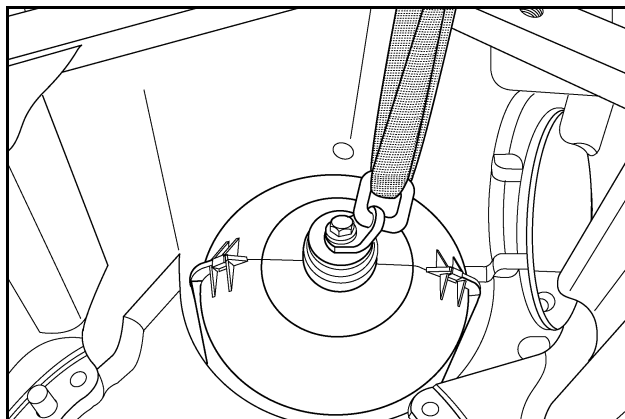
### STEP 26



RD05K014

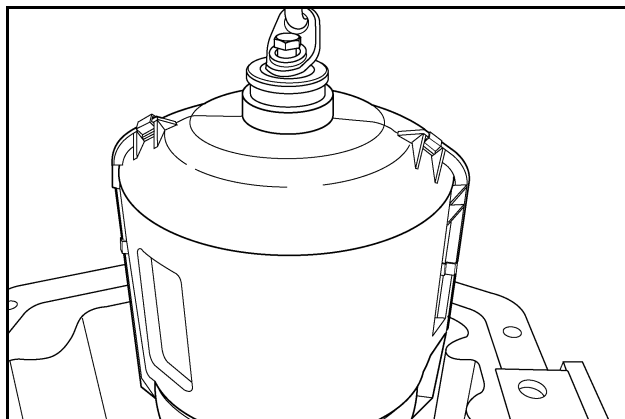
Remove the jumper tube for the emergency brake. Repeat for the FWD.

**STEP 29**



Properly support the FWD / emergency brake assembly.

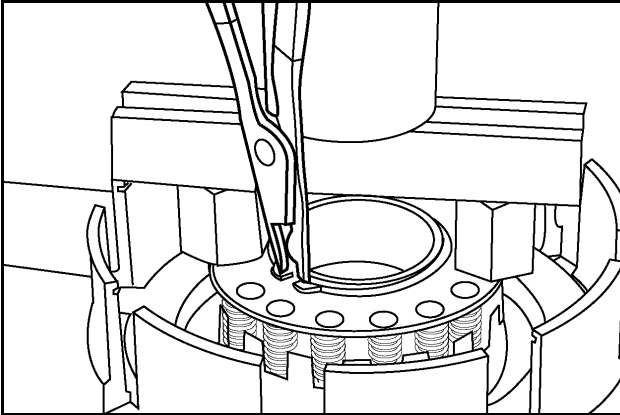
**STEP 30**



Carefully lift the assembly from the range housing.

## Disassembly of the Master Clutch

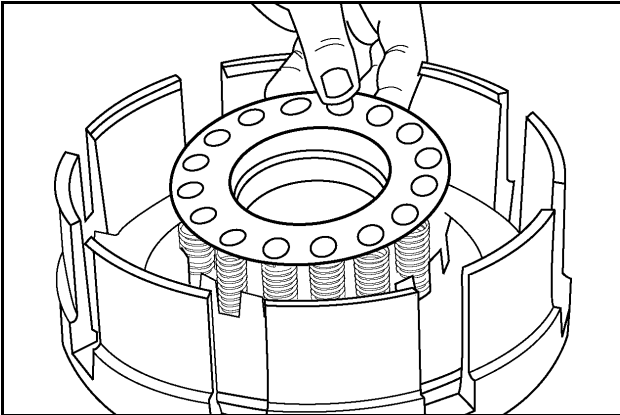
### STEP 31



A22350

Use a bridge and hydraulic press to compress the spring retainer plate. Remove the snap ring from the clutch carrier.

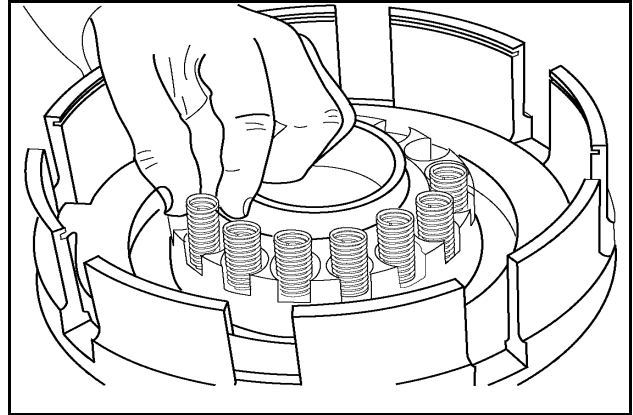
### STEP 32



A22348

Release the press and remove the spring retainer plate.

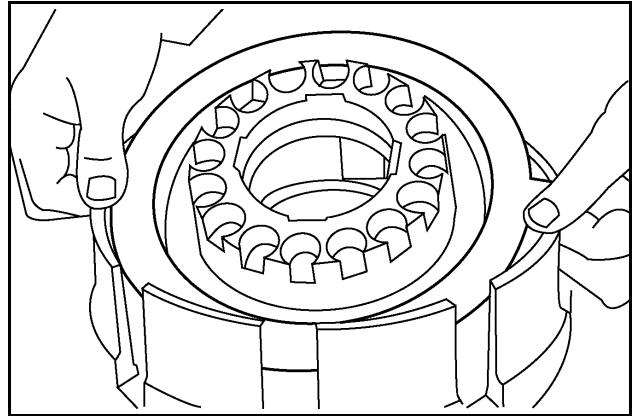
### STEP 33



A22347

Remove the 16 springs from the clutch piston.

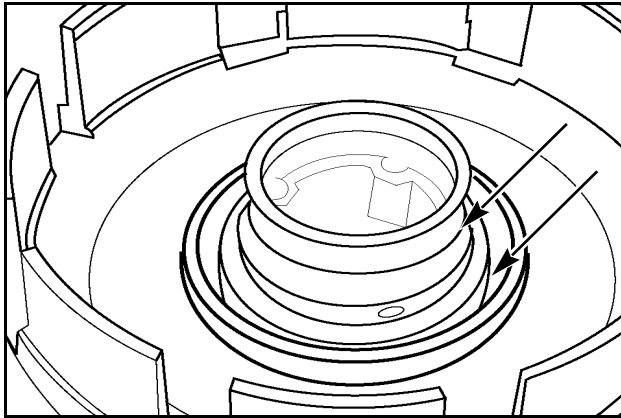
### STEP 34



A22346

Remove the piston from the clutch carrier.

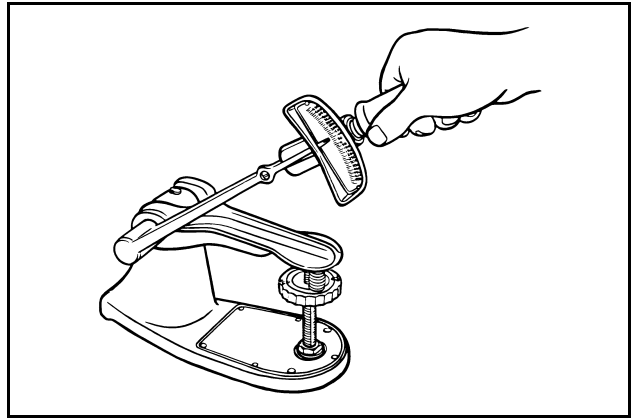
### STEP 35



Check seals and replace if necessary as follows:

1. Inspect the seals (see arrows) on the master clutch carrier.
2. If necessary, remove both the seals and the O-rings beneath them.
3. Replace the O-rings and seals.
4. Lightly lubricate with petroleum jelly.

### STEP 36



Check the clutch springs with a spring compression tester.

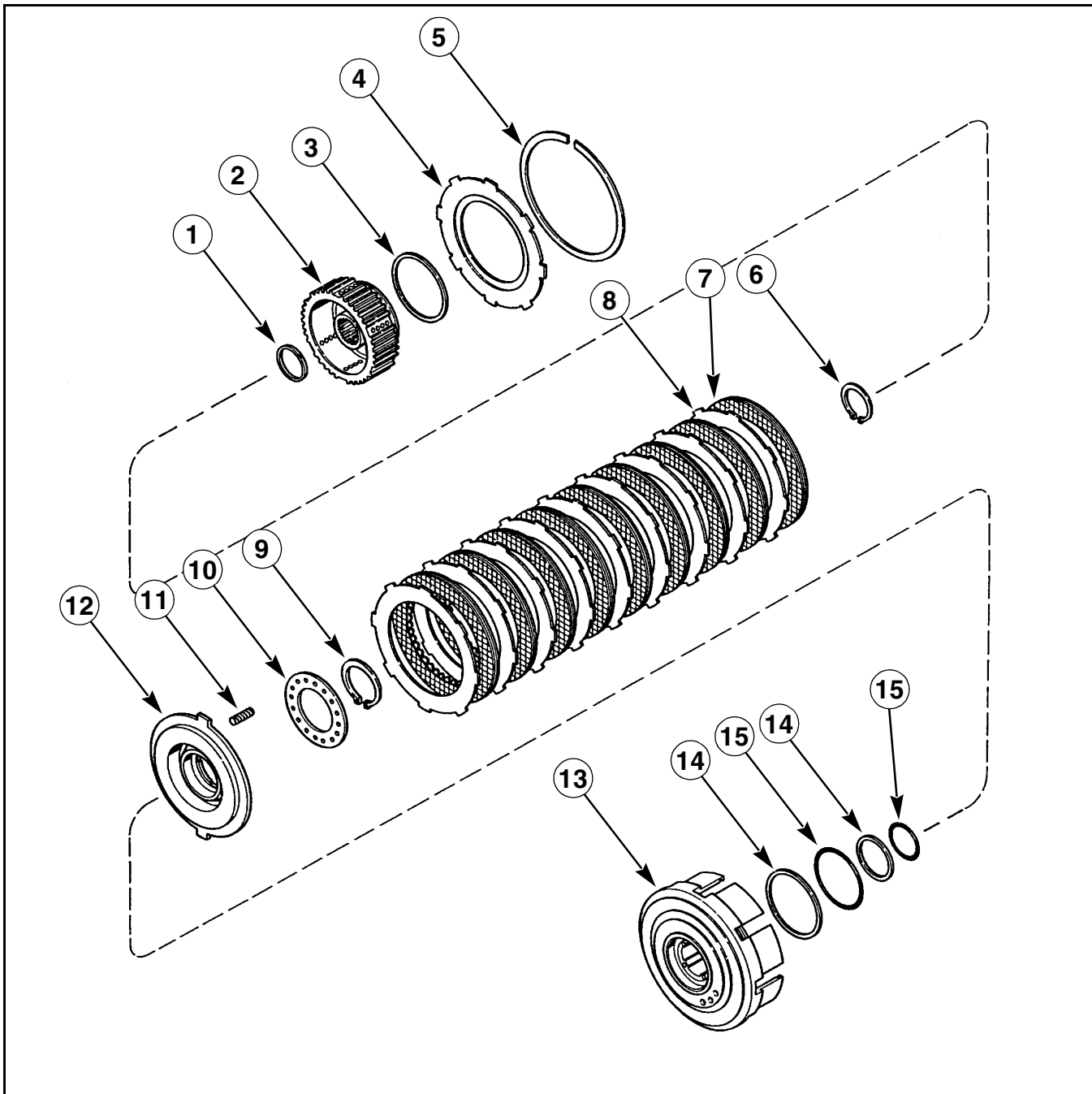
The springs must have the following specifications:

Free Length ..... 35.82 mm (1.410 inches)  
Compressed to 23.12 mm  
(0.910 inch) ..... 111.25 N (25 lb.)

**NOTE:** Do not compress these springs beyond 23.12 mm (0.910 inch).



## Exploded View of the Master Clutch

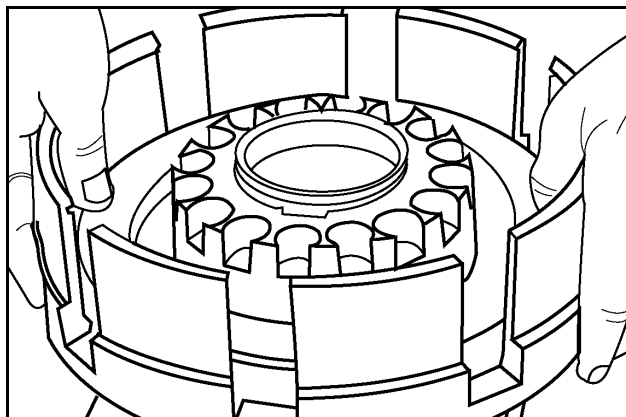


31L94R

- |                    |                     |
|--------------------|---------------------|
| 1. SEAL            | 9. SNAP RING        |
| 2. HUB             | 10. SPRING RETAINER |
| 3. SEAL            | 11. SPRING          |
| 4. BACKING PLATE   | 12. PISTON          |
| 5. SNAP RING       | 13. CLUTCH CARRIER  |
| 6. SNAP RING       | 14. SEALS           |
| 7. FRICTION PLATE  | 15. O-RINGS         |
| 8. SEPARATOR PLATE |                     |

## Assembly of the Master Clutch

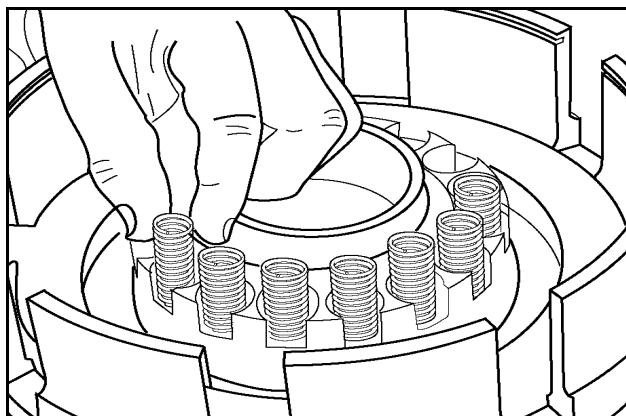
### STEP 37



A22345

Install the clutch piston into the clutch carrier. Carefully push the clutch piston down over the lubricated seals.

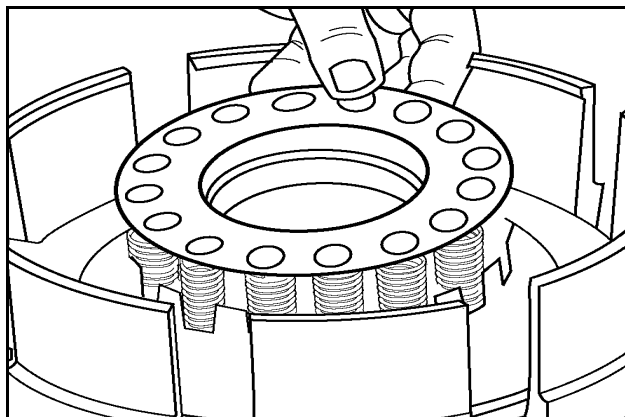
### STEP 38



A22347

Install the 16 springs.

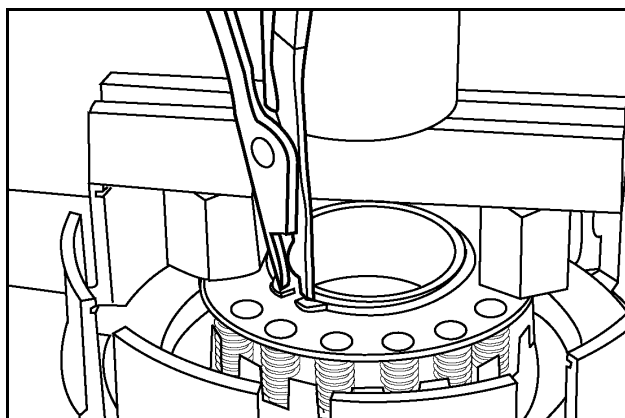
### STEP 39



A22348

Install the spring retainer plate. Be sure the spring locators in the plate engage each spring.

### STEP 40



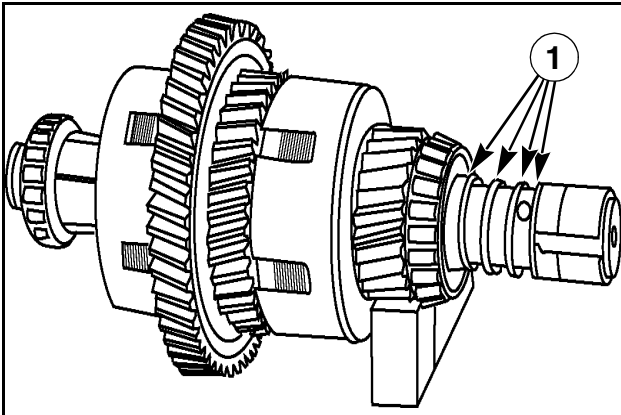
A22350

Use a bridge and hydraulic press to compress the springs. Install the snap ring in the groove in the clutch carrier.

**NOTE:** The assembly of the master clutch is continued after the master clutch is installed onto the range input shaft.

## Disassembly of the Range Transmission Input Shaft

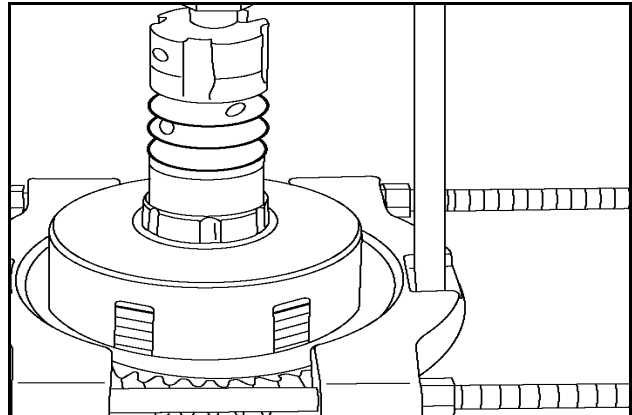
### STEP 41



A22361

Put the input shaft on a clean work bench. Remove the four seal rings on the front of the shaft (1).

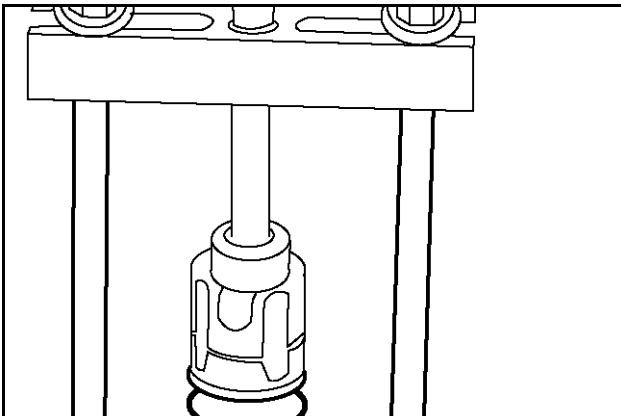
### STEP 43



T95702

Use a puller to remove the medium range clutch pack assembly.

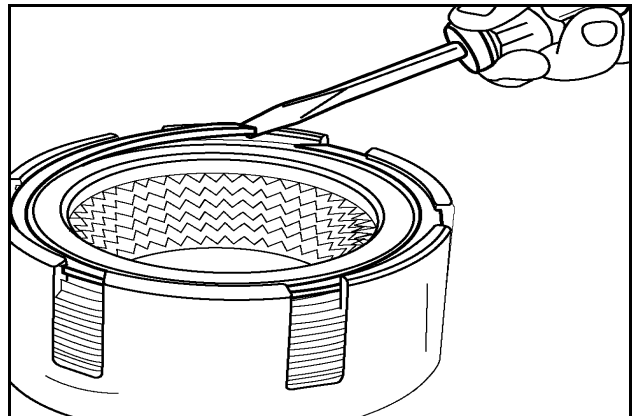
### STEP 42



T95697

Use a puller to remove the low range drive gear and front bearing cone.

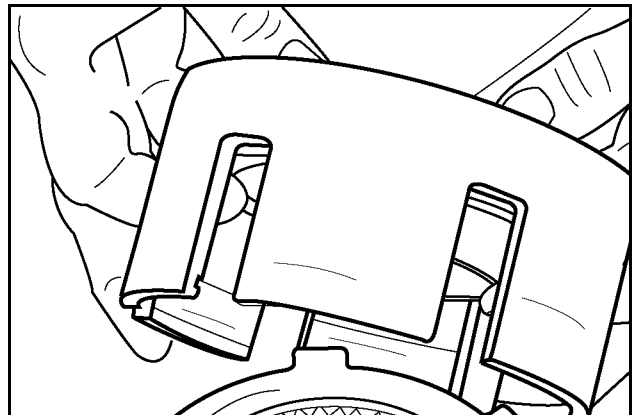
### STEP 44



A10871

Remove the snap ring from the clutch pack assembly.

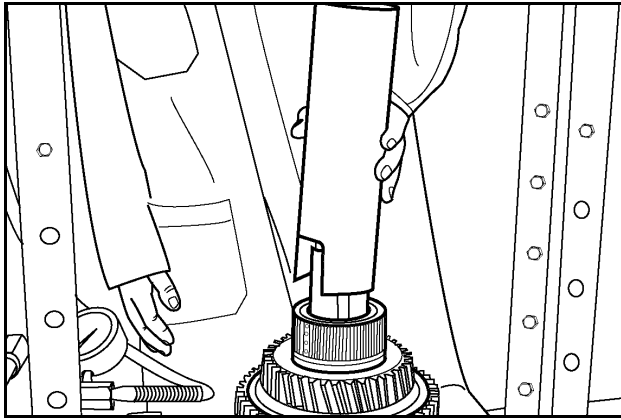
### STEP 45



40S33

Turn the assembly over and remove the friction, separator, and backing plates.

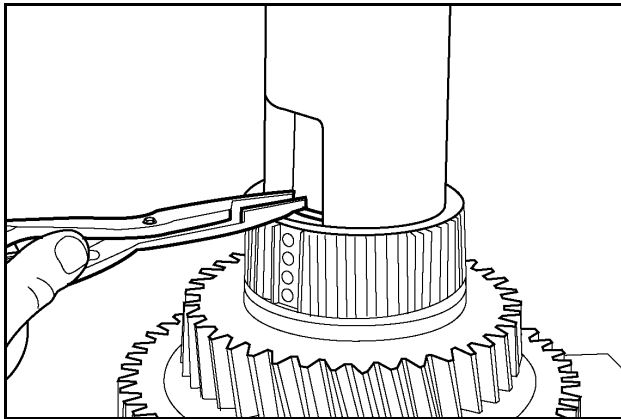
### STEP 46



A10882

Install the compression sleeve with the notch CAS1903-3 to remove the retaining ring for the piston return Belleville springs.

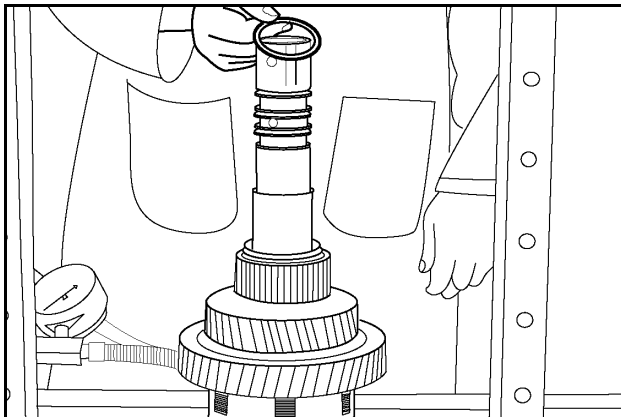
### STEP 47



A10881

Use a press to compress the Belleville springs. Move the snap ring out of the groove in the shaft.

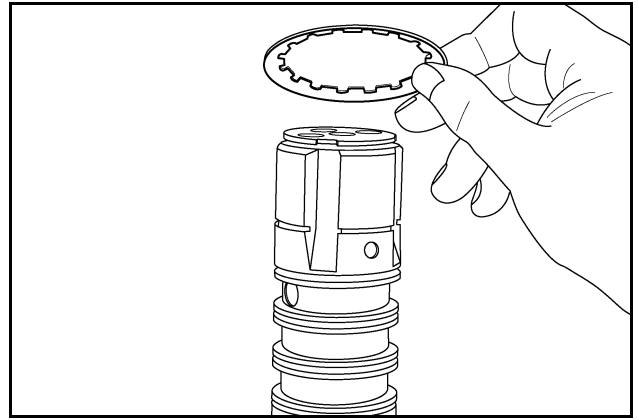
### STEP 48



T95713

Remove the compression sleeve and the snap ring.

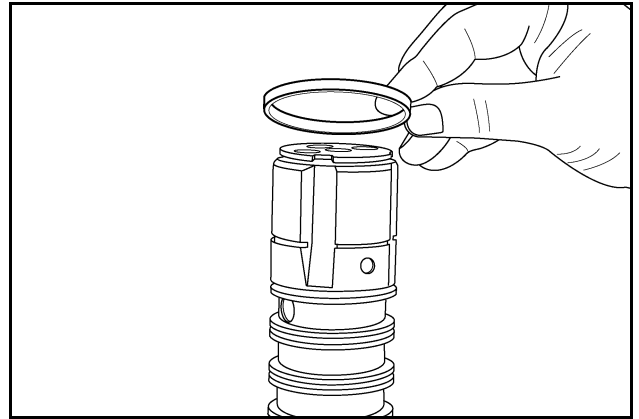
### STEP 49



RD05K110

Remove one piston return Belleville spring.

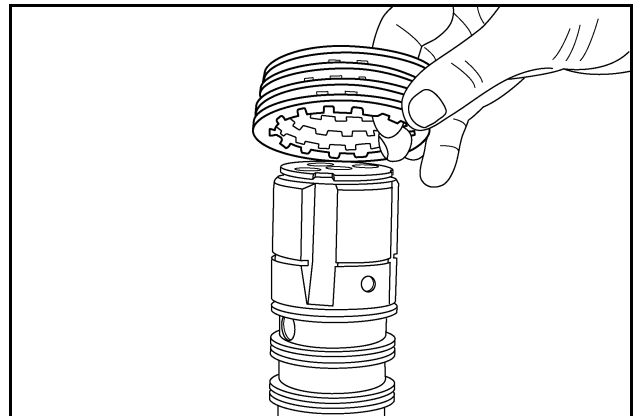
### STEP 50



RD05K109

Remove the lube management ring.

### STEP 51

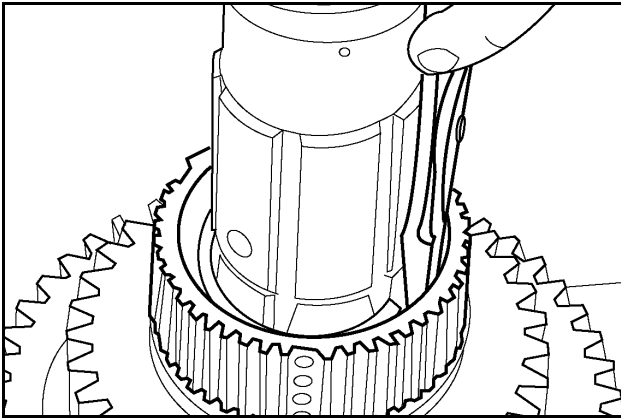


RD05K108

Remove eight piston return Belleville springs.

**NOTE:** Mark the orientation of the Belleville springs and lube management ring for proper reinstallation.

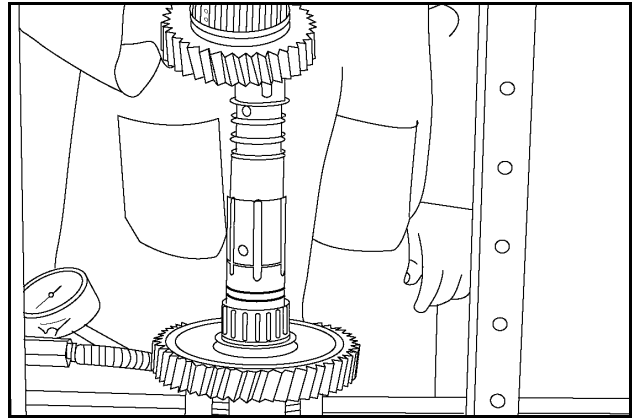
**STEP 52**



A10909

Remove the snap ring for the Belleville springs.

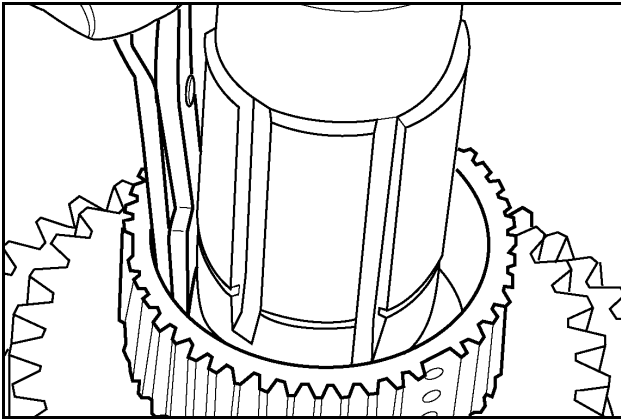
**STEP 55**



T95719

Remove the medium range drive gear.

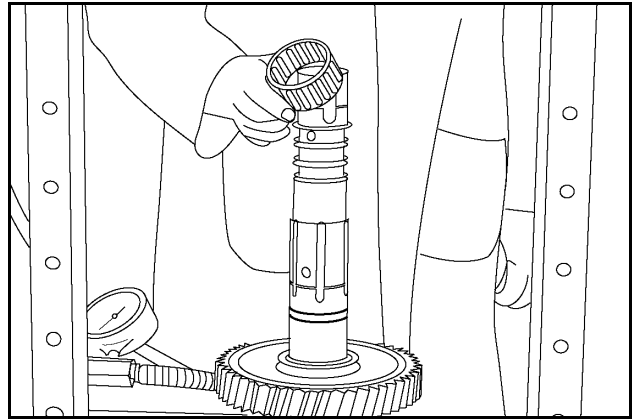
**STEP 53**



A10910

Remove the snap ring for the bearing thrust washers and needle thrust bearing.

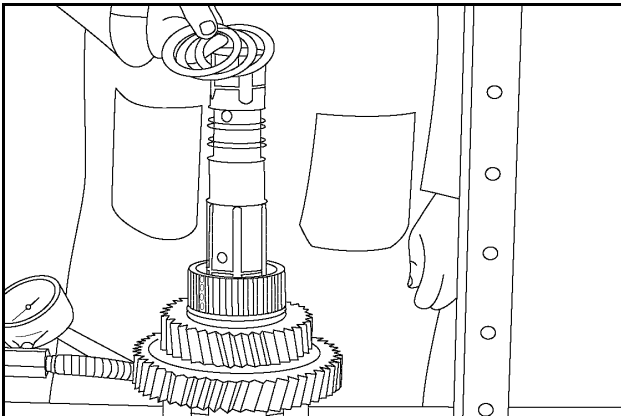
**STEP 56**



T95720

Remove the caged needle bearing.

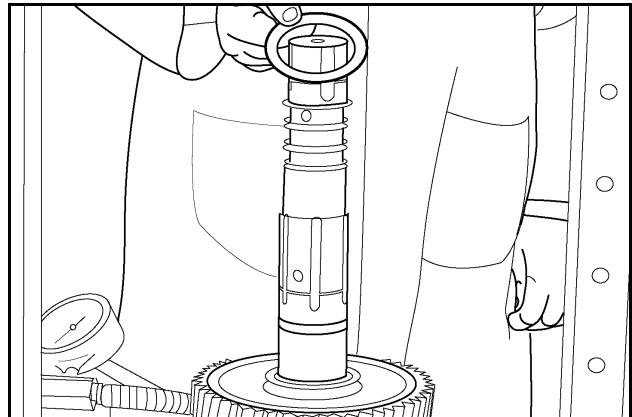
**STEP 54**



T95718

Remove the two bearing thrust washers and the needle thrust bearing.

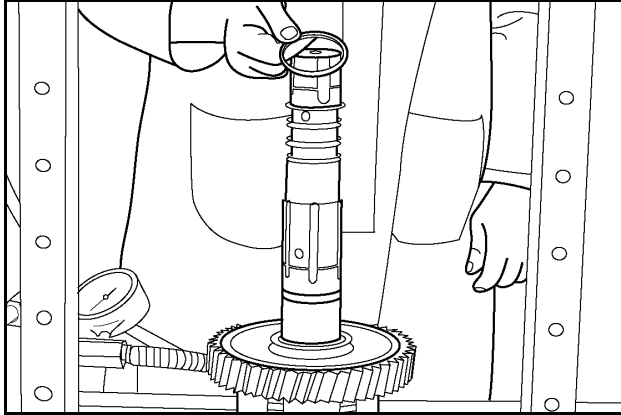
**STEP 57**



T95721R

Remove the thrust washer.

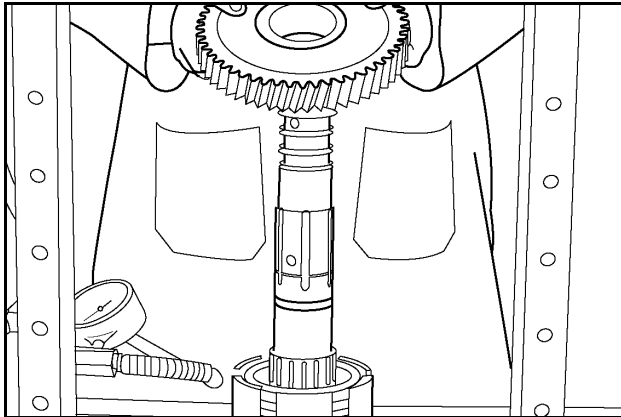
### STEP 58



T85722

Remove the thrust washer spacer ring.

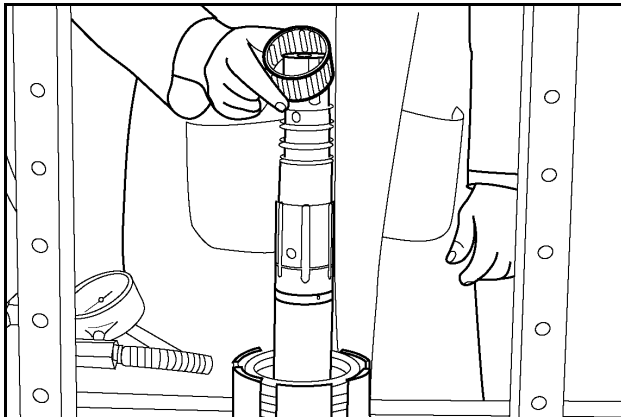
### STEP 59



T95723

Remove the high range drive gear.

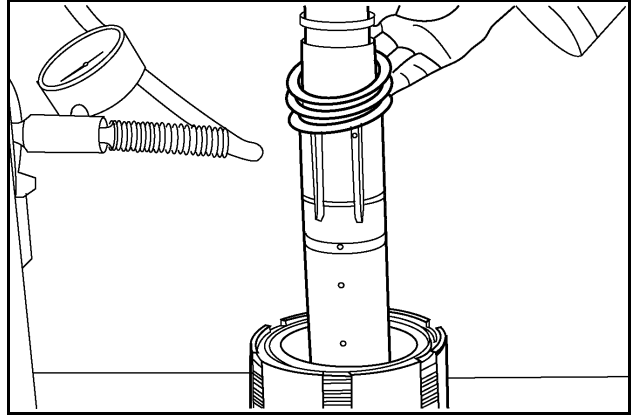
### STEP 60



T85724

Remove the caged needle bearing.

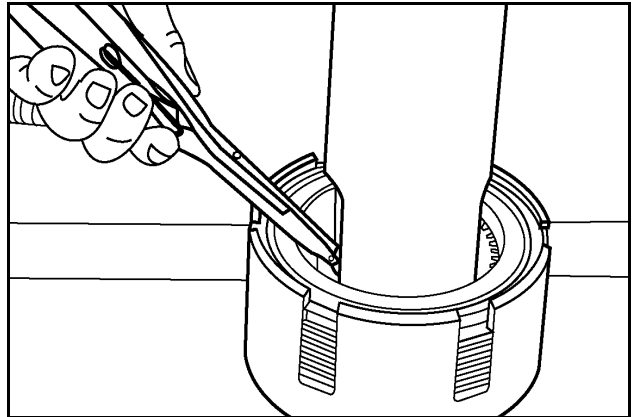
### STEP 61



A10908

Remove the two bearing thrust washers and the needle thrust bearing.

### STEP 62

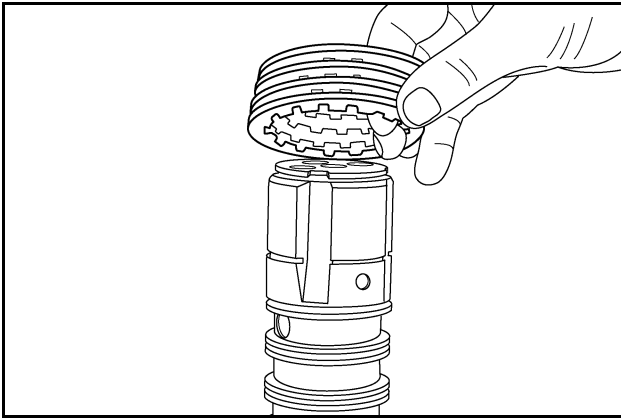


A10884

Remove the piston return Belleville springs as follows:

1. Install a compression sleeve with the notch CAS1903-3 over the piston return Belleville springs for removing the snap ring.
2. Position the opening in the compression sleeve over the ends of the snap ring.
3. Compress the Belleville springs with a press.
4. Remove the snap ring.

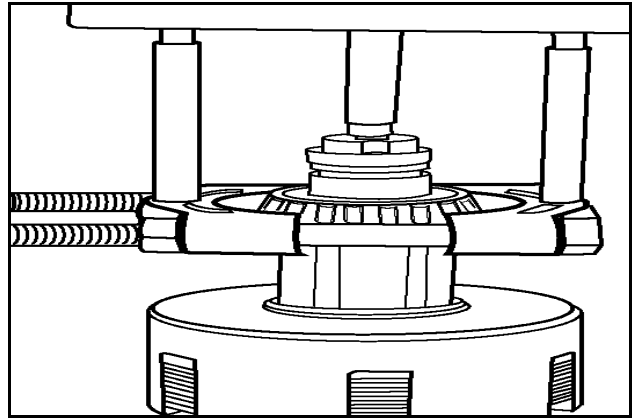
**STEP 63**



RD05K108

Remove 8 piston return Belleville springs.

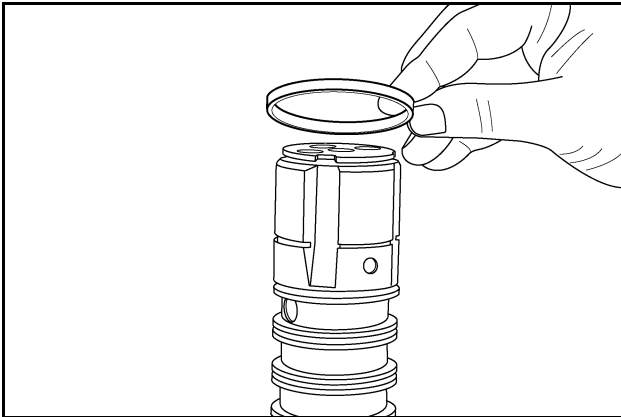
**STEP 66**



A10888

Use a puller to remove the rear bearing cone.

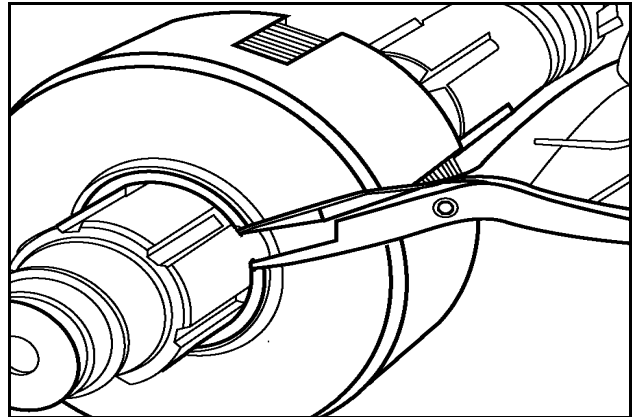
**STEP 64**



RD05K109

Remove the lube management ring.

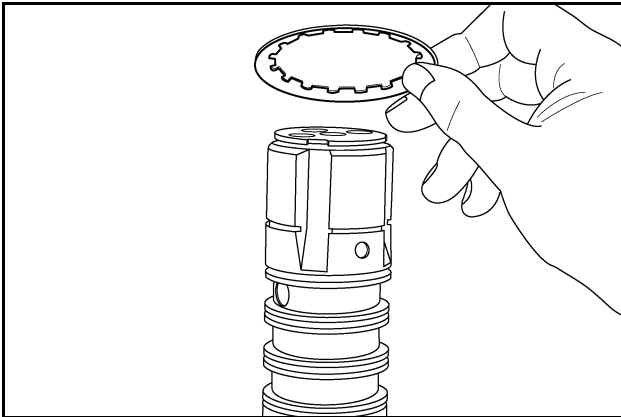
**STEP 67**



A10889

Remove the snap ring and remove the high range clutch pack assembly from the shaft.

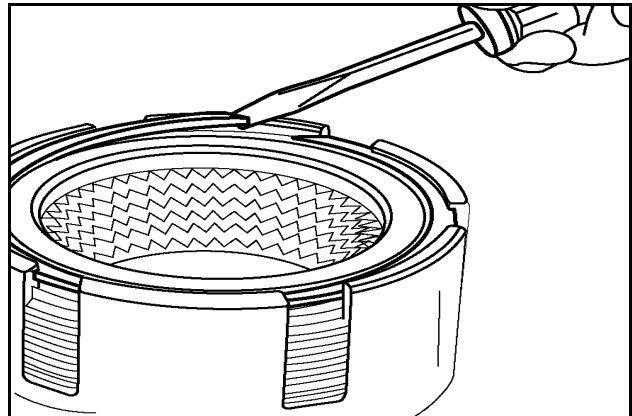
**STEP 65**



RD05K110

Remove the final Belleville spring.

**STEP 68**

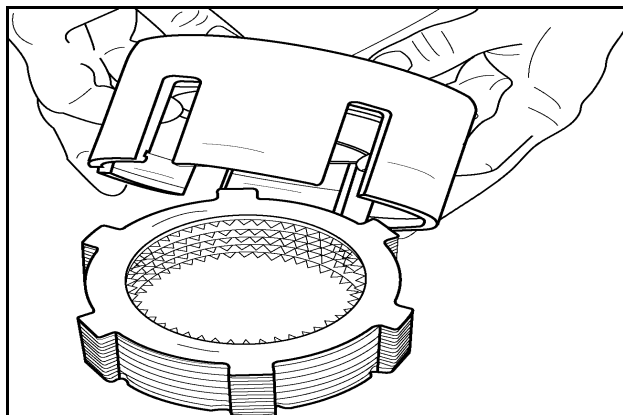


A10871

Remove the snap ring from the clutch pack assembly.

**NOTE:** Mark the orientation of the Belleville springs and lube management ring for proper reinstallation.

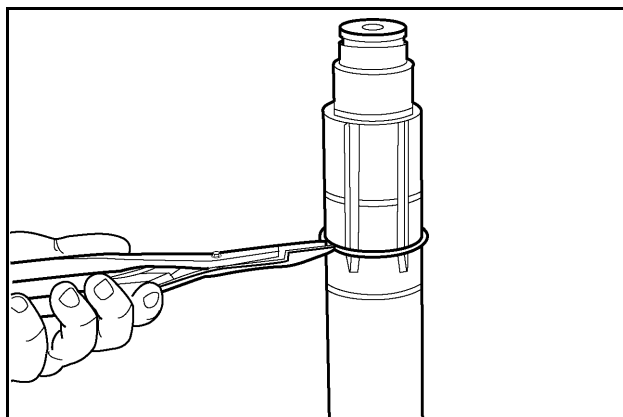
**STEP 69**



40S33

Turn the assembly over and remove the friction and separator plates.

**STEP 70**

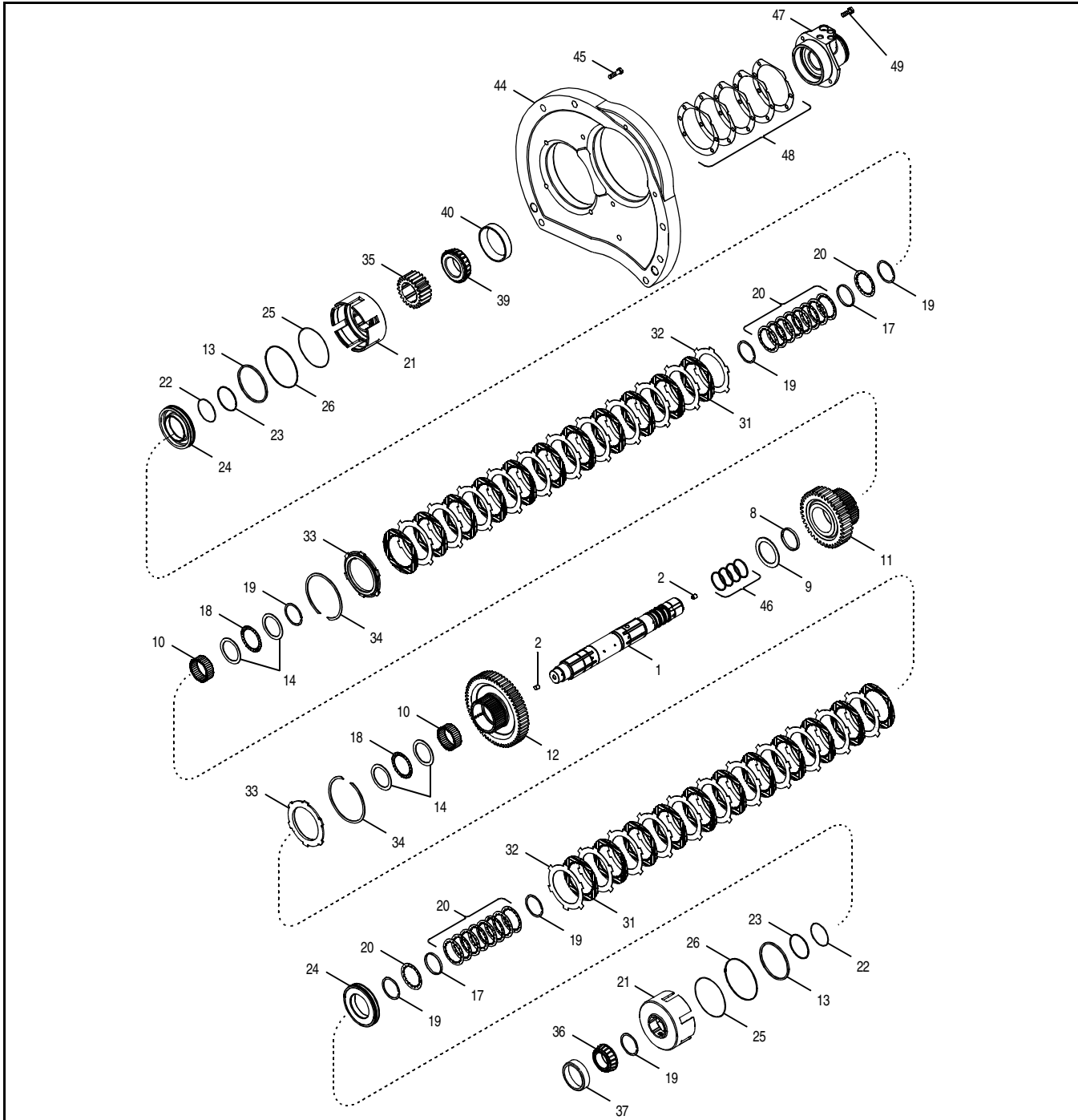


A10891

Remove the snap ring.



# Exploded View of the Range Transmission Input Shaft



RI05N027

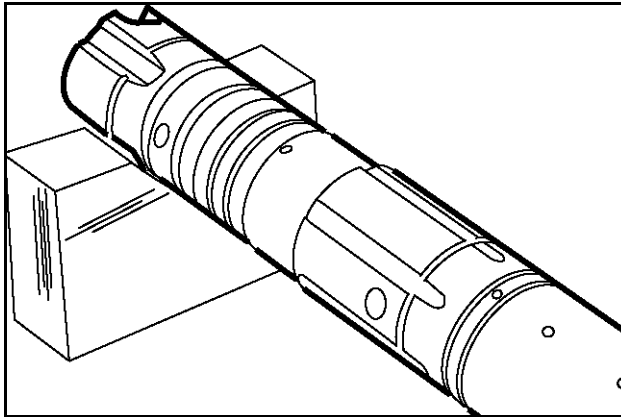
## Exploded View of the Range Transmission Input Shaft

- |                      |                       |                  |                    |
|----------------------|-----------------------|------------------|--------------------|
| 1. SHAFT ASSEMBLY    | 10. THRUST BEARING    | 19. O-RING       | 28. BEARING        |
| 2. PLUG              | 11. SNAP RING         | 20. SEAL RING    | 29. BEARING CONE   |
| 3. SEAL RING         | 12. CLUTCH DISC       | 21. O-RING       | 30. SUPPORT        |
| 4. THRUST WASHER     | 13. SEPARATOR DISC    | 22. SEAL RING    | 31. BOLT, M12 X 50 |
| 5. RING              | 14. FRICTION DISC     | 23. O-RING       | 32. SHIM           |
| 6. MEDIUM RANGE GEAR | 15. CIRCLIP           | 24. CARRIER      | 33. CAGE           |
| 7. HIGH RANGE GEAR   | 16. BELLEVILLE SPRING | 25. BEARING CONE | 34. BOLT, M10 X 30 |
| 8. NEEDLE BEARING    | 17. LUBE RING         | 26. BEARING      |                    |
| 9. THRUST WASHER     | 18. PISTON            | 27. DRIVING GEAR |                    |

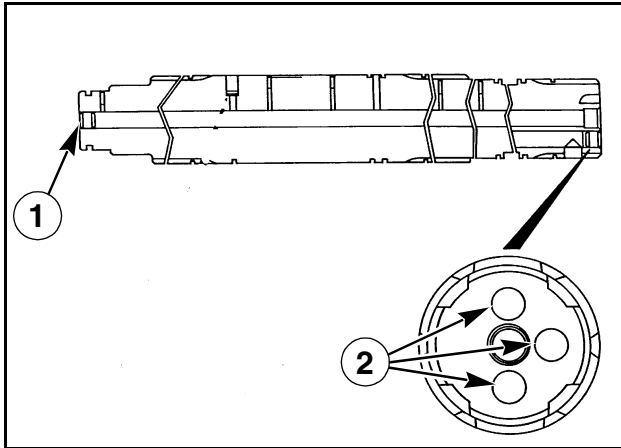
**NOTE:** When a clutch pack is disassembled, new friction plates must be installed.

## Assembly of the Range Transmission Input Shaft

### STEP 71



T95747

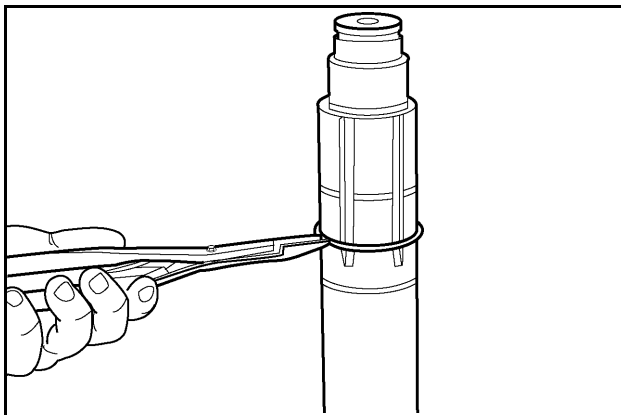


27L94

1. SEALING PLUG AT END OF SHAFT
2. 3 SEALING PLUGS AT END OF SHAFT

Inspect the sealing plugs in the input shaft. Make sure all the oil passages in the shaft are open. See illustration above.

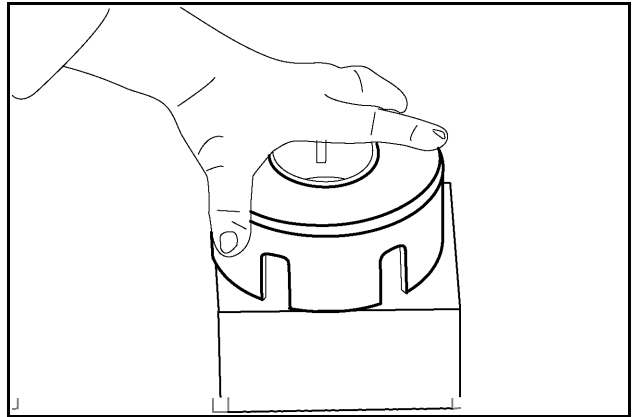
### STEP 72



A10891

Install the snap ring for the high range clutch plate carrier into the second groove on the shaft.

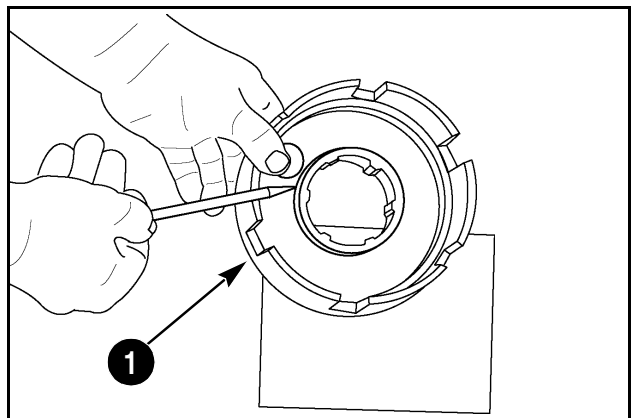
### STEP 73



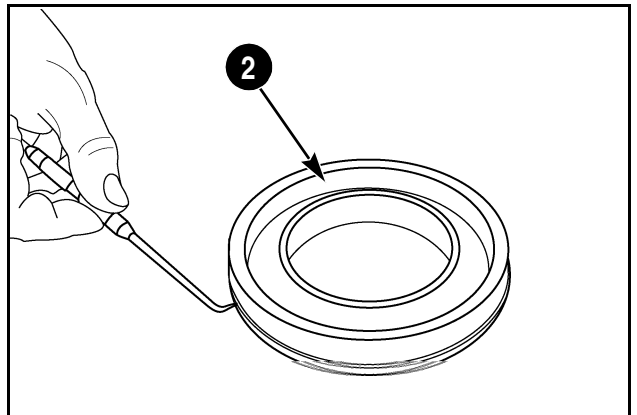
T95277

Hit the high range clutch plate carrier against a wooden block to remove the clutch piston.

### STEP 74



T95278

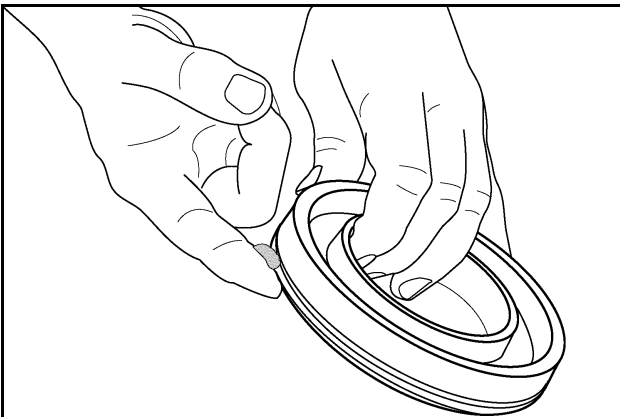
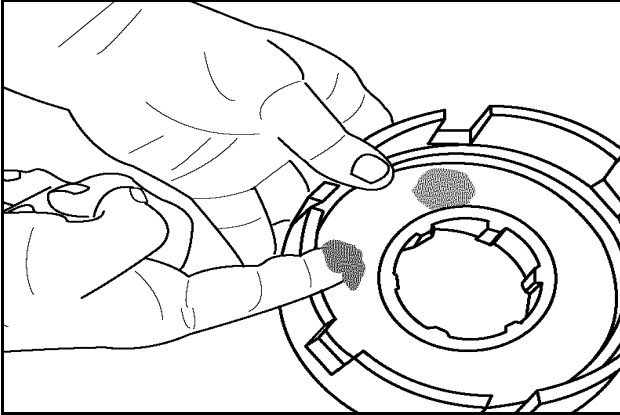


40S35

Install the teflon ring and O-ring as follows:

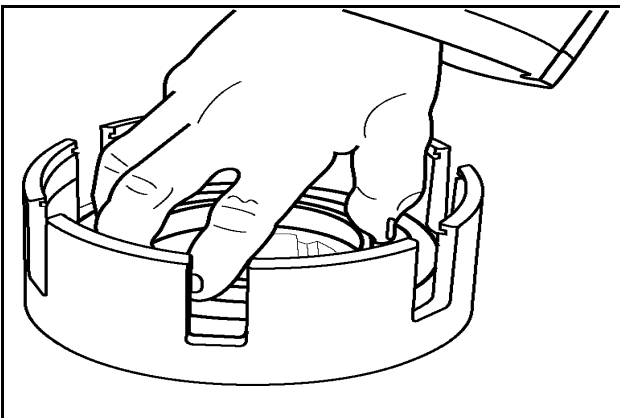
1. Replace the teflon ring and O-ring from the carrier (1) and piston (2).
2. Install the O-ring in the groove.
3. Install the teflon ring over the O-ring.

### STEP 75



Put petroleum jelly on the teflon rings.

### STEP 76

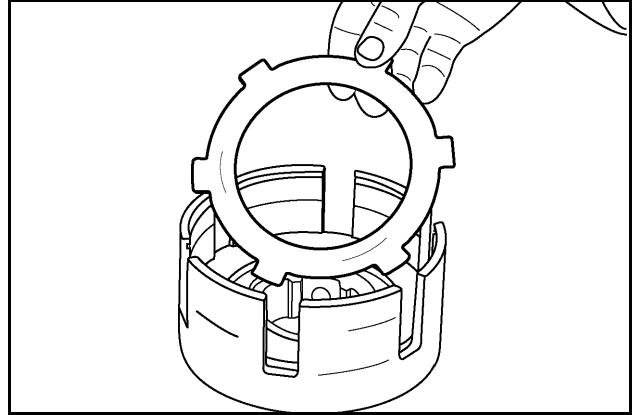


Install the clutch piston into the carrier. The flat side of the piston must face down. Push the piston into the carrier by hand.

### STEP 77

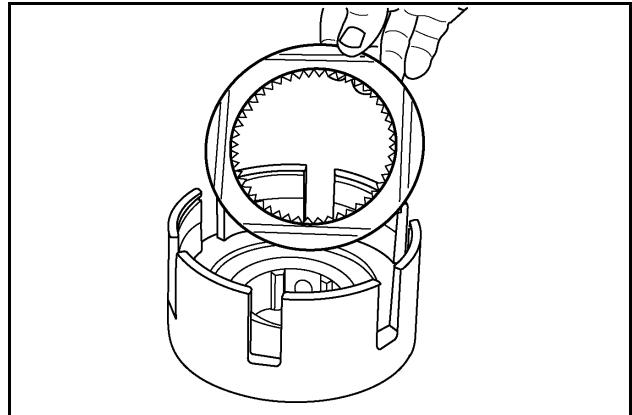
Repeat above Steps for the medium range clutch plate carrier.

### STEP 78



Install a separator plate.

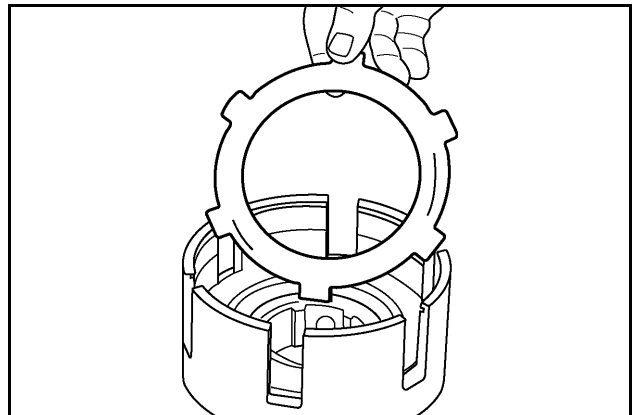
### STEP 79



Install a new friction plate.

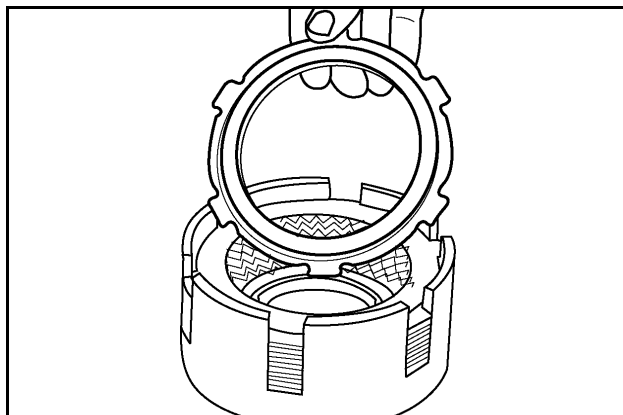
**NOTE:** Dip all friction plates in clean transmission fluid.

### STEP 80



Install a separator plate. Install the remaining 10 friction plates and 9 separator plates, alternating the plates.

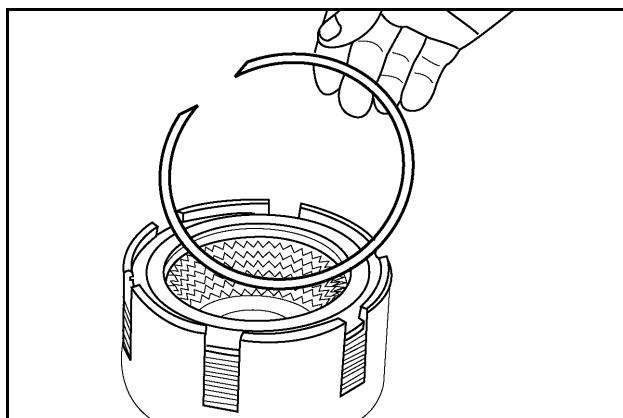
### STEP 81



A10878

Install the backing plate. The flat side of the plate must be facing down.

### STEP 82

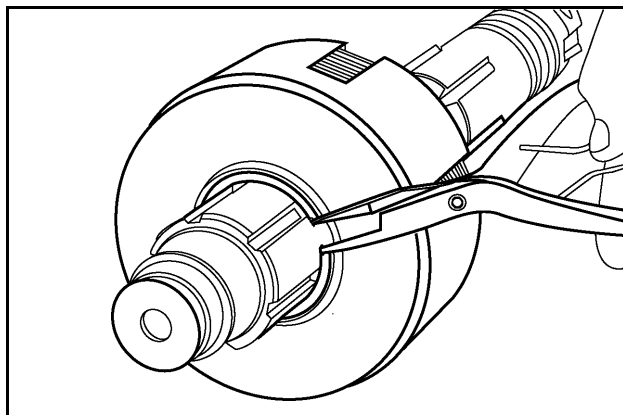


A10879

Install the clutch pack snap ring into the groove in the carrier.

**NOTE:** Do not assemble the medium range clutch pack. It will be assembled on the shaft.

### STEP 83

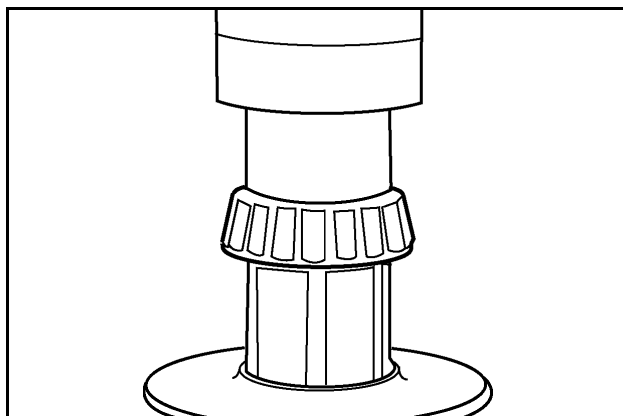


A10889

Install the high range clutch pack assembly as shown.

**NOTE:** The oil gallery hole in the shaft must be aligned with the hole in the carrier. Install the carrier snap ring onto the shaft.

### STEP 84

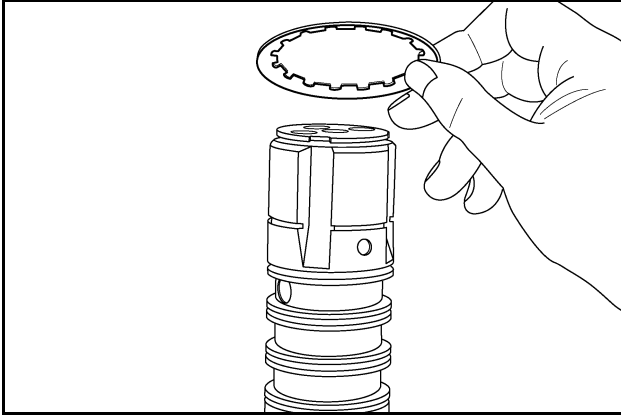


A10917

Install the bearing on the shaft with the larger OD end of the bearing facing down. Press the bearing into place to be sure that it is properly seated on the shaft.

**NOTE:** Do not press on the bearing cage.

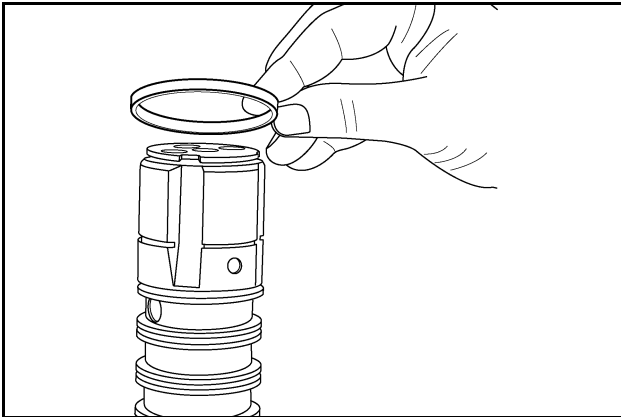
### STEP 85



RD05K110

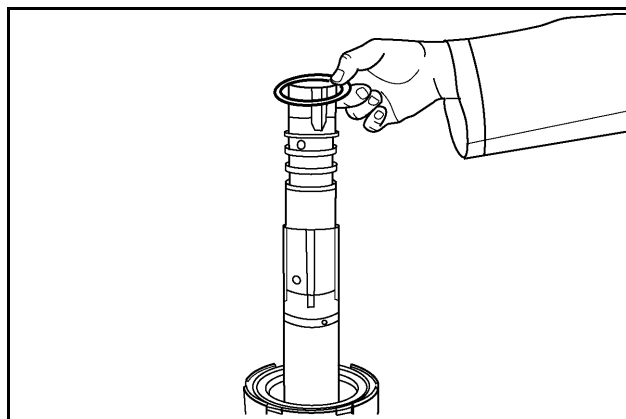
Install the first piston return Belleville spring. The concave side of the spring must be facing down.

### STEP 86



RD05K109

Install the lube management ring.

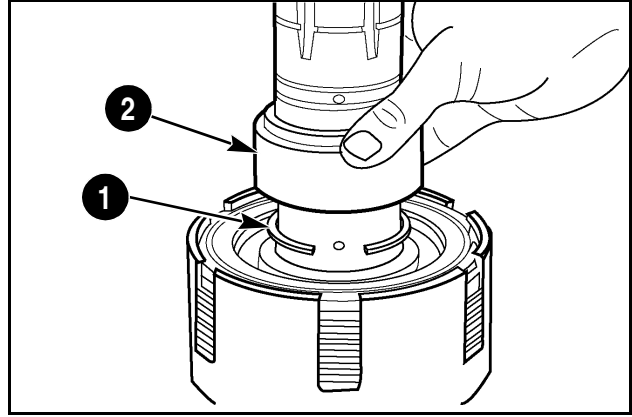


A10887

Install additional Belleville springs as follows:

1. Install a second Belleville spring. The concave side of the washer must be facing up.
2. Install the remaining 6 Belleville springs, alternating the position of the springs until the last washer with the concave side is facing down.

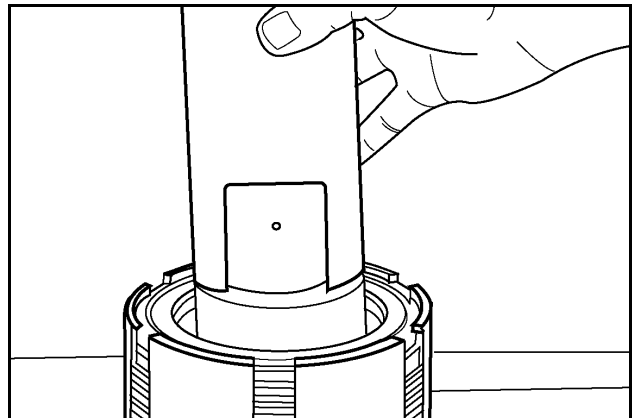
### STEP 87



A10899

1. Install a snap ring (1) over the shaft.
2. Install the Belleville spring compression sleeve CAS1903-5 (smaller OD up) over the shaft and on top of the snap ring.

### STEP 88

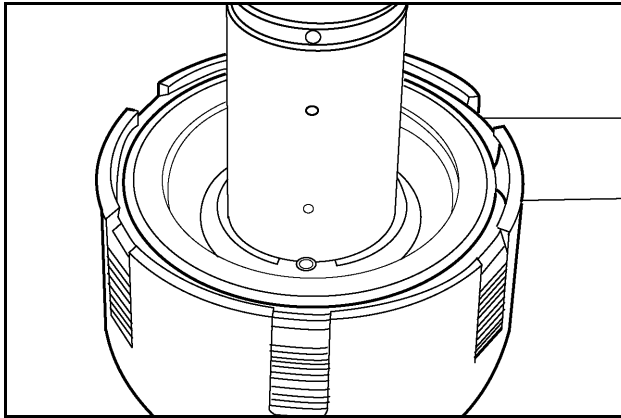


A10900

Install the snap ring as follows:

1. Install the compression sleeve with the notch CAS1903-3.
2. Use a hydraulic press to press the compression sleeve down onto the shaft.
3. The snap ring will slip into position in the groove.
4. *Check to be sure that the snap ring is properly seated in the groove on the shaft.*

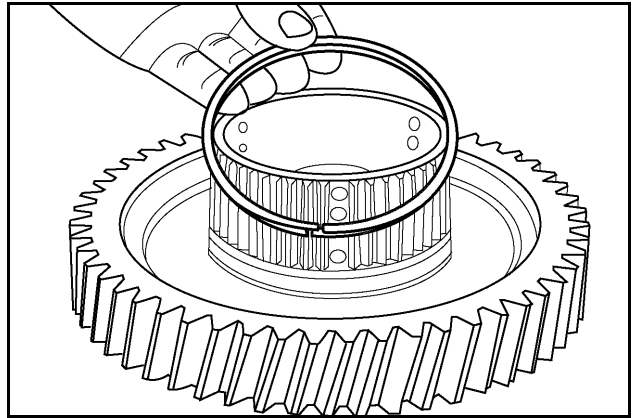
**STEP 89**



A10903

Remove the two compression sleeves.

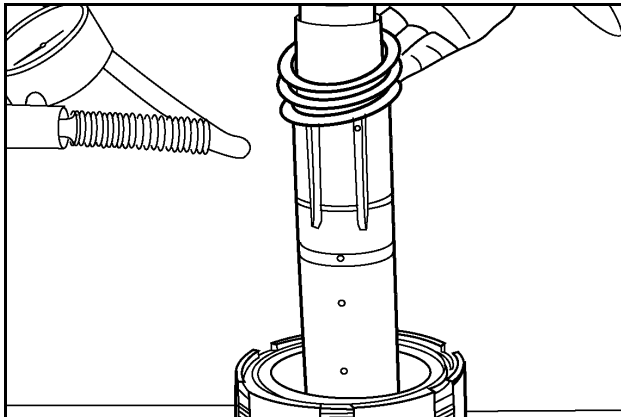
**STEP 92**



A10904

Install a new seal ring on the hub of the high range drive gear.

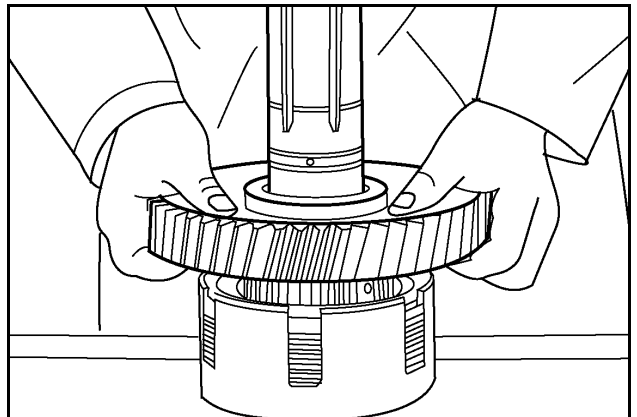
**STEP 90**



A10908

Install the needle thrust bearing and two bearing thrust washers. The needle bearing must be between the two bearing thrust washers.

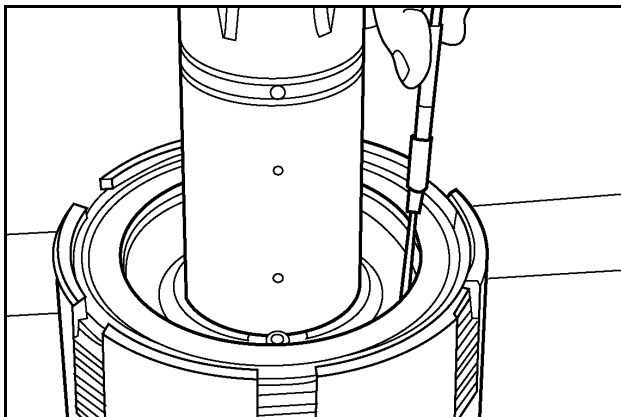
**STEP 93**



A10906

Install the high range drive gear. The teeth on the gear hub align with the friction plates. Slight oscillation of the drive gear will help with the installation.

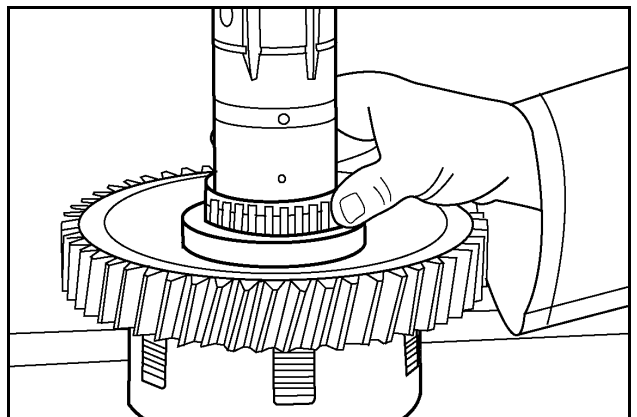
**STEP 91**



A10905

Align the gear teeth on all the friction plates.

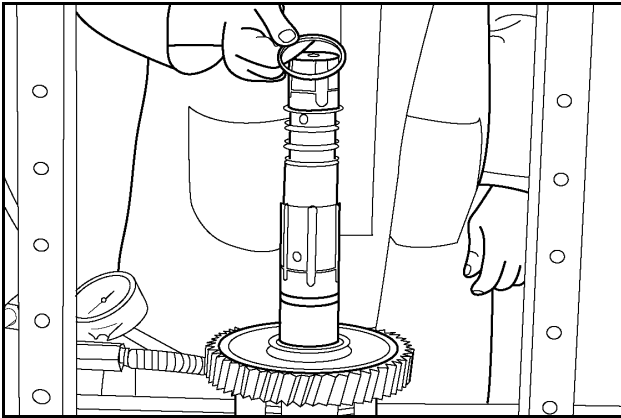
**STEP 94**



A10907

Install the caged needle bearing.

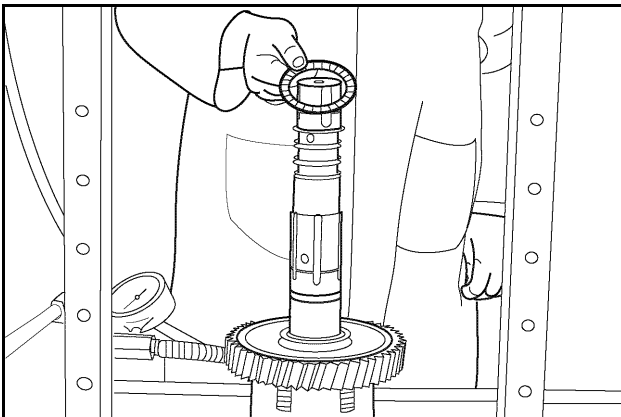
### STEP 95



T95722

Install the thrust washer spacer ring.

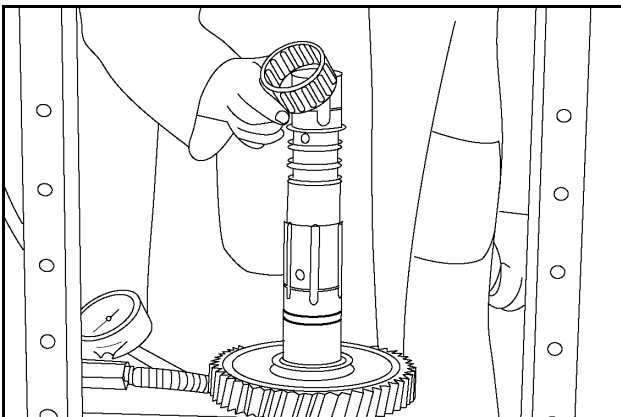
### STEP 96



T95721

Install the thrust washer.

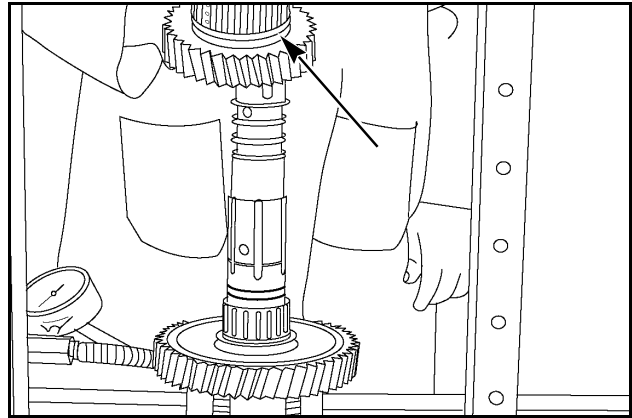
### STEP 97



T95720

Install the caged needle bearing.

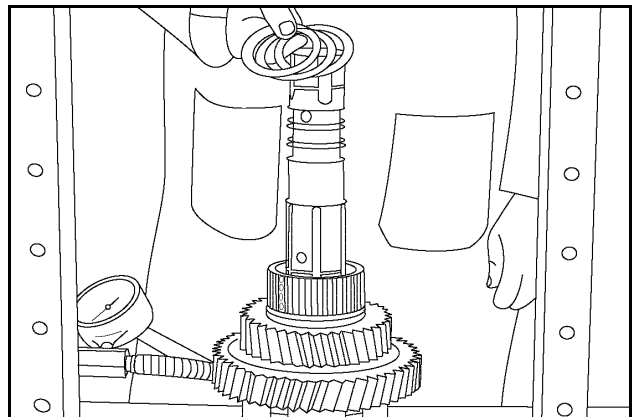
### STEP 98



T95719

Install a new seal ring on the medium range drive gear. Install the gear. The hub of the gear must be facing up.

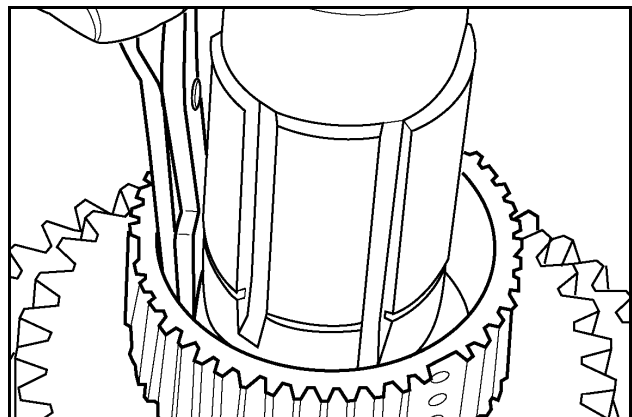
### STEP 99



T95718

Install the two bearing thrust washers and the needle thrust bearing. The needle thrust bearing must be positioned between the two bearing thrust washers.

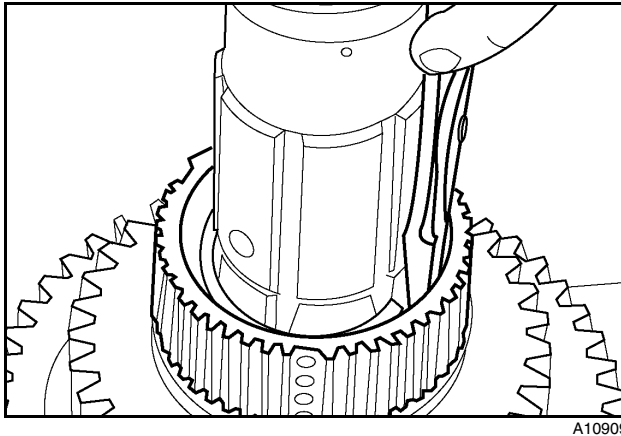
### STEP 100



A10910

Install the snap ring for the bearing thrust washers and needle thrust bearing. The ring goes into the lowest of the three grooves in the shaft.

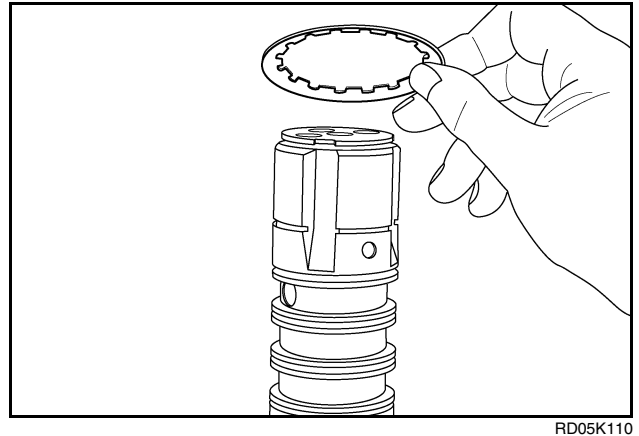
### STEP 101



A10909

Install the snap ring for the piston return Belleville washers. This ring goes into the second groove down on the shaft.

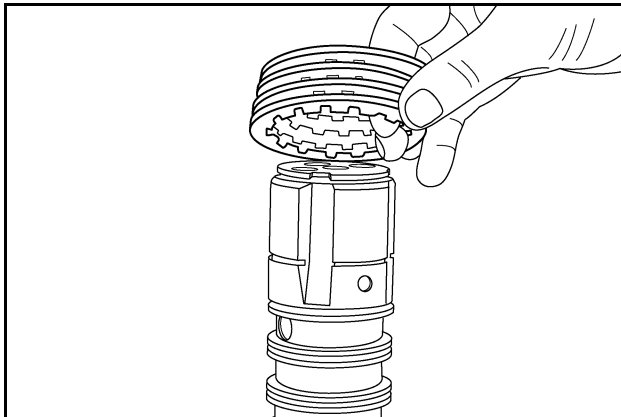
### STEP 104



RD05K110

Install the final Belleville spring concave side down.

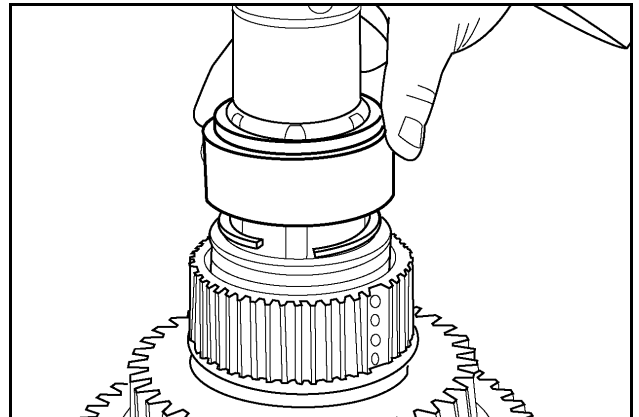
### STEP 102



RD05K108

Install the eight piston return Belleville springs. The concave side of the first spring must be facing up, the second facing down. Continue to alternate.

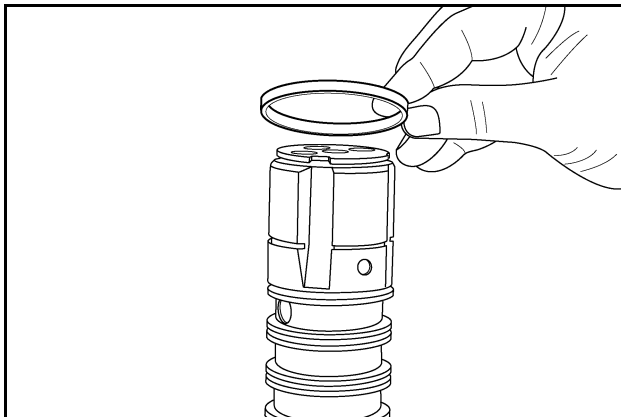
### STEP 105



A10911

Install the retaining ring onto the shaft along with the Belleville washer compression sleeve. Use tool CAS1903-5.

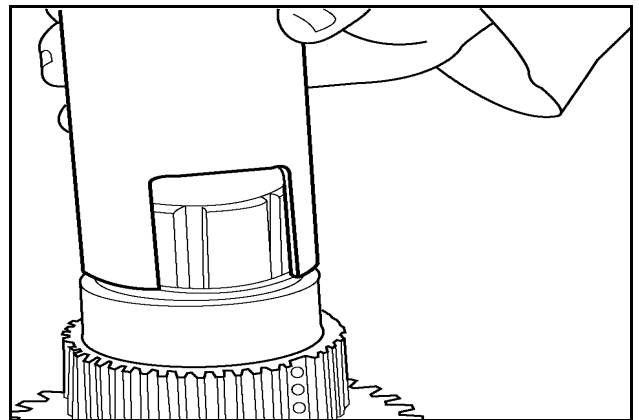
### STEP 103



RD05K109

Install the lube management ring.

### STEP 106

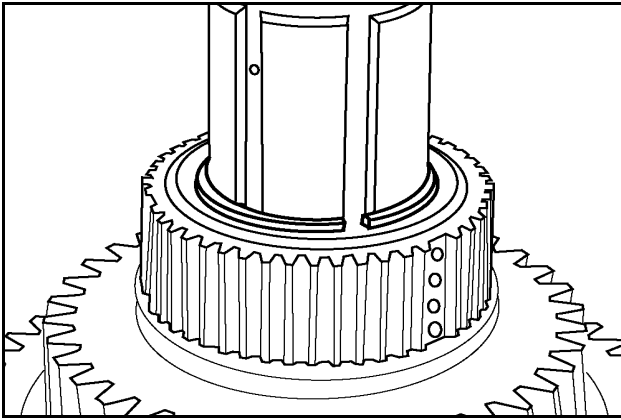


A10912

Install the compression sleeve with the notch CAS1903-3 over the shaft. Use a hydraulic press to press the compression sleeves down. The snap ring will slip into position in the groove.



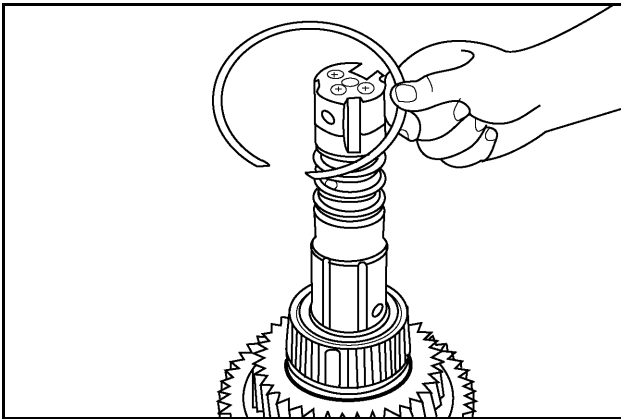
### STEP 107



A10913

Remove the compression sleeve. Check to make sure the snap ring is properly seated in the groove on the shaft.

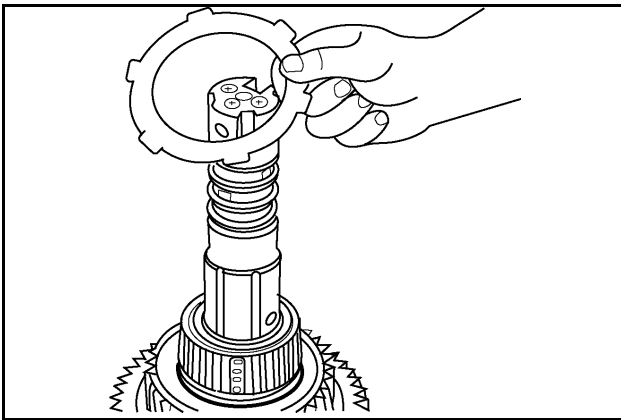
### STEP 108



T95710

Install the clutch plate snap ring on top of the gear.

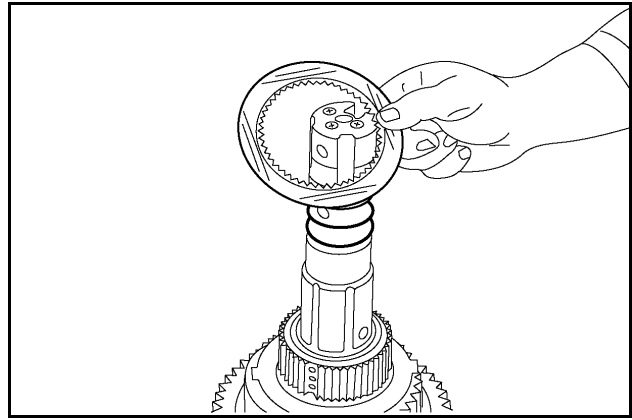
### STEP 109



T95709

Install the backing plate. The flat side of the plate must be facing up.

### STEP 110

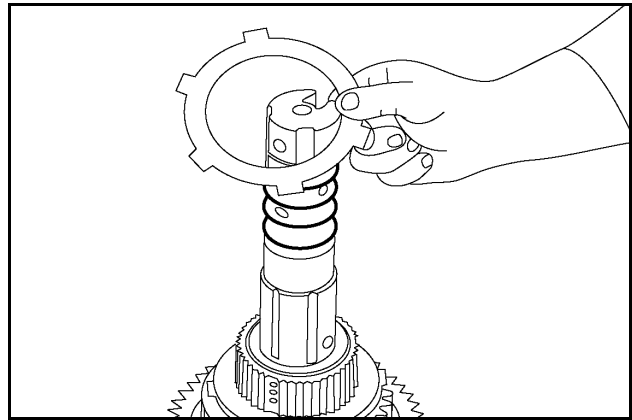


T95707

Install a friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

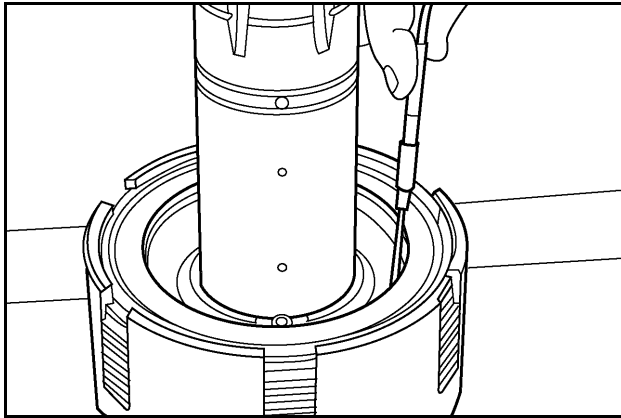
### STEP 111



T95708

Install a separator plate. Install the remaining 10 friction plates and 10 separator plates, alternating the plates. Whenever the clutch pack has been disassembled, new friction plates must be installed.

### STEP 112

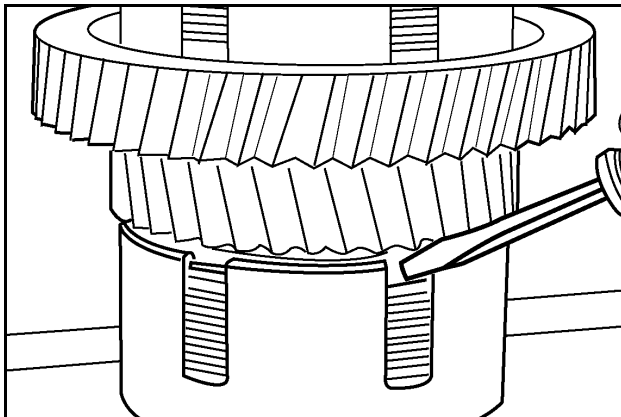


A10915

Install the medium range clutch plate carrier onto the shaft, open end facing down. Align holes between shaft and carrier. Carefully press the carrier on over the friction and separator plates.

**NOTE:** The oil gallery hole in the shaft must be aligned with the hole in the carrier.

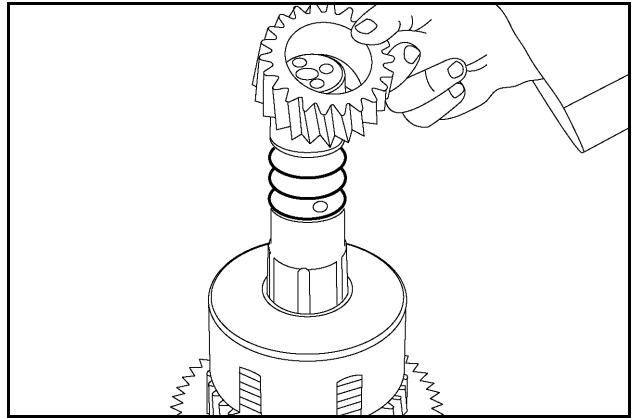
### STEP 113



A10916

Turn the shaft assembly over and move the snap ring into the groove in the carrier.

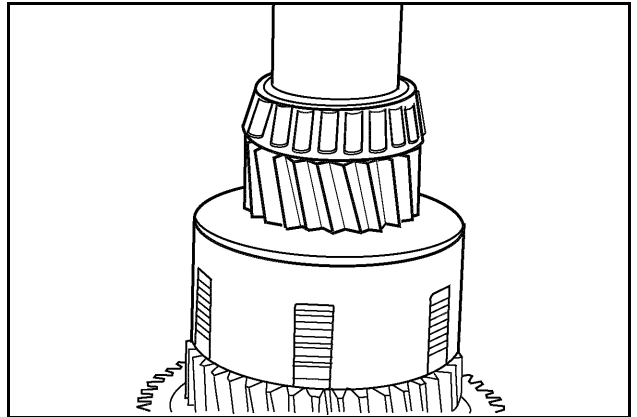
### STEP 114



T95699

Install the low range drive gear.

### STEP 115



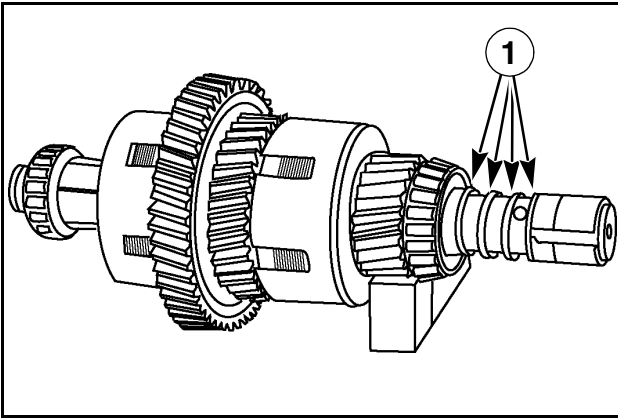
A10920

Install the bearing cone with the larger outside diameter (OD) side of the bearing cone facing down. Press the bearing with approximately 22250 N (5000 lb.) of force to compress the Belleville washers and properly seat the bearing.

**NOTE:** Do not press on bearing cage.

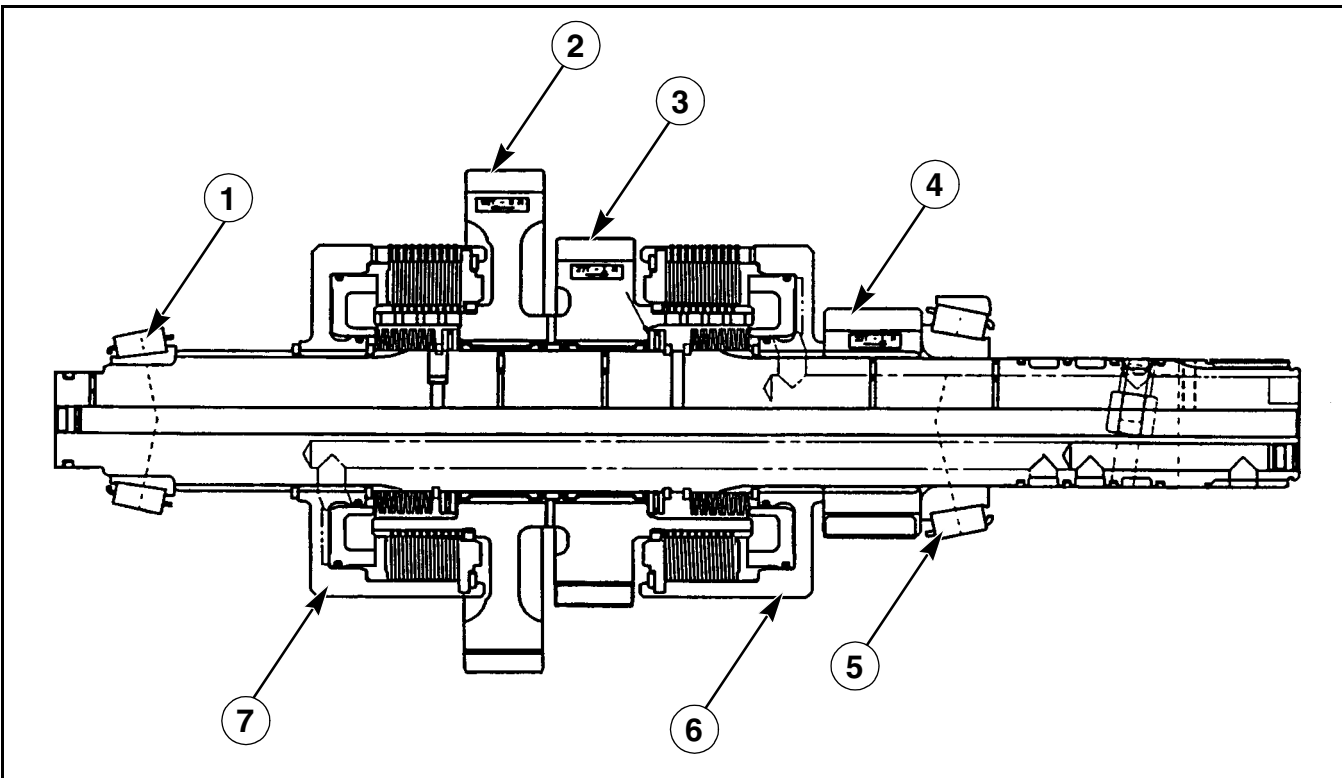
## STEP 116

Install four new seal rings (1) on the front end of the shaft.



A22361

## Cross-Section of Input Shaft



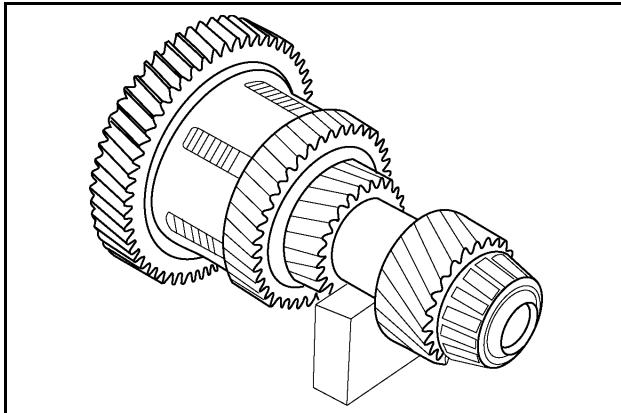
11L94R2

- 1. REAR BEARING CONE
- 2. HIGH RANGE DRIVE GEAR
- 3. MEDIUM RANGE DRIVE GEAR
- 4. LOW RANGE DRIVE GEAR

- 5. FRONT BEARING CONE
- 6. MEDIUM RANGE CLUTCH PLATE CARRIER
- 7. HIGH RANGE CLUTCH PLATE CARRIER

## Disassembly of the Range Transmission Countershaft

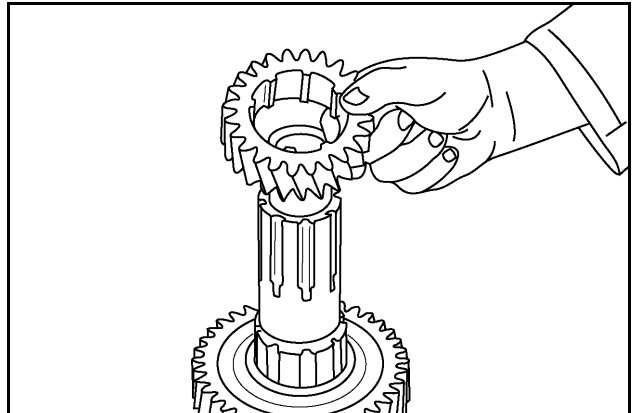
### STEP 117



T95748

Put the countershaft on a clean work bench.

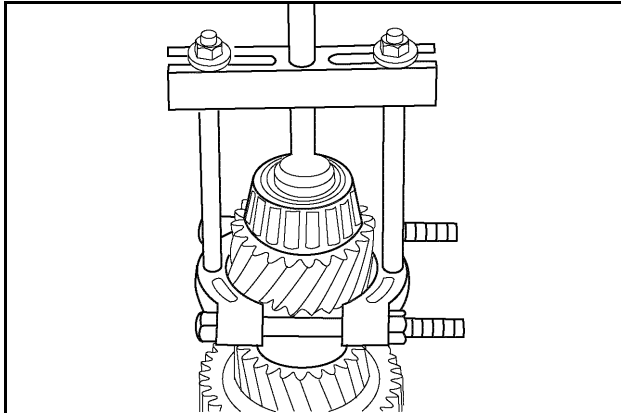
### STEP 120



T95751

Remove the high range driven gear.

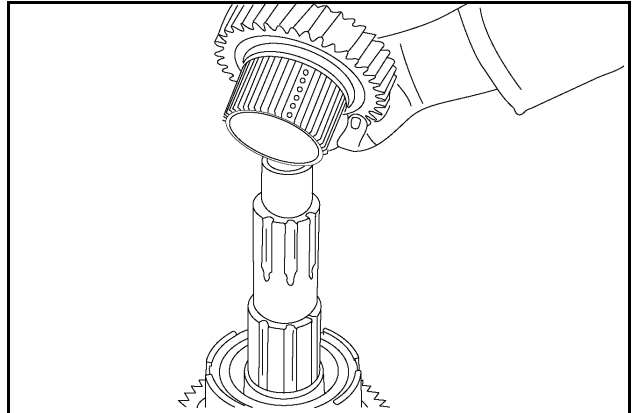
### STEP 118



T95749

Use a puller to remove the constant mesh gear and the rear bearing cone.

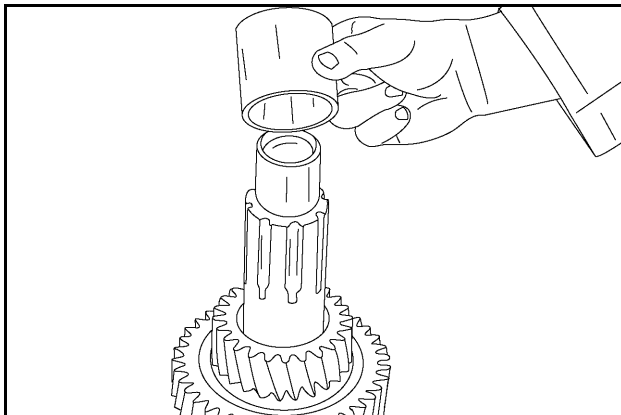
### STEP 121



T95752

Remove the medium range driven gear from the carrier.

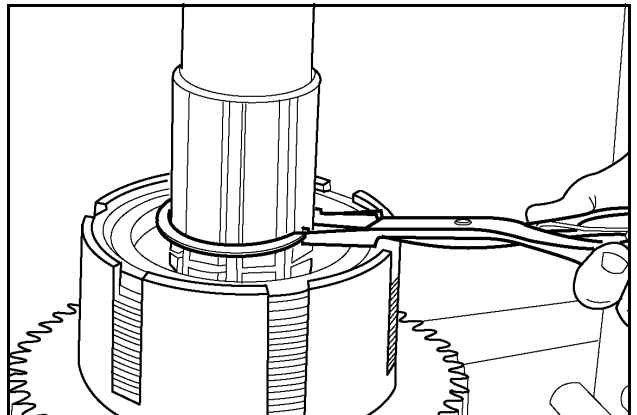
### STEP 119



T95750

Remove the gear spacer.

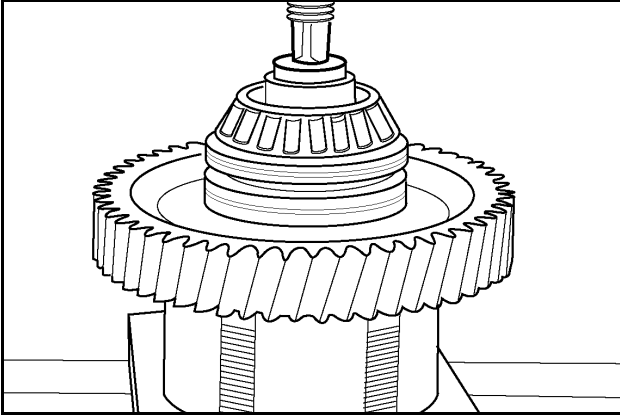
### STEP 122



A10921

Remove the snap ring for the medium range driven gear.

### STEP 123

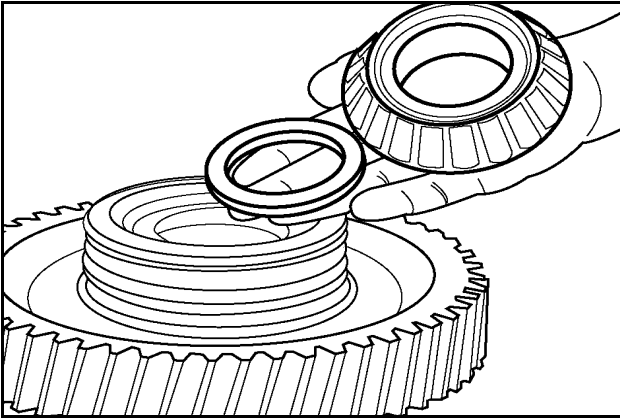


A10923

Turn the shaft assembly over and use a hydraulic press to push the shaft through the remaining parts.

**NOTE:** Be careful not to let the shaft fall through.

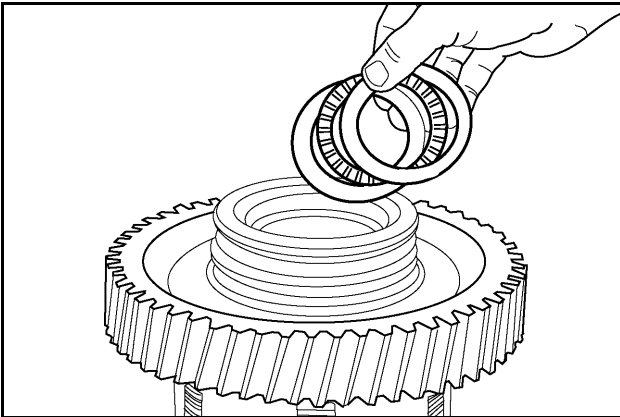
### STEP 124



A10924

Remove the front bearing cone and front bearing cone spacer.

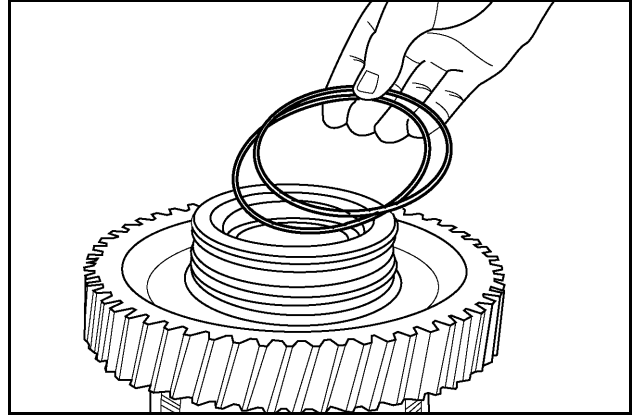
### STEP 125



A10925

Remove the two bearing thrust washers and the needle thrust bearing.

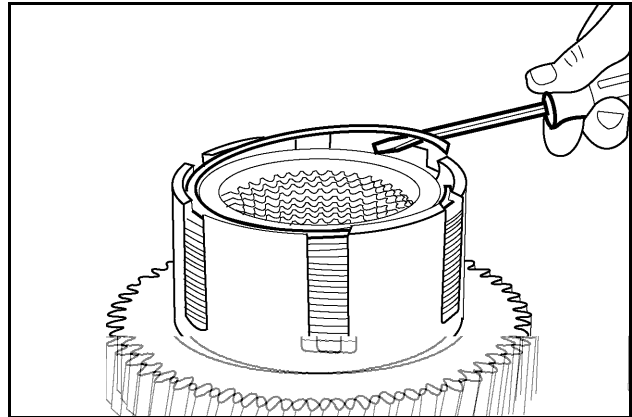
### STEP 126



A10926

Remove the four seal rings from the hub on the gear (two rings in each of two grooves).

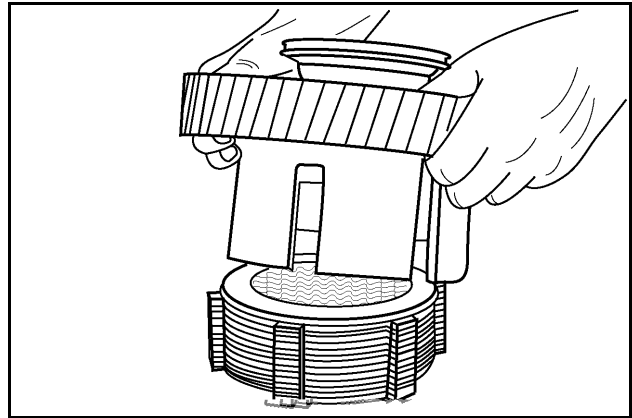
### STEP 127



A10928

Turn the low range driven gear and clutch plate carrier over and remove the snap ring.

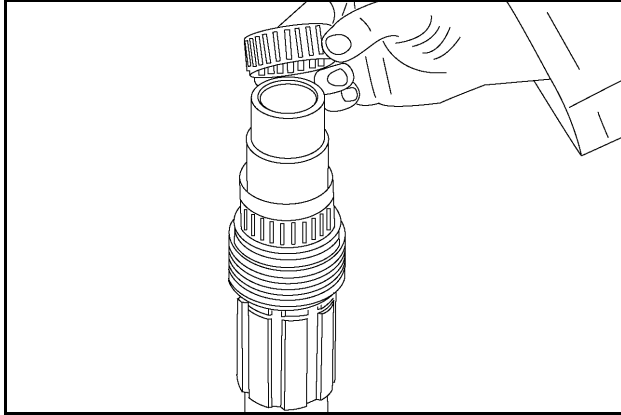
### STEP 128



A10929

Carefully turn the assembly over and remove backing, friction, and separator plates.

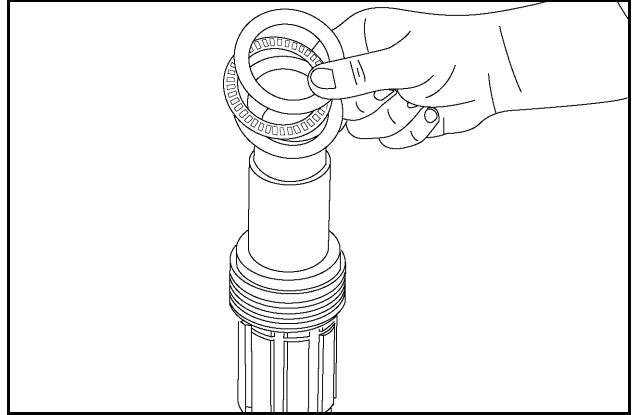
**STEP 129**



T95771

Remove the caged needle bearing.

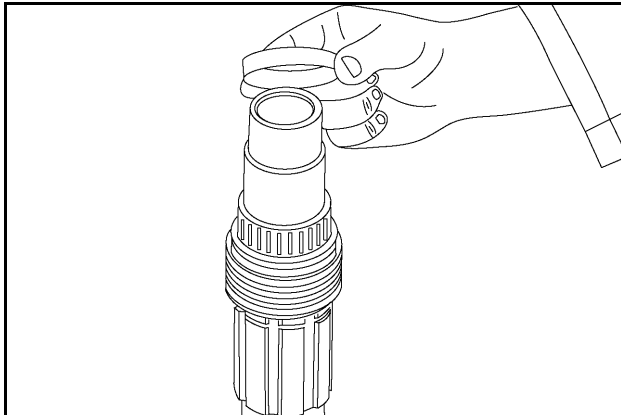
**STEP 132**



T95774

Remove the two bearing thrust washers and the needle thrust bearing.

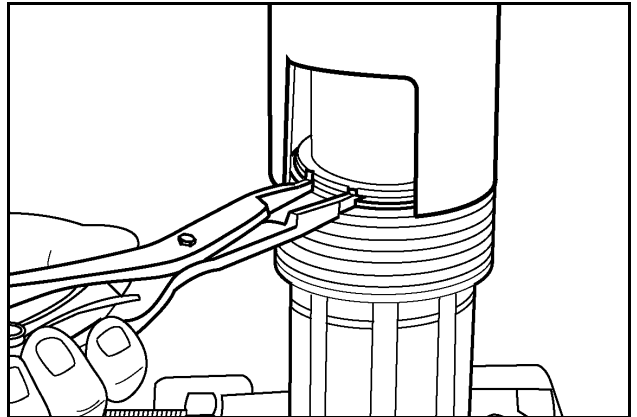
**STEP 130**



T95772

Remove the bearing spacer.

**STEP 133**

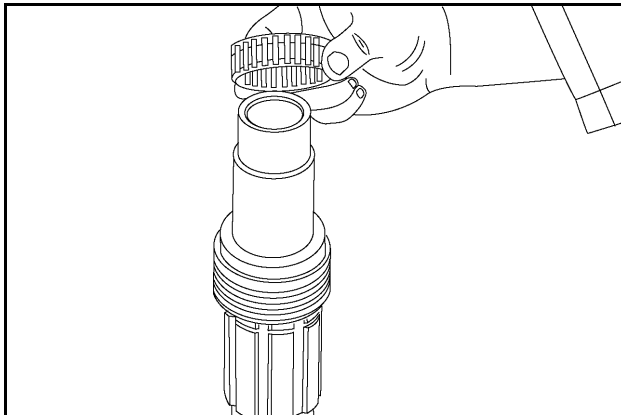


A10939

Remove the snap ring as follows:

1. Install compression sleeve with the notch CAS1903-3 over the shaft and on top of the piston return Belleville washers.
2. Position the opening in the compression sleeve over the ends of the snap ring.
3. Compress the Belleville washers with a press and remove the snap ring.

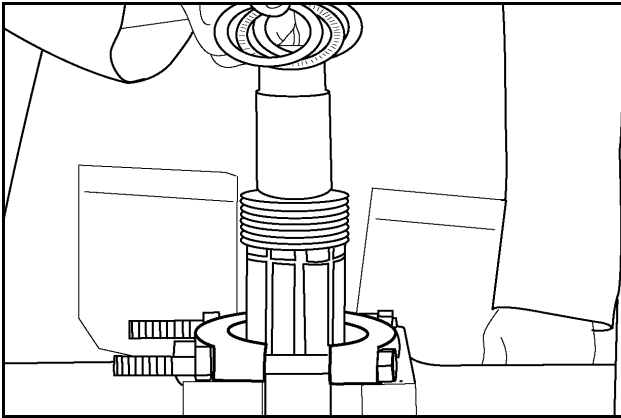
**STEP 131**



T95773

Remove the caged needle bearing.

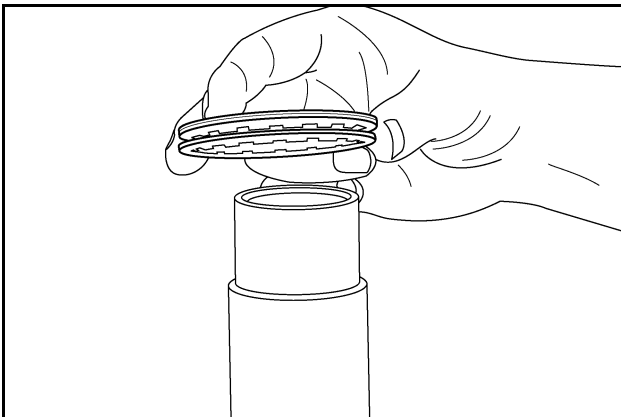
### STEP 134



T95778

Remove the two bearing thrust washers and the needle thrust bearing.

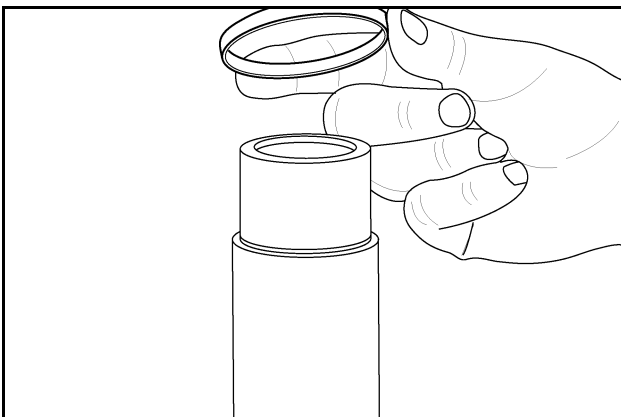
### STEP 135



RD05M016

Remove three piston return Belleville washers.

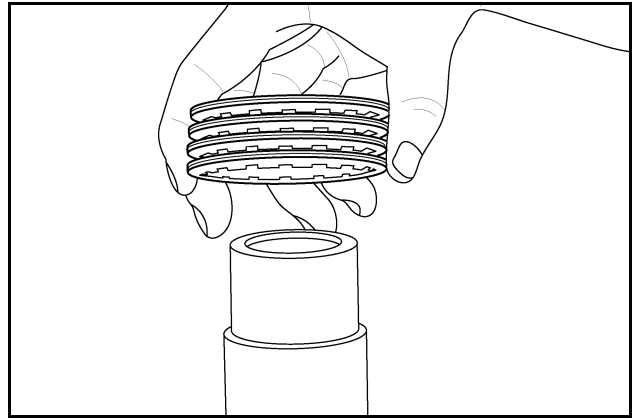
### STEP 136



RD05M017

Remove the lube oil management ring.

### STEP 137

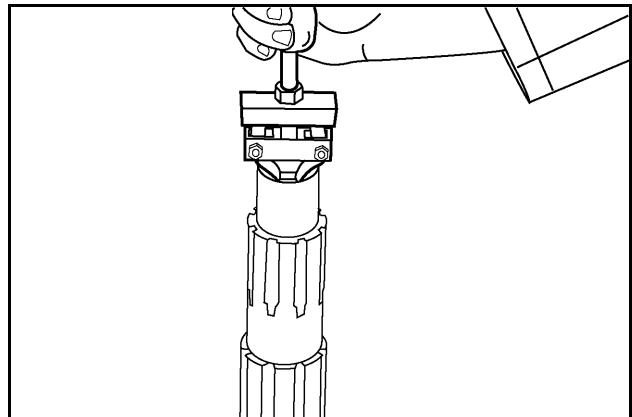


RD05M018

Remove eight piston return Belleville washers.

**NOTE:** Mark the orientation of the Belleville springs and lube management ring for proper reinstallation.

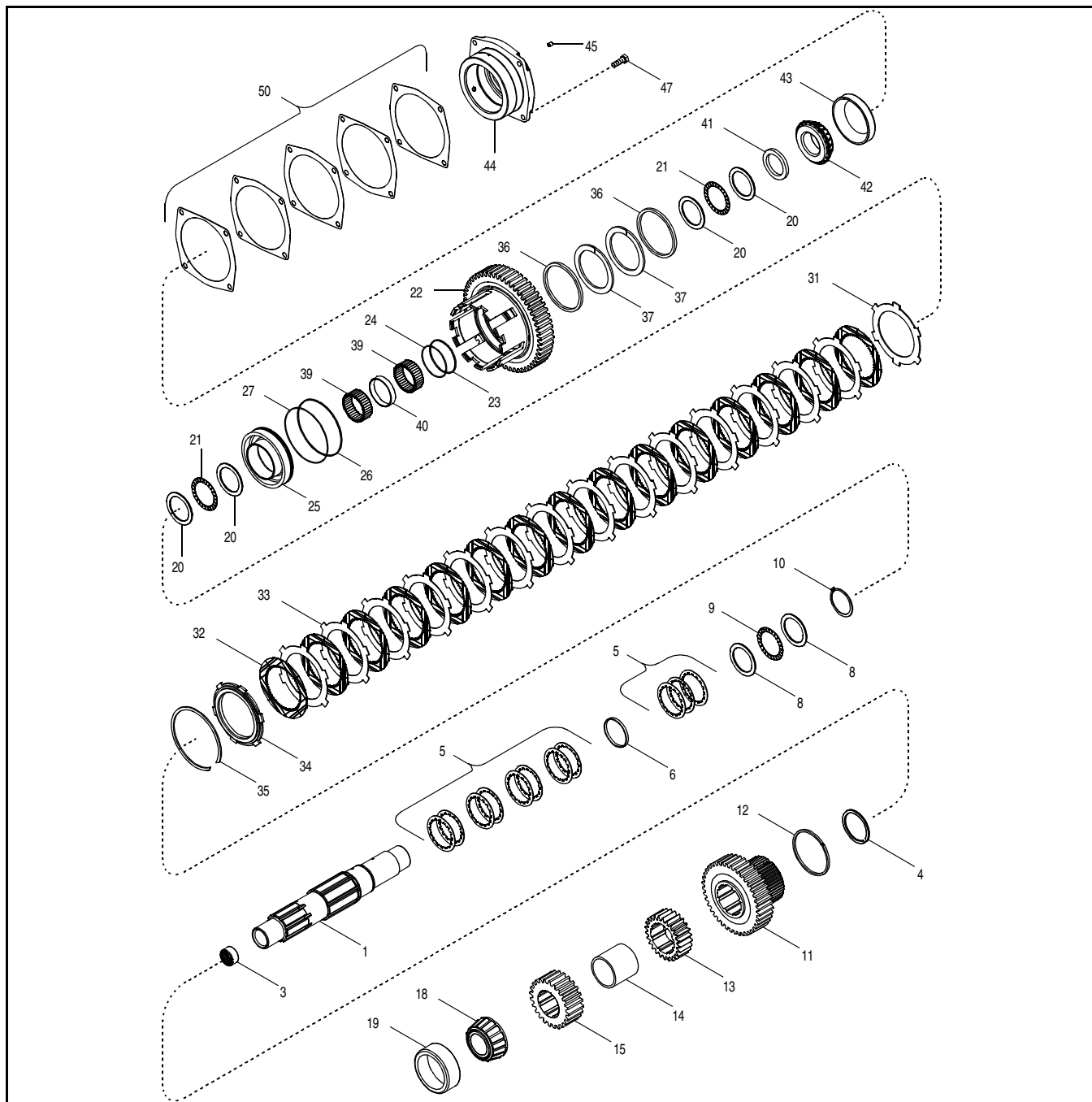
### STEP 138



T95783

Use a puller to remove the roller bearing from the rear end of the shaft.

## Exploded View of the Range Transmission Countershaft



RI05M088

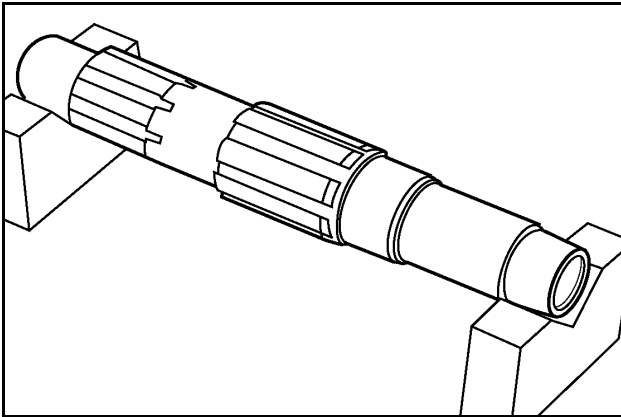
- |                       |                              |                    |
|-----------------------|------------------------------|--------------------|
| 1. SHAFT              | 14. THRUST BEARING           | 27. SPACER         |
| 2. NEEDLE BEARING     | 15. CIRCLIP                  | 28. O-RING         |
| 3. SNAP RING          | 16. SNAP RING                | 29. SEAL RING      |
| 4. RING               | 17. CLUTCH DISC              | 30. GEAR 54T       |
| 5. PINION GEAR 39T    | 18. FRICTION DISC            | 31. RING           |
| 6. PINION GEAR 25T    | 19. SEPARATOR DISC           | 32. SEAL RING      |
| 7. SPACER             | 20. SEPARATOR DISC (THICKER) | 33. SPACER         |
| 8. PINION 23T         | 21. THRUST BEARING           | 34. BEARING        |
| 9. BEARING            | 22. THRUST WASHER            | 35. BEARING CONE   |
| 10. BEARING CONE      | 23. PISTON                   | 36. SHIM           |
| 11. BELLEVILLE SPRING | 24. O-RING                   | 37. CAGE           |
| 12. LUBE RING         | 25. SEAL RING                | 38. PLUG           |
| 13. THRUST WASHER     | 26. NEEDLE BEARING           | 39. BOLT, M10 X 30 |

**NOTE:** When the clutch pack is disassembled, new friction discs must be installed.

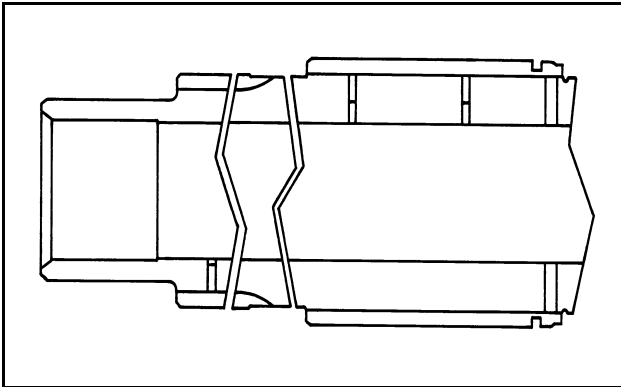


## Assembly of the Range Transmission Countershaft

### STEP 139



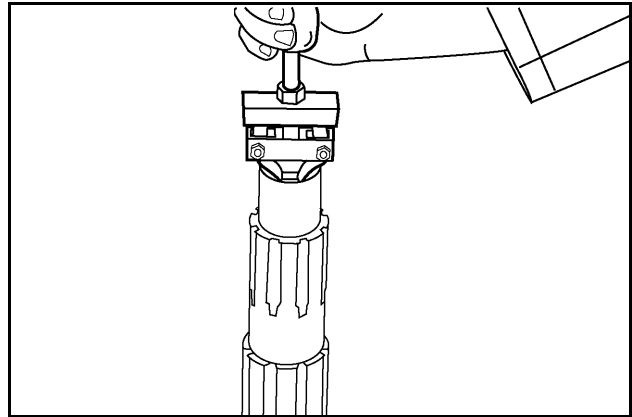
T95782



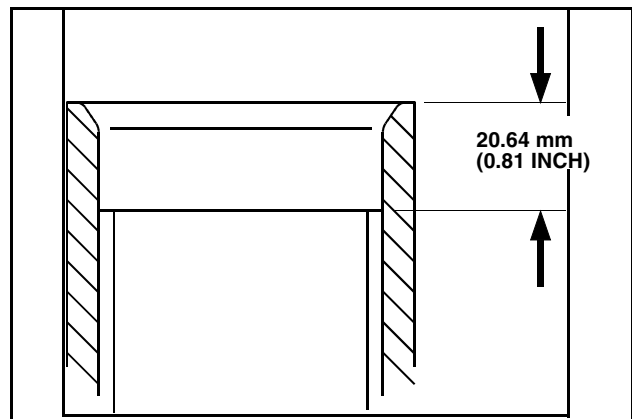
498L7

Make sure that all the oil passages in the shaft are open.

### STEP 140



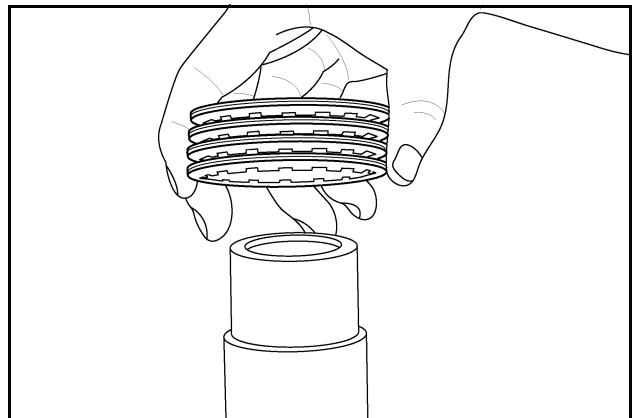
A10937



DEPTH1

Install bearing inside of shaft with the numbers on the bearing facing outward. Press to a depth of 20.64 mm (0.81 inch).

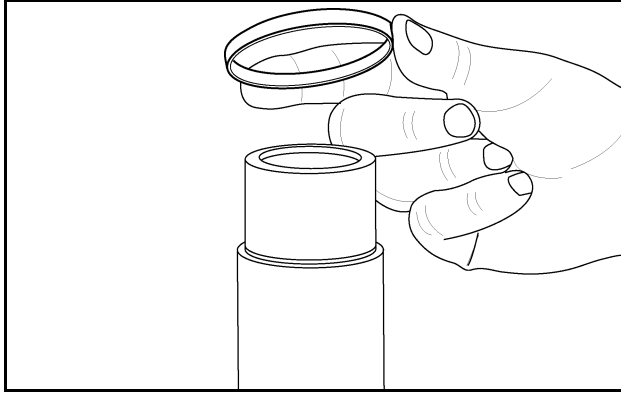
### STEP 141



RD05M018

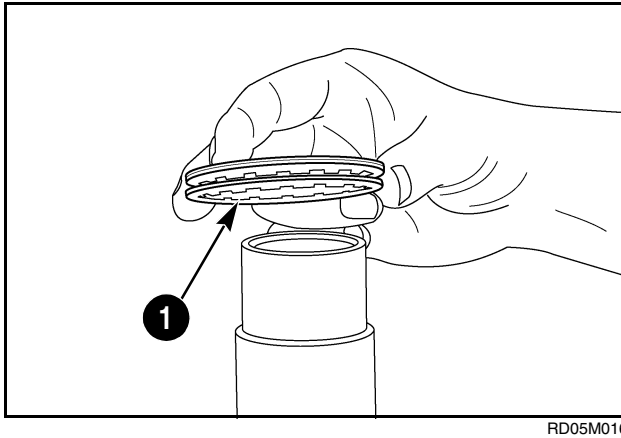
Install the eight piston return Belleville washers as shown.

### STEP 142



Install the lube management ring.

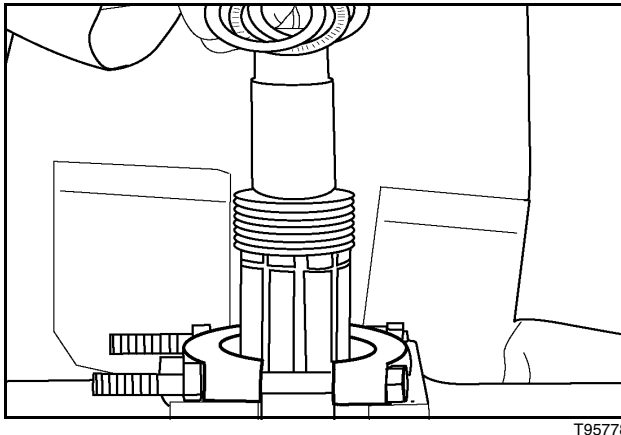
### STEP 143



Install the final three piston return Belleville washers as shown.

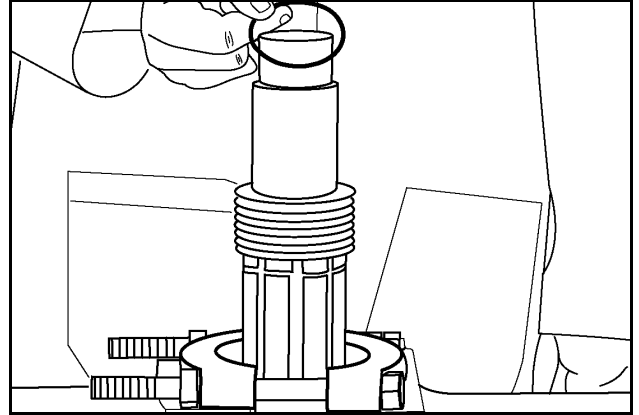
**NOTE:** Make sure the concave side of first washer (1) is facing downward.

### STEP 144



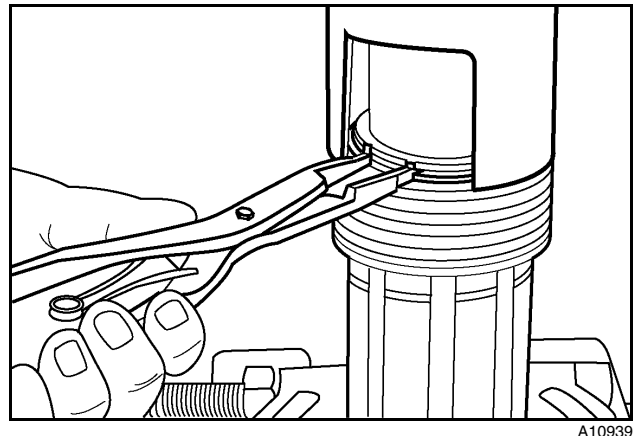
Install the needle thrust bearing and the two bearing thrust washers. The needle bearing must be between the two bearing thrust washers.

### STEP 145



Install the snap ring onto the shaft.

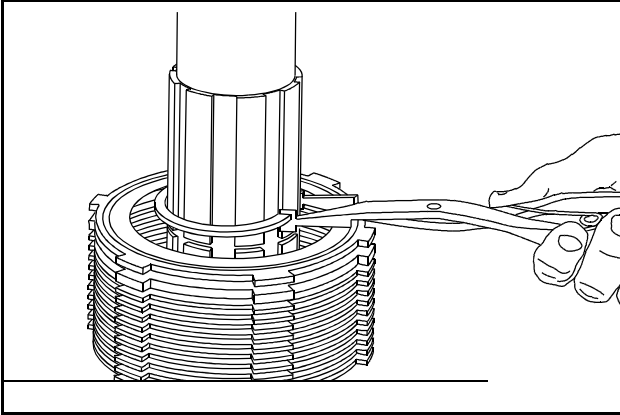
### STEP 146



Install the snap ring and Belleville washers as follows:

1. Install the compression sleeve with the notch CAS1903-3 over the shaft and snap ring (see Special Tools in this section).
2. Position the opening in the compression sleeve over the ends of the snap ring.
3. Compress Belleville washers with a hydraulic press.
4. Install the snap ring in the groove.

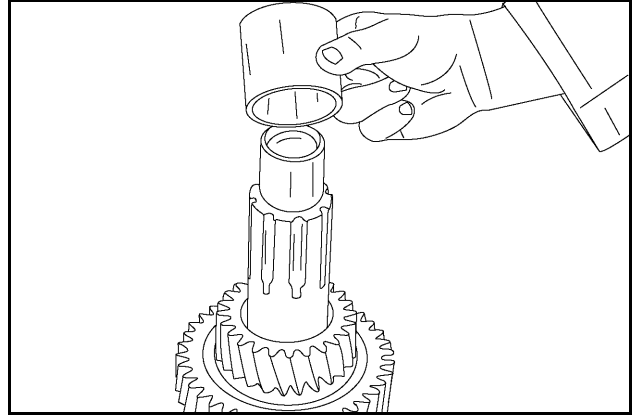
### STEP 147



SNAP07

Install the snap ring for the medium range driven gear.

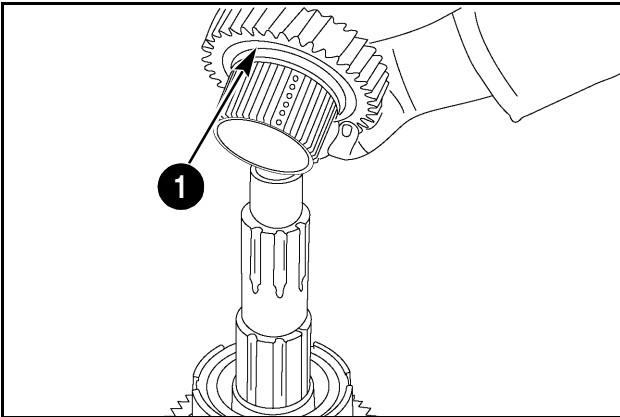
### STEP 150



T95750

Install the gear spacer.

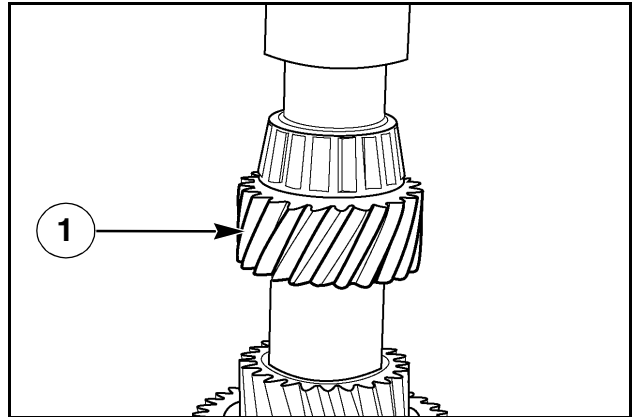
### STEP 148



T95752

Install a new seal ring (1) on the medium range driven gear. Install the gear on the shaft.

### STEP 151

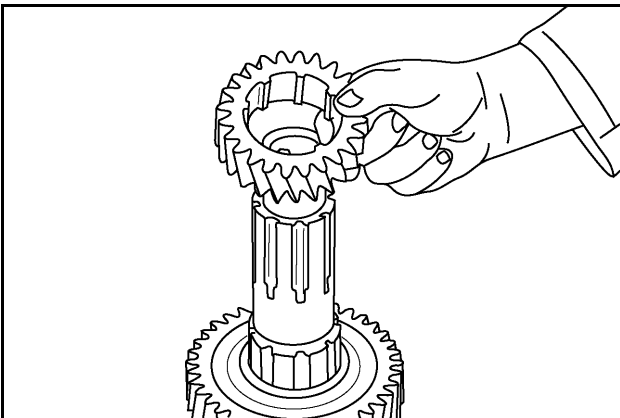


A10949

Install the constant mesh gear (1). Install the bearing cone. The larger OD side of the bearing cone must be facing down. Press the bearing in place to be sure the bearing is properly seated.

**NOTE:** Do not press on the bearing cage.

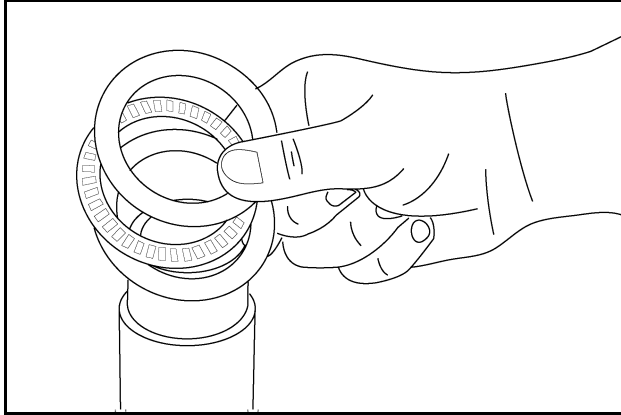
### STEP 149



T95751

Install the high range driven gear.

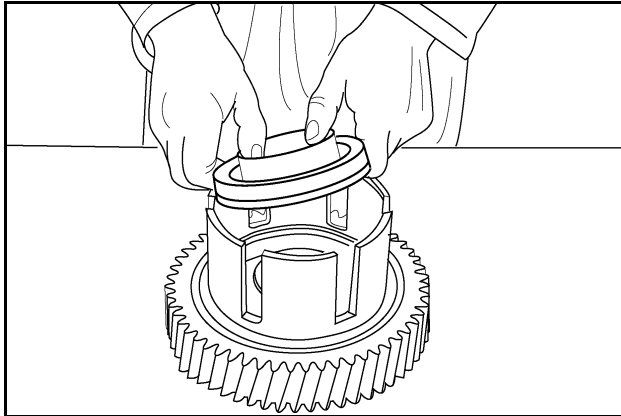
### STEP 152



T95774CR

Turn shaft over. Install the needle thrust bearing and the two bearing thrust washers. The needle thrust bearing must be between the two bearing thrust washers.

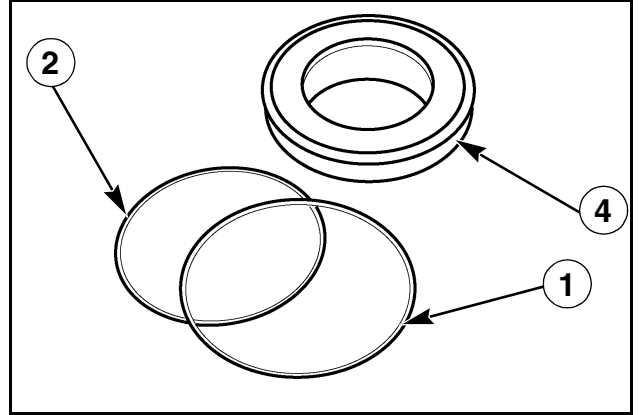
### STEP 153



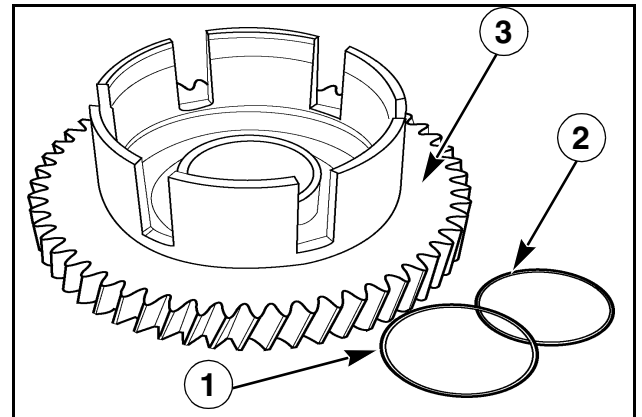
40S18

Remove the clutch piston from the clutch plate carrier. If necessary, hit the low range driven gear and clutch plate carrier against a wooden block to remove the clutch piston.

### STEP 154



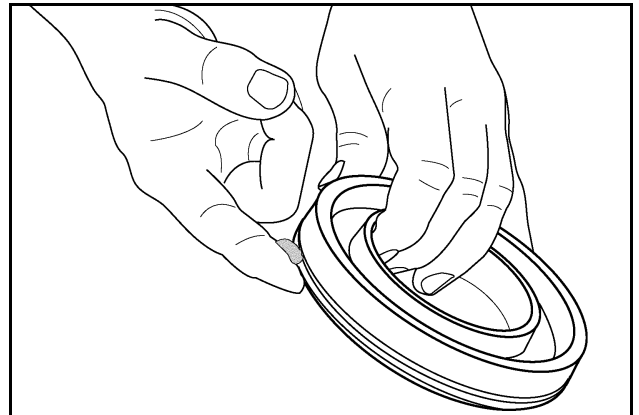
40S24



40S21

Remove the teflon ring (1) and O-ring (2) from the carrier (3) and piston (4). Install the new O-ring in the groove. Install the new teflon ring over the O-ring.

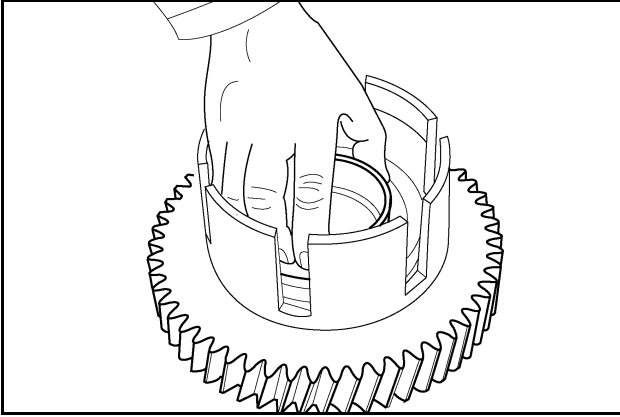
### STEP 155



41S3

Put petroleum jelly on the rings.

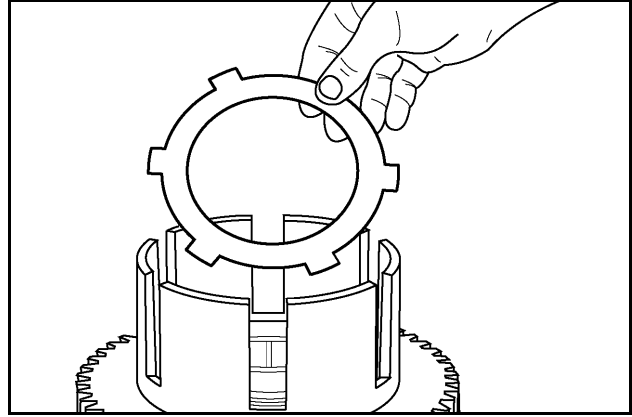
### STEP 156



40S27

Install the clutch piston into the carrier. The flat side of the piston must be down. Push the piston into the carrier by hand.

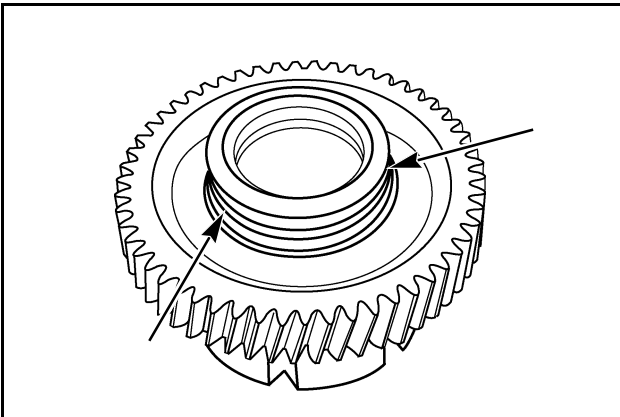
### STEP 158



A10932

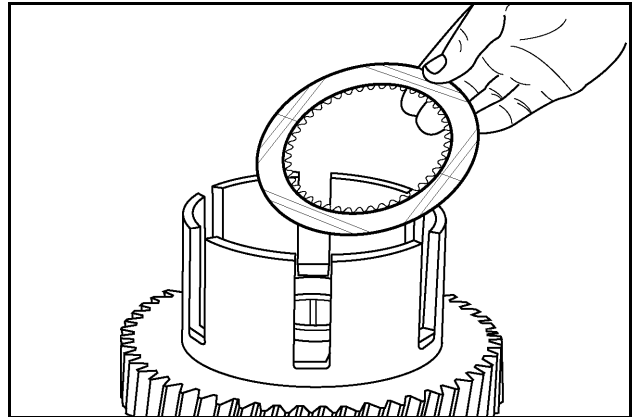
Install the reaction plate (thicker separator plate).

### STEP 157



40S29

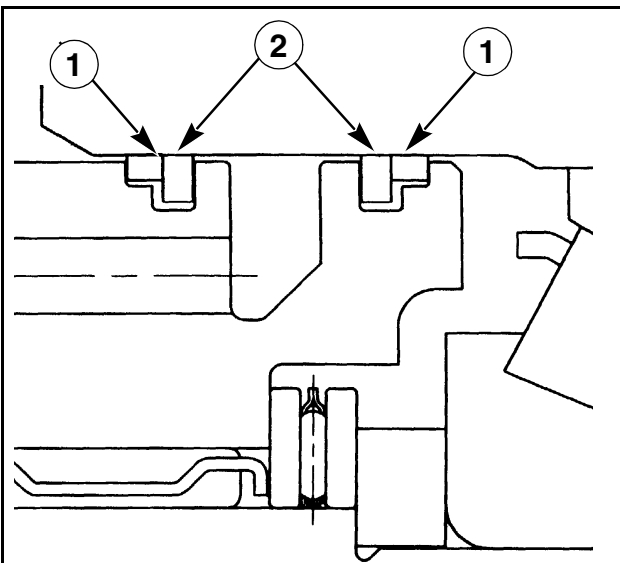
### STEP 159



A10933

Install a new friction plate.

**NOTE:** Dip all friction plates in clean transmission fluid.

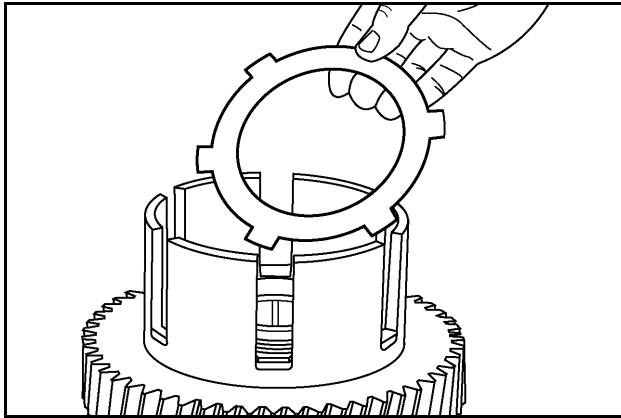


CTRINGS

1. TEFLON RING 2. CAST IRON RINGS

Install two new seal rings in each groove on the hub of the gear.

### STEP 160

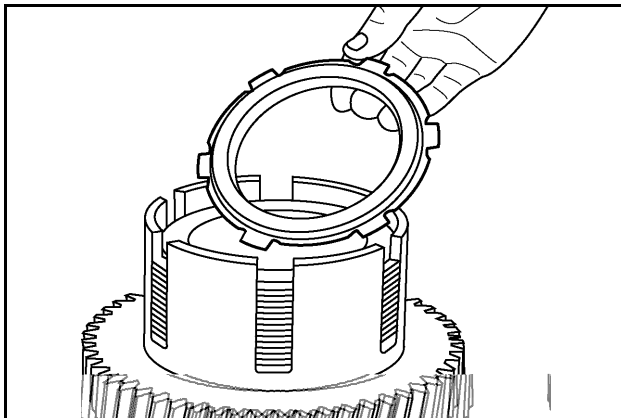


A10934

Install separator plates as follows:

1. Install a separator plate.
2. Install the remaining 14 friction plates and 13 separator plates, alternating the plates.

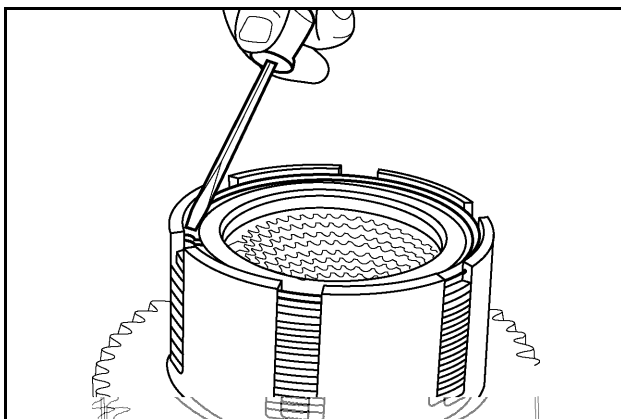
### STEP 161



A10935

Install the backing plate with the flat side of the plate facing down.

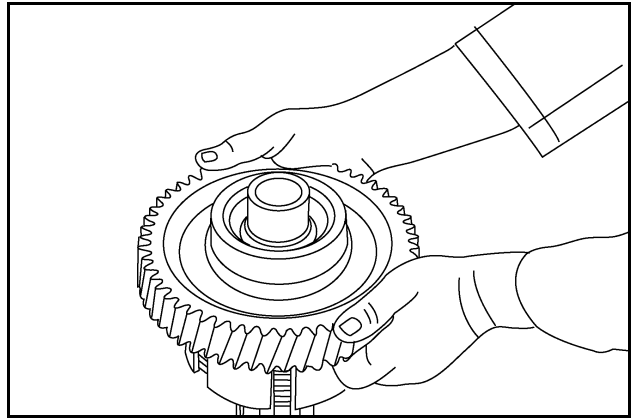
### STEP 162



A10936

Install the snap ring into the groove on the carrier.

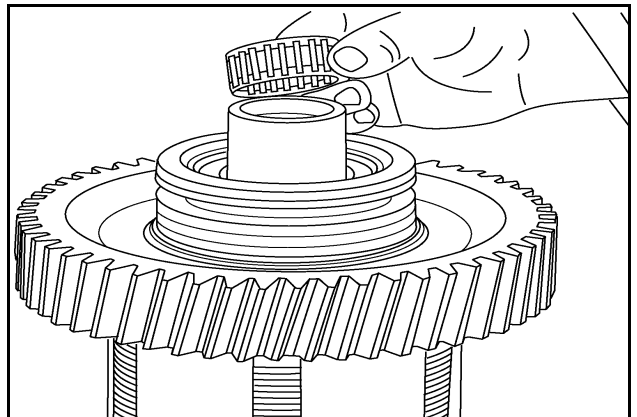
### STEP 163



T95785R2

Install the low range driven gear and clutch pack assembly onto the shaft. The gear end of the carrier must be facing up. The teeth on the medium gear hub align with the friction plate teeth. Slight oscillation of the low range driven gear will help with the installation. Be sure the hub passes through all the friction plates.

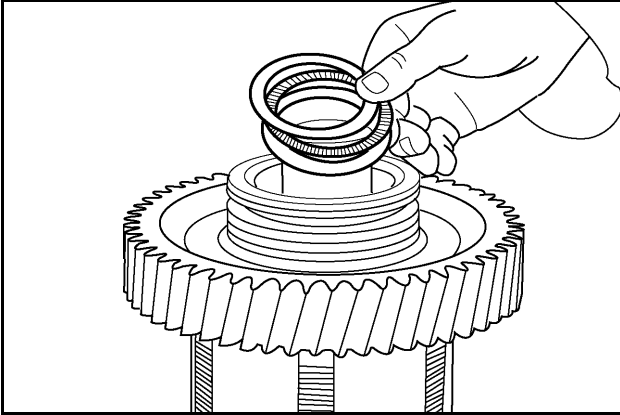
### STEP 164



A43T71C4

Install a caged bearing spacer and caged bearing.

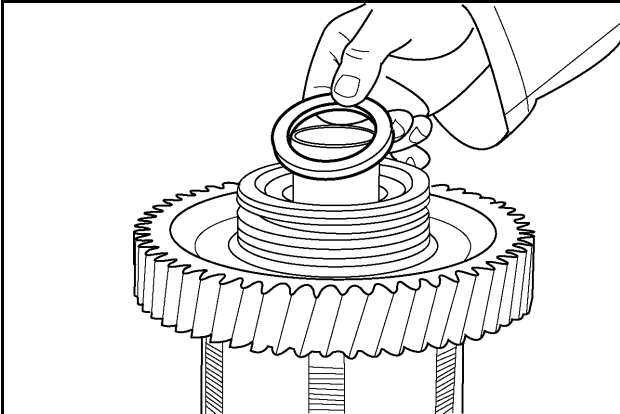
### STEP 165



A10942

Install the needle thrust bearing and the two bearing thrust washers. The needle bearing must be between the two bearing thrust washers.

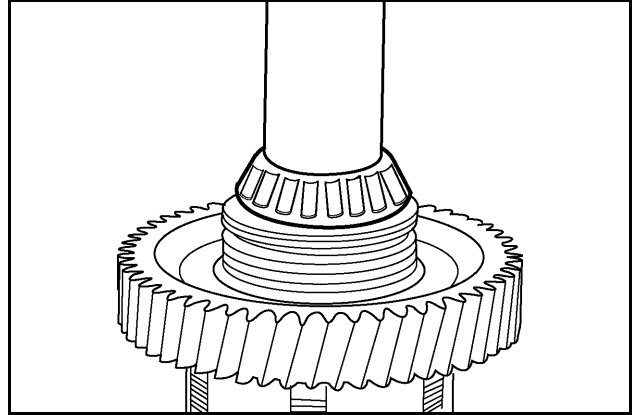
### STEP 166



A10943

Install the bearing spacer.

### STEP 167



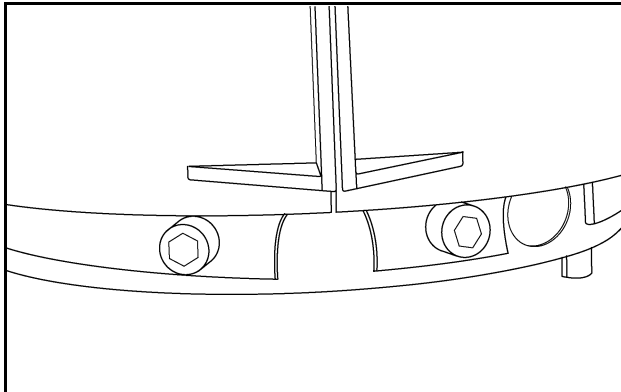
A10945

Install the front bearing cone so that the larger OD side of the bearing cone is facing down. Press the bearing in place to be sure the bearing is properly seated.

**NOTE:** Be sure the tool used to press the bearing does not contact the end of the shaft. Do not press on the bearing cage.

## Front Wheel Drive (FWD) - Emergency Brake Disassembly

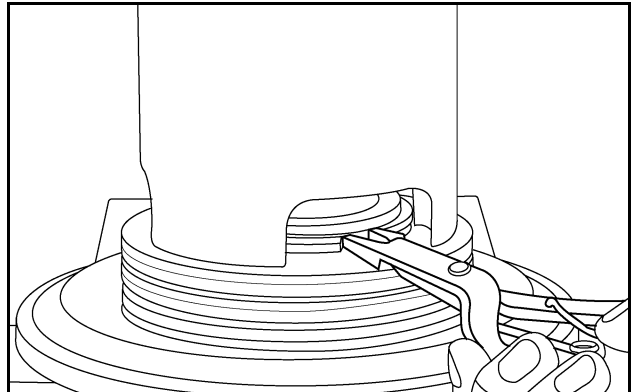
### STEP 168



RD05K020

Remove the two Allen head mounting screws. Repeat for the opposite side.

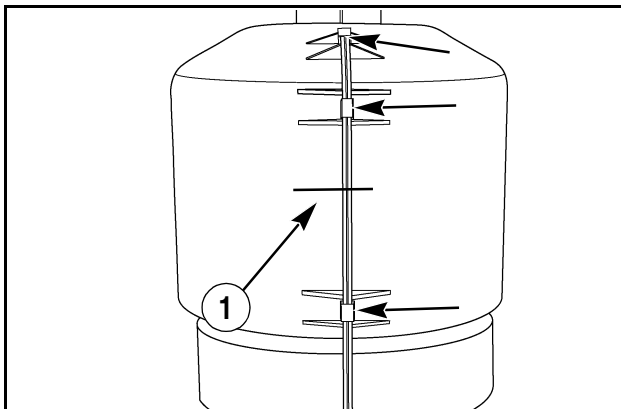
### STEP 171



RD05K040

Compress the Belleville springs using Tool 380002454 and release the retaining ring. Release the tool and remove retaining ring and locking ring.

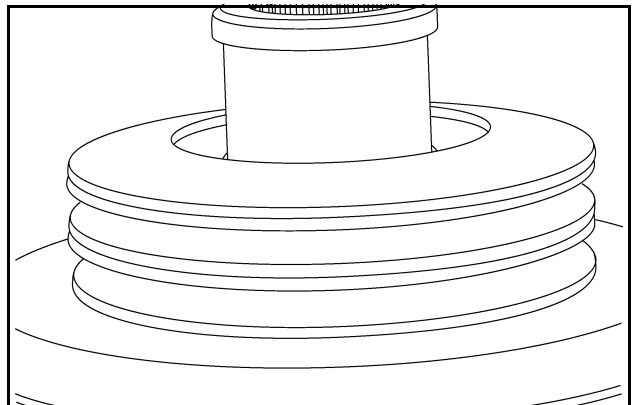
### STEP 169



RD05K019

Mark the shield (1) for proper reassembly. Remove the three clips. Repeat for the opposite side.

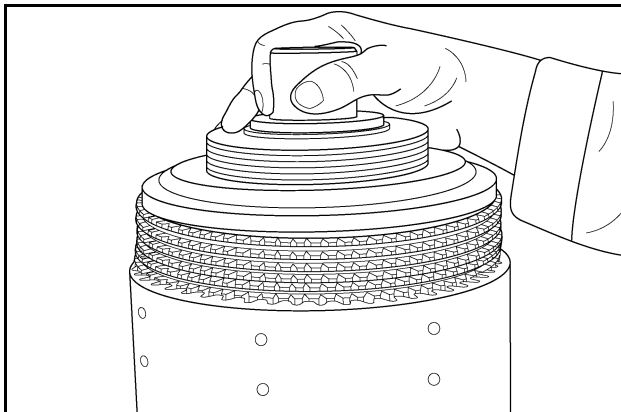
### STEP 172



RD05K076

Note the orientation of the Belleville springs and remove.

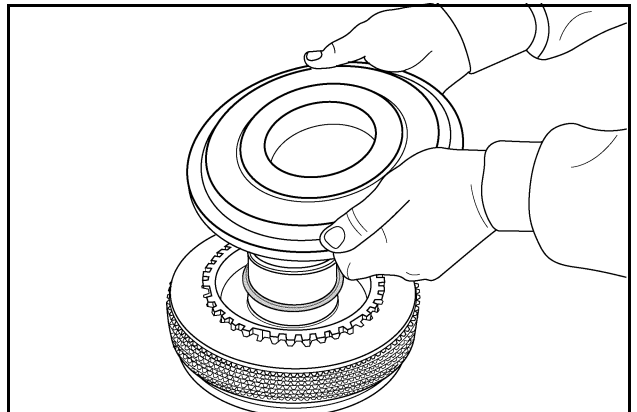
### STEP 170



RD05K021

Remove the FWD clutch assembly (1) from the gear/can weldment (2).

### STEP 173

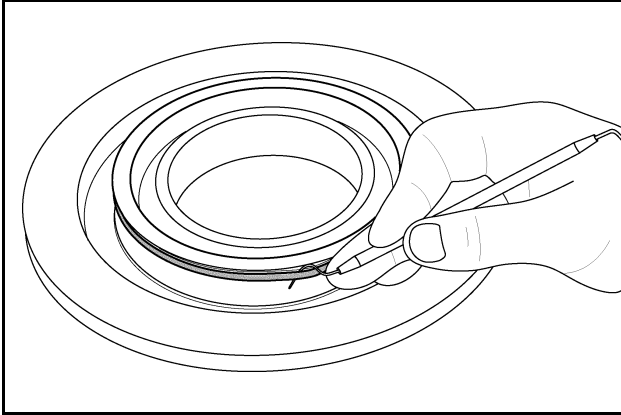


RD05K041

Remove the piston.



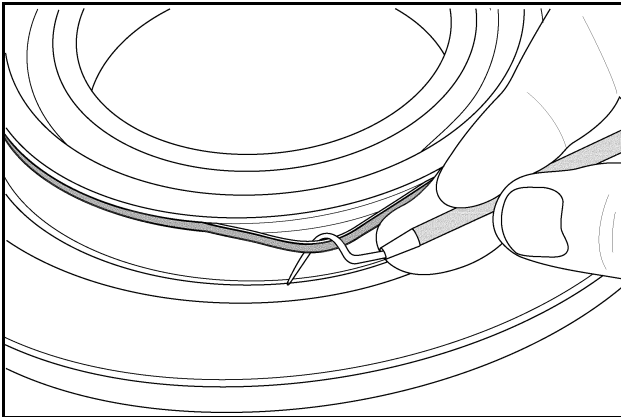
**STEP 174**



RD05K053

Remove the piston sealing ring and discard.

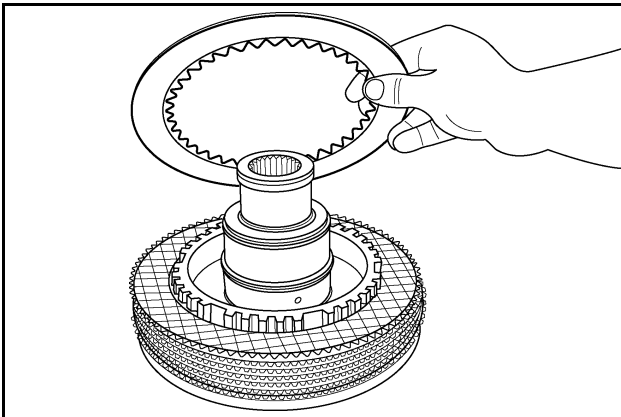
**STEP 175**



RD05K054

Remove the piston seal backing O-ring and discard.

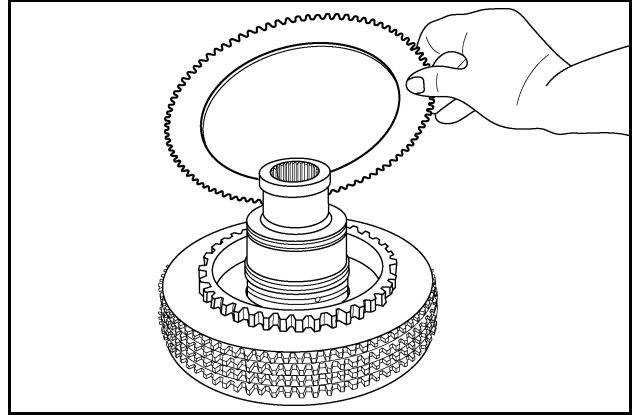
**STEP 176**



RD05K069

Remove the separator plate.

**STEP 177**

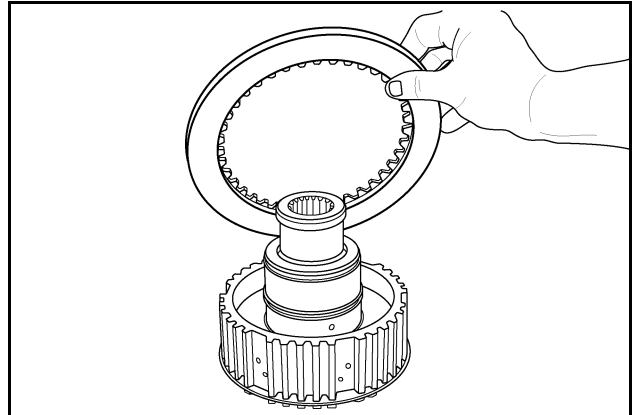


RD05K070

Remove the friction plate. Continue until all friction and separator plates are removed.

**NOTE:** When replacing separator and friction plates, they have to be replaced as complete assemblies.

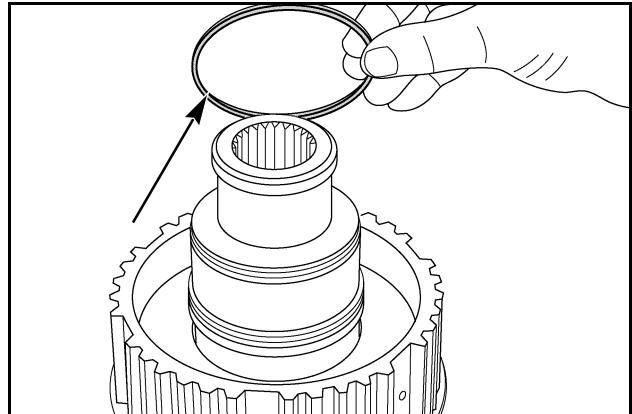
**STEP 178**



RD05K071

Remove the backing plate and mark for proper reassembly.

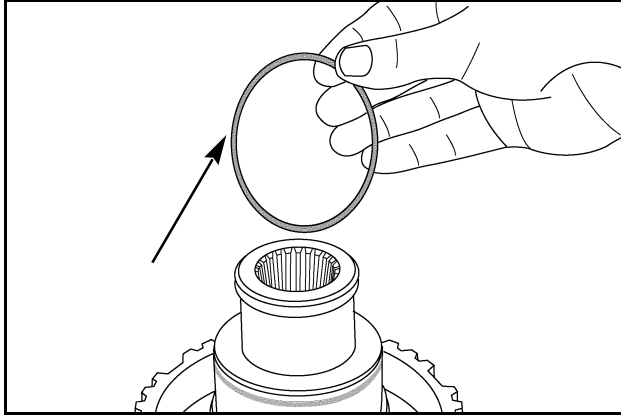
**STEP 179**



RD05K029

Remove the hub seal and discard.

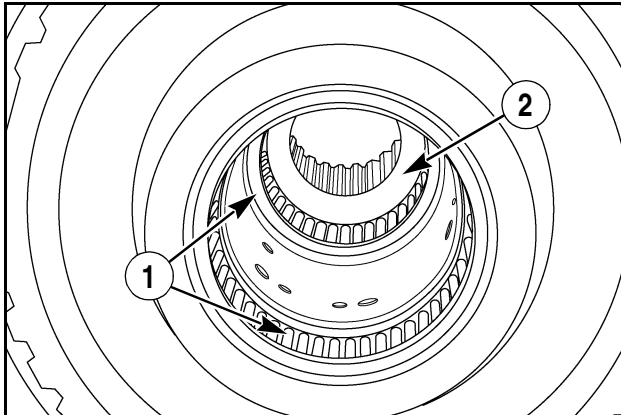
### STEP 180



RD05K030

Remove the hub seal backing O-ring and discard.

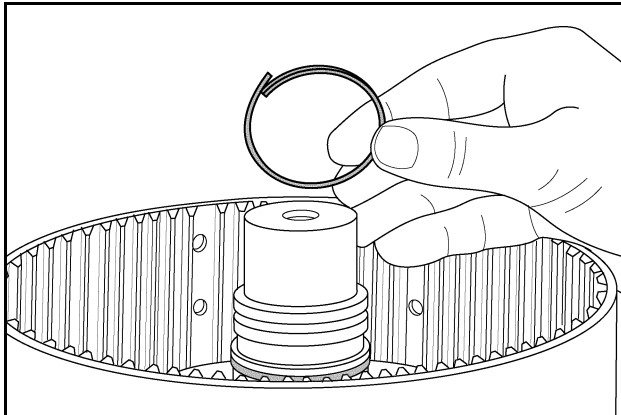
### STEP 181



RD05K072

Inspect the needle bearings (1) and composite washer (2) for wear or damage. If bearings and or washer are worn or damaged, the FWD hub will have to be replaced. Bearings and washer are NOT serviced.

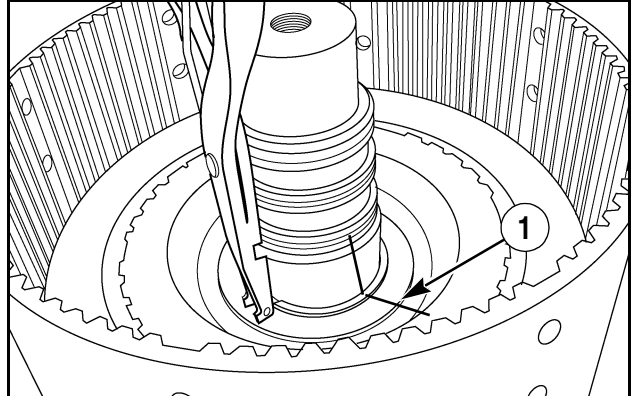
### STEP 182



RD05K033

Remove the three shaft seals and discard.

### STEP 183

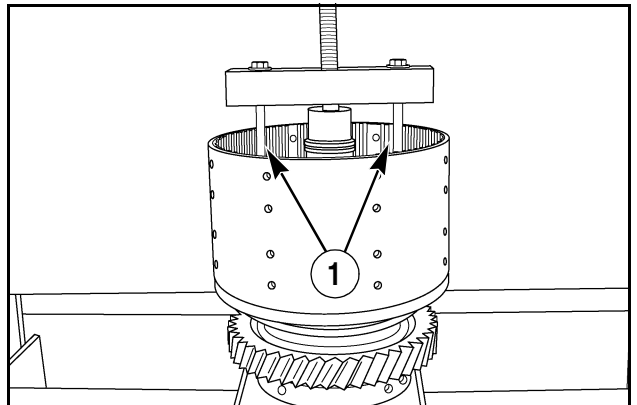


Rd05K034

Remove the retaining ring for the emergency brake clutch assembly.

**IMPORTANT:** Mark the shaft and hub (1) for proper reassembly.

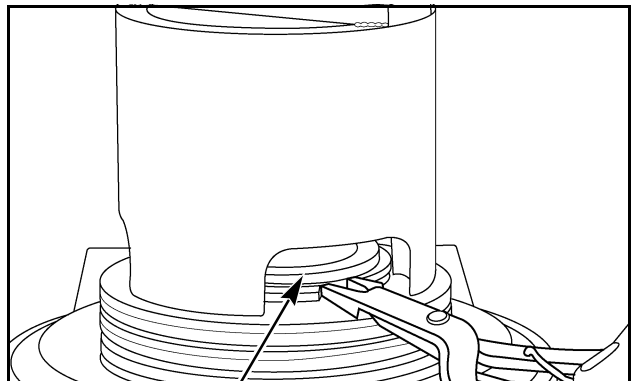
### STEP 184



RD05K035

Place a puller over the shaft assembly and using the two threaded holes in the emergency brake hub assembly, install two bolts (1) as shown and pull the assembly from the shaft.

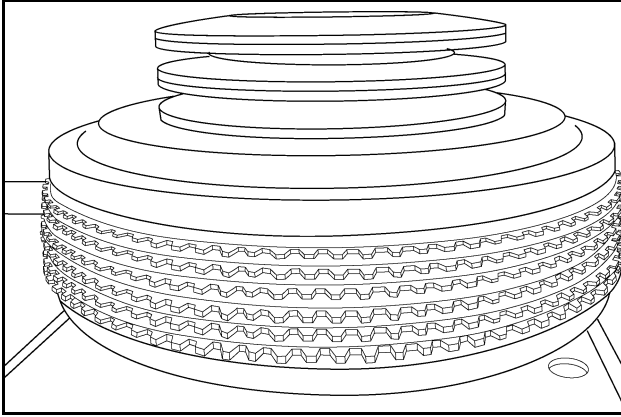
### STEP 185



RD05K040

Using tool 380002454 to compress the Belleville springs, remove the retainer ring.

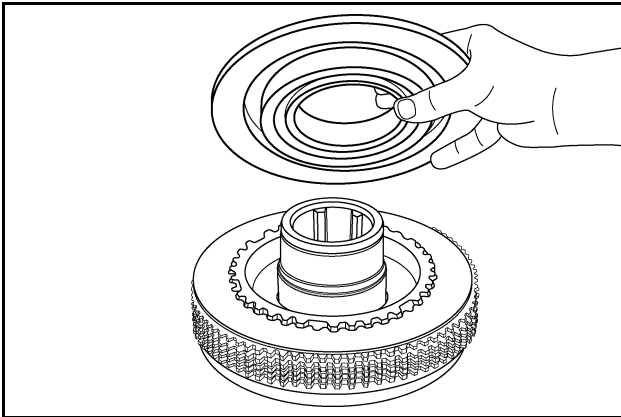
### STEP 186



RD05K075

Note the orientation of the Belleville springs and remove.

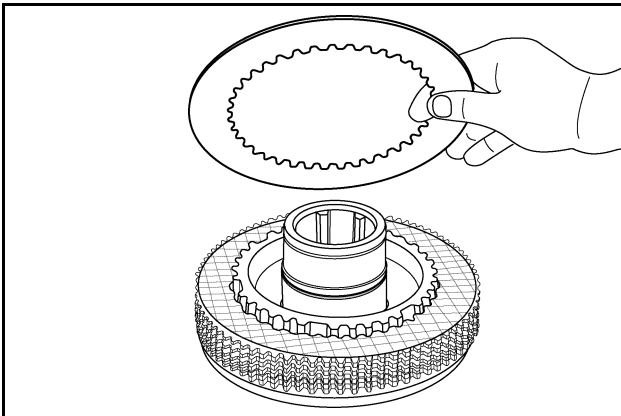
### STEP 187



RD05K036

Remove the piston.

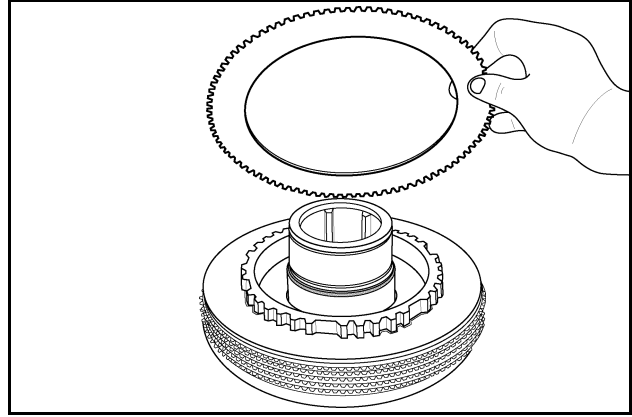
### STEP 188



RD05K037

Remove the separator plate.

### STEP 189

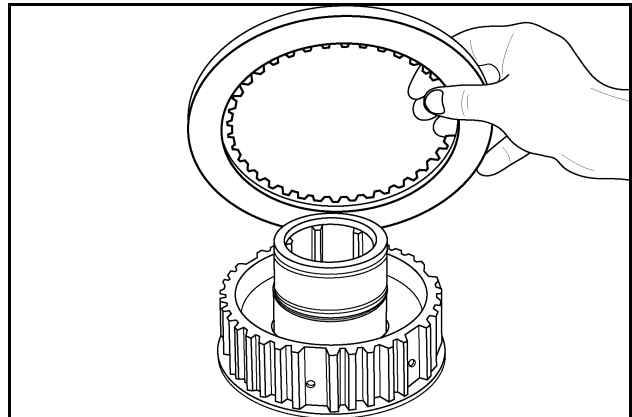


RD05K038

Remove the friction plate. Continue to remove all friction and separator plates. There is a total of six separator and six friction plates.

**NOTE:** When replacing separator and friction plates, they have to be replaced as complete assemblies.

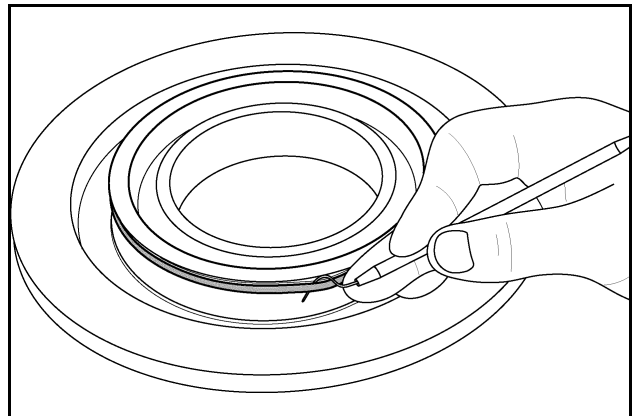
### STEP 190



RD05K042

Remove the backing plate.

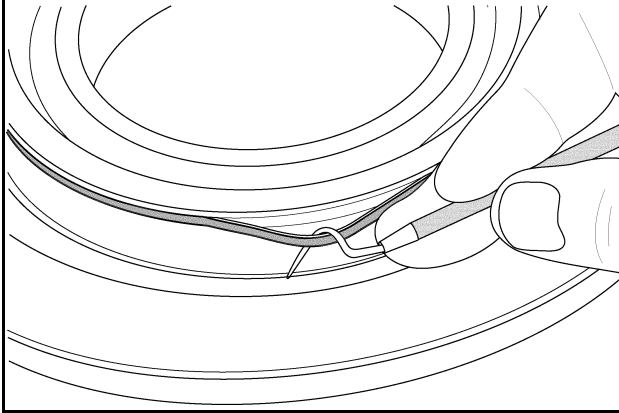
### STEP 191



R05K053

Remove the seal from the piston and discard.

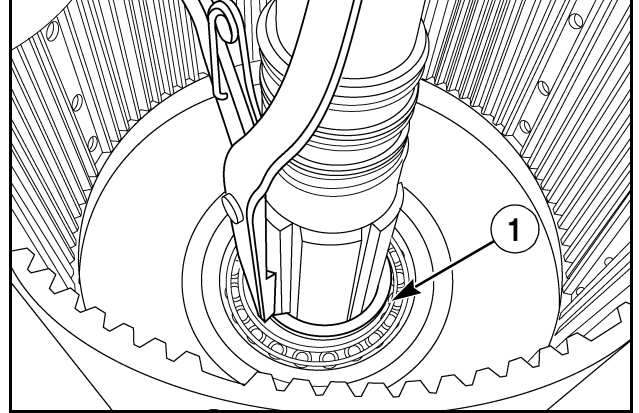
**STEP 192**



RD05K054

Remove the seal backing O-ring and discard.

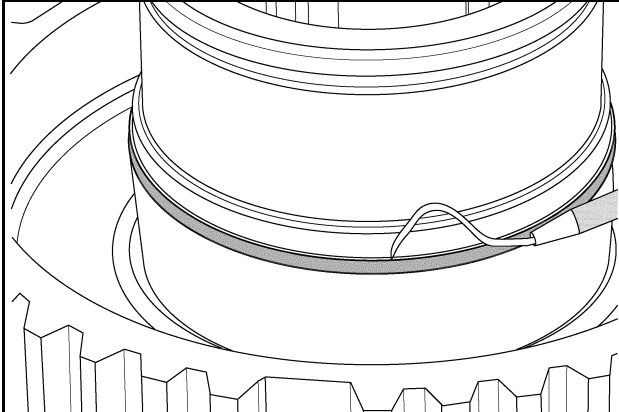
**STEP 195**



RD05K077

Remove bearing retainer ring (1) from the shaft.

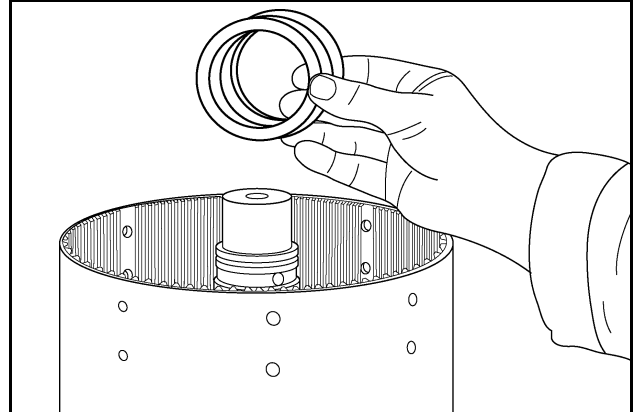
**STEP 193**



RD05K051

Remove the seal from the emergency hub.

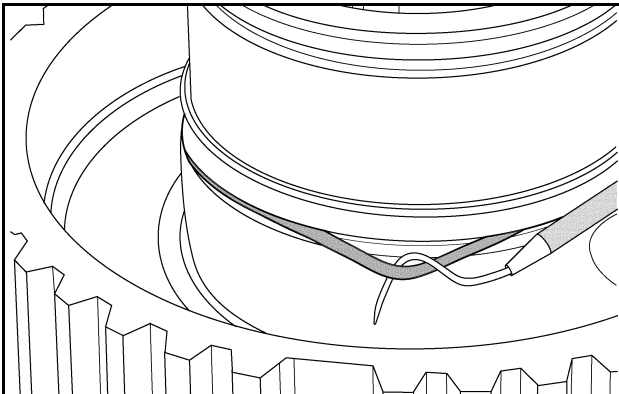
**STEP 196**



RD05K079

Remove the spacer and shim pack.

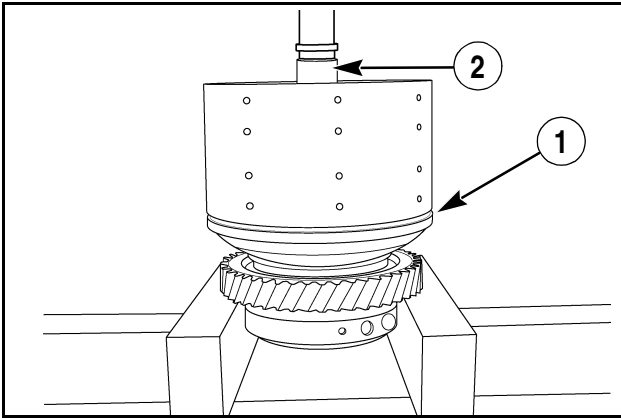
**STEP 194**



RD05K052

Remove the O-ring from the emergency hub.

### STEP 197



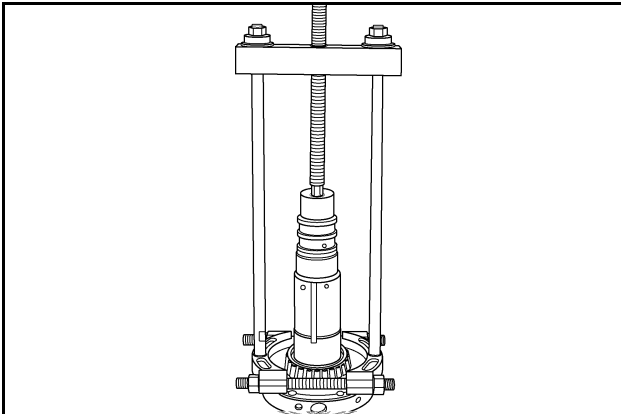
RD05K043

Support the gear/can weldment (1) as shown and press the FWD/park brake shaft (2) free from the weldment. Remove the bearing.

**IMPORTANT:** Make sure that the shaft dose not strike the floor once it is pressed free from the weldment, as damage to the shaft may occur.

**IMPORTANT:** Mark the bearing for location. If bearing is to be reused it **MUST** be reinstalled with the same bearing cup.

### STEP 198

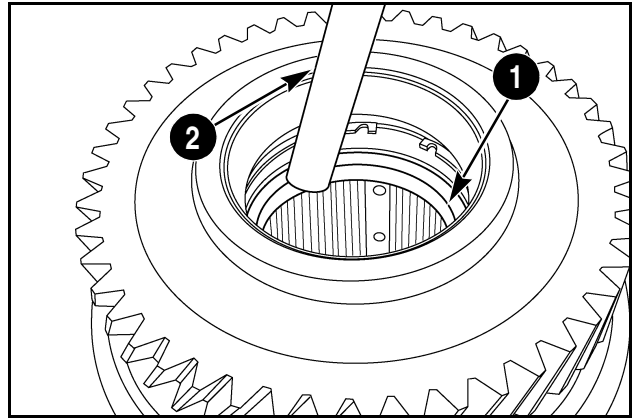


RD05K044

Remove the second bearing from the shaft.

**IMPORTANT:** Mark the bearing for location. If bearing is to be reused it **MUST** be reinstalled with the same bearing cup.

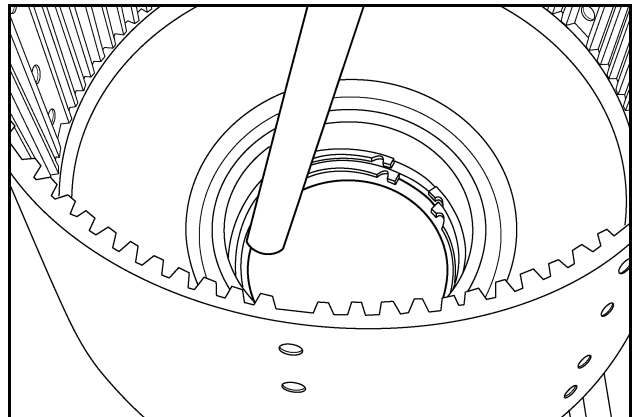
### STEP 199



RD05K045

Using a soft drift (1), remove the bearing cup (2).

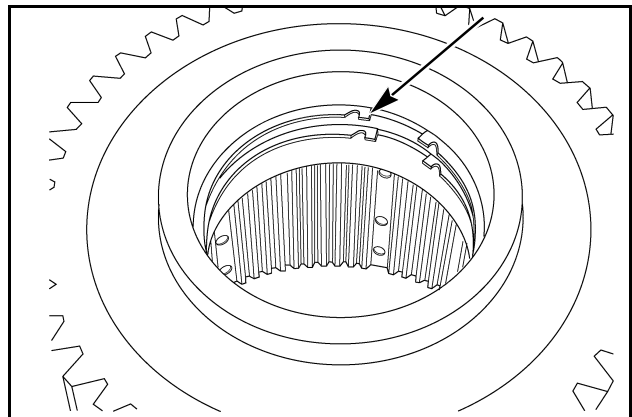
### STEP 200



RD05K046

Repeat for the second bearing cup.

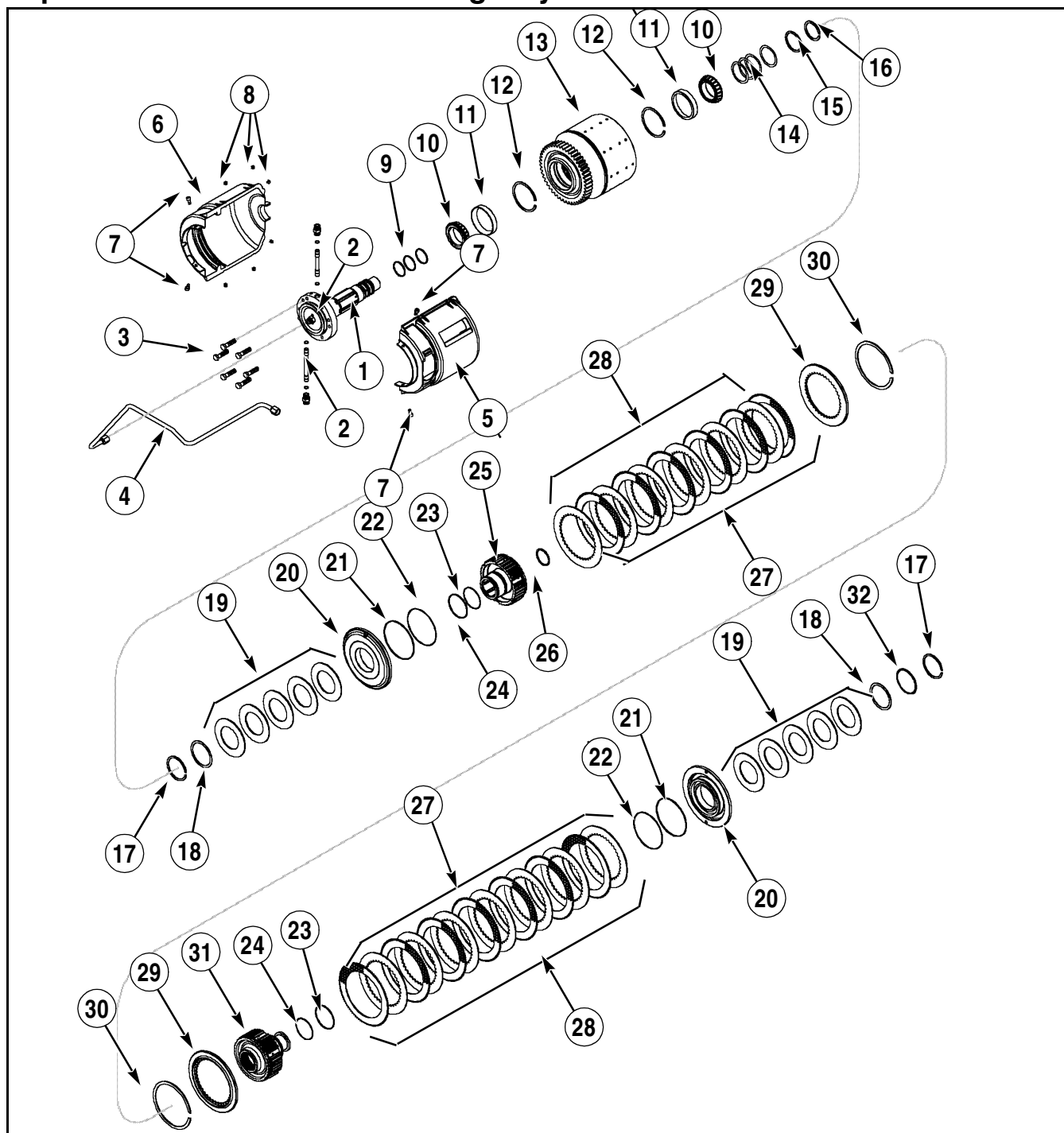
### STEP 201



RD05K046

Remove snap rings if needed.

## Exploded View of FWD and Emergency Brake

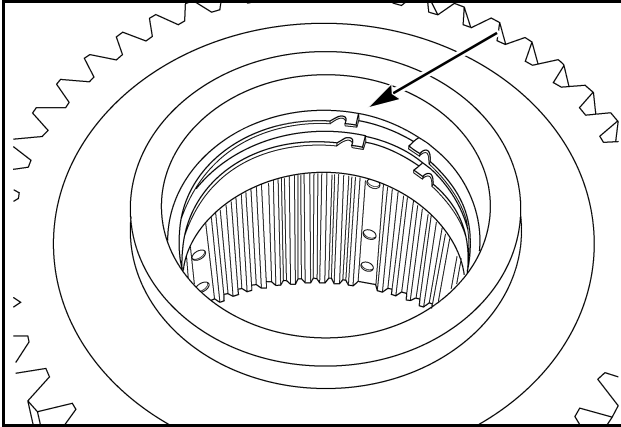


- |                                      |   |   |
|--------------------------------------|---|---|
| 1. SHAFT ASSY., FWD/PARK BRAKE       | 12. RING, RETAINER                              | 23. SEAL, EMERGENCY BRAKE HUB               |
| 2. TUBE, JUMPER W/ O-RINGS & FITTING | 13. WELDMENT, FWD GEAR/CAN                      | 24. O-RING, EMERGENCY BRAKE HUB             |
| 3. BOLT, HEX HD M12 X 50 MM          | 14. SHIM-PACK                                   | 25. HUB, EMERGENCY BRAKE                    |
| 4. TUBE, FWD                         | 15. SPACER, FWD CLUTCH BEARING                  | 26. RING RETAINER, EMERGENCY BRAKE HUB ASSY |
| 5. SHIELD, UPPER HALF                | 16. RING, RETAINER                              | 27. PLATE, SEPARATOR                        |
| 6. SHIELD LOWER HALF                 | 17. RING, RETAINER                              | 28. PLATE, FRICTION                         |
| 7. SCREW, SOC HD M8 X 16 MM          | 18. SPACER (IF REQUIRED)                        | 29. PLATE, BACKING                          |
| 8. U CLIP, FWD SHIELD                | 19. SPRING, BELLEVILLE, EMERGENCY BRAKE AND FWD | 30. RING, RETAINER                          |
| 9. SEAL RING, SHAFT                  | 20. PISTON, EMERGENCY BRAKE & FWD               | 31. HUB, FWD WITH NEEDLE BEARINGS           |
| 10. BEARING, TAPER ROLLER            | 21. O-RING, PISTON                              | 32. RETAINER, SNAP RING                     |
| 11. CUP, BEARING                     | 22. SEAL, PISTON                                |   |

## Assembly of the FWD / Emergency Brake

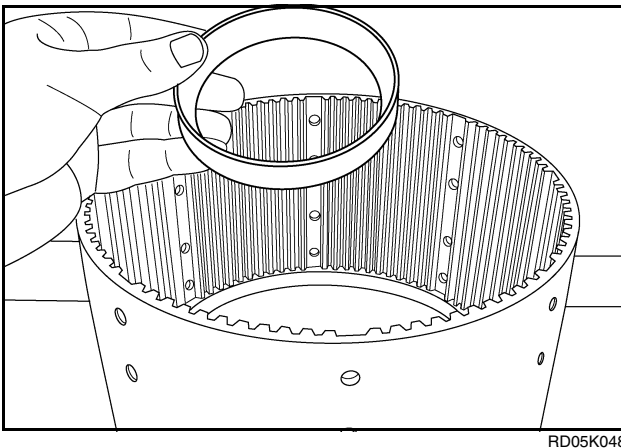
**NOTE:** Be sure parts are free of all contaminants before reassembly.

### STEP 202



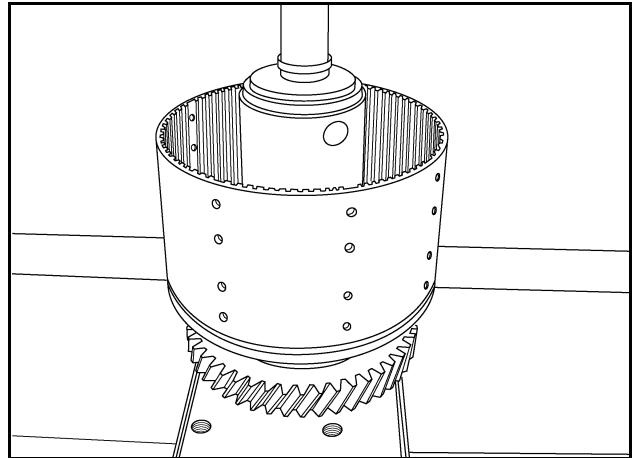
Install snap rings.

### STEP 203



Install new bearing cup in gear/can weldment.

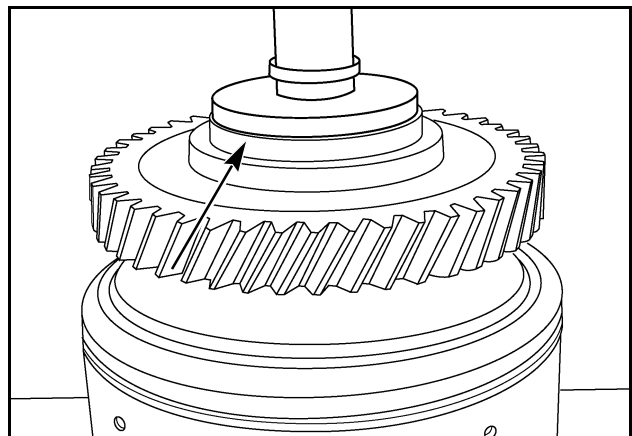
### STEP 204



Press cup into place.

**IMPORTANT:** DO NOT overpress cup against the snap ring.

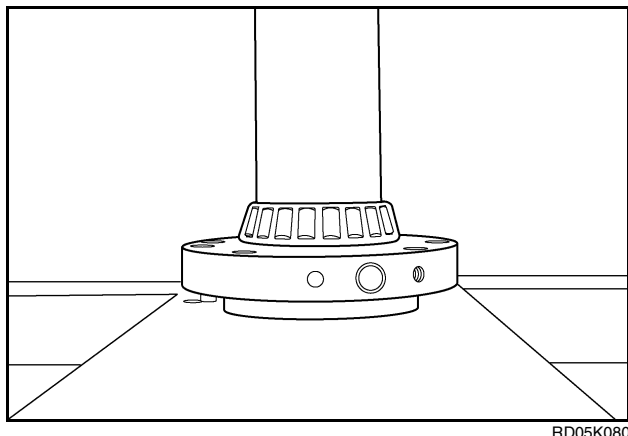
### STEP 205



Press the second bearing cup into the weldment.

**IMPORTANT:** DO NOT overpress cup against the snap ring.

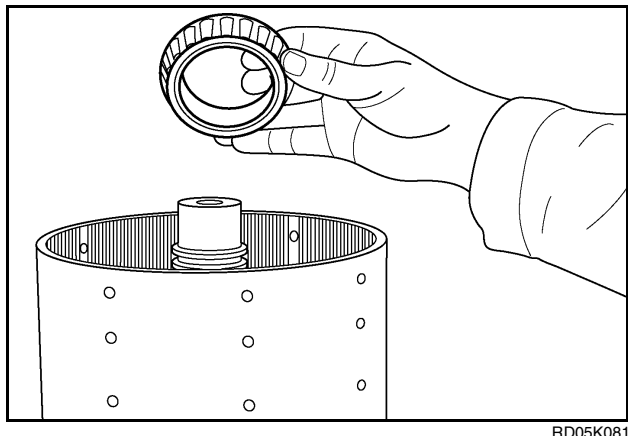
## STEP 206



Using an appropriate tool, press bearing onto the shaft.

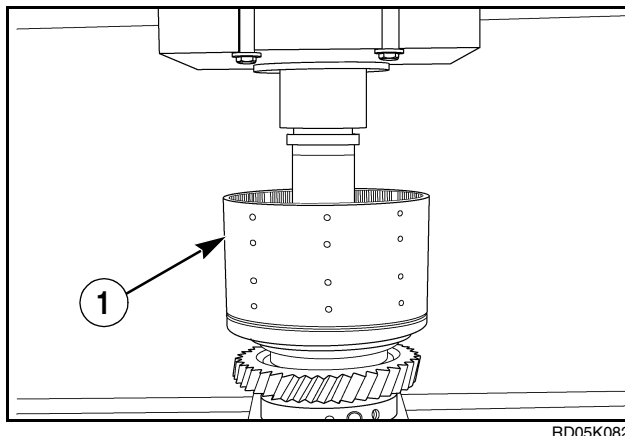
**IMPORTANT:** *Do not press on the bearing cage.*

## STEP 207



Place the weldment over the shaft and place the second bearing onto the shaft.

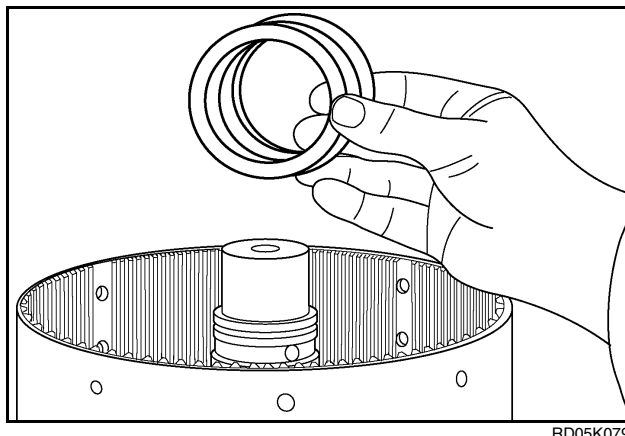
## STEP 208



**Set Bearing Preload As Follows:**

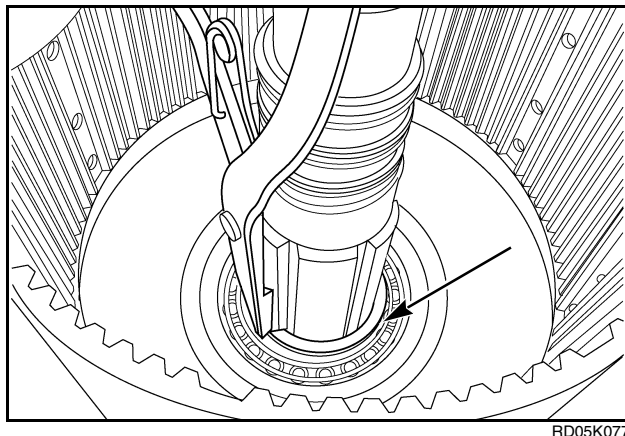
1. Attach a spring scale to one of the holes in the gear/can weldment (1).
2. As the bearing is being pressed onto the shaft, rotate the weldment until a rolling torque of 2.1 to 3.2 Nm (18 to 28 lb. inch) is obtained.

## STEP 209



Install the spacer and shim pack.

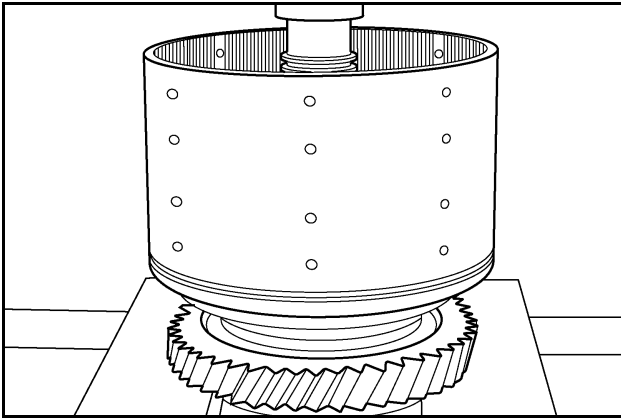
## STEP 210



Install the retainer ring.



## STEP 211

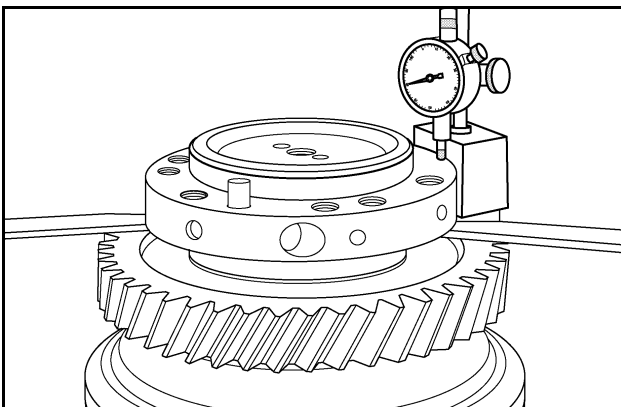


RD05K083

Support the gear (1) as shown. Backseat the bearing against the retainer ring. DO NOT over press.

**IMPORTANT:** Over pressing the bearing may distort the retainer ring which may cause improper shaft end play. Improper end play may cause premature bearing failure.

## STEP 212



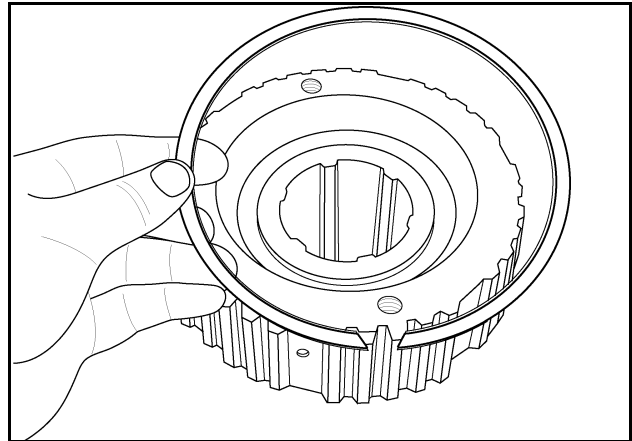
RD05K084

Check the shaft end play.

1. Place a dial indicator on the shaft.
2. Carefully pry up between the FWD gear and shaft flange.
3. Shaft end play: 0.089 mm (.0035 inch) +/- 0.064 mm (.0025 inch).
4. Add or subtract shims as needed.
5. Recheck end play if shims are changed.

**NOTE:** Do not install seals at this time.

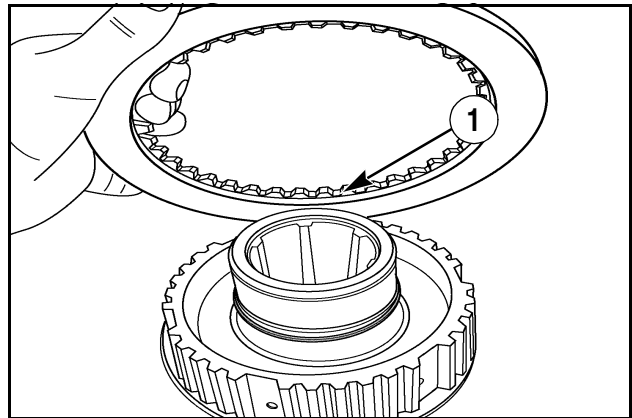
## STEP 213



RD05K062

Install the retainer ring.

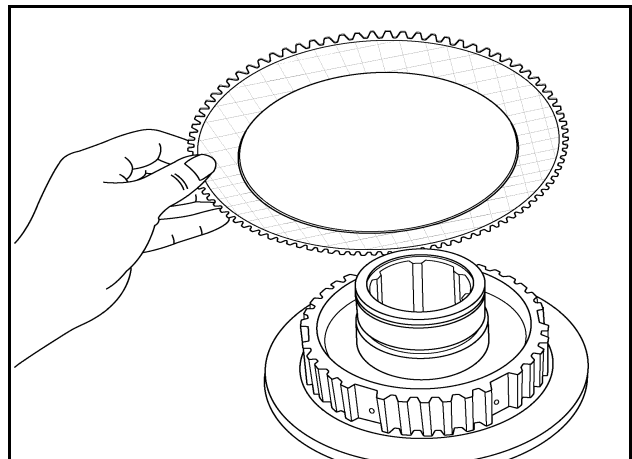
## STEP 214



RD05K064

Install a backing plate. Make sure the larger cutout (1) is facing the retainer ring.

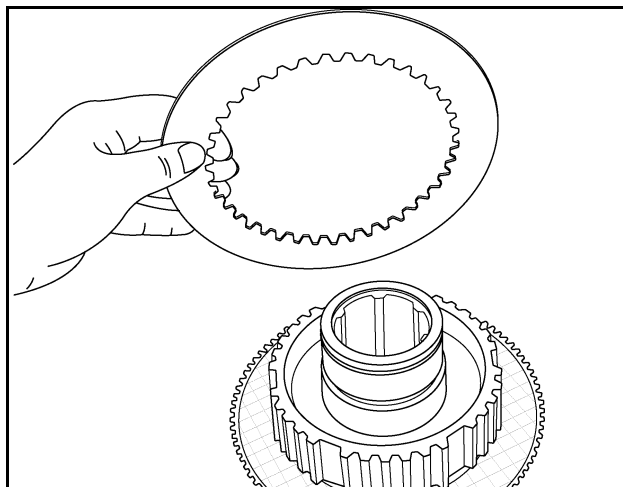
## STEP 215



RD05K065

Install a friction plate.

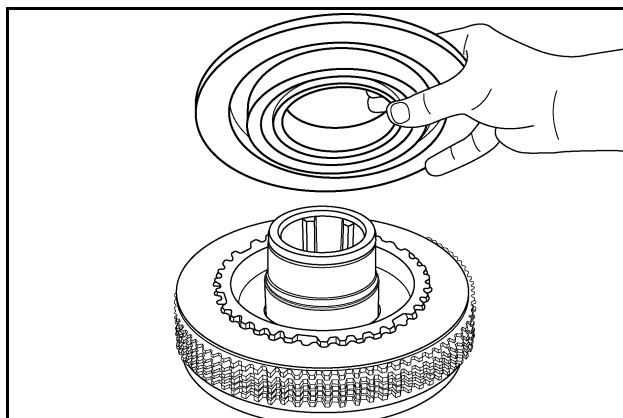
## STEP 216



Rd04K066

Install a separator plate. Continue until the six friction and six separator plates are installed.

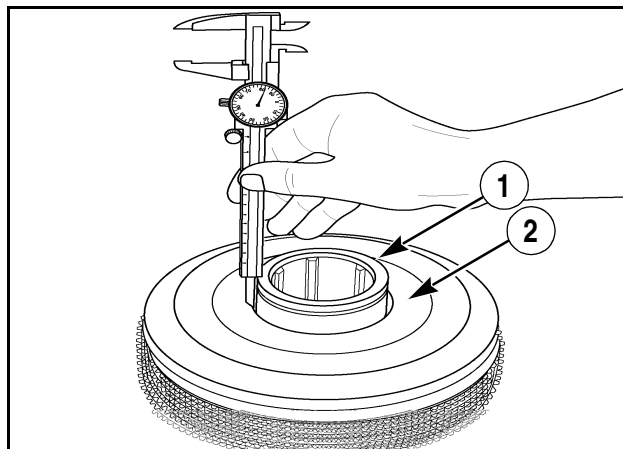
## STEP 217



RD05K036

Install the piston.

## STEP 218



Rd05K059

Measure the distance between the top of the hub (1) and the top of the piston (2).

If dimension is greater than 29.0 MM, use one spring spacer.

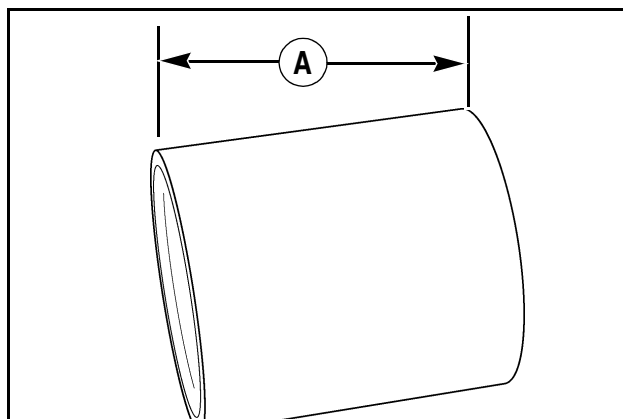
If dimension is greater than 30.5 MM use two spring spacers.

If dimension is less than 29.0 MM, DO NOT use spring spacer.

Remove piston, spacers, friction plates and backing plate from the hub.

**NOTE:** If spring spacer is needed it will be placed between the Belleville springs and the retainer ring during assembly.

## STEP 219

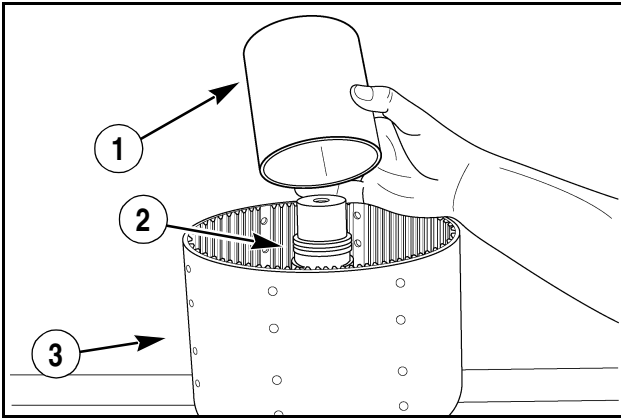


RD05K086

From a length of 4 inch ID, 1/4 inch wall PVC pipe, cut a piece 5 inches long (A).

**IMPORTANT:** When cutting the pipe, make sure each end is cut square.

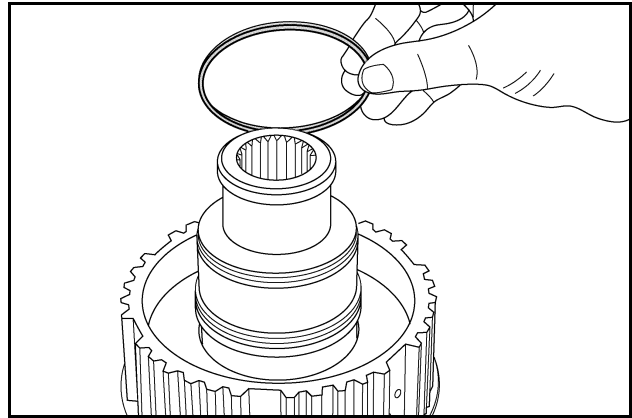
### STEP 220



RD05K087

Place the 5 inch long piece of PVC pipe (1) over the shaft (2). Make sure the pipe is centered at the bottom of the gear/can weldment (3).

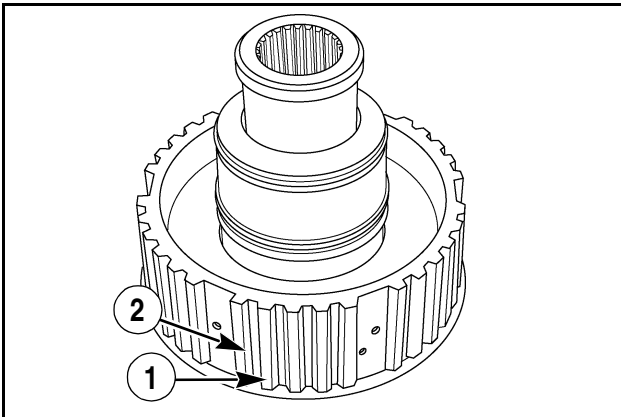
### STEP 223



RD05K029

Lubricate a new seal with petroleum jelly and install. Use care not to overstretch the seal.

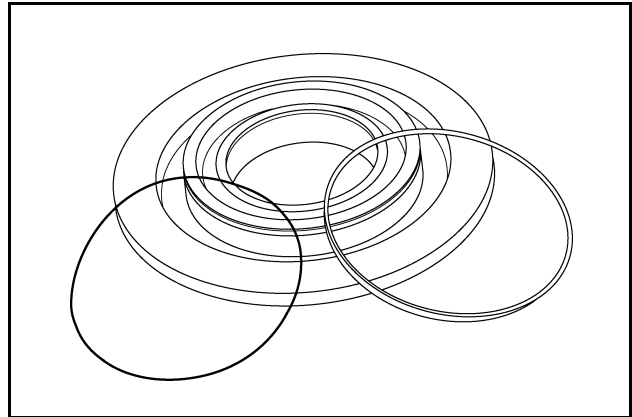
### STEP 221



RD05K068

Install retainer ring (1) in lower ring groove, as shown, for heavy duty twelve-bolt axle. For ten-bolt axle, install the retainer ring in the upper ring groove (2) (not shown).

### STEP 224

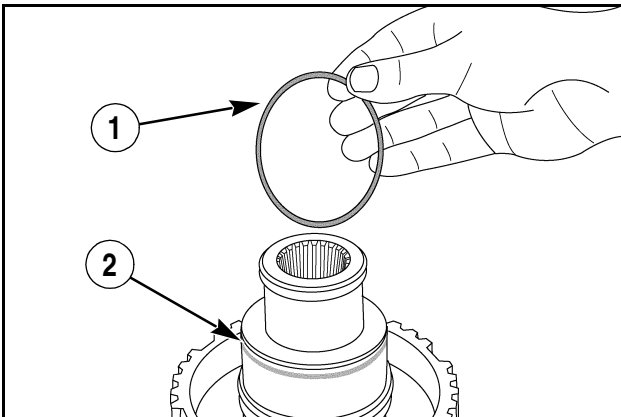


RD05K058

Lubricate a new O-ring (1) and seal (2) with petroleum jelly and install in the piston seal groove (3).

*DO NOT overstretch the seal during installation.*

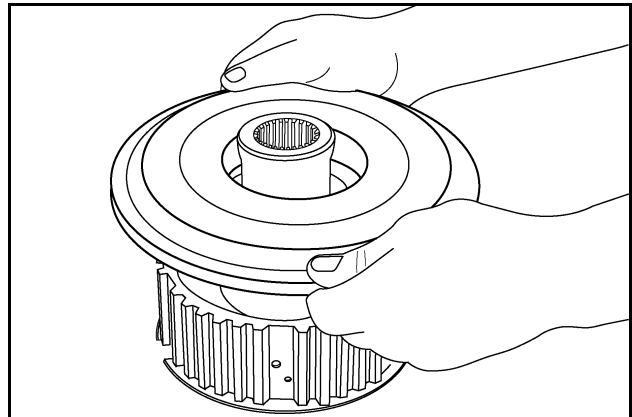
### STEP 222



RD05K030

Lubricate a new O-ring (1) with petroleum jelly and install in the seal ring groove (2).

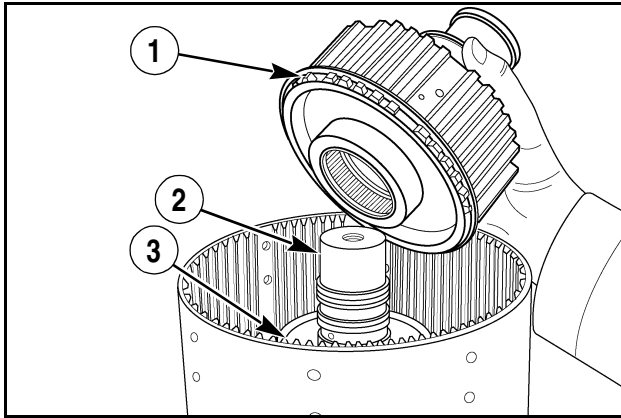
### STEP 225



RD05M019

Hand press the piston onto the hub to "size" the seal rings. Remove the piston and set aside.

### STEP 226

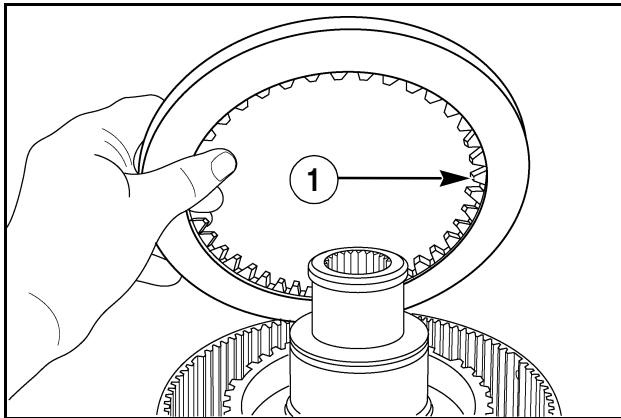


RD05K088

Place the FWD hub (1) over the shaft (2) and set on the PVC pipe (3).

**NOTE:** Do not install shaft seals at this time.

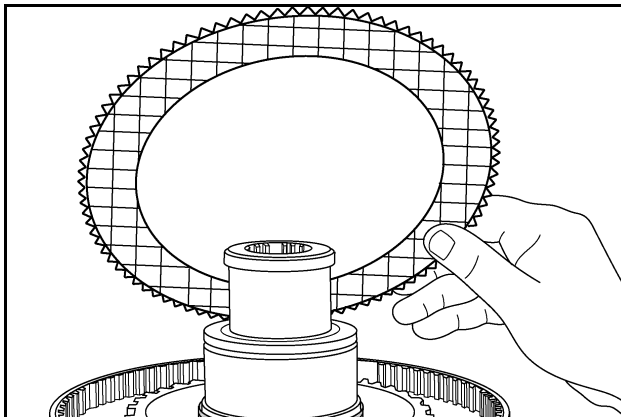
### STEP 227



RD05K027

Install the backing plate. Make sure the wide cutout (1) is facing downward.

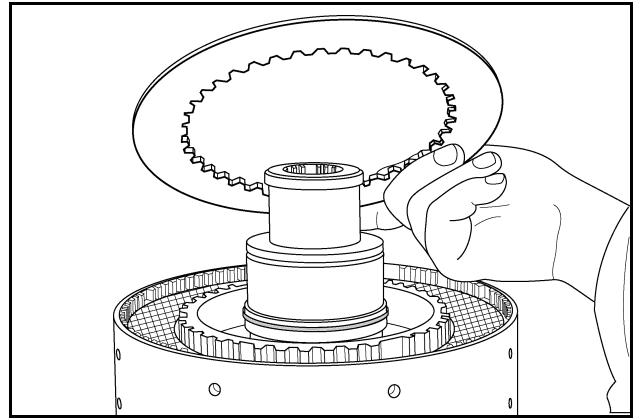
### STEP 228



RD05K026

Install a friction plate.

### STEP 229

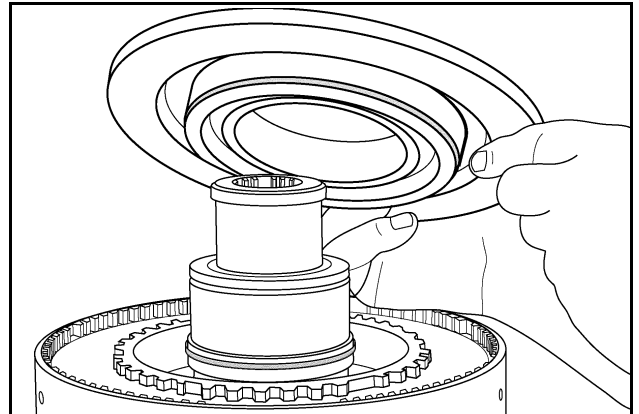


RD05K025

Install a separator plate. Alternate separator and friction plates until there are six separator and six friction plates for the ten-bolt FWD axle and seven separator plates and seven friction plates for the heavy-duty twelve-bolt FWD axle.

**NOTE:** Once all spacers and friction plates are installed, rotate the hub in one direction ONLY, to get maximum separator and friction plate spline clearance. This will aid in the removal and installation of the hub assemblies in later steps.

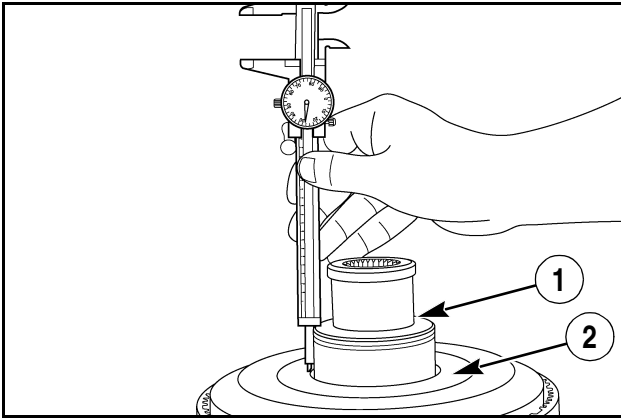
### STEP 230



RD05K024

Install the piston over the shaft.

### STEP 231



RD05K060

Measure the distance between the top of the hub flange (1) and the top of the piston (2).

If dimension is greater than 29.7 MM, use one spring spacer.

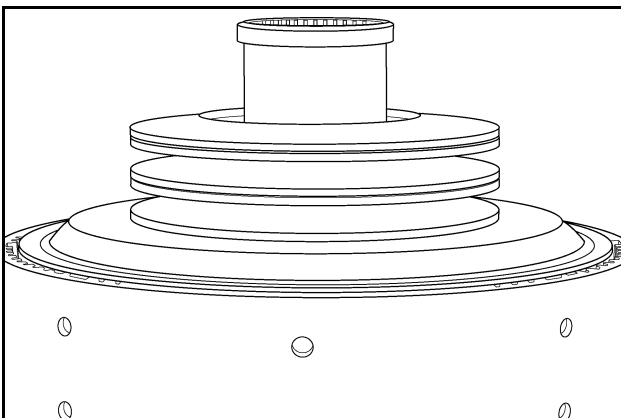
If dimension is greater than 31.2 MM, use two spring spacers.

If dimension is less than 29.7 MM, DO NOT use spring spacer.

Remove piston, spacers, friction plates and backing plate from the hub.

If spring spacer is needed, it will be placed between the Belleville springs and the retainer ring during assembly.

### STEP 232

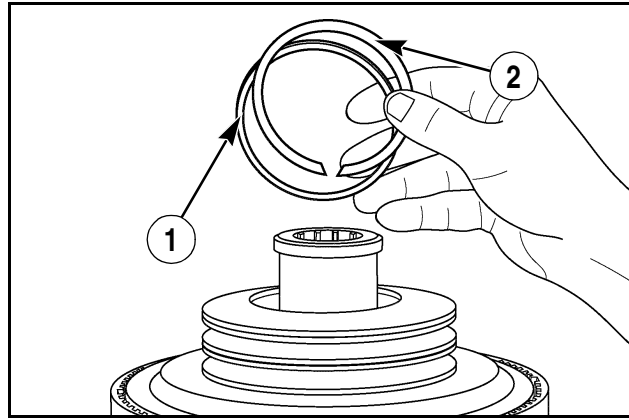


RD05K023

Install the five Belleville springs over the shaft as shown.

**IMPORTANT:** *Belleville springs must be aligned and centered so that they do not catch on the shaft when they are compressed.*

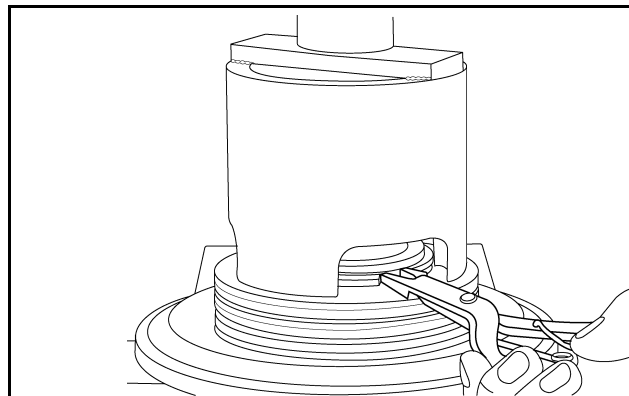
### STEP 233



RD05K022

Place the spring spacer(s) (if required), locking ring (1) and retaining ring (2) over the shaft.

### STEP 234

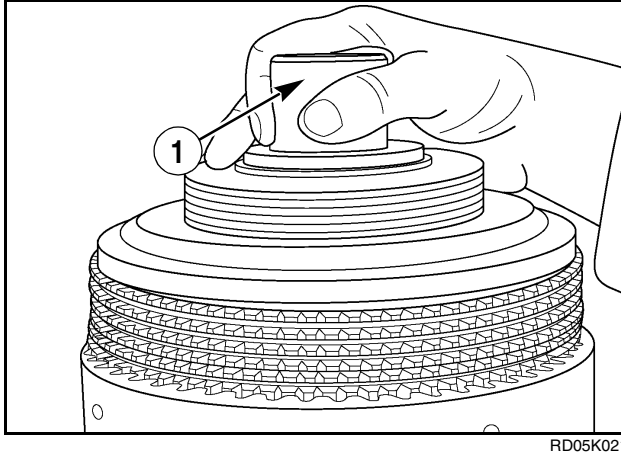


RD05K040

Center Tool 380002454 on the Belleville springs, compress the springs and install the retaining ring into the ring groove.

**IMPORTANT:** *Make sure retainer ring is sitting inside the locking ring and fully seated in the ring groove before removing compression tool.*

### STEP 235

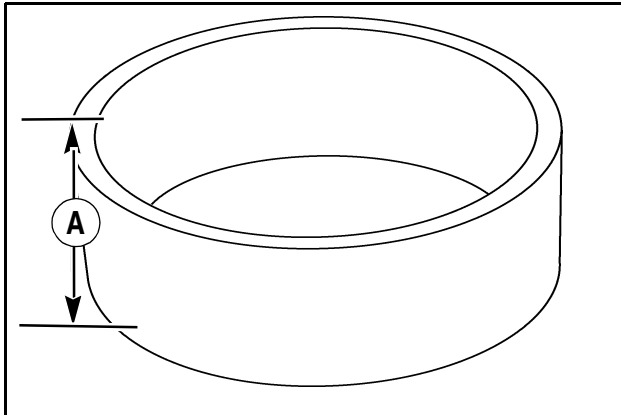


RD05K021

Remove the FWD clutch assembly from the weldment.

**NOTE:** A strap may be placed over the end of the shaft (1) to aid in removal.

### STEP 236

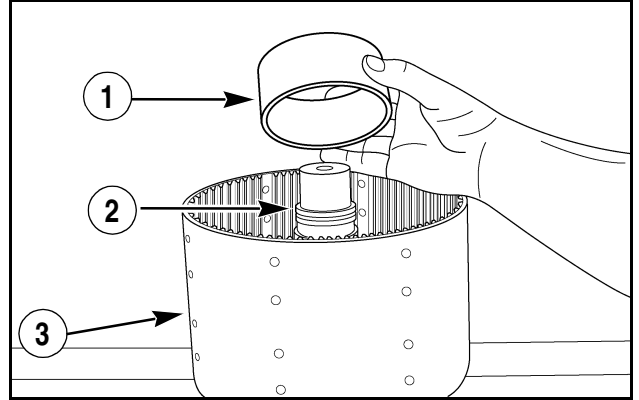


RD05K085

From a length of 4 inch ID, 1/4 inch wall PVC pipe, cut a piece 2 inches long (A).

When cutting the pipe, make sure each end is cut square.

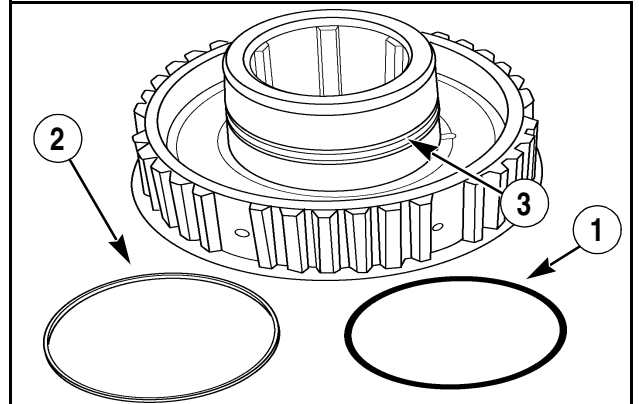
### STEP 237



RD05K093

Place the 2 inch long piece of PVC pipe (1) over the shaft (2). Make sure the pipe is centered at the bottom of the gear/can weldment (3).

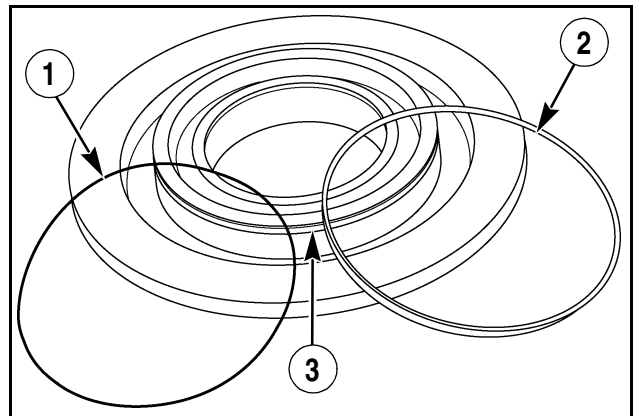
### STEP 238



RD05K105

Lubricate with petroleum jelly and install a new O ring (1) and seal (2) in the seal ring groove (3) of the park brake hub.

### STEP 239

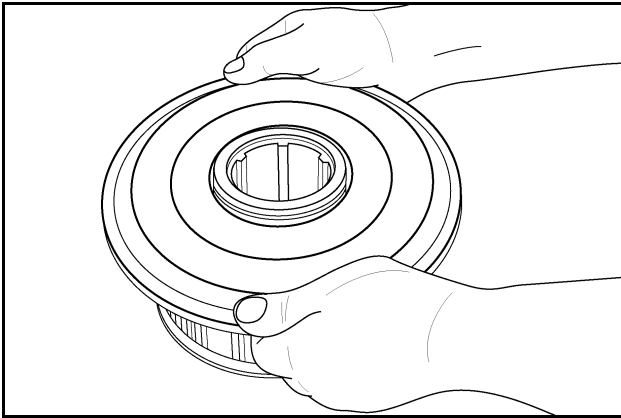


RD05K058

Lubricate a new O-ring (1) and seal (2) with petroleum jelly and install in the piston seal grove (3).

**DO NOT** overstretch the seal during installation.

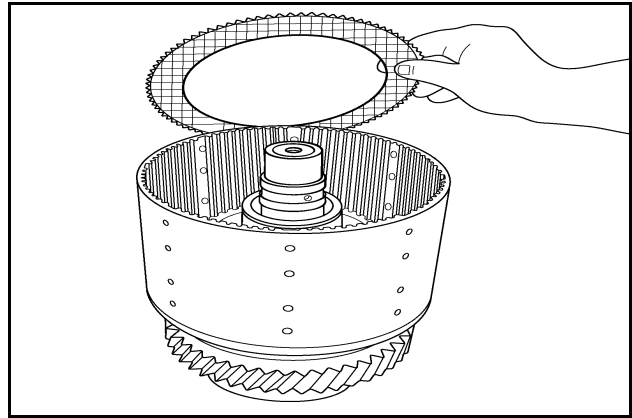
### STEP 240



RD05M020

Hand press the piston onto the hub to “size” the seal rings. Remove the piston and set aside.

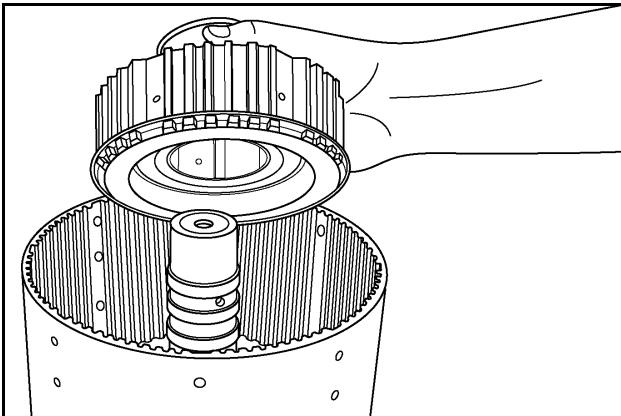
### STEP 243



RD05K096

Install a friction plate.

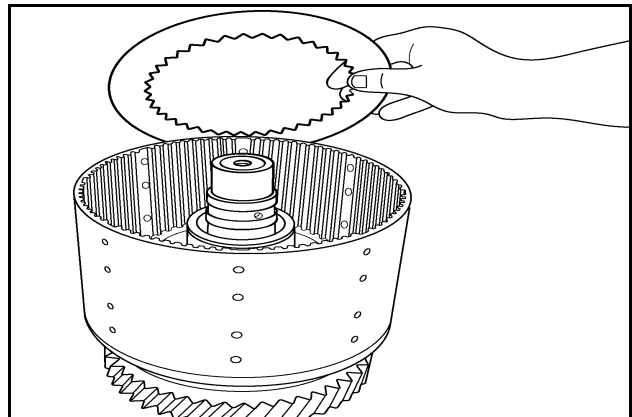
### STEP 241



RD05K094

Place the hub (upside down from normal installation) over the shaft. Make sure the hub splines are engaged in the shaft splines and sitting squarely on the PVC pipe.

### STEP 244

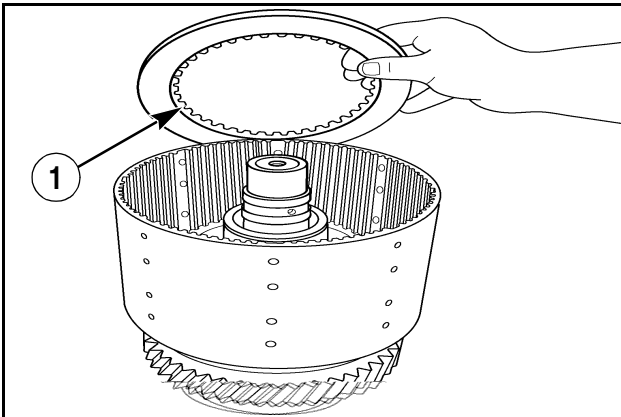


RD05K097

Install a separator plate. Alternate separator and friction plates until all six separator and six friction plates are installed.

**NOTE:** Once all spacers and friction plates are installed, rotate the hub in one direction *ONLY*, to get maximum separator and friction plate spline clearance. This will aid in the removal and installation of the hub assemblies in later steps.

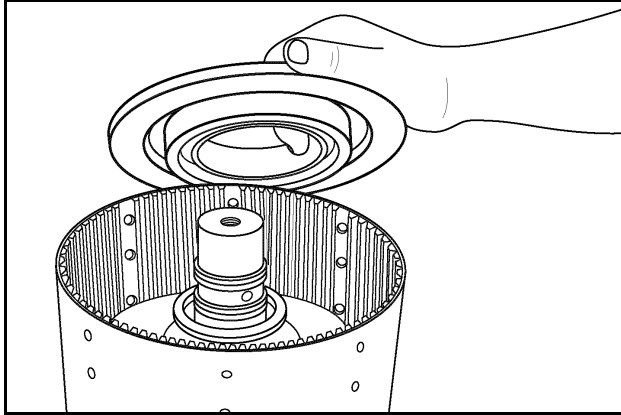
### STEP 242



RD05K095

Install the backing plate. Make sure the wide cutout (1) is facing downward.

## STEP 245

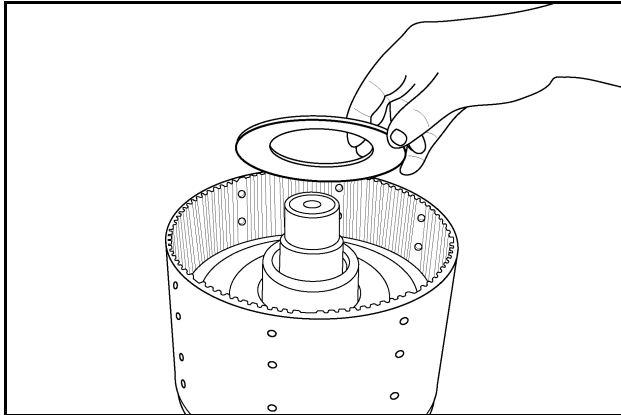


RD05K098

Install the piston.

**IMPORTANT:** Use care when installing the piston to prevent damage to the piston and hub seals.

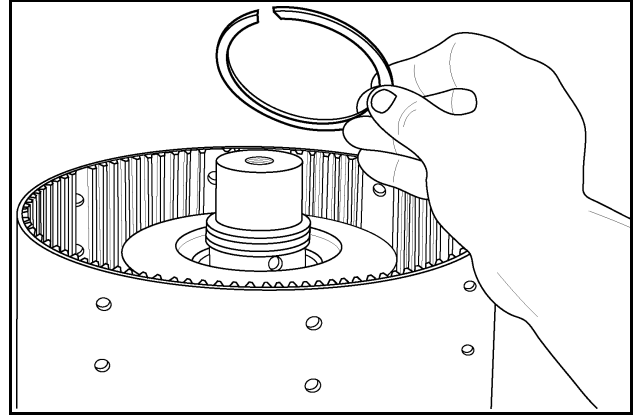
## STEP 246



RD05K099

Orientate the Belleville springs the same as for the FWD assembly and install.

## STEP 247

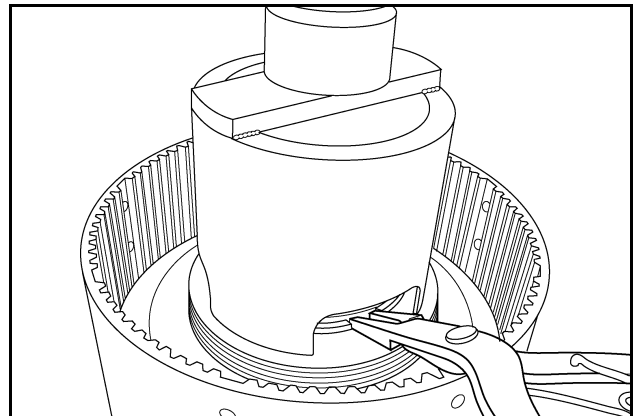


RD05K0101

Place the spacer(s) (if required) and retainer ring on top of the Belleville springs.

**IMPORTANT:** Belleville springs must be aligned and centered so that they do not catch on the shaft when they are compressed.

## STEP 248



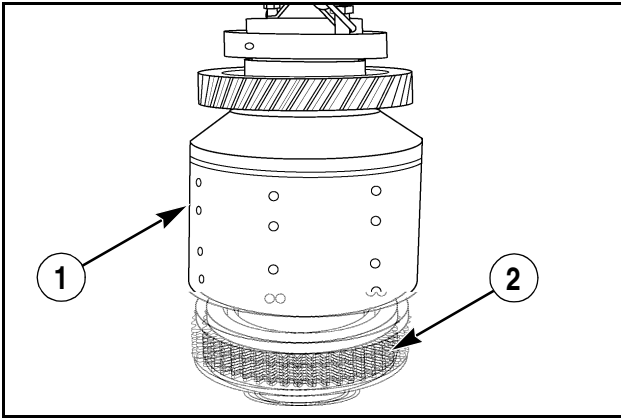
RD05K102

Compress the Belleville springs using Tool 380002454 and install the retainer ring.

**IMPORTANT:** Make sure retainer ring is fully seated in the ring groove before removing compression tool.



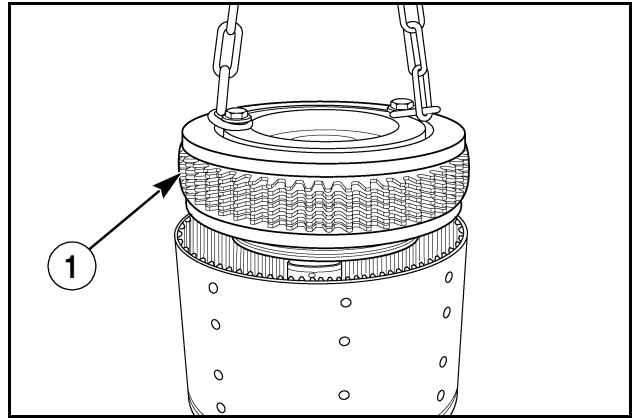
### STEP 249



RD05K103

Turn the weldment (1) over. Lift the weldment and remove the park brake hub assembly (2) and PVC spacer (not shown).

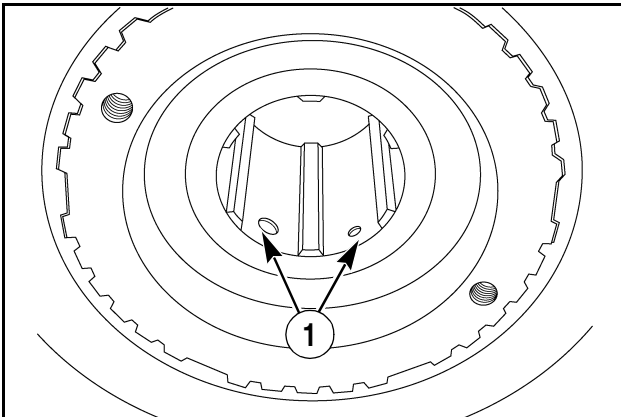
### STEP 251



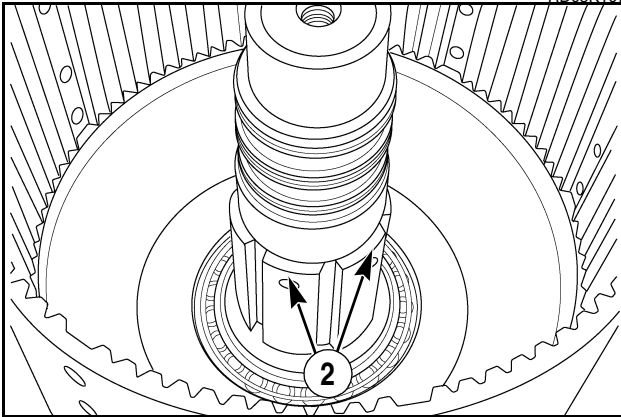
RD05K104

Properly support the park brake hub assembly as shown and lower into the weldment. Take care not to damage the friction plate tabs (1).

### STEP 250



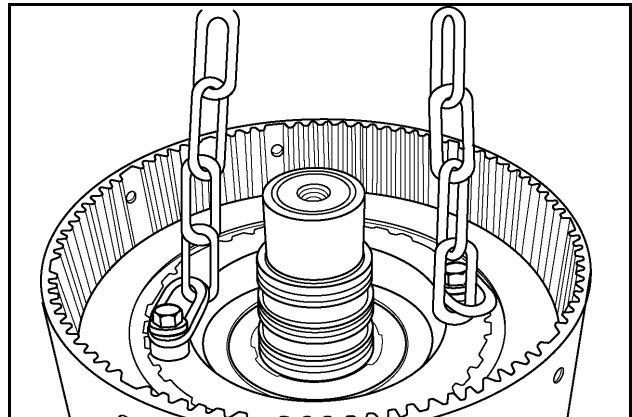
RD05K107



RD05K106

**IMPORTANT:** When installing the emergency brake assembly, make sure the oil supply holes (1) are properly aligned with the oil supply holes (2) in the shaft.

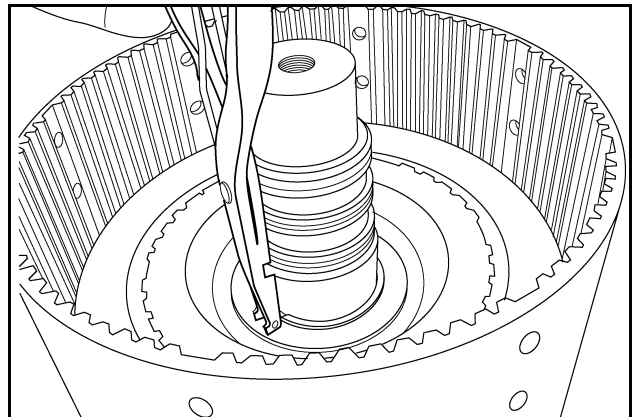
### STEP 252



RD05K073

Continue to lower the hub until it is fully seated into the weldment.

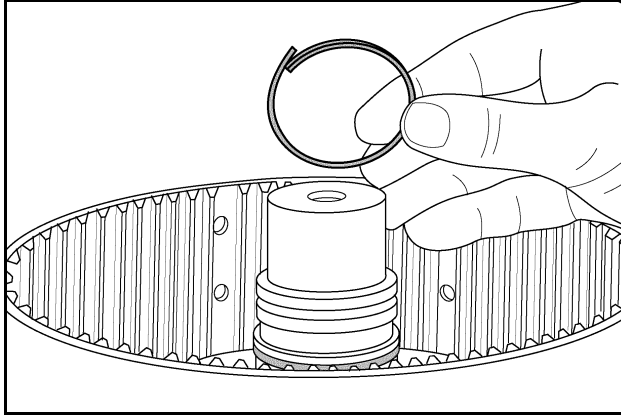
### STEP 253



RD05K034

Install the emergency brake assembly retainer ring.

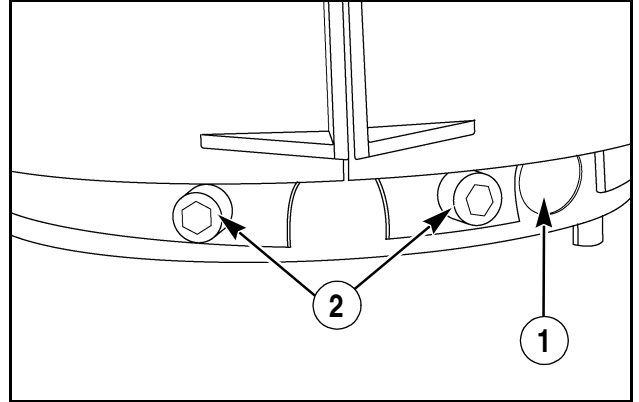
### STEP 254



RD05K033

Lubricate with petroleum jelly and install three new shaft seals.

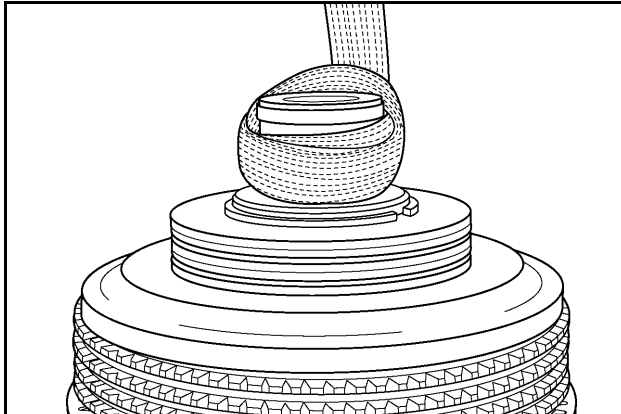
### STEP 257



RD05K020

Make sure that the jumper tube supply hole (1) is not covered by the shield. Install the allen head bolts (2). Repeat for the opposite side.

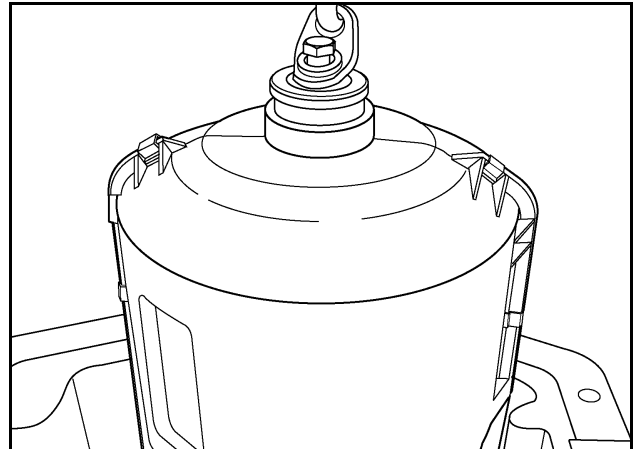
### STEP 255



RD05K021

Properly support the FWD clutch assembly and carefully lower into the weldment. Take care not to damage the friction plate tabs and shaft seals.

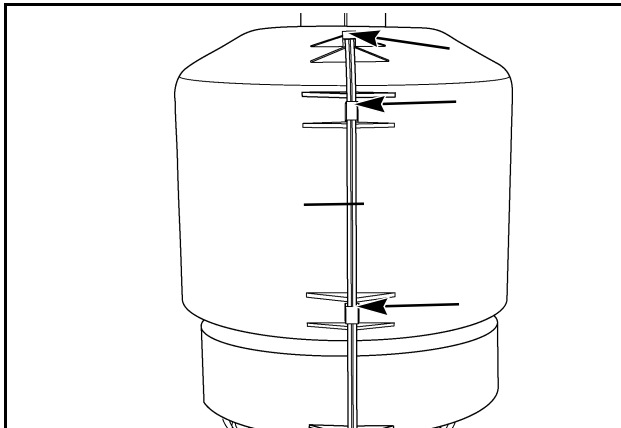
### STEP 258



RD05K018

Properly support the FWD/Park brake assembly and lower it into the range housing.

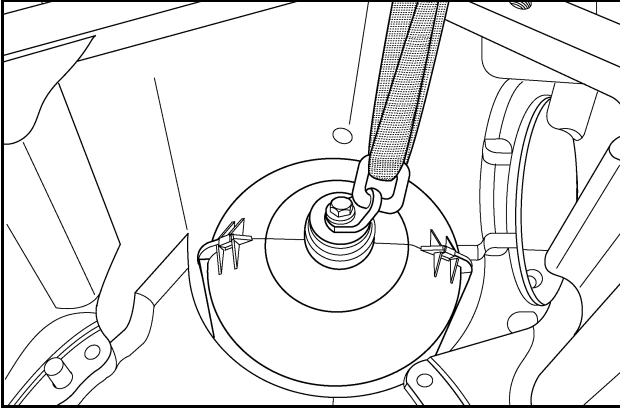
### STEP 256



RD05K019

Place the two halves of the shield together, making sure the marks are aligned. Install the retaining clips. Repeat for the opposite side.

## STEP 259

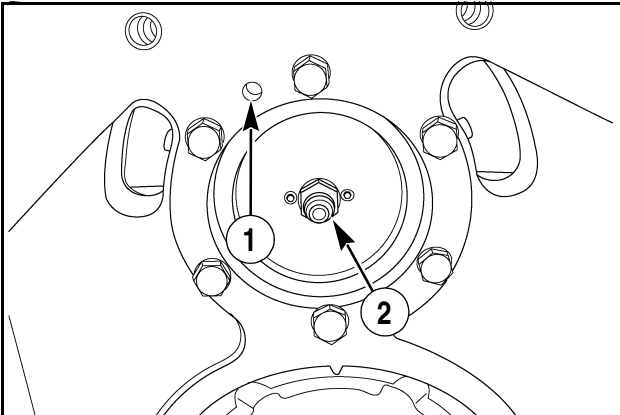


RD05K017

Continue to lower the assembly into the housing until it is seated in the bore.

**NOTE:** Make sure that the alignment pin located at the end of the output shaft mounting flange is aligned with the alignment hole as shown in the following step.

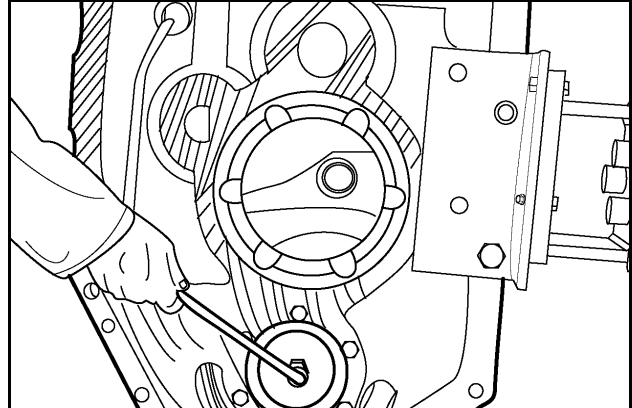
## STEP 260



RD05K063

Once the alignment pin (1) is properly aligned, install the six mounting bolts. Tighten bolts to a torque of 101 to 113 Nm (78 to 84 lb. ft.). Install the FWD lube fitting (2) if removed.

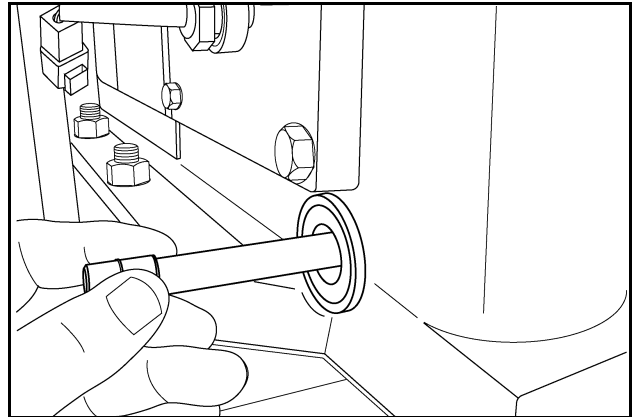
## STEP 261



A22327

Install the FWD lube tube at the shaft end and to fitting in top of range casting.

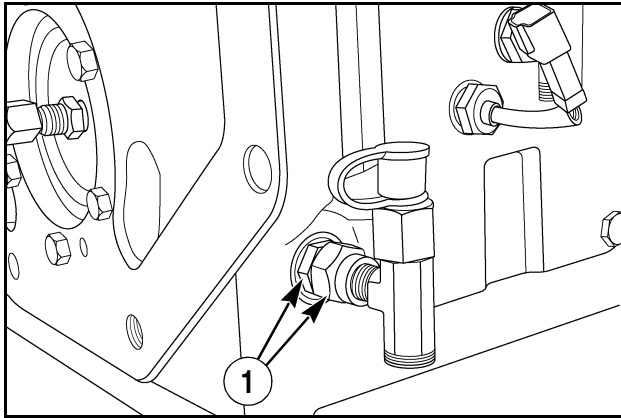
## STEP 262



16S35

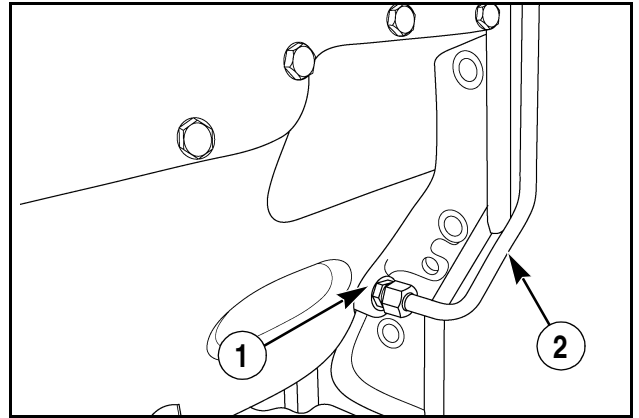
Install a new O-ring on each end of the jumper tube, lubricate with petroleum jelly and install. Repeat for the opposite side.

### STEP 263



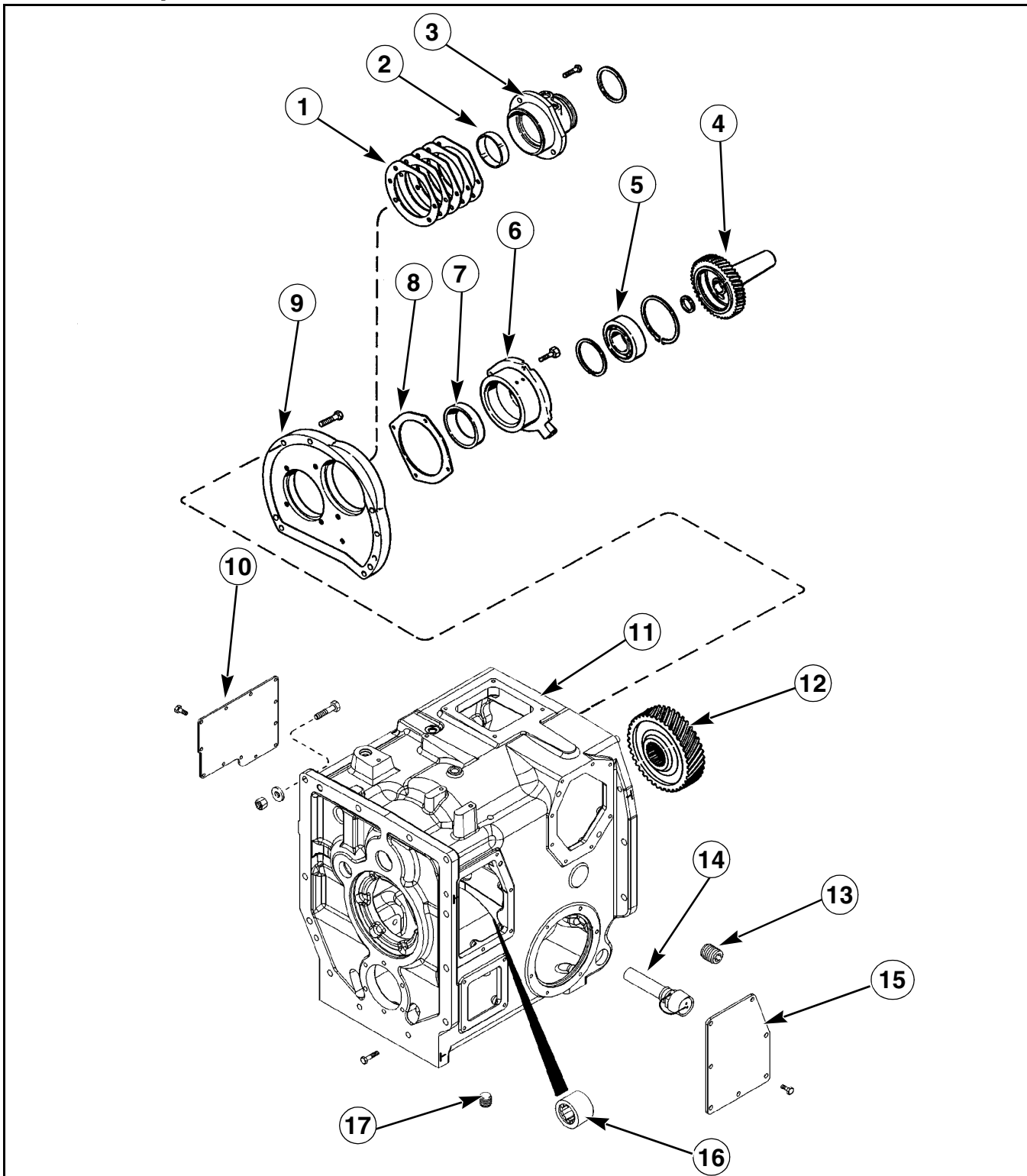
1. Install the emergency brake release supply fittings (1).
2. Attach a portable hydraulic hand pump to the fitting and pressurize to 350 PSI (2413 kPa). Brake should be released and pressure should hold at or near the original pressurization. If pressure does not hold, there is excessive leakage at the seals and will have to be replaced.

### STEP 264



1. Install the FWD fitting (1). DO NOT install the FWD supply tube (2) at this time.
2. Attach a portable hydraulic hand pump to the fitting and pressurize to 350 PSI (24.1 Bar) (2413 kPa). Because of design, there will be some leakage in the FWD clutch pack (pressure will not hold). If there is excessive leakage, (cannot pump up pressure to 350 PSI (2413 kPa), the shaft, piston and or hub seals may be damaged and will have to be replaced.
3. Install the FWD supply tube (2).

# Exploded View of the Range Transmission Countershaft, Input Shaft, and FWD Input Shaft

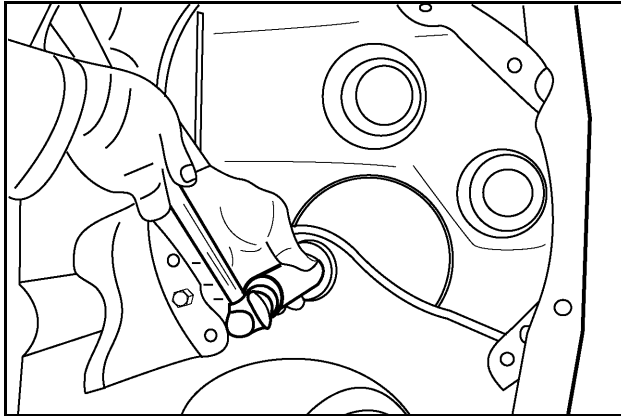


29L94R

- |                              |                                     |                    |
|------------------------------|-------------------------------------|--------------------|
| 1. SHIMS                     | 7. FRONT BEARING CUP                | 13. PLUG           |
| 2. FRONT BEARING CUP         | 8. SHIM                             | 14. HEATER         |
| 3. INPUT SHAFT BEARING CAGE  | 9. FRONT BEARING SUPPORT COVER      | 15. COVER          |
| 4. HYDRAULIC PUMP DRIVE GEAR | 10. COVER                           | 16. NEEDLE BEARING |
| 5. ROLLER BEARING            | 11. RANGE TRANSMISSION HOUSING      | 17. PLUG           |
| 6. COUNTERSHAFT BEARING CAGE | 12. BEVEL PINION CONSTANT MESH GEAR |                    |

## Installing the Range Transmission Countershaft, Input Shaft, and FWD Input Shaft into the Range Transmission Housing

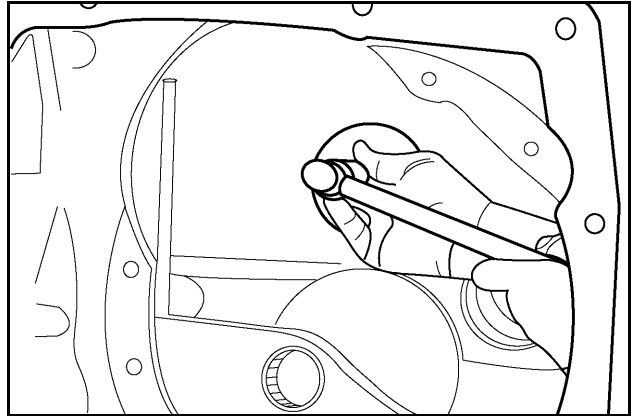
### STEP 265



T95671

Drive the bearing cage for the bevel pinion shaft out of the range transmission housing, if required. Drive a new bearing cage into the bore. The bearing cage must be centered in the bore.

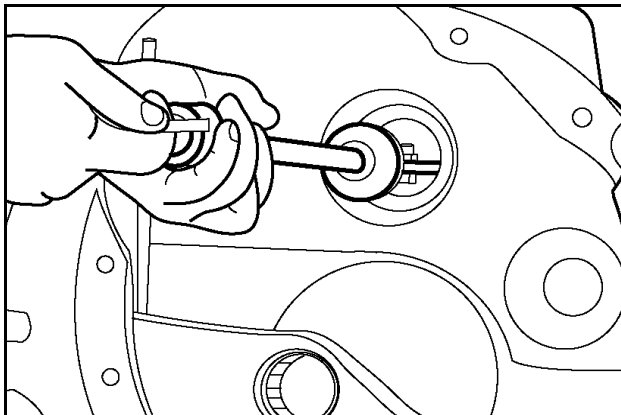
### STEP 267



T95673

Drive new bearing cups into the bores until the cups are seated against the housing shoulder.

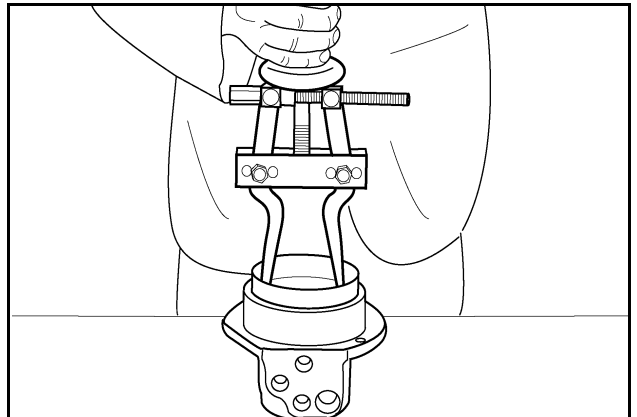
### STEP 266



T95672

Use a puller to remove the rear bearing cups from the range transmission housing.

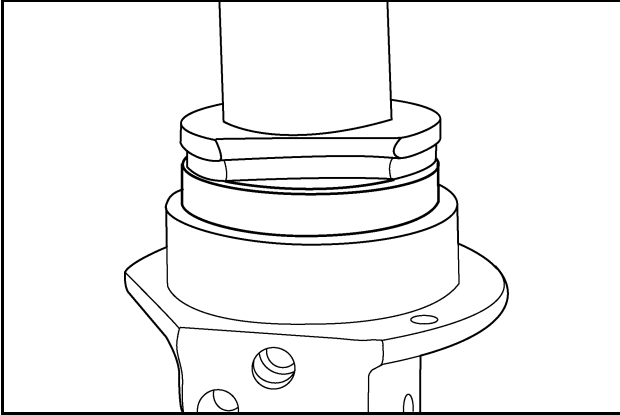
### STEP 268



40S10

Use a puller to remove the bearing cup from the range transmission input shaft bearing cage.

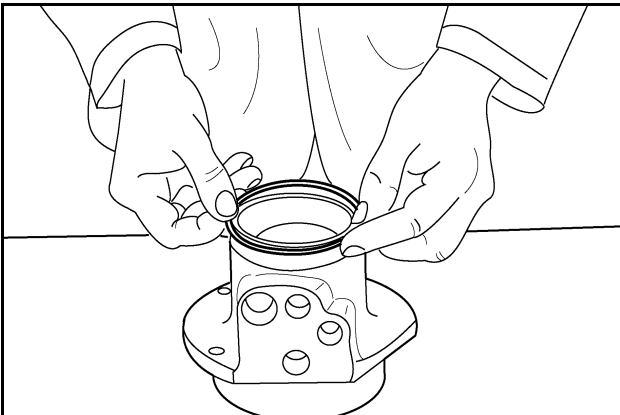
### STEP 269



41S19

Press a new cup into the bore of the input shaft bearing cage until the cup seats against the cage shoulder.

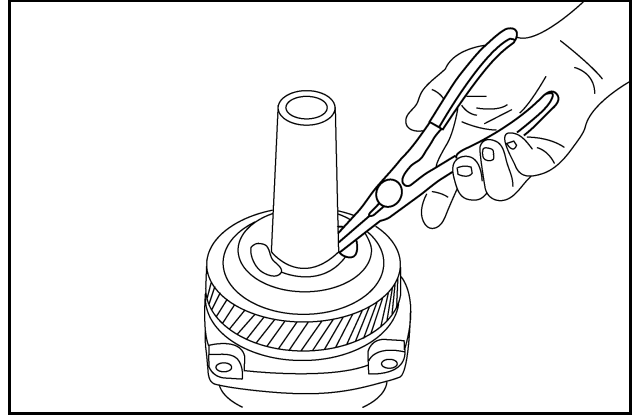
### STEP 270



40S13

Install a new seal ring on the input shaft bearing cage.

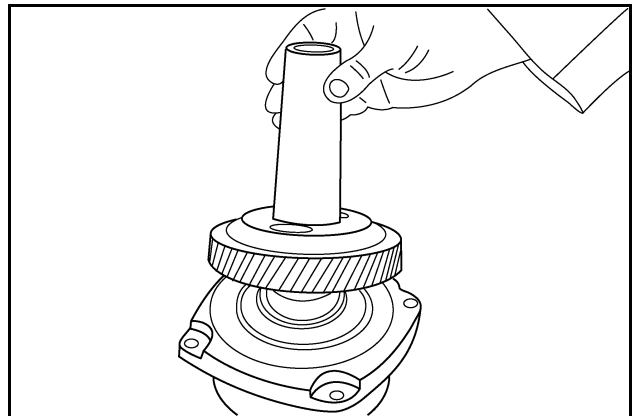
### STEP 271



T95883R

Install a snap ring pliers through the opening in the hydraulic pump drive gear which is installed on top of the range transmission countershaft bearing cage. Move the snap ring out of the groove that is in the bearing cage.

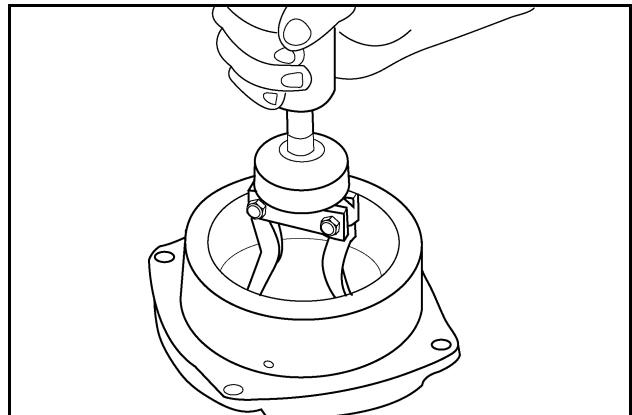
### STEP 272



T95884R

Remove the hydraulic pump drive gear.

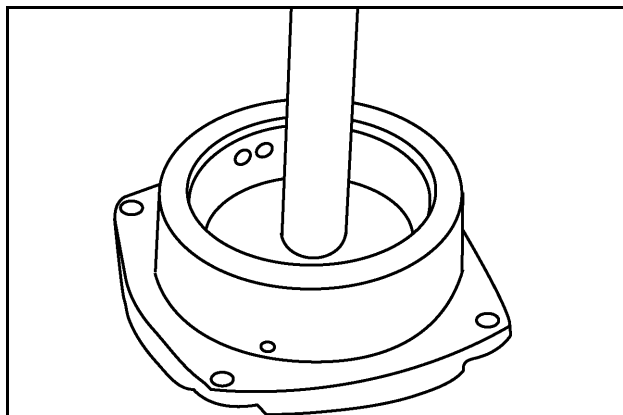
### STEP 273



T95885R

Use a puller to remove the bearing cup from the range transmission countershaft bearing cage.

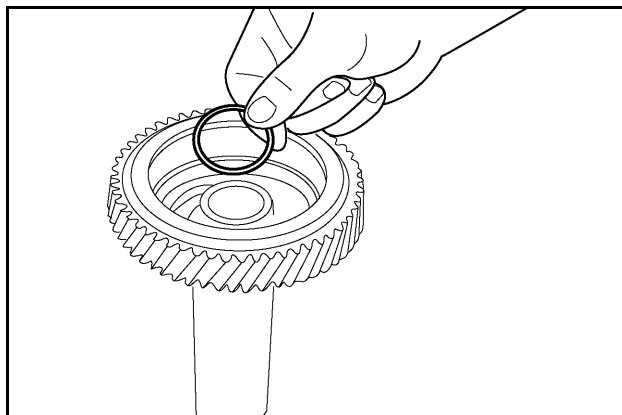
### STEP 274



T95886R

Press a new bearing cup into the bearing cage until the bearing seats against the cage shoulder.

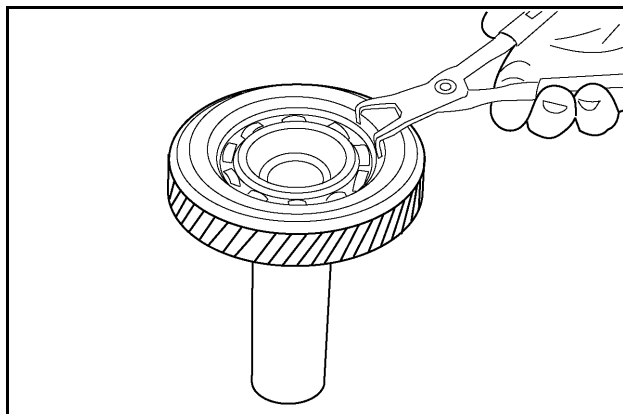
### STEP 277



T95889

Install a new seal ring inside the gear.

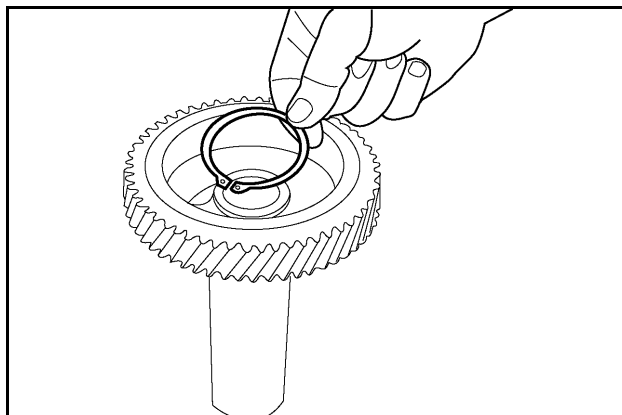
### STEP 275



T95887

Remove the snap ring from inside the hydraulic pump drive gear.

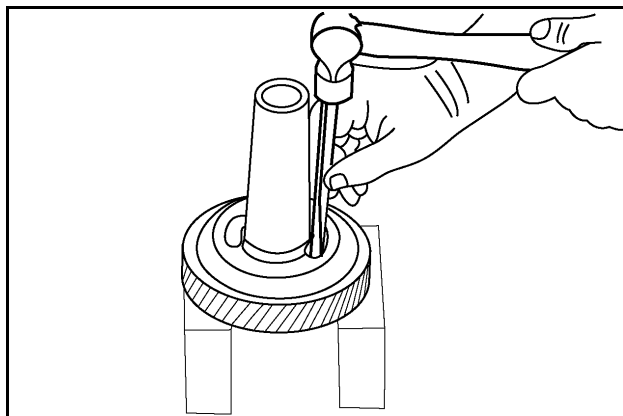
### STEP 278



T95890

Install the gear retaining snap ring inside the gear and over the hub. The flat side of the snap ring must be facing down.

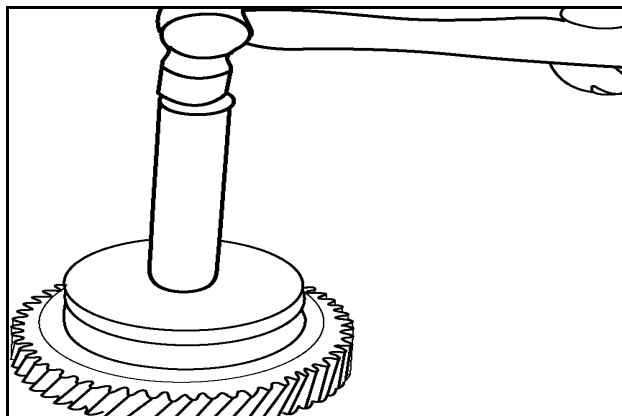
### STEP 276



T95888

Drive the roller bearing out of the gear. The gear retaining snap ring from Step 217 will come out with the roller bearing.

### STEP 279

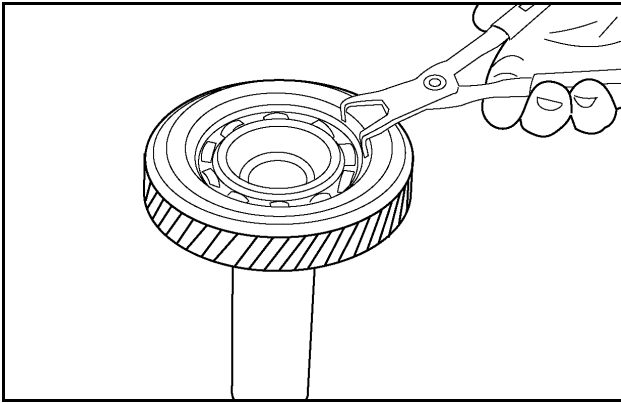


T95891R

Press a new ball bearing inside the gear until the roller bearing seats against the gear housing.



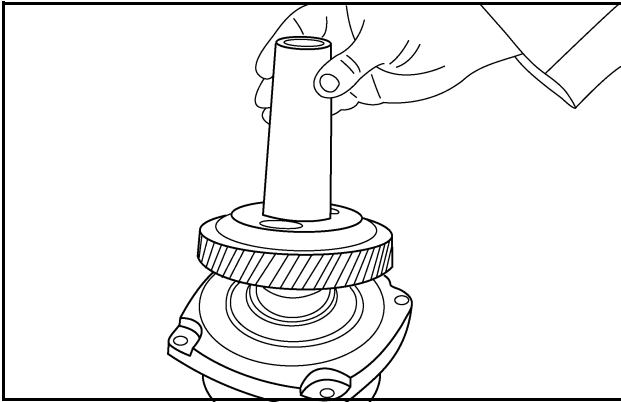
### STEP 280



T95887

Install the bearing snap ring.

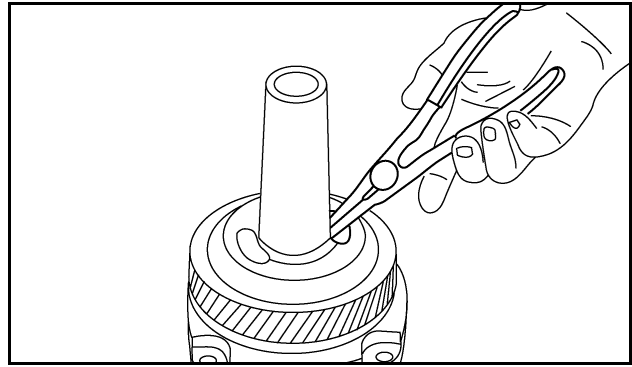
### STEP 281



T95884R

Install the gear on the countershaft bearing cage.

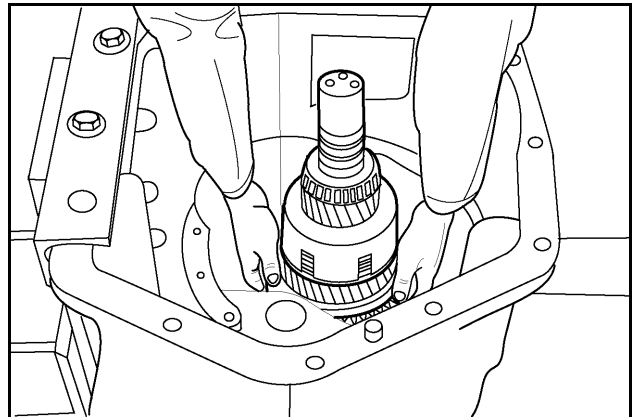
### STEP 282



T95883R

Reach through the opening in the gear and install the snap ring into the groove in the bearing cage.

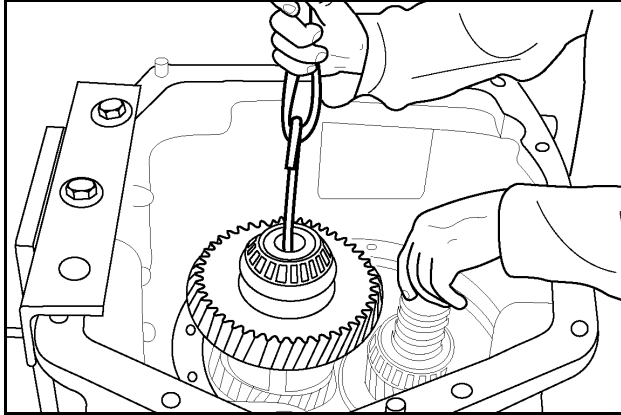
**NOTE:** Make sure that the alignment pin located at the end of the output shaft mounting flange is aligned with the alignment hole as shown in the following step.



A22321

Apply petroleum jelly to the seal ring on the rear end of the range transmission input shaft. Install the range transmission input shaft into the housing. Make sure that the rear bearing cone is resting in the bearing cup.

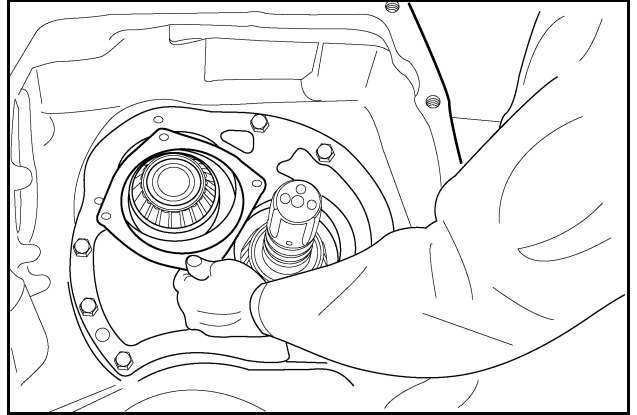
### STEP 283



A22319

Tilt the range input shaft over to the side and install the range transmission countershaft.

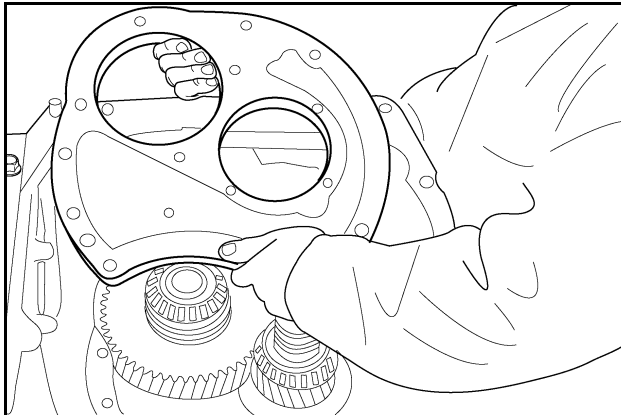
### STEP 286



16S21

Place the original shims over the end of the range transmission countershaft.

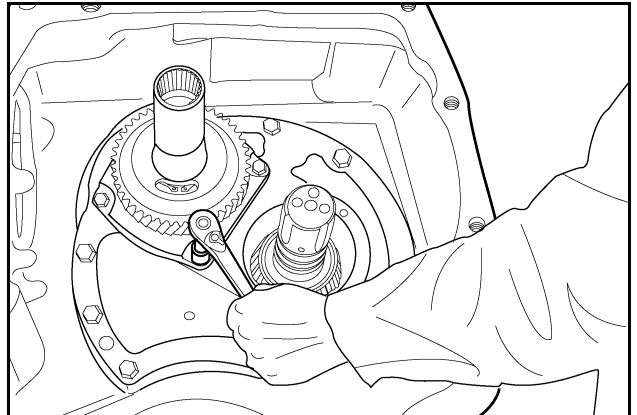
### STEP 284



16S27

Apply petroleum jelly to the seal rings on the countershaft low range driven gear. Install the front bearing support cover. Tap the support cover down over the dowel pins in the range housing.

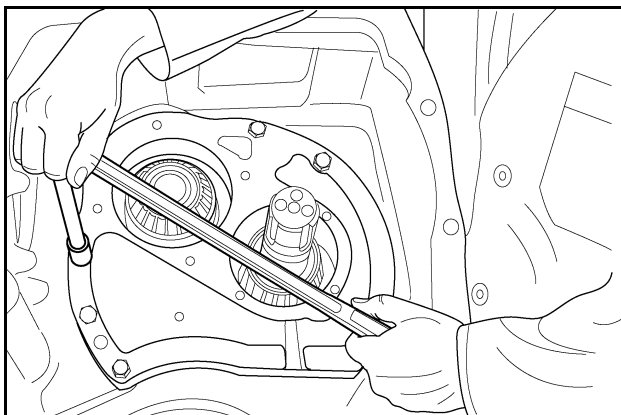
### STEP 287



16S17

Install the countershaft front bearing cage. Install the mounting bolts to a torque of 54 to 61 Nm (40 to 45 lb. ft.).

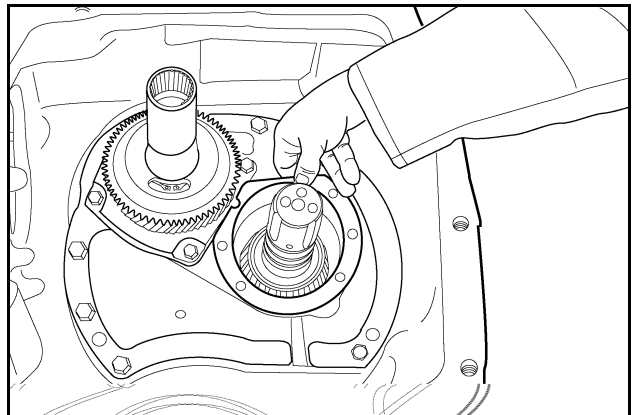
### STEP 285



16S24

Install and tighten the support cover bolts to a torque of 90 to 107 Nm (66 to 79 lb. ft.).

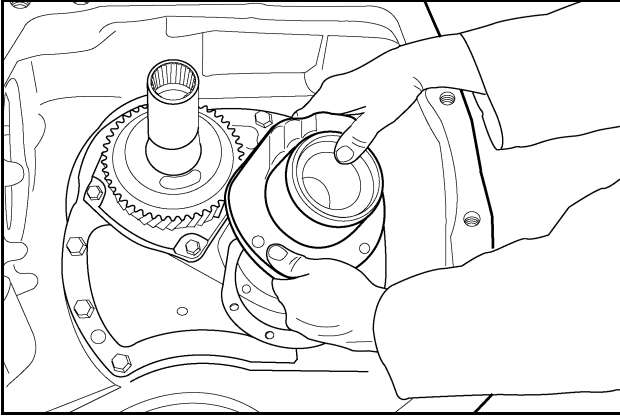
### STEP 288



16S12

Apply petroleum jelly to the four seal rings on the front end of the input shaft. Place the original shims over the range input shaft.

**STEP 289**



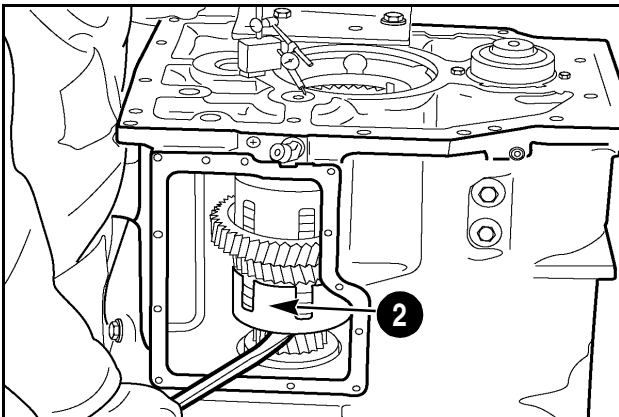
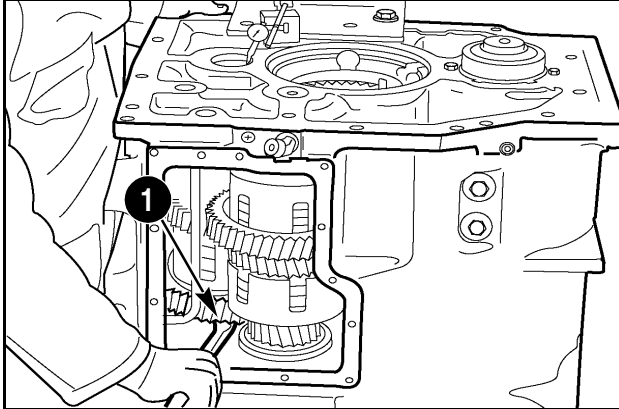
16S9

Install the range input shaft front bearing cage. Install the mounting bolts to a torque of 54 to 61 Nm (40 to 45 lb. ft.).

## SETTING THE END PLAY OF THE RANGE TRANSMISSION COUNTERSHAFT AND INPUT SHAFT

### STEP 290

The end play of each shaft must be checked if any of the following parts were replaced: shaft, front bearing cage, bearing cones and cups, or front bearing support cover.



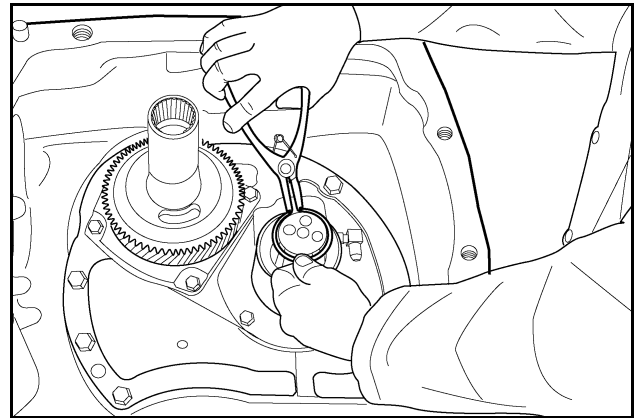
Rotate the shaft a minimum of 12 revolutions. Use a dial indicator to measure the end play. Use a prybar inside the range transmission housing to lift a gear on the shaft. The end play must be 0.025 to 0.127 mm (0.001 to 0.005 inches) for the input shaft (2) and 0.013 to 0.102 mm (0.0005 to 0.004 inches) for the countershaft (1).

If the end play is not within 0.025 to 0.127 mm (0.001 to 0.005 inches) for the input shaft, add or remove shims to get a correct reading.

If the end play for the countershaft is not within 0.013 to 0.102 mm (0.0005 to 0.004 inches), add or remove shims to get a correct reading.

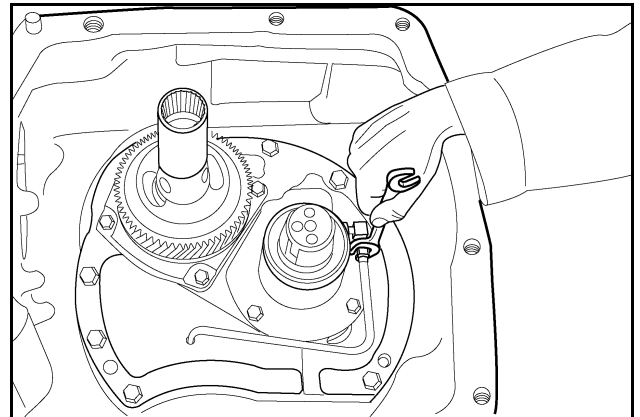
**NOTE:** Check one shaft at a time.

### STEP 291



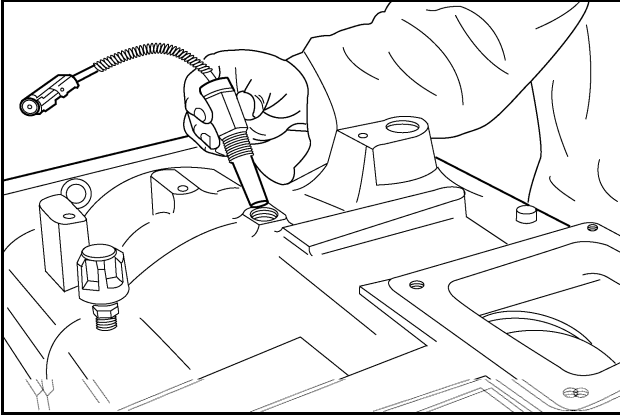
Install the snap ring on the input shaft that positions the master clutch.

### STEP 292



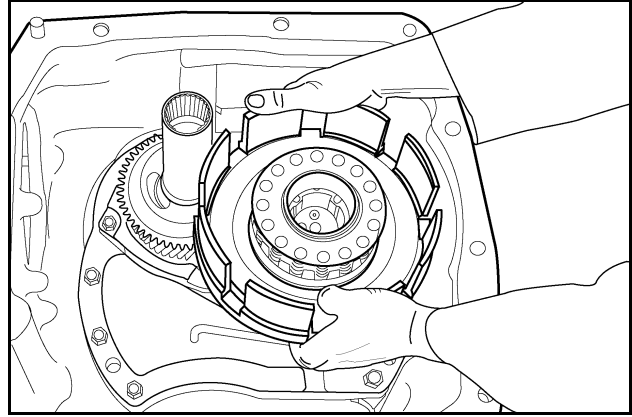
Install the lubrication tube to the input shaft bearing cage.

### STEP 293



Install a new O-ring onto the transmission speed sensor and install the sensor into the top of the range housing.

### STEP 294

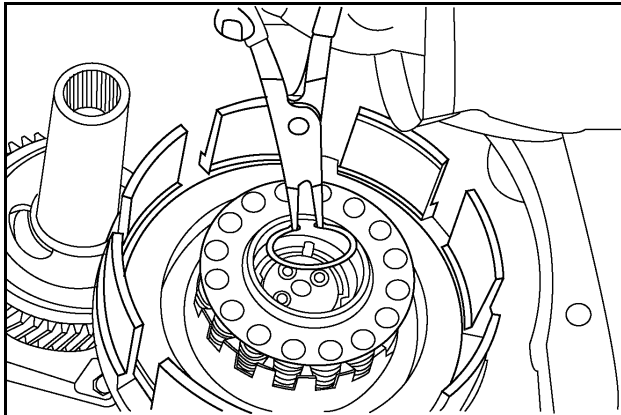


Apply petroleum jelly to the seal ring on the input shaft front bearing cage. Align the master clutch fill hole with the range transmission input shaft fill hole. Align the marks made before removal in Step 8. Install the master clutch on the range transmission input shaft.

**NOTE:** *The master clutch carrier assembly must be indexed correctly on the input shaft.*

## Installing the Range Input Master Clutch

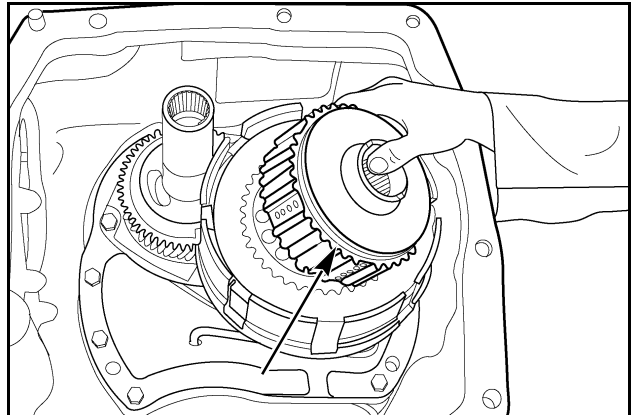
### STEP 295



A22306

Install the snap ring that fastens the master clutch assembly to the input shaft. Align the clutch to the input shaft according to the mark made in Step 8.

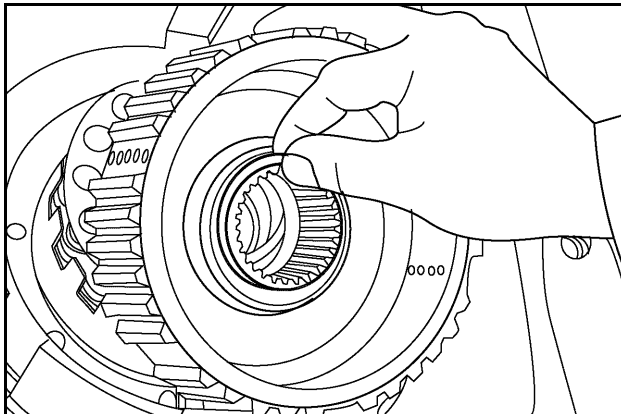
### STEP 297



15S24

Install new seal on the outside of the hub. Lubricate the seal ring with petroleum jelly. Install the hub assembly onto the master clutch carrier.

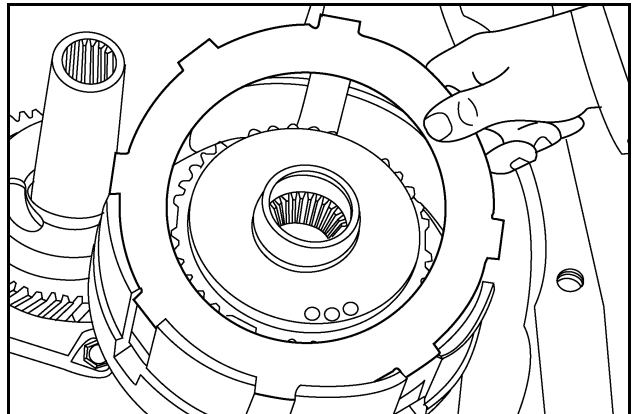
### STEP 296



A22302

Install a new seal ring into the hub assembly. Lubricate the seal ring with petroleum jelly.

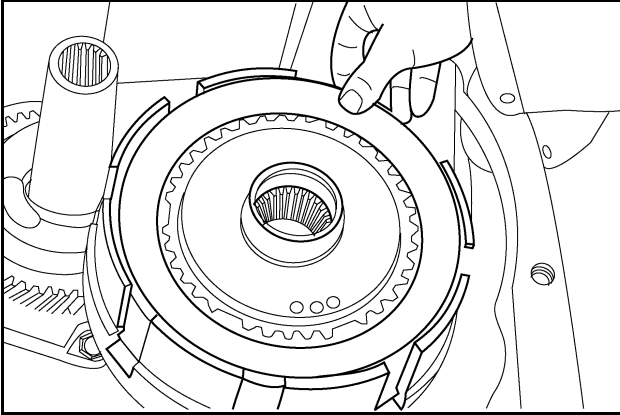
### STEP 298



A22304CR

Install a separator plate into the master clutch.

### STEP 299

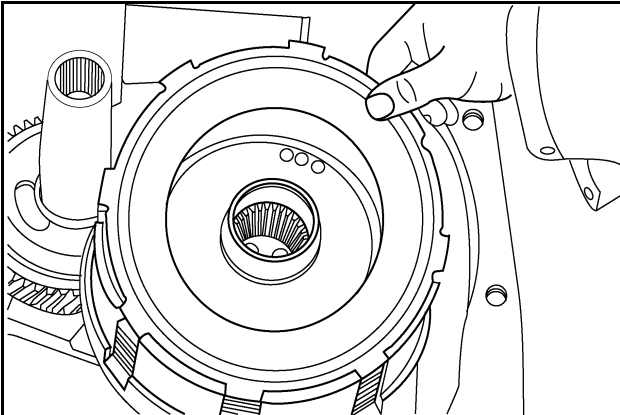


A22305CR

Install a new friction plate into the master clutch. Install the remaining eight separator plates and eight friction plates, alternating the plates.

**NOTE:** Dip all friction plates in clean transmission fluid before installation.

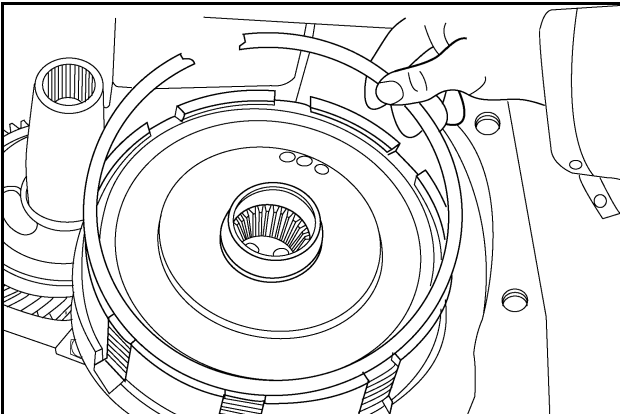
### STEP 300



A22298CR

Install the clutch backing plate.

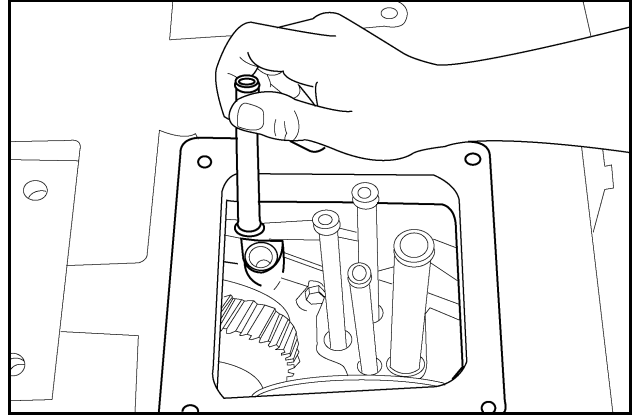
### STEP 301



A22297CR

Install the snap ring into the master clutch carrier.

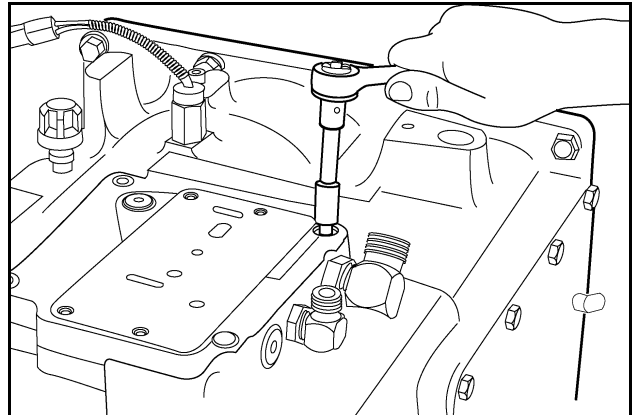
### STEP 302



12S15

Install new O-ring on the feeder tubes and lubricate with petroleum jelly. Install the feeder tubes.

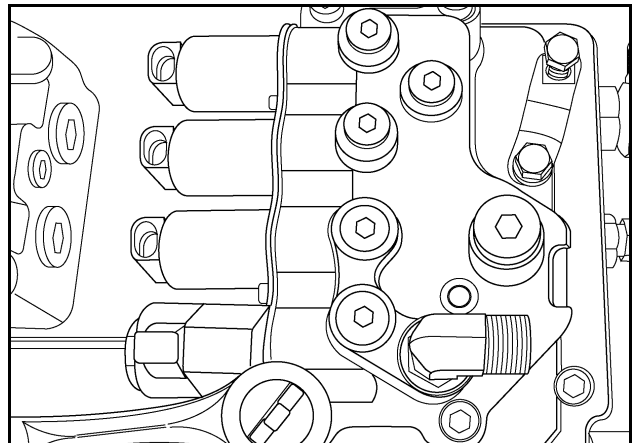
### STEP 303



12S9CUR4

Install a new gasket and install the range shift valve adapter plate.

### STEP 304



RD05K015

Install a new gasket and install the range shift valve.

# **Section 21**

## **Chapter 7**

### **TRANSMISSION CONTROL VALVES AND INCHING VALVE**



## TABLE OF CONTENTS

SPECIAL TORQUES .....	21-7-3
POWERSHIFT TRANSMISSION CONTROL VALVES .....	21-7-3
TRANSMISSION CONTROL VALVE CONFIGURATION .....	21-7-4
INCHING VALVE .....	21-7-15

## SPECIAL TORQUES

### Transmission Control Valves

Plug, M18 .....	19 to 25 Nm (14 to 18 lb. ft.)
Plug, M27 .....	34 to 54 Nm (25 to 40 lb. ft.)
Pressure Sensor .....	19 to 25 Nm (14 to 18 lb. ft.)
Solenoid Cartridge .....	19 to 25 Nm (14 to 18 lb. ft.)
Solenoid Nut .....	5.5 to 8 Nm (4 to 6 lb. ft.)

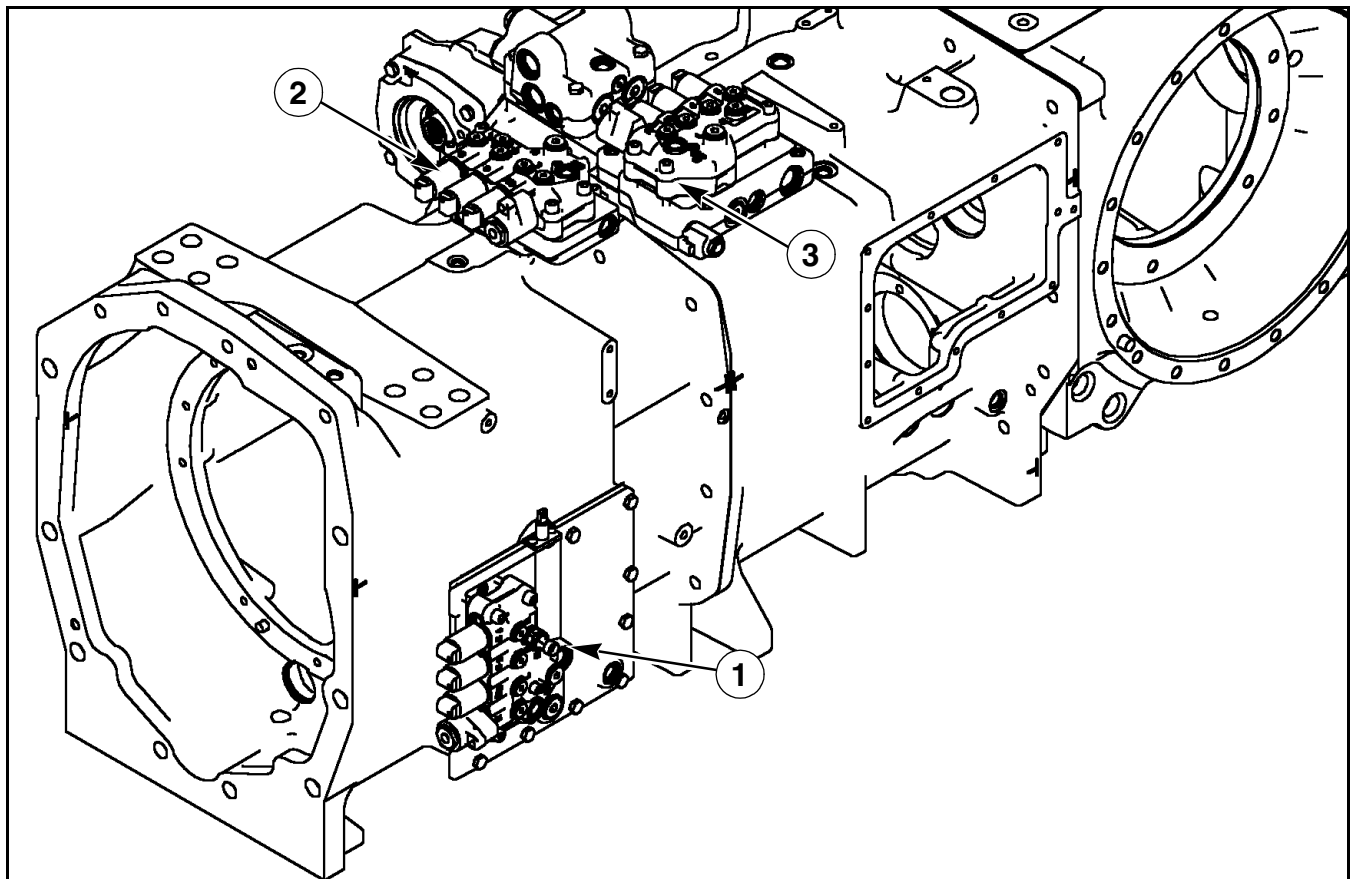
### Inching Valve

Hex Head Mounting Bolt .....	50 to 60 Nm (37 to 14 lb. ft.)
Plugs .....	34 to 54 Nm (25 to 40 lb. ft.)
Solenoid Cartridge .....	12 to 18 Nm (9 to 13 lb. ft.)
Solenoid Nut.....	5 to 8 Nm (4 to 6 lb. ft.)

## POWERSHIFT TRANSMISSION CONTROL VALVES

There is one basic transmission control valve that can be configured for three different applications: Speed Transmission Control Valve (1), Odd-Even Transmission Control Valve (2), and Range Transmission Control Valve (3). The function of this basic valves is determined by its location on the transmission, how it is connected hydraulically and number of solenoids.

The odd-even and range valve can be removed after raising the cab. See the Cab Raise/Removal and Installation Section in this Repair Manual for information. The speed valve can be removed without removing the fuel tank, but if equipped with the large tank, removing the fuel tank will make access easier. See the Fuel Tank Section in this Repair Manual for procedure.



1. SPEED TRANSMISSION CONTROL VALVE  
2. ODD-EVEN TRANSMISSION CONTROL VALVE

3. RANGE TRANSMISSION CONTROL VALVE

RD98D001

## TRANSMISSION CONTROL VALVE CONFIGURATION

This chart matches transmission valve configuration with tractor options controlled by those valves (Figures 1 through 6).

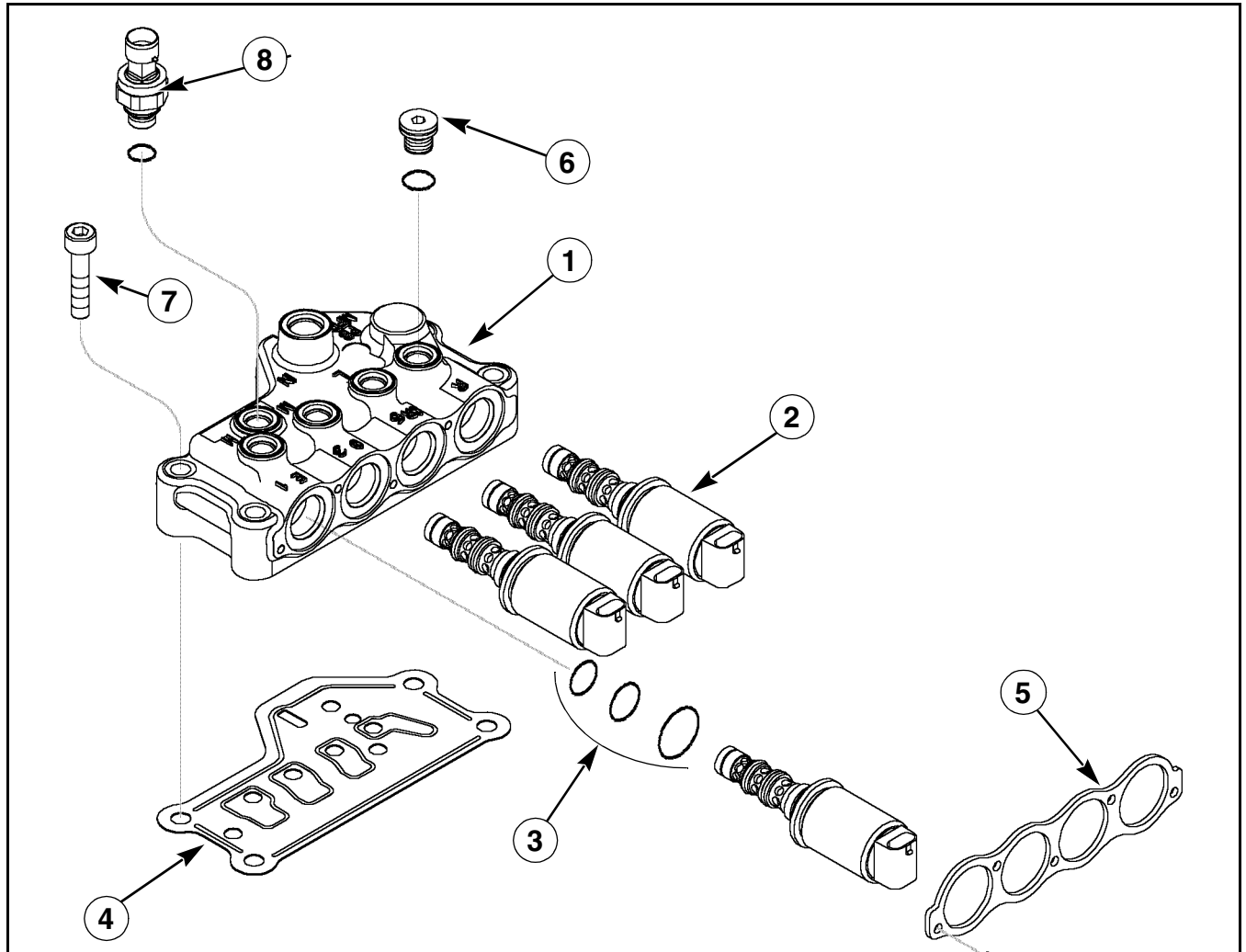
<u>TRANSMISSION OPTIONS</u>	<u>SPEED TRANSMISSION CONTROL VALVE</u>	<u>ODD-EVEN TRANSMISSION CONTROL VALVE</u>	<u>RANGE TRANSMISSION CONTROL VALVE</u>
NAO WITHOUT FWD/WITHOUT CREEP	FIGURE 1	FIGURE 4	FIGURE 3
NAO WITHOUT FWD/WITH CREEP	FIGURE 1	FIGURE 2	FIGURE 3
NAO WITH FWD/WITHOUT CREEP	FIGURE 1	FIGURE 4	FIGURE 2
NAO WITH FWD/WITH CREEP	FIGURE 1	FIGURE 2	FIGURE 2
EURO WITH FWD/WITHOUT CREEP	FIGURE 1	FIGURE 5	FIGURE 2
EURO WITH FWD/WITH CREEP	FIGURE 1	FIGURE 6	FIGURE 2

**NOTE:** Before removing any components, thoroughly clean the valve body and the area on the transmission housing adjacent to the valve body to eliminate any contamination.

## Figure 1 - Transmission Control Valve with Four Solenoids

This type of control valve is used with these transmission configurations:

- Speed control valve for all tractor configurations.



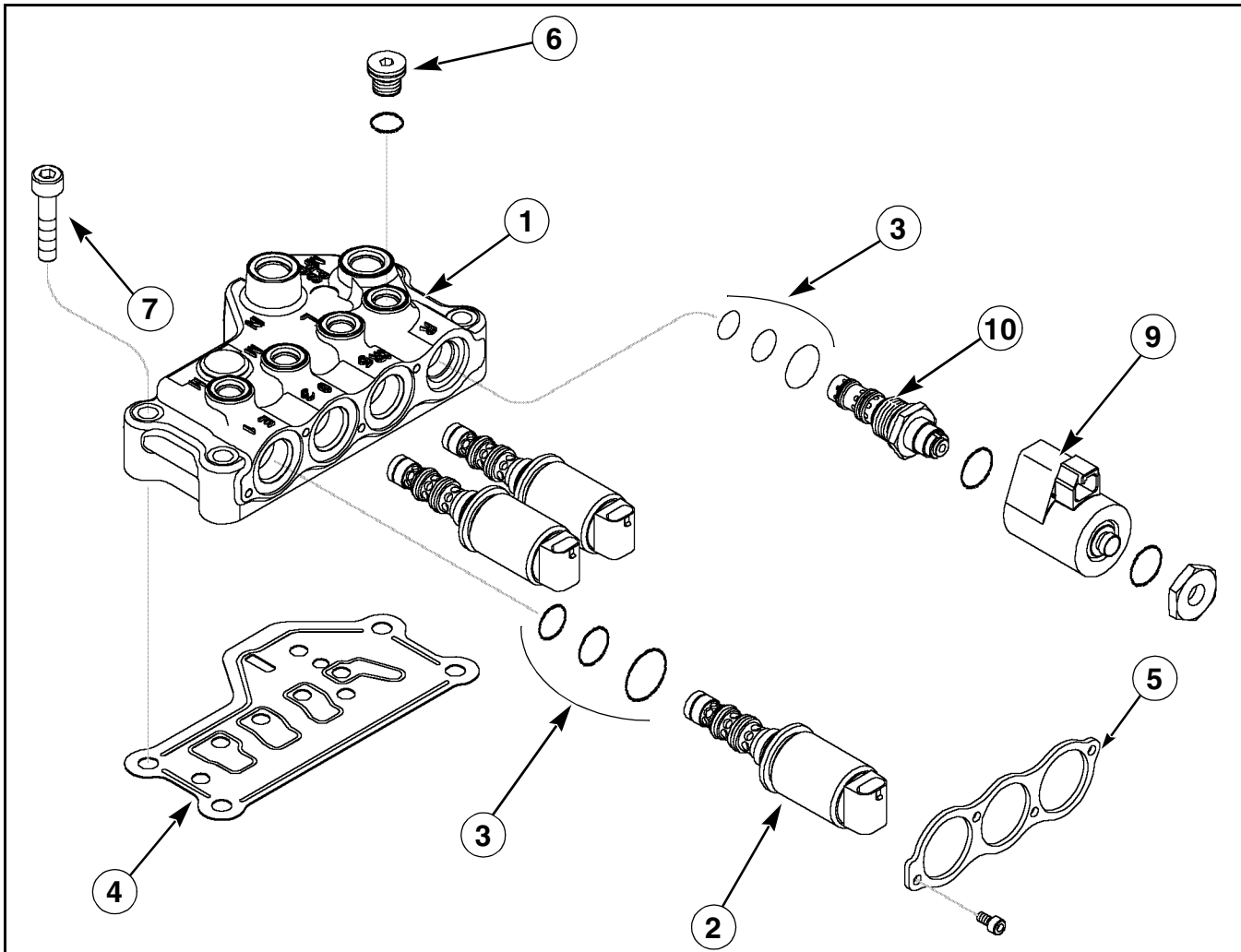
RI02E100

- |                 |                                       |
|-----------------|---------------------------------------|
| 1. VALVE BODY   | 5. COVER PLATE                        |
| 2. PWM SOLENOID | 6. PLUG                               |
| 3. O-RINGS      | 7. MOUNTING BOLT                      |
| 4. GASKET       | 8. PRESSURE SENSOR (SPEED VALVE ONLY) |

## Figure 2 - Transmission Control Valve with Four Solenoids

This type of control valve is used with these transmission configurations:

- Range control valve with FWD.
- Odd - Even control valve with NA park and creep.



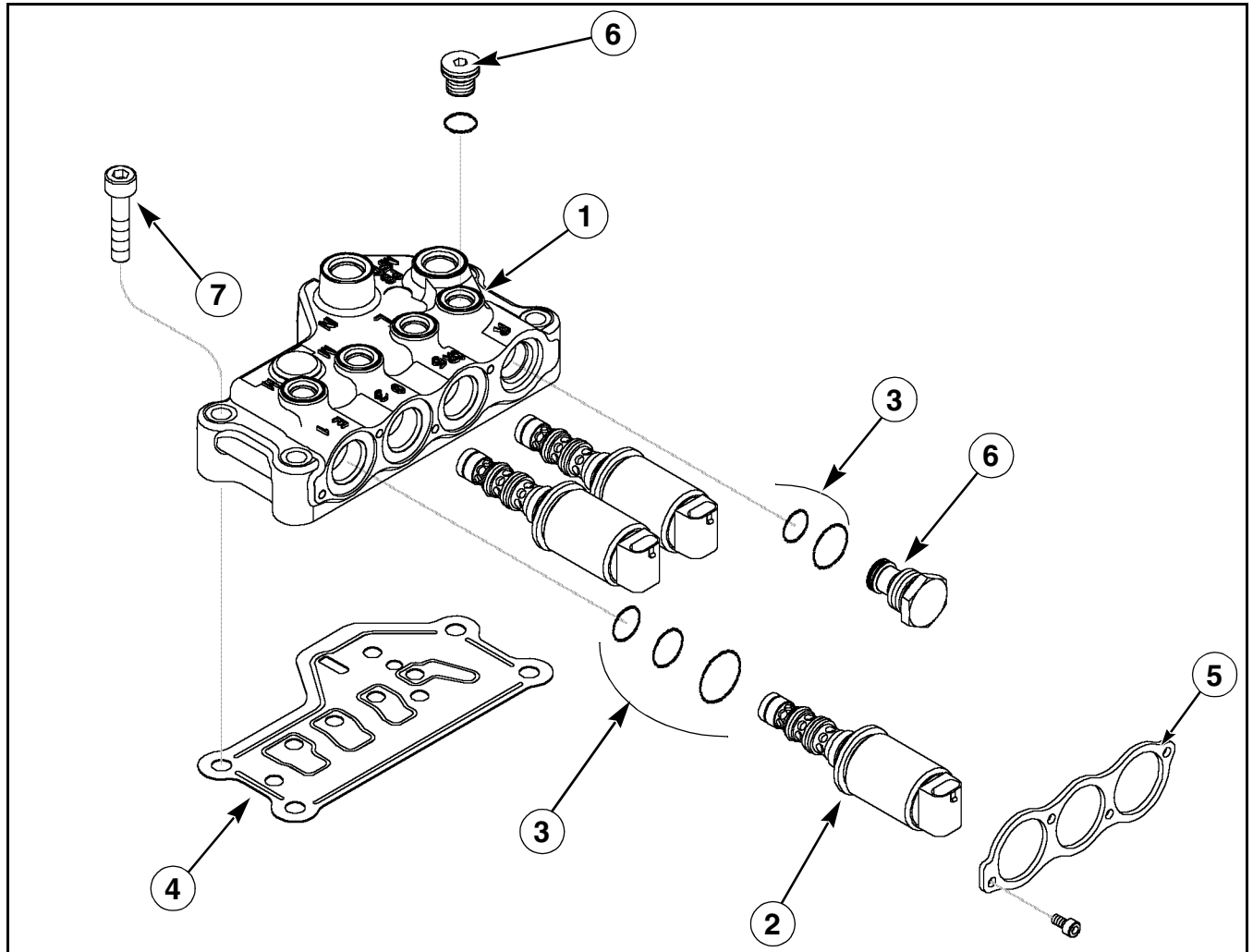
RI02E099

- |                 |                       |
|-----------------|-----------------------|
| 1. VALVE BODY   | 6. PLUG               |
| 2. PWM SOLENOID | 7. MOUNTING BOLT      |
| 3. O-RINGS      | 8. SOLENOID           |
| 4. GASKET       | 9. SOLENOID CARTRIDGE |
| 5. COVER PLATE  |                       |

**Figure 3 - Transmission Control Valve with Three Solenoids and Plug**

This type of control valve is used with these transmission configurations:

- Range control valve without FWD.



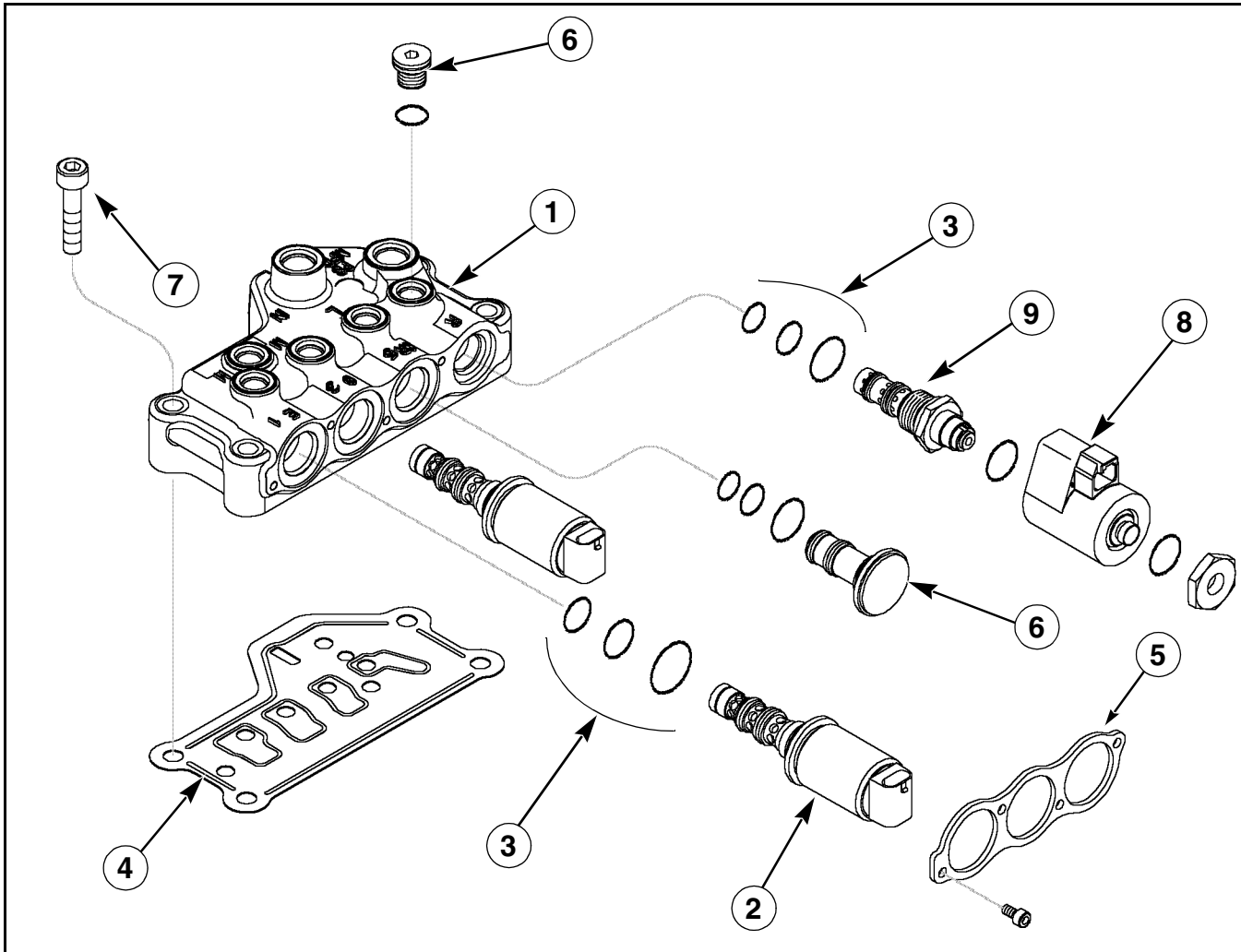
R102E096

- |                 |                  |
|-----------------|------------------|
| 1. VALVE BODY   | 5. COVER PLATE   |
| 2. PWM SOLENOID | 6. PLUG          |
| 3. O-RINGS      | 7. MOUNTING BOLT |
| 4. GASKET       |                  |

**Figure 4 - Transmission Control Valve with Three Solenoids and Plug**

This type of control valve is used with these transmission configurations:

- Odd-even control valve with NA park without creep.



RI02E097

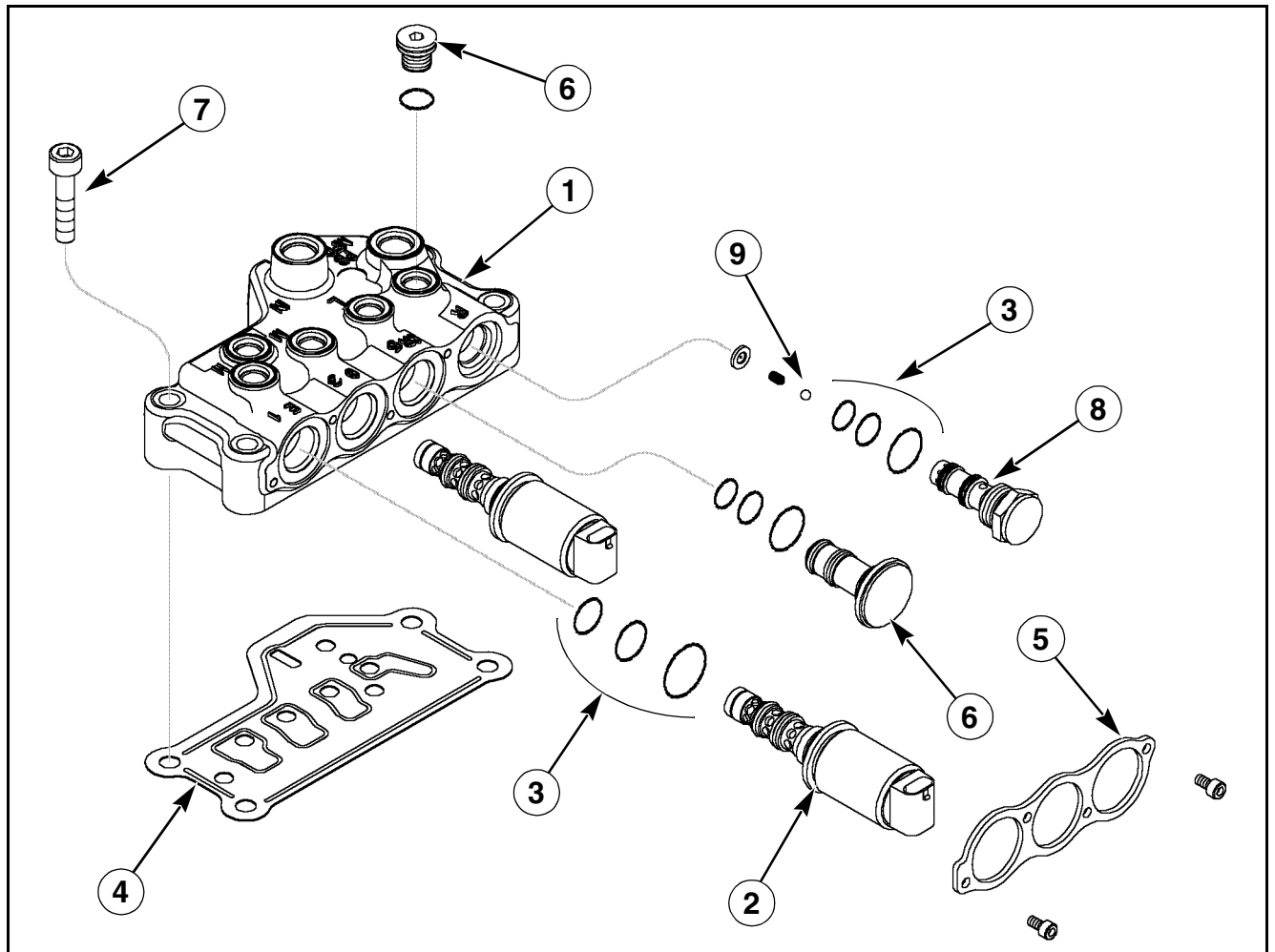
1. VALVE BODY
2. PWM SOLENOID
3. O-RINGS
4. GASKET
5. COVER PLATE

6. PLUG
7. MOUNTING BOLT
8. SOLENOID
9. SOLENOID CARTRIDGE

**Figure 5 - Transmission Control Valve with Two Solenoids, Check Valve and Plug**

This type of control valve is used with this transmission configuration:

- Odd-even control valve with Euro park without creep.



1. VALVE BODY
2. PWM SOLENOID
3. O-RINGS
4. GASKET
5. COVER PLATE

6. PLUG
7. MOUNTING BOLT
8. CHECK VALVE
9. BALL

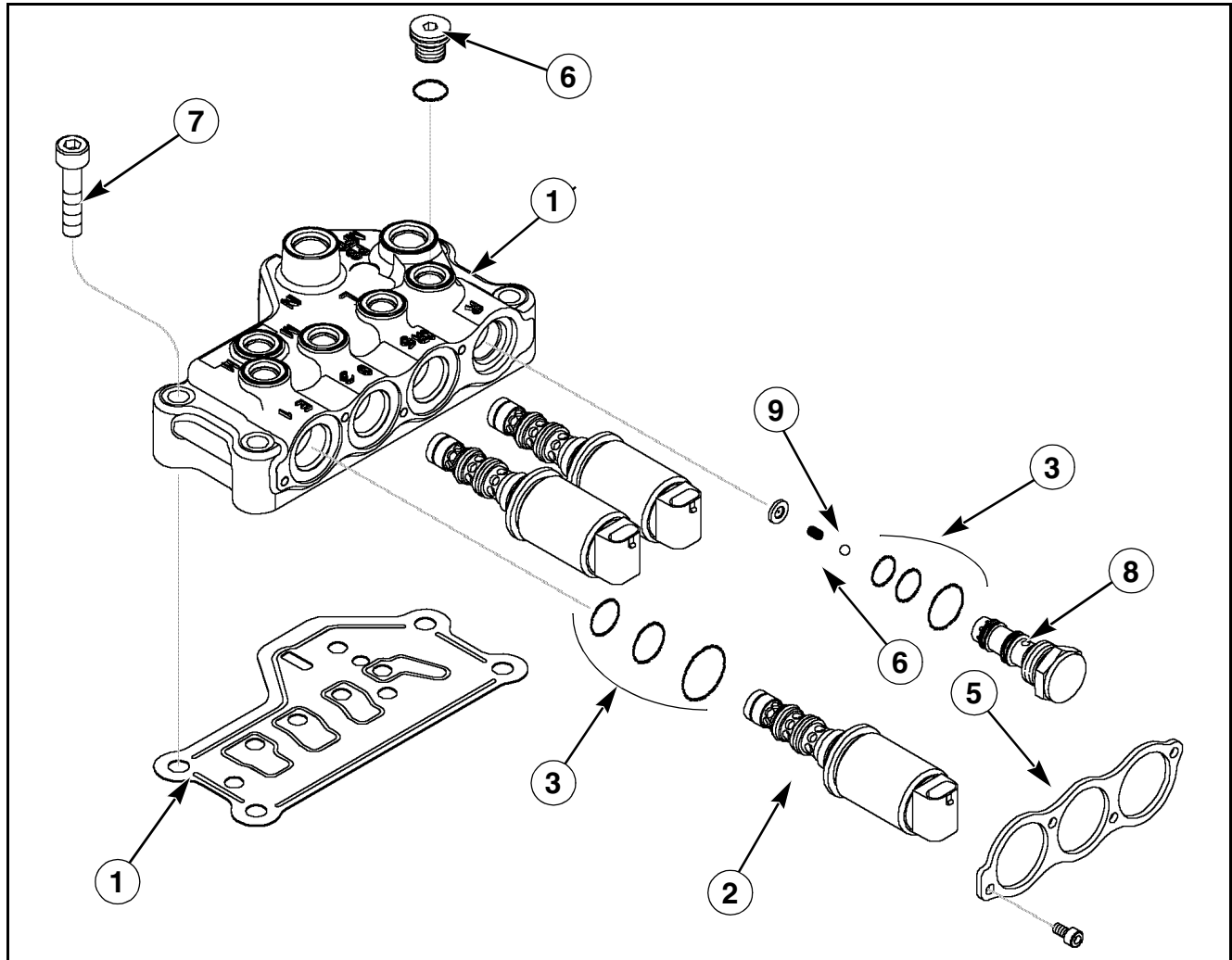
RI02E095



**Figure 6 - Transmission Control Valve with Three Solenoids and Check Valve**

This type of control valve is used with this transmission configuration:

- Odd-even control valve with Euro park with creep.



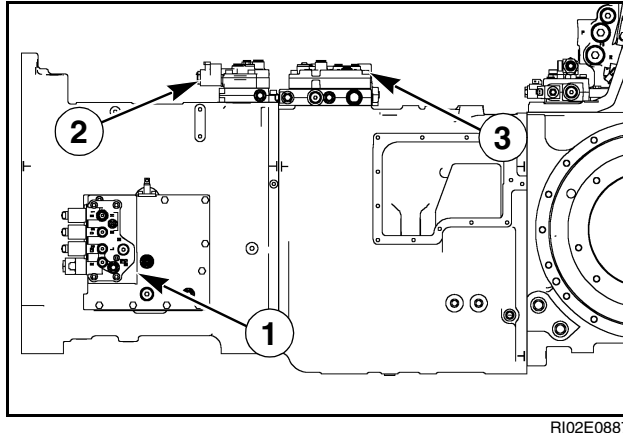
RI02E098

- |                 |                  |
|-----------------|------------------|
| 1. VALVE BODY   | 6. PLUG          |
| 2. PWM SOLENOID | 7. MOUNTING BOLT |
| 3. O-RINGS      | 8. CHECK VALVE   |
| 4. GASKET       | 9. BALL          |
| 5. COVER PLATE  |                  |

## Valve Removal

**NOTE:** Before removing any components, thoroughly clean the valve body and the area on the transmission housing adjacent to the valve body to eliminate any contamination.

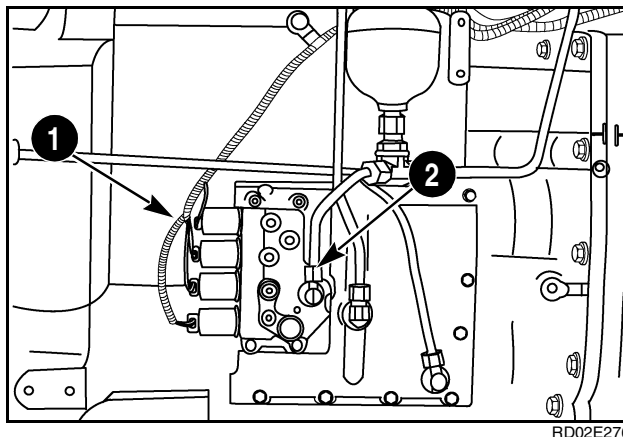
### STEP 1



1. SPEED TRANSMISSION CONTROL VALVE
2. ODD-EVEN TRANSMISSION CONTROL VALVE
3. RANGE TRANSMISSION CONTROL VALVE

To gain access to the speed transmission control valve, remove the fuel tank. See the Fuel Tank section of this manual for procedure. For access to the odd-even and range transmission control valves, raise or remove the cab. See the Cab Raise/Removal and Installation Section of this Repair Manual for procedure.

### STEP 2

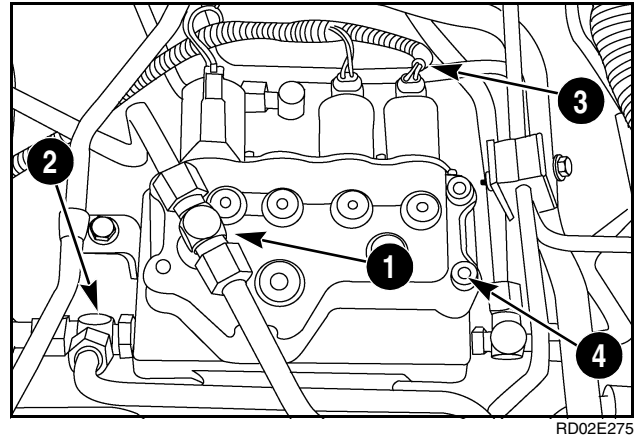


Remove speed transmission control valve as follows:

1. Tag the wire harness connectors to the solenoids and pressure sensor (1) and disconnect.
2. Remove the valve supply tube (2).

3. Remove the valve retaining bolts, valve body, and gasket. Discard the gasket.

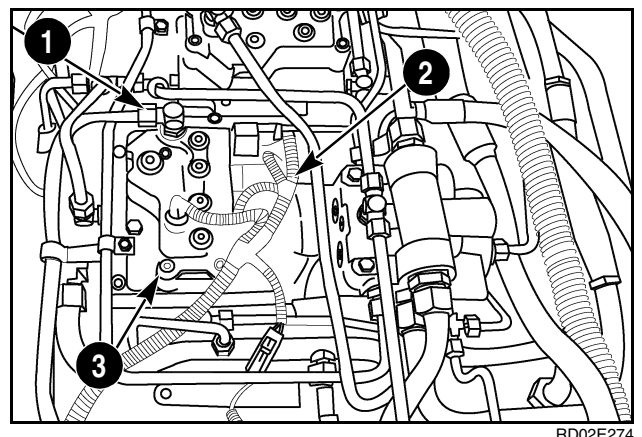
### STEP 3



Remove the odd-even transmission control valve as follows:

1. Tag and disconnect the park lock and if equipped, the FWD tubes (1). Tag and disconnect the regulated pressure tubes (2).
2. Tag and disconnect the solenoid wires (3).
3. Remove the mounting bolts (4) and remove the valve and gasket. Discard the gasket.

### STEP 4



Remove the range transmission control valve as follows:

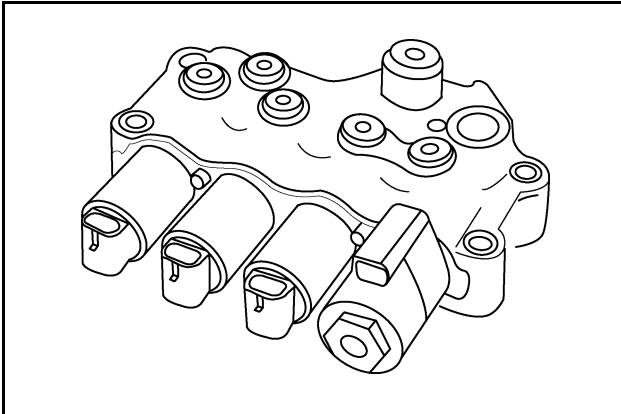
1. Tag and remove the regulated supply tube (1).
2. Tag and disconnect the wire harness from the solenoid (2).
3. Remove the mounting bolts (3), valve body, and gasket. Discard the gasket.

## Disassembly

**NOTE:** Disassembly of range valve shown. Other valves are similar.

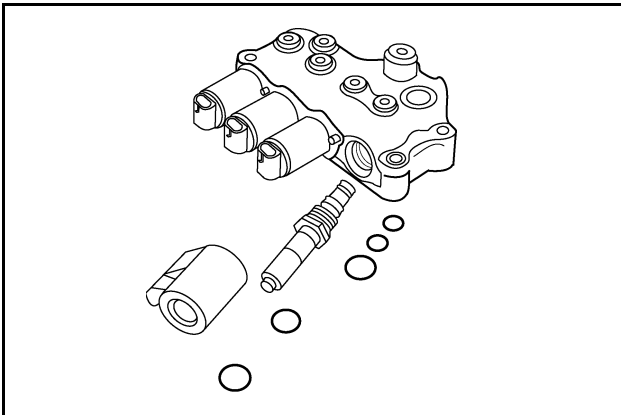
**NOTE:** Only the speed control valve is equipped with a pressure sensor. See Figure 1 - Transmission Control Valve with Four Solenoids for pressure sensor location.

### STEP 5



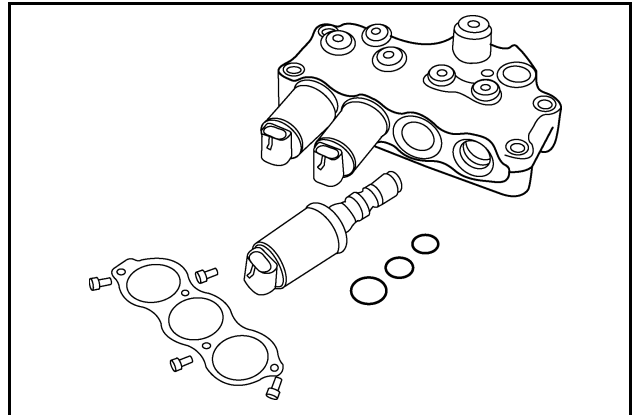
Place the valve on a clean surface.

### STEP 6



Remove the park lock solenoid nut and coil and cartridge. Remove and discard the O-rings.

### STEP 7



Remove the solenoid cover plate. Remove the solenoid assembly and discard the O-rings.

### STEP 8

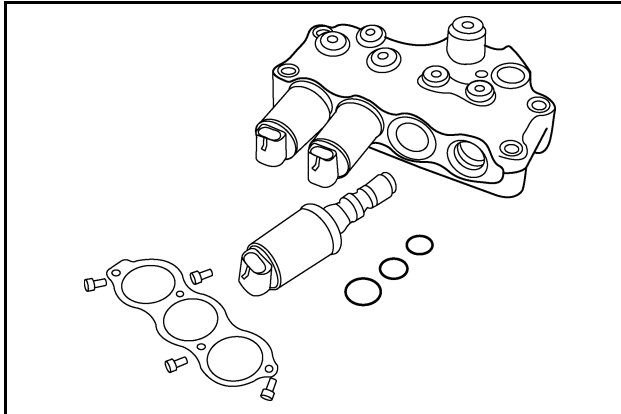
Repeat for the remaining solenoids.

## Assembly

**NOTE:** *Disassembly of range valve shown. Other valves are similar.*

**NOTE:** *Only the speed control valve is equipped with a pressure sensor. See Figure 1 - Transmission Control Valve with Four Solenoids for pressure sensor location.*

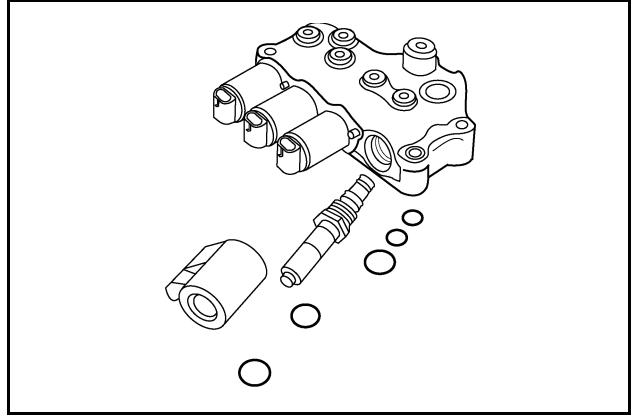
### STEP 9



RD02E223

Install new O-rings on the solenoid/ Install the solenoid into the valve body. Repeat for the remaining solenoids. Install the cover plate and retaining bolts. Tighten the bolts to a torque of 6 to 8 Nm (4 to 6 lb. ft.).

### STEP 10



RD02E222

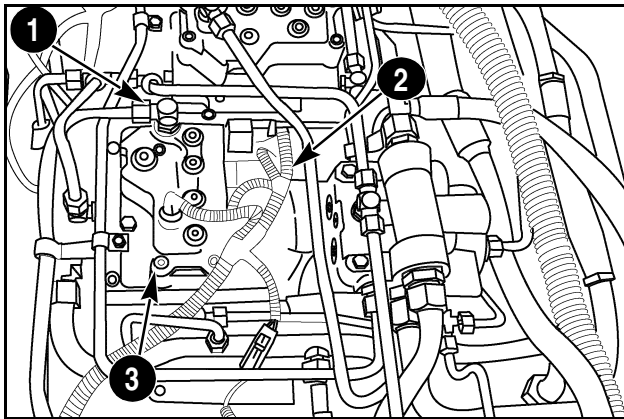
Install new O-rings on the cartridge. Install the cartridge into the valve body.

Tighten to a torque of 19 to 25 Nm (14 to 18 lb. ft.). Install new O-rings on the coil and install the coil onto the cartridge. Tighten the retaining nut to a torque of 6 to 8 Nm (4 to 6 lb. ft.).

Install a new O-ring on the plug. Install the plug to a torque of 34 to 54 Nm (25 to 40 lb. ft.).

## Valve Installation

### STEP 11

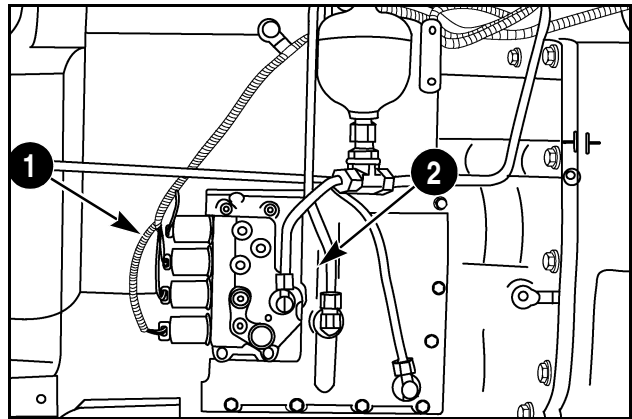


RD02E274

Install the range transmission control valve as follows:

1. Install a new gasket and the valve.
2. Tighten the M8 socket head mounting bolt (3) to a torque of 27 to 32 Nm (20 to 24 lb. ft.).
3. Connect the wire harness to the solenoids (2).
4. Connect the regulated supply tube (1).

### STEP 13

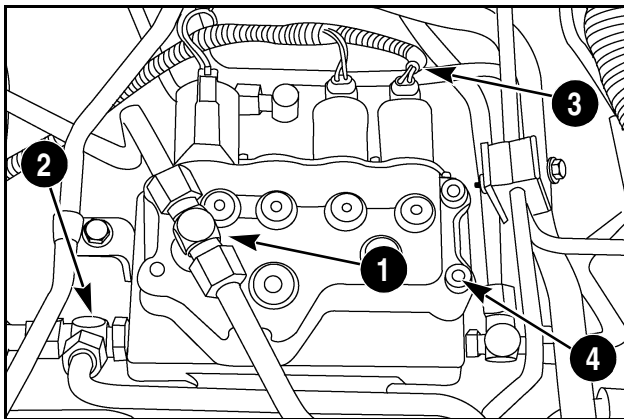


RD02E276

Install the speed transmission valve as follows:

1. Install a new gasket and the valve.
2. Tighten the M8 socket head mounting bolts to a torque of 27 to 32 Nm (20 to 24 lb. ft.).
3. Connect the wiring harness to the pressure sensor and solenoids (1).
4. Connect the supply tube (2).

### STEP 12



RD02E275

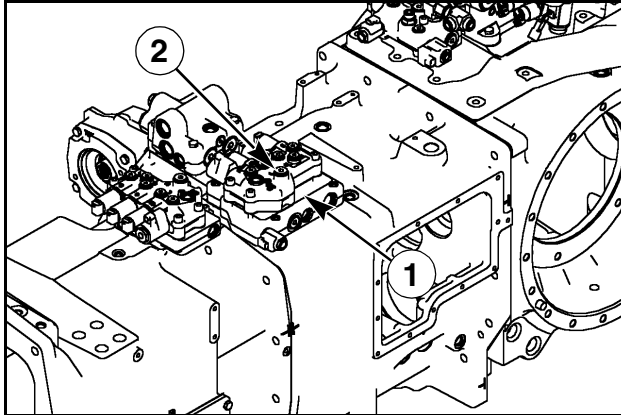
Install the odd-even transmission control valve as follows:

1. Install a new gasket and the valve.
2. Tighten the M8 socket head mounting bolts (4) to a torque of 27 to 32 Nm (20 to 24 lb. ft.).
3. Connect the wire harness to the solenoids (2).
4. Connect the regulated pressure tube (2). Connect the park lock and if equipped, the FWD tubes (1).

## INCHING VALVE

### Removal

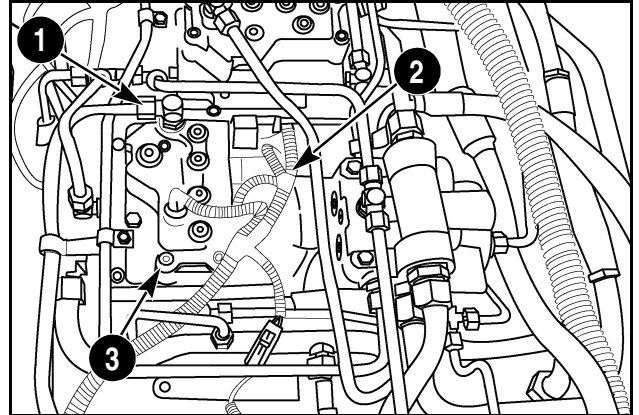
#### STEP 14



RI02E086

The inking valve (1) is located under the range transmission valve (2). Raise or remove the cab for access to the valves. See the Cab Raise/Removal and Installation section of this manual.

#### STEP 15



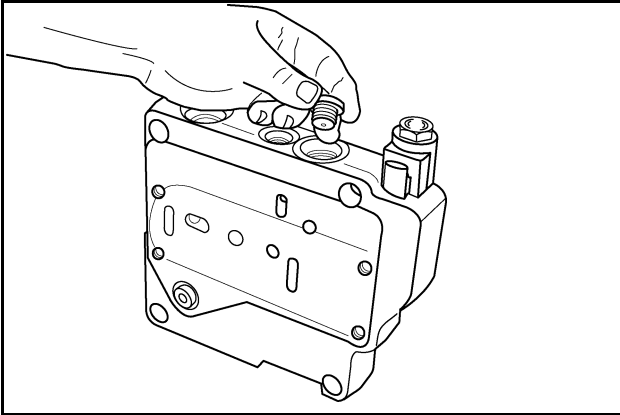
RD02E274

Remove the inking valve as follows:

1. Tag and remove the regulated supply tube (1).
2. Tag and disconnect the wire harness from the range valve solenoids (2).
3. Remove the mounting bolts (3), range valve, and gasket. Discard the gasket.
4. Tag and remove the hydraulic tubes from the inking valve.
5. Disconnect the wire harness from the inking valve solenoid.
6. Remove four attaching bolts for the inking valve.
7. Remove the inking valve and mounting gasket. Discard the gasket.

## Disassembly

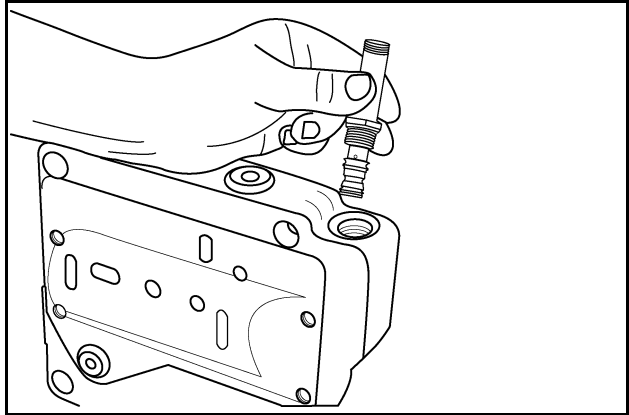
### STEP 16



56-34

Place the inching valve on a clean work surface. Remove plug.

### STEP 18

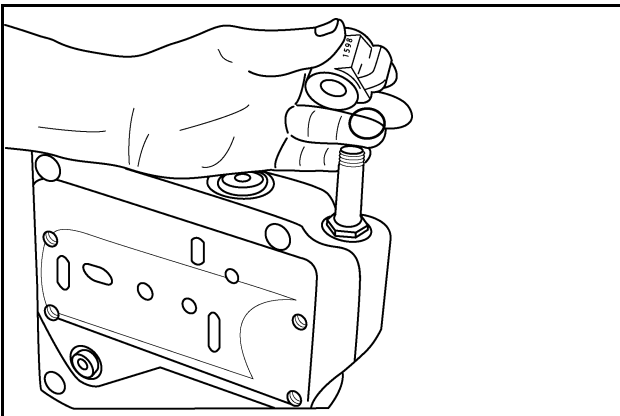


57-10

Remove solenoid cartridge.

**NOTE:** The solenoid cartridge is not designed to be disassembled.

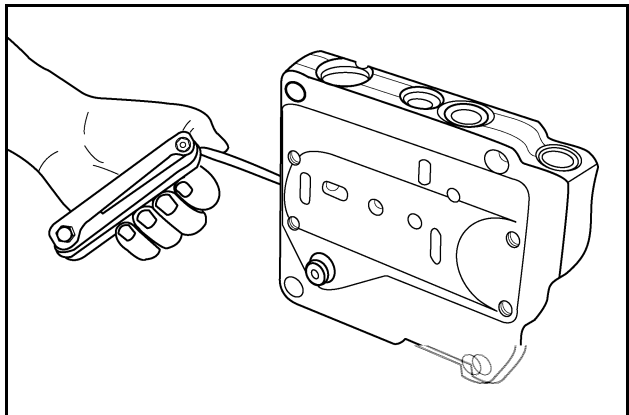
### STEP 17



57-6

Remove nut, two O-rings and coil from the solenoid assembly.

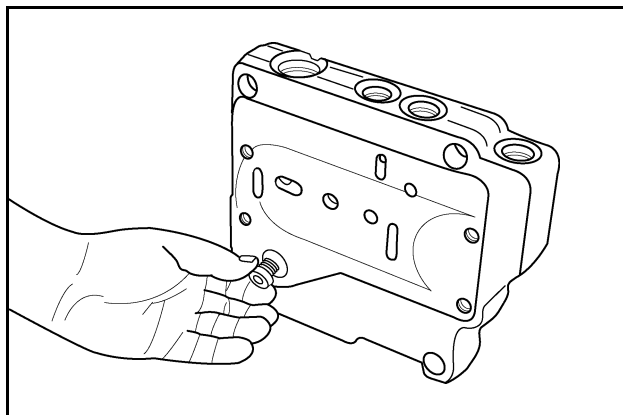
### STEP 19



57-13

Remove plug.

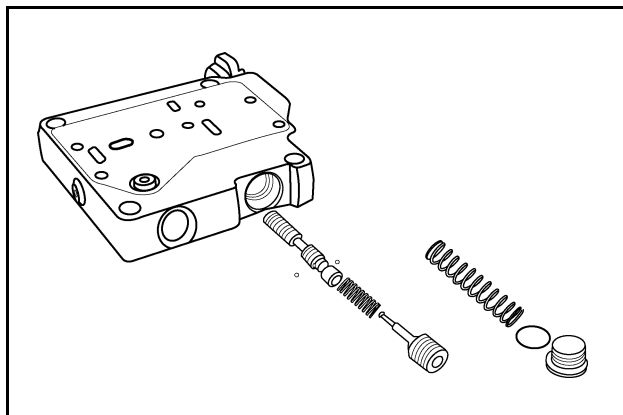
## STEP 20



57-19

Remove the plug.

## STEP 21



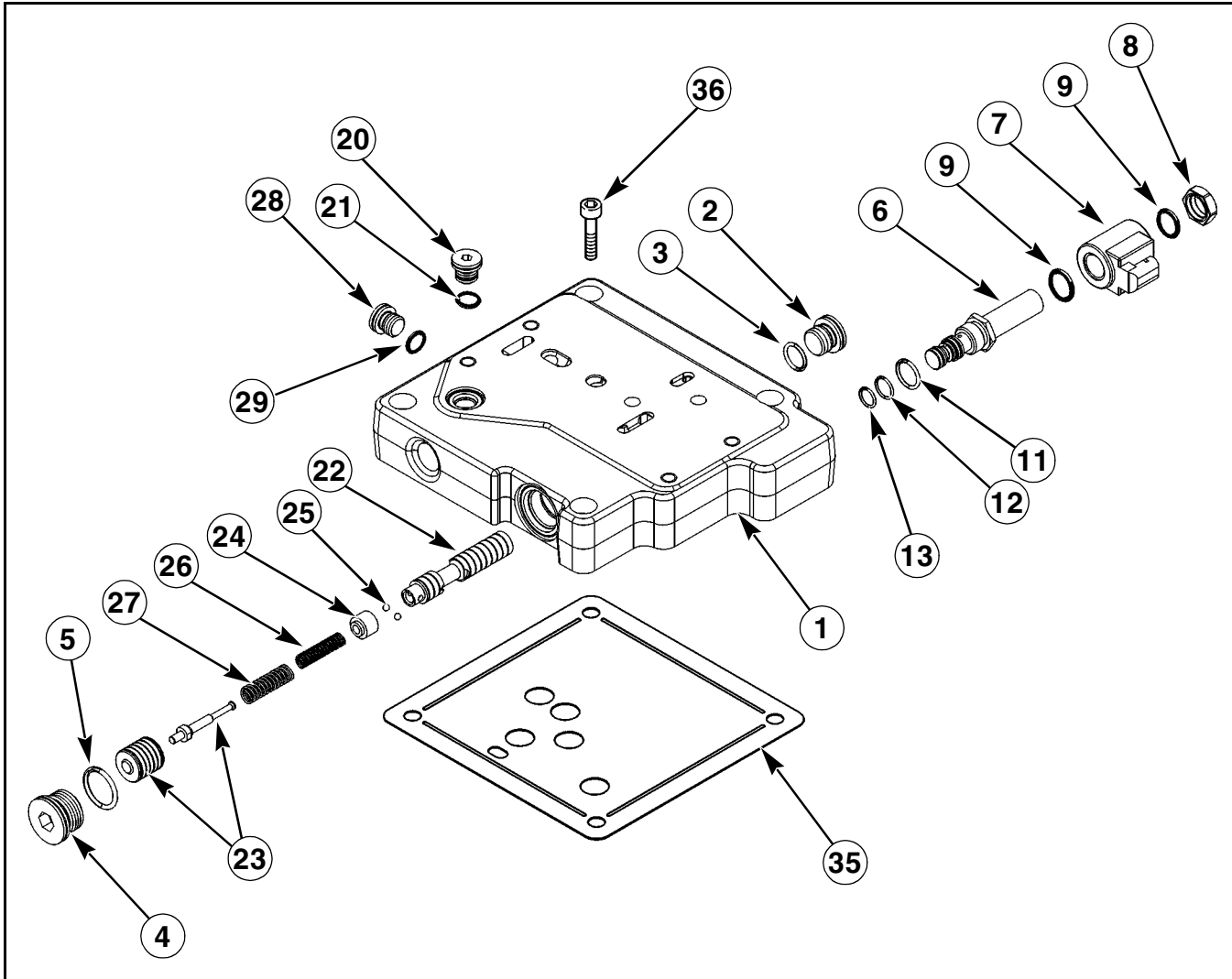
54-33

Remove the plug, spring and modulator spool assembly.

**NOTE:** *Parts of the modulator spool assembly are not serviced separately.*



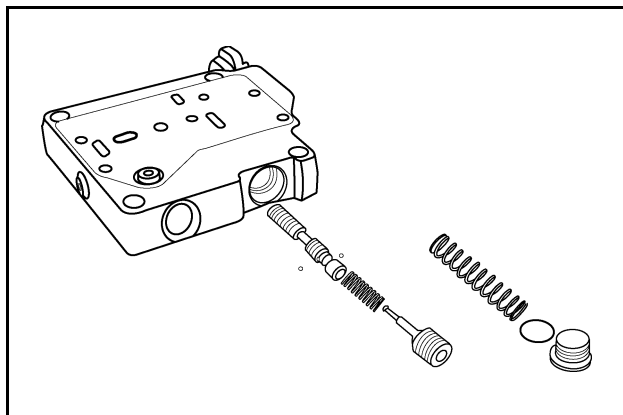
## Assembly



RT98C002

- |               |                      |                 |
|---------------|----------------------|-----------------|
| 1. VALVE BODY | 9. O-RING            | 24. SLEEVE      |
| 2. M18 PLUG   | 11. O-RING           | 25. BALL        |
| 3. O-RING     | 12. O-RING           | 26. SPRING      |
| 4. M27 PLUG   | 13. O-RING           | 27. SPRING      |
| 5. O-RING     | 20. M14 PLUG         | 28. M14 PLUG    |
| 6. CARTRIDGE  | 21. O-RING           | 29. O-RING      |
| 7. COIL       | 22. SPOOL            | 35. GASKET      |
| 8. NUT        | 23. MODULATOR PISTON | 36. SOCKET BOLT |

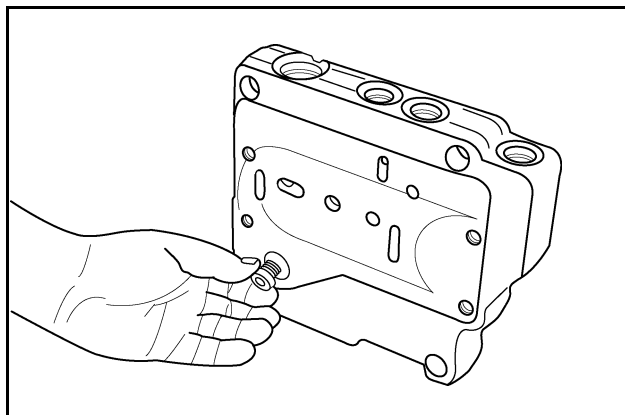
## STEP 22



54-33

Install the inching modulator spool assembly and spring.

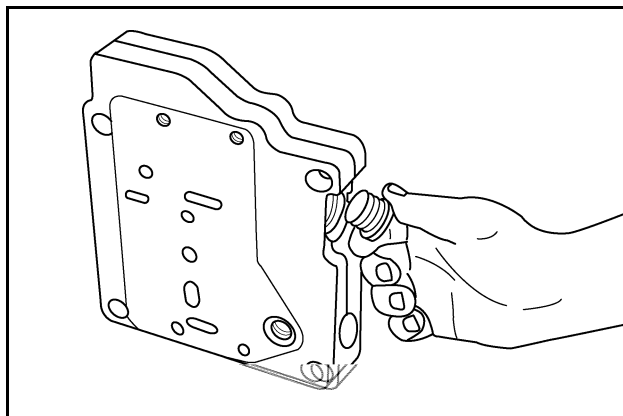
## STEP 25



57-19

Install a new O-ring on plug. Install plug in valve body and tighten to a torque of 34 to 54 Nm (25 to 40 lb. ft.).

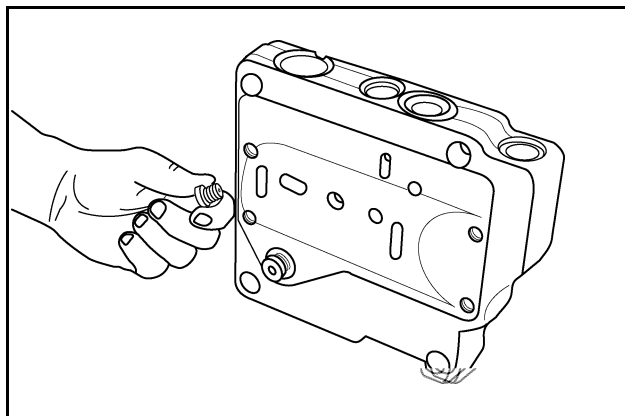
## STEP 23



57-25

Install a new O-ring on plug. Install plug. Tighten the plug to a torque of 34 to 54 Nm (25 to 40 lb. ft.).

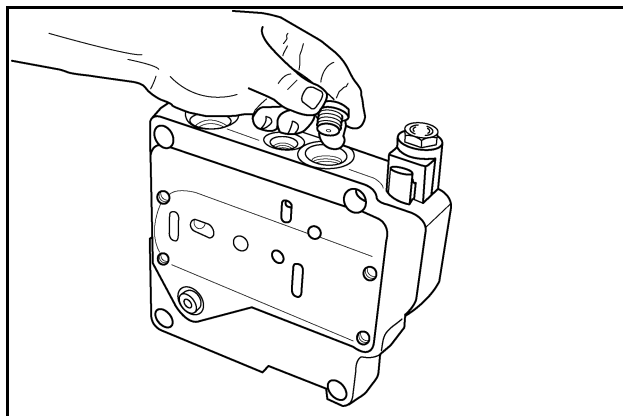
## STEP 26



57-16

Install a new O-ring on plug. Install plug in valve body and tighten to a torque of 34 to 54 Nm (25 to 40 lb. ft.).

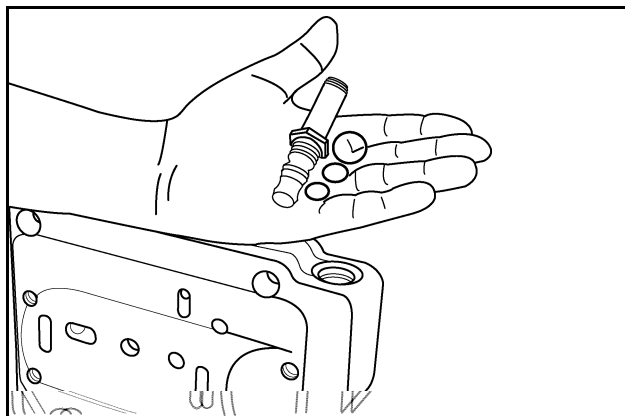
## STEP 24



56-34

Install a new O-ring on the plug. Install plug. Tighten the plug to a torque of 34 to 54 Nm (25 to 40 lb. ft.).

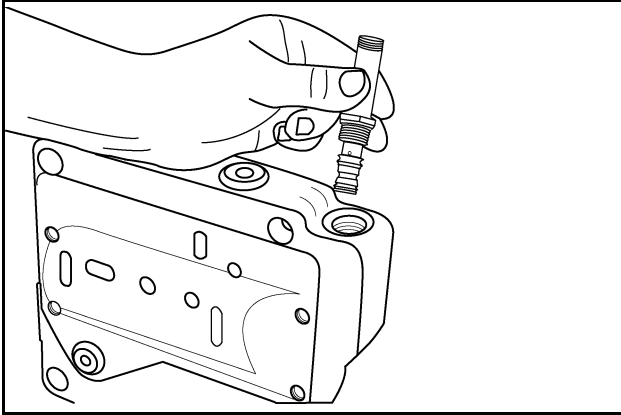
## STEP 27



57-28

Install new O-rings on the solenoid cartridge.

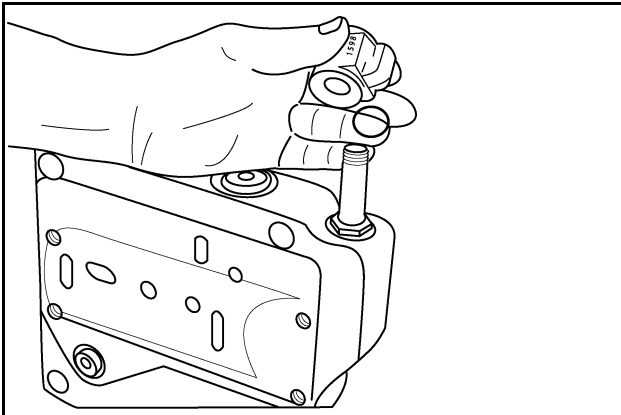
## STEP 28



57-10

Install the solenoid cartridge and tighten to a torque to 12 to 18 Nm (9 to 13 lb. ft.).

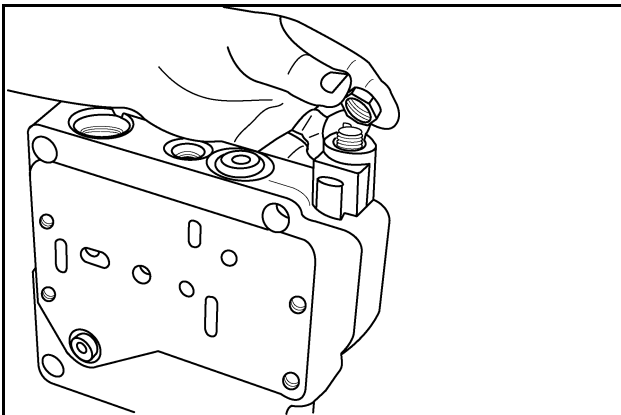
## STEP 29



57-6

Install new O-rings on both ends of coil. Install over the solenoid cartridge. Make sure the connector on the coil is facing outward.

## STEP 30

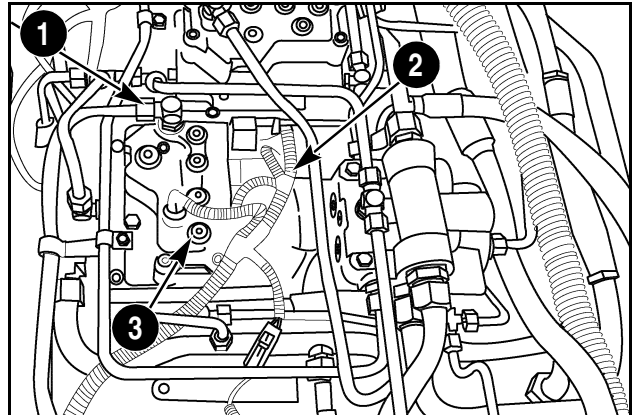


57-5

Install the nut and tighten to a torque to 5 to 8 Nm (4 to 6 lb. ft.).

## Installation

## STEP 31



RD02E274

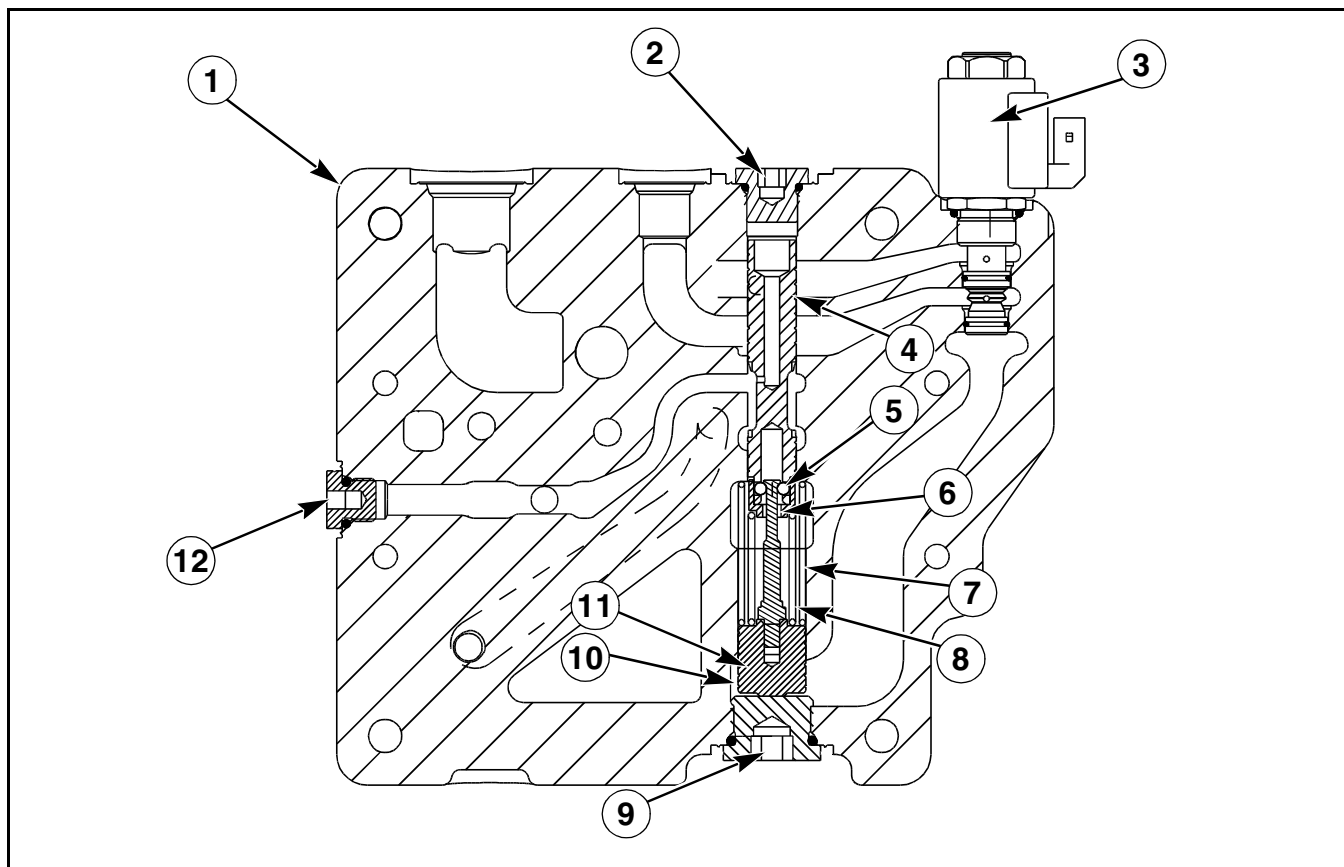
Install the inching valve and range transmission control valve as follows:

1. Install a new inching valve gasket on top of the range transmission. Install the inching valve and four retaining bolts. Tighten the bolts to a torque of 50 to 60 Nm (37 to 44 lb. ft.).
2. Install a new gasket on top of the inching valve and install the range transmission control valve. Install the M8 socket head bolts(3) and tighten to a torque of 27 to 32 Nm (20 to 24 lb. ft.).
3. Connect the Hydraulic tubes to the inching valve.
4. Connect the wire harness to the inching valve solenoid.
5. Connect the wire harness to the range valve solenoids (2).
6. Connect the regulated supply tube (1) to the range valve.

## STEP 32

Install or lower the cab as shown in in the Cab Raise/ Removal and Installation Section of this Repair Manual.

## Inching Valve Cross Section



302171AA.WMF

- |                     |                                      |
|---------------------|--------------------------------------|
| 1. VALVE BODY       | 7. SPRING                            |
| 2. PLUG             | 8. SPRING                            |
| 3. SOLENOID         | 9. PLUG                              |
| 4. INCHING SPOOL    | 10. INCHING MODULATOR SPOOL ASSEMBLY |
| 5. BALL             | 11. MODULATOR ASSEMBLY PISTON        |
| 6. RETAINING SLEEVE | 12. PLUG                             |

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# **Section 21**

## **Chapter 8**

**REAR FRAME**

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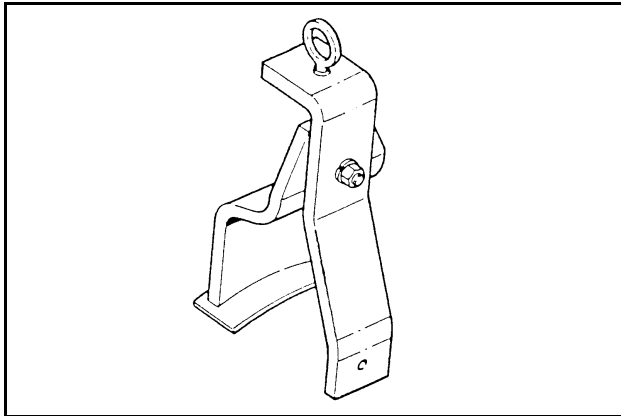
## SPECIFICATIONS

Differential Bearing Retainer Seal Recess .....	0.8 mm (0.031 inch)
Differential Bearing Rolling Torque (New).....	4.5 to 7.9 Nm (40 to 70 lb. inch)
Differential Bearing Rolling Torque (Used) .....	2.25 to 3.95 Nm (20 to 35 lb. inch)
Ring and Pinion Backlash.....	0.179 to 0.279 mm (0.007 to 0.011 inch)
Pinion Shaft End Play .....	0.013 to 0.102 mm (0.0005 to 0.004 inch)
Ring and Pinion Nominal Setting Distance.....	33.92 mm (1.335 inch)

## SPECIAL TORQUES

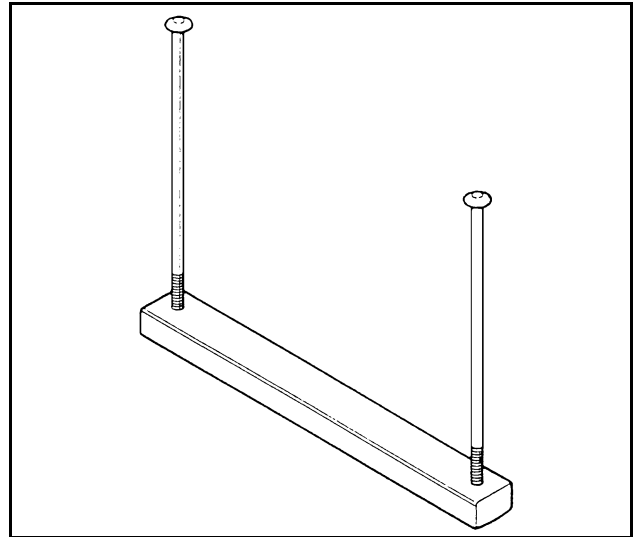
Right-Hand (RH) Retainer (Initial) .....	11 Nm (100 lb. inch)
Bearing Retainer (Final Phosphate Coated with Oiled Threads).....	235 to 260 Nm (173 to 195 lb. ft.)
Pinion Shaft Assembly Mounting Bolts .....	101.7 to 112.5 Nm (75 to 83 lb. ft.)

## SPECIAL TOOLS



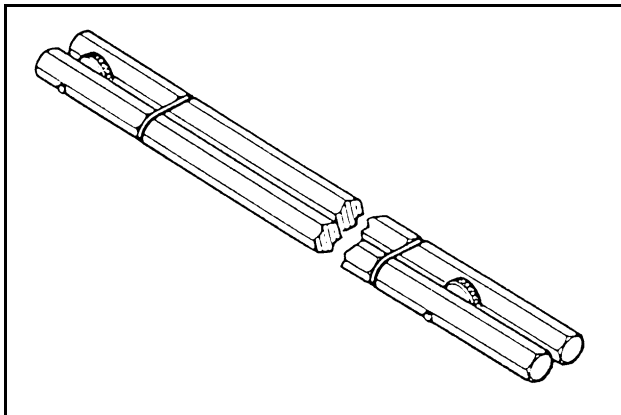
CAS1952

Differential Lifting Tool CAS1952



504L7

Pinion Setting Tool CAS1902-1



CAS1902-2

Rolling Torque Adapter, CAS1902-2



## DIFFERENTIAL

### Removal

#### STEP 1

Prepare to remove the differential as follows:

1. Start the tractor and lower the hitch.
2. Turn the tractor OFF and remove the key.

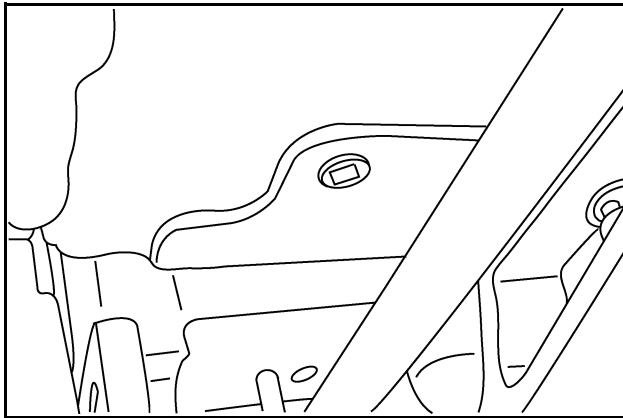
#### STEP 2

Remove the cab (refer to Cab Removal in this manual).

#### STEP 3

Remove the axle shafts and planetaries (refer to Rear Axle and Planetaries in this manual). If necessary, remove the brake cylinders (refer to Brake Cylinders in this manual).

#### STEP 4



91-16

Remove the drain plug from the bottom of the rear frame housing. Drain the oil from the housing into a suitable container.

#### STEP 5

Refer to Hydraulic Systems and Troubleshooting in this manual and remove the following:

1. Supply line from PFC piston pump to remote valve.
2. Signal line to compensator.
3. PTO lube supply.
4. Bevel gear lube tube.

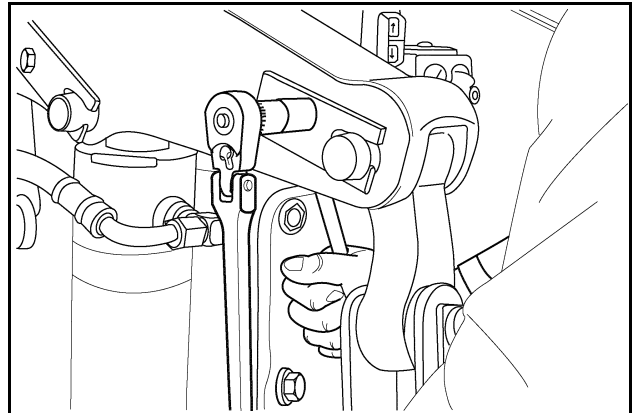
5. Remote valve return line.
6. Regulated supply to PTO valve.
7. Difflock supply tube.

#### STEP 6

Disconnect the hydraulic lines to the hitch lift cylinders.

**NOTE:** If the pinion shaft must be serviced, the power train must be split between the range housing and the rear frame. Refer to Range Transmission to Rear Frame Split in this manual for procedures.

#### STEP 7

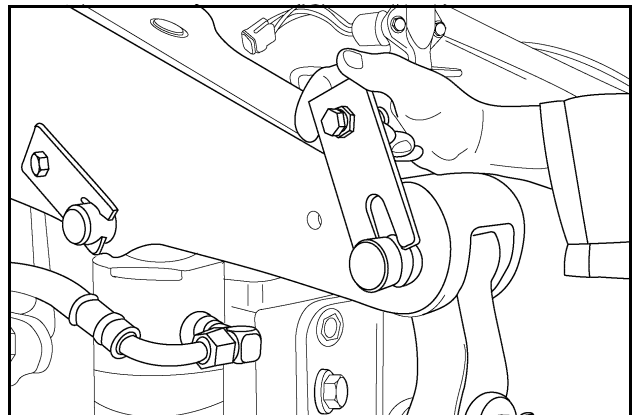


26s21b

Remove the hex head bolt and nut from the locking flag plate where the vertical lifting link is attached to the rock shaft.

**NOTE:** Refer to Tractor Hitch in this manual for details.

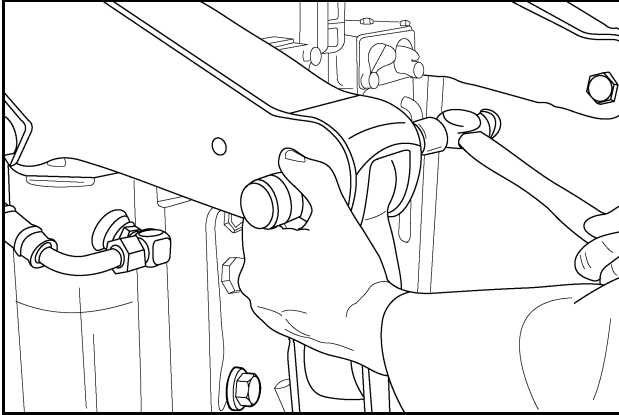
#### STEP 8



26s24b

Lift up on the locking flag plate to remove it.

### STEP 9

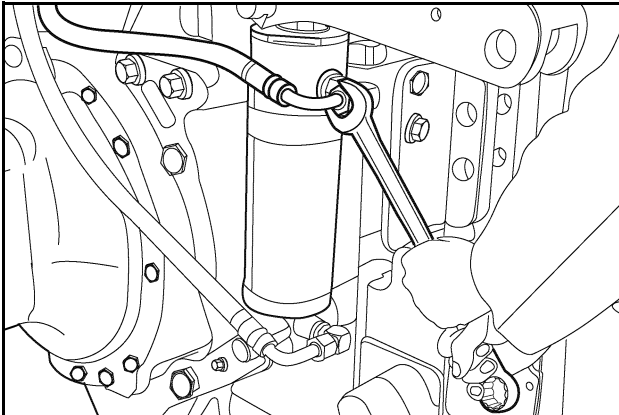


26s27b

While supporting the vertical lifting link, drive out the hitch swivel pin with a suitable tool. Repeat Steps 9 through 11 for the other vertical lifting link.

**NOTE:** Be prepared for the sudden drop in the vertical lifting link as the pin is driven out.

### STEP 10

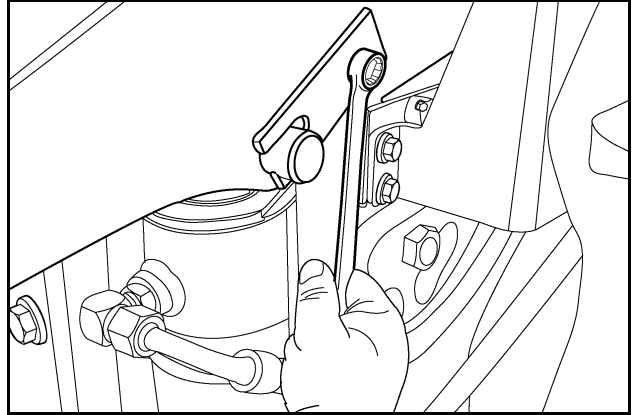


27s12b

Remove the hydraulic lines to the hitch lift cylinder as follows:

1. Be prepared to catch hydraulic fluid as the hydraulic system is opened.
2. Remove the hydraulic line from the top of the hitch lift cylinder and then from the bottom of the hitch lift cylinder (both sides).

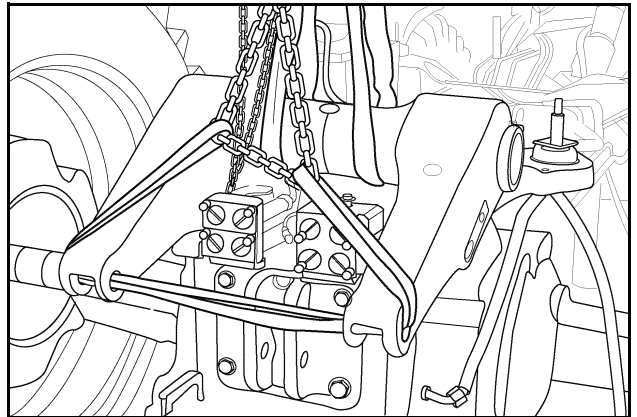
### STEP 11



76-6a

Remove the bolt and locking flag plate in the upper end of the hitch lift cylinder (both sides).

### STEP 12

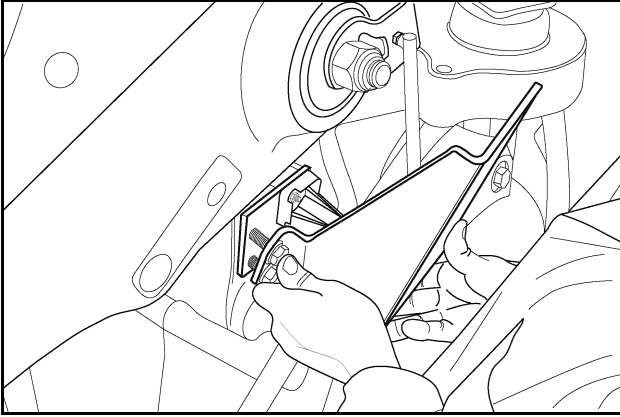


35-24

Secure the rockshaft assembly as follows:

1. Attach a chain hoist to the top of the rockshaft assembly.
2. Place enough tension on the chains to support the assembly without adding a lifting force.

### STEP 13

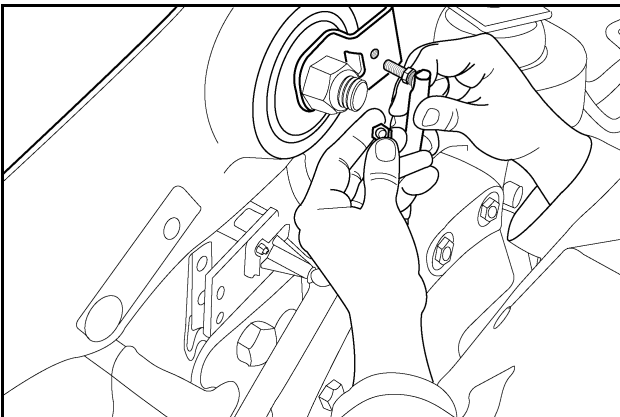


36s21b

Remove the two bolts that attach the rockshaft sensor shield to the hitch support C-bracket.

**NOTE:** Be sure to remove hitch position sensor (potentiometer) prior to removing the hitch lift cylinders. If the cylinders are removed first, there may be excessive travel of the rockshaft, which would damage the sensor.

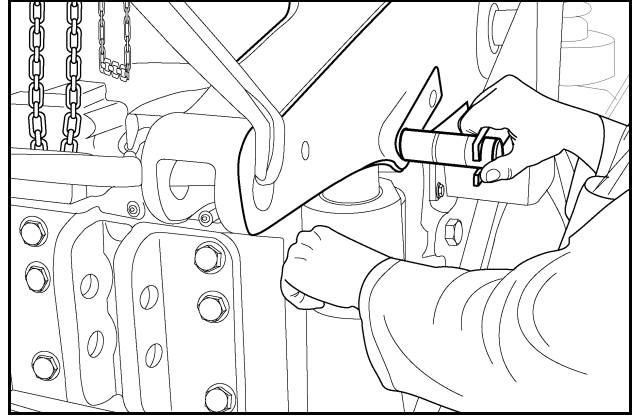
### STEP 14



36s17

Remove the nut from the link assembly.

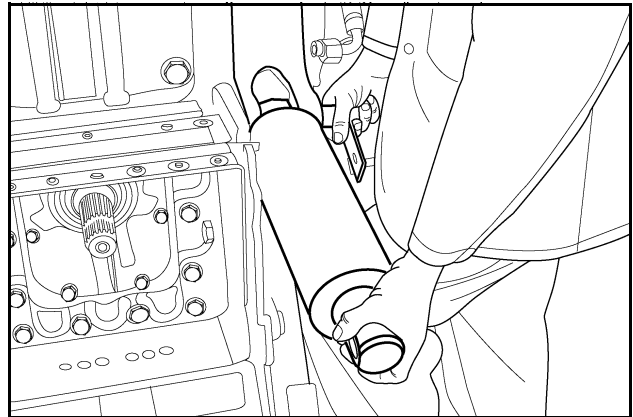
### STEP 15



36s34b

Remove pin and free the upper end of the hitch lift cylinder.

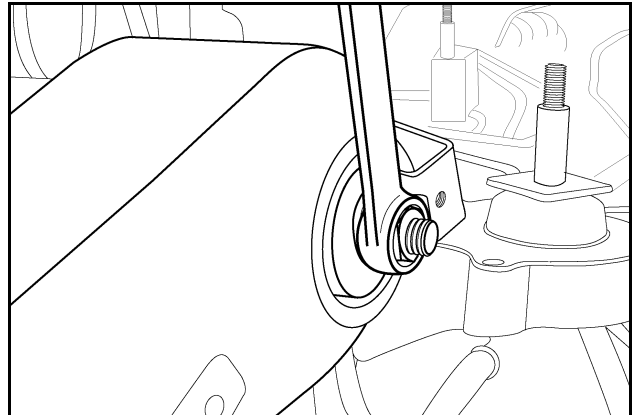
### STEP 16



36s28b

Remove the bolt, locking flag plate pin and free the lower end of the hitch lift cylinder. Remove the cylinder.

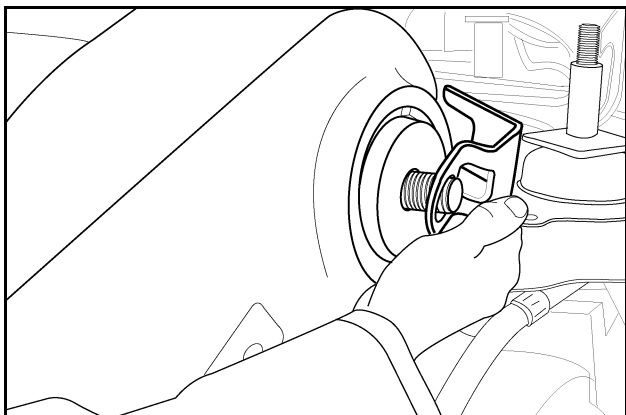
### STEP 17



36s8

Hold the left nut on the tie rod and turn the right side nut (shown).

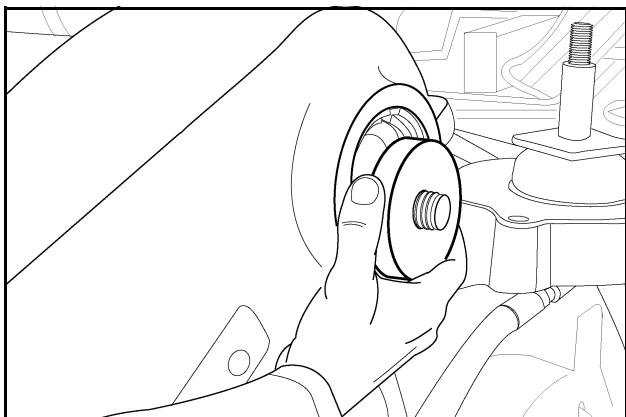
### STEP 18



36s4

Remove the position sensor bracket.

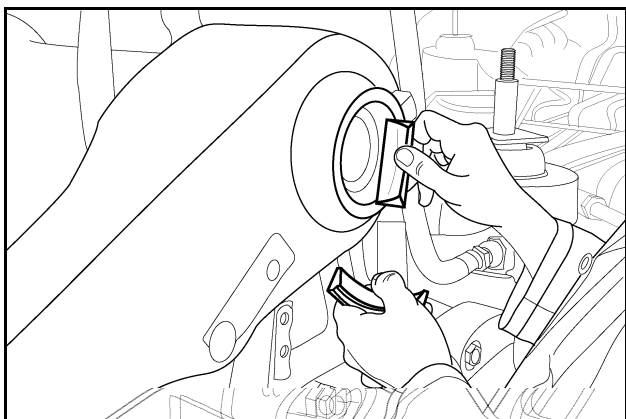
### STEP 19



36s1

Remove the split ring washer. Remove the tie rod through the opposite end from which the washer and retainer were removed. If tires are on tractor, the tie rod may be disassembled by sliding tie rod through the chain support hole in the disc. Position the wheels as necessary.

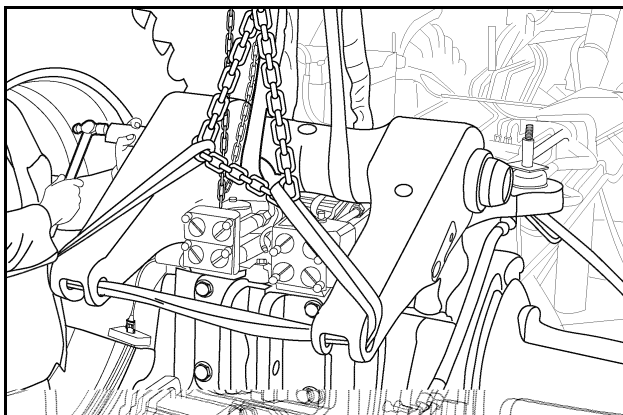
### STEP 20



35-30

Remove the split ring retainers from both ends of the rockshaft.

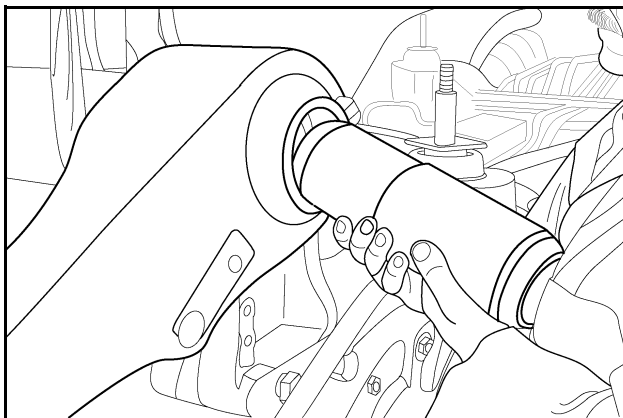
### STEP 21



35-21

Use a long piece of wood to reach through the rockshaft and contact the rocker pin. Tap the piece of wood to dislodge the rockshaft pin. Use care not to damage the seal or bushing.

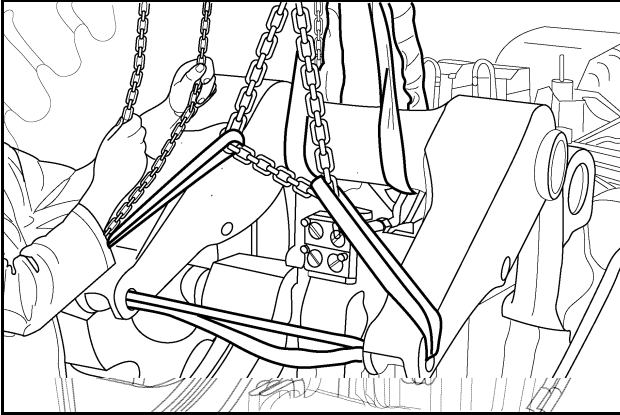
### STEP 22



35-18

Remove the rockshaft pin.

### STEP 23

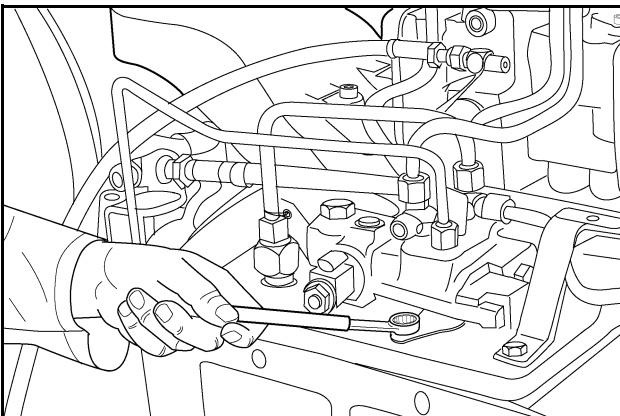


35-14

When both rockshaft pins are removed, lift and set aside the rockshaft casting.

**NOTE:** Keep bearings and seals free of foreign material.

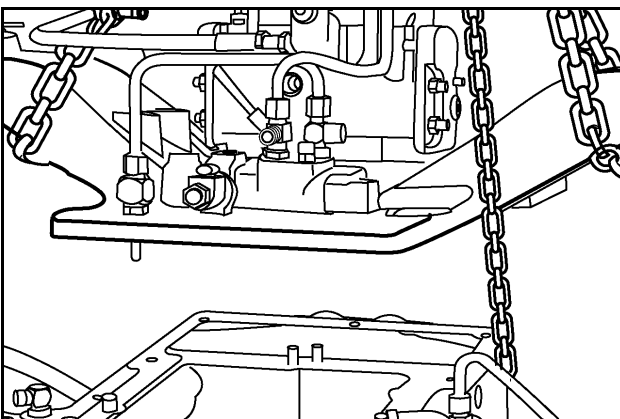
### STEP 24



28-11CU

Remove the bolts that attach the cover and rear cab bracket to the rear frame.

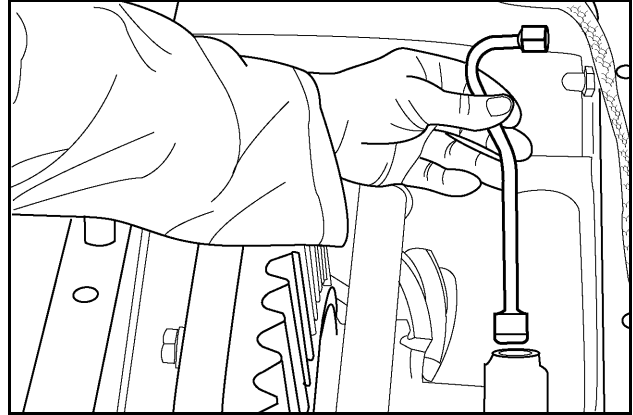
### STEP 25



28s22r

Remove the rear frame top cover and set aside.

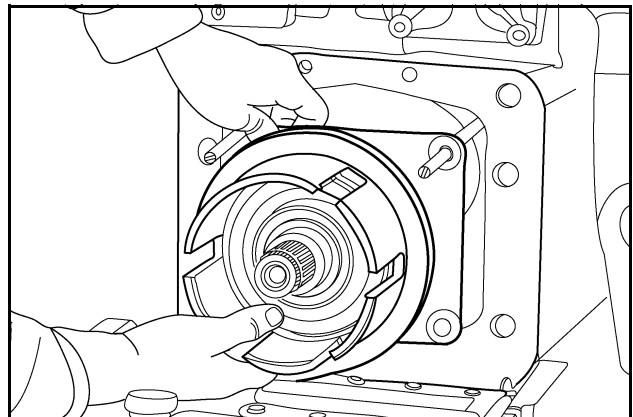
### STEP 26



T98138

Remove the differential lock supply line from the differential.

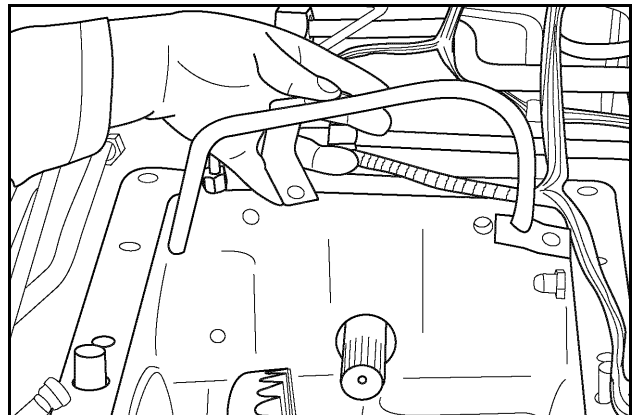
### STEP 27



69RS13

Remove the rear frame cover and the PTO clutch assembly. (Refer to PTO Assembly, Single and Dual Speeds in this manual).

### STEP 28

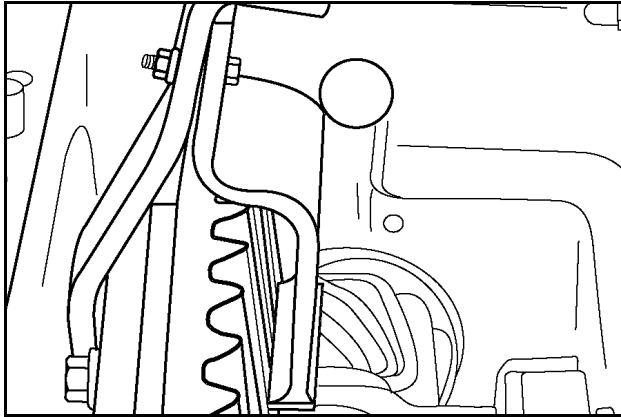


T98213

Remove the differential lube line from the rear frame.

**NOTE:** Bevel pinion must be removed from rear frame housing before proceeding.

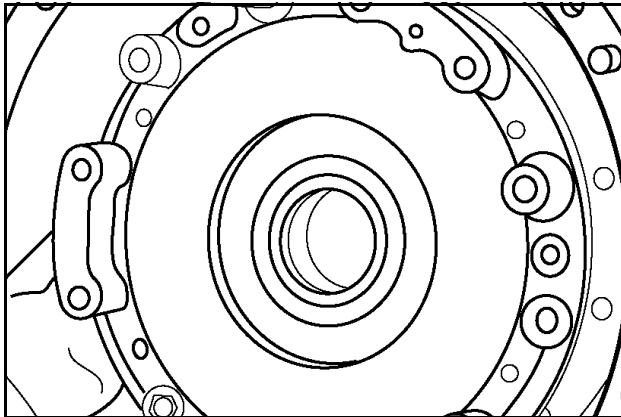
### STEP 29



T98214A

Install the differential lifting tool, CAS-1952, on the differential. Connect a hoist to the differential lifting tool and put tension on the hoist chain or strap.

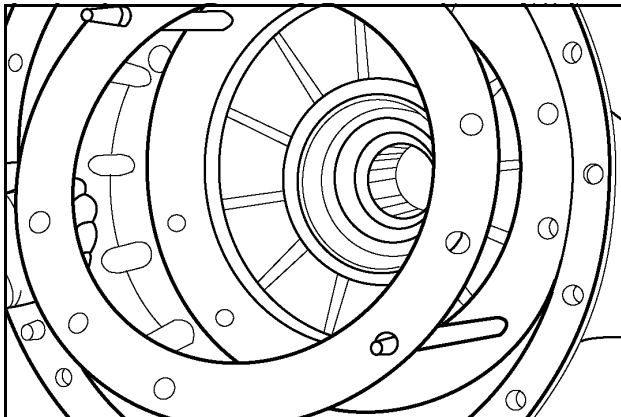
### STEP 30



T98194

Remove the left-hand bearing retainer from the rear frame.

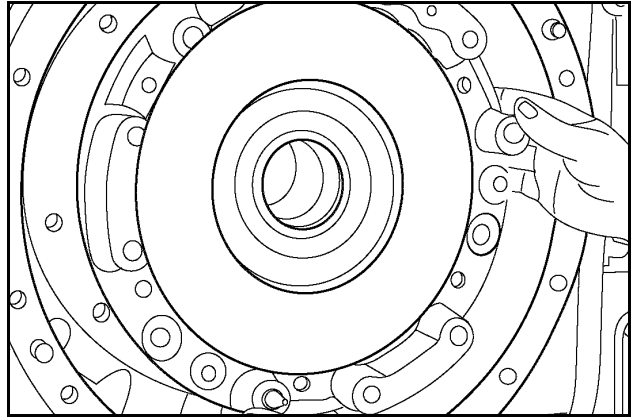
### STEP 31



T98199

Remove the LH bearing retainer shims from the rear frame and tag for location.

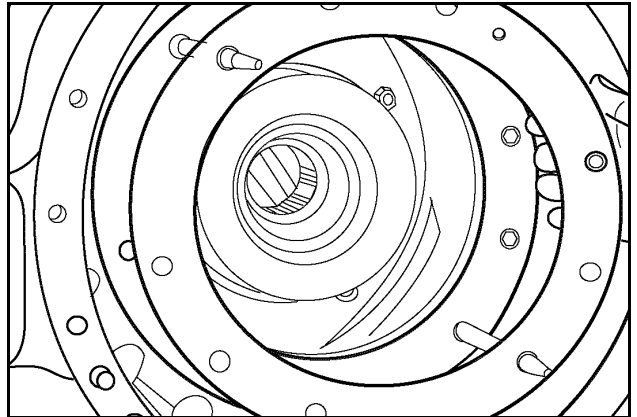
### STEP 32



T98187

Remove the RH bearing retainer from the housing.

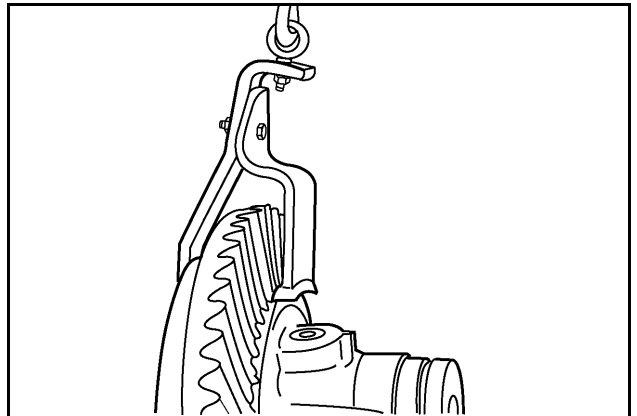
### STEP 33



T98200

Remove the right-hand bearing retainer shims from the housing and tag for location.

### STEP 34



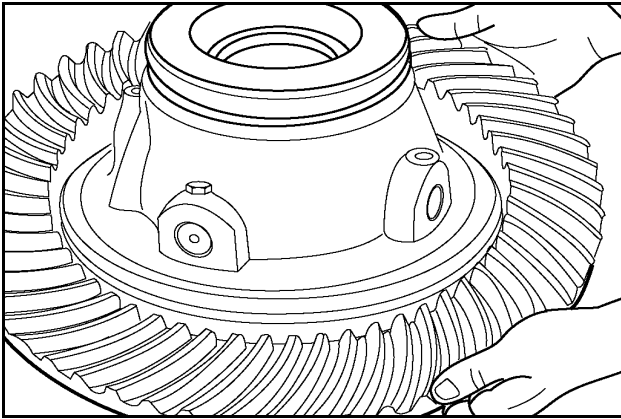
T98204

Remove and set up the differential assembly as follows:

1. Remove the differential assembly from the rear frame.
2. Place the differential assembly on a clean workbench with the ring gear facing up.
3. Support the assembly on a wood block(s) to provide clearance for bolt removal.

## Disassembly

### STEP 35

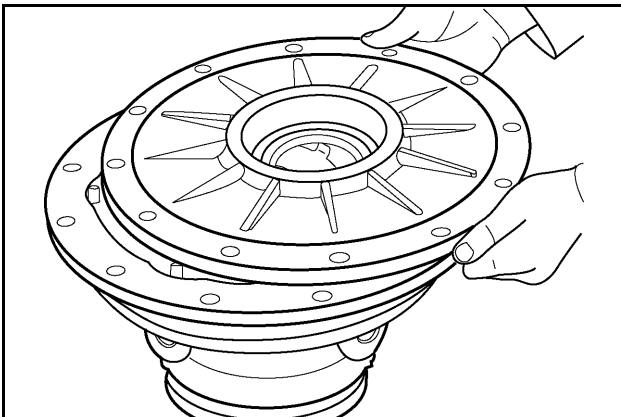


T98146

Remove and discard the 12 ring gear mounting bolts. Remove the ring gear. Remove the differential housing seal rings.

**NOTE:** Attach the differential case to the cover using a nut and bolt. Carefully turn the assembly over. Remove the nut and bolt.

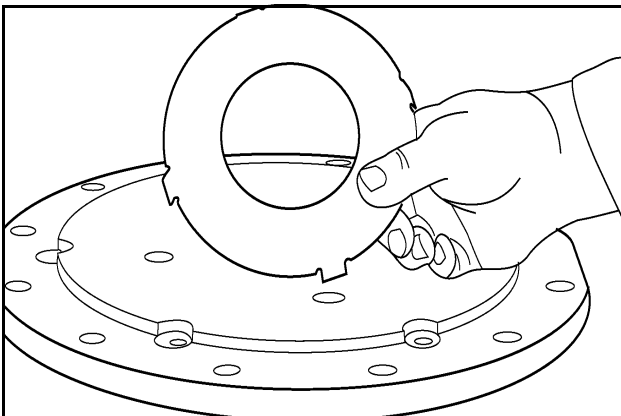
### STEP 36



T98149

Remove the differential cover from the housing.

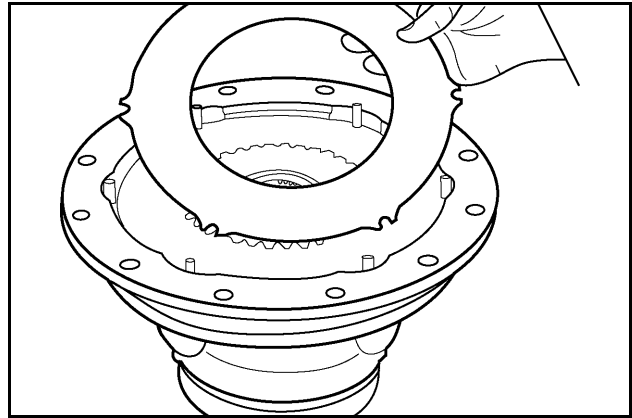
### STEP 37



88-28A

Remove the thrust washer from the cover.

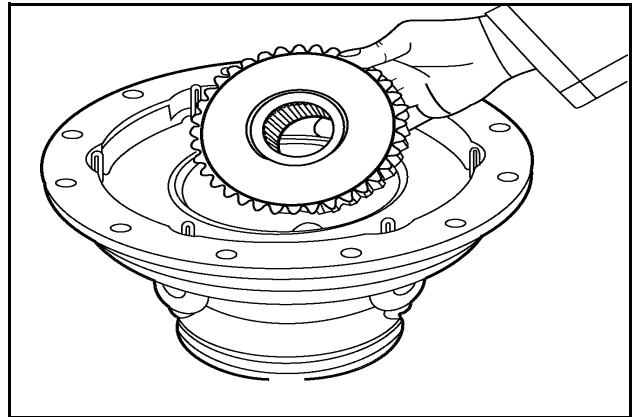
### STEP 38



T98151

Remove the differential lock separator and friction plates from the housing.

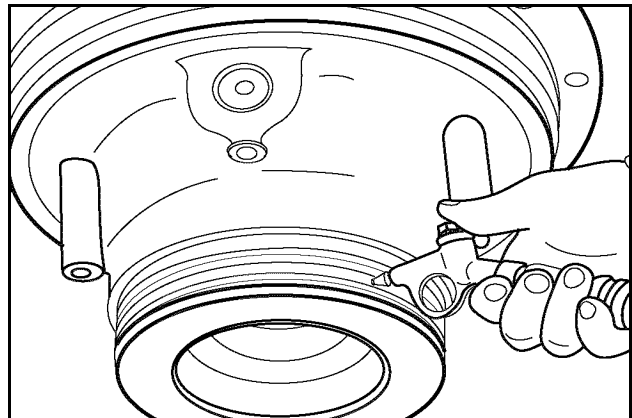
### STEP 39



T98153

Remove the bevel lock side gear and six dowel pins from the housing.

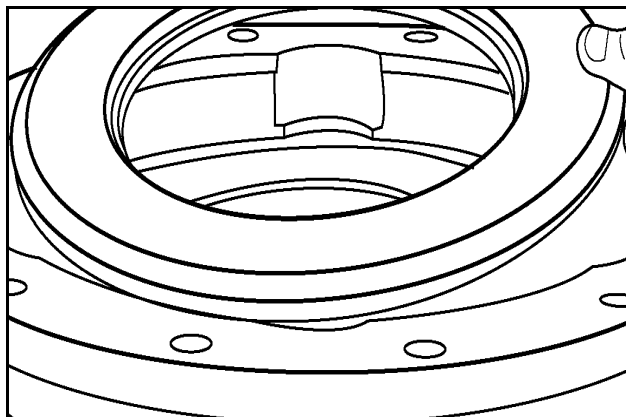
### STEP 40



T98156

Apply compressed air to the differential lock piston supply port to break the piston loose.

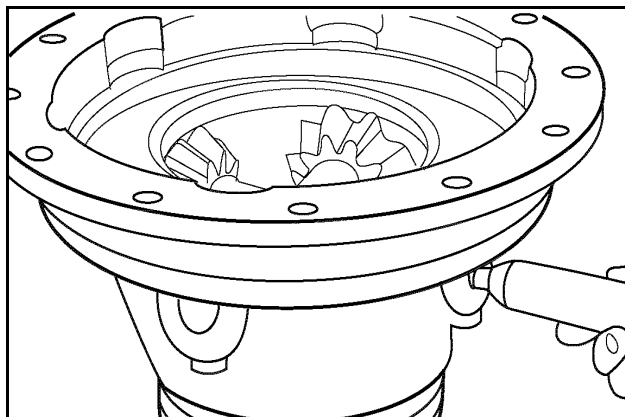
**STEP 41**



RD98C189

Remove the piston from the housing.

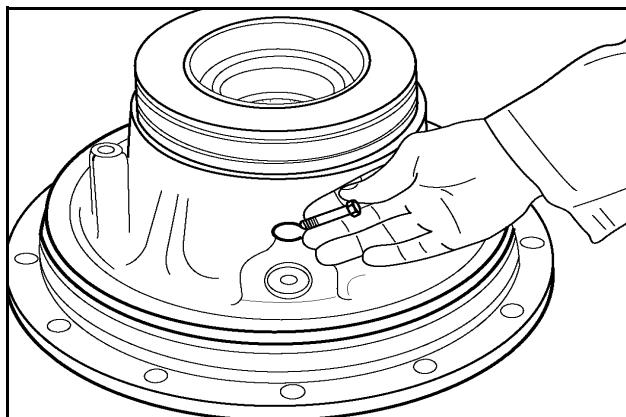
**STEP 44**



T98160

Remove each short pinion shaft from the housing.

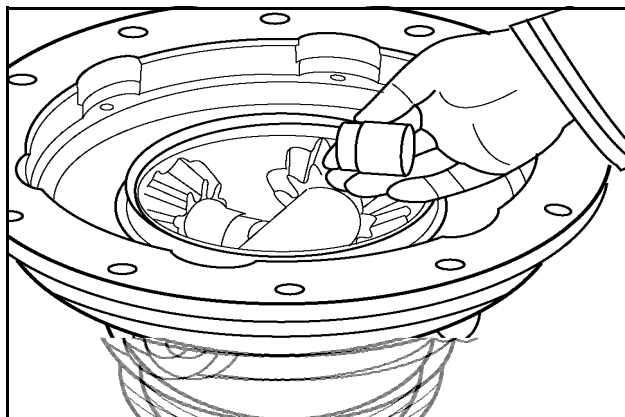
**STEP 42**



T98155

Remove the short pinion shaft retaining bolts from the housing.

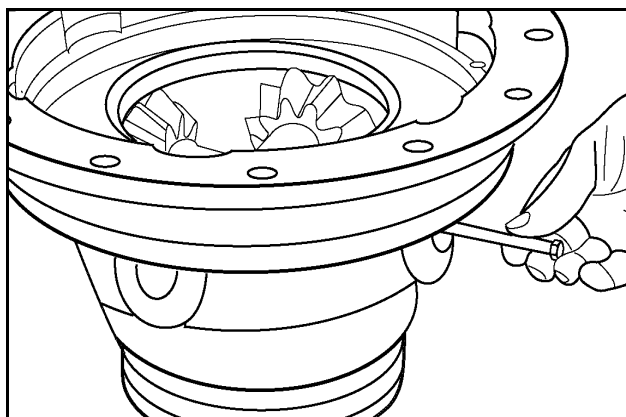
**STEP 45**



T98161

Remove the short spacers from the housing.

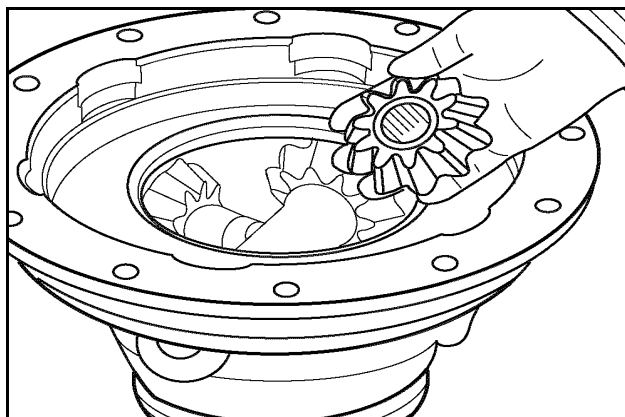
**STEP 43**



R98159

Insert an M8 bolt into the short pinion shaft hole.

**STEP 46**

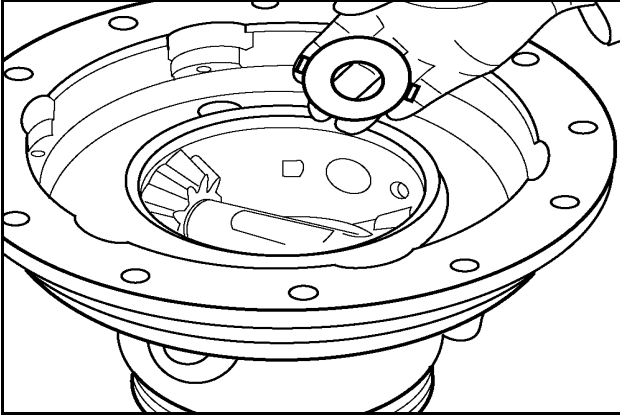


T98162

Remove the short shaft pinion gears from the housing. Remove the thrust ring and needle bearings from both short shaft pinion gears.

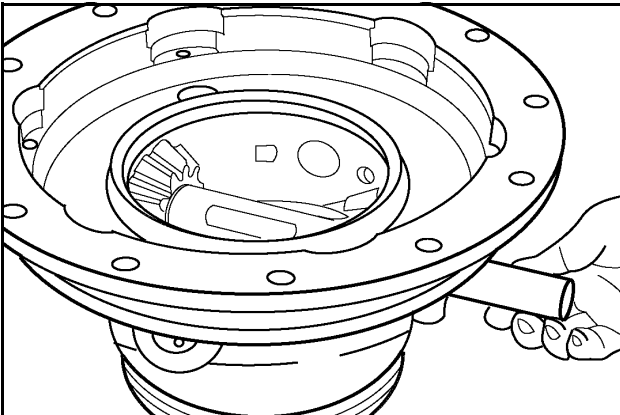


**STEP 47**



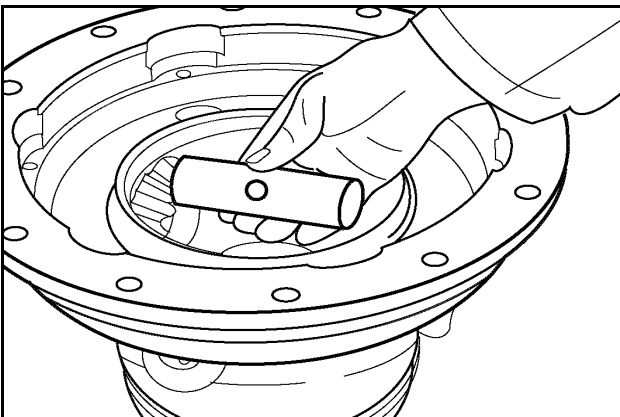
Remove the thrust washers from the housing.

**STEP 48**



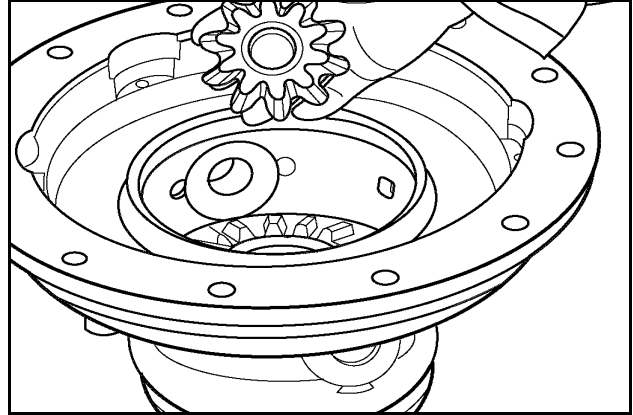
Remove the long shaft from the housing.

**STEP 49**



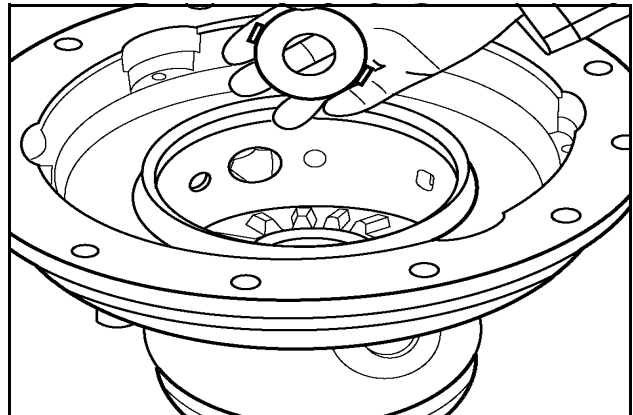
Remove the long spacer from the housing.

**STEP 50**



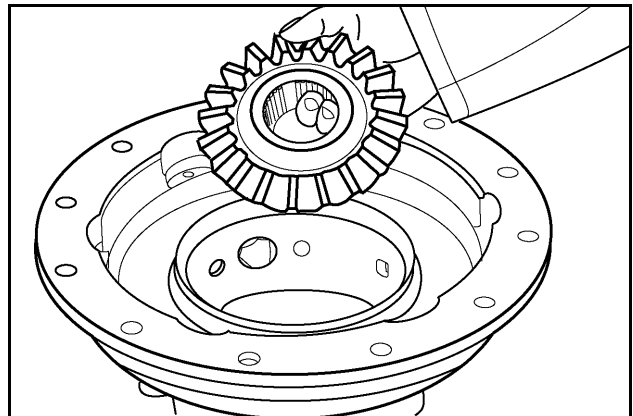
Remove the long pinion shaft gears from the housing. Remove the thrust ring and needle bearings from both long shaft pinion gears.

**STEP 51**



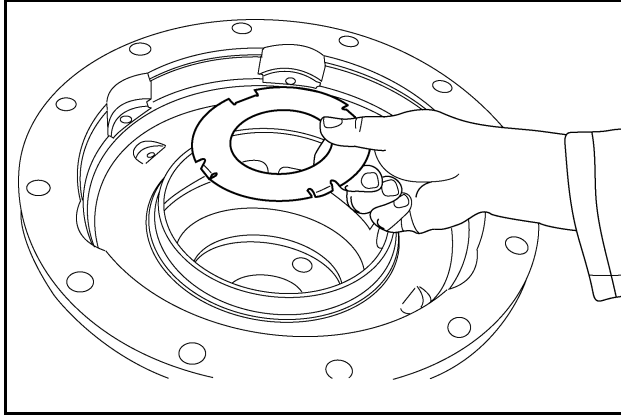
Remove the thrust washers from the housing.

**STEP 52**



Remove the bevel side gear from the housing.

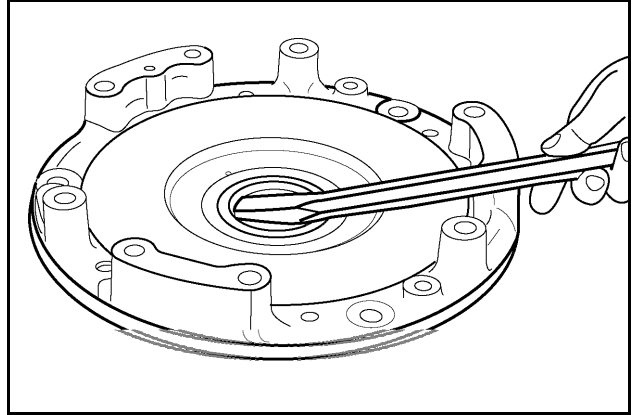
**STEP 53**



88-19A

Remove the thrust washer from the housing.

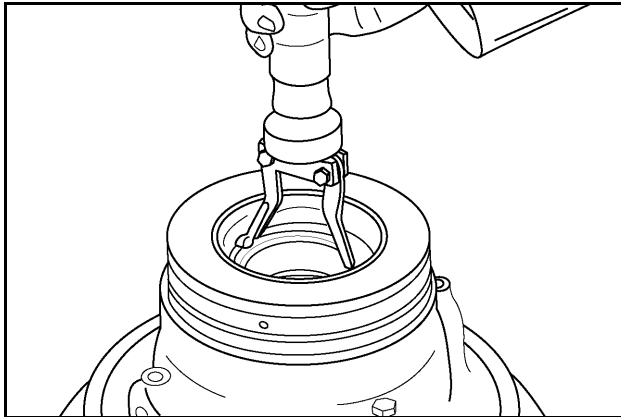
**STEP 56**



T98205

Remove the oil seal from each bearing retainer.

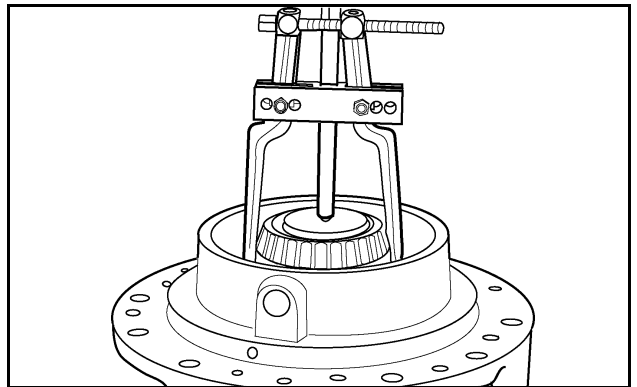
**STEP 54**



T98183

Remove the bearing cup from the housing.

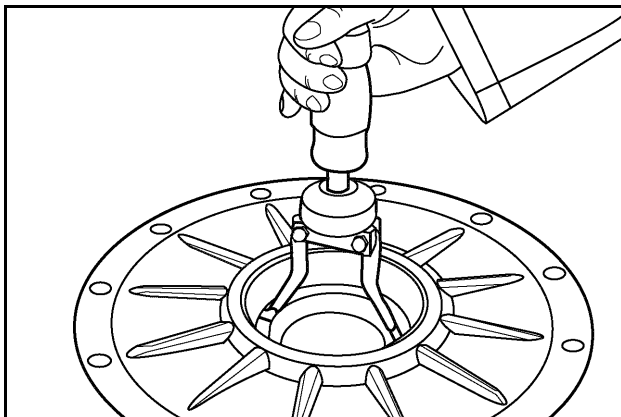
**STEP 57**



RD98C192

Remove the seal ring and the bearing cone from the right hand bearing retainer.

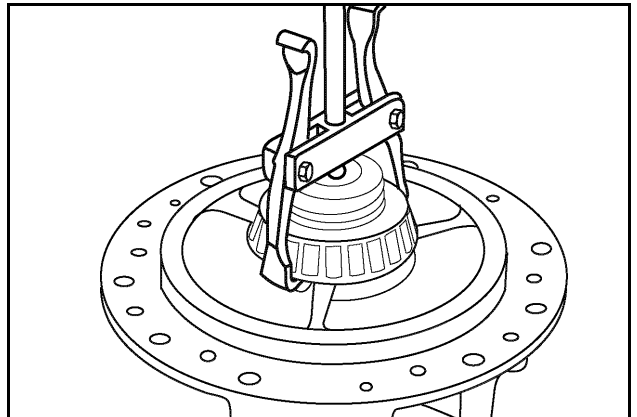
**STEP 55**



T98171

Remove the bearing cup from the differential cover.

**STEP 58**



T98174

Remove the seal ring and the bearing cone from the left hand bearing retainer.

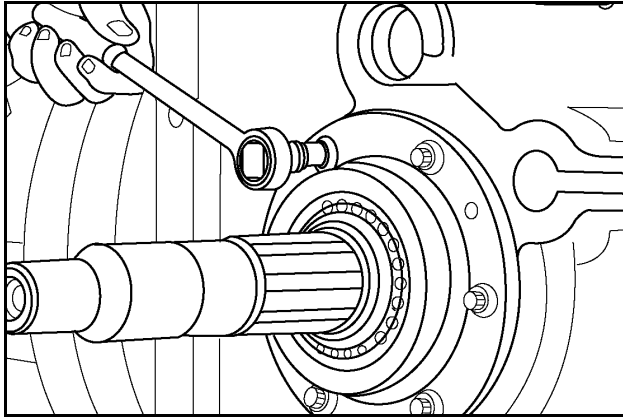
## PINION SHAFT

### Removal and Disassembly

#### STEP 59

If required, split the rear frame and range transmission (refer to Range Transmission to Differential Split in this manual) before servicing the pinion shaft.

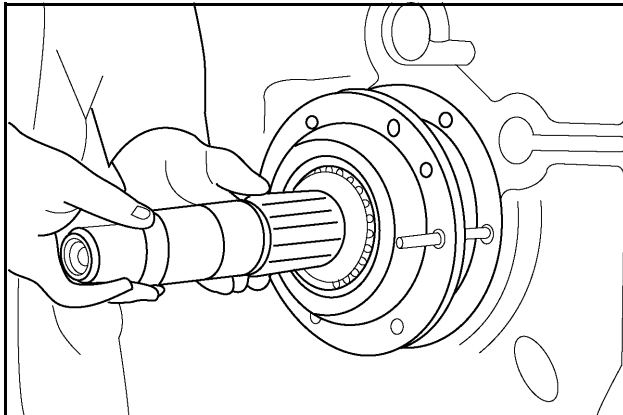
#### STEP 60



T95910

Remove the pinion shaft bearing cage mounting bolts.

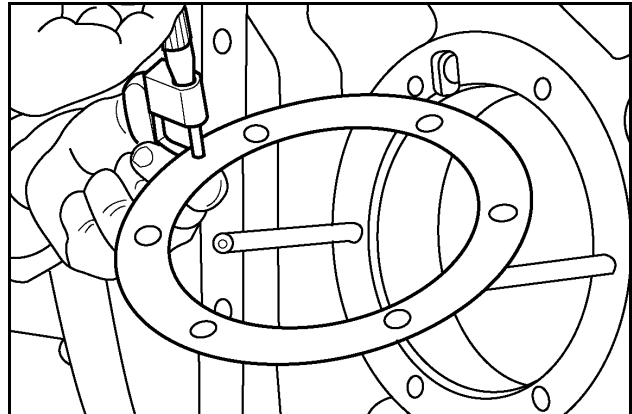
#### STEP 61



T95912

Install two aligning dowels through the bearing cage and into the rear frame. Remove the pinion shaft assembly from the rear frame.

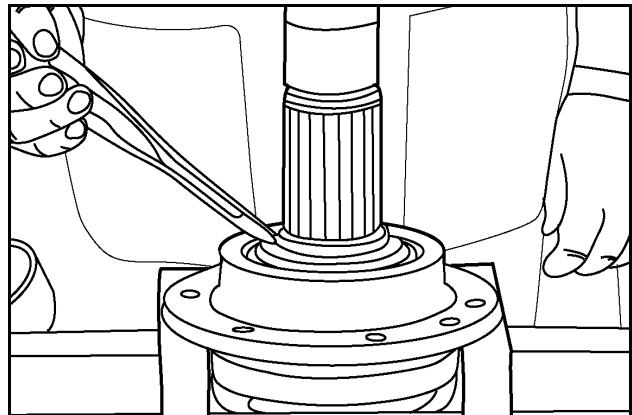
#### STEP 62



T95913

Remove the shims from the bearing cage. Use a micrometer to measure all the shims and record the shim pack size.

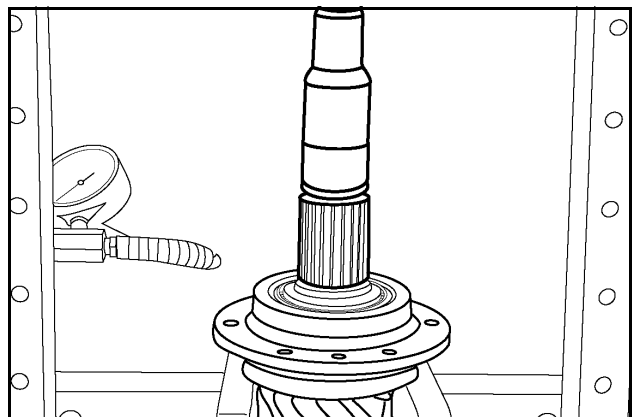
#### STEP 63



T95915

Remove the front pinion shaft snap ring. Press on the bearing cone race if it blocks removal of the snap ring.

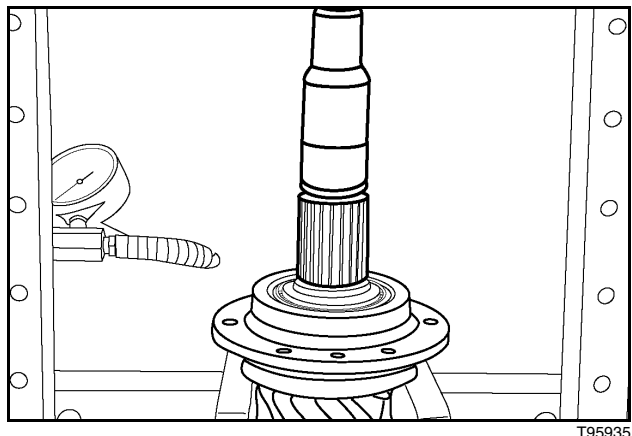
#### STEP 64



T95935

Mount pinion shaft in a press with pinion gear facing down. Position support plates under bearing carrier.

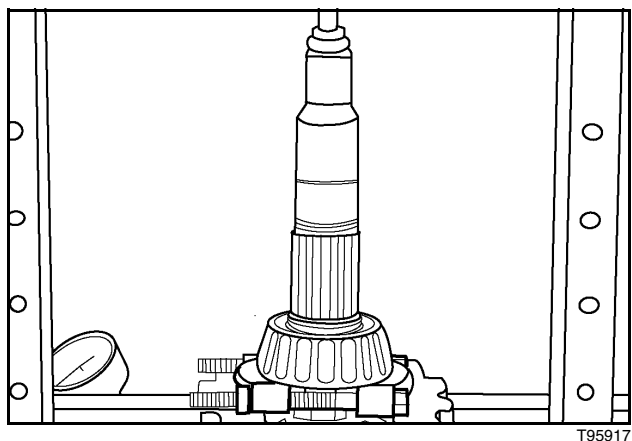
### STEP 65



Press the pinion shaft and bearings out of the bearing cage.

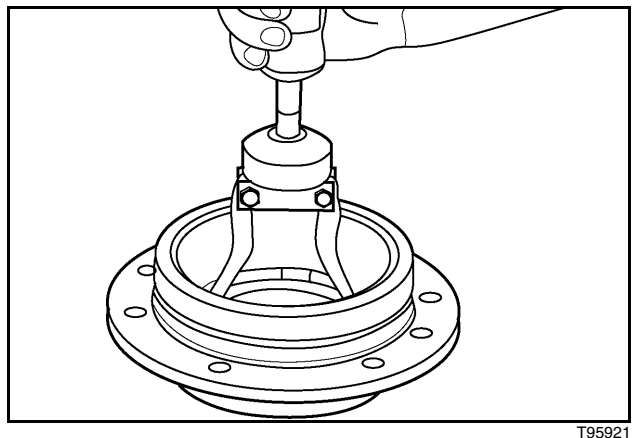
**NOTE:** Make sure that the rear bearing (against the gear) will clear the press.

### STEP 66



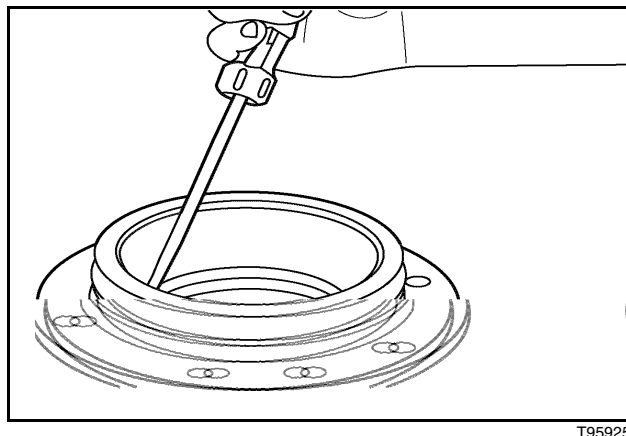
Press the bearing cone from the pinion shaft.

### STEP 67



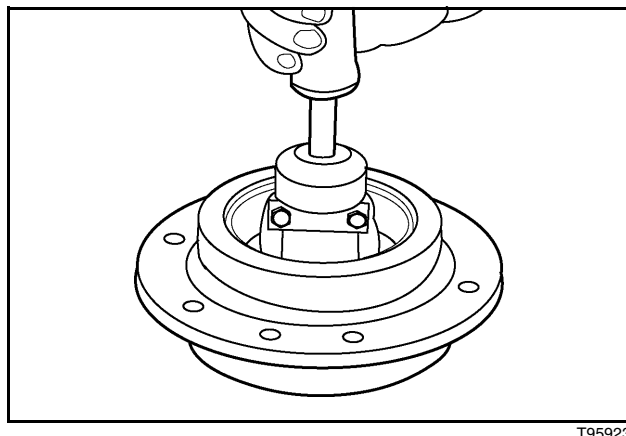
Remove the front bearing cup from the bearing cage.

### STEP 68



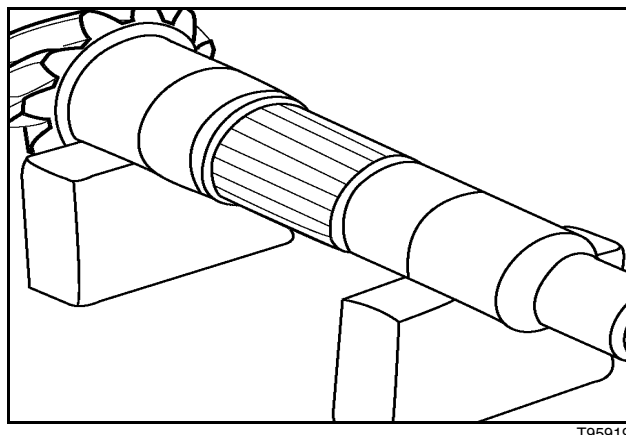
Remove the inner snap ring from the bearing cage.

### STEP 69



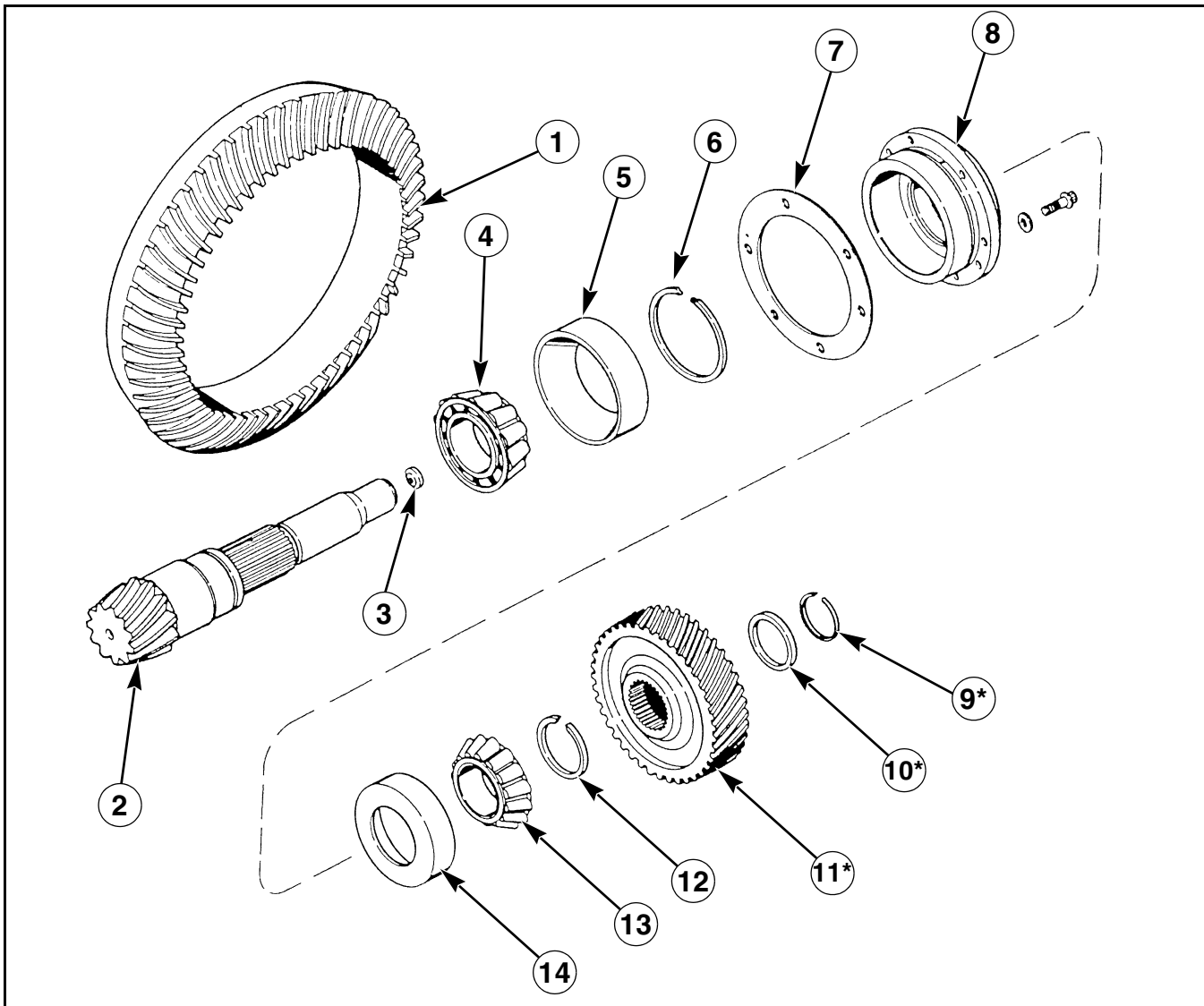
Remove the rear bearing cup from the bearing cage.

### STEP 70



Be sure the hole in the button of the pinion shaft is open.

## Assembly and Installation

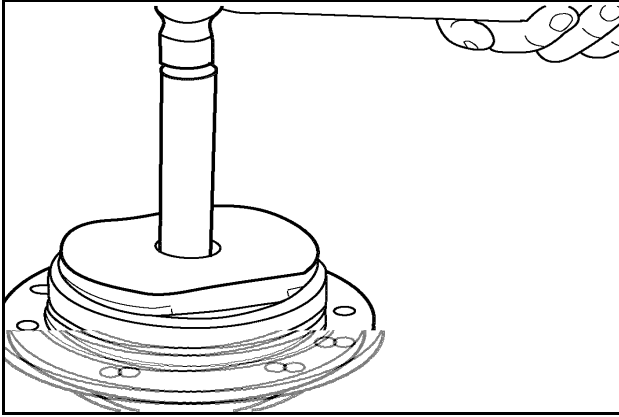


23817

- |                       |                         |
|-----------------------|-------------------------|
| 1. RING GEAR          | 8. BEARING CAGE         |
| 2. PINION SHAFT       | 9. SNAP RING*           |
| 3. CUP PLUG WITH HOLE | 10. SPACER*             |
| 4. BEARING CONE       | 11. CONSTANT MESH GEAR* |
| 5. BEARING CUP        | 12. SHIM RING           |
| 6. SNAP RING          | 13. BEARING CONE        |
| 7. SHIM               | 14. BEARING CUP         |

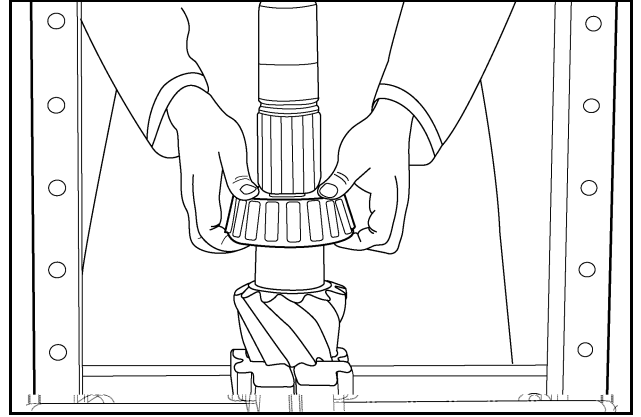
**NOTE:** All parts marked with \* remain in the range transmission.

**STEP 71**



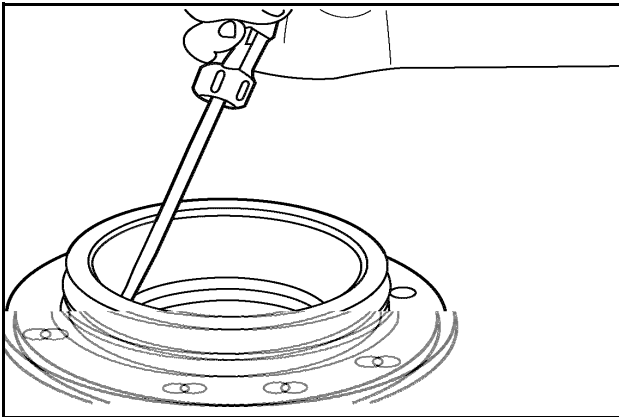
Press the rear bearing cup into the bearing cage until seated.

**STEP 74**



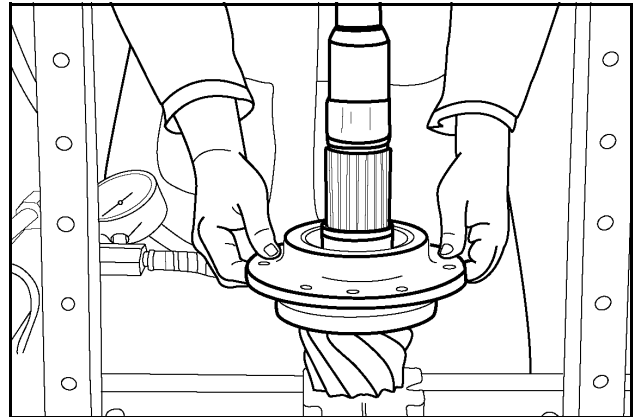
Press the bearing cone on the pinion shaft until seated against the gear.

**STEP 72**



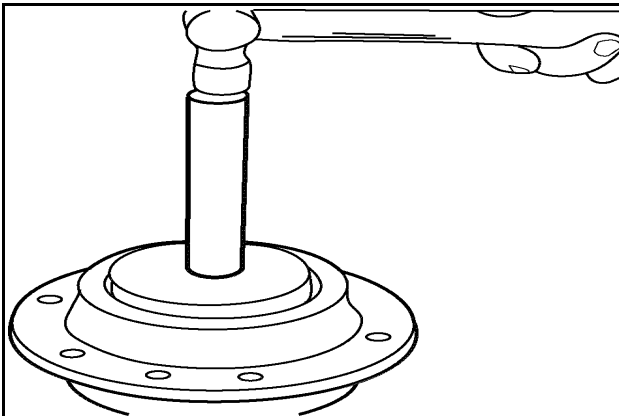
Install the rear snap ring in the bearing cage groove.

**STEP 75**



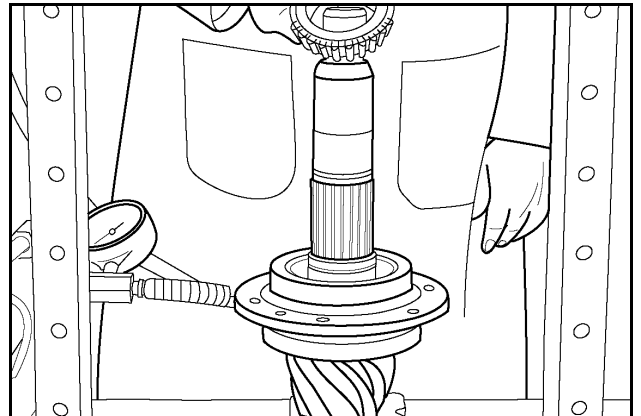
Install the bearing cage over the shaft and bearing.

**STEP 73**



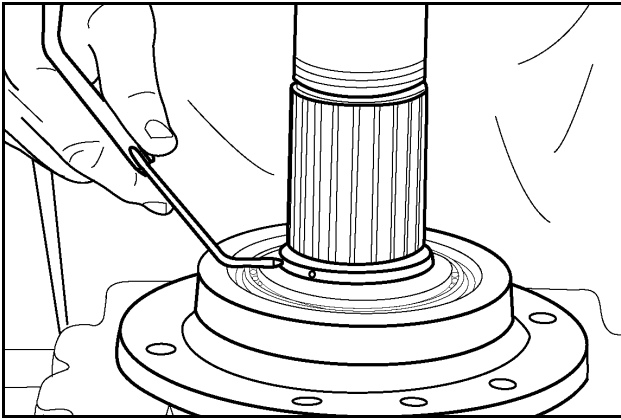
Press the front bearing cup into the bearing cage until seated against the snap ring.

**STEP 76**



Press the front bearing on the pinion shaft and into the bearing cup as you turn the bearing cage to help seat the bearing.

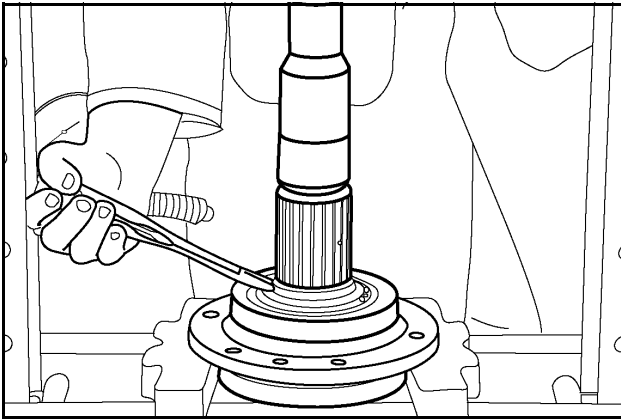
### STEP 77



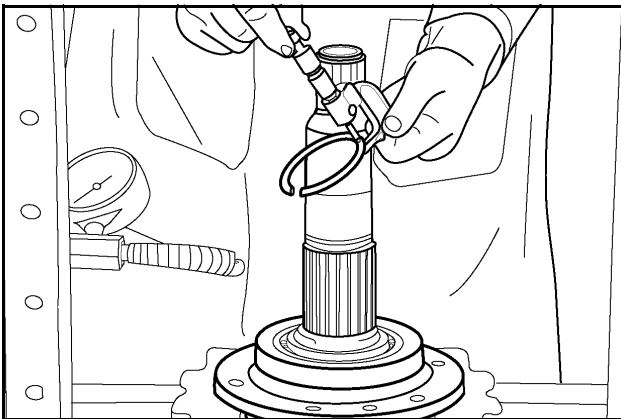
T95923

Measure the distance from the bearing cone to the front of the snap ring groove using feeler gauges.

### STEP 78



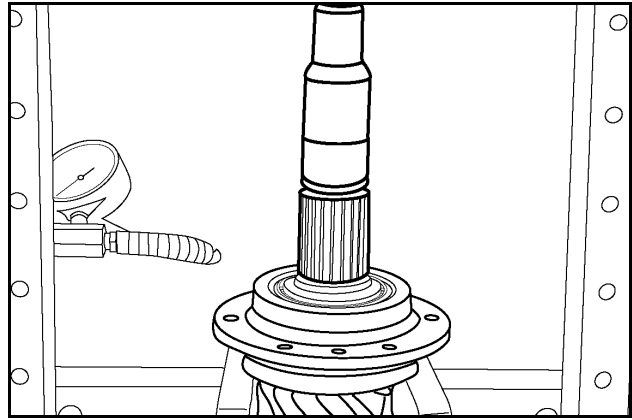
T95934



T95933

Select a snap ring with a thickness between 0.05 mm (0.002 inch) less than your measurement to 0.007 mm (0.003 inch) more than your measurement. If more than one ring can be used, install the thicker ring in the pinion shaft groove.

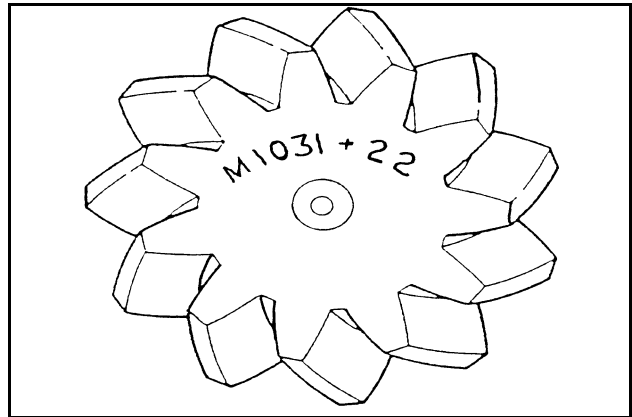
### STEP 79



T95935

Backseat the front bearing on the snap ring with 10,000 to 15,000 lb. of force. Check the end play again. The end play must be from 0.013 to 0.102 mm (0.0005 to 0.004 inch). If the end play is incorrect, install the correct size snap ring (larger or smaller) to obtain the correct end play.

It may be necessary to make calculations to determine the force to use with your ram. See "How to Determine Ram Pressure" below.



1060L9

Determine pinion shaft bearing end play as follows:

1. Mount the bearing cage in a vise.
2. Attach a dial indicator on the bearing cage so that it indicates from the end of the pinion shaft.
3. Measure the end play by pushing on the shaft with 50 to 100 lb. of force.
4. Record the indicator reading while slightly oscillating the shaft.
5. Repeat the procedure in the opposite direction.

The difference between the two readings is the pinion shaft bearing end play.

### How To Determine Ram Pressure

Do the following to determine what the pressure gauge must show for your ram:

1. Determine the effective area of your ram.
2. Determine the minimum and maximum pressure gauge readings desired.

EXAMPLE: Find the effective area of twin rams, each ram having a piston diameter of 1.5 inch.

The formula for the effective area is:

$$\text{Effective area} = (d^2 + d^2) \times 0.7854$$

d = diameter of each ram (1.5 inch)

$$d^2 = d \times d \text{ or } 1.5 \times 1.5 = 2.25 \text{ sq inch for each ram}$$

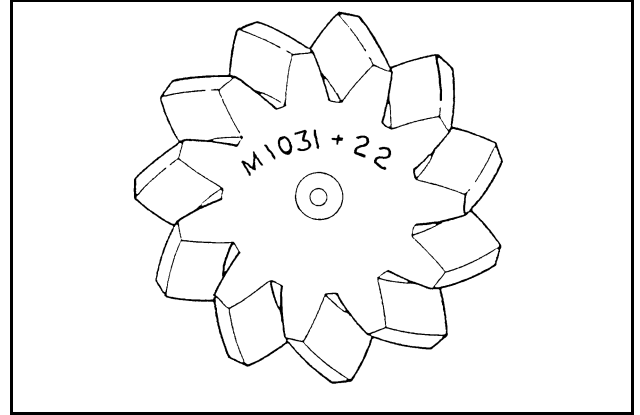
$$\text{Effective area} = (2.25 + 2.25) \times 0.7854 = 3.574 \text{ sq inch}$$

EXAMPLE: Find the pressure gauge reading for the specified minimum and maximum lb ft force rising a ram with 3.528 sq inch effective area.

$$\begin{aligned} \text{Minimum pressure gauge} \\ \text{reading (PSI)} &= \frac{2090 \text{ lb}}{3.534 \text{ sq inch}} = 591 \text{ PSI} \end{aligned}$$

$$\begin{aligned} \text{Maximum pressure gauge} \\ \text{reading (PSI)} &= \frac{2610 \text{ lb}}{3.528 \text{ sq inch}} = 738 \text{ PSI} \end{aligned}$$

### STEP 80



1061L9

Determine correct dimension as follows:

1. The reference number etched on the end of the pinion shaft is a + or - adjustment in hundredths of a mm.
2. Add or subtract the reference number from the standard nominal dimension of 33.92 mm. This will provide the desired dimension in mm.
3. To convert the desired dimension to inches, multiply by 0.03937.

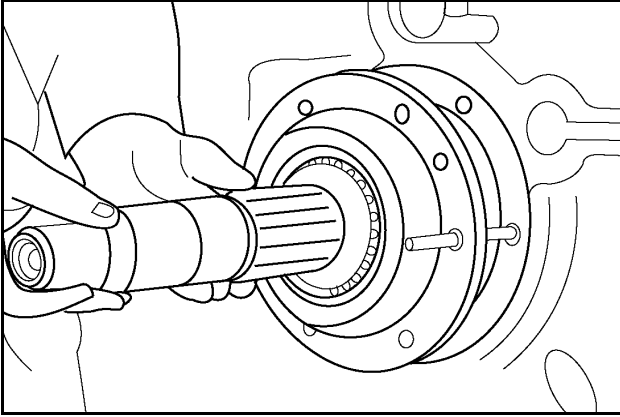
Example:

$$\begin{aligned} &33.92 \text{ mm Standard Dimension} \\ &+0.22 \text{ mm Reference} \\ &34.14 \text{ mm Desired Dimension} \end{aligned}$$

$$34.14 \times 0.03937 = 1.344 \text{ inches}$$

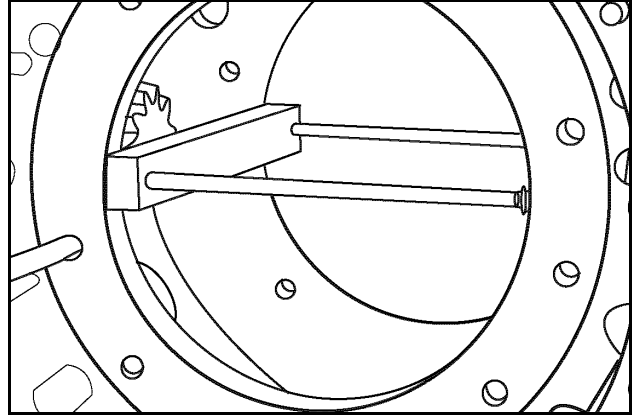


**STEP 81**



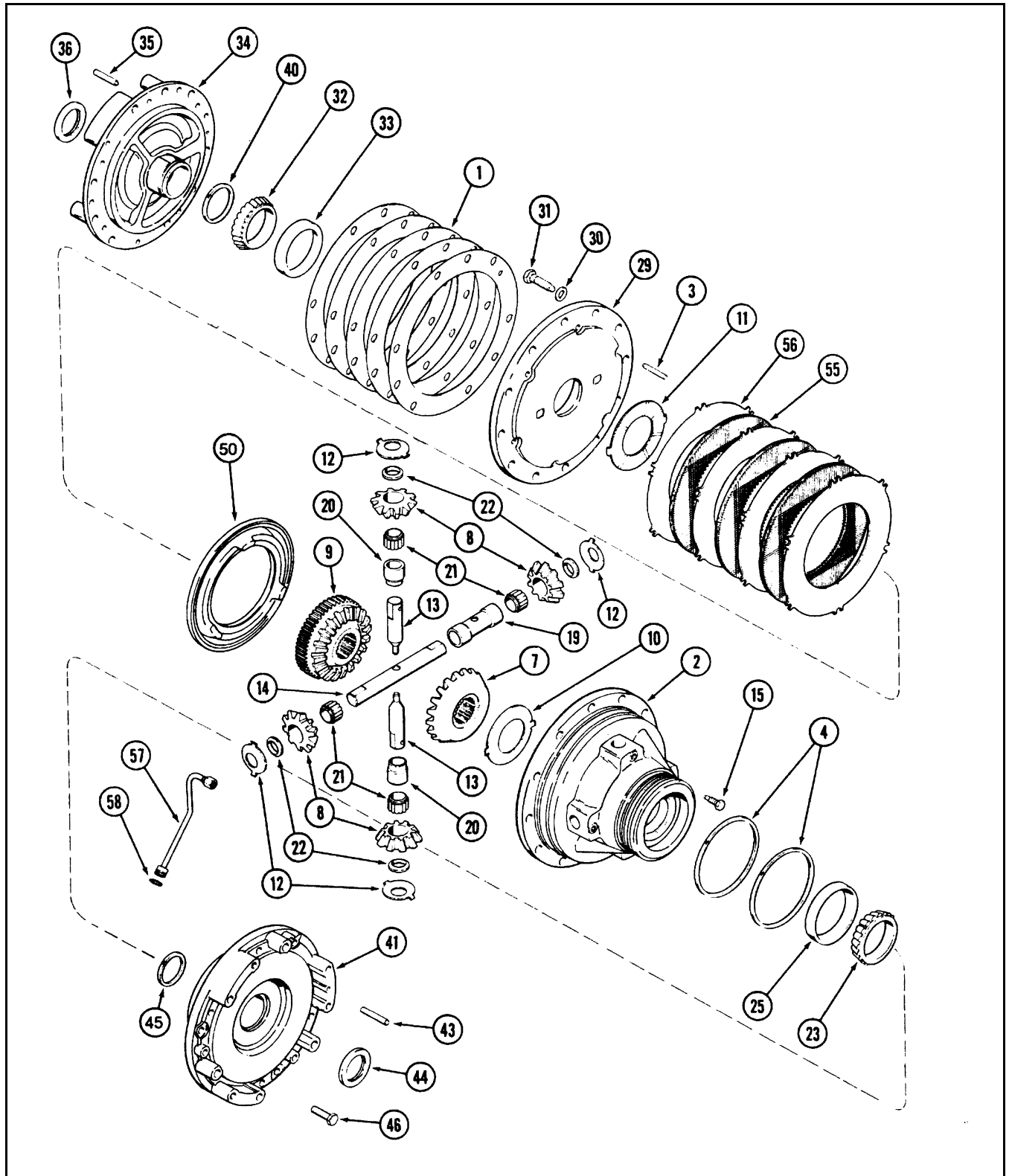
Install the pinion shaft assembly without any shims. Install and tighten retaining bolts to a torque of 102 to 113 Nm (75 to 83 lb. ft.).

**STEP 82**



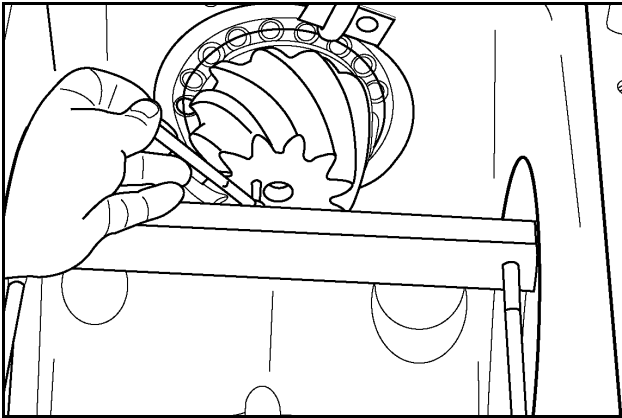
Install the pinion shaft depth setting tool CAS1902-1 into the differential bearing retainer bores so the bar is centered on the pinion shaft.

# Differential Assembly



- |                   |                   |                    |                  |            |            |
|-------------------|-------------------|--------------------|------------------|------------|------------|
| 1. SHIM           | 11. THRUST WASHER | 21. NEEDLE BEARING | 32. CONE BEARING | 43. PIN    | 55. PLATE  |
| 2. HOUSING        | 12. WASHER        | 22. RING           | 33. CUP BEARING  | 44. SEAL   | 56. PLATE  |
| 3. PIN            | 13. SHAFT         | 23. CONE BEARING   | 34. RETAINER     | 45. RING   | 57. TUBE   |
| 4. RING           | 14. SHAFT         | 25. CUP BEARING    | 35. PIN          | 46. BOLT   | 58. O-RING |
| 7. GEAR           | 15. BOLT          | 29. COVER          | 36. SEAL         | 50. PISTON |            |
| 8. GEAR           | 19. SPACER        | 30. WASHER         | 40. RING         |            |            |
| 10. THRUST WASHER | 20. SPACER        | 31. BOLT           | 41. RETAINER     |            |            |

### STEP 83



T98202

Determine dimension as follows:

1. Apply 50 to 100 lbs forward loading on the pinion shaft to remove all bearing end play.
2. Measure from the face of the pinion shaft to the face of the depth setting tool bar in millimeters. This is your measured dimension.
3. Subtract this measurement from the desired dimension calculated in Step 80.

Example:

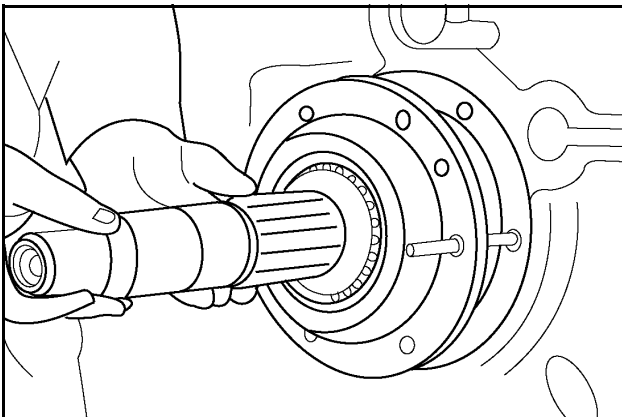
34.14 mm Desired Dimension

-33.82 mm Measured Dimension

0.32 mm Shim Pack Size

4. Shims are available in the following sizes:  
0.003, 0.004, 0.005 and 0.012 inches (0.076, 0.10, 0.13, and 0.30 mm).

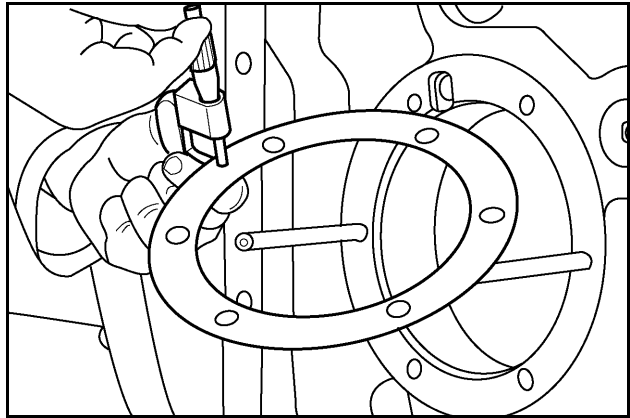
### STEP 84



T95912

Remove the pinion shaft assembly from the housing.

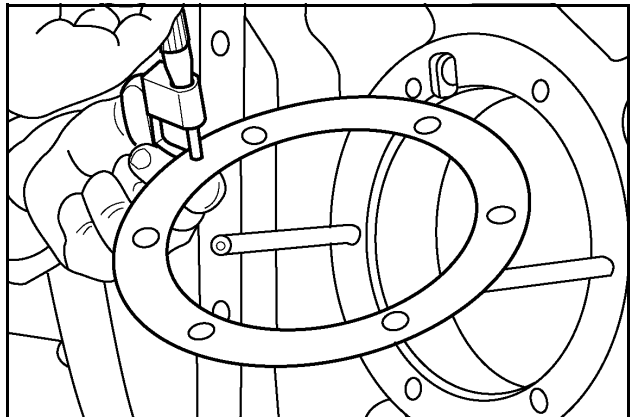
### STEP 85



T95913

Select the correct shim pack, determined in Step 83, within 0.03 mm (0.001 inch). Install the shims over the alignment dowels.

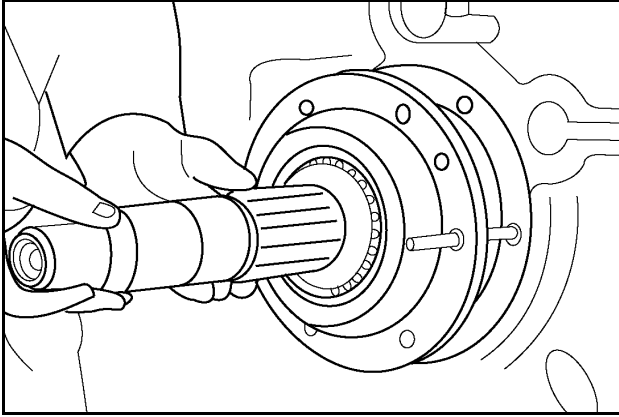
### STEP 86



T95913

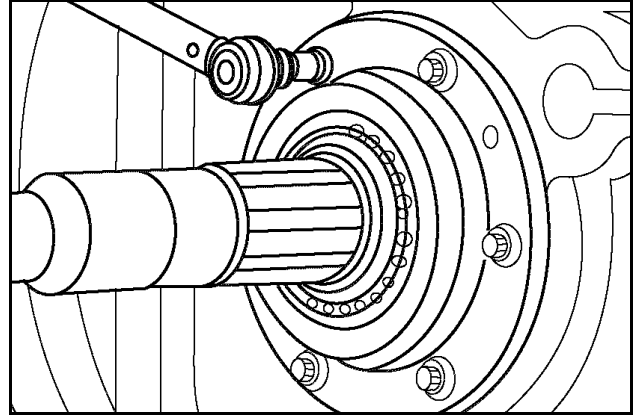
Select the correct shim pack, determined in Step 83, within 0.03 mm (0.001 inch). Install the shims over the alignment dowels.

**STEP 87**



Place the pinion shaft assembly on the housing.

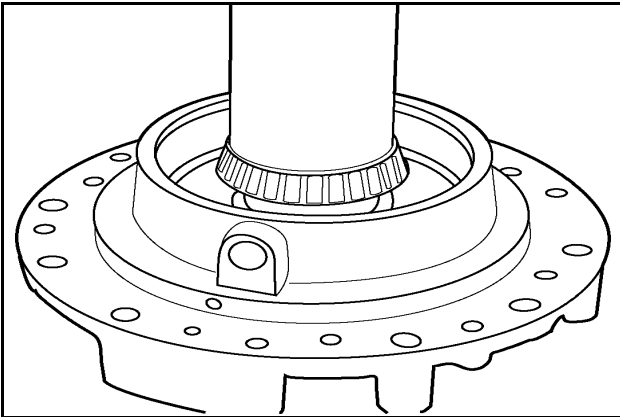
**STEP 88**



Install the pinion shaft assembly mounting bolts. Apply a torque of 101.7 to 112.5 Nm (75 to 83 lb ft) to each bolt.

## DIFFERENTIAL ASSEMBLY

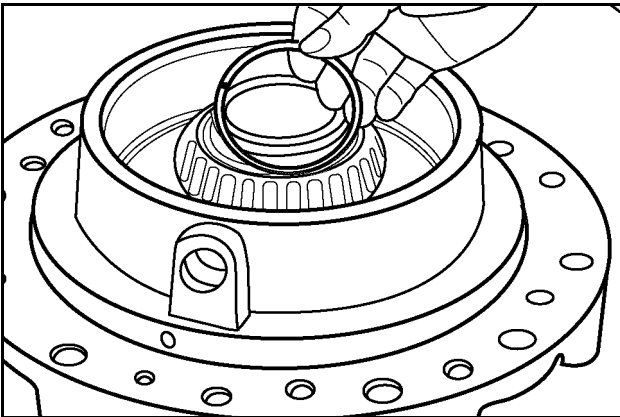
### STEP 89



rd98c191

Install the bearing cones on both the right-hand (RH) and left-hand (LH) bearing retainer until seated against the shoulder of the retainer.

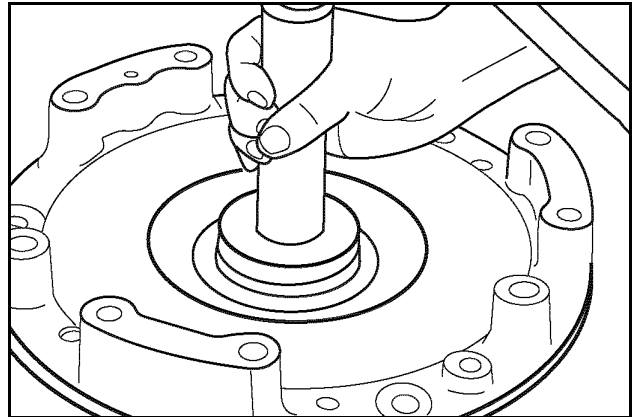
### STEP 90



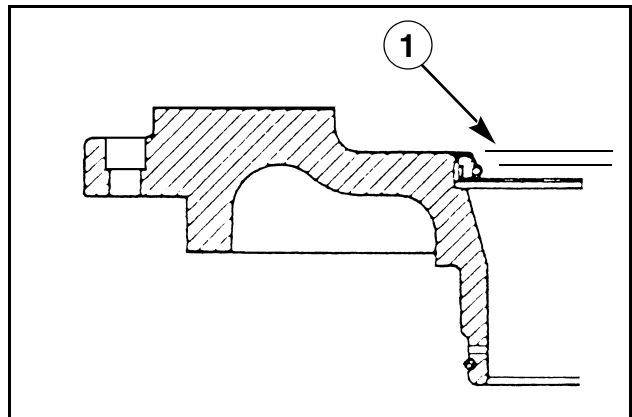
RR98C045

Install the seal rings on both the RH and LH retainer. Make sure the ends of the ring lock together.

### STEP 91



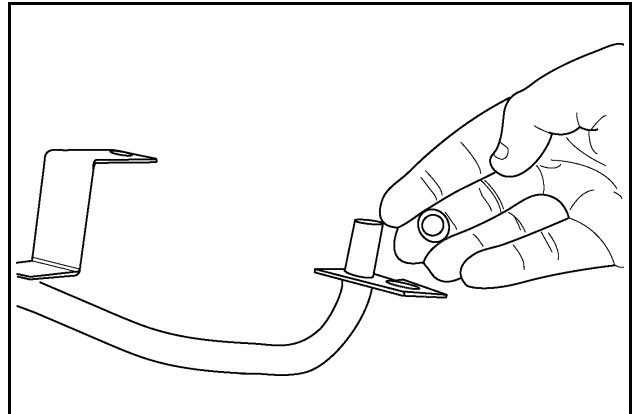
T98206



397L7

Install the oil seals into the bearing retainers. The rubber lip faces the outside of the retainer. The seal must be recessed below the retainer face (1) 0.8 mm (0.032 inch).

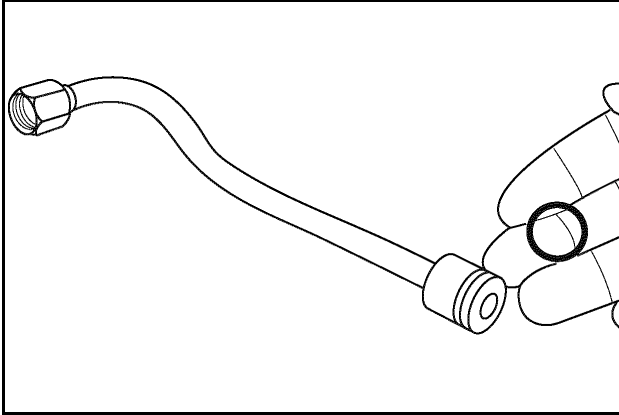
### STEP 92



RD98C188

Install a new O-ring lubricated with petroluem jelly on the pinion shaft lubrication tube.

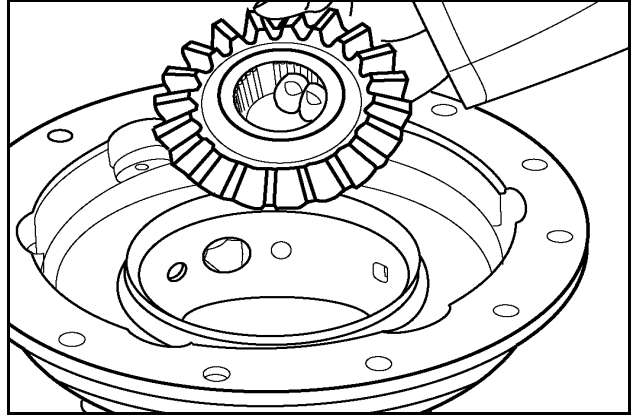
### STEP 93



T98209

Install a new O-ring lubricated with petroleum jelly on the differential lock supply tube.

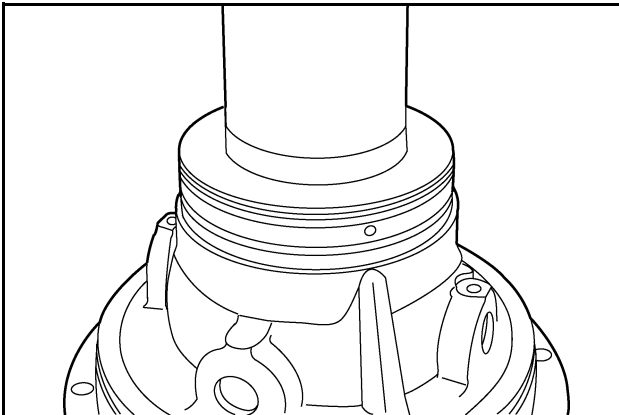
### STEP 96



T98168

Install the standard side gear in the housing so the gear teeth face away from the thrust washer.

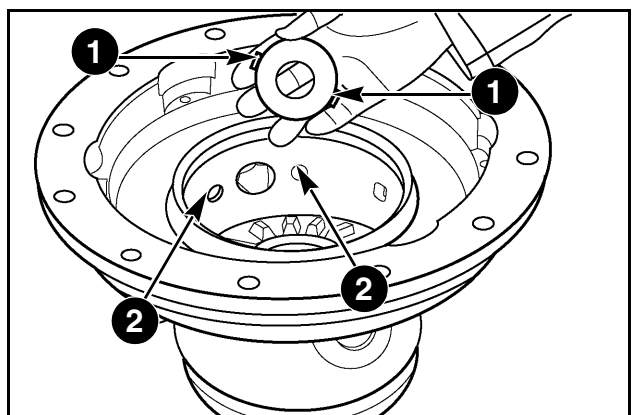
### STEP 94



88-22A

Install the bearing cup into the housing until seated against the housing.

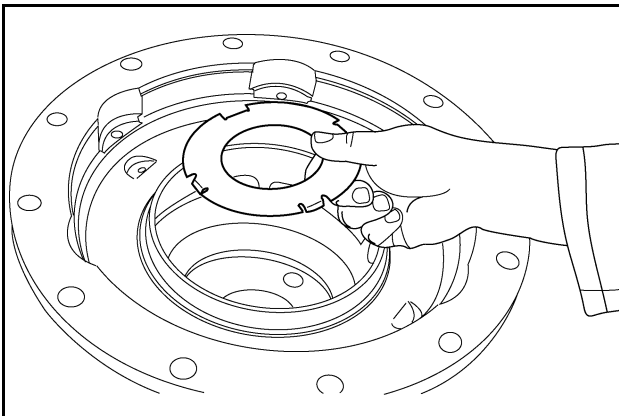
### STEP 97



T98167

Apply petroleum jelly to the four thrust washers. Install two washers for the long pinion shaft so the tabs (1) enter the cavities (2) in the housing. The long shaft does not use locking bolts.

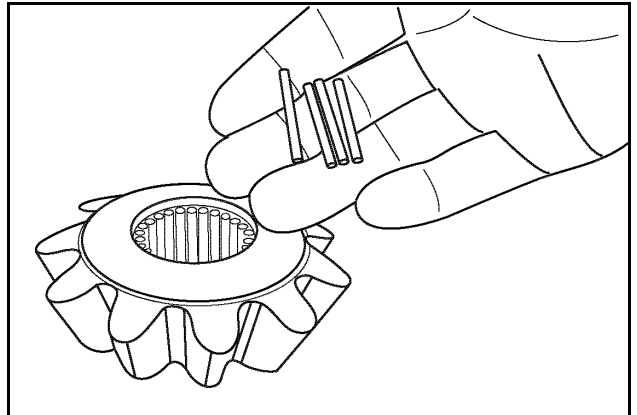
### STEP 95



88-19A

Install the smaller thrust washer into the differential housing so the washer tabs enter the cavities in the housing.

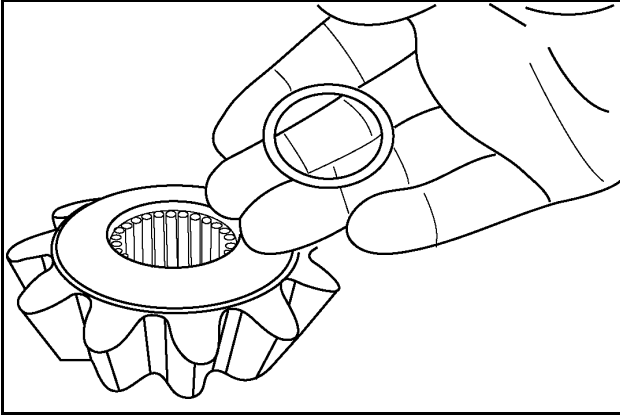
### STEP 98



T98208

Apply petroleum jelly to the inside of the four pinion gears. Install 28 needle bearings in each gear.

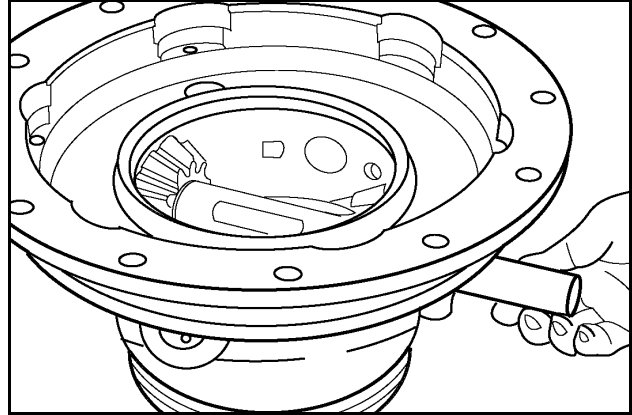
**STEP 99**



T98207

Install the needle bearing spacers in the gears on top of the needle bearings.

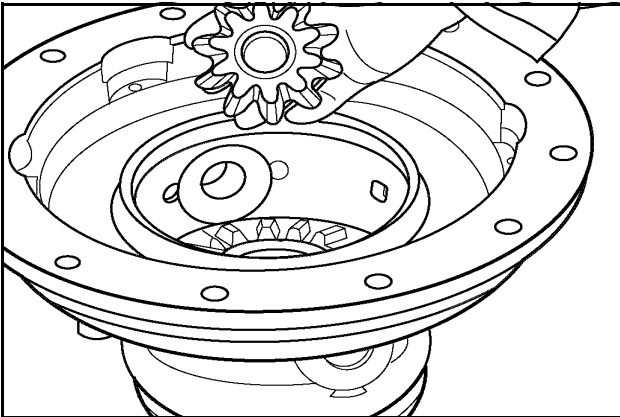
**STEP 102**



T98164

Install the long pinion shaft into the housing bore without locking bolts holes and through the long spacer.

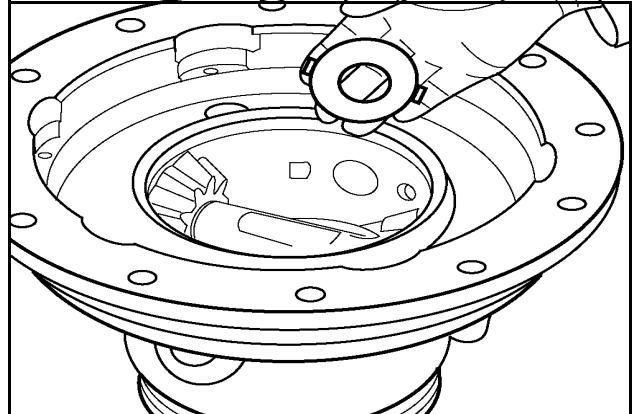
**STEP 100**



T98166

Install the two pinion gears for the long shaft into the housing against the thrust washers.

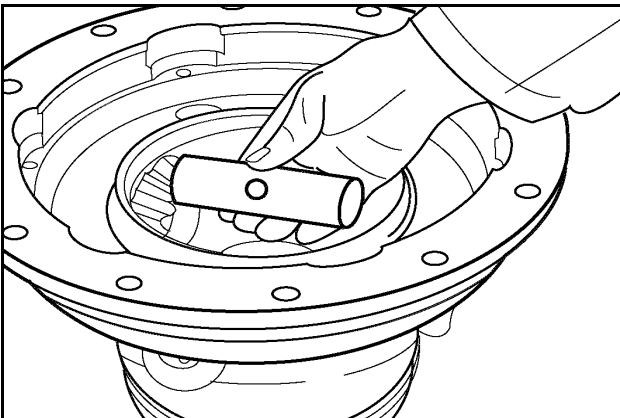
**STEP 103**



T98163

Install the remaining two thrust washers into the housing so that the washer tabs enter the cavities in the housing.

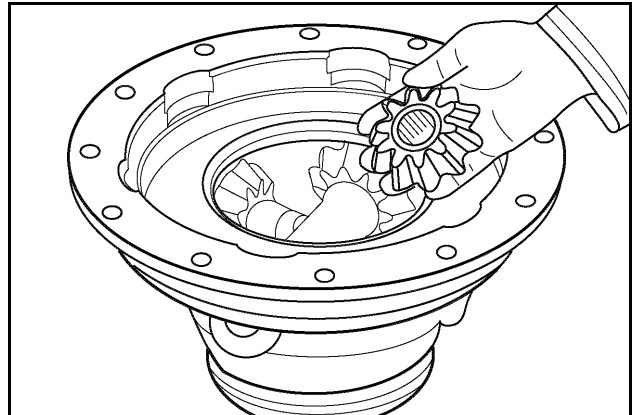
**STEP 101**



T98165

Install the long spacer into the housing cavity.

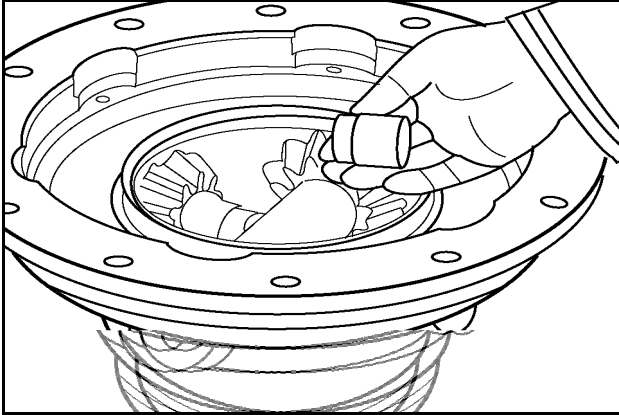
**STEP 104**



T98162

Install the two remaining pinion gears into the housing against the thrust washers.

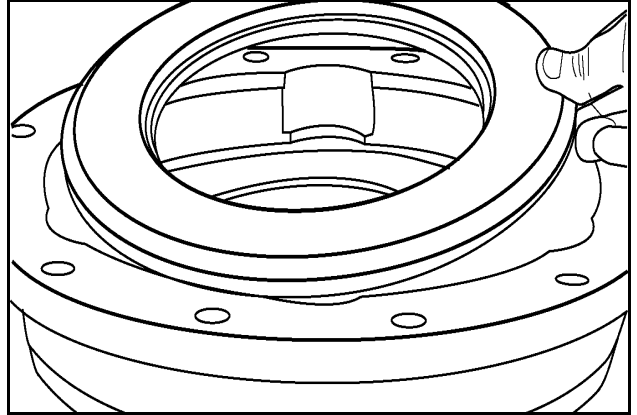
### STEP 105



T98161

Install the short spacers into the housing so the smaller diameter ends face the long shaft.

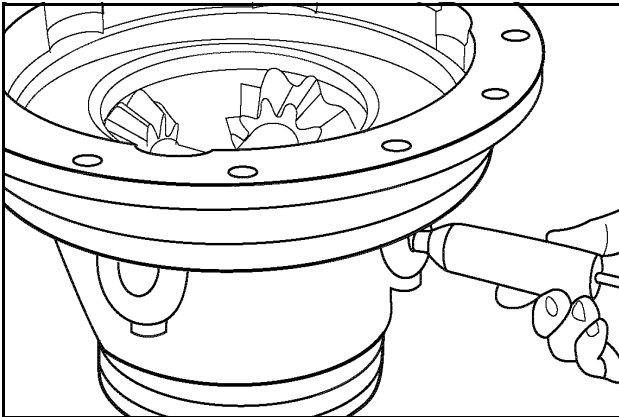
### STEP 108



RD98C189

Install the differential lock piston in the housing.

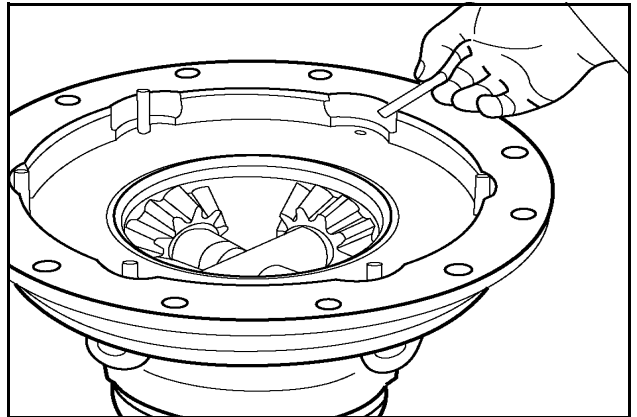
### STEP 106



T98160

Install the two short pinion shafts (small end first) into the housing bores, through the short spacers and into the hole in the long spacer and long pinion shaft. Keep the locking bolt hole of the short shaft aligned with the bolt hole in the housing.

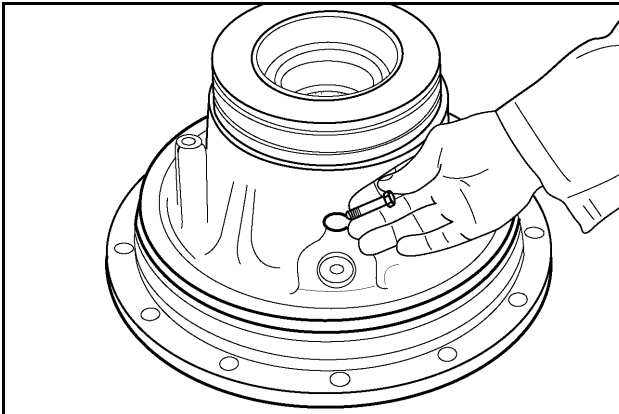
### STEP 109



T98154

Install the six dowel pins into the housing.

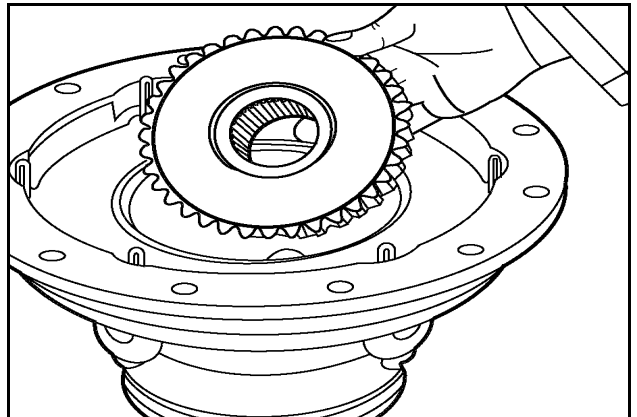
### STEP 107



T98155

Install the short pinion shaft locking bolts through the housing into the shafts.

### STEP 110

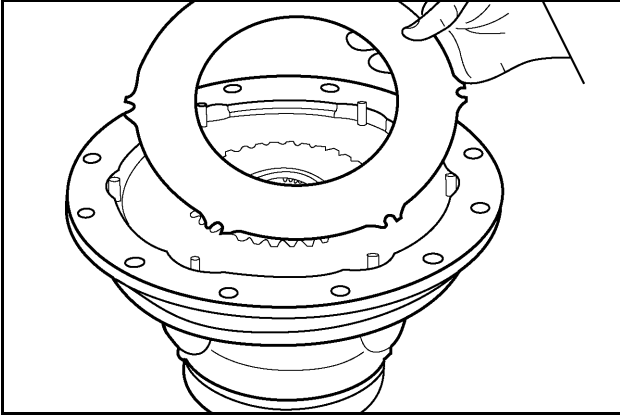


T98153

Install the locking side gear into the housing so that the teeth mesh with the pinion gears.

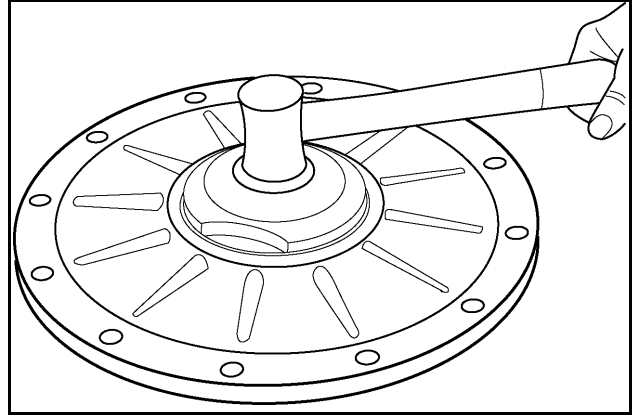


**STEP 111**



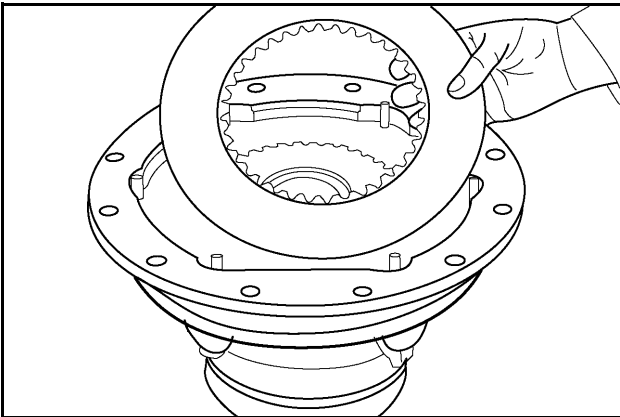
Install one separator plate in the housing so it locks on the dowel pins.

**STEP 114**



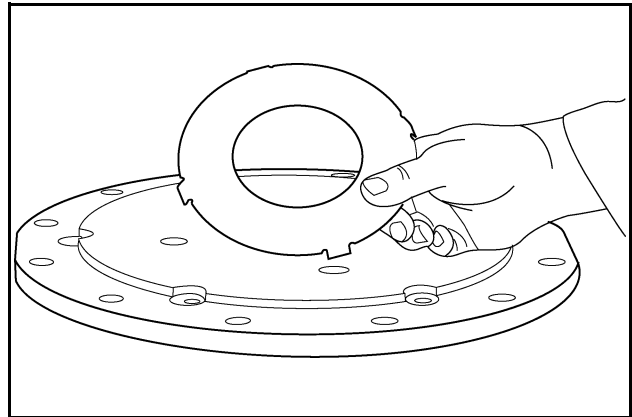
Install the bearing cup into the differential cover until seated against the cover.

**STEP 112**



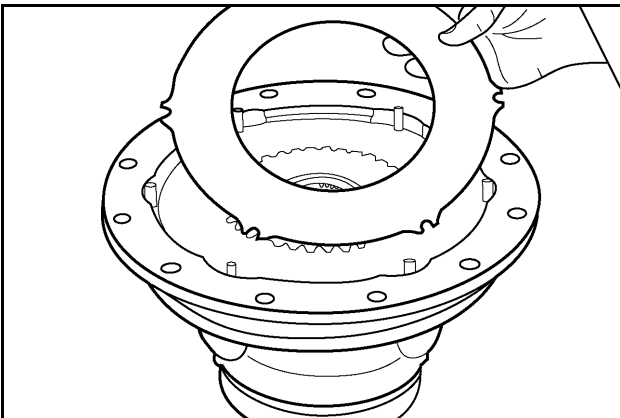
Install one friction plate in the housing so it will mesh with the locking side gear.

**STEP 115**



Apply grease to the larger thrust washer and install the washer on the cover so the tabs enter the cover cavities.

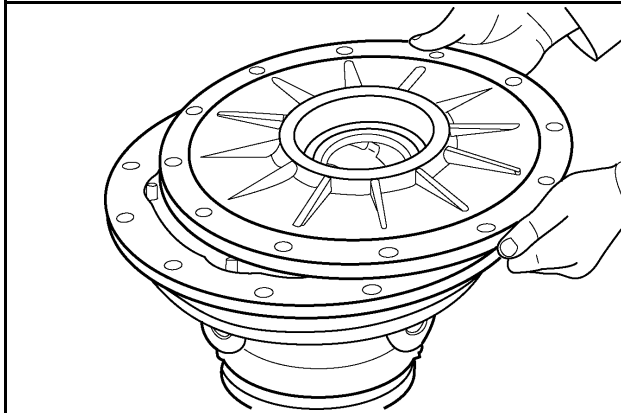
**STEP 113**



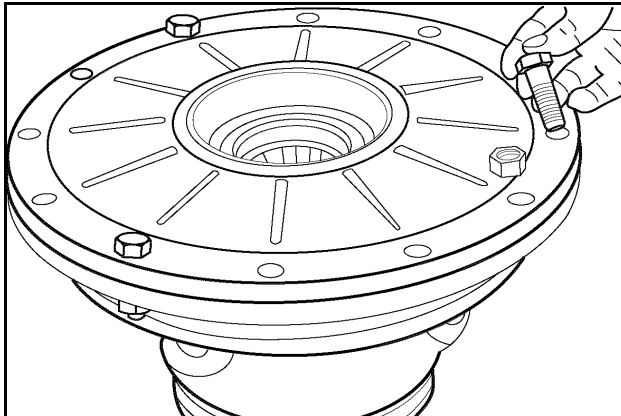
Alternate the separator and friction plates until you have a total of three friction plates and four separator plates in the housing.

## DIFFERENTIAL INSTALLATION

### STEP 116



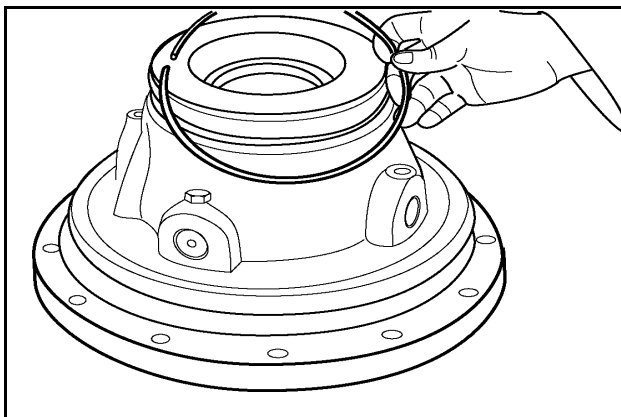
T98149



T98182

Install the differential cover on the housing.

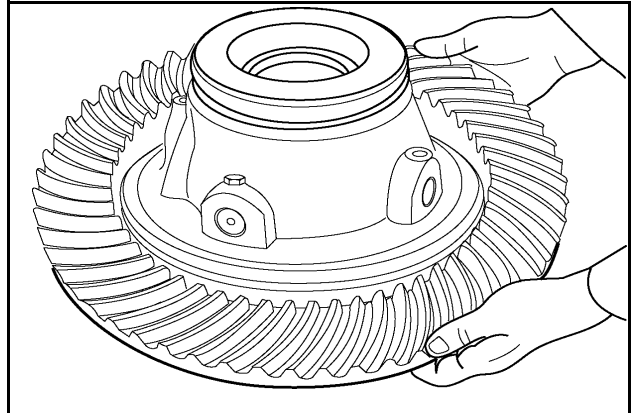
### STEP 117



T98147

Install the seal rings on the housing. Make sure the ends of the rings are locked together.

### STEP 118



T98146

Place the ring gear on the differential housing. Install 12 new ring gear bolts and torque to 310 Nm (230 lb. ft.).

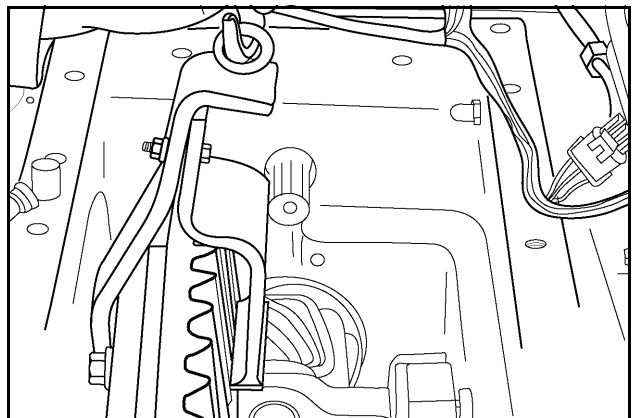
### STEP 119



T98204

Install the differential lifting tool onto the differential.

### STEP 120

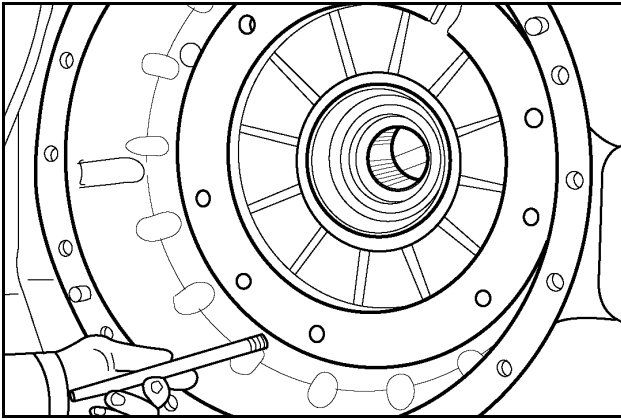


T98214

Install the differential into the rear frame with the ring gear to the left-hand side.

**IMPORTANT:** *The pinion shaft must not be assembled into the housing.*

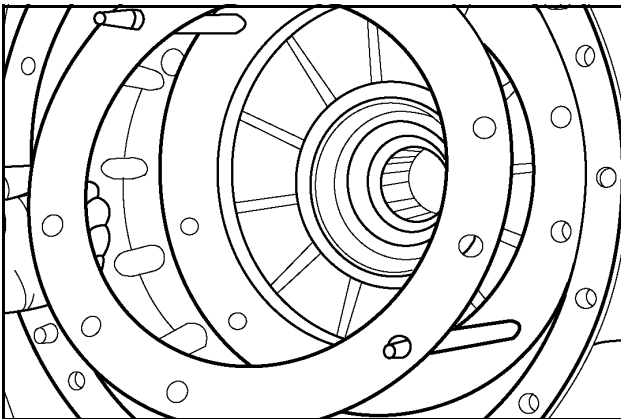
## STEP 121



T98192

Install two aligning dowels in each bearing retainer mounting surface of the rear frame.

## STEP 122

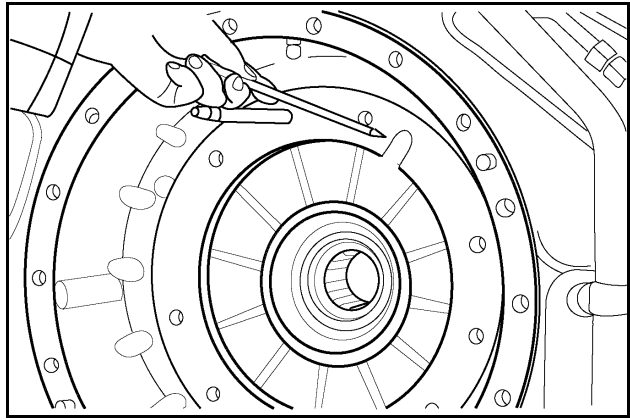


T98199

Install shims as follows:

1. If no changes were made with the differential bearings, install the original shims back in their original locations at each bearing retainer. Check differential rolling torque.
2. Check the backlash on the ring and pinion and adjust if necessary.
3. When new bearings are installed or the housing is replaced, the new shim pack dimension determined by the preload adjustment procedure must be used. Install half the shim pack under each bearing retainer (see Adjusting Differential Preload, beginning at Step 148).
4. Make sure that the lube passages in the rear frame align with the proper hole in each shim (see Step 122).

## STEP 123



T98193

Install bearing retainers as follows:

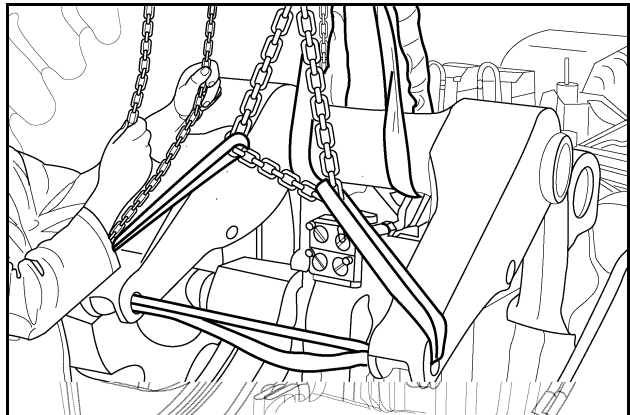
1. Align the lube passage on the rear frame housing with the lube passage in the bearing retainer (shown).
2. Install the bearing retainers on the rear frame housing.
3. Gradually and evenly torque the retainer mounting bolts to 235 to 260 Nm (173 to 192 lb. ft.).

**NOTE:** If the differential bearings were changed, the backlash on the ring and pinion must be set. See *Adjusting the Ring and Pinion Backlash* in this section.

## STEP 124

Install the Diff Lock supply line, Diff Lube line, rear frame cover, and PTO assemblies that were removed. Install rear frame top cover.

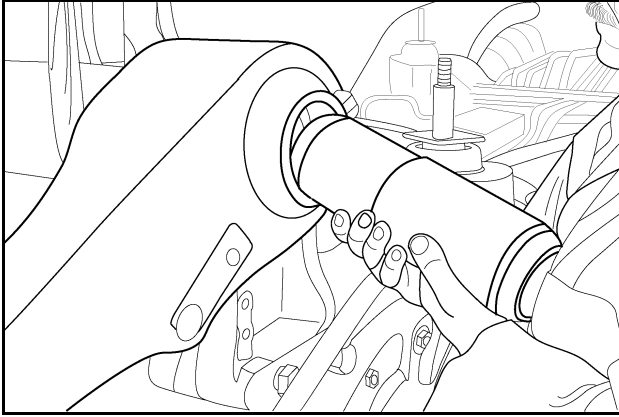
## STEP 125



35-14

With a 3-point sling and hoist, lift the rockshaft casting into place.

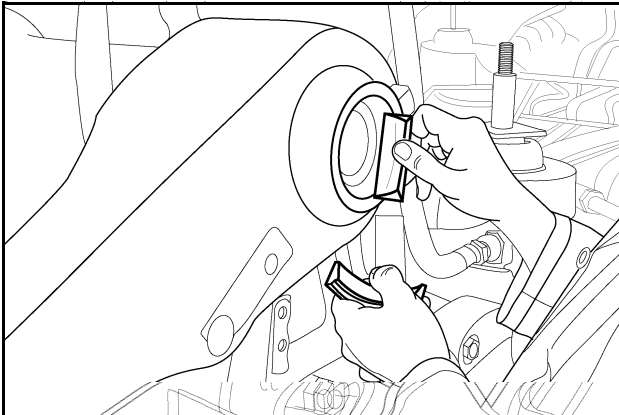
### STEP 126



35-18

The rockshaft pins must be clean and free of oil, grease, antiseize compound, etc. Orient pin with bearing surface outboard. Insert a rockshaft pin. Use a wooden block to tap the pin until it is seated in place. Insert the other rockshaft pin.

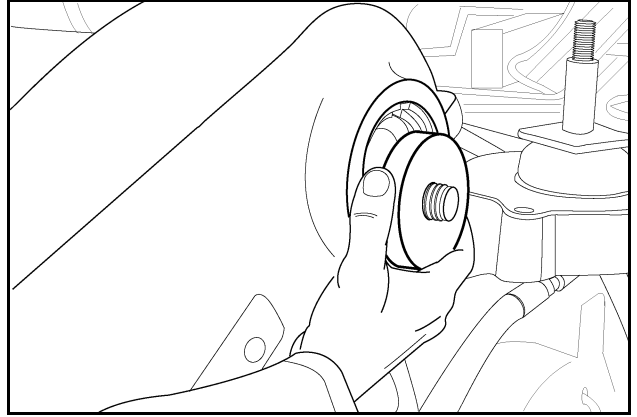
### STEP 127



35-30

Insert new split washer retainers at the ends of both rockshaft pins.

### STEP 128

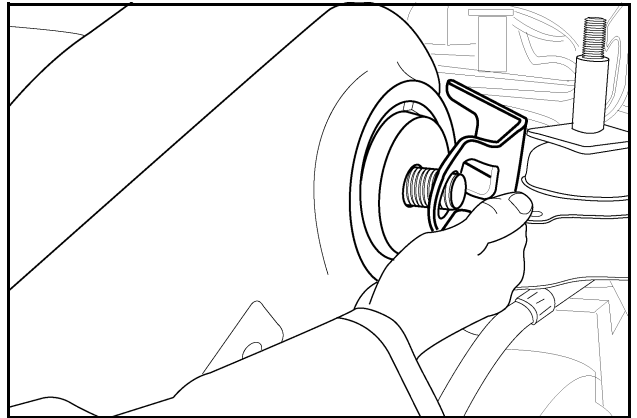


36s1

Install the tie rod as follows:

1. Place one washer and retainer in place on the end tie rod with the nut.
2. Insert the end of the tie rod without the washer and retainer through the centers of the rockshaft pins.
3. Attach the split rings washer and retainer to the end projecting through the rockshaft pin.

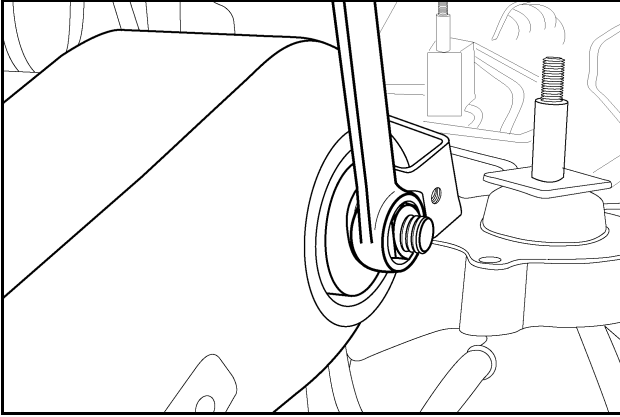
### STEP 129



36s4

Attach the position sensor bracket.

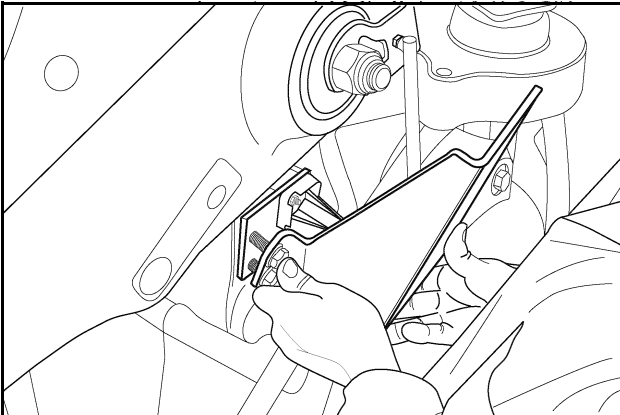
### STEP 130



36s8

Install the nut that attaches the position locator bracket to the end of the tie rod. Tighten to a torque of 490 to 555 Nm (362 to 410 lb. ft.). The nut on the opposite end of the tie rod will need to be held with a wrench to achieve torque.

### STEP 131

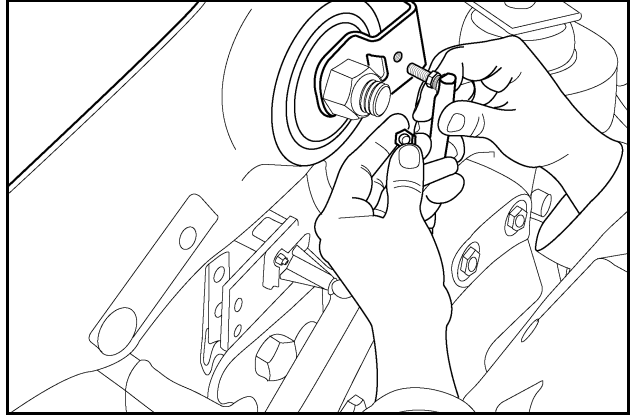


36s21b

Install the two bolts that attach the rockshaft sensor shield to the hitch support arm. Tighten to a torque of 62 to 80 Nm (46 to 59 lb. ft.).

**NOTE:** Refer to *Tractor Hitch* in this manual for details about adjusting the hitch support system.

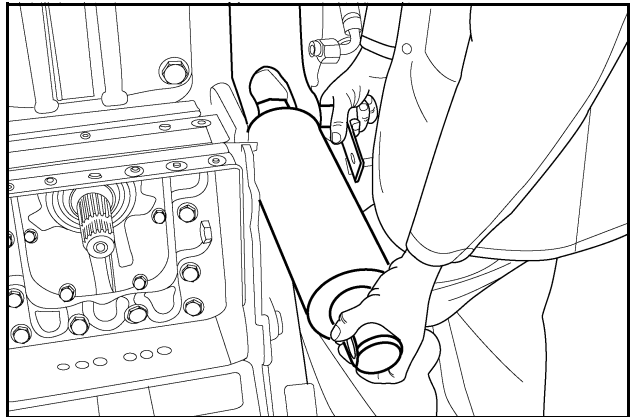
### STEP 132



36s17

Install the nut for the rockshaft sensor link assembly. Torque to 18 to 23 Nm (14 to 17 lb ft.).

### STEP 133

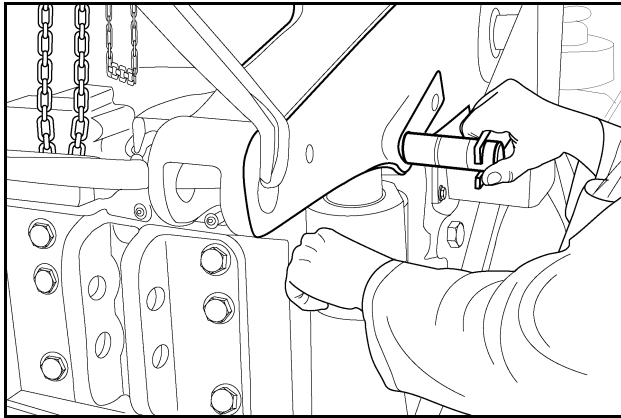


36s28b

Install the hitch lift cylinder as follows:

1. Pins must be clean and free of dirt, grease, oil and anti-seize compound, etc.
2. Position a hitch lift cylinder into place. Insert the bottom cylinder pin (groove outside) through the mounting bracket and cylinder.
3. Attach the locking flag plate.
4. Tighten bolt to a torque of 82 to 106 Nm (60 to 78 lb. ft.).

### STEP 134

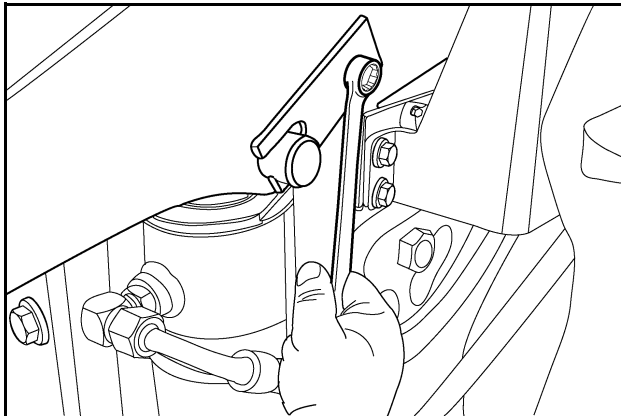


36s34b

Insert the top cylinder pin as follows:

1. Pin must be clean and free of oil, grease, anti-seize.
2. Adjust the vertical position of the rockshaft, if necessary to align holes in cylinder rod and rockshaft.
3. Insert the top cylinder pin through the holes (groove to inside).

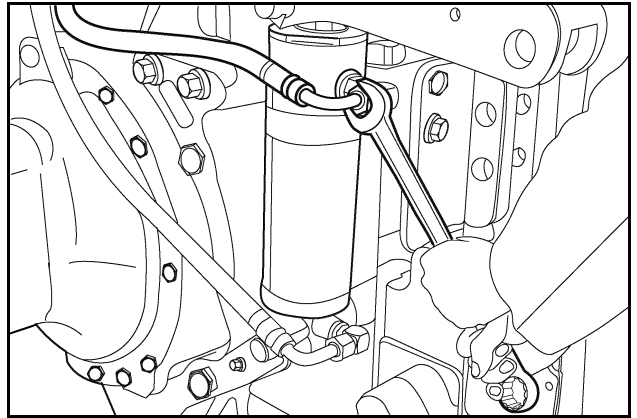
### STEP 135



76-6a

Install the locking flag plate. Install the bolt and tighten to a torque of 82 to 106 Nm (60 to 70 lb. ft.).

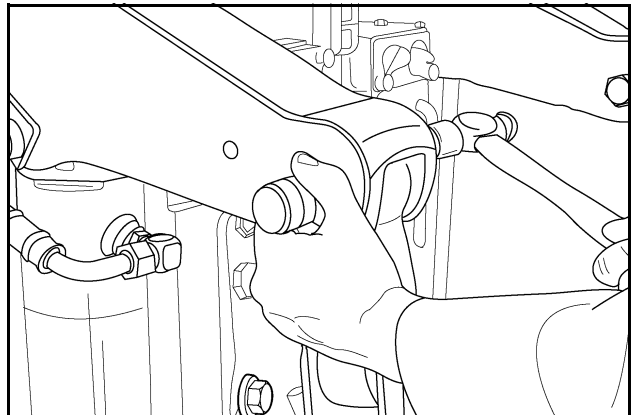
### STEP 136



27s12b

Connect the hydraulic lines to the top and bottom of the hitch cylinder. Repeat for the other hitch lift cylinder.

### STEP 137

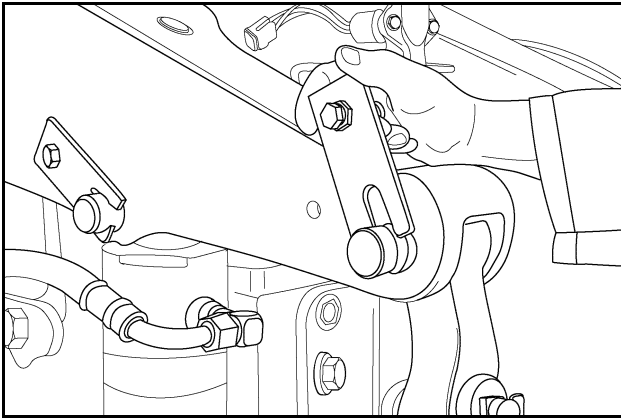


26s27cu

Install the vertical lift links as follows:

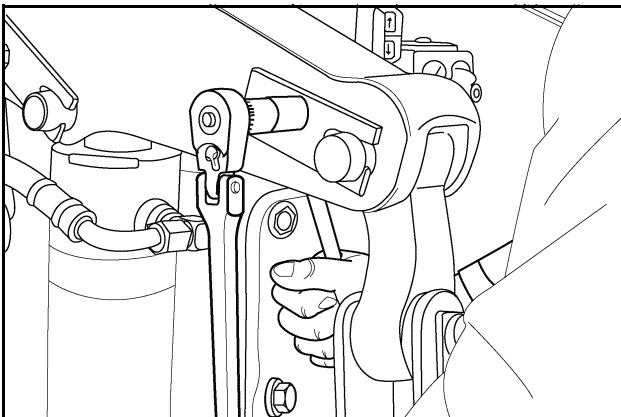
1. Pin must be clean and free of oil, grease, anti-seize.
2. Refer to the view in Step 10 if necessary to assemble the vertical lift link for proper orientation of swivels and flags.
3. Place a hitch swivel pin (groove to outside) part-way through the outside hole in the rockshaft arm.
4. Lift the link into position by aligning the swivel pin with the hole in the swivel.
5. Push the swivel pin through the lift link into the inner ear of the rockshaft arm.

### STEP 138



Insert the slotted end of a locking flag plate into the groove on the inside of the hitch swivel pin.

### STEP 139



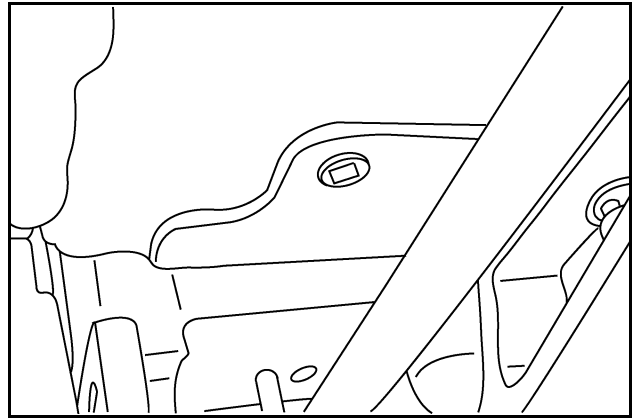
Install the hex-head bolt and tighten it to a torque of 82 to 106 Nm (60 to 78 lb ft). Repeat for the other vertical lifting link.

**NOTE:** Refer to *Tractor Hitch* in this manual for details about orienting the links in the three-point hitch if they were removed.

### STEP 140

When the rockshaft is fully assembled, calibrate the hitch (see *Hitch Controller Calibration and Fault Codes* in this manual for the procedure).

### STEP 141



Install and tighten the rear frame drain plug in the housing.

### STEP 142

Install the drawbar on the tractor and secure with the pin. Torque the pivot pin retaining bolt to 125 to 150 Nm (93 to 112 lb ft). Refer to *Tractor Hitch* in this manual for details.

### STEP 143

Install the brake cylinders onto the tractor.

### STEP 144

Install the axle shafts and planetaries on the tractor.

### STEP 145

Connect the range transmission and the rear frame together (refer to *Range Transmission to Differential Split* in this manual).

### STEP 146

Install the fuel tank on the tractor.

### STEP 147

After filling the transmission, operate the tractor for a few minutes. Shut down and check the transmission fluid level.

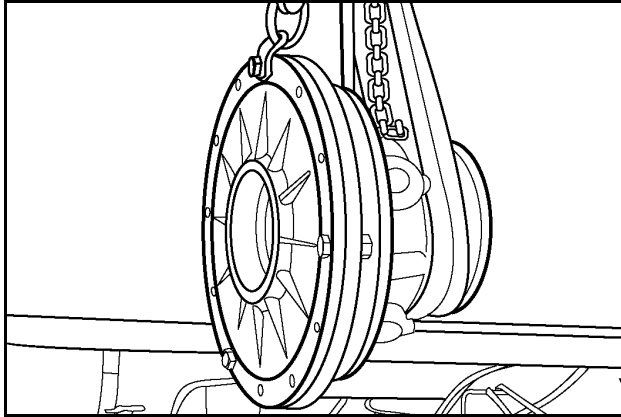
### STEP 148

If not already performed, calibrate the hitch (see *Hitch Controller Calibration and Fault Codes* in this manual).

## ADJUSTING THE DIFFERENTIAL PRELOAD

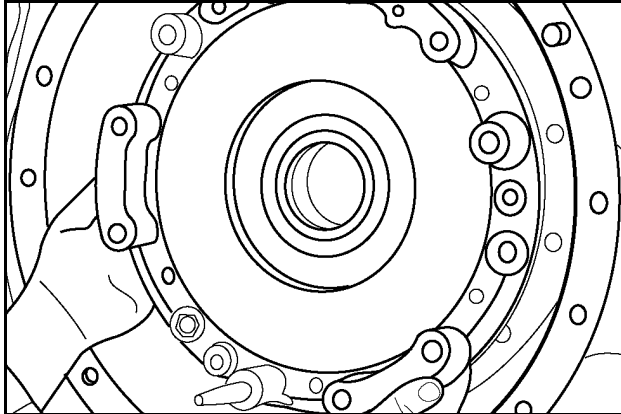
**NOTE:** When the differential bearings or housing are replaced, the bearing preload must be adjusted.

### STEP 149



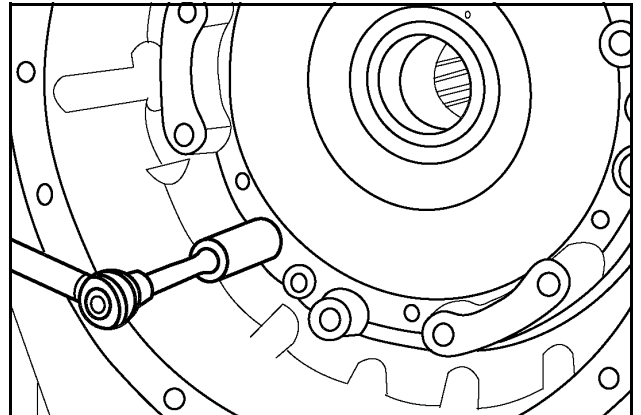
Install the differential assembly into the rear frame without the ring gear when the pinion assembly is in place or with the ring gear when the pinion assembly is removed. If no adjustment is necessary, go to Step 156 for the differential rolling torque check.

### STEP 150



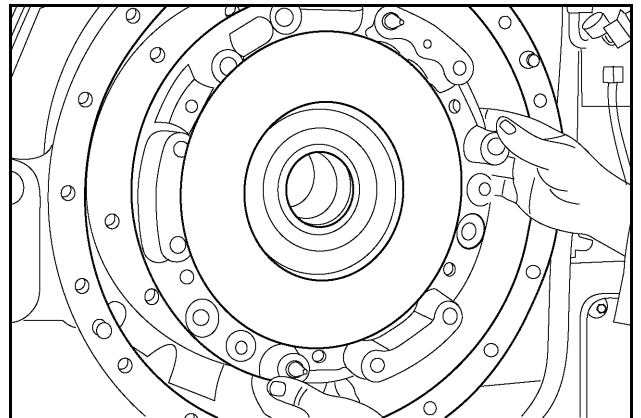
Install the LH bearing retainer assembly on the rear frame without shims.

### STEP 151



Tighten the three retainer mounting bolts to a torque of 235 to 260 Nm (173 to 192 lb ft).

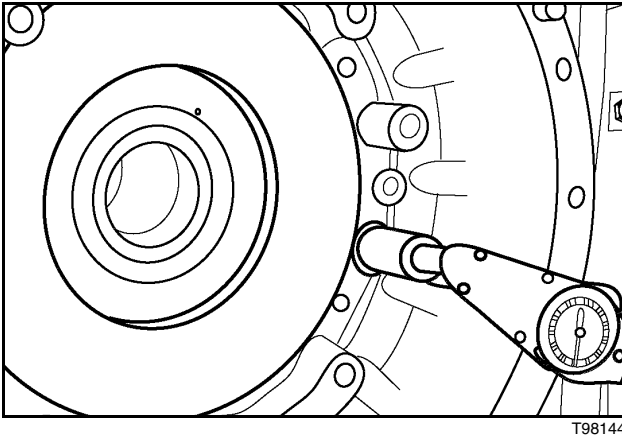
### STEP 152



Install the RH bearing retainer assembly on the rear frame without shims.

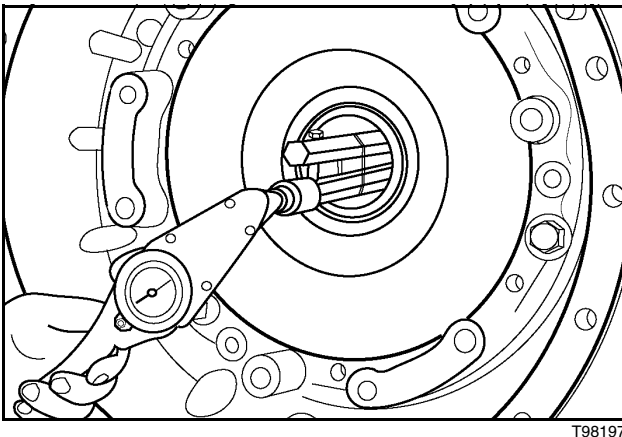


### STEP 153



Tighten the three bearing retainer bolts while rotating the differential to seat the bearings. Torque the bolts equally and evenly in steps of 2.8 Nm (25 lb inch) steps, until 11 Nm (100 lb inch) of torque is reached on each bolt.

### STEP 154

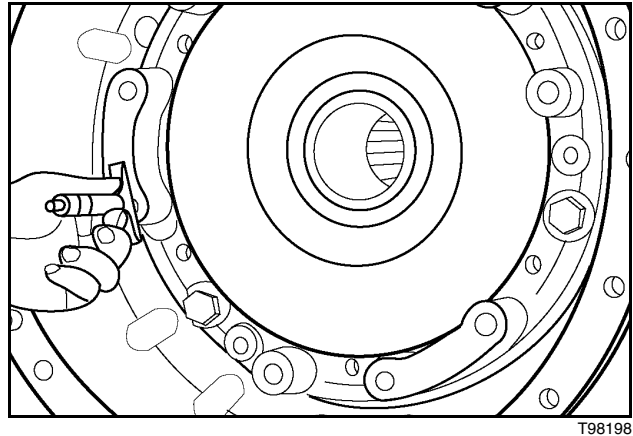


Obtain the rolling torque as follows:

1. Install the rolling torque adapter into the differential assembly.
2. Loosen the RH carrier bolts evenly until they are finger-tight.
3. Tighten the RH carrier bolts equally and evenly until a rolling torque of 5 Nm (45 lb. inch) is reached.

**NOTE:** Do not tighten beyond this point.

### STEP 155

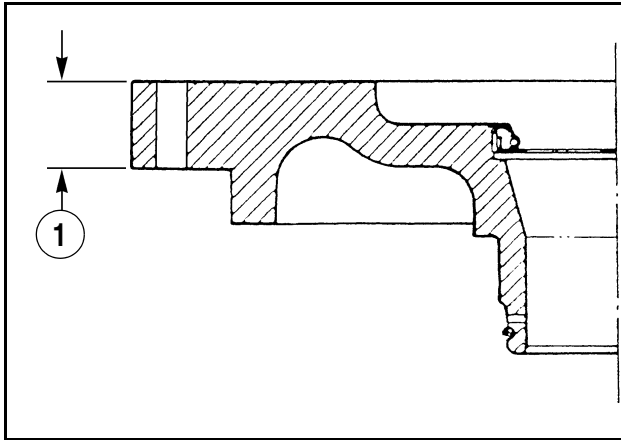
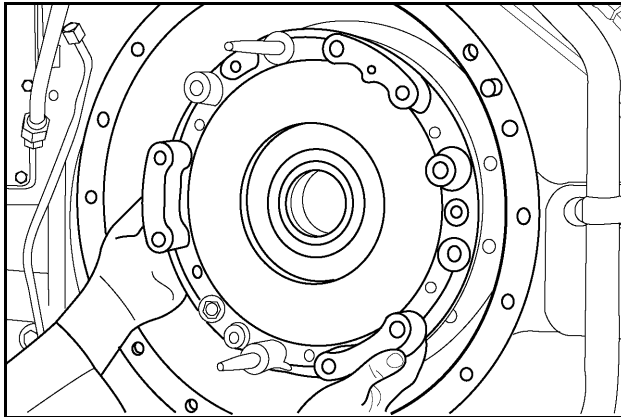


Use a depth micrometer to measure from the RH bearing retainer face to the rear frame through the three equally spaced holes. Average the three measurements and record the dimension.

**NOTE:** If any two readings vary by more than 0.254 mm (0.010 inch), loosen the bolts and check for proper seat, burrs, or foreign material. Repeat the procedure until the desired range is obtained.

## ADJUSTING THE RING AND PINION BACKLASH

### STEP 156



Determine required shim pack thickness as follows:

1. Measure the thickness of the RH bearing retainer at the machined surfaces (1).
2. Subtract this dimension from the average dimension obtained when measuring the retainer face to the rear frame (Step 154).
3. The difference is the required shim pack thickness.
4. Split the shim pack equally between the two bearing retainers.

### STEP 157

Install bearing carriers as follows:

1. After installing the new shim pack, or the original shim pack, install the bearing carriers.
2. Tighten the bearing carrier bolts to a torque of 255 to 260 Nm (130 to 144 lb. ft.) while rotating the differential.

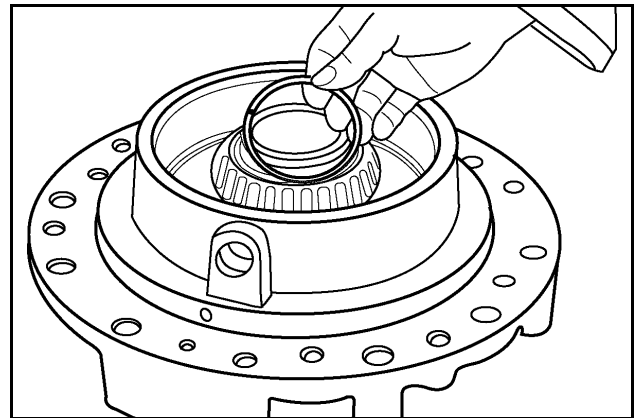
3. The rolling torque of the differential must be 4.5 to 8.0 Nm (40 to 70 lb inch) for new bearings and 2 to 4 Nm (20 to 35 lb inch) for old bearings (used for more than 200 hours). The desired settings are in the upper half of the ranges.
4. To increase the rolling torque, remove approximately 0.05 mm (0.002 inch) of shim material from the right-hand bearing retainer.
5. To decrease the rolling torque, add approximately 0.05 mm (0.002 inch) of shim material to the right-hand bearing carrier.

### STEP 158

If the differential was installed without the ring gear, remove the differential assembly from the rear frame and complete Steps 117 to 122 to install the ring gear.

If the pinion assembly is not installed, refer to Pinion Shaft Assembly and Installation in this section to install the pinion. Then proceed with the following steps.

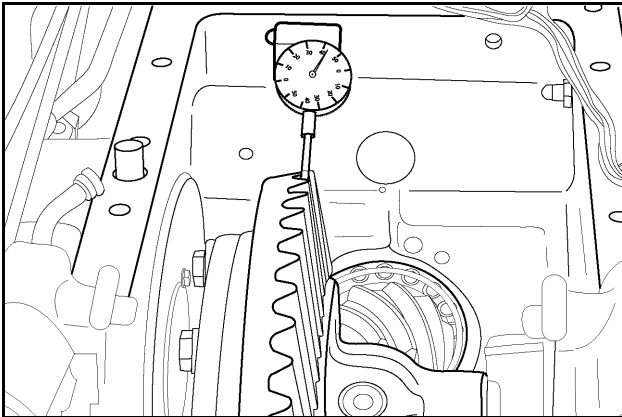
### STEP 159



Install the seal rings on both the LH and RH bearing retainer. Make sure the ends of the ring lock together.

## BEVEL PINION AND GEAR TOOTH CONTACT CHECK

### STEP 160



t98215A

Adjust the ring and pinion backlash as follows:

1. Mount a dial indicator on the rear frame.
2. Position the dial indicator so that it contacts one tooth on the ring gear. Do not move the pinion gear.
3. Rotate the ring gear in either the forward or reverse direction to achieve full contact with the pinion gear.

**IMPORTANT:** *Pinion shaft must be held in place so it will not move.*

4. Zero the dial indicator.
5. Rotate the ring gear in the opposite direction to achieve full contact with the pinion gear in the opposite direction.

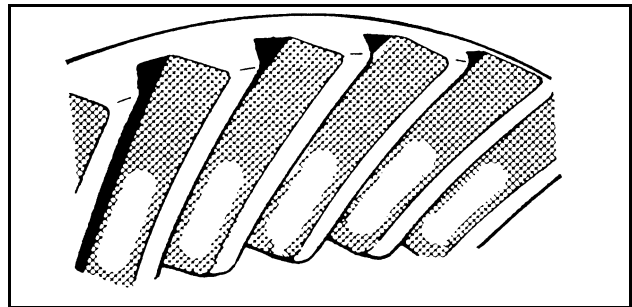
**IMPORTANT:** *Pinion shaft must be held in place so it will not move.*

6. Record the dial indicator reading.
7. The dial indicator reading is the ring and pinion gear backlash. The backlash must be between 0.179 to 0.279 mm (0.007 to 0.11 inch).
8. To adjust the ring and pinion gear backlash, move shims from one side of the differential to the other. Moving a 0.254 mm (0.010 inch) shim from one side to the other will change the backlash approximately 0.169 mm (0.0067 inch).

### STEP 161

Put Prussian Blue or red lead onto the convex side of the gear teeth. Turn the pinion several revolutions in the forward (clockwise) direction, while applying a braking force on the gear, to determine the contact pattern. See the contact patterns in the following illustrations.

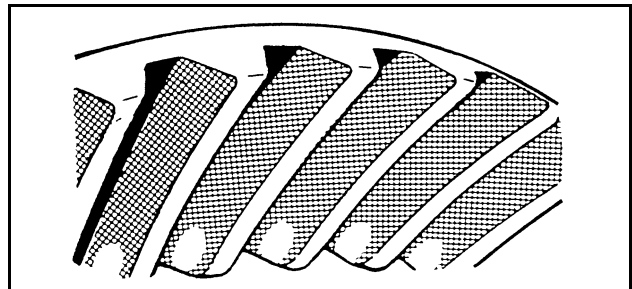
**NOTE:** *The contact pattern of the gear teeth that are shown are approximate shapes. The gear tooth contact patterns can change from the illustrations. Any shape or pattern (L-type, band, C-type, triangle, etc.) is acceptable if it is tapering off from toe to heel and falls into the contact area shown. The tooth contact pattern can change in a used gear set because of wear of the parts. Try to get a contact pattern that is similar to the illustrations to get the best results.*



64L8

#### Correct Tooth Contact Pattern

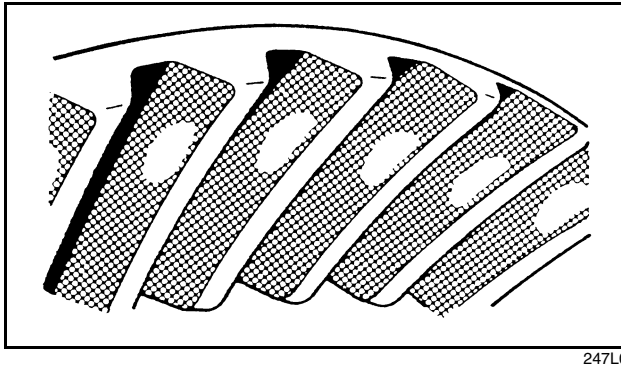
Correct adjustment is made when the pattern of the tooth contact area (both horizontal and vertical) is as shown.



66L8

#### Pattern A

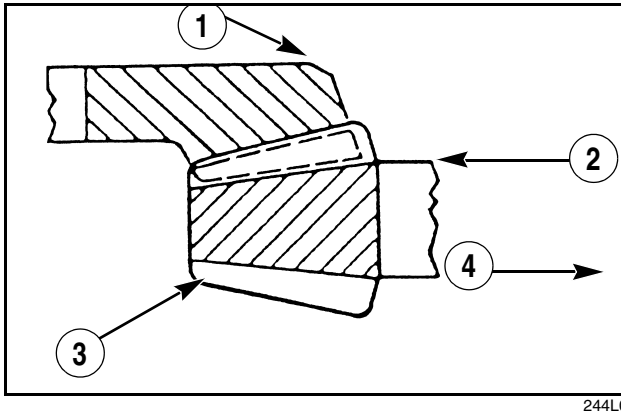
The pinion is out too far. Remove approximately 0.10 mm (0.005 inch) of shim material that was installed in Step 75.



### Pattern B

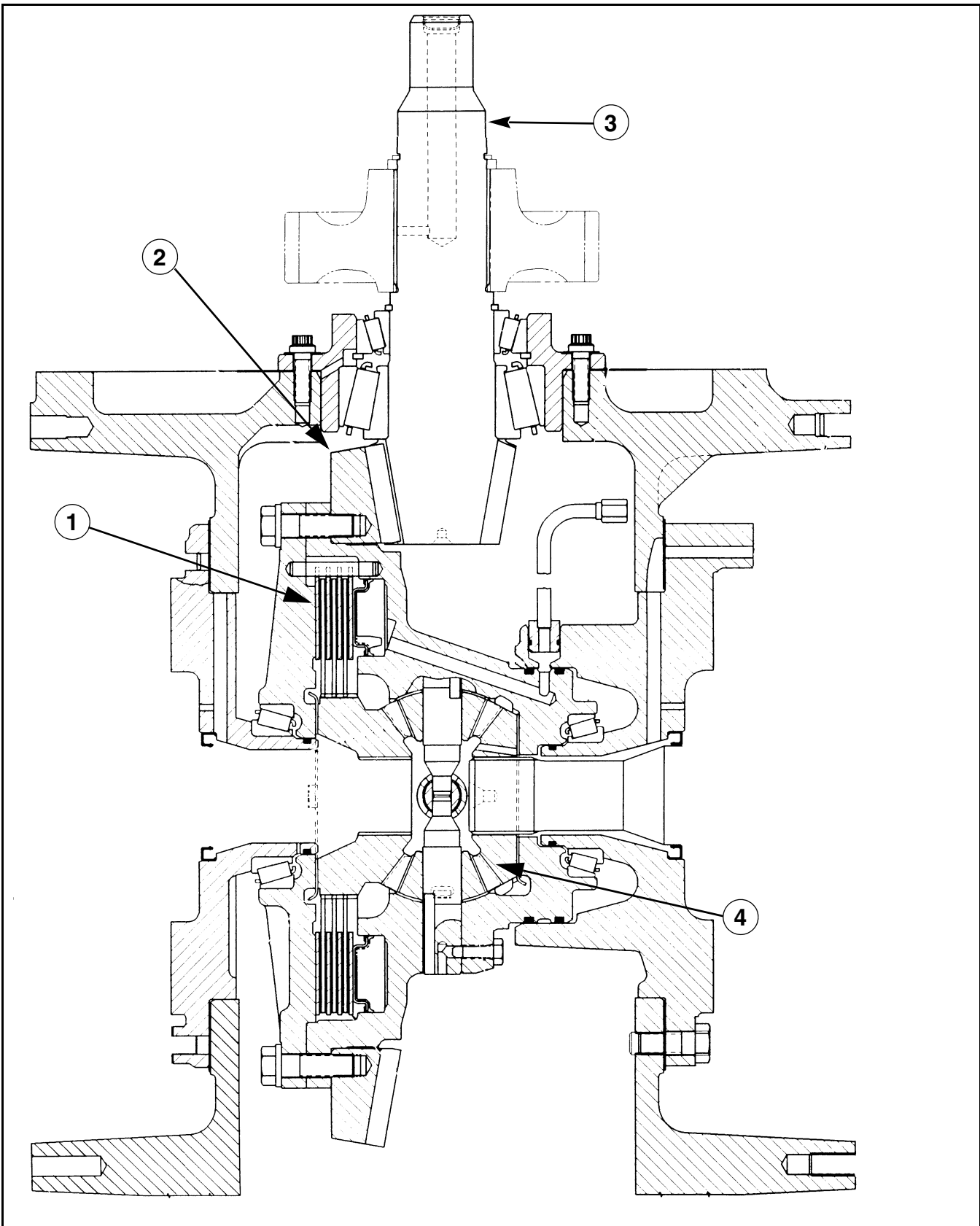
The pinion is in too far. Add approximately 0.10 mm (0.005 inch) of shim material under the pinion bearing cage.

Adjust the backlash to specifications. See Step 159 before checking contact pattern again.



1. RING/BEVEL GEAR  
2. BEVEL PINION  
IN TO CORRECT  
PATTERN A

3. BEVEL GEAR  
4. BEVEL PINION IN TO  
CORRECT PATTERN B



1. DIFFERENTIAL LOCK ASSEMBLY  
2. RING GEAR

3. DRIVE PINION SHAFT  
4. DIFFERENTIAL ASSEMBLY

RH98C093

# **Section 21**

## **Chapter 9**

### **HYDRAULIC PUMP DRIVE**

## TABLE OF CONTENTS

SPECIAL TORQUES .....	21-9-3
SPECIFICATIONS .....	21-9-3
PUMP DRIVE .....	21-9-3
Removal .....	21-9-3
Disassembly .....	21-9-4
Assembly .....	21-9-7
Installation .....	21-9-12

## SPECIAL TORQUES

Bearing Cage Bolt .....	55 to 60 Nm (41 to 44 lb. ft.)
Hydraulic Drive Pump Assembly Mounting Bolts.....	52 to 61 Nm (38 to 45 lb. ft.)

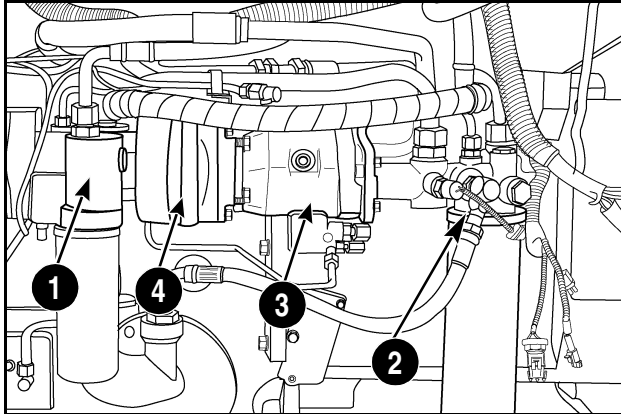
## SPECIFICATIONS

Driven Gear Shaft End Play.....	0.026 to 0.1 mm (0.001 to 0.004 inch)
---------------------------------	---------------------------------------

## PUMP DRIVE

### Removal

#### STEP 1

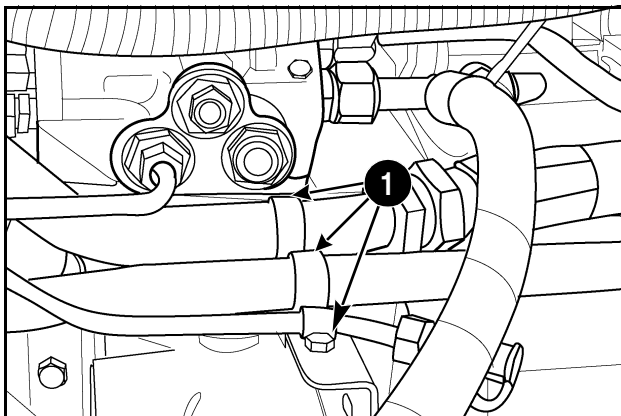


RD02D002

Use identification tags to mark the hydraulic lines. Cap the lines and open fittings. Remove the charge pump and filter (1). Refer to the Charge Pump section of this manual. Remove the transmission filter with base (2) and the hydraulic PFC piston pump (3) from the hydraulic pump drive (4). Refer to the PFC Piston Pump section of this manual for transmission filter base and PFC piston pump removal.

**NOTE:** Provide open access to the pump drive by blocking the front wheels and properly supporting the rear axle. Loosen the six wheel bushing bolts and move the wheel outward on the axle.

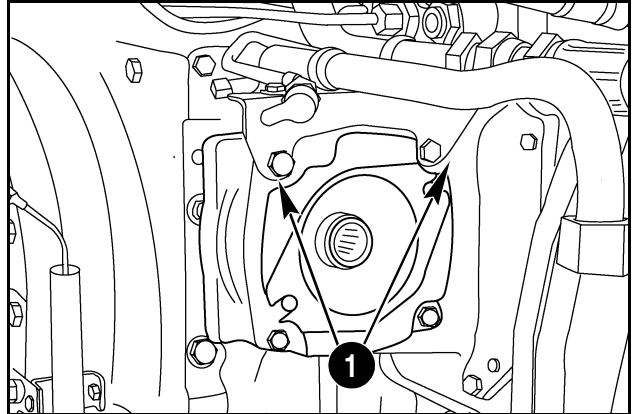
#### STEP 2



RD02D023

Remove the three hydraulic line clamps (1) on top of the hydraulic line support bracket.

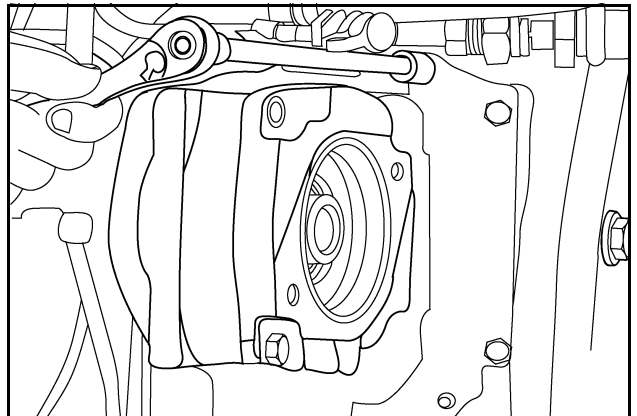
#### STEP 3



RD02D021

Remove the two mounting bolts (1) from the hydraulic line support bracket.

#### STEP 4



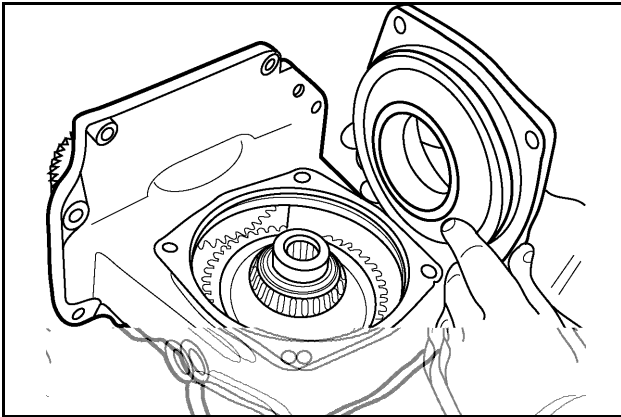
RD02D026

Remove the two longer top mounting bolts and the six shorter bolts from the pump drive mounting flange. Remove the pump drive assembly.



## Disassembly

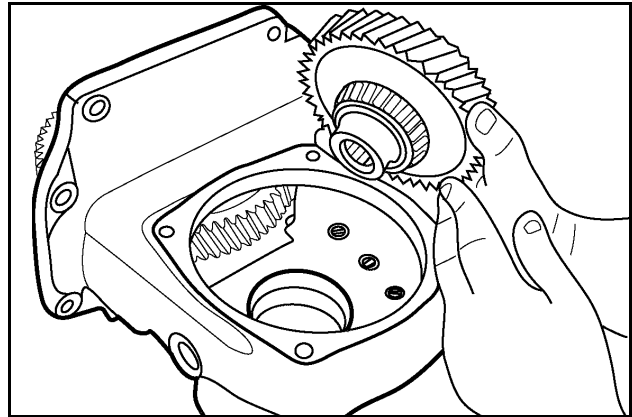
### STEP 5



RP98B083

Remove the bearing cage from the pump drive housing.

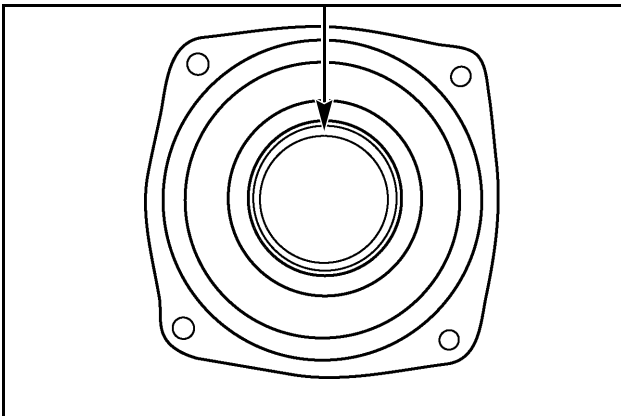
### STEP 8



RP98B049

Mark the gear positions and remove the drive gear assembly from the pump drive housing.

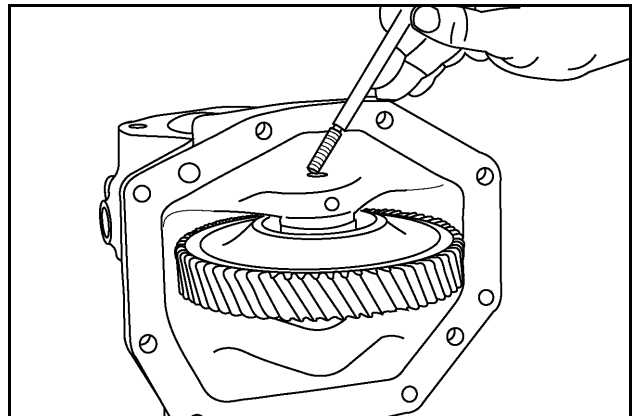
### STEP 6



RP98B053

Remove the bearing cup from the bearing cage.

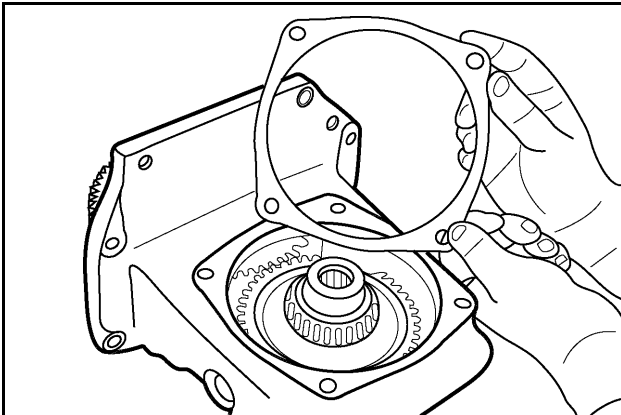
### STEP 9



T94753

Remove the idler gear bolt and washer from the pump drive housing.

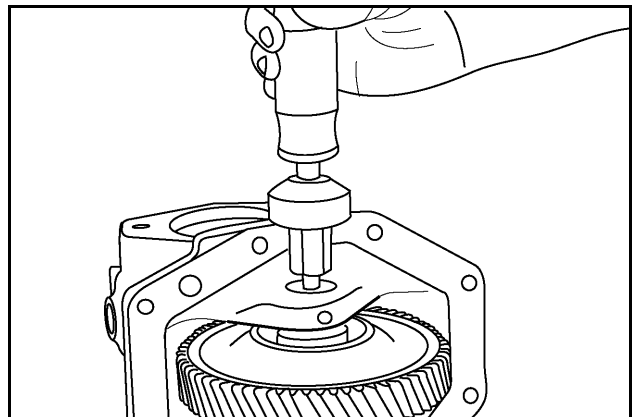
### STEP 7



RP98B048

Remove the shims from the pump drive housing.

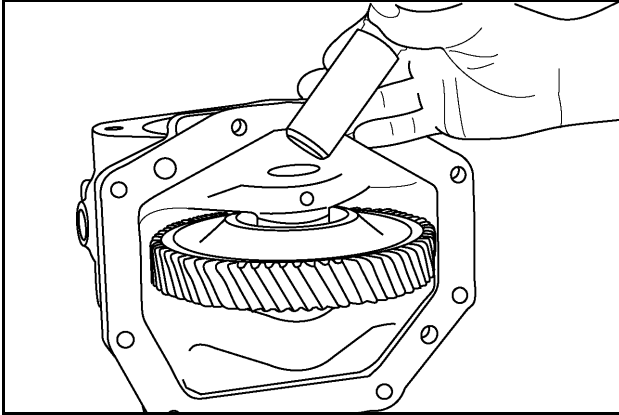
### STEP 10



T94764

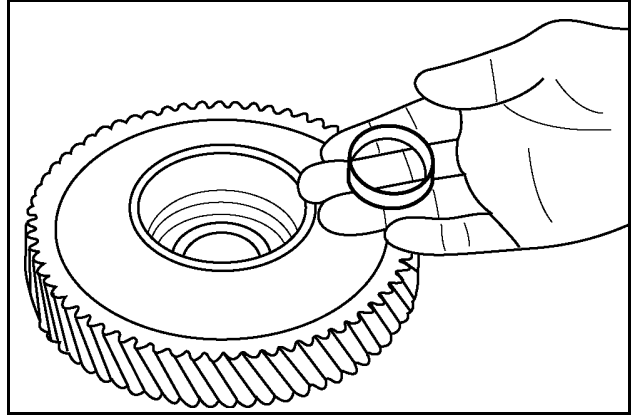
Install a slide hammer on the idler gear shaft.

**STEP 11**



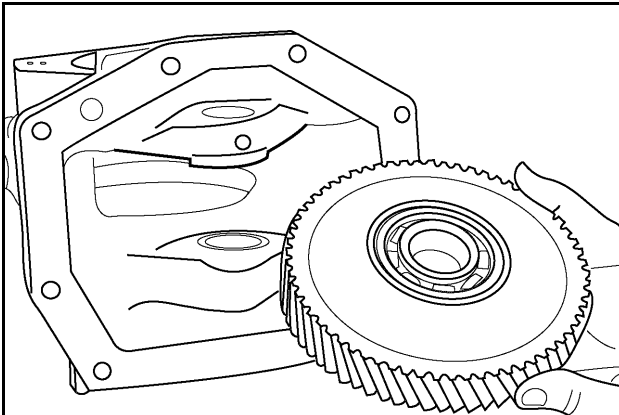
Remove the idler gear shaft from the pump drive housing.

**STEP 14**



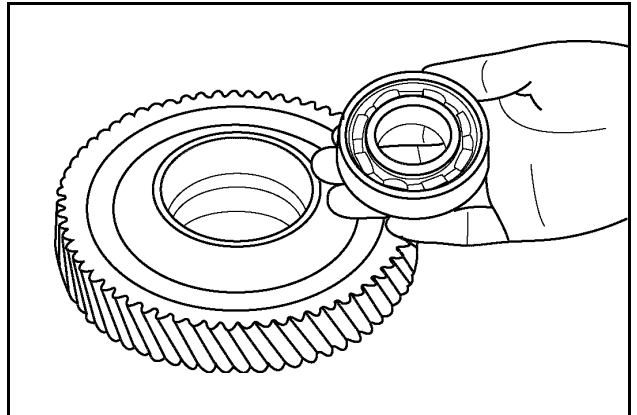
Remove the spacer from the idler gear.

**STEP 12**



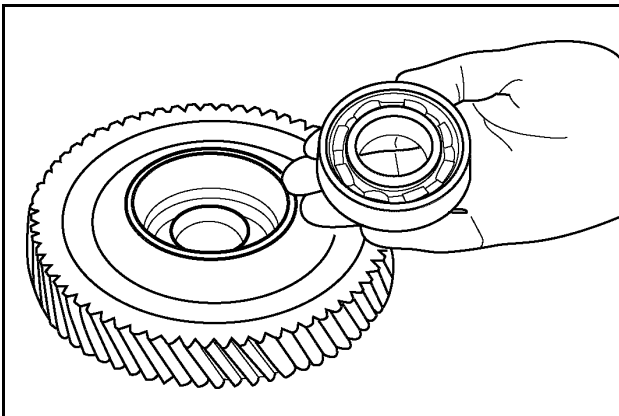
Remove the idler gear assembly from the pump drive housing.

**STEP 15**



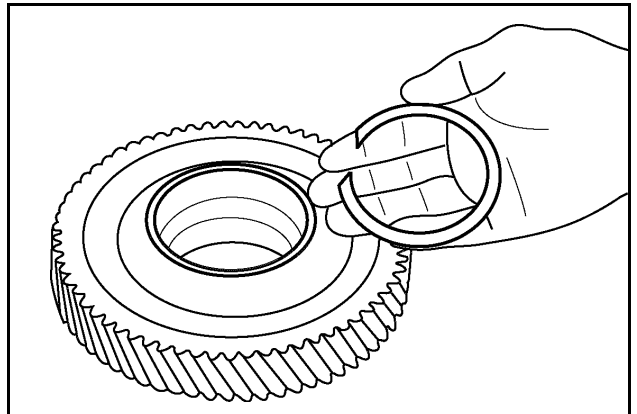
Press the other bearing from the idler gear. Discard the bearing.

**STEP 13**



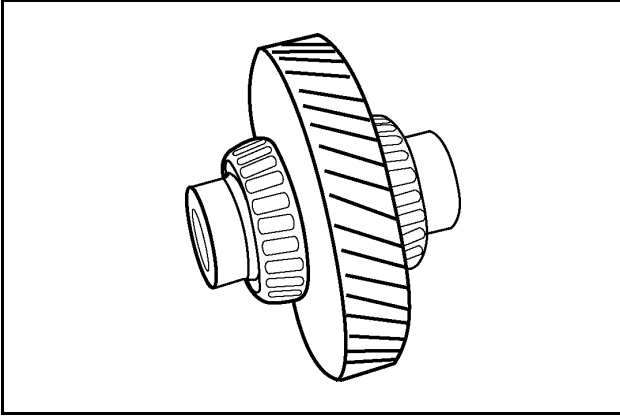
Drive one of the bearings from the idler gear. Discard the bearing.

**STEP 16**



Remove the two snap rings from the idler gear.

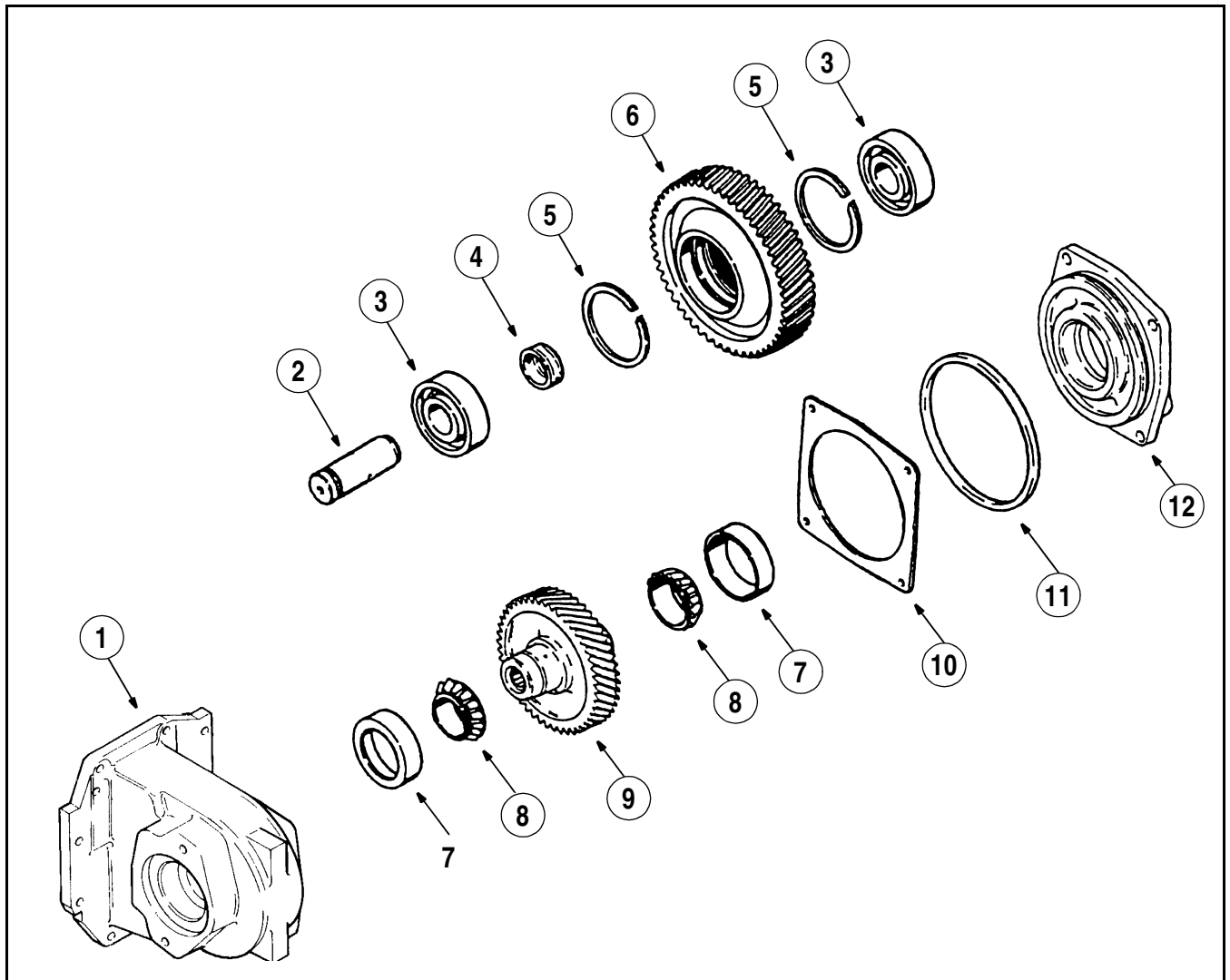
**STEP 17**



RP98B051

Remove the front and rear bearing cone from the driven gear shaft using a bearing puller or a press and collet.

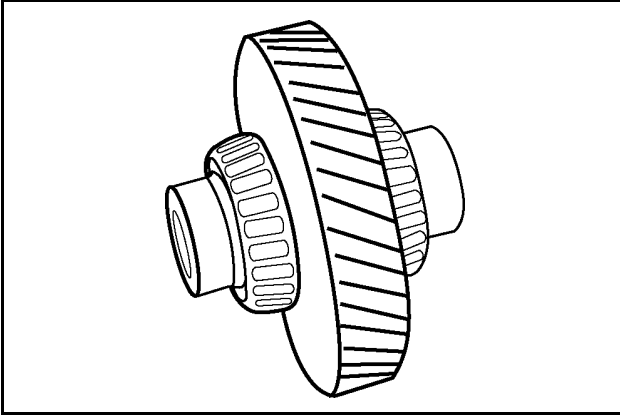
## Assembly



SCRH98A5

- |                       |                  |
|-----------------------|------------------|
| 1. PUMP DRIVE HOUSING | 7. BEARING CUP   |
| 2. IDLER SHAFT        | 8. BEARING CONE  |
| 3. BEARING            | 9. DRIVEN GEAR   |
| 4. SPACER             | 10. SHIM         |
| 5. RETAINING RING     | 11. O-RING       |
| 6. IDLER GEAR         | 12. BEARING CAGE |

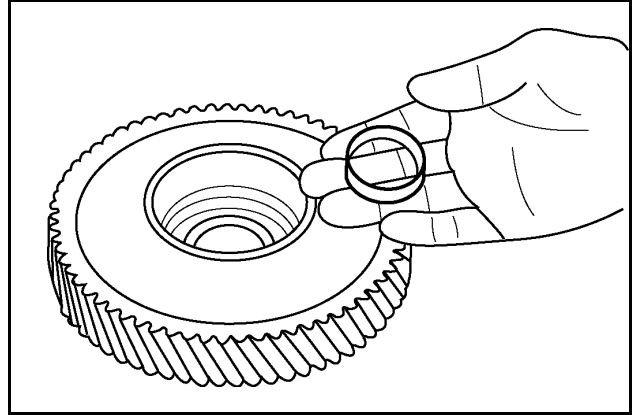
### STEP 18



RP98B051

Press the front and rear bearing cones on the drive gear shaft until the bearing cones are flush with the shaft shoulder.

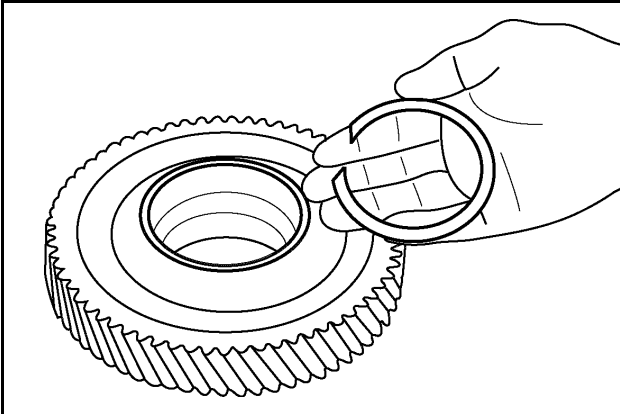
### STEP 21



T94749

Install the spacer on top of the bearing in the idler gear. Install a new spacer if damaged or worn.

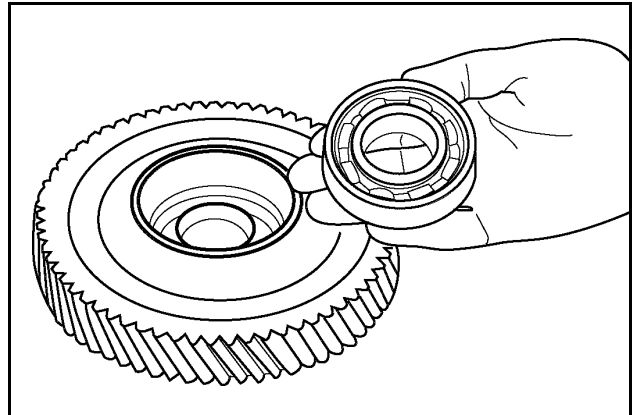
### STEP 19



T94747

Install the two snap rings into the grooves of the idler gear.

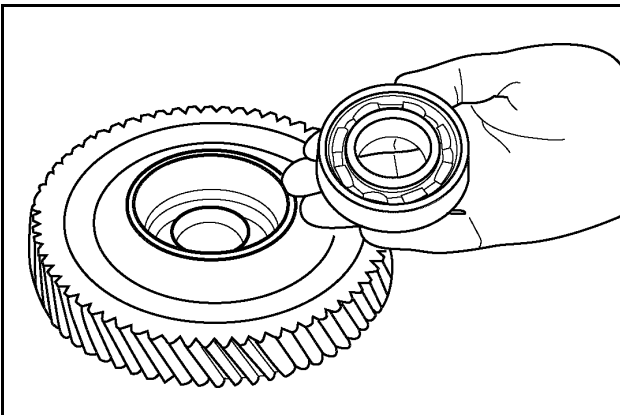
### STEP 22



T94750

Press the other new bearing into the idler gear until it rests solidly against the snap ring.

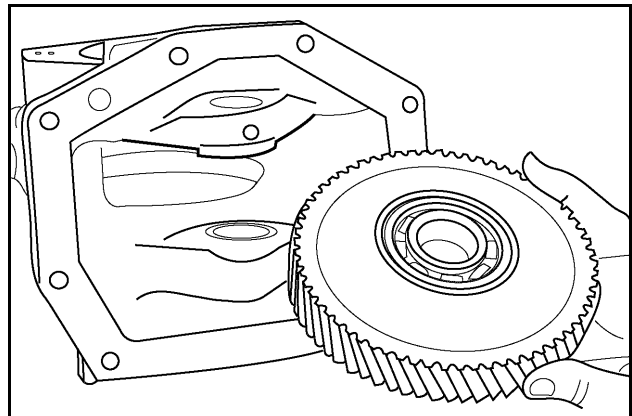
### STEP 20



T94748

Press a new bearing into the idler gear until it rests solidly against the snap ring.

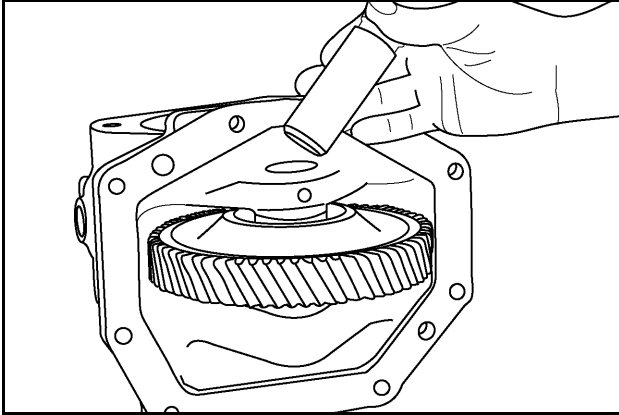
### STEP 23



T94751

Install the idler gear assembly into the pump drive housing.

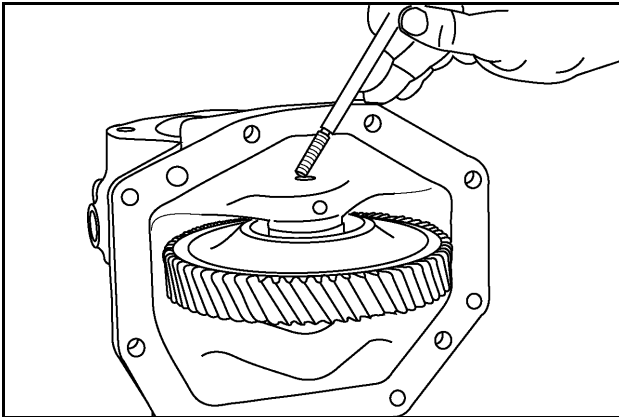
### STEP 24



T94752

Install the idler gear shaft through the pump drive housing and the idler gear.

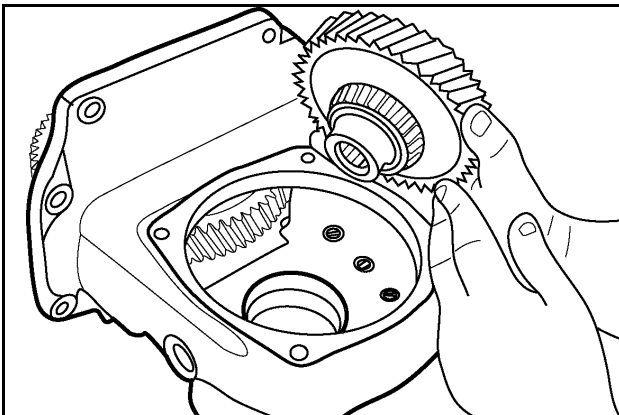
### STEP 25



T94753

Install the idler shaft retaining bolt and the flat washer through the idler shaft and into the pump drive housing.

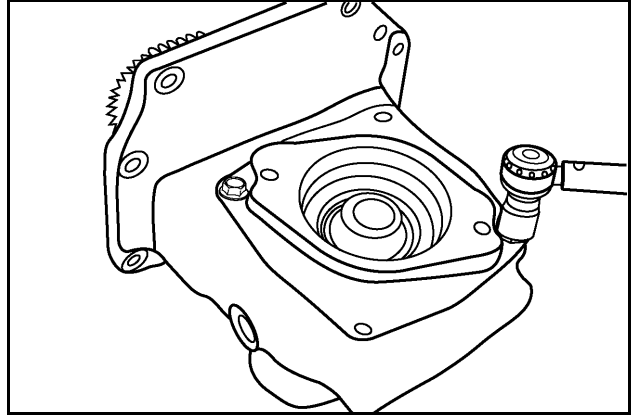
### STEP 26



RP98B049

Using the identifying marks made during disassembly, install the drive gear assembly into the pump drive housing.

### STEP 27



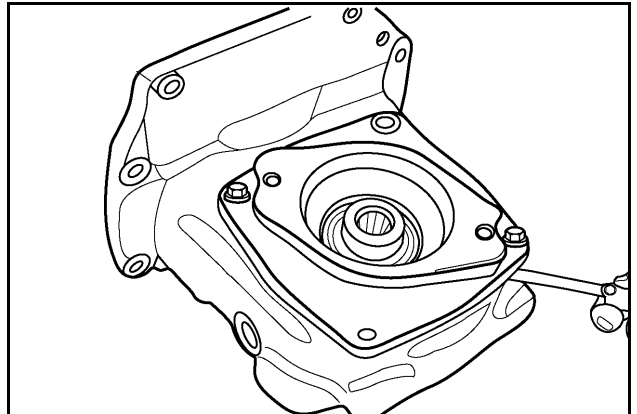
RR98C026

Install the bearing cage as follows:

1. Install the bearing cage on the pump drive housing without shims or O-rings.
2. Install two opposite bolts, rotate the shaft, and alternately, in two increments, tighten the bearing cage bolts to a torque of 3.4 Nm (30 lb. in.).
3. Turn the shaft while tightening the bolts to help seat the bearings.

Check all bolt torques. Tighten again if necessary.

### STEP 28

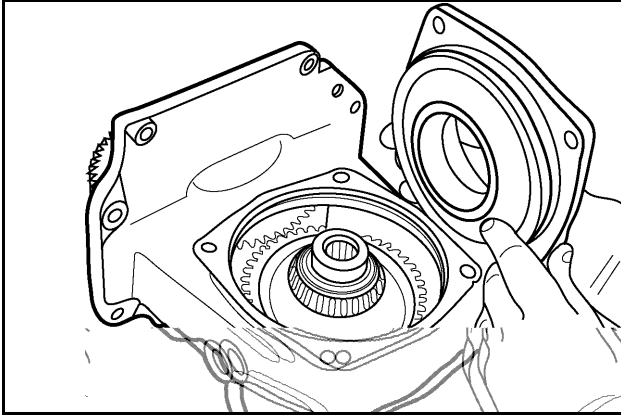


RR98B003

Determine required shim pack size as follows:

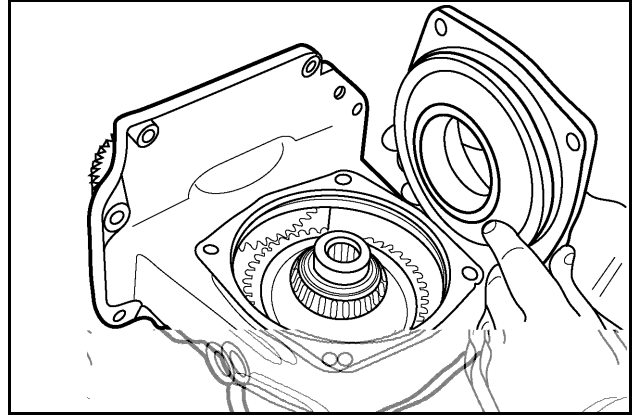
1. Measure the gap between the bearing cage and the pump drive housing at each bolt.
2. If the difference between the measurement at the two bolt areas is greater than 0.254 mm (0.010 inch), check for proper bearing seating, burrs, or foreign matter.
3. Repeat the steps until the required difference, less than 0.254 mm (0.010 inch), is obtained.
4. Take the average measurement. Add 0.13 mm (0.005 inch) to the measurement. This is the shim pack size needed.

**STEP 29**



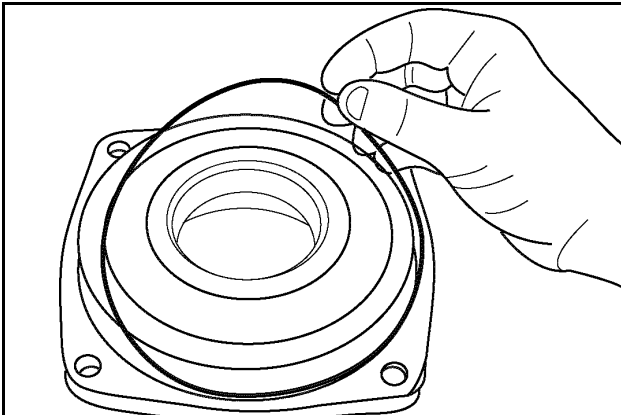
Remove the bearing cage from the pump drive housing.

**STEP 32**



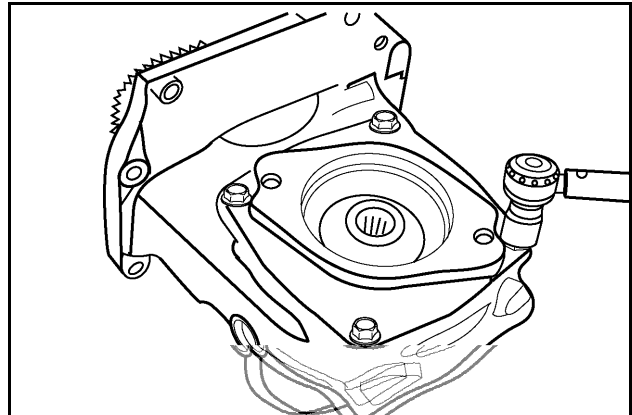
Install the bearing cage on the pump drive housing.

**STEP 30**



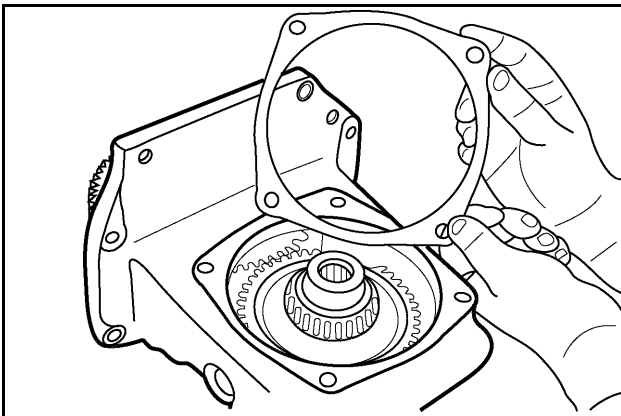
Lubricate a new O-ring with petroleum jelly. Install the O-ring on the bearing cage.

**STEP 33**



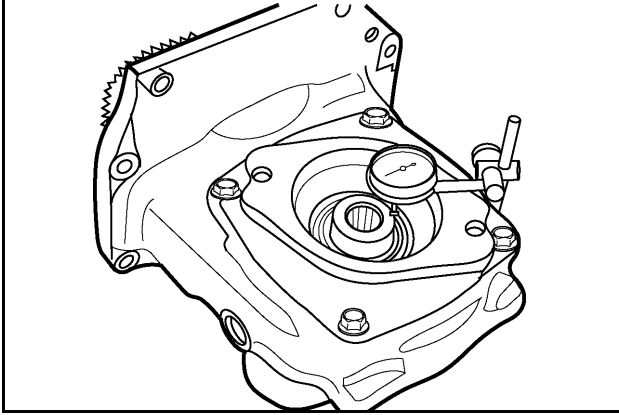
Tighten the bearing cage bolts to a torque of 55 to 60 Nm (41 to 44 lb. ft.).

**STEP 31**



Install the shim pack, determined in Step 28, on the bearing cage mounting surface of the pump drive housing.

## STEP 34



If necessary, adjust shim pack to obtain correct end play as follows:

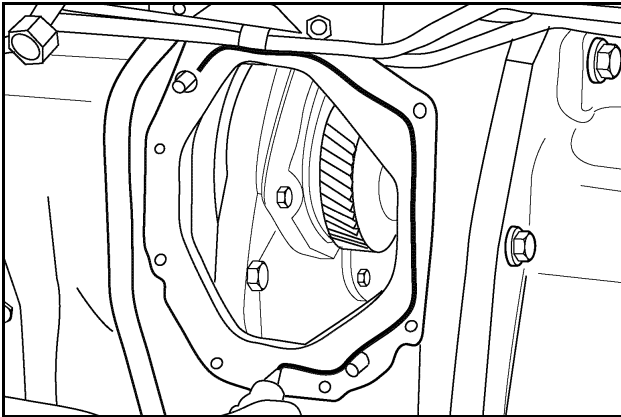
1. Rotate and push down the drive gear shaft.
2. Install a dial indicator on the bearing cage and indicate to the end of the drive gear shaft.
3. Set the dial face to zero.
4. Move the drive gear shaft in and out of the housing as you observe the dial indicator. End play must be 0.025 to 0.1 mm (0.001 to 0.004 inch).

If needed, adjust the shim pack to get the correct end play.



## Installation

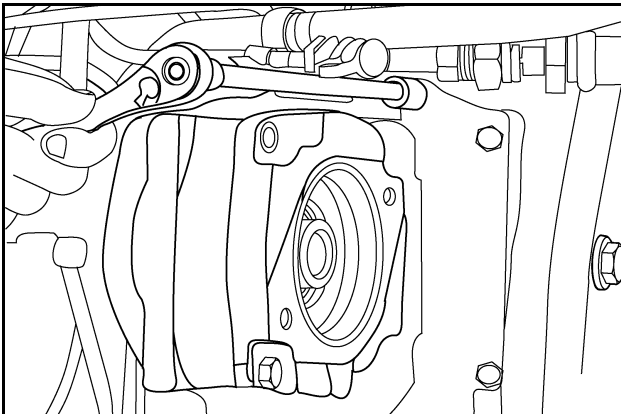
### STEP 35



RD02D029

Apply a continuous bead of Loctite® 515 Sealant, 4.76 mm (3/16 inch) wide to the mounting surface of the pump drive housing and around the bolt holes.

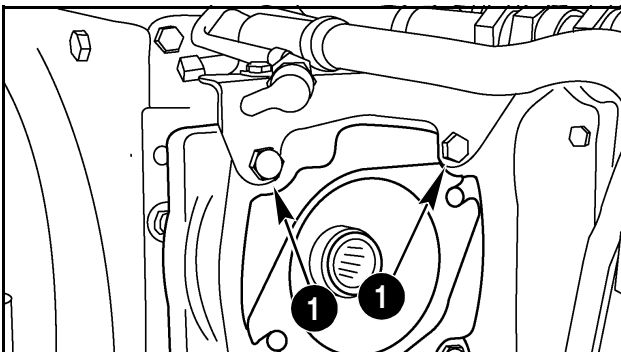
### STEP 36



107-8

Install the hydraulic pump drive assembly on the transmission. Install the mounting bolts and tighten to a torque of 52 to 61 Nm (38 to 45 lb. ft.).

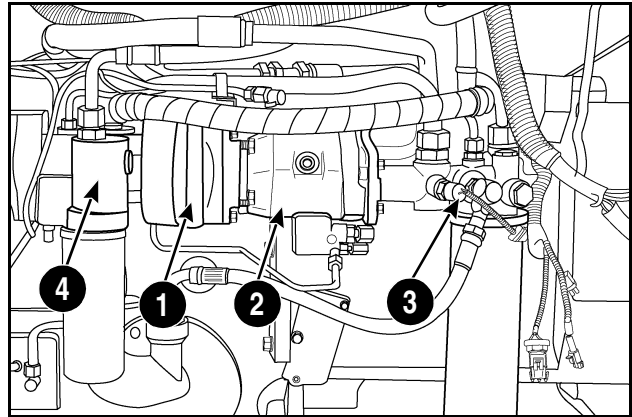
### STEP 37



RD02D021

Install the two hydraulic line support bracket mounting bolts (1).

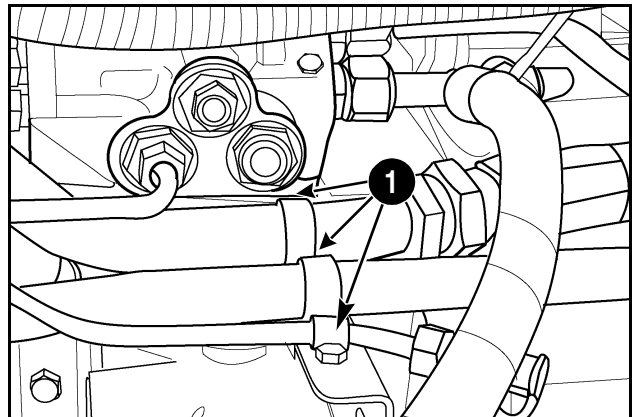
### STEP 38



RD02D002

With the hydraulic pump drive (1) installed on the transmission, install the hydraulic PFC pump (2) and the transmission filter and base (3). Refer to the PFC Piston Pump and Hydraulic Filter section in this manual. Install the charge pump and filter (4). Refer to the Charge Pump section in this manual. When installing the charge pump, it will be necessary to loosen the clamps on the rubber charge pump suction hose and pry up on the hose to provide needed clearance for the suction flange O-ring.

### STEP 39



RD02D023

Connect the hydraulic lines. Install the three hydraulic line clamps (1) on top of the hydraulic line support bracket.

### STEP 40

Move the rear wheel inward on the axle. Apply antiseize to the bushing bolts. Tighten the bushing bolts to a torque of 300 to 350 Nm (220 to 260 lb. ft.). Remove the axle support equipment and the front wheel blocks. Check the hydraulic fluid level in the tractor and add fluid as needed.

# **Section 25**

## **Chapter 1**

**FRONT WHEEL DRIVE**

**FWD CONTROL SYSTEM**

**How It Works**

## TABLE OF CONTENTS

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## FRONT WHEEL DRIVE (FWD)

### General Description

The Front Wheel Drive (FWD) consists of the FWD axle, a drive shaft, FWD clutch, FWD control valve, FWD control switch, brake pedal switches, true ground speed circuit, hitch position circuit, transmission speed circuit, and electronic control modules (through the Data Bus). Because the FWD is electronically controlled, automatic operation is possible.

The FWD solenoid valve is mounted externally on top of the range transmission (front coil of range powershift manifold). The control valve is supplied with regulated circuit pressure from the priority/regulator valve. This pressurized supply is directed to the FWD clutch for disengagement purposes. If the FWD clutch is activated (solenoid not activated) the valve drains the pressurized supply from the FWD clutch allowing four (4) Belleville springs to activate the FWD clutch.

**IMPORTANT:** *To activate the FWD clutch pack, the solenoid valve is de-energized. The clutch pack is applied mechanically by means of Belleville springs.*

### WARNING

These tractors are equipped with a spring-applied mechanical front wheel drive (FWD) clutch and a limited slip differential. Even with the engaging switch in the OFF position, the FWD clutch can propel both front wheels if any of the following conditions exist:

1. The engine is shut off (regulated supply pressure will drain).
2. The engine is stopped when the rear wheels are still coasting).
3. Any interruption in the clutch operating regulated pressure (hydraulically released clutch).
4. Any interruption in the electrical control power (coil energized to release clutch).
5. Both brakes are applied (automatic FWD operation).

The PTO controller supplies current to the FWD valve to operate the FWD clutch based on commands from the operator (FWD switch). Signals supplied to the controller from the brake pedal switches, true ground speed circuit, hitch position control system, and transmission speed signal circuit provide for automatic operation.

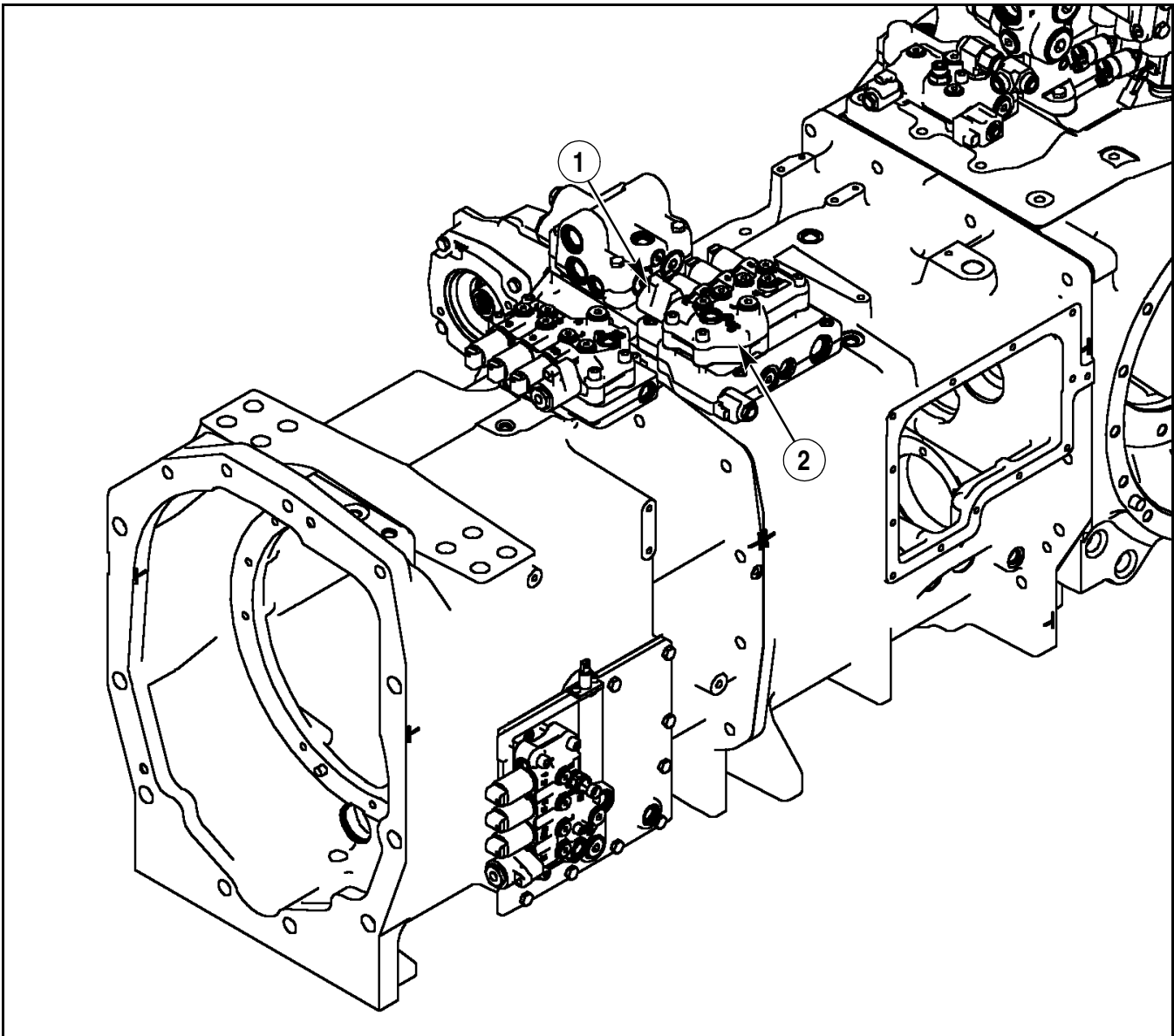
Diagnosing control system faults is accomplished by reading appropriate fault codes through the instrument cluster display or with the service tool. Refer to fault code section for a complete list of fault codes related to the PTO, FWD, and Differential Lock system.

For these reasons the following service procedures must be utilized:

Before rotating the rear wheels of an FWD equipped tractor (when using engine power with the rear wheels raised off the ground) one of the following must be done to prevent accidental tractor movement.

- Jack up and support both front wheels completely off the ground.
- Disconnect the front wheel drive shaft (transmission end).

Observing one of these options will ensure that engagement of the FWD clutch will not result in tractor movement.



RI02E086

1. FWD SOLENOID    2. POWERSHIFT VALVE RANGE

## ELECTRONIC FRONT WHEEL DRIVE (FWD) CONTROL

### General Description

The FWD consists of the FWD axle, a drive shaft, FWD clutch, FWD control valve, FWD control switch, brake pedal switches, true ground speed circuit, hitch position circuit, transmission speed circuit, and electronic control modules (through the Data Bus). Because the FWD is electronically controlled, automatic operation is possible.

All FWD operator commands are sent to the Arm Rest Control Module (hard wired to the Arm Rest Control Module), then relayed to the PTO controller via the Data Bus. Transmission speed and true ground speed signals are sent (hard wired) to the Instrument Cluster Unit (ICU) then relayed to the PTO controller. Diagnostic and programming information are communicated between the PTO controller and the Instrument Cluster Unit (ICU) by way of the Data Bus.

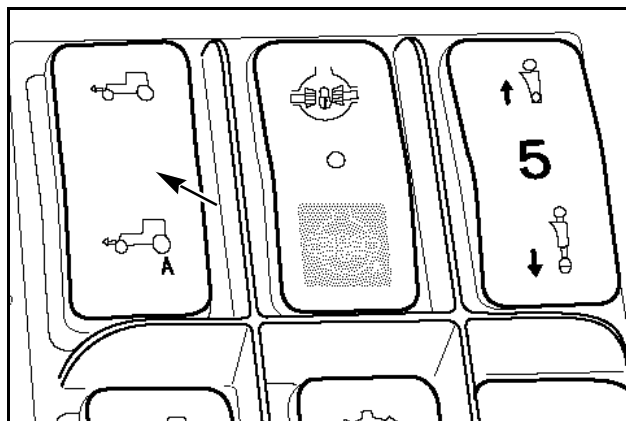
### Operating Modes

The FWD system operates in one of three (3) modes based on operator commands and the signals received from the other tractor systems.

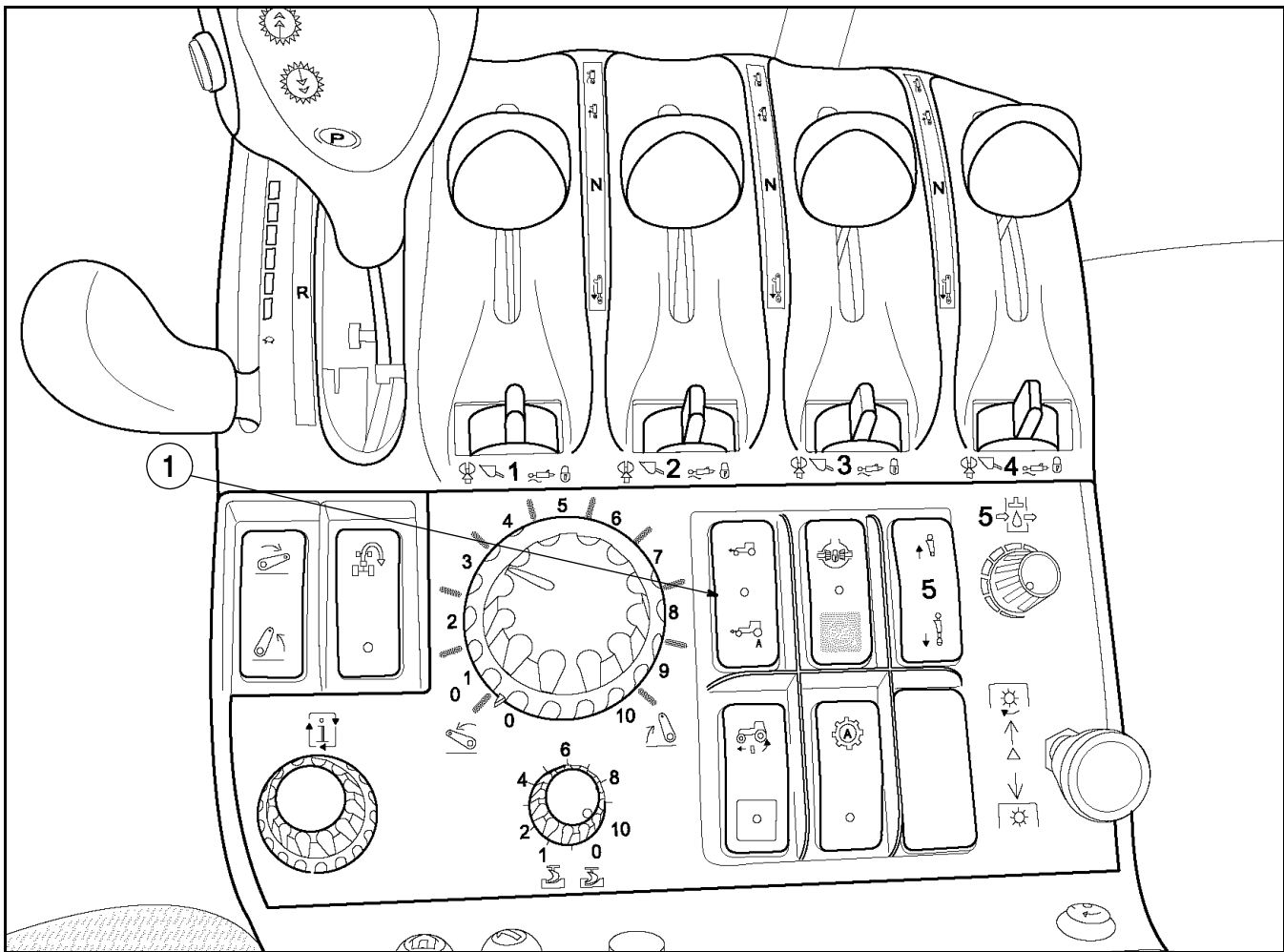
OFF (O) ISO Symbol

Manual FWD Control (FWD Symbol)

Automatic FWD Control (A)



RH05J067

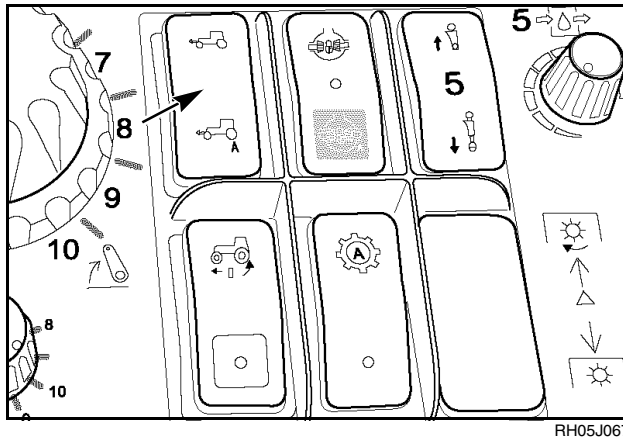


RH05J060

1. FRONT WHEEL DRIVE (FWD) SWITCH

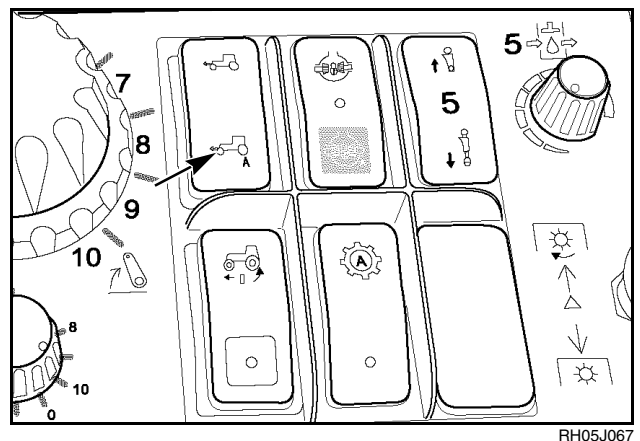
## FRONT WHEEL DRIVE (FWD) CONTROL MODES

**OFF** – When the FWD switch is placed in the OFF position, the FWD clutch will be deactivated (coil-energized) unless both brakes are applied. The FWD clutch is applied as both brake pedals are applied to allow four wheel braking.



**Manual FWD Control (ON)** – When the FWD switch is placed in the ON position the FWD will be activated (solenoid deactivated) at all times.

**IMPORTANT:** *To activate the FWD clutch pack, the solenoid valve is de-energized. The clutch pack is applied mechanically by means of Belleville springs.*



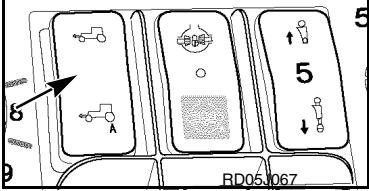
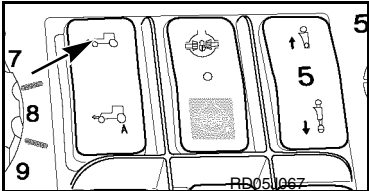
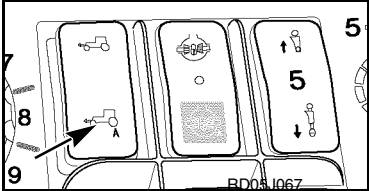
**Automatic FWD Control** – When the FWD switch is placed in the Automatic position the FWD will be activated (solenoid deactivated) unless the following conditions are applicable.

1. Operating with the hitch position control lever down and the hitch is raised with the UP/DOWN switch (End of Row Feature deactivates FWD).
2. One of the brake pedals is depressed and slip is below 15%.
3. Ground speed is in excess of 10 MPH and slip is below 15%.

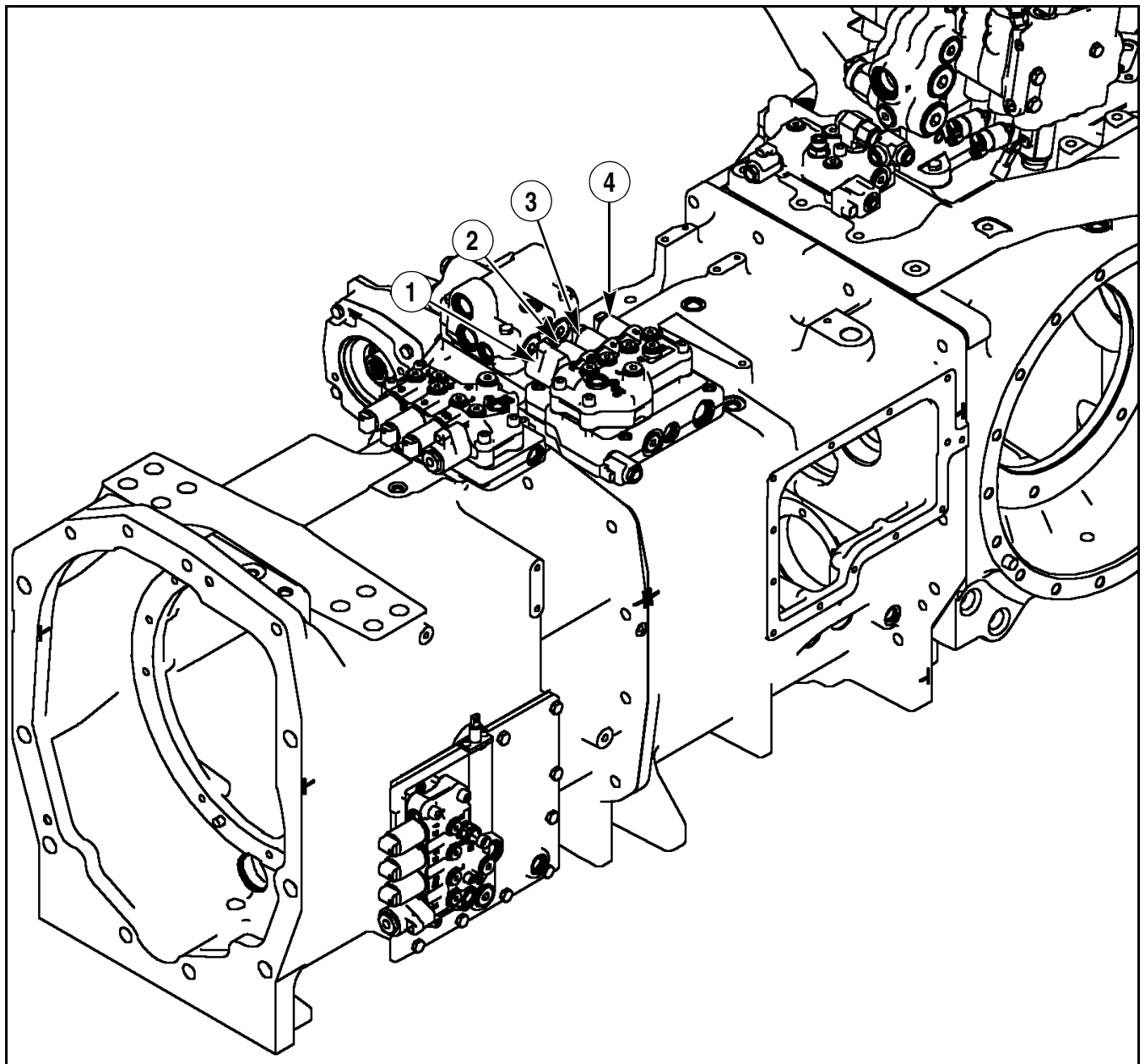
**NOTE:** *If the FWD disengages due to ground speed, it will automatically re-engage when ground speed decreases below 8 MPH. To operate the FWD at speeds in excess of 10 MPH, place the switch in the ON position.*



## FRONT WHEEL DRIVE (FWD) FUNCTIONAL TESTS

Switch Position	FWD Engaged/ Disengaged	FWD Operation Description
<b>OFF</b> 	Disengaged	<b>Except:</b> When both brake pedals are pressed.
<b>ON</b> 	Engaged	Operator will feel engagement as switch is cycled. Check operational indicator.
<b>AUTO</b> 	Disengaged	Hitch is UP with UP/DOWN switch. Position lever in down position.  <b>Except:</b> Both brake pedals are pressed.  <b>Except:</b> When slip is above 15%.
	Engaged	Hitch DOWN with UP/DOWN switch. Position lever in down position.  <b>Except:</b> When speed is in excess of 10 MPH.  <b>Except:</b> When one brake is pressed and slip is below 15%.
	Engaged	Hitch UP with UP/DOWN switch. Position lever in UP position.  <b>Except:</b> When speed is above 10 MPH. FWD reapplies if speed is decreases below 8 MPH.  <b>Except:</b> When one brake is pressed and slip is below 15%.

**IMPORTANT:** Hitch position and wheel slip will also influence FWD operation when tractor is in motion.



1. FWD SOLENOID  
2. LOW CLUTCH SOLENOID

3. MID CLUTCH SOLENOID  
4. HIGH CLUTCH SOLENOID

RI02E086

## FWD Valve

The FWD valve is a closed center valve and is contained as a part of the range transmission powershift valve manifold. Oil is supplied to the FWD valve from the regulated pressure circuit. The valve is mounted on top of the range transmission.

## Solenoid Cartridge Valve

The solenoid is controlled by an armrest mounted rocker switch. The armrest controller communicates (via Data Bus) with the PTO controller, supplying current to deactivate the FWD clutch, based on commands from the operator (FWD switch) and signals supplied to it from the brake pedal switches, true ground speed circuit, hitch position control system, and transmission speed signal circuit. The FWD is a spring-engaged and hydraulics-disengaged type clutch.

## TROUBLESHOOTING

### Problem – FWD clutch will not disengage

1. Check for PTO fault codes. (FWD fault codes are monitored by PTO controller.)
  - A. If fault codes are found, follow procedures outlined in PTO system fault code troubleshooting in this section.
2. Place the FWD switch in the OFF position. Check the tractor monitor for the FWD icon in the instrumentation display.
  - A. If the FWD icon is not displayed, this is an indication the electrical control circuit is functioning correctly. Go to Step 4.
  - B. If the FWD icon is displayed, this is an indication the electrical control circuit is not functioning correctly. Check fault codes, controller, and data bus function.
3. Place the FWD switch in the OFF position. Check for 12 VDC at FWD valve coil.
  - A. If 12 VDC is available to the coil, the electrical circuit is functioning properly.
  - B. If 12 VDC is not found, troubleshoot the FWD electrical circuit.
    1. Check wires 540B R and 175D (BK) (ground).
    2. Check all connections for excessive resistance.

Place the FWD switch in the manual ON position. Check for 12 VDC at FWD valve coil.

- C. If 12 VDC is not available to the coil, the electrical circuit is functioning properly.
  - D. If 12 VDC is found, troubleshoot the FWD electrical circuit.
    3. Check wires 540B (R) and 175D (BK) (ground).
    4. Check all connections for excessive resistance.
4. Start and run the engine.
    - A. Press the INCR or DECR key on the programmable instrumentation until the TRANS OIL TEMP screen is reached.

**NOTE:** Screen order is set by the operator. The TRANS OIL TEMP and TRANS SYS PRESSURE screens could or could not be together depending on setup.

- B. Operate the engine at 1500 RPM until the transmission temperature displayed on the instrumentation reads at least 49° C (120° F).
  - C. Press the INCR key as required to display the TRANS SYS PRESSURE screen.
5. While viewing the display, deactivate the FWD. The display pressure should dip, then recover to normal regulated pressure. If the pressure dips but does not recover, there is a leak in the FWD circuit. Repeat this check several times.
    - A. Inspect the FWD valve cartridge for leaking seals.
    - B. Inspect the FWD clutch for leaking seals.
  6. Check and repair the FWD clutch as needed.

## TROUBLESHOOTING

### Problem – FWD will not engage

1. Check for PTO fault codes. (FWD fault codes are monitored by PTO controller.)
  - A. If fault codes are found, follow procedures outlined in PTO system fault code troubleshooting in this section.
2. Place the FWD switch in the ON position. Check tractor monitor for FWD icon in the instrumentation display.
  - A. If the FWD icon is displayed, this is an indication the electrical control circuit is functioning correctly. Go to Step 4.
  - B. If the FWD icon is not displayed, this is an indication the electrical control circuit is not functioning correctly. Check fault codes, controller and data bus function.
3. Place the FWD switch in the ON position. Check for 12 VDC at FWD valve coil.
  - A. If 12 VDC is not available to the coil, the electrical circuit is functioning properly.
  - B. If 12 VDC found, troubleshoot the FWD electrical circuit.
    1. Check wires 540B (R) and 175D (BK) ground.
    2. Check all connections for excessive resistance

Place the FWD switch in the OFF position. Check for 12 VDC at FWD valve coil.

  - C. If 12 VDC is available to the coil, the electrical circuit is functioning properly.
  - D. If 12 VDC is not found, troubleshoot the FWD electrical circuit.
    3. Check wires 540B (R) and 175D (BK) ground.
    4. Check all connections for excessive resistance.
4. Check and repair the FWD clutch as needed.
5. See Section 50 of the electrical schematic for FWD circuit information.

## WARNING

These tractors are equipped with a spring-applied mechanical front wheel drive (FWD) clutch and a limited slip differential. Even with the engaging switch in the OFF position, the FWD clutch can propel both front wheels if any of the following conditions exist.

1. The engine is shut off (regulated supply pressure will drain).
2. The engine is stopped when the rear wheels are still coasting).
3. Any interruption in the clutch operating regulated pressure (hydraulically released clutch).
4. Any interruption in the electrical control power (coil energized to release clutch).
5. Both brakes are applied (automatic FWD operation).

For these reasons, the following service procedures must be utilized:

Before rotating the rear wheels of an FWD-equipped tractor (when using engine power with the rear wheels raised off the ground), one of the following must be done to prevent accidental tractor movement.

- Jack up and support both front wheels completely off the ground.
- Disconnect the front wheel drive shaft (transmission end).

Observing one of these options will ensure that engagement of the FWD clutch will not result in tractor movement.

# **Section 25**

## **Chapter 2**

### **DIFFERENTIAL LOCK CONTROL SYSTEM**

#### **How It Works**

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DIFFERENTIAL LOCK FUNCTIONAL TESTS .....	25-2-9
TROUBLESHOOTING .....	25-2-12
PTO/DIFFERENTIAL LOCK VALVE CIRCUIT .....	25-2-15

## DIFFERENTIAL LOCK

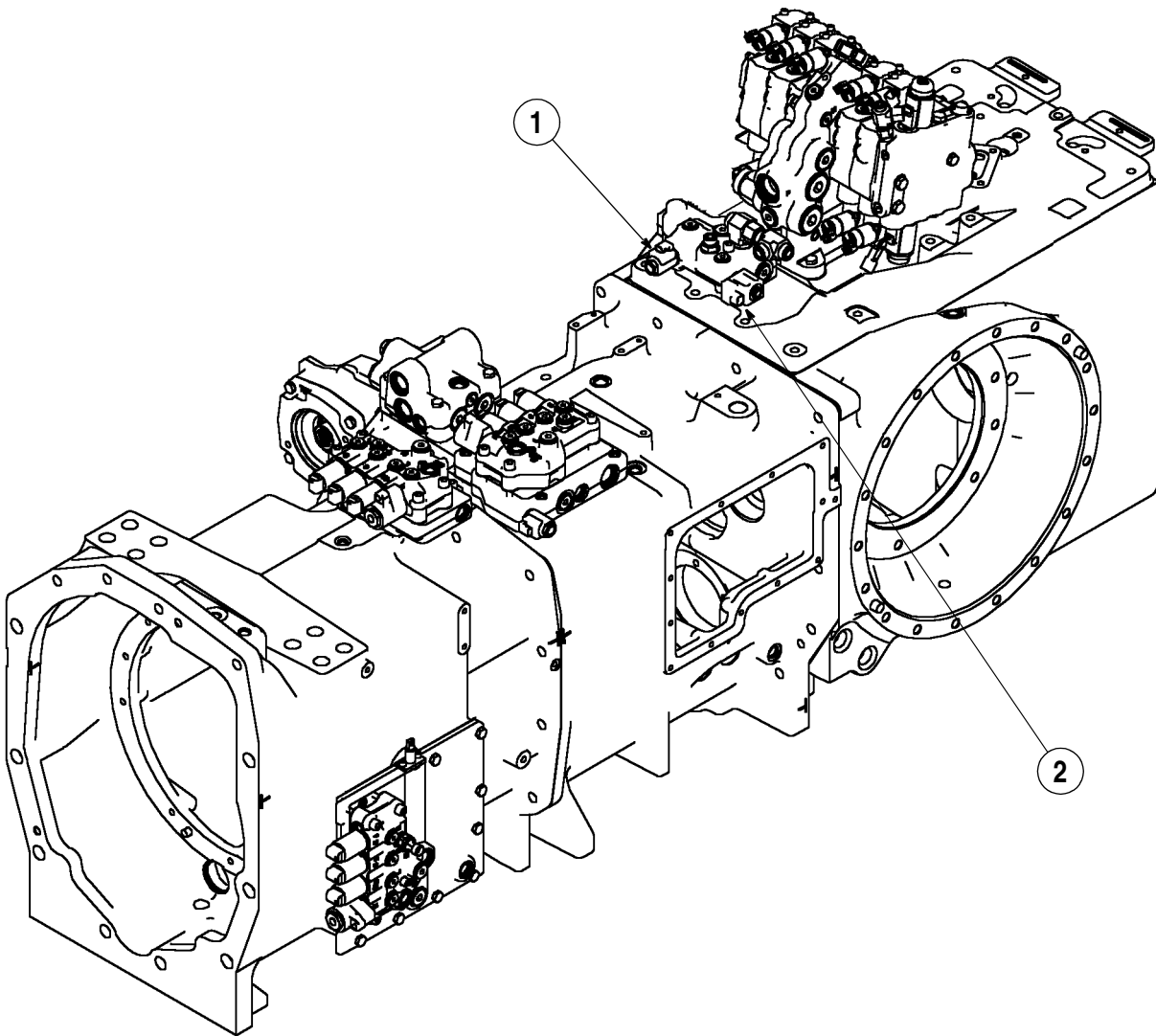
**General Description** – The Differential Lock consists of the differential lock piston, differential lock control valve, differential lock control switch, brake pedal switches, true ground speed circuit, hitch position circuit, transmission speed circuit, and electronic control modules (through the Data Bus). Because the differential lock is electronically controlled, automatic operation is possible.

The PTO/Differential Lock valve is mounted externally on top of the rear frame transmission housing. The control valve is supplied with regulated circuit pressure from the priority/regulator valve. This pressurized supply is directed to the differential lock piston for engagement. If the differential lock is activated, pressurized oil from the regulated supply circuit is ported to the differential lock piston in the differential carrier housing. As the piston extends friction discs and separator plates are locked together. The separator plates are pinned to the differential carrier, while the friction plates are splined to the left differential side gear. When the differential lock is applied, the clutch pack locks causing the left side gear to rotate with the differential carrier. This eliminates all differential action, causing power to be transmitted equally through both rear axles.

The PTO controller supplies current to the differential lock valve to activate the clutch based on commands from the operator (Differential Lock switch) and signals supplied to it from the brake pedal switches, true ground speed circuit, hitch position control system, and transmission speed signal circuit.

Diagnosing control system faults is accomplished by reading appropriate fault codes through the instrument cluster display or the service tool. Refer to PTO system fault code section of this manual for a complete list of fault codes related to the PTO, FWD, and Differential Lock system.





1. PTO/DIFF LOCK VALVE    2. DIFF LOCK CLUTCH SOLENOID

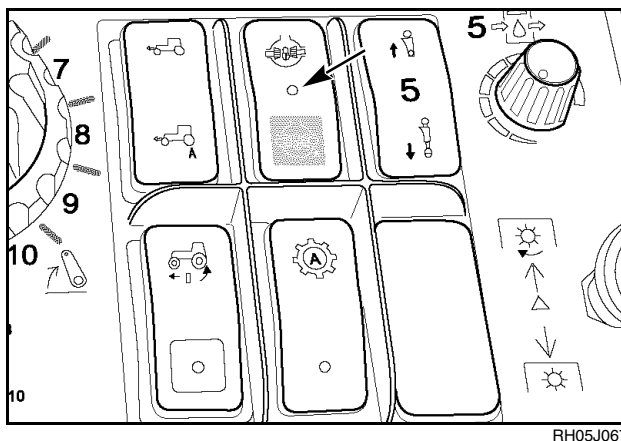
RI02E086

## ELECTRONIC DIFFERENTIAL LOCK CONTROL

**General Description** – The Differential Lock consists of the differential lock clutch, differential lock control valve, differential lock control switch, brake pedal switches, true ground speed circuit, hitch position circuit, transmission speed circuit, and electronic control modules (through the Data Bus). Because the differential lock is electronically controlled, automatic operation is possible.

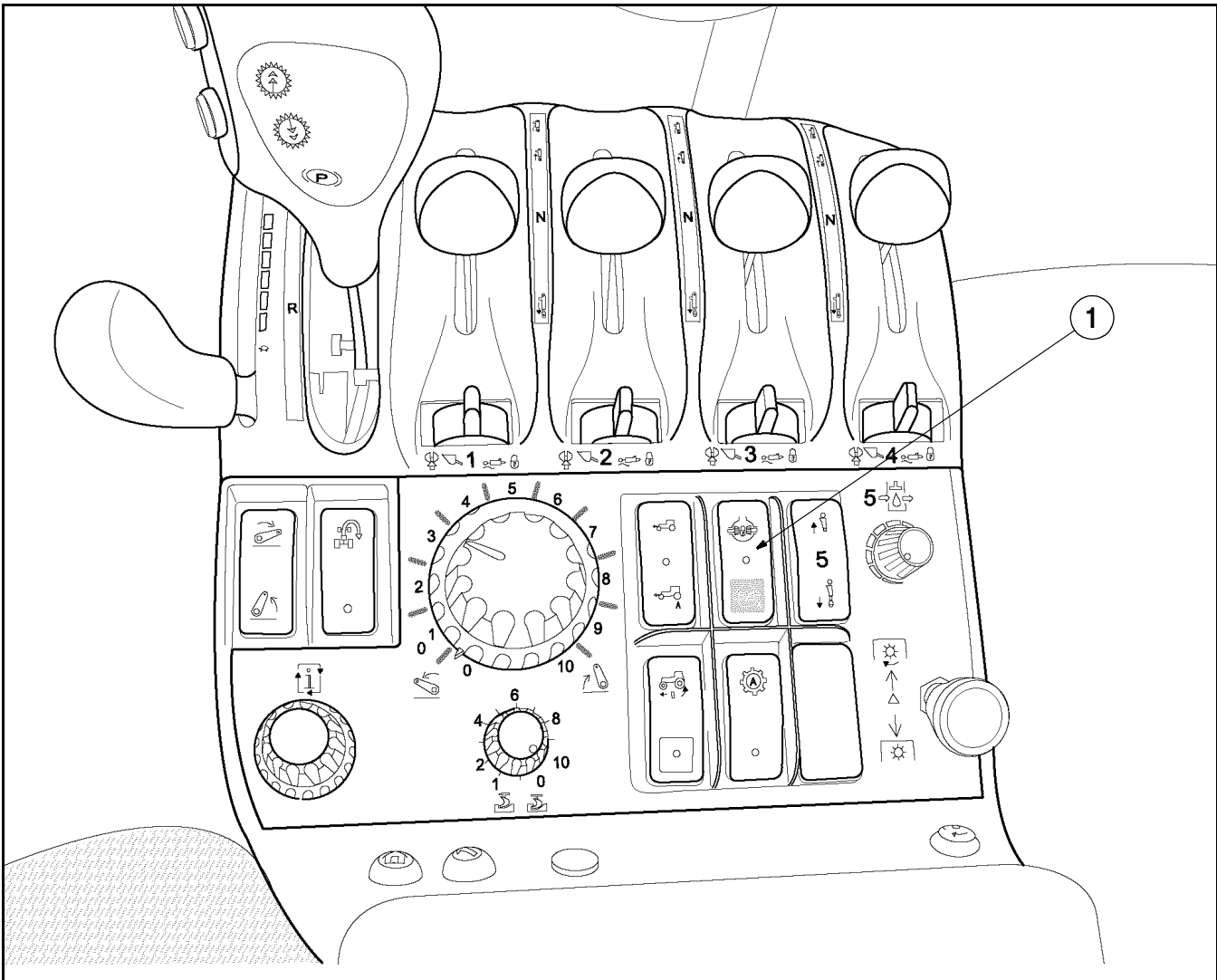
All differential lock operator commands are sent to the Arm Rest Control Module then relayed to the PTO controller via the Data Bus. Transmission speed and true ground speed signals are sent to the instrument Cluster Unit (ICU) then relayed to the PTO controller. Diagnostic and programming information are communicated between the PTO controller and the Instrument Control Unit (ICU) by way of the Data Bus.

**Operational Modes** – The differential lock system operates in one of two (2) modes based on operator commands and the signals received from the other tractor systems.



OFF (see NOTE below)  
 ON (Differential Symbol)  
 Automatic Differential Lock Control (A)

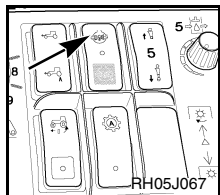
**NOTE:** It is not possible to disengage the differential lock with the switch control. Pushing either brake pedal will deactivate the differential lock.



RD05J060

1. DIFFERENTIAL LOCK SWITCH

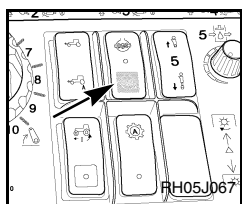
## DIFFERENTIAL LOCK CONTROL MODES



**ON (Differential Symbol)** – When the differential lock switch is placed in the ON position the differential lock will be activated. A differential symbol will be illuminated on the tractor monitor. The differential lock will disengage when either brake pedal is pushed.

**NOTE:** *It is not possible to disengage the differential lock with the switch control. Pushing either brake pedal will deactivate the differential lock.*

The differential lock switch has three (3) positions. The mid switch position is OFF when the differential lock is deactivated. The same switch position is ON when the differential lock is activated manually.

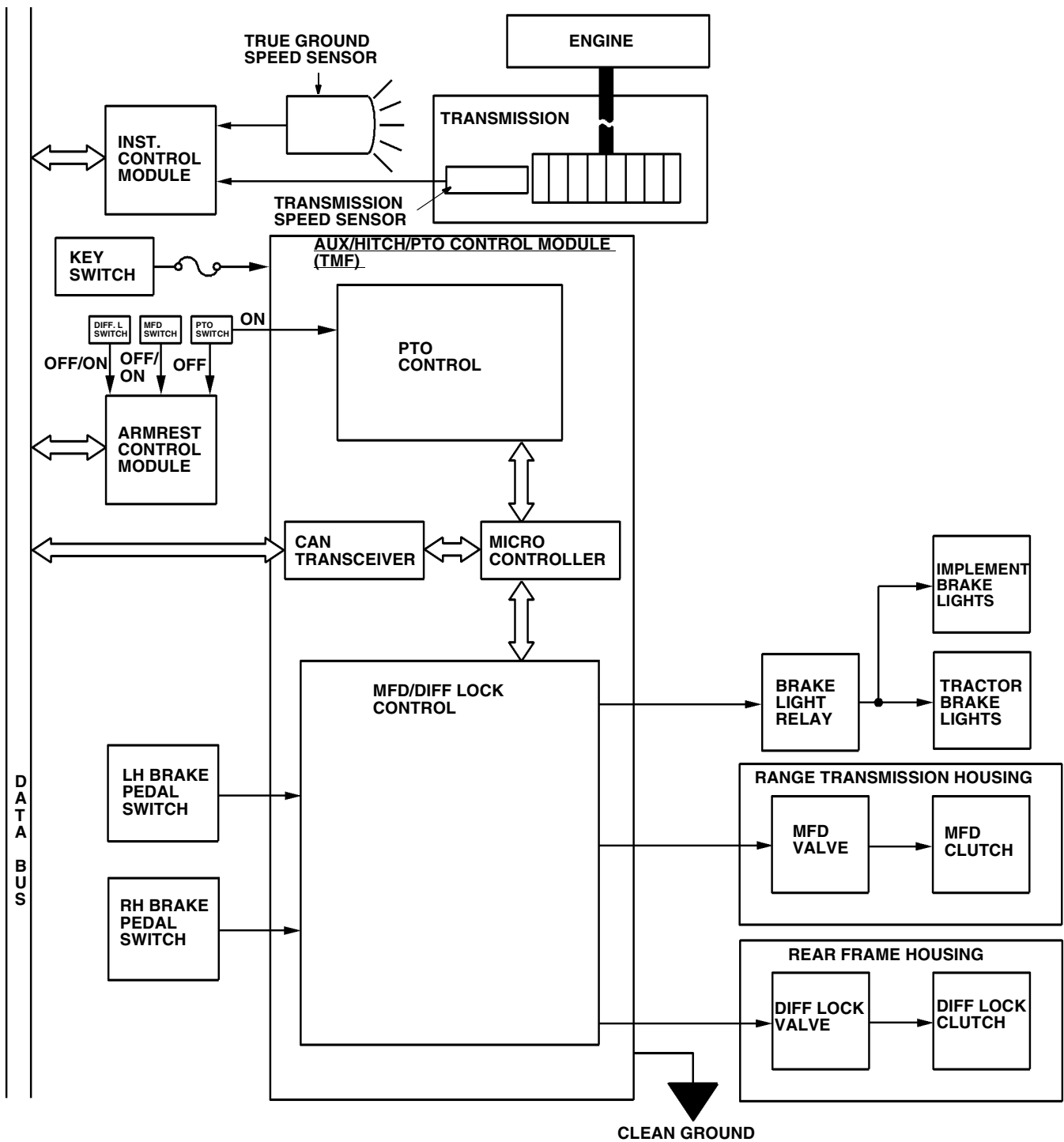


**Automatic Differential Lock Control** – When the differential lock switch is placed in the Automatic position (A symbol) the differential lock will be activated (differential symbol will be illuminated on the tractor monitor) unless the following conditions are applicable.

1. Operating with the hitch position control lever down and the hitch is raised with the UP/DOWN switch (End of Row Feature deactivates differential lock).
2. One of the brake pedals is depressed and slip is below 15%.
3. Ground speed is in excess of 10 MPH and slip is below 15%.

**NOTE:** *If the differential lock automatically disengages when ground speed exceeds 10 MPH. The differential lock will not automatically engage when ground speed decreases. To reactivate the differential lock after speed decreases (below 8 MPH), place the switch in the AUTO position and return the switch to the middle position.*

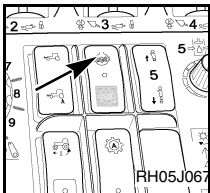
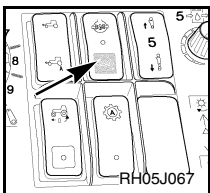
## DIFFERENTIAL LOCK CONTROL



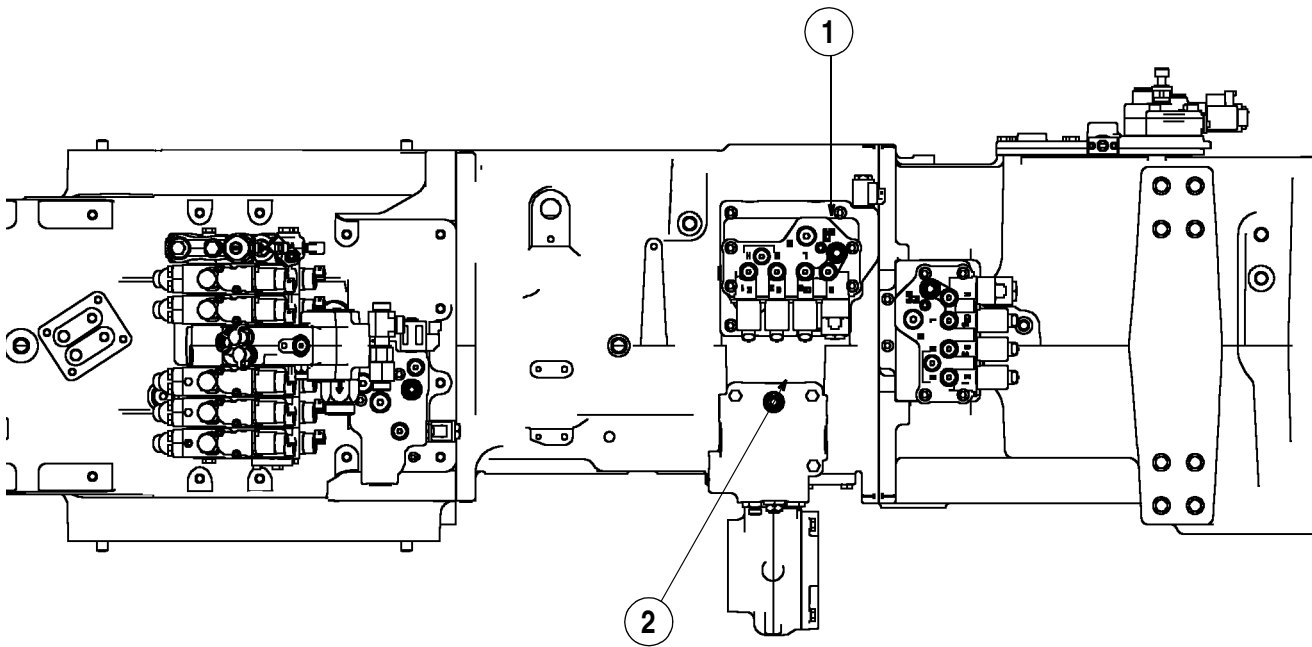
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## DIFFERENTIAL LOCK FUNCTIONAL TESTS

**IMPORTANT:** Hitch position and wheel slip will influence differential lock operation when tractor is in motion.

Switch Position	Engaged/ Disengaged	Operational Comments
ON 	Engaged	The differential Lock icon will illuminate.  If one (or both) brake pedals is pushed the differential lock light will go out and the differential lock will be deactivated.
AUTO 	Disengaged	As hitch raises and reaches upper 30% of travel. (lever down/switch.  <b>NOTE:</b> If slippage is above 15% the differential lock will engage (or stay engaged).
	Disengaged	As travel speed exceeds 10 MPH.  <b>NOTE:</b> If slippage is above 15% the differential lock will engage (or stay engaged).
	Disengaged	As one or both brakes is applied. Differential lock will re-engage if both brake pedals are released.
	Engaged	As hitch lowers below upper 30% of travel. (lever down/switch down)
	Engaged	Brakes not applied.

**IMPORTANT:** Hitch position and wheel slip will influence differential lock operation when tractor is in motion.



RI02E087

1. PTO/DIFF LOCK VALVE

2. DIFF LOCK SOLENOID

## Differential Lock Valve

The differential lock valve is a closed center valve and is contained as a part of the PTO valve. Oil is supplied to the differential lock cartridge valve from the regulated pressure circuit. The differential lock clutch supply flow is distributed internally (no external tubing) to the clutch. The valve is mounted on the top of the rear frame transmission housing. The following components of the PTO valve are involved in the differential lock system.

## Solenoid Cartridge Valve

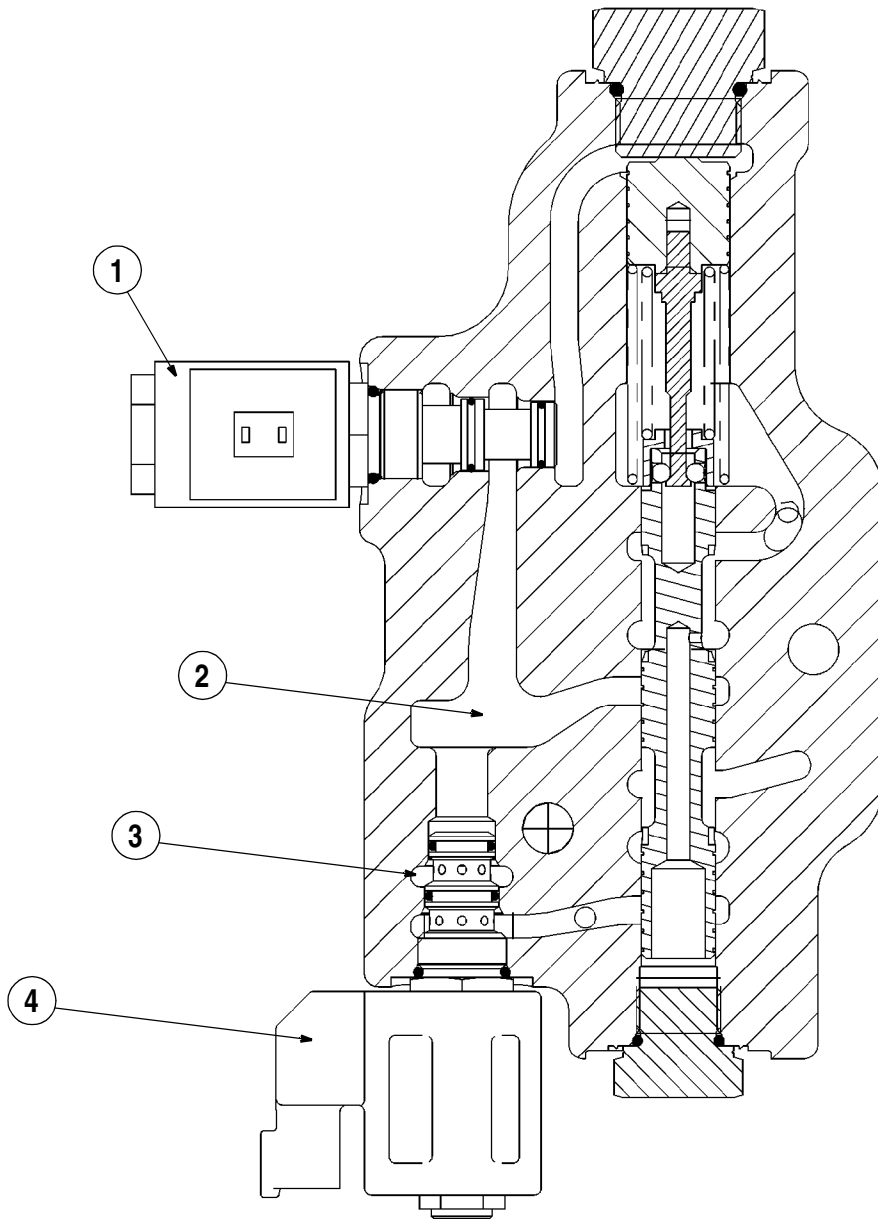
The solenoid is controlled by an armrest mounted rocker switch. The armrest controller communicates (via the Data Bus) with the PTO controller. The PTO controller supplies current to the differential lock valve to activate the differential lock clutch based on commands from the operator (differential lock switch) and signals supplied to it from the brake pedal switches, true ground speed circuit, hitch position control system, and transmission speed signal circuit. The differential lock is a hydraulically applied clutch.

## Differential Lock Clutch Disengaged

When the switch is in the disengaged position (middle) and a brake pedal is pushed, the solenoid will be de-energized. Regulated pressure will be at the valve cartridge. The piston of the differential lock clutch is mechanically returned to the neutral position. As the piston retracts, oil will be ported to the transmission housing and the differential lock clutch will disengage.

**NOTE:** It is not possible to disengage the differential lock with the switch control. Pushing either brake pedal will deactivate the differential lock.

The differential lock switch has three (3) positions. The mid switch position is OFF when the differential lock is deactivated. The same switch position is ON when the differential lock is activated manually.



1. PTO SOLENOID

2. REGULATED SUPPLY PASSAGE  
(THROUGH TOP OF VALVE BODY)

3. TO DIFF LOCK CLUTCH  
(PORTED THROUGH BACK OF VALVE)

4. DIFF LOCK SOLENOID

RT98A024



## TROUBLESHOOTING

### Problem – Differential lock will not engage

1. Check for PTO System fault codes.
  - A. If fault codes are found, follow procedures outlined in PTO system fault code troubleshooting in this section.
2. Push either brake pedal switch to deactivate the differential lock. Check the tractor monitor for the differential lock icon in the instrumentation display.
  - A. If the differential lock icon is not displayed, this is an indication the electrical control circuit is functioning correctly. Go to step 4.
  - B. If the differential lock icon is displayed, this is an indication the electrical control circuit is not functioning correctly. Check fault codes, controller, and data bus function.
3. Activate the differential lock with the manual switch position. Check for 12 VDC at differential lock valve coil.
  - A. If 12 VDC is available to the coil, the differential lock electrical circuit is functioning properly.
  - B. If 12 VDC is not found, troubleshoot the differential lock electrical circuit.
    1. Check wires 530A (R) and 175E (BK) ground.
    2. Check all connections for excessive resistance.

Apply the brakes, this will deactivate the differential lock. Check for 12 VDC at differential lock valve coil.

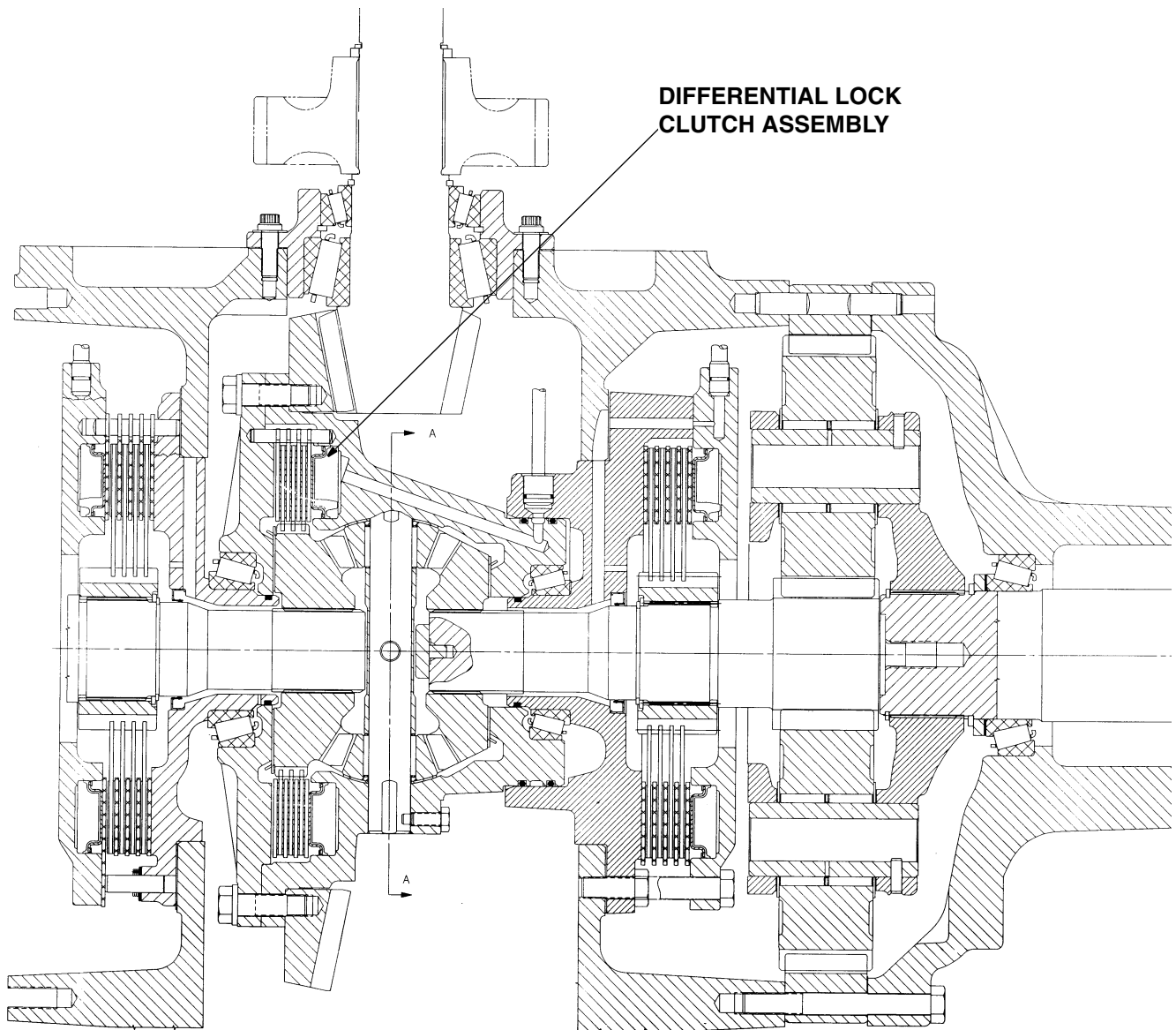
- C. If 12 VDC is available to the coil, the differential lock electrical circuit is not functioning properly.
    1. Check left and right brake switches.
  - D. If 12 VDC is not found the differential lock electrical circuit is functioning properly.
4. Start and run the engine.
  - A. Press the INCR or DECR key on the programmable instrumentation until the TRANS OIL TEMP screen is reached.

**NOTE:** Screen order is set by the operator. The TRANS OIL TEMP and TRANS SYS PRESSURE screens could or could not be together depending on setup.

- B. Operate the engine at 1500 RPM until the transmission temperature displayed on the instrumentation reads at least 49° C (120° F).
  - C. Press the INCR key as required to display the TRANS SYS PRESSURE screen.
5. While viewing the display, activate the Differential Lock. The display pressure should dip, then recover to normal regulated pressure. If the pressure dips, but does not recover there is a leak in the Differential Lock circuit. Repeat this check several times.
6.
  - A. Inspect the differential lock valve cartridge for leaking seals.
  - B. Inspect the differential lock slip ring teflon seals.
  - C. Inspect the differential lock piston o-ring.
7. Check and repair the differential lock clutch as needed.

## Differential Lock Engaged

When the switch is in the engaged position (differential symbol) the solenoid will be activated. Oil pressure, available to the valve cartridge, will be ported (internally) to the rear frame transmission housing of the tractor. The clutch will be engaged, as the piston extends, locking the friction and separator plates together. The clutch pack locks causing the left side gear to rotate with the differential carrier, eliminating differential action.



RH98H056

## TROUBLESHOOTING

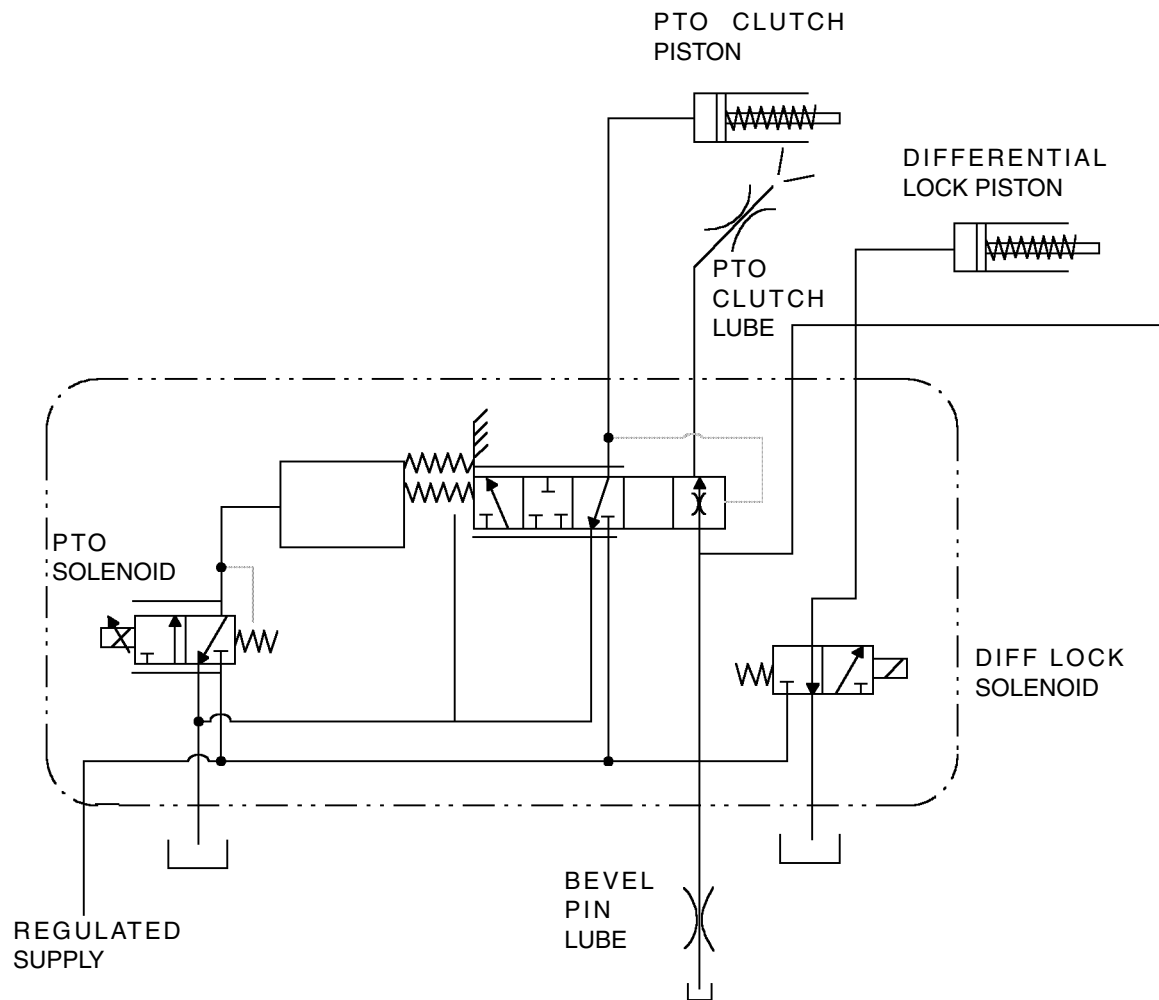
### Problem – Differential lock will not disengage

1. Check for PTO fault codes.
  - A. If fault codes are found, follow procedures outlined in PTO system fault code troubleshooting in this section.
2. Place the differential lock switch in the ON position. Check the tractor monitor for the differential lock icon in the instrumentation display.
  - A. If the differential lock icon is displayed, this is an indication the electrical control circuit is functioning correctly. Go to step 4.
  - B. If the differential lock icon is not displayed, this is an indication the electrical control circuit is not functioning correctly. Check fault codes, controller, and data bus function.
3. Place the differential lock switch in the ON position. Check for 12 VDC at differential lock valve coil.
  - A. If 12 VDC is available to the coil, the differential lock electrical circuit is functioning properly.
  - B. If 12 VDC is not found, troubleshoot the differential lock electrical circuit.
    1. Check wires 530A (R) and 175E(BK) ground.
    2. Check all connections for excessive resistance.

Apply the brakes, this will deactivate the differential lock. Check for 12 VDC at differential lock valve coil.

- C. If 12 VDC is available to the coil, the differential lock electrical circuit is not functioning properly.
    1. Check left and right brake switches.
  - D. If 12 VDC is not found the differential lock electrical circuit is functioning properly.
4. Check and repair the differential lock clutch as needed.

## PTO/DIFFERENTIAL LOCK VALVE CIRCUIT



**NOTE:** Refer to Differential Lock electrical schematic diagram.

RH02A059

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# **Section 25**

## **Chapter 3**

**FWD OUTPUT SHAFT**

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    FWD Output Shaft Disassembly ..... 25-3-5

    FWD Output Shaft Assembly ..... 25-3-9

## **SPECIAL TORQUES**

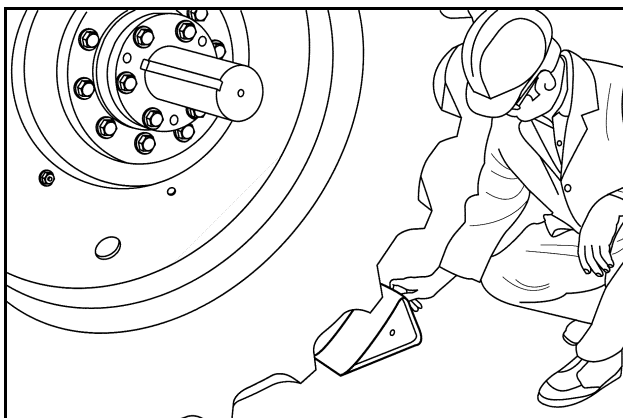
FWD Output Shaft Yoke Retaining Bolt .....	252 to 280 Nm (186 to 206 lb. ft.)
FWD Output Shaft Bearing Cage Bolt .....	375 to 485 Nm (276 to 358 lb. ft.)
FWD Drive Shaft Retaining Bolts .....	58 to 64 Nm (43 to 47 lb. ft.)



## FWD OUTPUT SHAFT

### FWD Output Shaft Removal

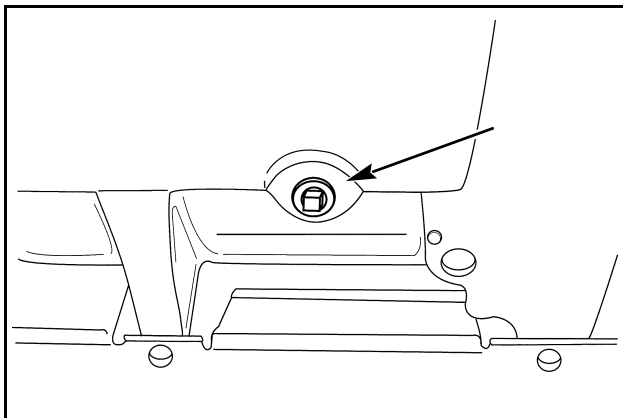
#### STEP 1



96RS28A

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Turn off the engine and remove the key. Place blocks in front of and behind the rear wheels.

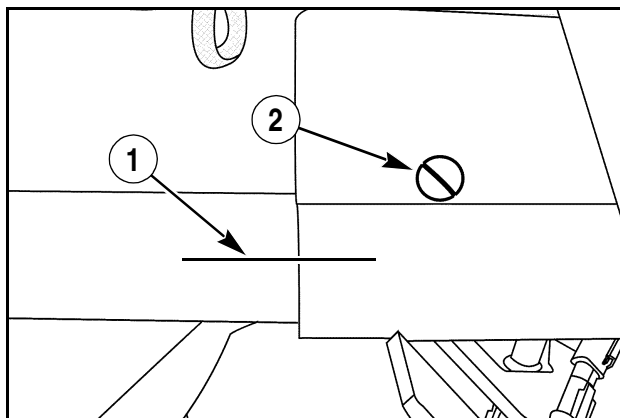
#### STEP 2



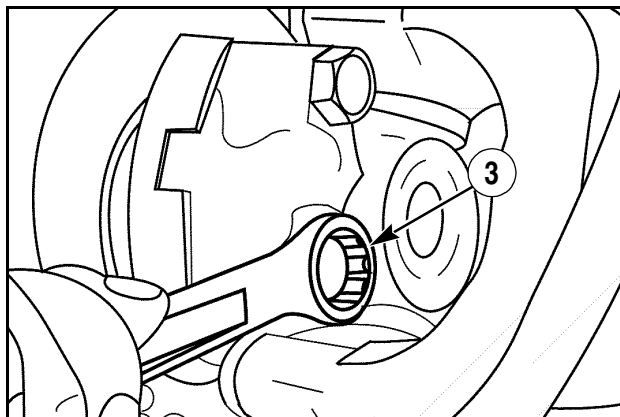
91S17

Remove the plug and drain the transmission oil from the speed transmission into a suitable, clean container.

#### STEP 3



RD02H172

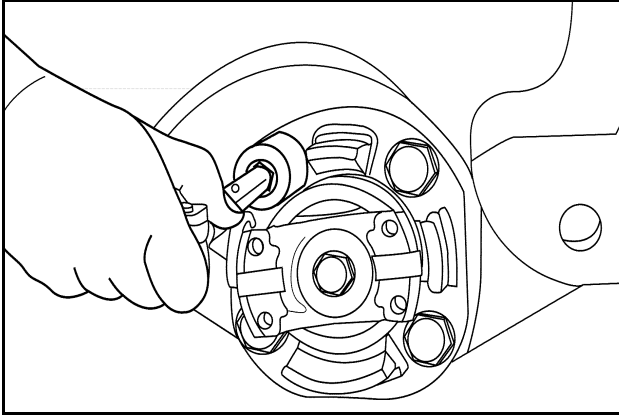


RD02H173

Mark the position of the sleeve on the drive shaft protector (1). Remove the drive shaft protector pins (2). Slide the drive shaft protector toward the transmission. Properly support the drive shaft. Refer to the information in this manual for the drive shaft removal procedure. Remove the four bolts (3) from the pinion yoke, and the transmission yoke. Remove the drive shaft protector and the drive shaft.

**NOTE:** *Suspended FWD axle shown. The procedure will be similar for all FWD axles.*

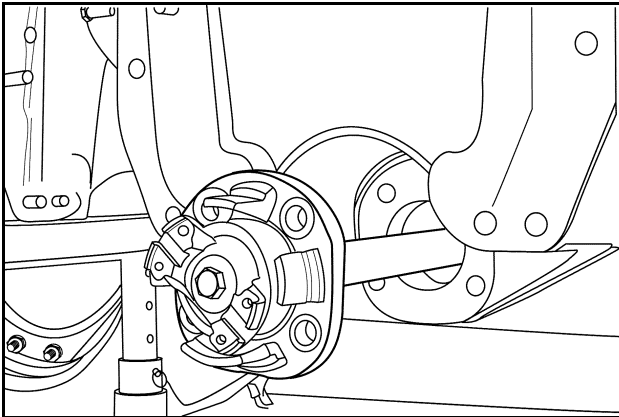
#### STEP 4



11S19

Remove four bolts and four washers on the output shaft bearing cage.

#### STEP 5

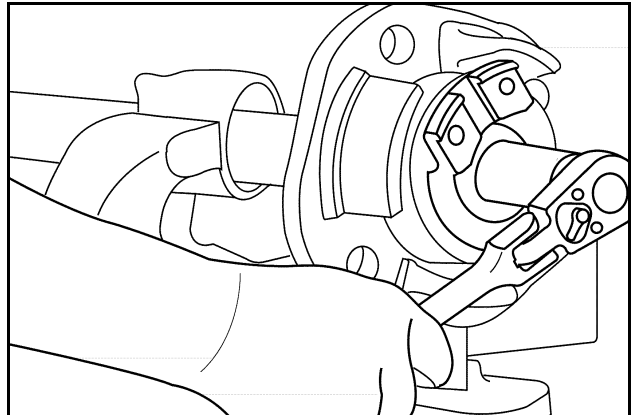


11S21

Remove FWD shaft and bearing cage from drop box.

### FWD Output Shaft Disassembly

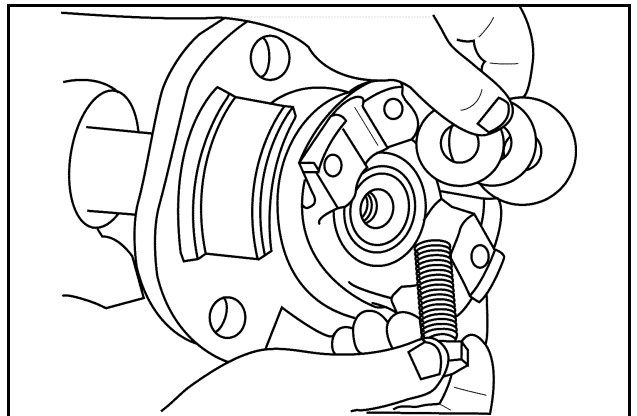
#### STEP 6



108RS4

Place the FWD output shaft in a vise and remove the yoke retaining bolt.

#### STEP 7

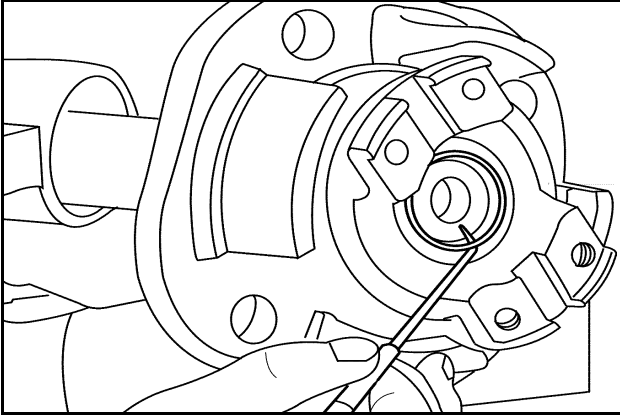


108RS7

Remove the yoke retaining bolt washer and the shim(s).

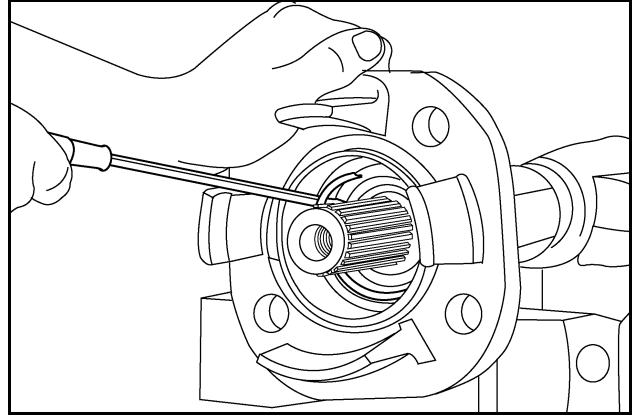
**NOTE:** *Keep the shims with the yoke.*

**STEP 8**



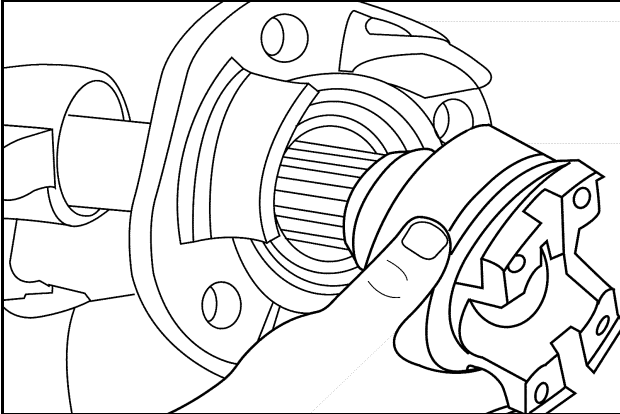
Remove and discard the O-ring.

**STEP 11**



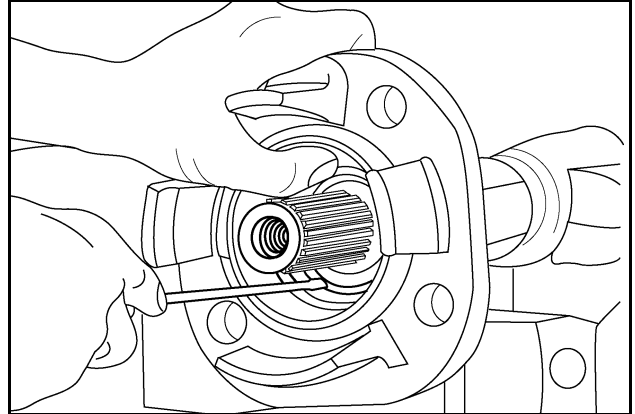
Remove the internal retaining ring.

**STEP 9**



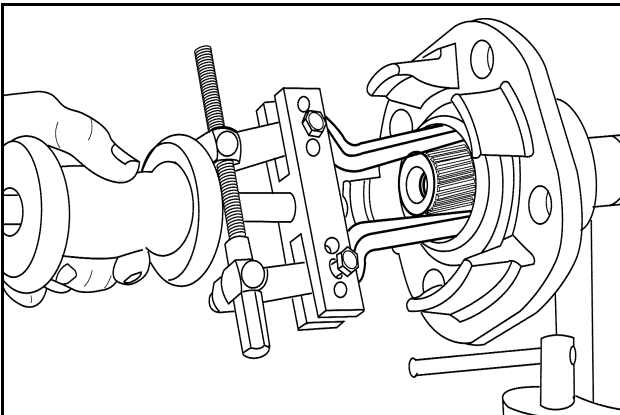
Remove the yoke from the output shaft spline.

**STEP 12**



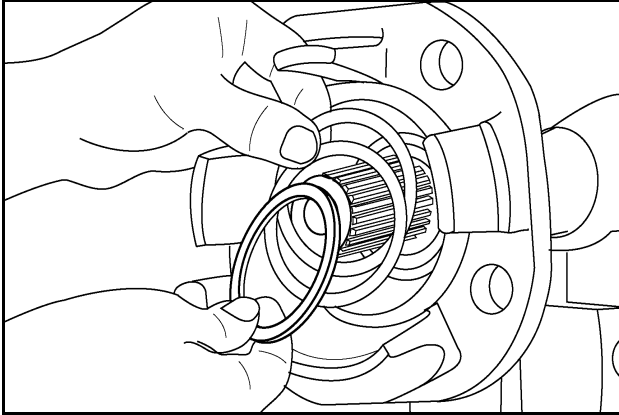
Remove the bearing spacer.

**STEP 10**



Remove and discard the oil seal

### STEP 13

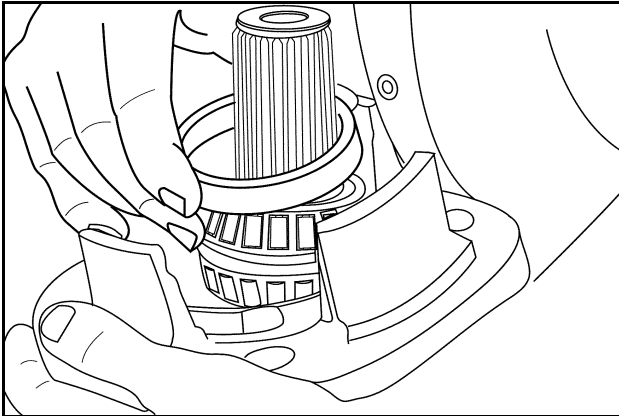


108RS29

Remove the shim(s). The bearing spacer is shown with two shims.

**NOTE:** Keep the shim(s) with the bearing cage.

### STEP 14

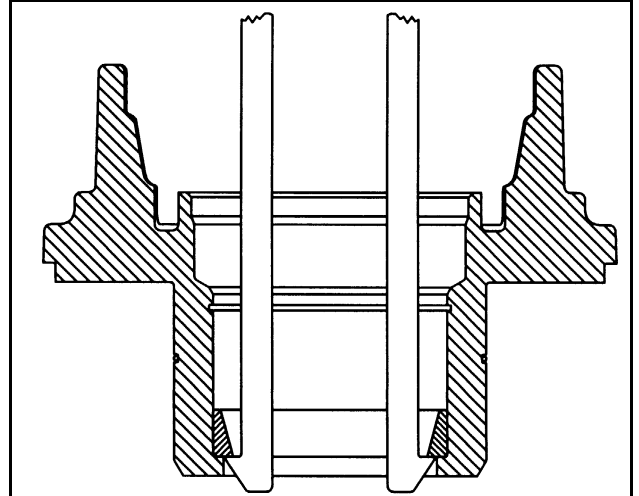


109RS7

Remove the bearing cage as follows:

1. Rest the bottom of the drive shaft on a wooden block.
2. Hold the bearing cage.
3. Tap downward on the ears of the bearing cage in a crossing pattern.
4. Remove the front bearing cup.
5. Remove the bearing cage.

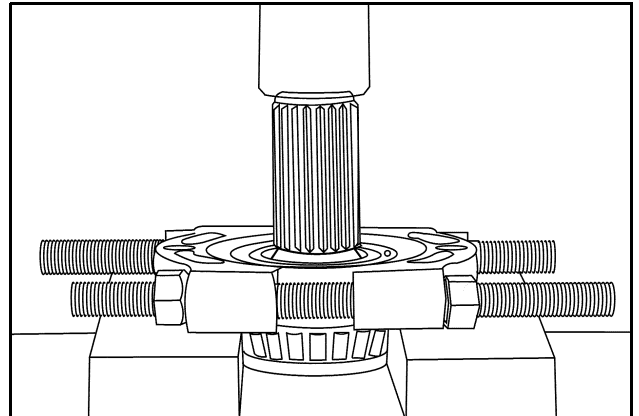
### STEP 15



2940CUP1

Remove the rear bearing cup from the bearing cage, as shown in drawing above.

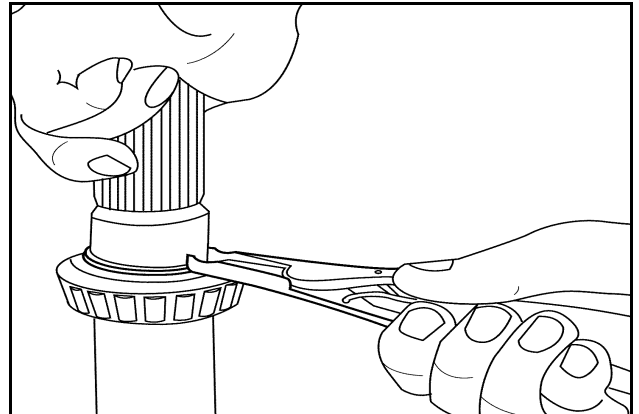
### STEP 16



109RS17

Press the front bearing cone from the output shaft.

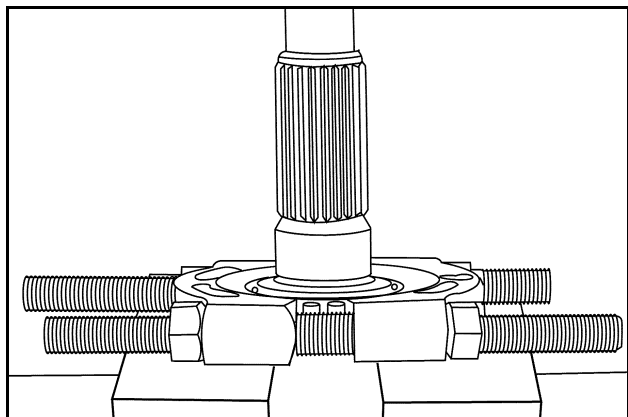
### STEP 17



109RS22

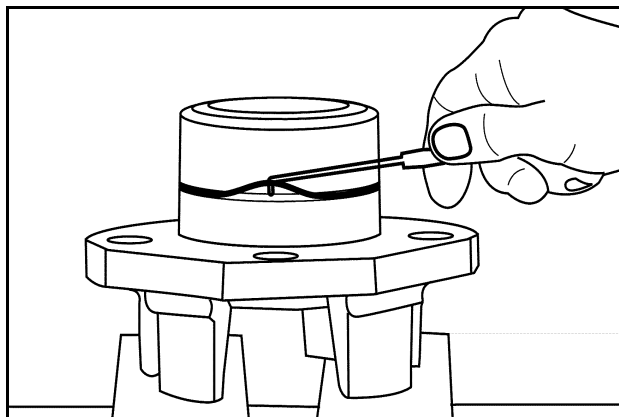
Remove the external retaining ring.

## STEP 18



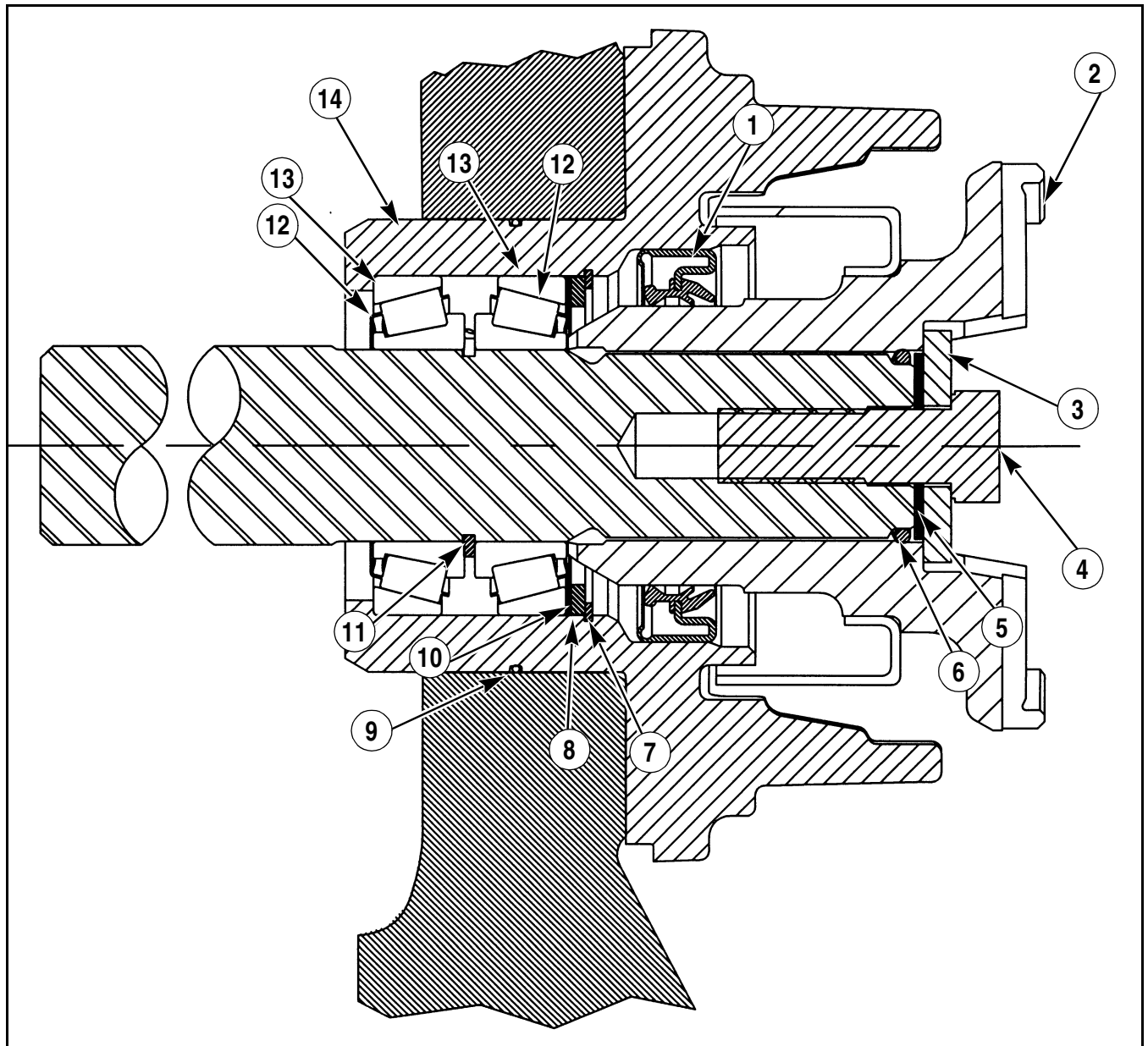
Press the rear bearing cone from output shaft.

## STEP 19



Remove and discard the O-ring from bearing cage.

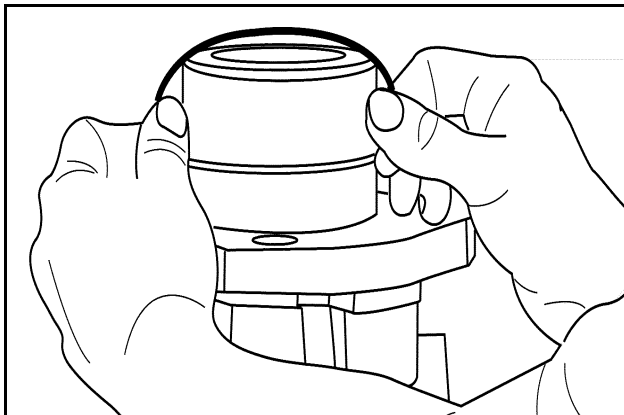
## FWD Output Shaft Assembly



2940FUL2

- |                            |                             |
|----------------------------|-----------------------------|
| 1. SEAL                    | 8. BEARING SPACER           |
| 2. YOKE                    | 9. O-RING                   |
| 3. WASHER                  | 10. SHIMS                   |
| 4. BOLT                    | 11. EXTERNAL RETAINING RING |
| 5. SHIMS                   | 12. BEARING CONE            |
| 6. O-RING                  | 13. BEARING CUP             |
| 7. INTERNAL RETAINING RING | 14. BEARING CAGE            |

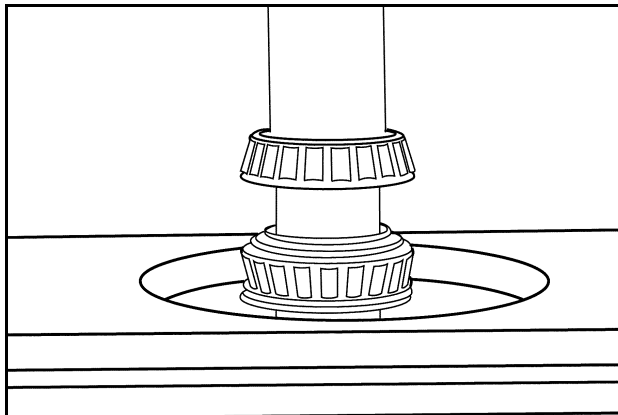
## STEP 20



109RS16

Lubricate a new O-ring with clean hydraulic oil and install into the groove on the bearing cage.

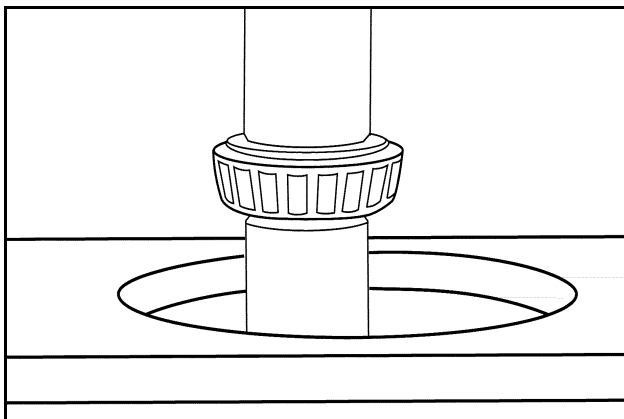
## STEP 23



109RS31

Install a new front bearing cone on the output shaft. Press the front bearing cone against the external retaining ring.

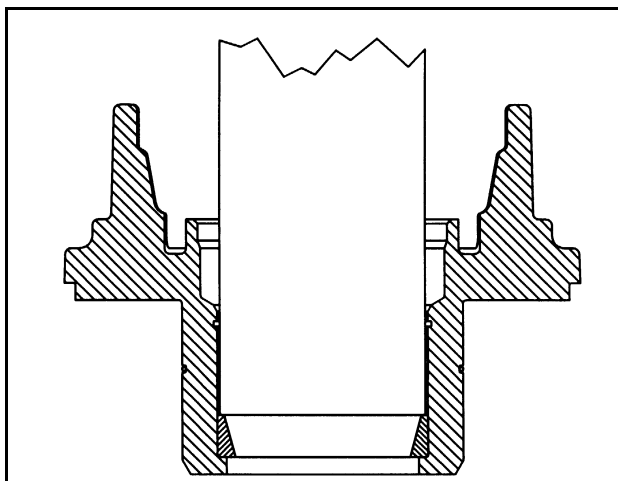
## STEP 21



109RS23

Install a new rear bearing cone just below the external retaining ring groove.

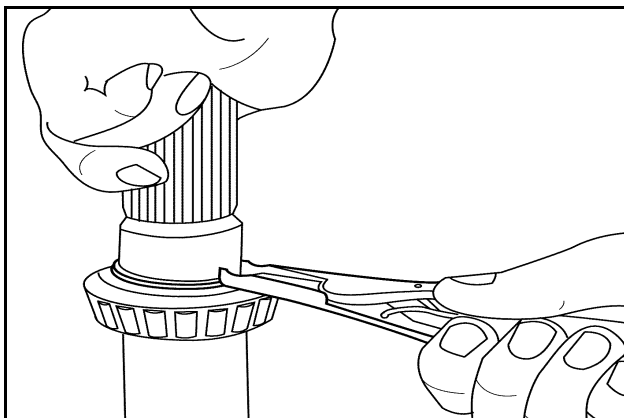
## STEP 24



2940CUP2

Press a new rear bearing cup into the bearing cage.

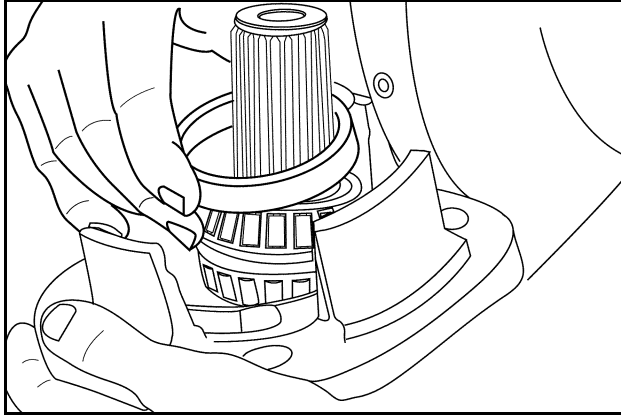
## STEP 22



109S22

Install a new external retaining ring and press the rear bearing cone against the retaining ring.

## STEP 25

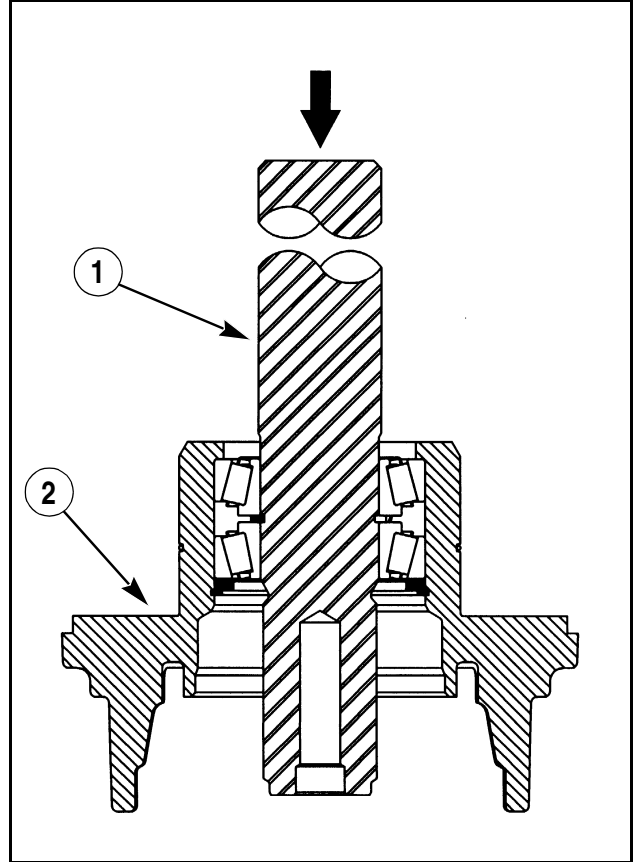


109RS7

Install the bearings and shims as follows:

1. Install the output shaft into the bearing cage.
2. Install a new front bearing cup.
3. Use a press to seat the front bearing cup into the bearing cage while rotating and moving the shaft back and forth. Install the bolt into the end of the output shaft. Measure the rolling torque of the output shaft. The reading obtained must be 1.5 to 2.2 Nm (13 to 19 lb. in).
4. Measure the distance from the bearing cup face to the top edge of the internal retaining ring groove in the bearing cage. Subtract 0.27 MM. (0.011 inch) for bearing end play.
5. This will be the total shim, spacer, and internal retaining ring dimension required. Select shims that, with the spacer and the internal retaining ring, will equal the dimension to within 0.25 MM. (0.010 inch). Refer to Step 14 to remove the front bearing cup from the bearing cage. Install the shims and the spacer.

## STEP 26



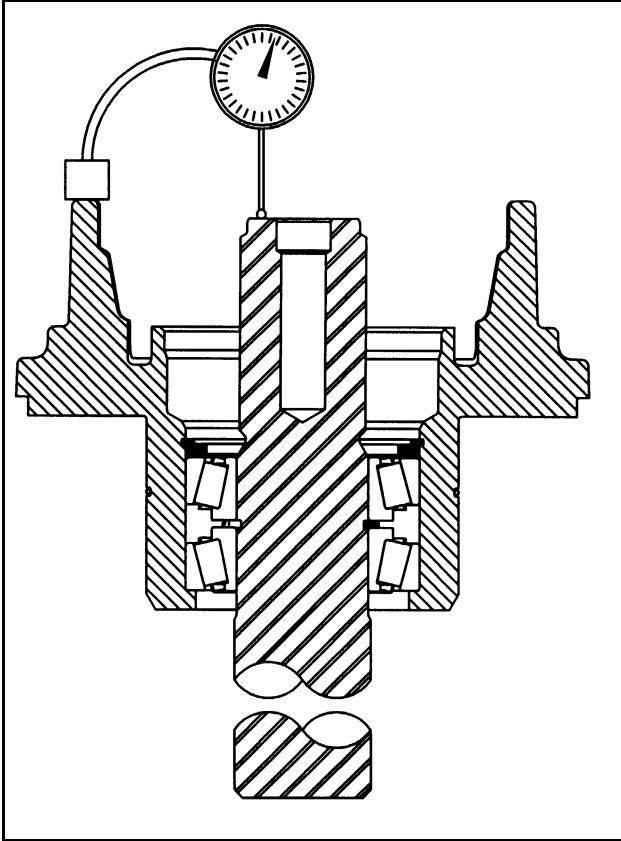
2940SEAT

1. FWD OUTPUT SHAFT
2. BEARING CAGE

Install the internal retaining ring. Hold the bearing cage and press on the shaft end to seat the bearing cup until the internal retaining ring is seated tightly to the top edge of the internal retaining ring groove.

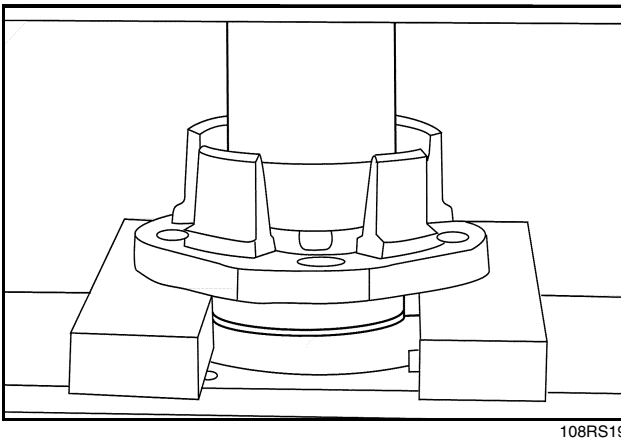


## STEP 27



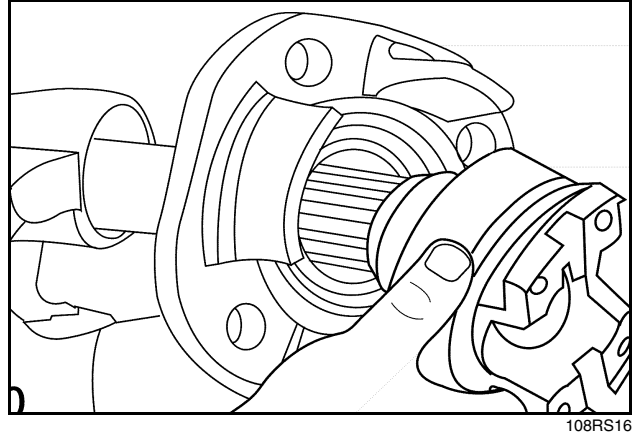
Use a dial indicator to measure the bearing end play while slightly moving the shaft up and down. If the end play does not fall within 0.025 to 0.150 MM. (0.001 to 0.006 inch), remove the output shaft from the bearing cage and repeat Steps 25 and 26 to obtain the proper measurement.

## STEP 28



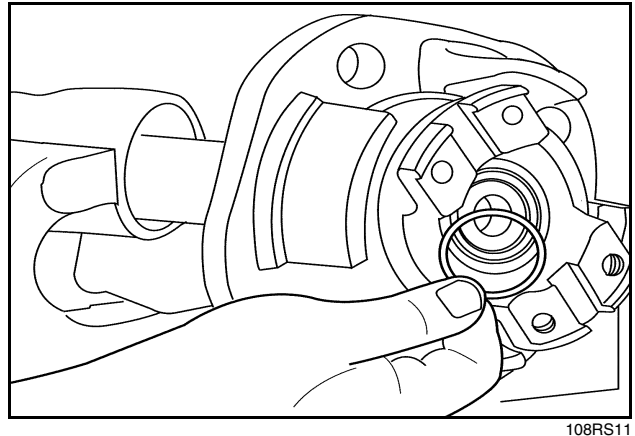
Lubricate the inner diameter of the FWD output shaft seal with clean hydraulic oil. Install the oil seal. The seal must be installed 8.5 MM. (0.335 inch) below the surface of the bearing cage.

## STEP 29



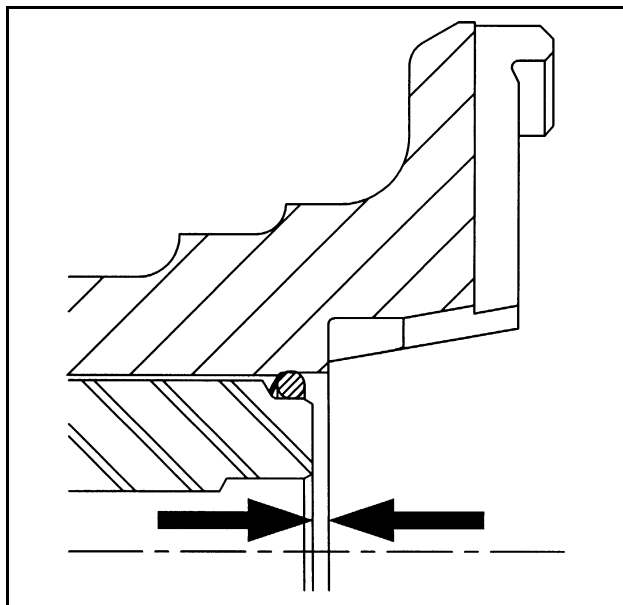
Install the yoke on the output shaft spline.

## STEP 30



Lubricate a new O-ring with hydraulic fluid and install into the yoke.

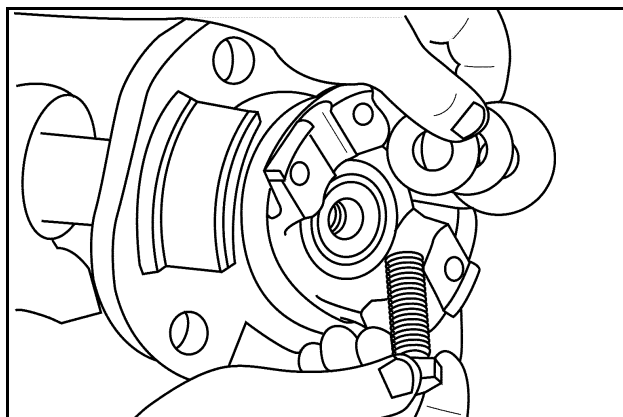
### STEP 31



YOKESHIM

Measure from the end of output shaft to the surface of yoke. Select a shim combination to obtain a distance of 0 to 0.1 MM. (0 to 0.004 inch).

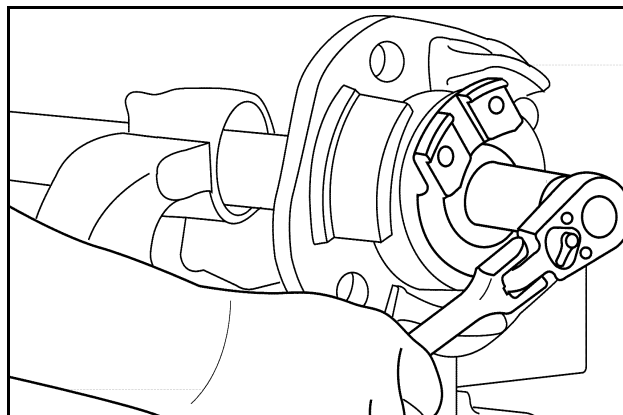
### STEP 32



108RS7

Install the shims and the yoke retaining bolt washer.

### STEP 33

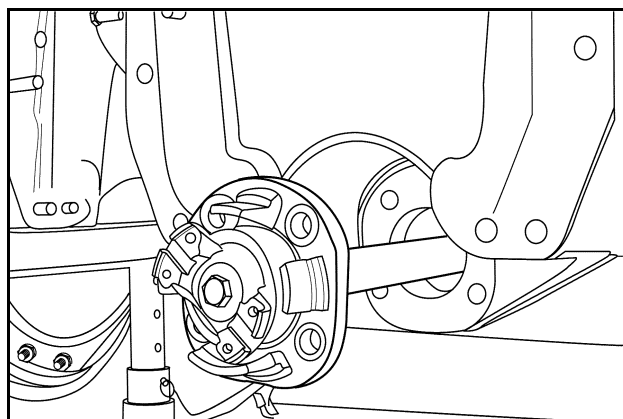


108RS4

Place the FWD output shaft in a vise and install the yoke retaining bolt. Apply a torque of 252 to 280 Nm (186 to 206 lb. ft.) to the bolt.

**NOTE:** Do not install the output shaft if the FWD clutch is to be serviced. Refer to FWD Clutch Removal found in the Range Section of this Repair Manual.

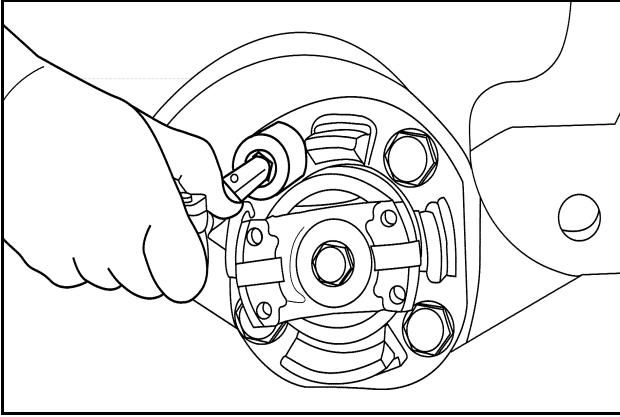
### STEP 34



11S21

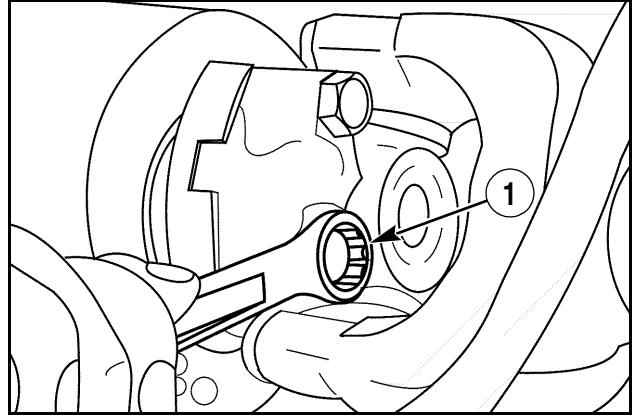
Install the FWD output shaft and bearing cage into the housing.

**IMPORTANT:** The output shaft engages a needle bearing in the rear wall of the speed transmission housing. Be careful not to dislodge the bearing.

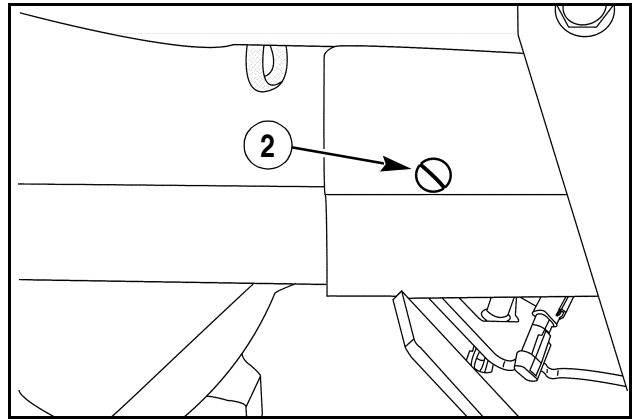
**STEP 35**

11S19

Install the FWD output shaft into the needle bearing in the rear wall of the speed housing. Engage the FWD output shaft with the FWD hub spline. Install the four bolts through the output shaft bearing cage and the drop box. Tighten the four bolts to a torque of 375 to 485 Nm (276 to 358 lb. ft.).

**STEP 36**

RD02H173

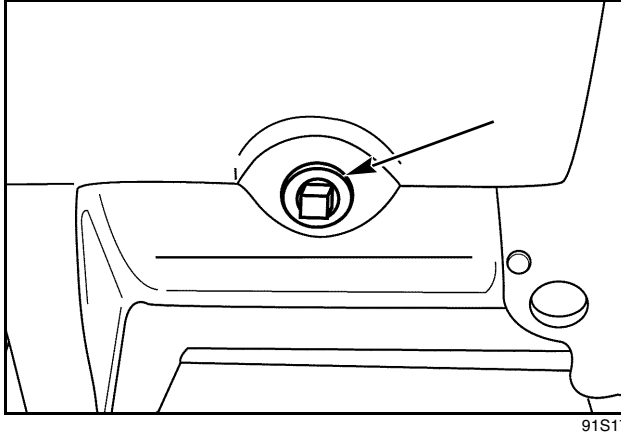


RD02H172

Install the FWD drive shaft and the drive shaft protector. Refer to the installation procedure contained in this manual. Properly support the drive shaft. Tighten the drive shaft retaining bolts (1) to a torque of 58 to 64 Nm (43 to 47 lb. ft.). Install the drive shaft protector pins (2), using the position marks on the drive shaft protector made during disassembly.

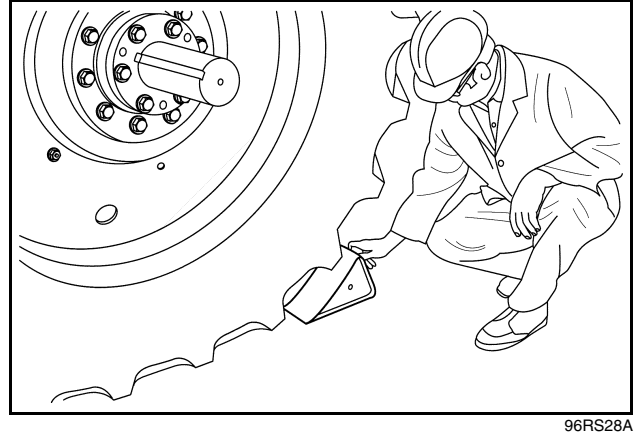
**NOTE:** *Suspended FWD axle shown. The procedure will be similar for all FWD axles.*

### STEP 37



Replace the transmission drain plug and fill the transmission with hydraulic oil.

### STEP 38



Check for oil leaks. Make sure the transmission shift lever is in Park. Remove the blocks in front of and behind the rear wheels. Start the tractor and check the operation of the FWD suspended axle and the transmission. Check the hydraulic oil level. Turn the engine off and remove the key.

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# **Section 25**

## **Chapter 4**

**FWD DRIVE SHAFT**

**TABLE OF CONTENTS**

SPECIAL TORQUES ..... 25-4-3

FWD DRIVE SHAFT ..... 25-4-4

## SPECIAL TORQUES

Drive Shaft Retaining Bolts..... 58 to 64 Nm (43 to 47 lb. ft.)



## FWD DRIVE SHAFT

### Removal

**NOTE:** Tractor with suspended axle shown. All drive shafts are similar.

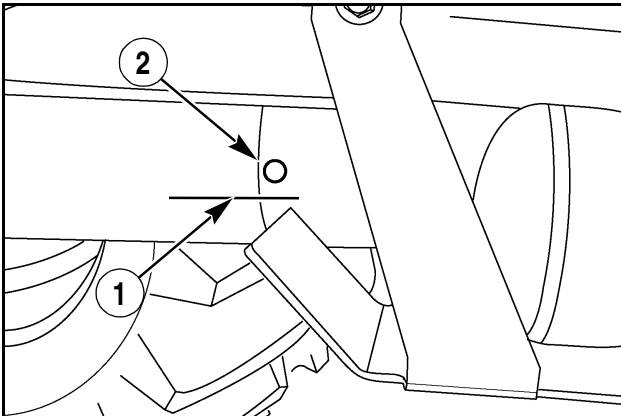
#### STEP 1



96RS28A

Park the tractor on a hard, level surface. Put the transmission shift lever in **PARK**. Turn off the engine and remove the key. Place blocks in front of and behind the rear wheels.

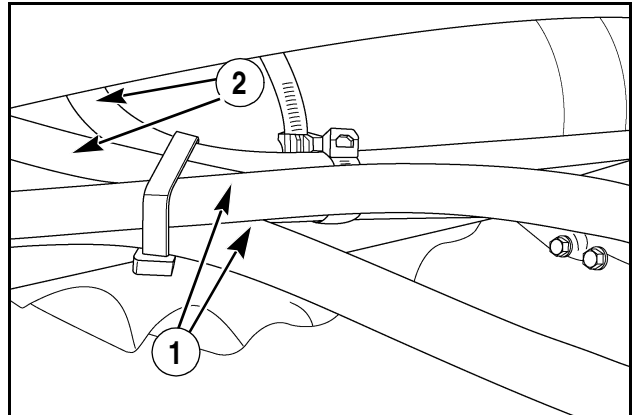
#### STEP 2



RD02H166

Mark the position of the sleeve on the drive shaft cover (1). Remove the plastic pin (2). Slide the cover toward the transmission.

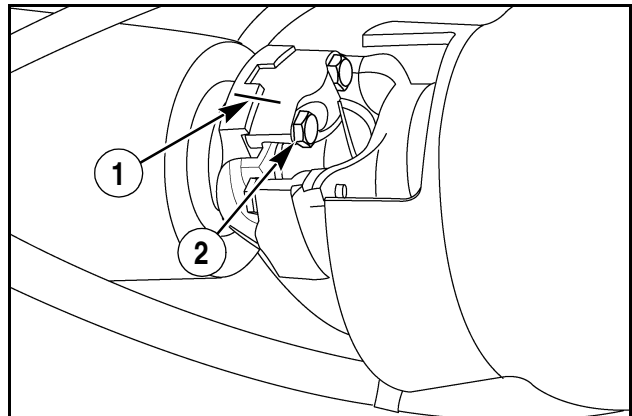
#### STEP 3



RD06A007

Remove the suspended front axle hoses (1), if equipped. Remove the steering hoses (2) (right side shown) from the drive shaft cover.

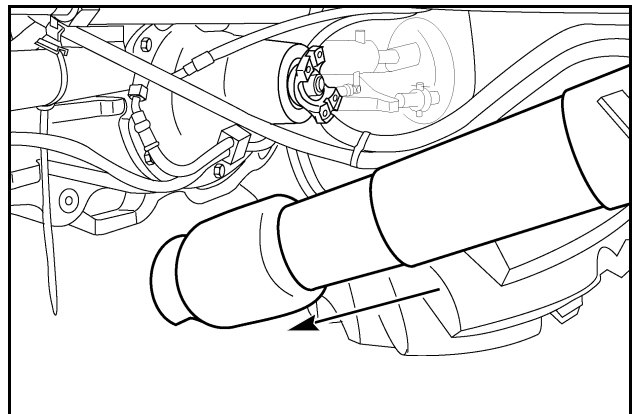
#### STEP 4



RD02H169

Mark the drive shaft to pinion yoke (1). Support the drive shaft. Remove the four drive shaft to pinion yoke retaining bolts (2).

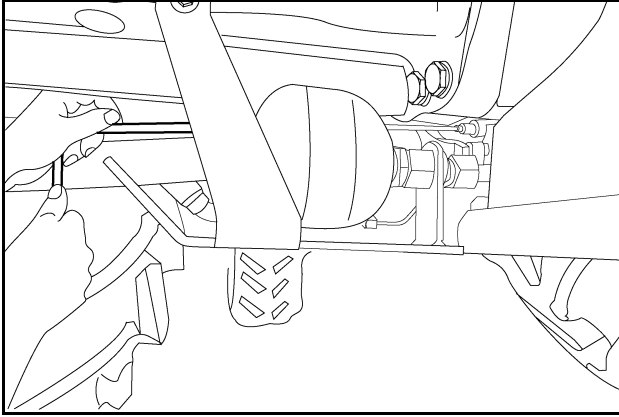
#### STEP 5



RD02H154

Slide the drive shaft protector from the drive shaft.

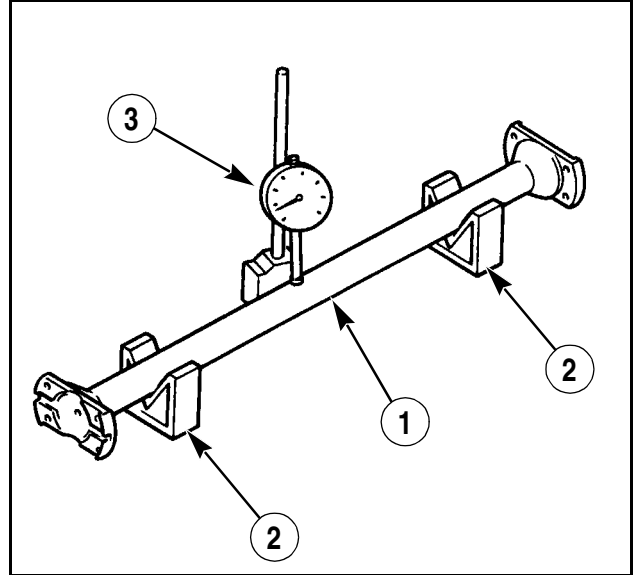
**STEP 6**



RD02H168

Mark the drive shaft to FWD output shaft yokes. Remove the four drive shaft to transmission yoke retaining bolts. Remove the drive shaft.

**STEP 7**

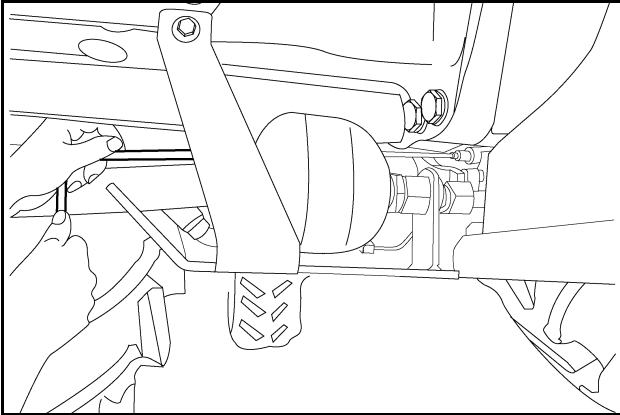


RD02H191

Place the drive shaft (1) on V blocks (2). Position a dial indicator (3) over the drive shaft. Turn the drive shaft one complete revolution to check for straightness. Replace the drive shaft, if necessary.

## Installation

### STEP 8

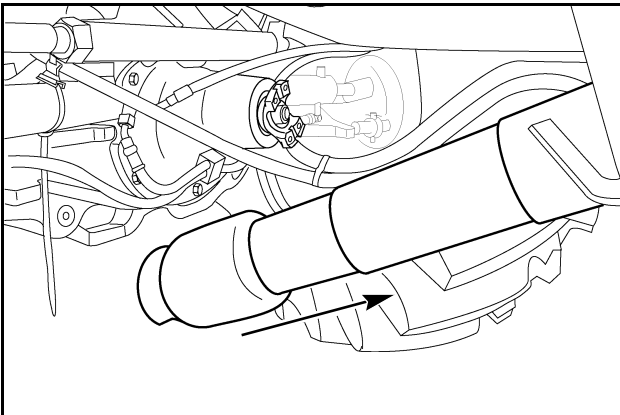


RD02H168

Align the marks on the yokes. Install the four drive shaft to transmission yoke retaining bolts. Tighten the bolts to a torque of 58 to 64 Nm (43 to 47 lb. ft.).

**NOTE:** Tighten bolts in a crossing pattern until the yoke is fully seated.

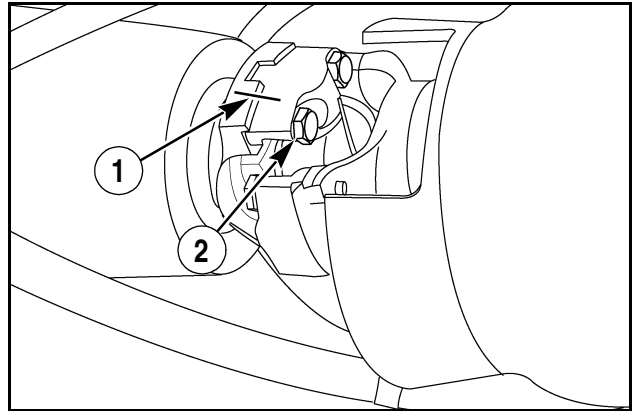
### STEP 9



RD02H154

Slide the cover over the drive shaft.

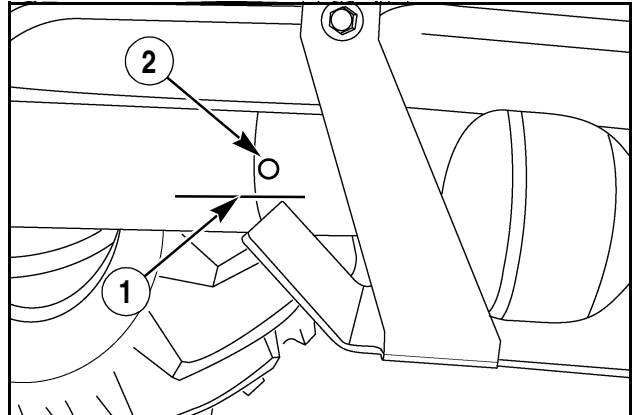
### STEP 10



RD02H169

Support the FWD drive shaft. Align the marks on the yokes (2). Install and tighten the four drive shaft to pinion yoke bolts (2) to a torque of 58 to 64 Nm (43 to 47 lb. ft.).

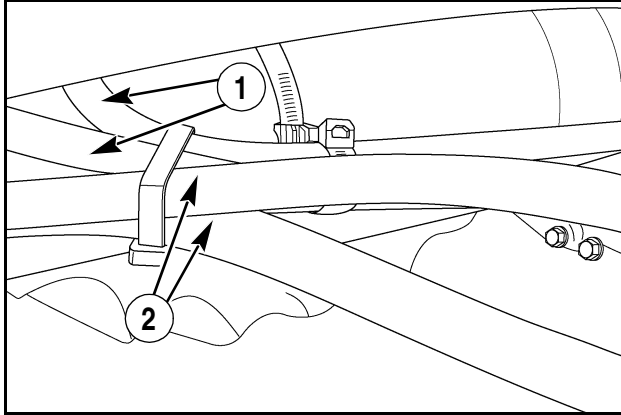
### STEP 11



RD02H166

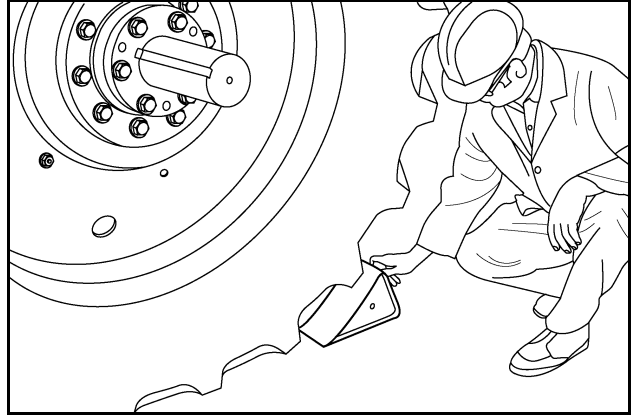
Move the position marks (1) made on the drive shaft cover and sleeve until the holes are aligned (2). Install a new plastic pin.

### STEP 12



Attach the steering hoses (1). Tie strap the suspended axle hoses (2), if equipped to the steering hoses.

### STEP 13



Check for oil leaks. Make sure the transmission shift lever is in PARK. Remove the blocks in front of and behind the rear wheels. Start the tractor and check the operation of the FWD suspended axle and the transmission. Check the hydraulic oil level. Turn the engine off and remove the key.



# **Section 25**

## **Chapter 5**

**SUSPENDED FWD AXLE SYSTEM**  
**How It Works and Troubleshooting**

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SUSPENDED FWD AXLE OPERATION ..... 25-5-3

SUSPENDED MFD AXLE- CALIBRATION MODE ..... 25-5-9

    ERROR TABLE ..... 25-5-11

SUSPENDED FWD AXLE- MANUAL OPERATION MODE (TEST MODE) ..... 25-5-13

SUSPENDED FWD AXLE- DEMONSTRATION MODE ..... 25-5-16

## SUSPENDED FWD AXLE OPERATION

The front axle suspension system:

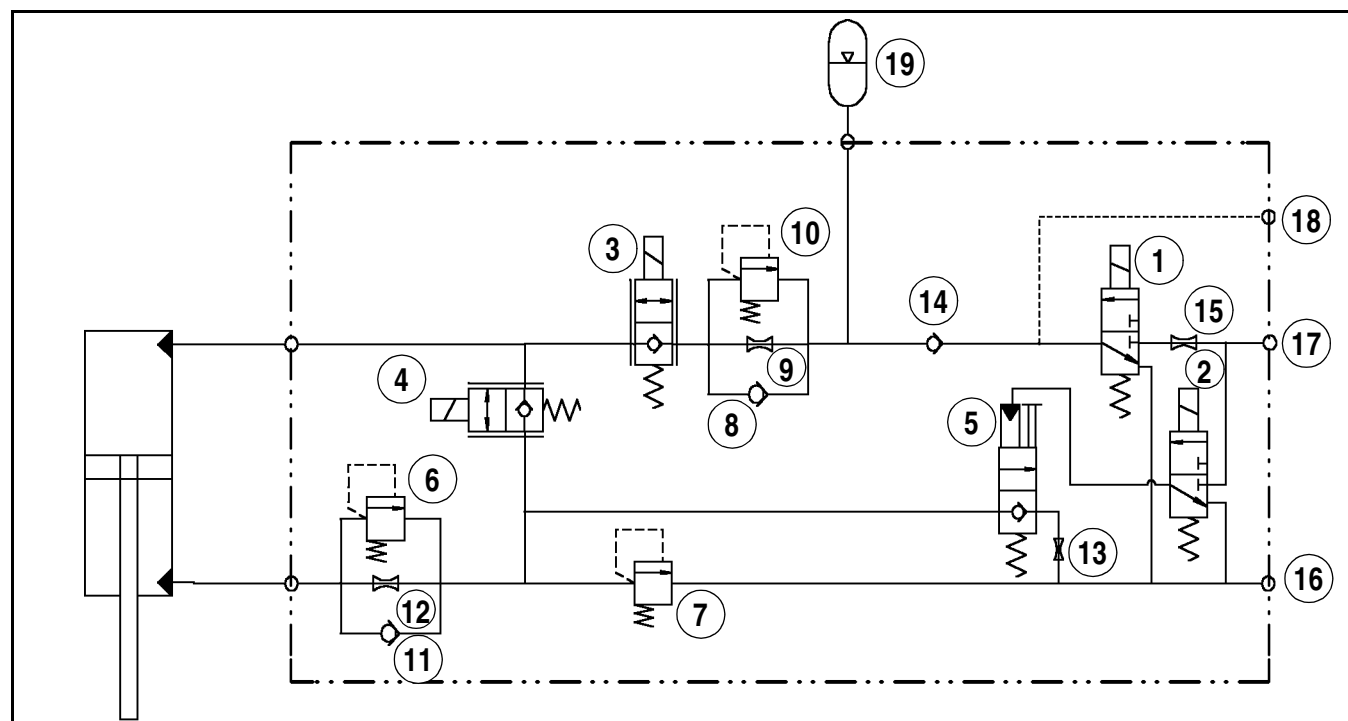
- A. allows increased operating speeds with greater tractor stability in the field and on the road.
- B. improves ride quality and operator comfort when working on rough terrain and for high speed shuttling.
- C. provides better front tire to ground contact for improved tractor control and prolonged tire life.

Automatic front suspension is beneficial in most applications, but can be disengaged when performing some front hitch and loader operations.

The suspended axle will default to the auto mode when the tractor is started. However, the axle will be locked until the tractor reaches 1.0 km/h (0.6 mph) for one second. When the transmission controller sees 1.0 km/h (0.6 mph) for one second it will energize both lockout solenoids (3) and (4) activating the system. Pressing and releasing the suspended axle switch to the momentary position will turn off the system, this will lock the axle in position and the light on the switch will illuminate. The lockout solenoids are PWM type and will ramp up from 0 to 1.5 amp in about a 5 seconds. These solenoids are PWM to avoid any unwanted movement of the front axle that may occur if the solenoids simply turn on or off.

With the system turned off, the axle will be locked in position until the tractor reaches 12 km/h (7.5 mph), at 12 km/h (7.5 mph) the system will switch to the auto mode for roading. This can only be overridden with the Electronic Service Tool (EST) connected and the DEMO mode accessed through the ICU.(See demonstration instructions in this section). This will allow the operator to experience the difference at road speed with and without the suspension axle function.

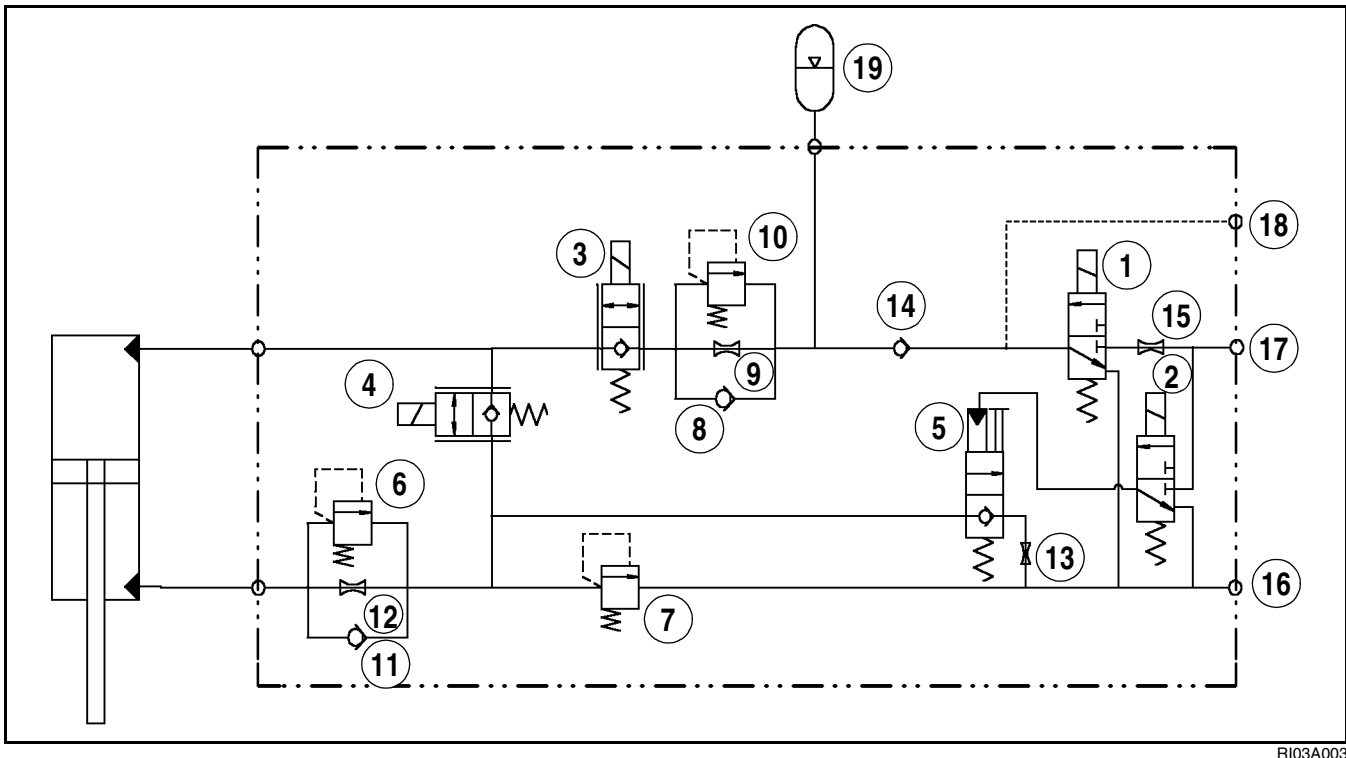
The transmission controller controls the suspension system. The controller receives a signal from the position potentiometer. The controller in turn sends signals to four solenoids located on the hydraulic control valve. The lockout solenoids (3) and (4) are energized anytime the system is on. The control valve receives its supply oil from the PFC pump. The control valve is also connected to the PFC piston pump compensator through a signal line. When additional oil is needed in the system the signal line communicates this need to the pump. The control valve is also plumbed to sump for when oil flows over a relief valve and when the axle is lowered.



RI03A003

- |                     |                  |                 |                 |
|---------------------|------------------|-----------------|-----------------|
| 1. RAISE SOLENOID   | 6. RELIEF VALVE  | 11. CHECK VALVE | 16. TANK        |
| 2. LOWER SOLENOID   | 7. RELIEF VALVE  | 12. ORIFICE     | 17. SUPPLY      |
| 3. LOCKOUT SOLENOID | 8. CHECK VALVE   | 13. ORIFICE     | 18. SIGNAL LINE |
| 4. LOCKOUT SOLENOID | 9. ORIFICE       | 14. CHECK VALVE | 19. ACCUMULATOR |
| 5. UNLOAD VALVE     | 10. RELIEF VALVE | 15. ORIFICE     |                 |





RI03A003

- |                     |                  |                 |                 |
|---------------------|------------------|-----------------|-----------------|
| 1. RAISE SOLENOID   | 6. RELIEF VALVE  | 11. CHECK VALVE | 16. TANK        |
| 2. LOWER SOLENOID   | 7. RELIEF VALVE  | 12. ORIFICE     | 17. SUPPLY      |
| 3. LOCKOUT SOLENOID | 8. CHECK VALVE   | 13. ORIFICE     | 18. SIGNAL LINE |
| 4. LOCKOUT SOLENOID | 9. ORIFICE       | 14. CHECK VALVE | 19. ACCUMULATOR |
| 5. UNLOAD VALVE     | 10. RELIEF VALVE | 15. ORIFICE     |                 |

### Suspended axle turned off

There is no power from the controller to any of the system solenoids. The oil in the system is trapped between check valve (14), the check valve in the unload valve (5) and the relief valve (7). There will be no movement of the axle unless the axle hits an object hard enough to blow oil over the relief valve (7) to tank. There will be no makeup oil available to the system when in the off position. PFC supply is blocked at the raise solenoid (1) and the lower solenoid (2).

### Suspended axle in ride control mode

The lock out solenoids (3) and (4) are energized and oil is allowed to flow from the piston side to the rod side of the cylinder and to the accumulator. The difference in the volume from the rod side to the piston side of the cylinder and the pressure in the accumulator maintain the axle position.

When the axle hits a small bump, oil will be forced from the piston side through the lockout valve (4) and check (11) to the rod side of the cylinder and through lock out valve (3) and orifice (9) to the accumulator. Oil moving into the accumulator against the nitrogen charge absorbs the shock to the axle. No oil passes to tank, it is stopped at check valve (14), check in unload valve (5), and relief valve (7).

To return the axle to its original position the increased pressure in the accumulator will force oil flow back to the piston end of the cylinder through check valve (8). Oil displaced from the rod end of the cylinder will flow back through orifice (12) and lockout valve (4) back to the piston end of the cylinder.

When the axle hits a medium-sized bump, oil will be forced from the piston side through the lockout valve (4) and check (11) to the rod side of the cylinder and through lock out valve (3) to orifice (9) and relief valve (10). Since orifice (9) will not handle this much flow relief valve (10) will open allowing the oil to pass to the accumulator. The accumulator absorbs the shock to the axle. No oil passes to tank, it is stopped at check valve (14), the check in the unload valve (5), and relief valve (7).

To return the axle to its original position the additional pressure now in the accumulator will force oil flow back to the piston end of the cylinder through check valve (8). Oil displaced from the rod end of the cylinder will flow back through orifice (12) and lockout valve (4) back to the piston end of the cylinder.

If the axle hits a large bump oil will be forced from the piston side through the lockout valve (4) and check (11) to the rod side of the cylinder and through lock out valve (3) to orifice (9) and relief valve (10). Since orifice (9) will not handle this much flow relief valve (10) will open allowing the oil to pass to the accumulator. With the volume of oil now too great for the accumulator to absorb, excess oil will pass through lock out valve (4) then through relief valve (7) to tank.

Returning the axle to its original position will require additional oil to the system since some was lost to sump. When the potentiometer signals the controller that the axle has moved out of the mid point band for more than 0.1 second the controller will energize the raise solenoid (1) and maintain current to both lockout valves (3 and 4). PFC oil will be directed to the signal line, through check valve (14), check (8), through the energized lockout solenoid (3) to the piston end of the cylinder. Oil from the rod end will also flow through the orifice (12) through lockout valve (4) into the piston end of the cylinder.

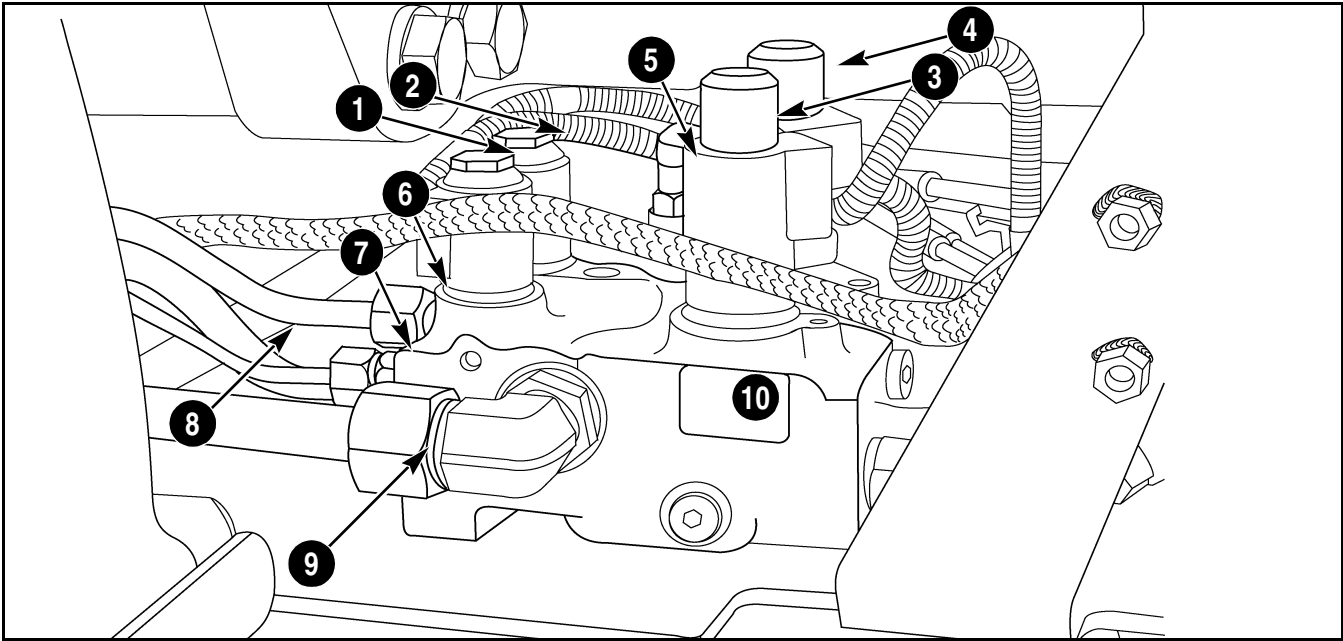
To lower the front of the tractor the lower solenoid (2) is energized along with the two lockout valves (3 and 4). This allows PFC pressure to flow through the solenoid (2) to open the unload valve (5). Oil from the piston side of the cylinder will flow through the check in lockout valve (4) with some going to tank through the unloading valve and some through check (11) and orifice (12) to fill the void in the rod side of the cylinder. Lowering the front of the tractor will normally only occur during calibration or if weight is removed from the front of the tractor.

### **Specifications:**

Lockout solenoid resistance 5.6 ohms.

Raise and Lower solenoids resistance 10 ohms.

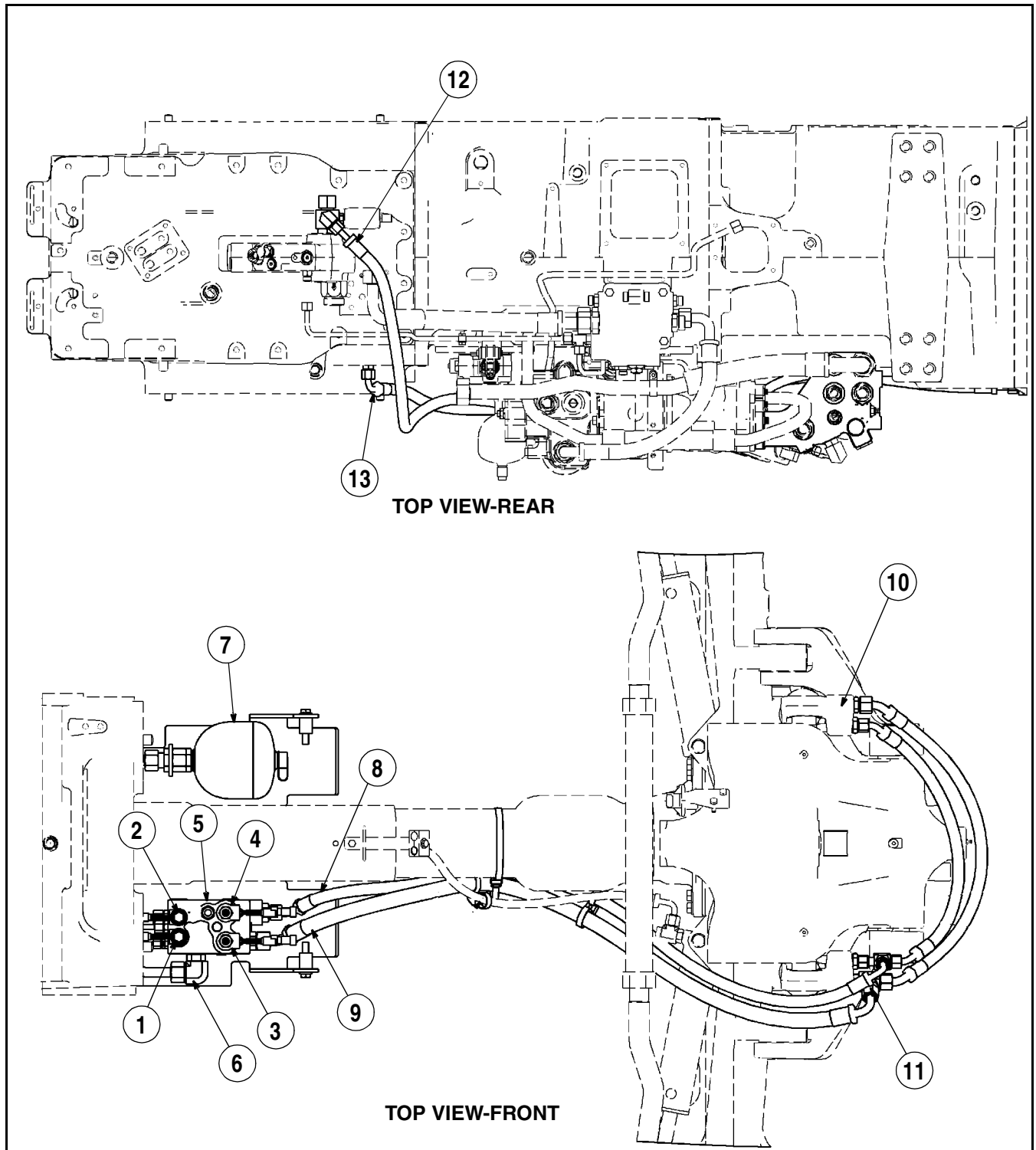
Accumulators come pre-charged to 420 to 450 PSI with dry nitrogen and are not serviceable.



RD03A035

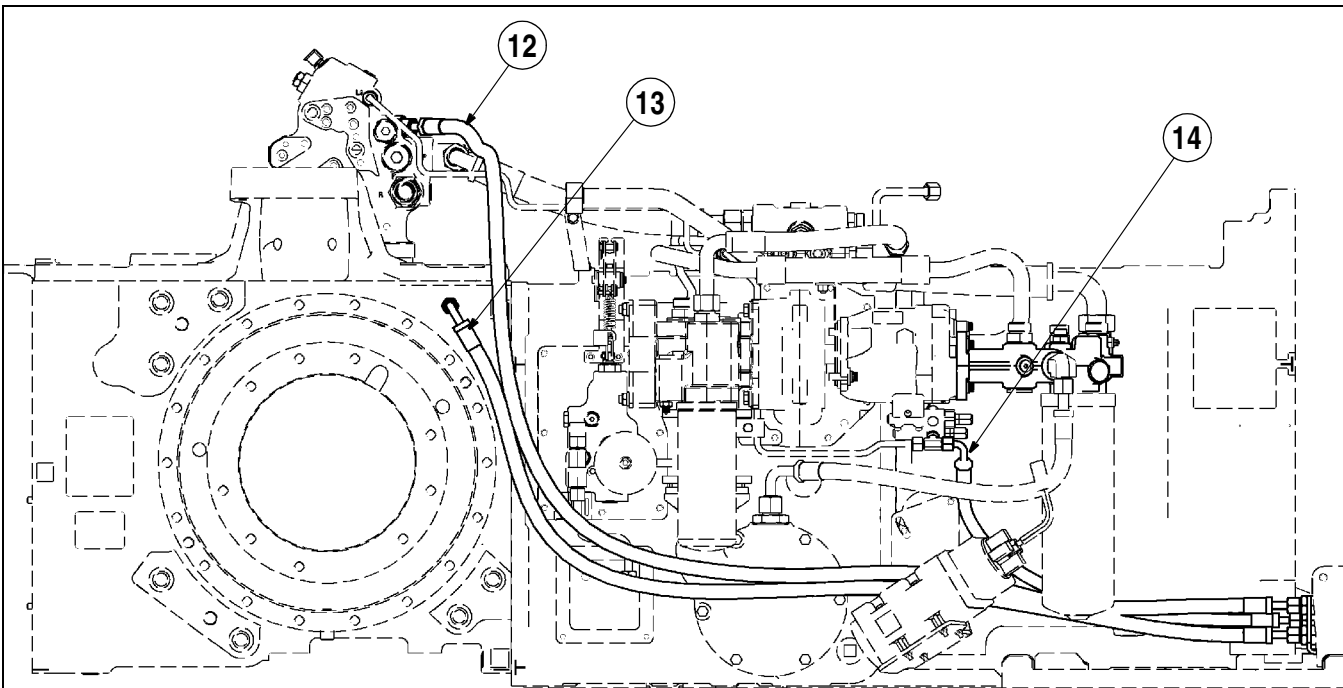
### FRONT SUSPENDED AXLE CONTROL VALVE

- |   |                        |
|---|------------------------|
| 1. RAISE SOLENOID - COLOR CODE RED                  | 6. PUMP SUPPLY         |
| 2. LOWER SOLENOID - COLOR CODE GREEN                | 7. LOAD SENSE SIGNAL   |
| 3. PISTON SIDE LOCKOUT SOLENOID - COLOR CODE YELLOW | 8. TANK                |
| 4. ROD SIDE LOCKOUT SOLENOID - COLOR CODE BLUE      | 9. TO ACCUMULATOR      |
| 5. UNLOAD VALVE                                     | 10. CONTROL VALVE BODY |

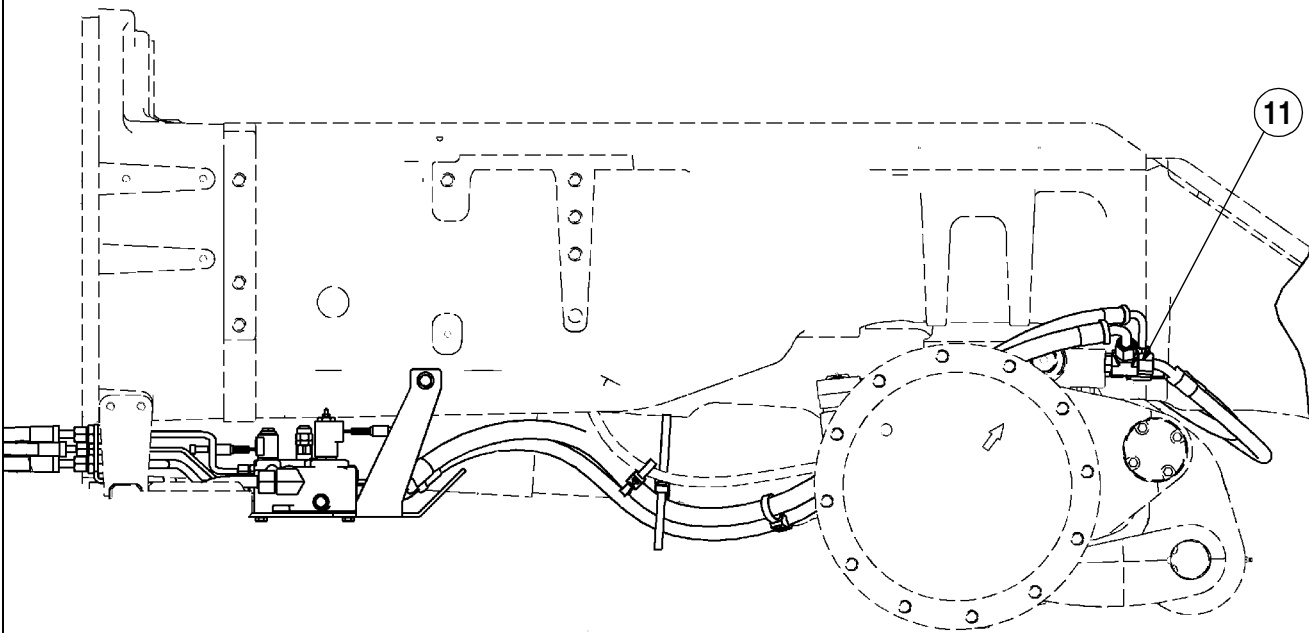


RH03A106 AND 108

- |   |   |
|---|---|
| 1. RAISE SOLENOID - COLOR CODE RED                  | 8. ROD END SUPPLY TO SUSPENSION CYLINDER    |
| 2. LOWER SOLENOID - COLOR CODE GREEN                | 9. PISTON END SUPPLY TO SUSPENSION CYLINDER |
| 3. PISTON SIDE LOCKOUT SOLENOID - COLOR CODE YELLOW | 10. LEFT SUSPENSION CYLINDER                |
| 4. ROD SIDE LOCKOUT SOLENOID - COLOR CODE BLUE      | 11. RIGHT SUSPENSION CYLINDER               |
| 5. UNLOAD VALVE                                     | 12. SUPPLY HOSE                             |
| 6. TO ACCUMMULATOR                                  | 13. RETURN TO TANK HOSE                     |
| 7. ACCUMMULATOR                                     | 14. SIGNAL LINE HOSE                        |



**SIDE VIEW-REAR**



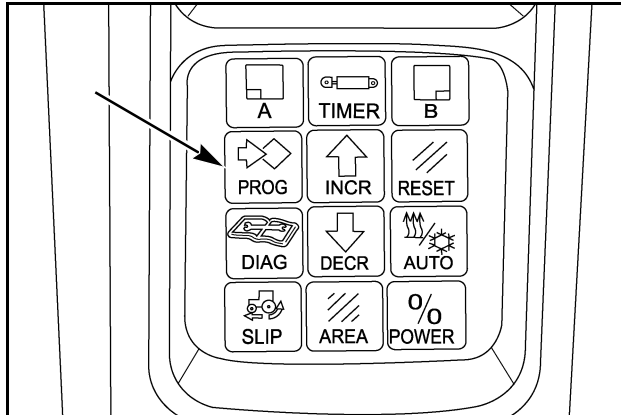
**SIDE VIEW-FRONT**

RH03A107 AND 109

- |   |   |
|---|---|
| 1. RAISE SOLENOID - COLOR CODE RED                  | 8. ROD END SUPPLY TO SUSPENSION CYLINDER    |
| 2. LOWER SOLENOID - COLOR CODE GREEN                | 9. PISTON END SUPPLY TO SUSPENSION CYLINDER |
| 3. PISTON SIDE LOCKOUT SOLENOID - COLOR CODE YELLOW | 10. LEFT SUSPENSION CYLINDER                |
| 4. ROD SIDE LOCKOUT SOLENOID - COLOR CODE BLUE      | 11. RIGHT SUSPENSION CYLINDER               |
| 5. UNLOAD VALVE                                     | 12. SUPPLY HOSE                             |
| 6. TO ACCUMMULATOR                                  | 13. RETURN TO TANK HOSE                     |
| 7. ACCUMMULATOR                                     | 14. SIGNAL LINE HOSE                        |

## SUSPENDED MFD AXLE- CALIBRATION MODE

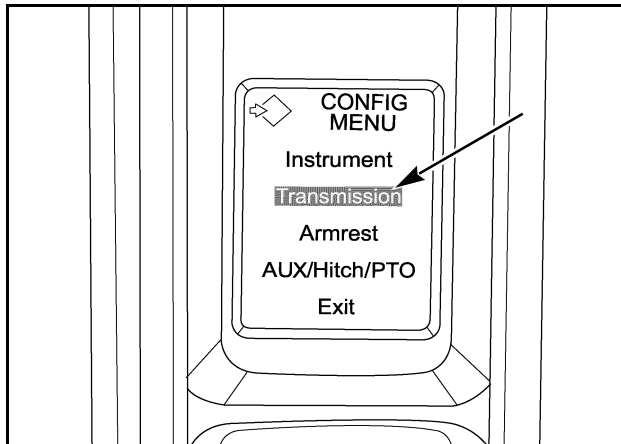
### STEP 1



RD06A021

Push and hold the PROG key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read CONFIG MENU.

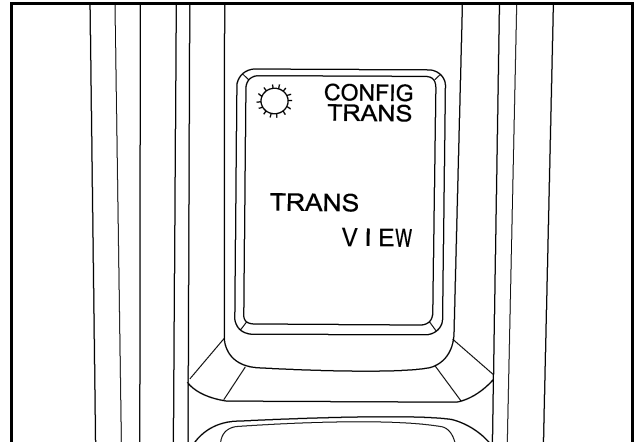
### STEP 2



RD06A022

Push the DECR key until Transmission is highlighted. Press the PROG key.

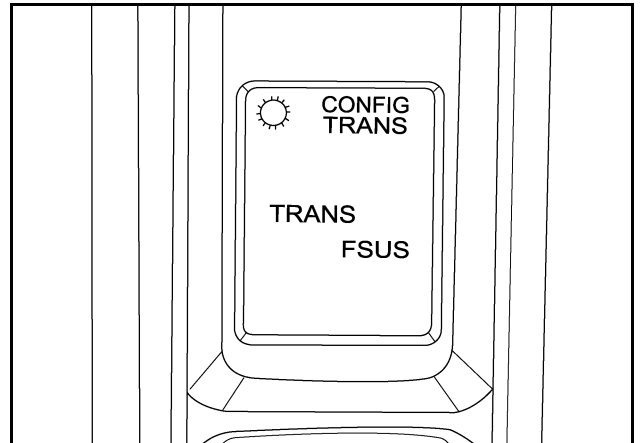
### STEP 3



RD06A023

The display will read TRANS VIEW.

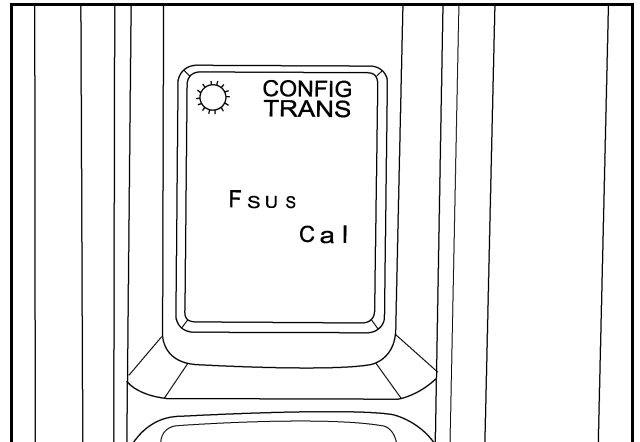
### STEP 4



RD06A024

Push the DECR key until the display reads TRANS FSUS.

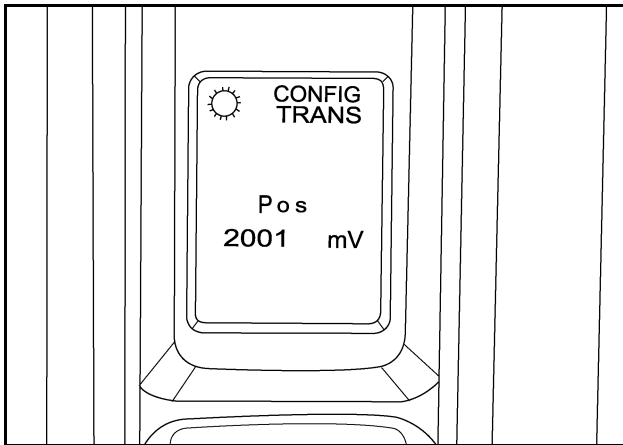
### STEP 5



RD06A025

Press the PROG key and the display reads Fsus Cal.

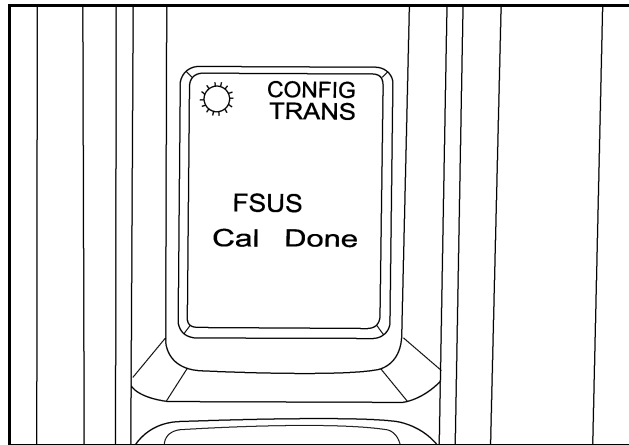
## STEP 6



RD06A026

Press the PROG key. The calibration process is now activated. The lamp will flash at 2.5 Hertz. The controller will lower and raise the front axle automatically. Axle output sensor voltage will appear on the display.

## STEP 8

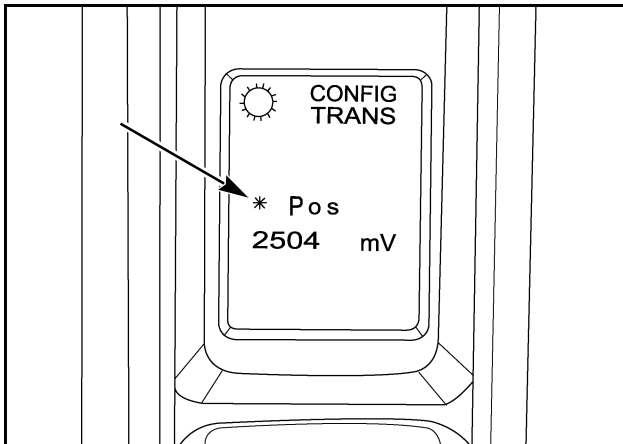


RD06A028

Seconds later the display will read FSUS Cal Done and the lamp will stop flashing.

**NOTE:** If the display reads Cal Failed, continue with Step 10.

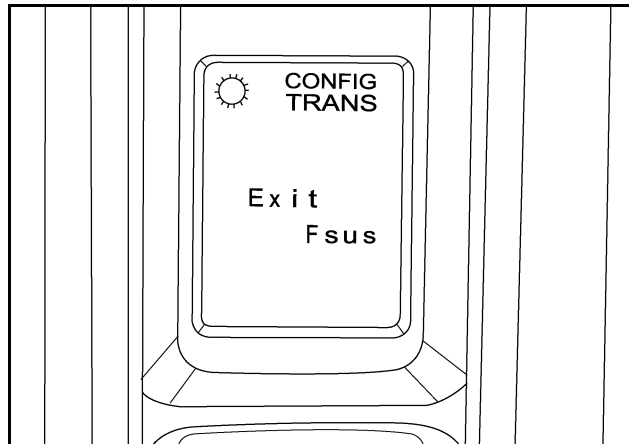
## STEP 7



RD06A027

As the calibration process is almost completed an asterik (\*) will appear on the display.

## STEP 9



RD06A029

Press the DECR key until the display reads Exit Fsus. Press the PROG key to exit calibration.

Exit out of the calibration menu. If there are any calibration errors, they will appear on the display.

Turn the ignition key off.

## STEP 10

If the display reads Cal Failed, press the PROG key to read the error message display.

**ERROR TABLE**

<b>ERROR MESSAGE</b>	<b>ERROR DESCRIPTION AND TROUBLESHOOTING</b>
Pot Open Ckt	<p>Front axle potentiometer open circuit. Automatic Calibration Procedure will not work.</p> <p>Check wire harness. Check position sensor signal circuit. Check continuity from connector 192 pin 3 to connector 185 pin C, next from connector 185 pin C to connector 353 pin 2.</p> <p>Check position sensor 12 volt power. Check for 12 volts at fuse 26, connector 10 pin 19, connector 185 pin A and connector 193 pin 2.</p> <p>Change potentiometer. Potentiometer value (0-999) less than 51.</p>
Pot High Val	<p>Front axle potentiometer threshold is higher than set limit.</p> <p>Look at potentiometer (0-999), if value is greater than 4.8 volts</p> <p>Check potentiometer installation and adjust as necessary.</p> <p>Change potentiometer.</p>
Pot Shrt Ckt	<p>Front axle potentiometer short circuit. Automatic Calibration Procedure will not work.</p> <p>Check wire harness.</p> <p>Check the position sensor ground circuit. Check connector 193 pin 1 to ground.</p> <p>Change potentiometer.</p>
Pot Low Val	<p>Front axle potentiometer threshold is lower than set limit.</p> <p>Check potentiometer and adjust as necessary.</p> <p>Change potentiometer.</p>
Pot Low Rng	<p>Suspension is not reaching the minimum/maximum position during Automatic Calibration Procedure.</p> <p>Look at the potentiometer values (1.0 to 4.8 volts), if the total range between the maximum and minimum values is less than 2 volts.</p> <p>Check suspension mechanics.</p> <p>Check potentiometer linkage.</p>
Slow Up Mvmnt	<p>Suspension is stationary during raise command in the Automatic Calibration Procedure.</p> <p>Check raise solenoid "RED" harness.</p> <p>Check suspension mechanics.</p> <p>Check pressure of accumulator.</p> <p>Check hydraulic pressure.</p> <p>Disconnect Implement.</p>



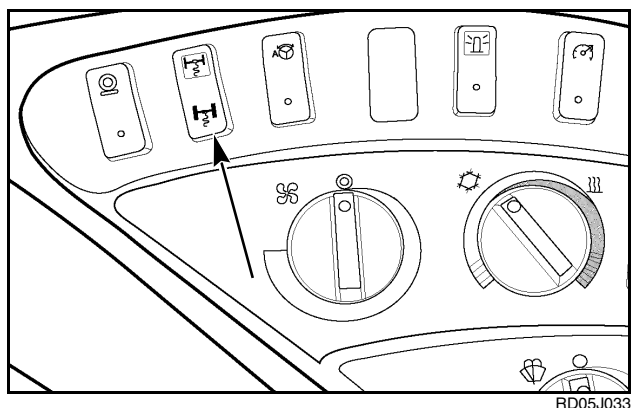
Slow to max	<p>Suspension unable to reach maximum height within 20 seconds.</p> <p>Check the raise valve installation.</p> <p>Check unload solenoid "GREEN" installation.</p> <p>Check suspension mechanics.</p> <p>Check hydraulic pressure.</p> <p>Disconnect Implement.</p>
Slow Dn Mvmnt	<p>Suspension is stationary during lowering command in the Automatic Calibration Procedure.</p> <p>Check unload solenoid "GREEN" harness.</p> <p>Check suspension mechanics.</p> <p>Check hydraulic pressure.</p> <p>Disconnect Implement.</p>
Slow to min	<p>Suspension unable to reach minimum height within 25 seconds.</p> <p>Check unload solenoid "GREEN" installation.</p> <p>Check hydraulic pressure.</p> <p>Disconnect Implement.</p>
Not Cal	<p>Unable to calibrate suspension.</p> <p>Check suspension mechanics.</p> <p>Check hydraulic pressure.</p>
ACP error	<p>Automatic Calibration Procedure (ACP) stopped.</p> <p>Vehicle not stationary.</p> <p>Hand brake not applied.</p>

## SUSPENDED FWD AXLE- MANUAL OPERATION MODE (TEST MODE)

The Manual Operation Mode is used to test the front suspension system. It permits bypass of the front suspension controller and gives the operator the ability to directly command the valves. The manual operation can be done through the front suspension manual menu on the programmable display and using the front suspended axle momentary switch on the right hand fender console.

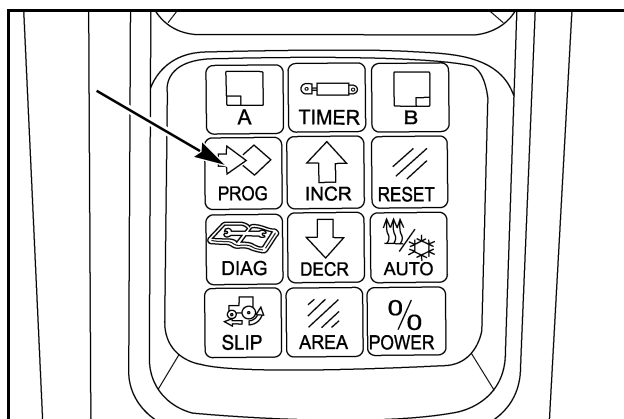
The Manual Operation Mode will only work when the tractor is stationary. The manual mode operation is useful to verify that the valves and potentiometer are working and installed correctly.

In the manual mode the system valves can be used to raise, lower, or unlock the front suspension.



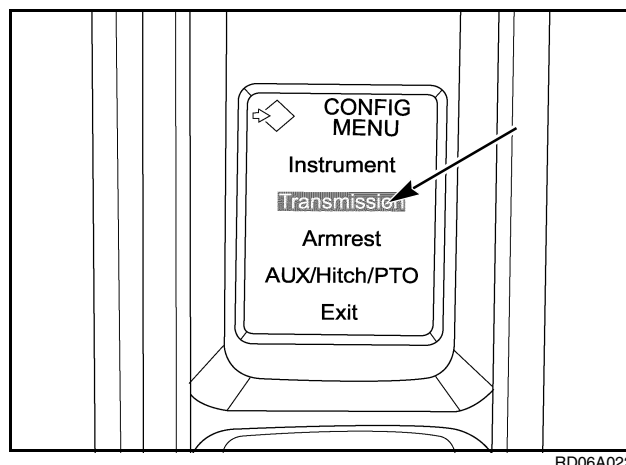
To enable the front suspension Manual mode:

### STEP 1



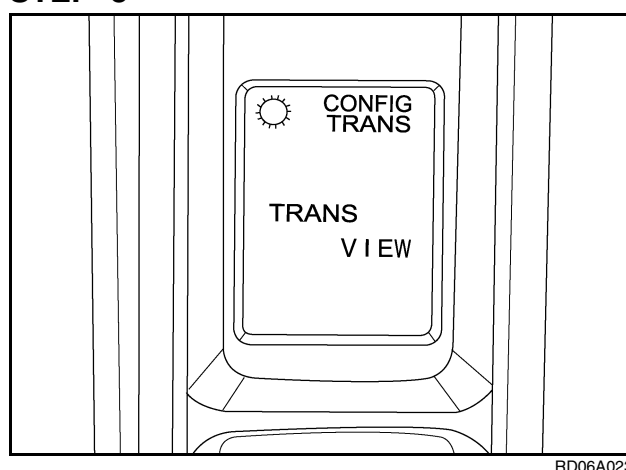
Push and hold the PROG key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read CONFIG MENU.

### STEP 2



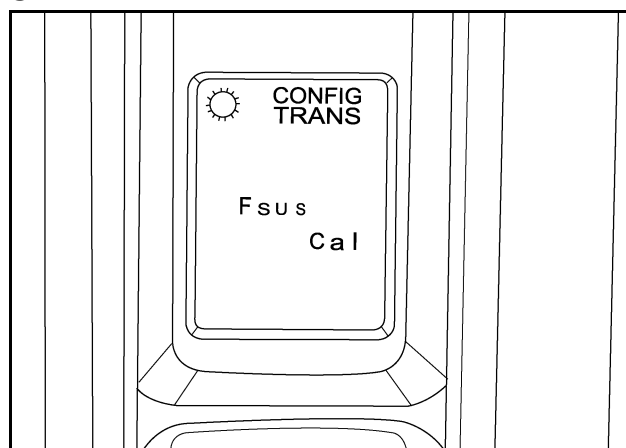
Push the DECR key until Transmission is highlighted. Press the PROG key.

### STEP 3



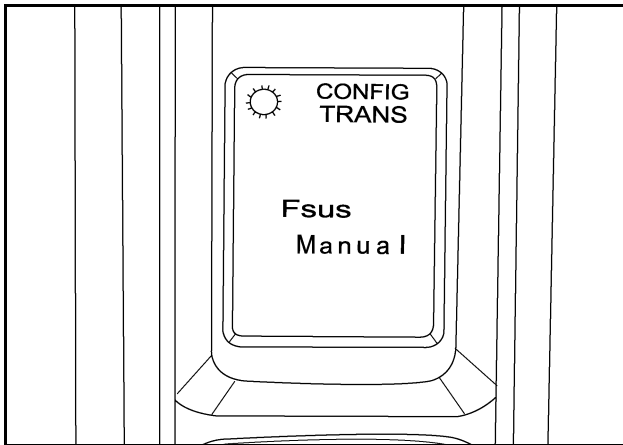
The display will read TRANS VIEW.

### STEP 4



Push the DECR key until the display reads Fsus Cal.

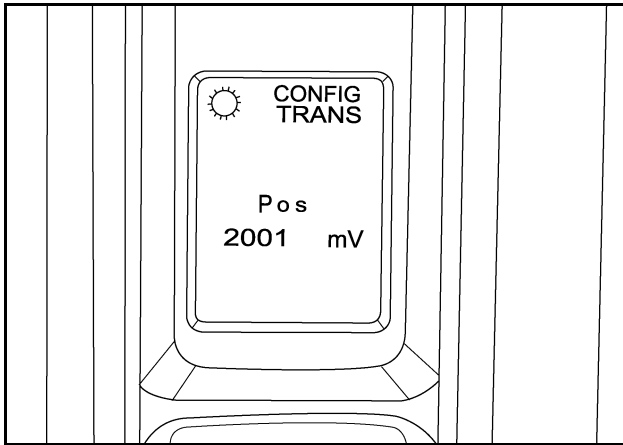
## STEP 5



RD06A030

Push the DECR key until the display reads Fsus Manual. Press the PROG key.

## STEP 6

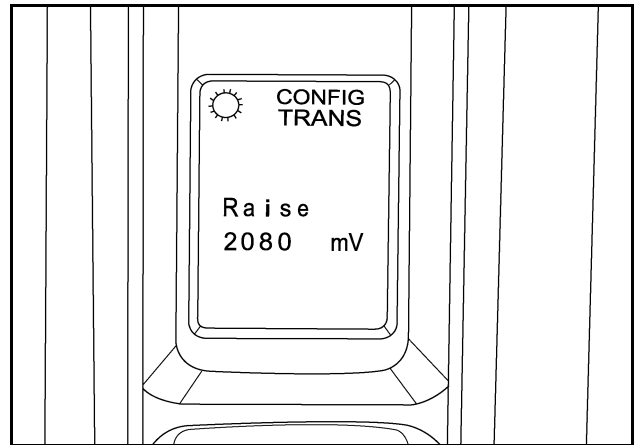


RD06A026

The display should read POS nnnnn mV, where nnnnn is the millivolt reading of the position sensor. The Front Suspension upper and lower lockout valves are now both energized to the ON position.

When POS nnnnn mV is displayed the front suspension momentary rocker switch is disabled. This display is for monitoring the front suspension position sensor.

## STEP 7



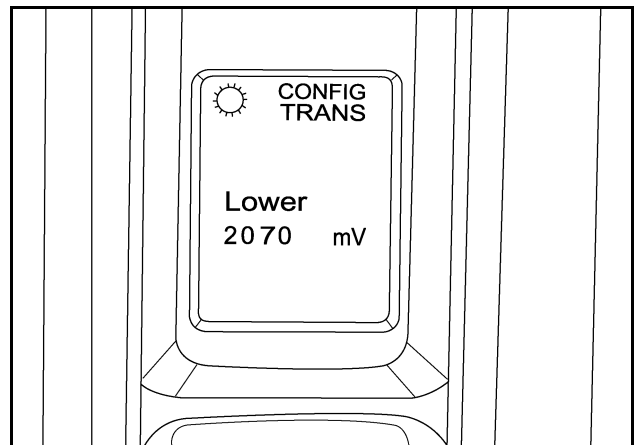
RD06A031

Next use the DECR key until the display reads Raise nnnnn mV. The nnnnn reading is the millivolt reading for the position sensor output.

Press and hold down the front suspension momentary rocker switch to energize the front suspension raise solenoid. Release the rocker switch to turn off.

Press the DECR key.

## STEP 8



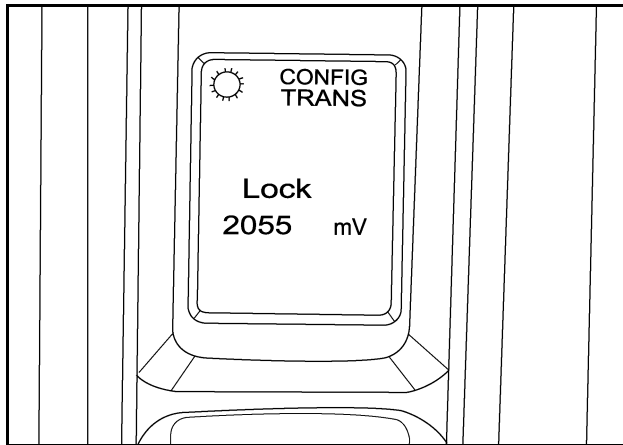
RD06A032

The display will read Lower nnnnn mV. The nnnnn reading is the millivolt reading for the position sensor output.

Press and hold down the front suspension momentary rocker switch to energize the front suspension lower solenoid. Release the rocker switch to turn off.

Press the DECR key.

### STEP 9



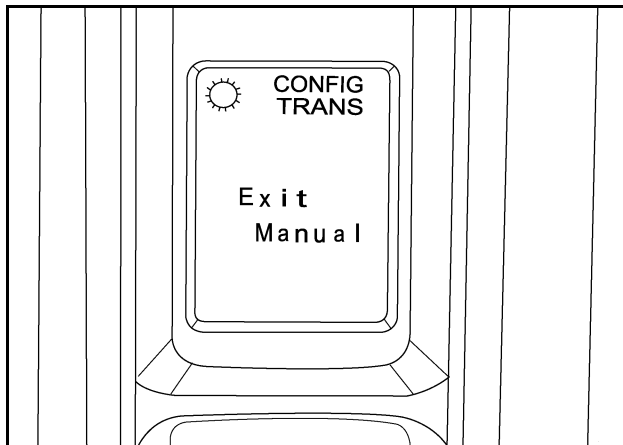
RD06A033

The display will read Lock nnnnn mV. The nnnnn reading is the millivolt reading for the position sensor output.

Press and hold down the front suspension momentary rocker switch to turn off both the raise and lower lockout solenoids. This can be used to troubleshoot the raise and lower lockout circuits. Use a multimeter to check the voltage at the lockout solenoids. Release the rocker switch and both lockout solenoids will be energized again.

Press the DECR key.

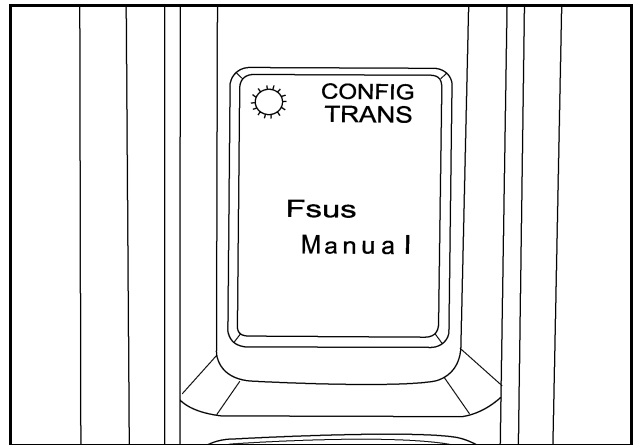
### STEP 10



RD06A034

The display will read Exit Manual. Press the PROG key.

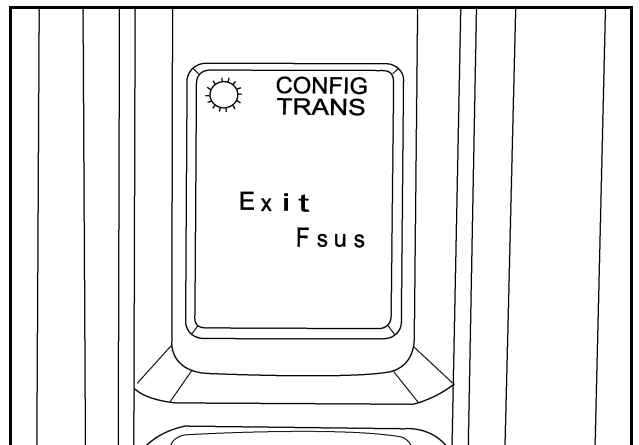
### STEP 11



RD06A030

The display will read Fus Manual. Press the DECR key.

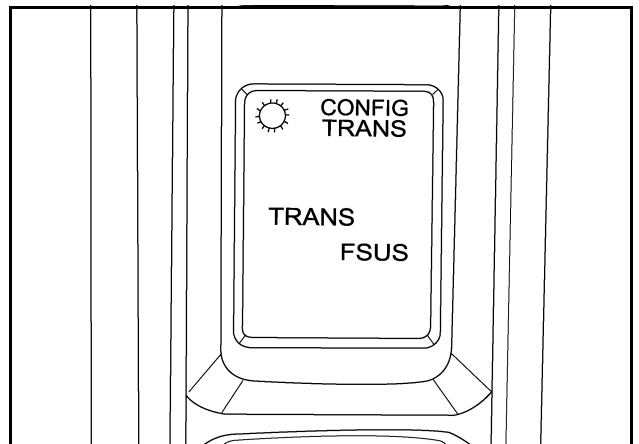
### STEP 12



RD06A035

Press the DECR key until Exit Fsus is displayed. Press the PROG key.

### STEP 13



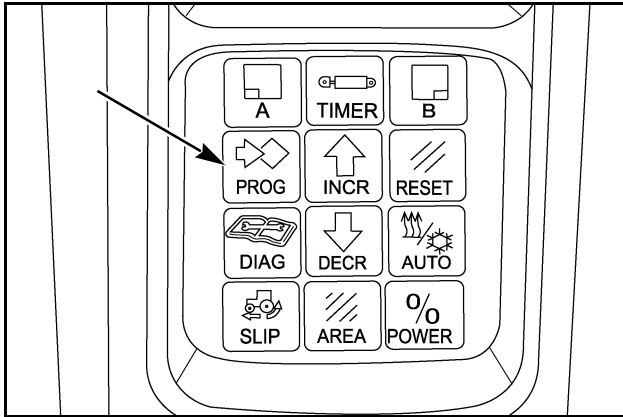
RD06A024

The display will read TRANS FSUS. Use the DECR key to select TRANS EXIT. Turn ignition key to OFF.

## SUSPENDED FWD AXLE - DEMONSTRATION MODE

**IMPORTANT:** The Electronic Service Tool (EST) must be connected to the diagnostic port to get into the Demonstration mode.

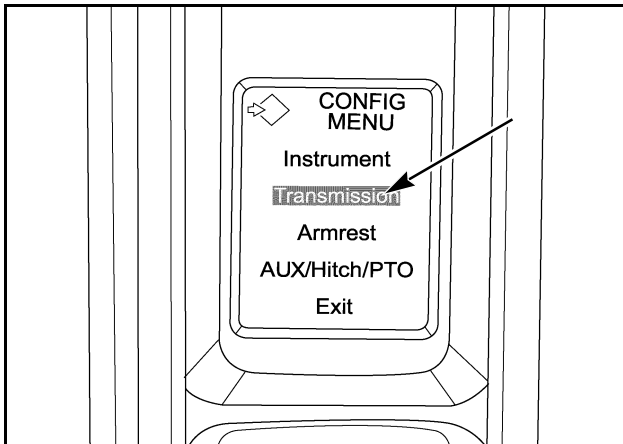
### STEP 1



RD06A021

Push and hold the PROG key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read CONFIG MENU.

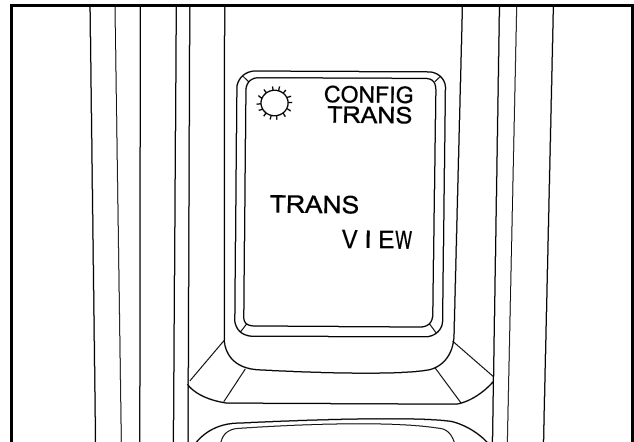
### STEP 2



RD06A022

Push the DECR key until Transmission is highlighted. Press the PROG key.

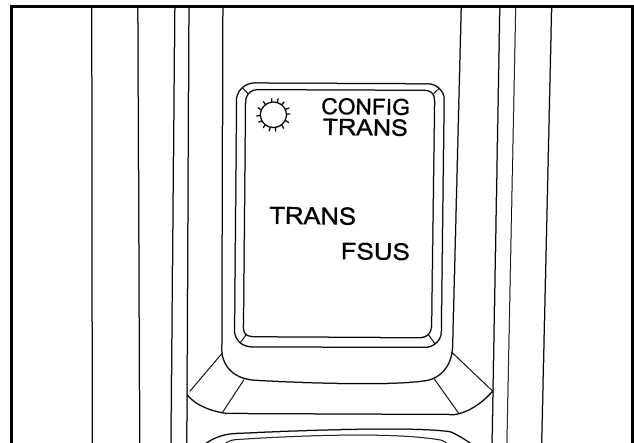
### STEP 3



RD06A023

The display will read TRANS VIEW.

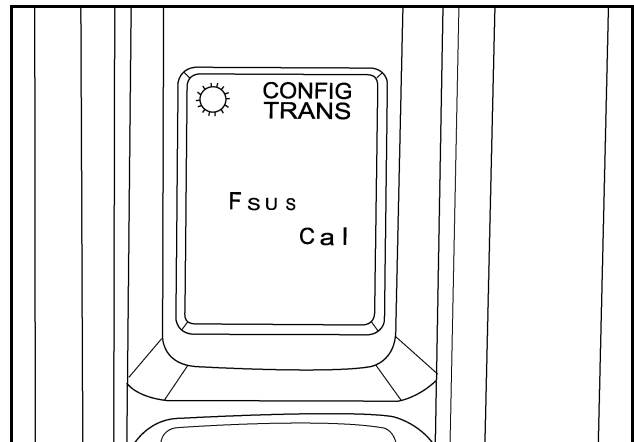
### STEP 4



RD06A024

Push the DECR key until the display reads TRANS FSUS.

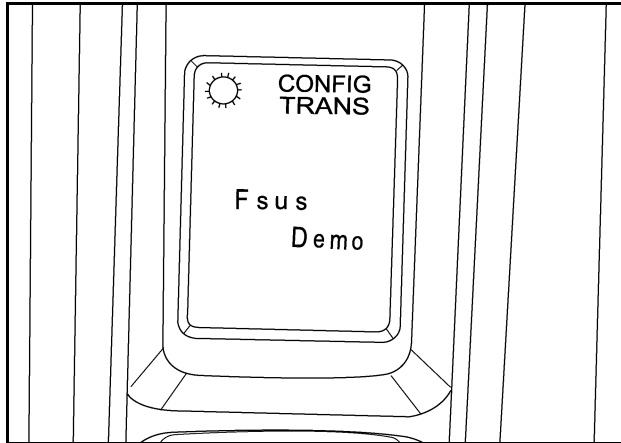
### STEP 5



RD06A025

Press the PROG key and the display reads Fsus Cal.

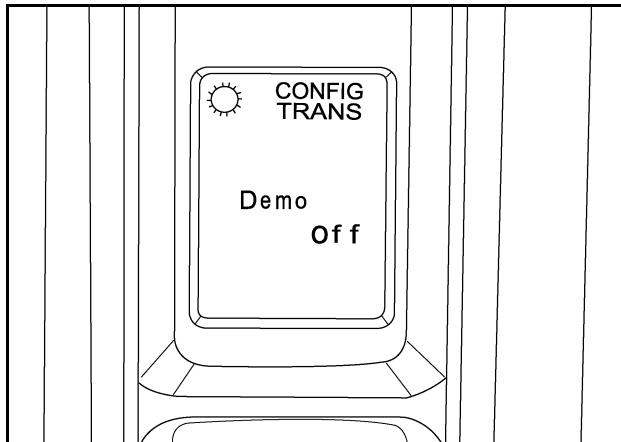
### STEP 6



RD06A036

Press the DECR key and the display will read Fsus Demo.

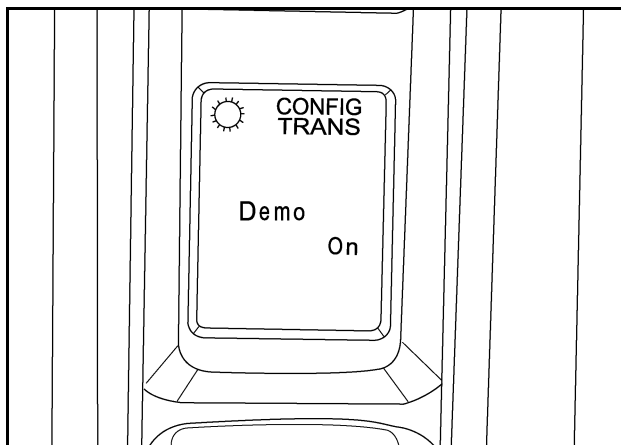
### STEP 7



RD06A037

Press the PROG key. The display will read Demo Off.

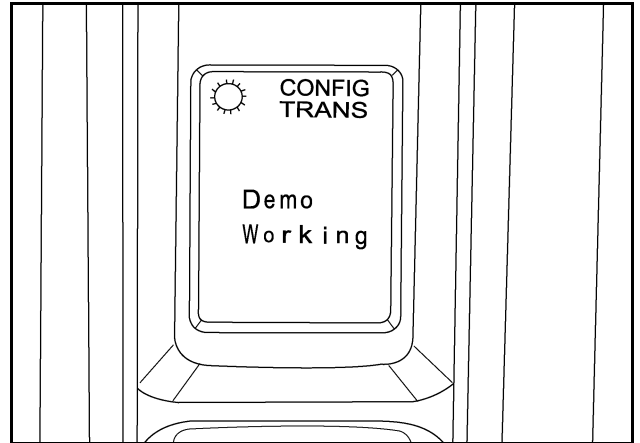
### STEP 8



RD06A038

Press the DECR key. The display will read Demo On.

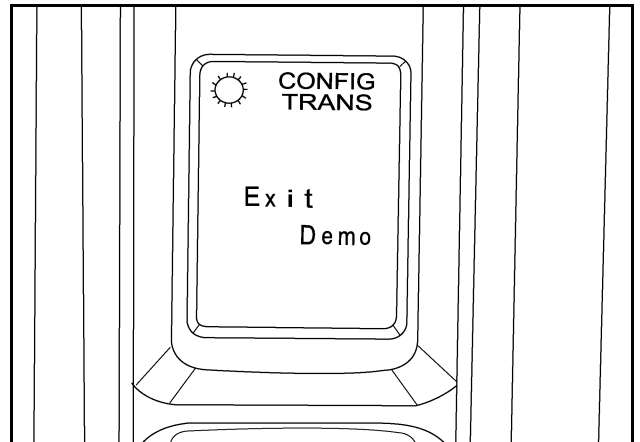
### STEP 9



RD06A039

Press the PROG key and the display now reads Demo Working. The front suspension can now be turned ON and OFF at speeds above 12 km/h (7.5 mph) by pressing the front suspension rocker switch.

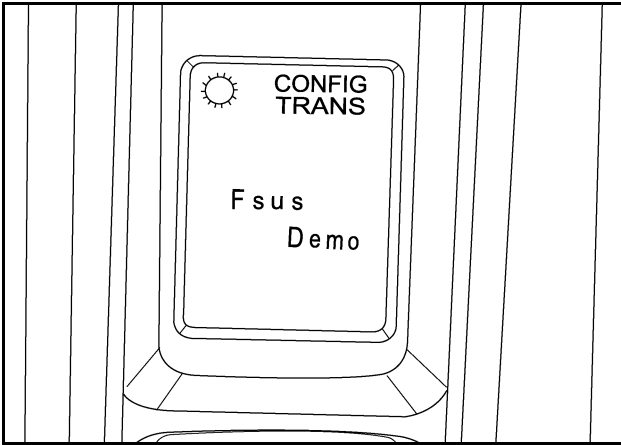
### STEP 10



RD06A040

Press the PROG key. Press the DECR key until the display reads Demo Off. Next press the PROG The display will read Exit Demo.

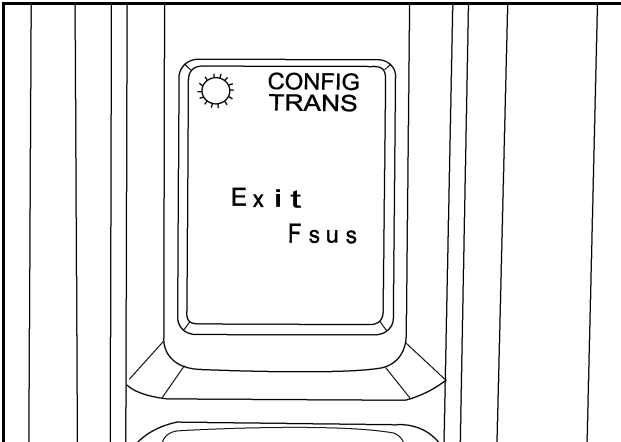
### STEP 11



RD06A036

Press the PROG key. The display will read Fsus Demo.

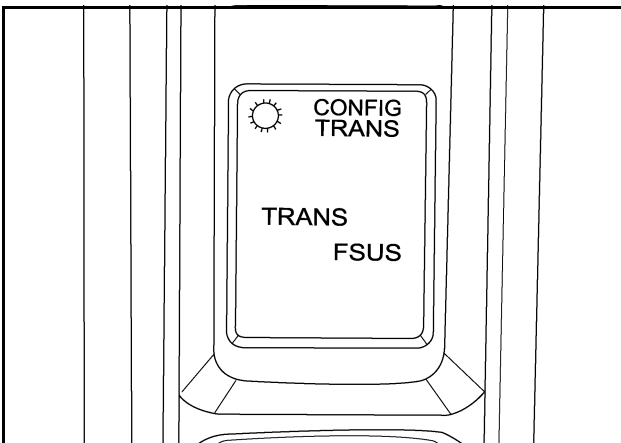
### STEP 12



RD06A035

Press the DECR key and select Exit Fsus.

### STEP 13



RD06A024

Press the PROG key and the display will read TRANS FSUS. Turn the key to the OFF position.

# **Section 25**

## **Chapter 6**

### **SUSPENDED FWD AXLE REMOVAL**



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## SUSPENDED FWD AXLE

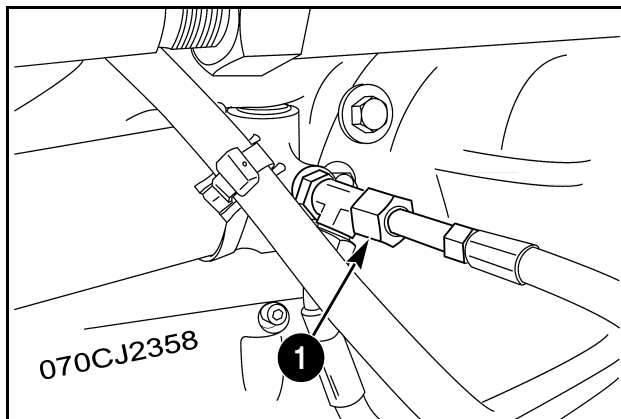
### Removal

#### STEP 1

Before removing the axle, do the following:

1. Park the tractor on a hard, level surface and place the transmission in PARK. Remove the keys and block the front and rear of the rear wheels.
2. See information for FWD Drive Shaft Removal and remove the drive shaft.
3. Remove the front weights and weight frame, if equipped.
4. Raise the front of the tractor and properly support. Remove the front fenders, if equipped. Remove the front wheels.

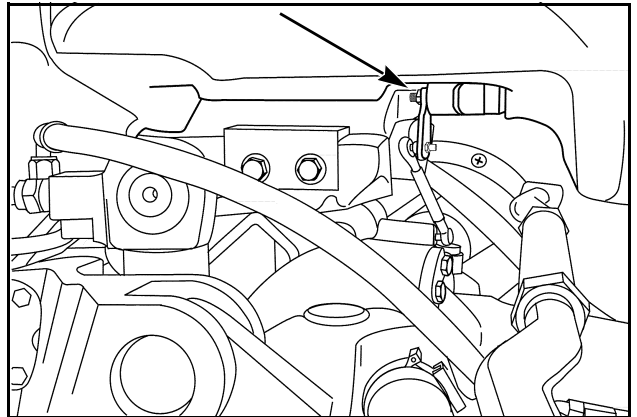
#### STEP 2



RD02K103

Tag and remove right and left steering lines (1) if equipped, tag and remove the hydraulic differential lock supply and return lines (not shown).

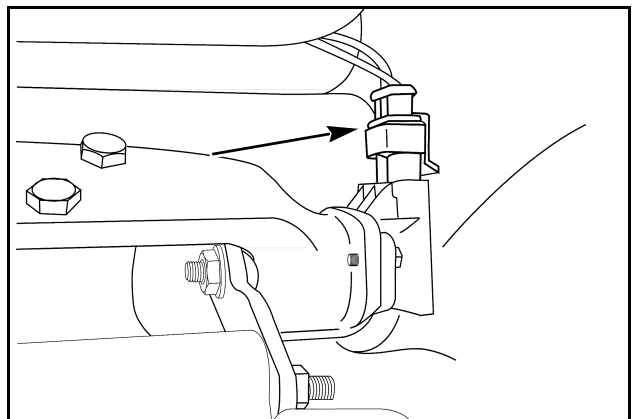
#### STEP 3



RD02K100

The axle position sensor is located near the center at the left rear of the axle.

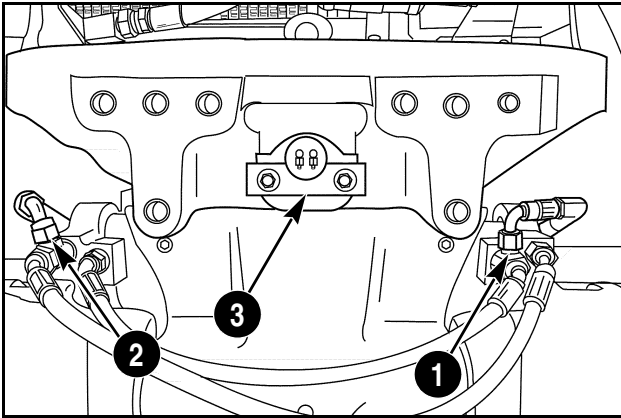
#### STEP 4



RD02K099

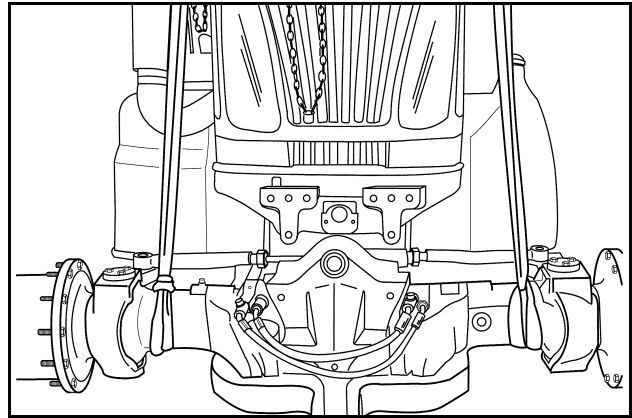
Disconnect the axle position connector.

### STEP 5



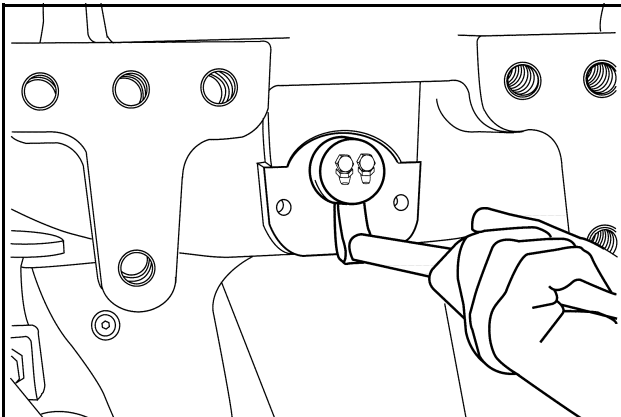
Tag and remove the axle hydraulic supply (1) and return (2) lines. Remove the axle pivot pin retaining plate bolts and retaining plate (3).

### STEP 7



Remove the jack. Lower the axle and remove from the tractor.

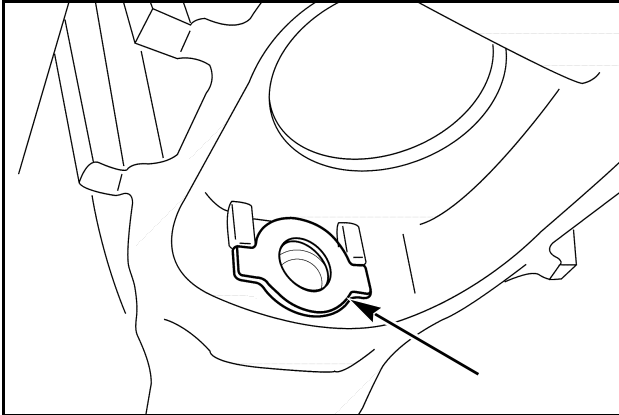
### STEP 6



Properly support the axle by wrapping a chain or lifting strap around each side of the axle near the steering knuckle. Lift axle slightly to remove any tension on the pivot pin. Place a jack under the center of the axle to help keep it level. Remove the pivot pin and thrust washers.

## Installation

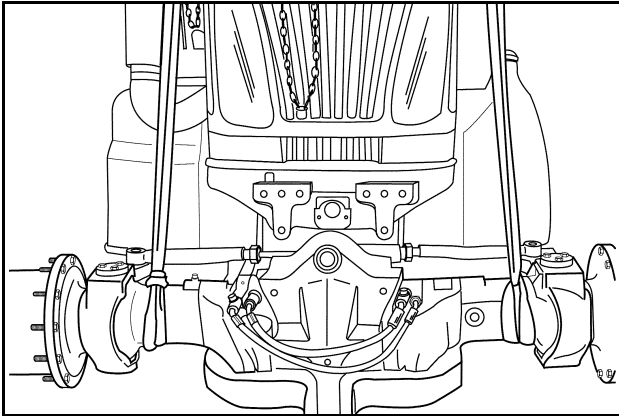
### STEP 8



RD02K192

Install the thrust washers as shown.

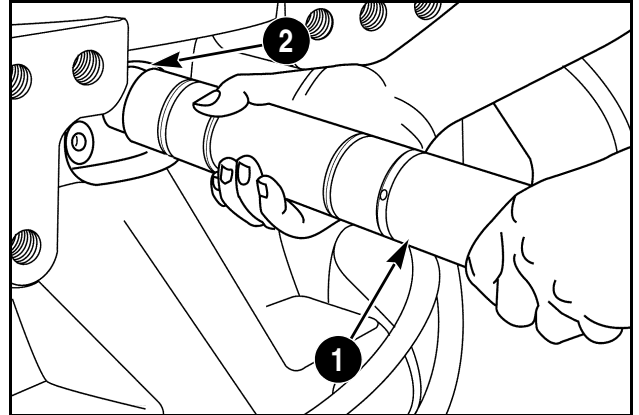
### STEP 9



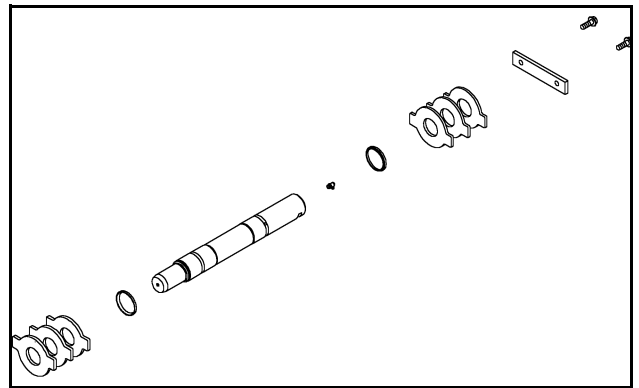
RD02K101

Properly support the axle, move under the tractor and lift into place. Once in place, install a jack under the center of the axle and level.

### STEP 10



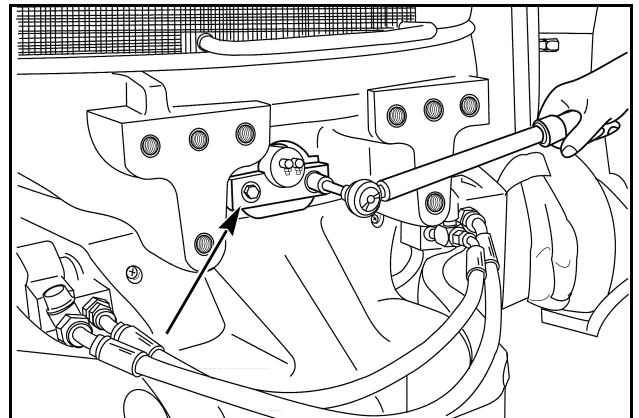
RD02K114



RI02K095

Making sure the axle pivot pin bore and thrust washers are aligned with the frame bore, install the pivot pin (1). Be sure not to damage the pivot pin bore seals (2).

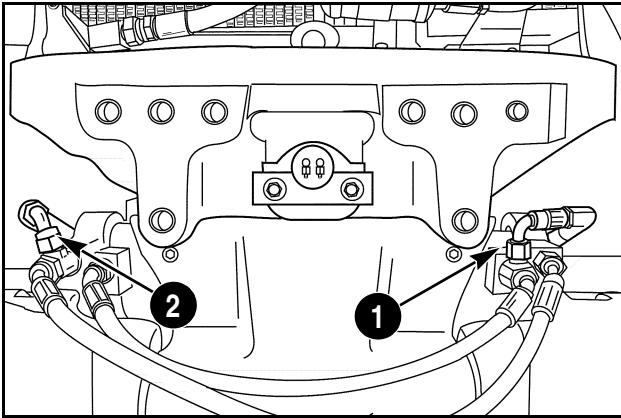
### STEP 11



RD02K115

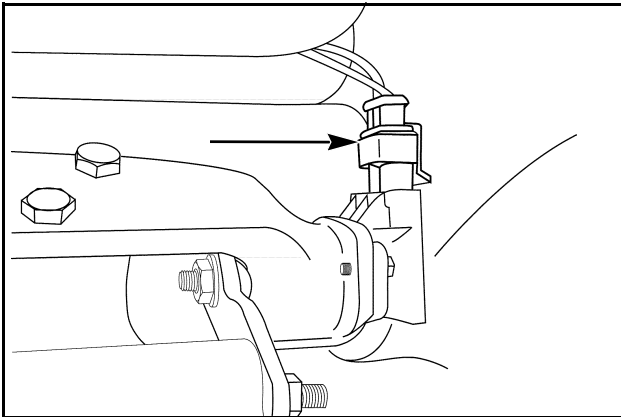
Install the pivot pin locking plate and bolts. Torque bolts to 59 to 105 Nm (44 to 78 lb. ft.).

### STEP 12



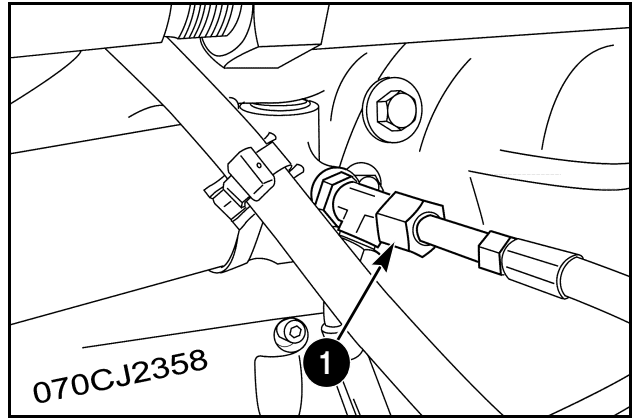
Install the axle hydraulic supply (1) and return (2) lines.

### STEP 13



Connect the axle sensing connector.

### STEP 14



Connect the right and left steering lines (1). If equipped, connect the hydraulic differential lock supply and return lines (not shown).

### STEP 15

Install the front wheels. Install the front fenders, if equipped. Install the FWD drive shaft. Installed the front weight frame and weights, if equipped.

# **Section 25**

## **Chapter 7**

### **SUPERSTEER AXLE REMOVAL AND INSTALLATION**

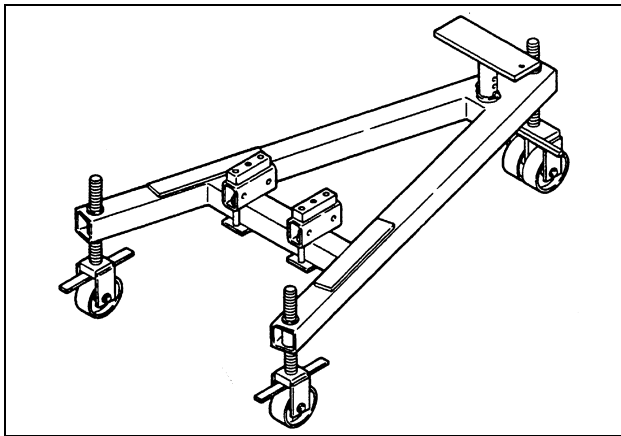
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FRONT AXLE INSTALLATION .....	25-7-7

## SPECIAL TORQUES

Axle Side Plate Bolt .....	735 to 945 Nm (542 to 627 lb. ft.)
Front Pivot Pin Bolt .....	111 to 198 Nm (82 to 146 lb. ft.)
Tie Rod Support Plate Retaining Bolt.....	300 to 550 Nm (225 to 405 lb. ft.)
Tie Rod End Castle Nut.....	373 Nm (275 lb. ft.)
Tie Rod End Adjusting Nut .....	373 to 441 Nm (275 to 325 lb. ft.)
Front Weight Bracket Bolt .....	662 to 851 Nm (488 to 627 lb. ft.)
Front Wheel Stud Nut .....	385 to 425 Nm (285 to 315 lb. ft.)
Front Drive Shaft Bolts.....	58 to 64 Nm (43 to 47 lb. ft.)

## SPECIAL TOOLS



RH02D006

**17-527 REAR HOUSING HANDLER**

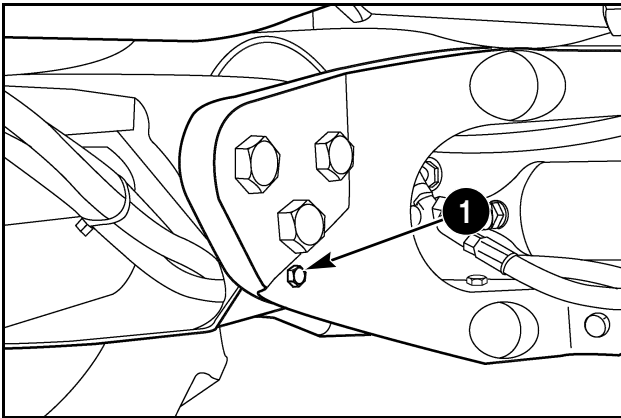


## FRONT AXLE REMOVAL

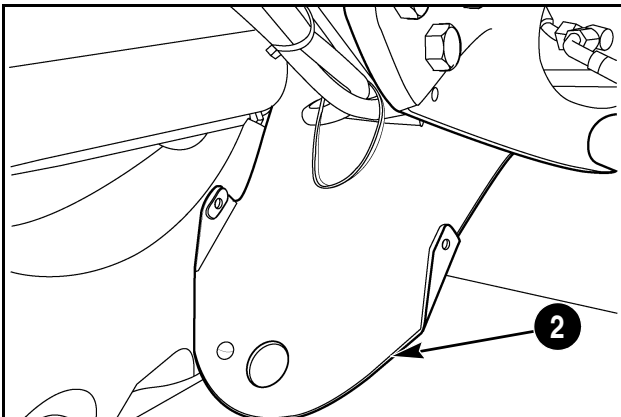
### STEP 1

Park the tractor on hard, level ground, with the wheels straight ahead. Place the transmission in park. Stop the engine and remove the key. Put blocks in front of and behind the rear wheels.

### STEP 2



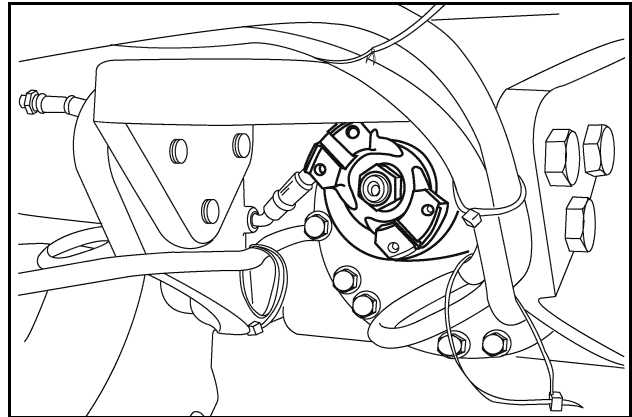
RD02B150



RD02B151

Remove the two axle shield retaining bolts (1). Remove the axle shield (2).

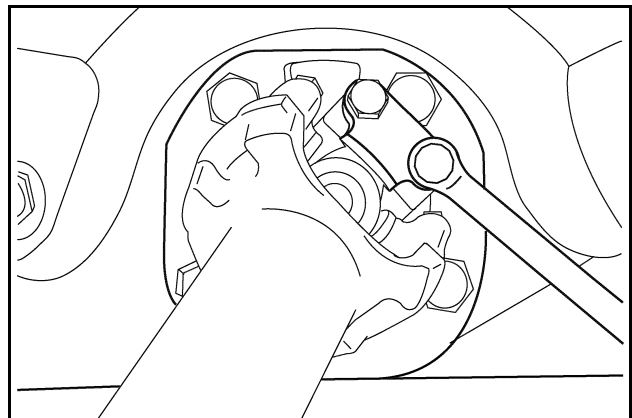
### STEP 3



RD02B152

Mark the alignment of the pinion flange and universal yoke for reassembly. Remove the four drive shaft to pinion flange bolts and remove the drive shaft at the front axle. Mark the position of the drive shaft protector. Remove the plastic drive shaft protector pin and discard. Slide the drive shaft protector from the drive shaft.

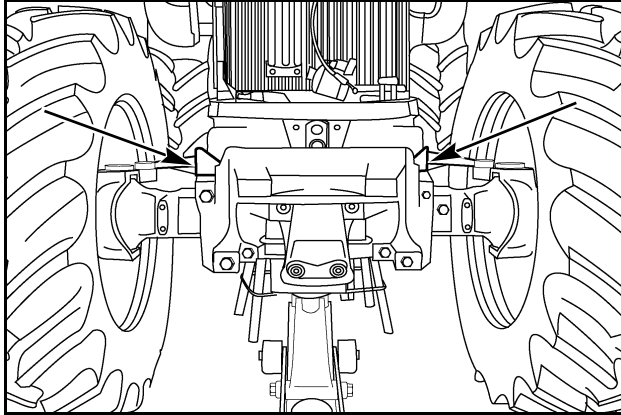
### STEP 4



RD02B153

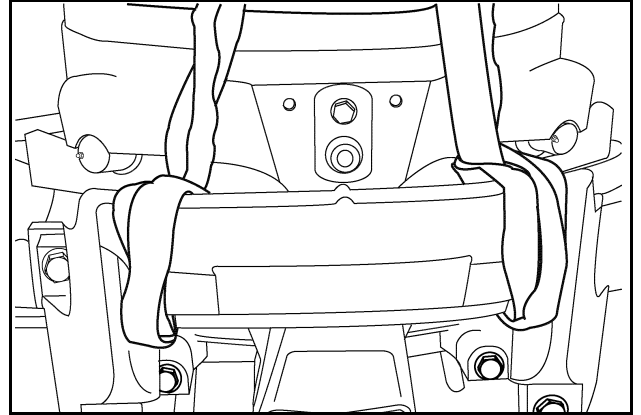
Mark the alignment of the transmission output flange and the drive shaft universal joint. Properly support the drive shaft. Remove the four drive shaft bolts from the output flange at the transmission and remove the drive shaft from the tractor.

### STEP 5



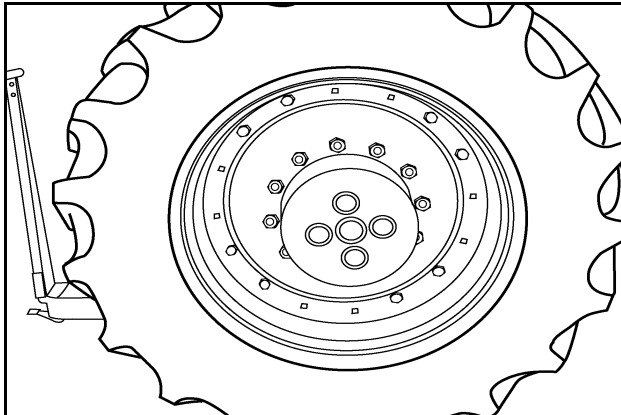
Properly support and remove the tractor front weights. Wedge the axle (arrows) to keep the axle from moving from side to side when lifting the axle. Properly support the front axle.

### STEP 8



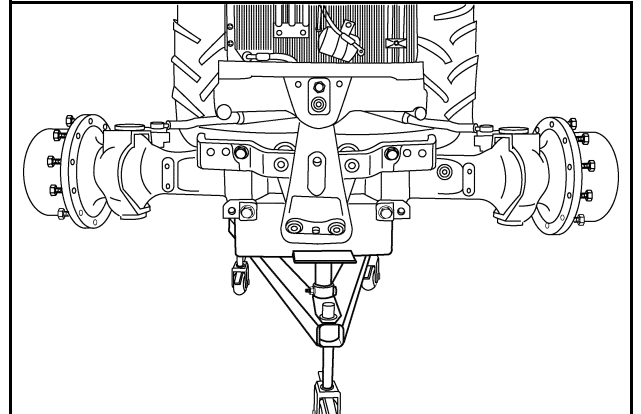
Use proper lifting equipment to support the front weight bracket. Remove the four retaining bolts and the weight bracket.

### STEP 6



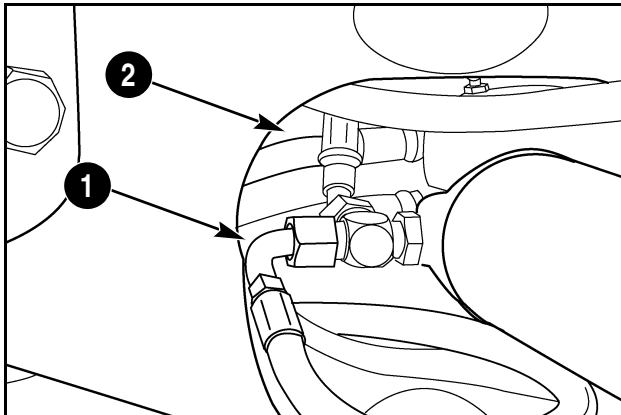
Remove the front wheels.

### STEP 9



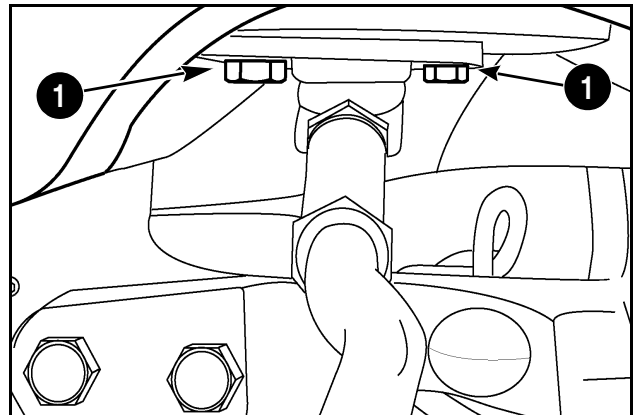
Properly support the front axle for removal using 17-527 rear housing handler.

### STEP 7



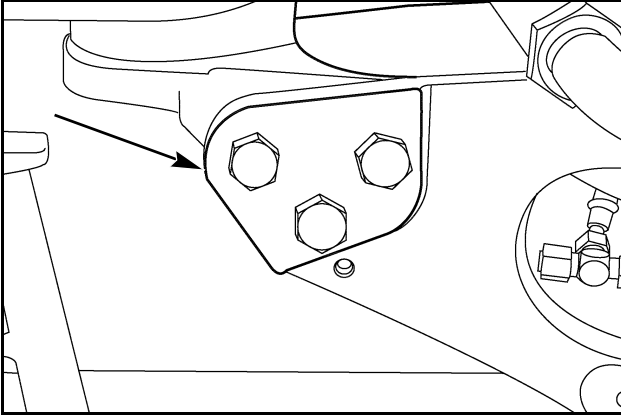
Use identification tags to mark the hoses. Remove the cylinder supply hoses (1) from each cylinder. Remove the two front axle differential lock hoses (2) from the axle cover (if equipped).

### STEP 10



Remove the two tie rod support plate retaining bolts (1) from both sides of the axle. Check for worn tie rod ends.

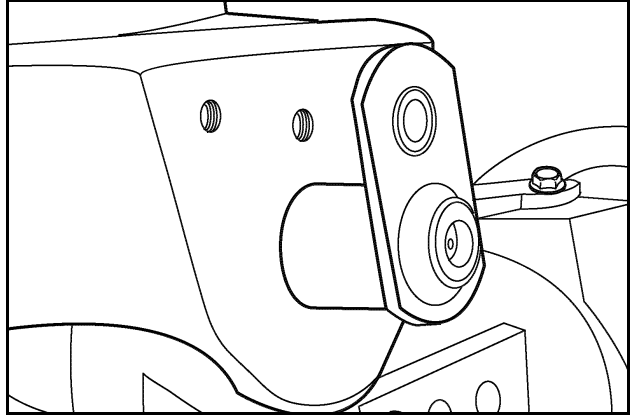
**STEP 11**



RD02C017

Remove the three axle side plate retaining bolts from both sides of the axle.

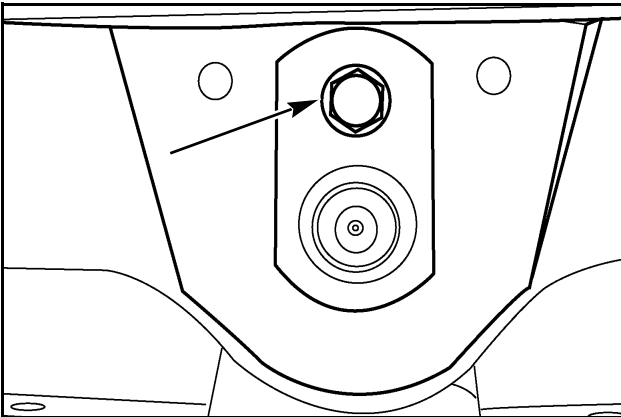
**STEP 13**



RD02C011

Remove the pivot pin and the front and rear pivot arm shims.

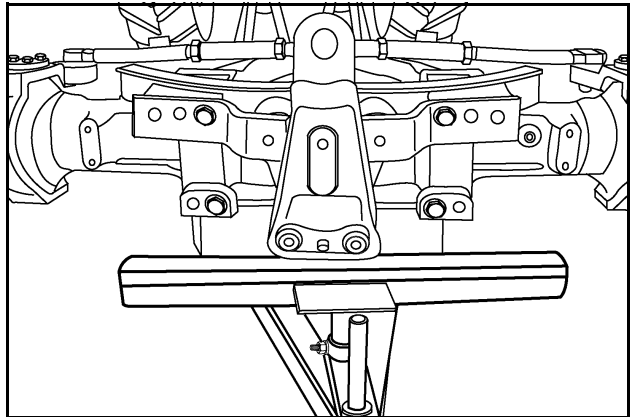
**STEP 12**



RD02C015

Remove the front pivot pin bolt.

**STEP 14**

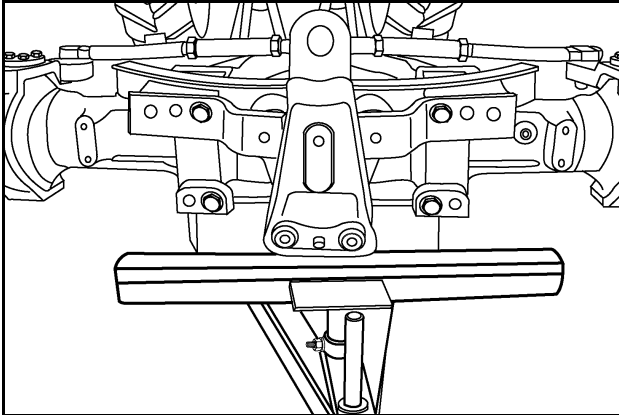


RD02C026

Lower the front axle and remove from under the tractor.

## FRONT AXLE INSTALLATION

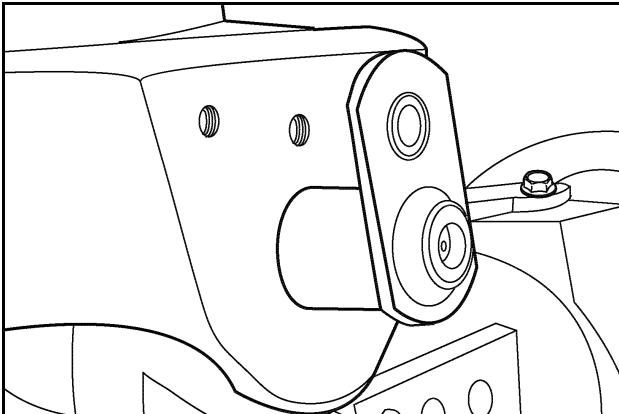
### STEP 15



RD02C026

Properly support the front axle and carefully move under the tractor. Raise the front axle into position.

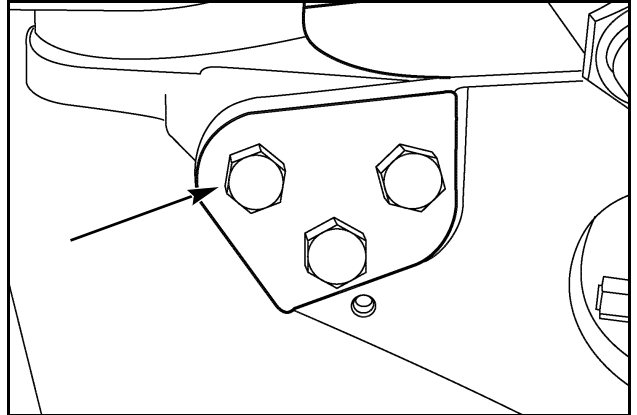
### STEP 16



RD02C011

Lubricate the pivot pin with grease. Install the front and rear pivot arm shims and the pivot pin.

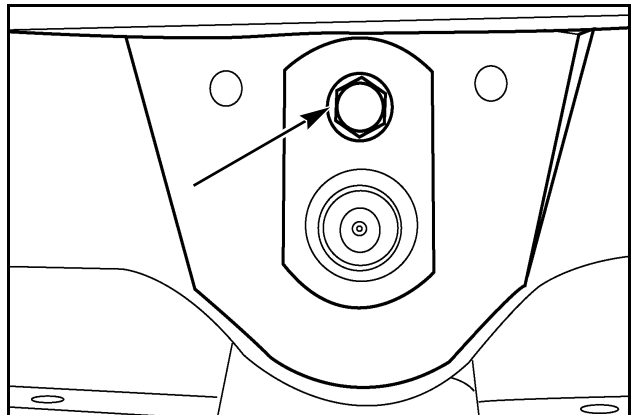
### STEP 17



RD02C017

Properly support the rear pivot bushing bracket to align the holes in the side plates. Install the side plate bolts on both sides of the front axle. Tighten the bolts to a torque of 735 to 945 Nm (542 to 627 lb. ft.).

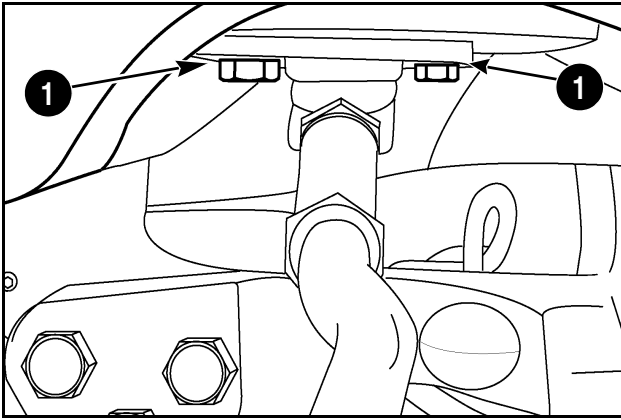
### STEP 18



RD02C015

Install the front pivot pin bolt (1). Tighten the bolt to a torque of 111 to 198 Nm (82 to 146 lb. ft.).

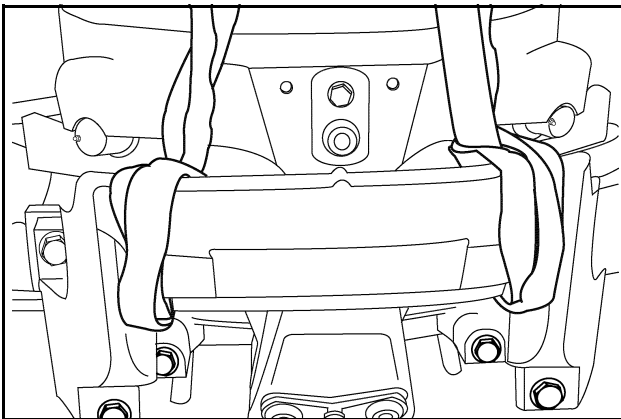
### STEP 19



RD02C024

Install the two tie rod support plate retaining bolts (1) on both sides of the axle. Tighten the bolts to a torque of 300 to 550 Nm (225 to 405 lb. ft.). If removed, install the tie rod ends. Tighten the castle nut to a torque of 373 Nm (275 lb. ft.) then advance to the next slot in the nut. Tighten the tie rod adjusting nut to 373 to 441 Nm (275 to 325 lb. ft.).

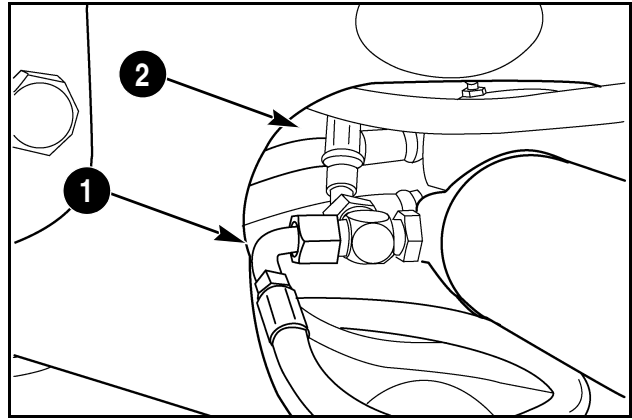
### STEP 20



RD02B159

Use proper lifting equipment to install the front weight bracket. Tighten the four retaining bolts to a torque of 662 to 851 Nm (488 to 627 lb. ft.).

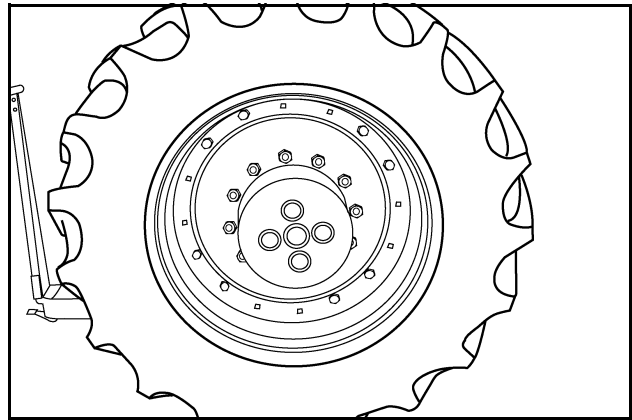
### STEP 21



RD02B158

Using the identification tags from the disassembly procedure, install and tighten the cylinder supply hose (1) to each cylinder. Install and tighten the two front axle differential lock hoses (2) to the axle cover.

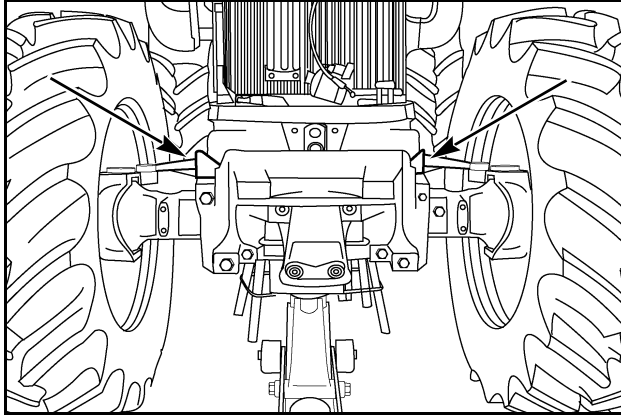
### STEP 22



RD02B157

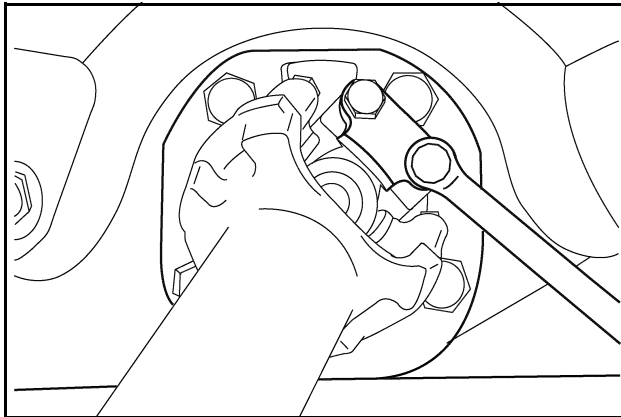
Install the front wheels. Apply a thin coat of antiseize to the front wheel studs. Tighten the wheel stud nuts to a torque of 385 to 425 Nm (285 to 315 lb. ft.).

### STEP 23



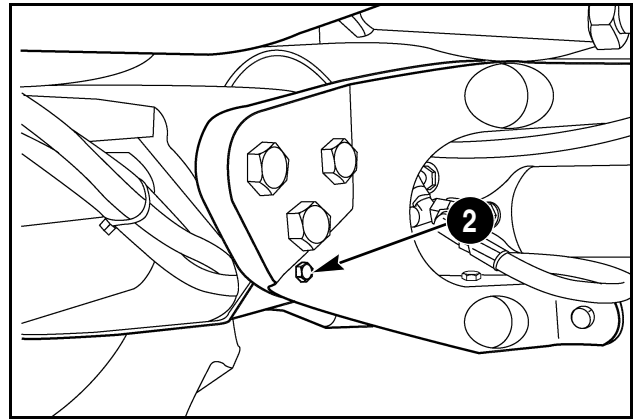
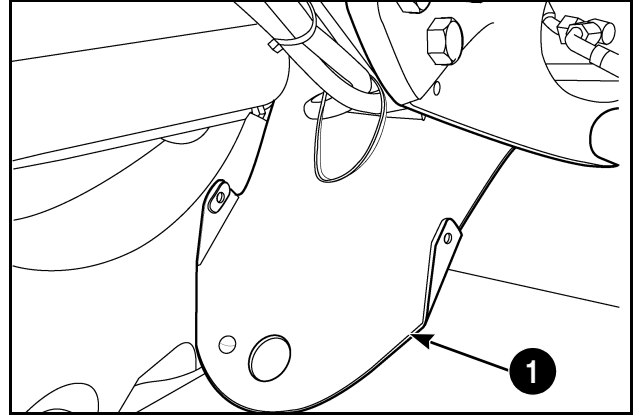
Remove the axle supports and lower the front axle. Remove the wedges (arrows).

### STEP 24



Install the drive shaft at the transmission output flange, using the alignment marks made during disassembly. Slide the drive shaft protector on the drive shaft and install a new plastic pin. Install the drive shaft at the front axle pinion flange, using the alignment marks. Tighten the drive shaft bolts to a torque of 58 to 64 Nm (43 to 47 lb. ft.).

### STEP 25



Install the axle shield (1). Install and tighten the two shield retaining bolts (2). Properly support and install the tractor front weights. Check the hydraulic fluid level and add if necessary. Remove rear axle wheel blocks. Start the tractor. Check for leaks. Check front axle operation and front fender to wheel clearance, if equipped. Place the tractor in Park, turn the ignition off, and remove the key.



# **Section 25**

## **Chapter 8**

**LIMITED SLIP FWD DIFFERENTIAL**



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## SPECIFICATIONS

Pinion Shaft Rolling Torque (Preload) .....	2.26 to 5.65 Nm (20 to 50 lb. inch)
Differential Assembly Rolling Torque (without input seal) .....	2.83 to 5.65 Nm (25 to 50 lb. ft.)
Differential Ring Gear Backlash	
10 Stud Wheel End Axle .....	0.127 to 0.254 mm (0.005 to 0.010 inch)
12 Stud Wheel End Axle .....	0.127 to 0.203 mm (0.005 to 0.008 inch)

## SPECIAL TORQUES

Differential Adjusting Ring .....	85 to 115 lb ft (115 to 156 Nm)
Differential Adjusting Ring Clip Bolts .....	27 to 40 Nm (20 to 30 lb. ft.)
Differential Bearing Cap Bolts .....	244 to 271 Nm (180 to 200 lb. ft.)
Differential Front Ring Gear Bolts .....	163 to 190 Nm (120 to 140 lb. ft.)
Differential Housing Bolts .....	122 to 135 Nm (90 to 100 lb. ft.)
Differential Pinion Shaft Nut .....	325 to 406 Nm (240 to 300 lb. ft.)

## SPECIAL TOOLS

FNH 00400 or 380001109	Pinion Setting Tool Kit
FNH 00409 or 380001110	Side Bearing Adjusting Wrench
FNH 00410 or 380001111	Pinion Shaft Oil Seal Driver
CAS 2596 or 3800011108	Yoke Dust Shield Installer
FNH 299077 or 380001112	Handle

## DIFFERENTIAL CARRIER ASSEMBLY REMOVAL

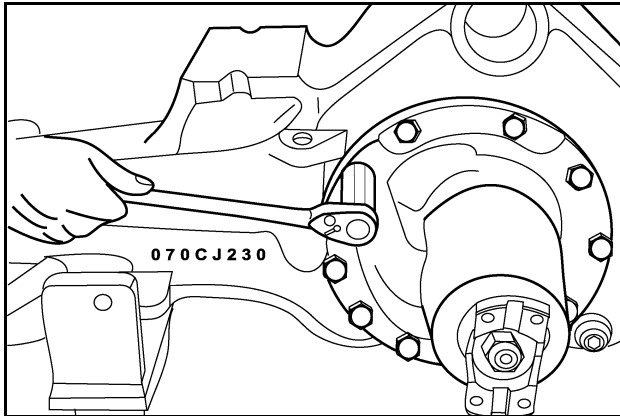
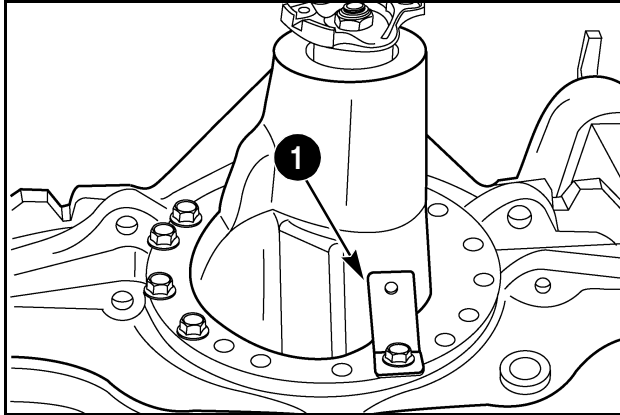
### STEP 1

Remove the front axle from the tractor.

Remove the axle shafts (both sides) from the axle (refer to axle disassembly information).

**NOTE:** Do not alter the tie rod adjustment.

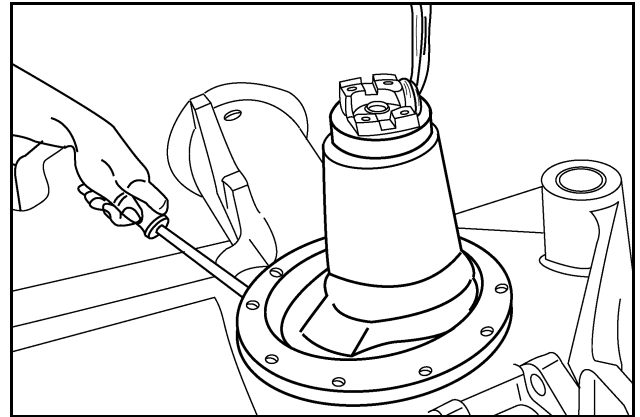
### STEP 2



A hose clamp bracket is located on a lower carrier housing bolt (1). Note the location before bolt removal.

Remove the bolts and washers that hold the differential carrier to the axle housing (21 mm socket).

### STEP 3



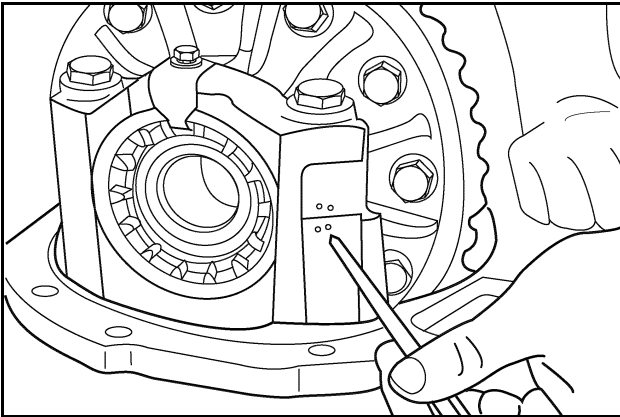
Support the differential carrier with a chain or lift strap and hoist. Carefully pry the differential carrier from the axle housing. When lifting the carrier assembly out of the axle assembly, make certain the carrier does not hit the axle housing.

### STEP 4

Remove the differential carrier from the axle housing and mount it in a suitable holding fixture.

## DIFFERENTIAL DISASSEMBLY

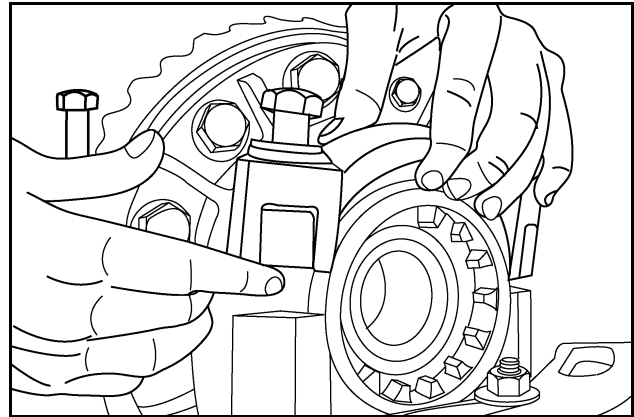
### STEP 5



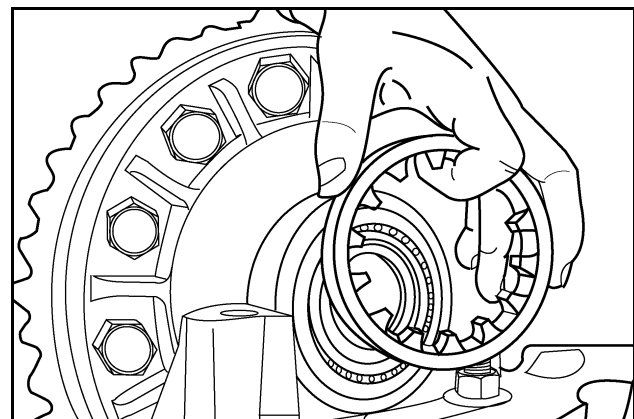
RR98K038

Mark the bearing cap and differential housing for reassembly.

### STEP 8



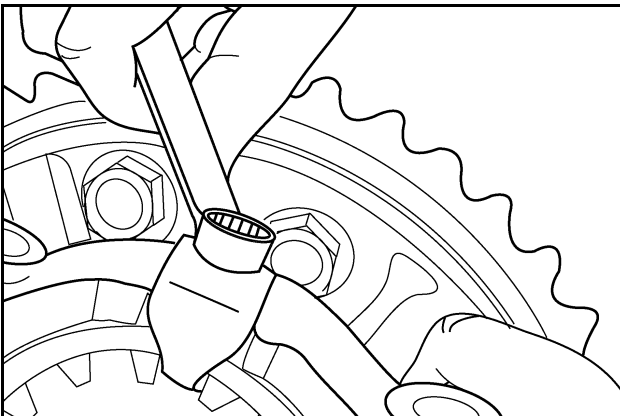
RR98K015



RR98K016

Remove the bearing caps and adjusting rings.

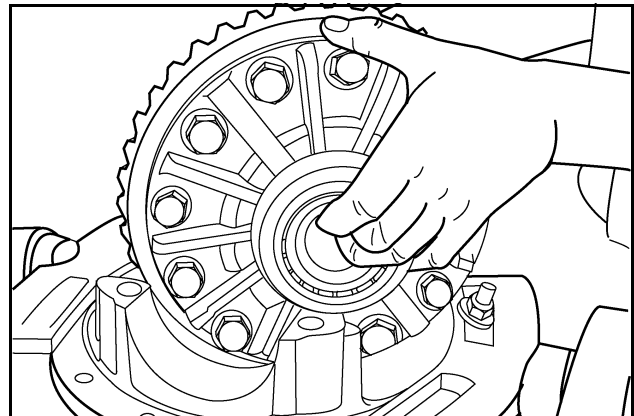
### STEP 6



RR98K046

Remove the bolts, washers and ring clips from the bearing caps. (13 mm socket or wrench).

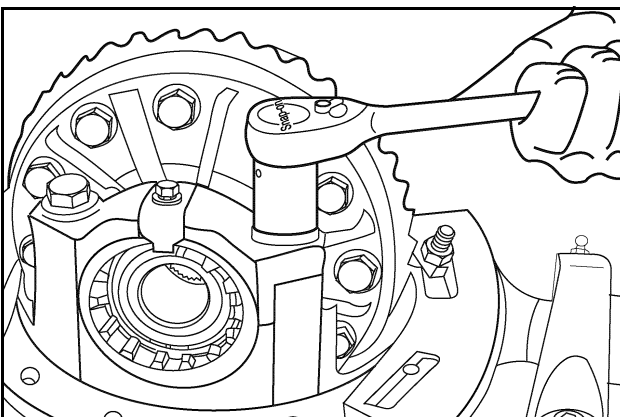
### STEP 9



RR98K047

Lift and remove the differential assembly from the carrier. Remove the differential bearing cups from the bearing cones. Note which side each cup originates from.

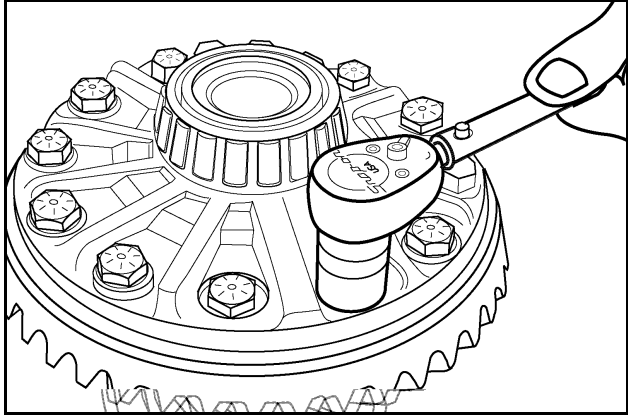
### STEP 7



RR98K045

Remove bearing cap retaining bolts and washer. (24 mm or 15/16 inch socket).

## STEP 10



RR98K049

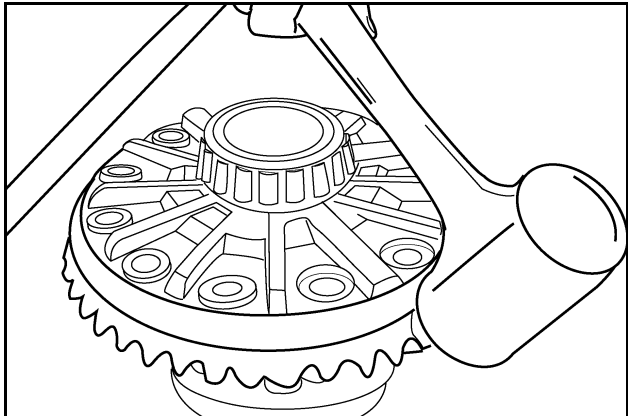
To remove the ring gear from the differential gear housing half, place shop towels over vise jaws and secure the assembly in the vise. Do not nick or otherwise damage the ring gear teeth. Remove ring gear screws and discard them. New ring gear screws will be installed during reassembly. (13/16 inch socket).



**WARNING:** Gear teeth may have sharp edges. When handling gear, use care to avoid personal injury.

M687

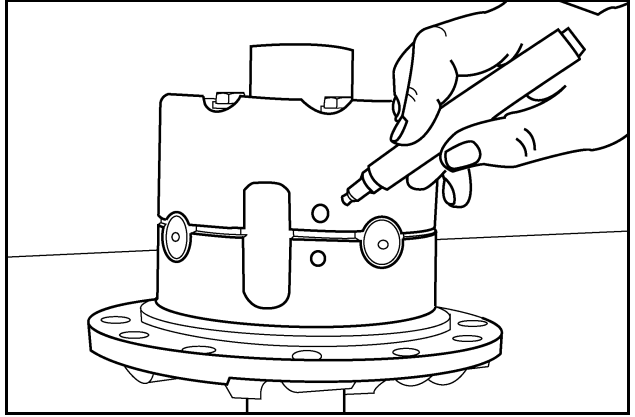
## STEP 11



RR98K013

After removing screws, tap the ring gear with a rawhide or plastic hammer to separate the gear from the housing half.

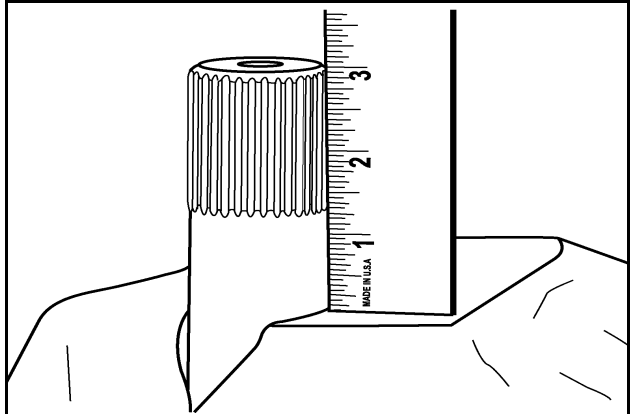
## STEP 12



RR98K228

Mark the housing halves for reassembly. Also, mark the end of the cross shaft that is nearest the housing mark for reassembly.

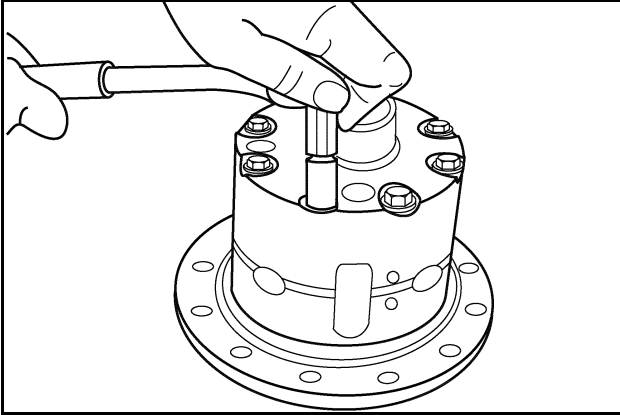
## STEP 13



RR98K017

Place shop towels over and between the vise jaws. This will prevent possible damage to the axle shaft. Place one of the axle shafts into the vise with the spline end extending approximately 76.2 mm (3 inches) above the vise. This will be used as a holding device for disassembly and assembly of the differential housing.

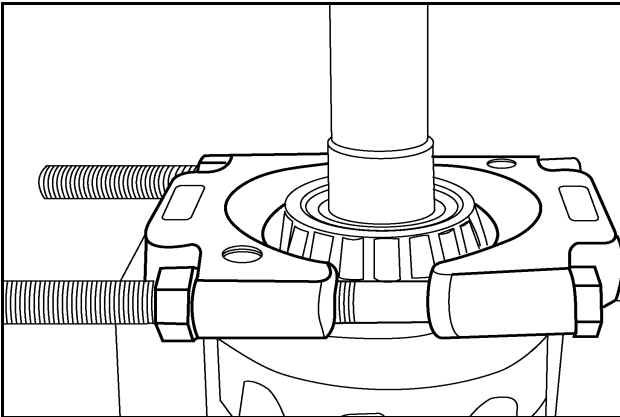
### STEP 14



RR99K229

Remove the differential housing bolts. (9/16 inch socket).

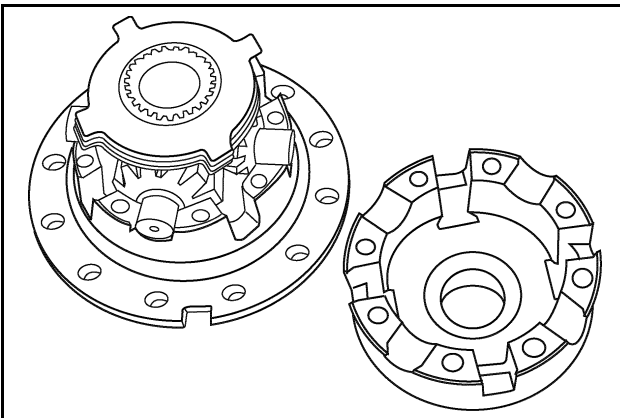
### STEP 15



RR98K032

Install a split collet and remove the bearing cone from the differential housing half.

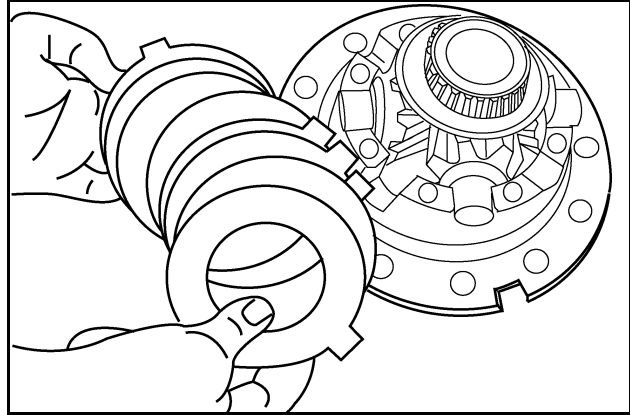
### STEP 16



RR99K230

Remove the differential housing half.

### STEP 17

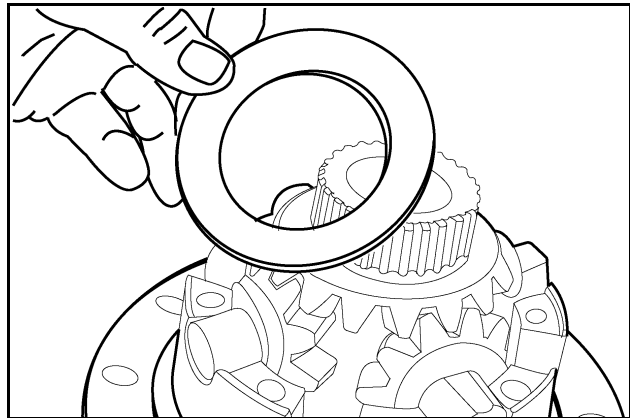


RR99K231

Remove the friction discs and the separator plates.

**NOTE:** If reused, make sure the discs and plates are kept in the same order for reassembly.

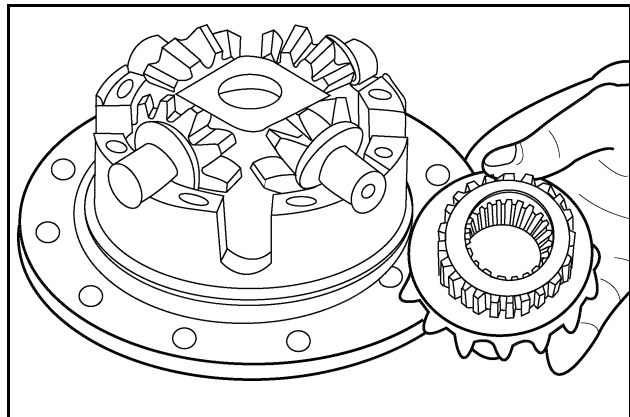
### STEP 18



RR99K223

Remove the dished disc.

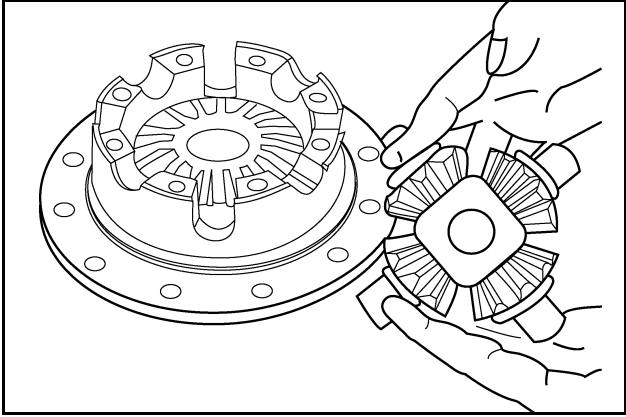
### STEP 19



RR99K234

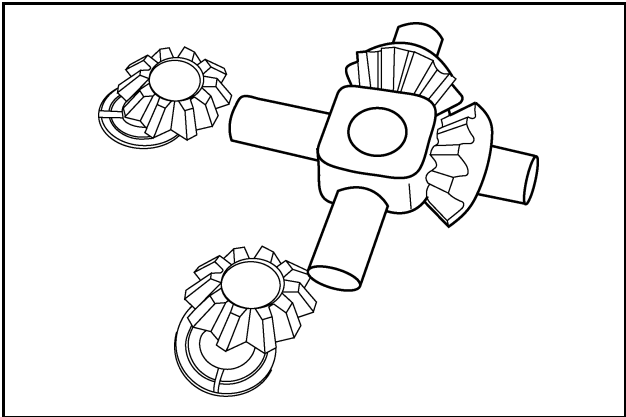
Remove the side gear.

**STEP 20**



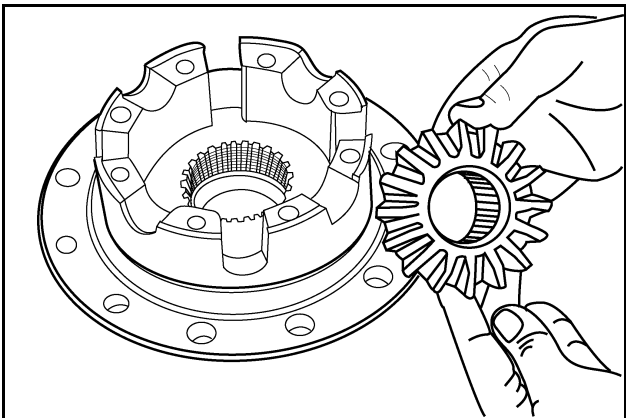
Remove the pinion mate cross shaft, pinion mates (pinion gears), and thrust washers.

**STEP 21**



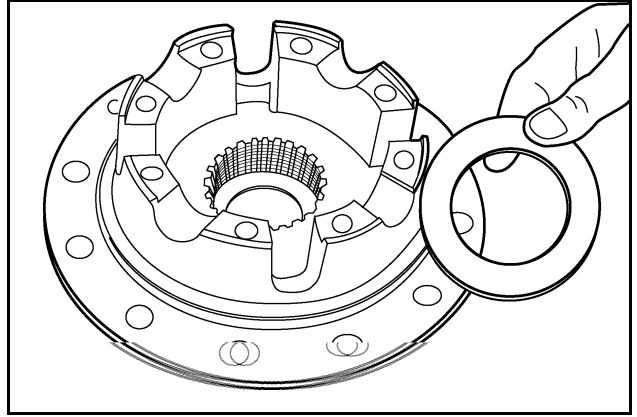
Separate the pinion mate cross shaft, the pinion mate gears and thrust washers.

**STEP 22**



Remove the side gear.

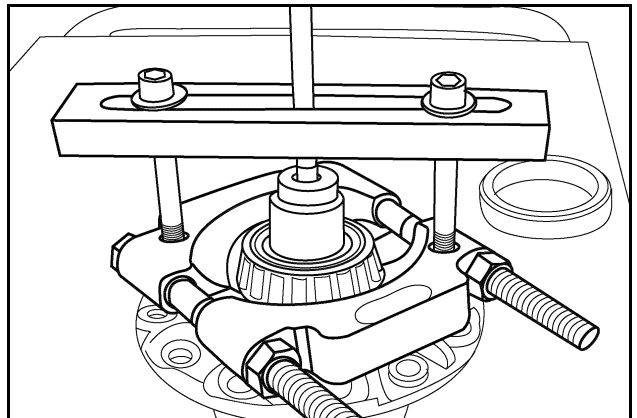
**STEP 23**



Remove the dished disc, the separator plate and friction discs.

**NOTE:** If reused, make sure the discs and plates are kept in the same order for reassembly.

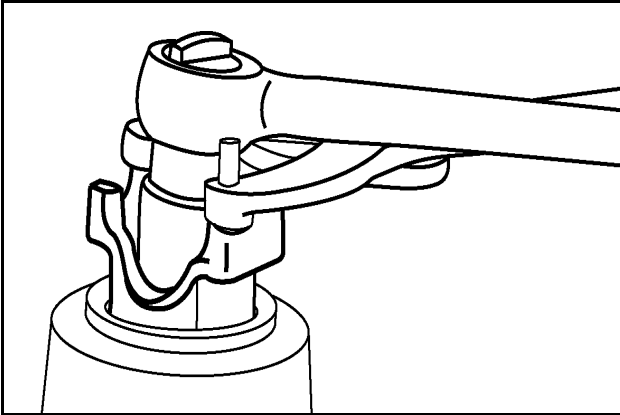
**STEP 24**



Install a split collet and remove the bearing cone from the differential gear housing half.

## Pinion Disassembly

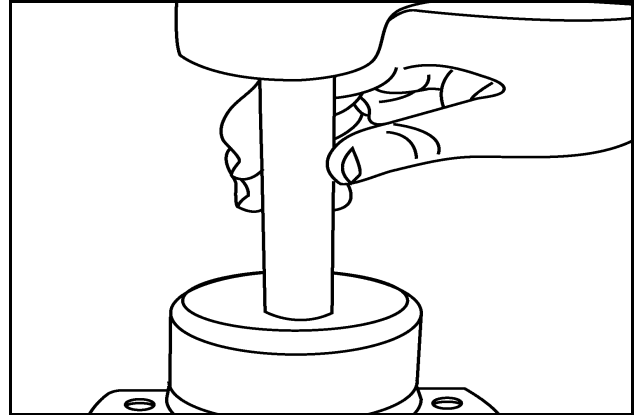
### STEP 25



RR98K021

Hold end yoke or flange with tool similar to the one shown, and remove nut and washer. Discard nut as new one must be used at reassembly. (1-5/16 inch socket).

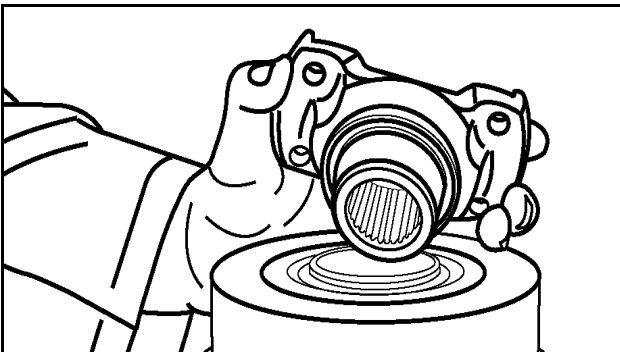
### STEP 27



RR98K012

If a new yoke dust shield is required, use CAS-2596 or 3800011108 Yoke Dust Shield Installer with FNH 299077 or 380001112 Handle

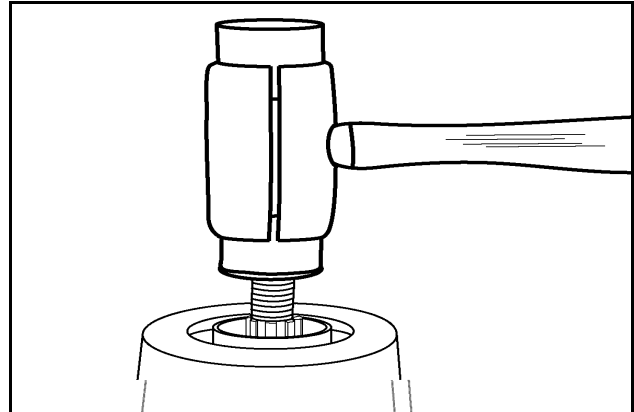
### STEP 26



T98483

Remove end yoke. If yoke or flange shows wear in the seal contact area, it should be replaced

### STEP 28



RR98K019

Remove the pinion by tapping with a rawhide hammer. Support the pinion to prevent it from falling and being damaged.



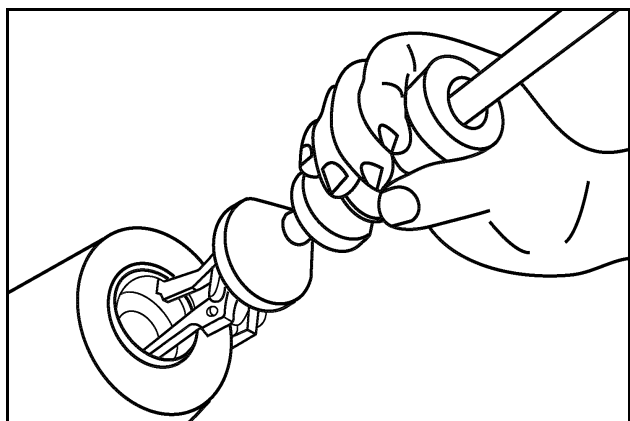
**WARNING:** Gear teeth may have sharp edges. When handling gear, use care to avoid personal injury.

M687

**NOTE:** On the spline end of the pinion, there are bearing preload shims. These shims may stick to the bearing, pinion or even fall out. The shims are to be collected and kept together since they will be used later in reassembly. Do not damage the shims. If the shims are damaged, replace with new ones: shims are available in thicknesses of 0.003 inch, 0.005 inch, 0.010 inch and 0.030 inch.

**NOTE:** If ring gear and/or pinion shaft needs to be replaced, ring gear and pinion shaft must be replaced as matched set.

## STEP 29



RR98K020

Remove the pinion seal with a puller as shown. DISCARD SEAL. Replace with new seal during reassembly. Also, remove bearing cone and outer pinion oil slinger.

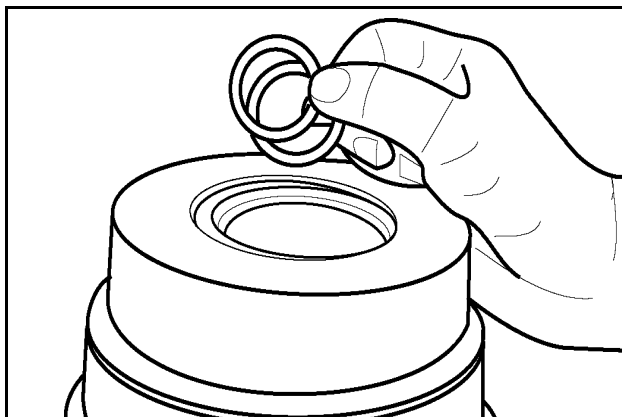
## STEP 30



T98492

Remove the spacer from the pinion shaft as shown.

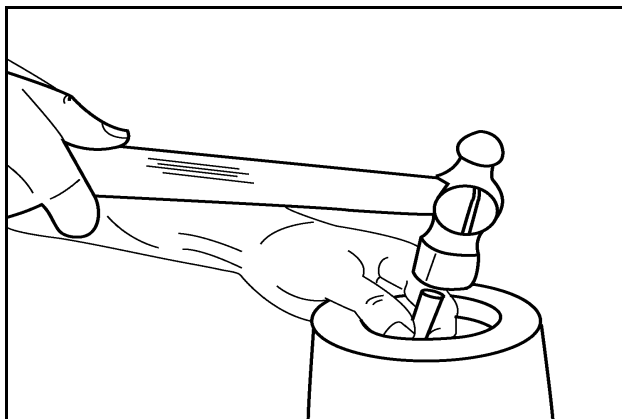
## STEP 31



T98490

Remove pinion adjustment shims from the pinion shaft.

## STEP 32



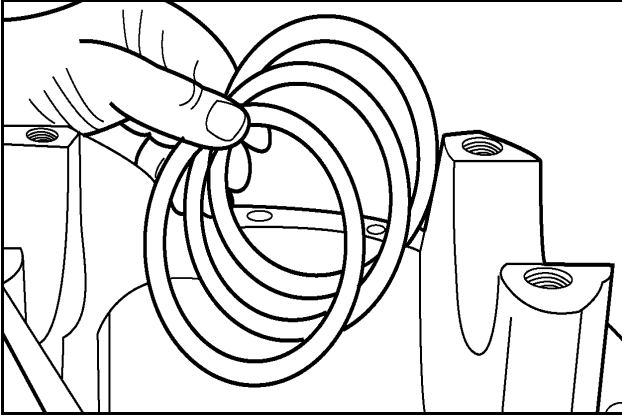
RR98K039

Remove the inner bearing cup.

**NOTE:** Shims are located between the bearing cup and carrier bore. If shims are bent or nicked, they should be replaced at time of assembly. Wire the stacks together and measure each. If a stack is replaced, replace with the same thickness.



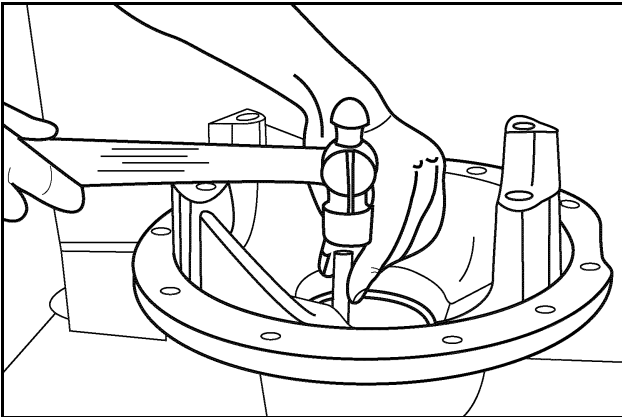
### STEP 33



T98491

Remove inner bearing adjustment shims.

### STEP 34

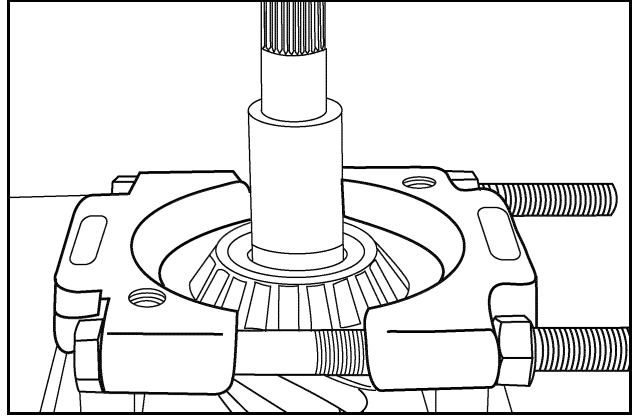


RR98K040

Turn nose of carrier down. Remove outer pinion bearing cup as shown. Locate driver on back edge cup; drive cup out of carrier if necessary.

**NOTE:** Do not damage the carrier bore.

### STEP 35



RR98K036

Install a split collet and press the bearing cone off of the pinion shaft.

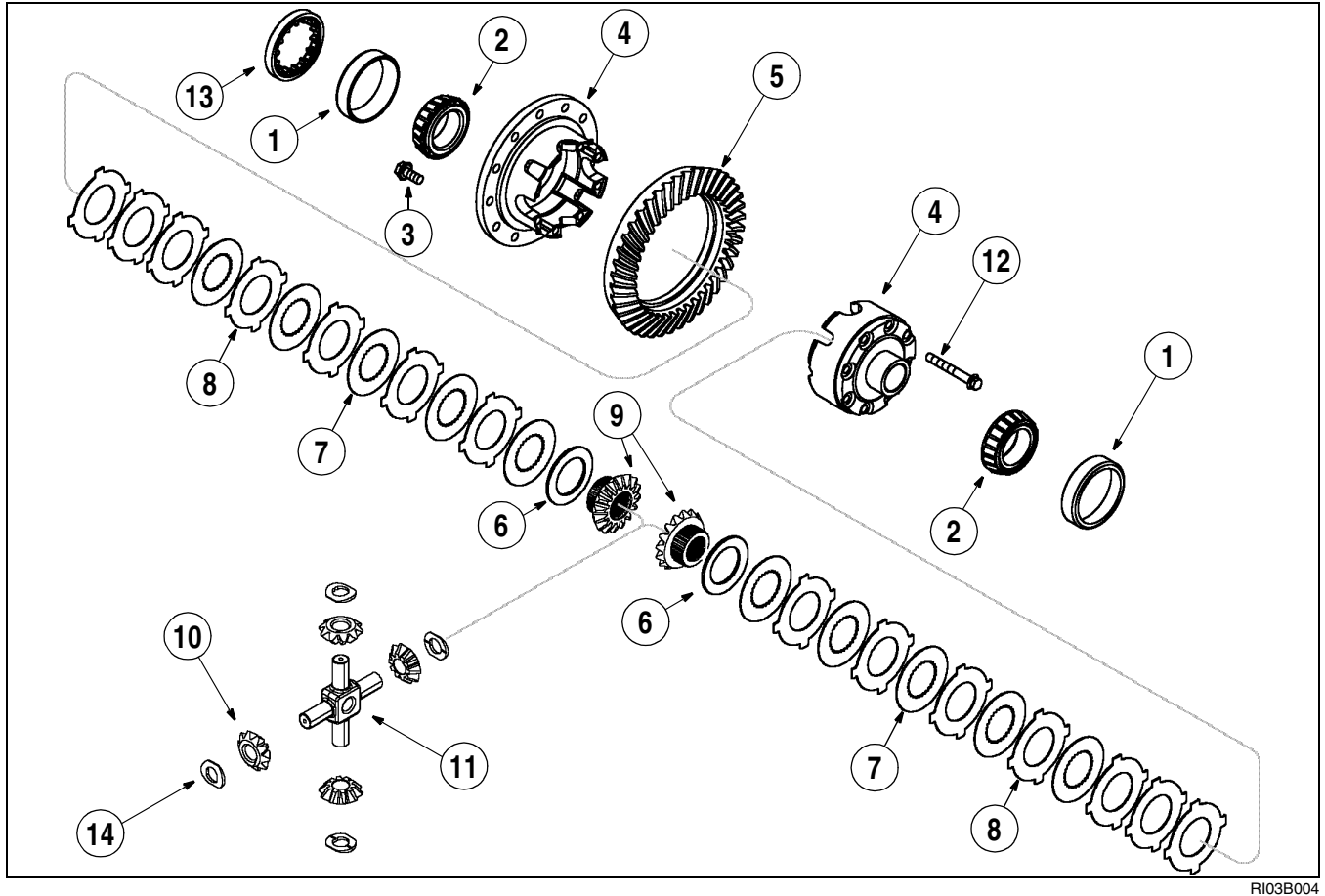


**WARNING:** Do not allow the shaft to fall. It can strike legs or feet and may cause serious injury. Gear teeth may have sharp edges. Use care when handling to avoid injury. M688

**NOTE:** It is recommended that whenever bearings are removed, they are to be replaced with new ones (regardless of hours).

**NOTE:** If replacement of a damaged bearing cup or cone is necessary, the cup and cone must be replaced as a set.

## DIFFERENTIAL ASSEMBLY

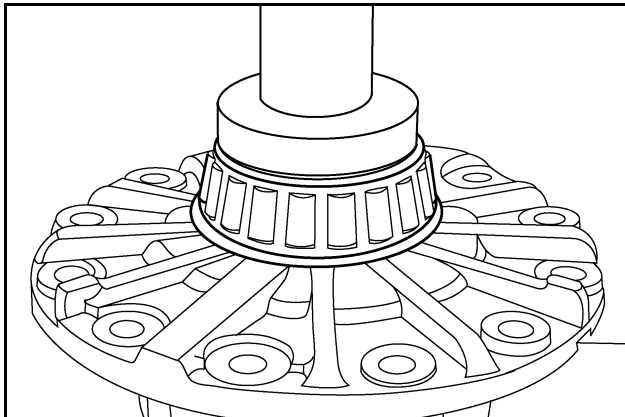


RI03B004

1. BEARING CUP
2. BEARING CONE
3. RING GEAR BOLT
4. HOUSING HALF
5. DIFFERENTIAL RING GEAR
6. DISHED DISC
7. FRICTION DISCS

8. SEPARATOR PLATES
9. SIDE GEAR
10. PINION GEAR (4)(PINION MATES)
11. CROSS SHAFT (1)
12. DIFFERENTIAL CASE SCREW
13. ADJUSTING RING
14. THRUST WASHER

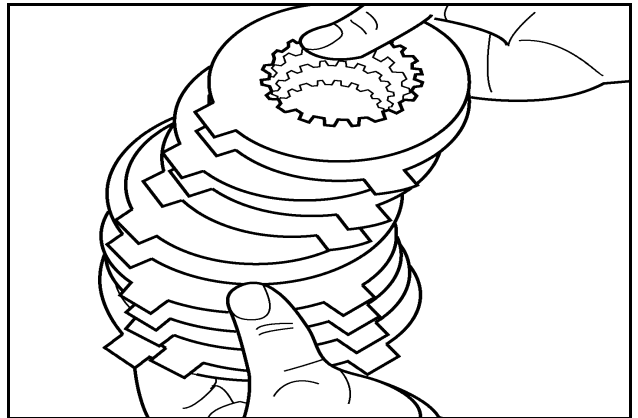
### STEP 36



RR98K033

Press bearing cone on each trunnion of each differential case half.

### STEP 37

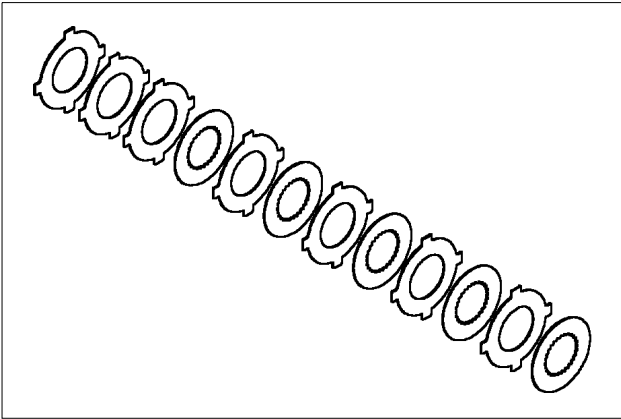


RR99K239

Apply friction modifier (B91246) to all the disc and plate friction surfaces.

**NOTE:** Make sure the discs and plates are kept in the same order as disassembly.

### STEP 38



RI03B005

Be sure the plates are arranged for installation as follows:

3 Plates (in board side)

1 Discs

1 Plate

1 Disc

1 Plate

1 Disc

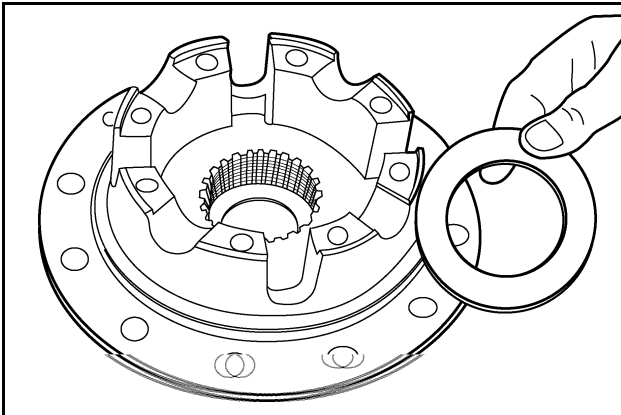
1 Plate

1 Disc

1 Plate

1 Disc

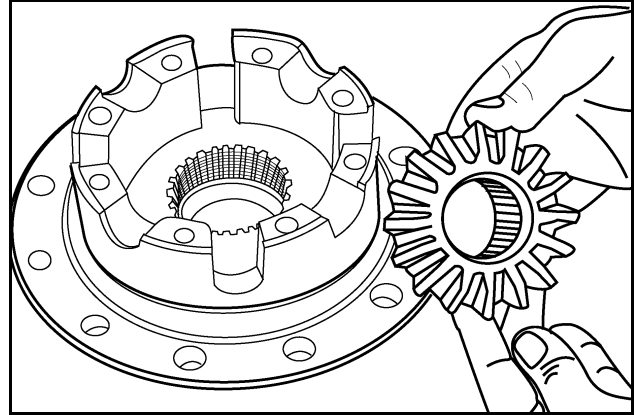
### STEP 39



RR99K238

Install the plate/disc stack into the differential housing. Install the dished disc into the differential housing. The convex side of the disc must be up so the ID of the disc makes contact with the side gear that is installed next.

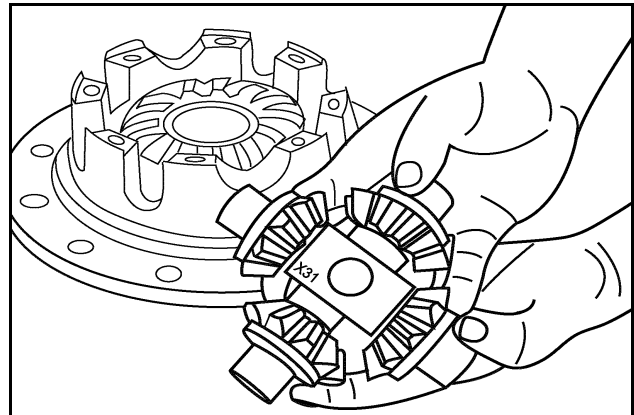
### STEP 40



RR99K237

Apply grease to the shoulder of the side gear, then install the side gear in dished disc in the flanged housing half.

### STEP 41

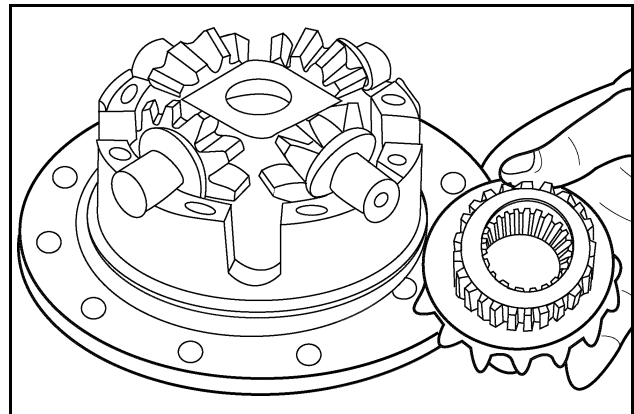


RR98K025

Lubricate the pinion mate gear ID's. Install the pinion mate gears and thrust washers.

**NOTE:** Make sure the shafts are installed in the same order as disassembly. Refer to the alignment marks made prior to disassembly.

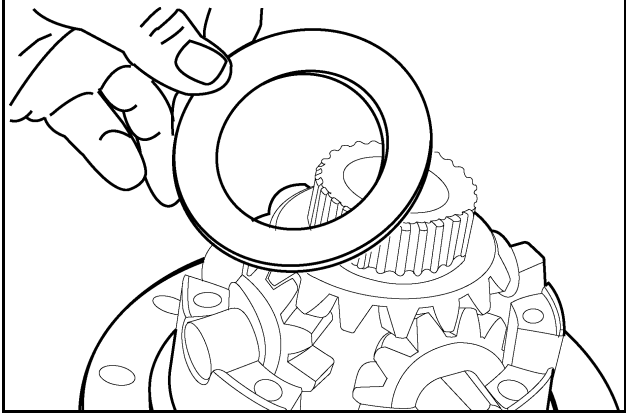
### STEP 42



RR99K234

Place the side gear on top of the pinion gears.

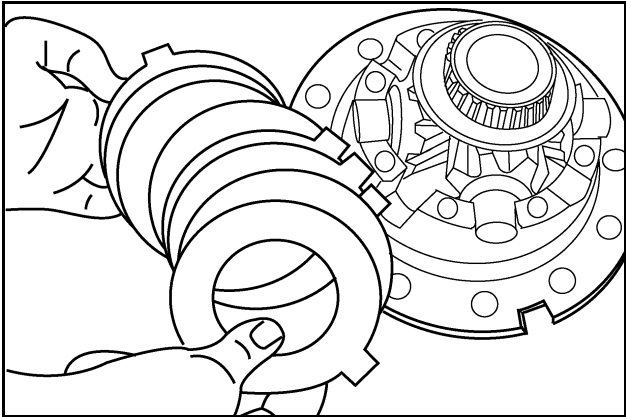
### STEP 43



RR99K233

Install a dished disc. Position the disc so the convex ID touched the side gear shoulder.

### STEP 44

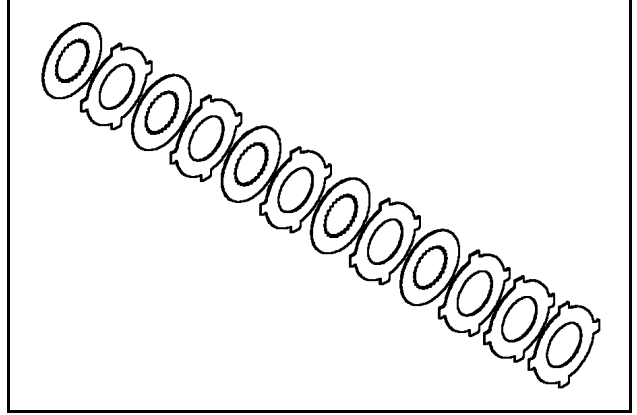


RR99K231

Apply friction modifier (B91246) to all the discs and plate friction surfaces.

**NOTE:** Make sure the discs and plates are kept in the same order as disassembly.

### STEP 45



RI03B005

Be sure the plates are arranged for installation as follows:

3 Plates (in board side)

1 Discs

1 Plate

1 Disc

1 Plate

1 Disc

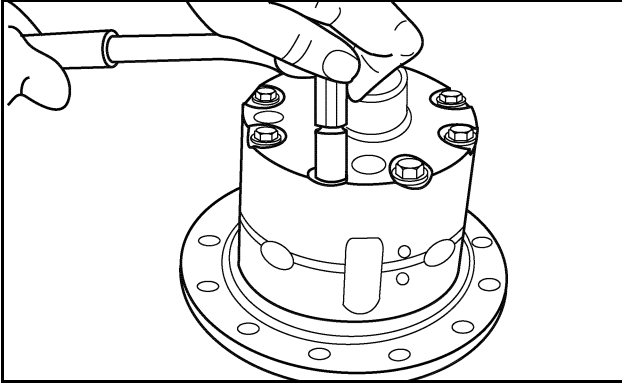
1 Plate

1 Disc

1 Plate

1 Disc

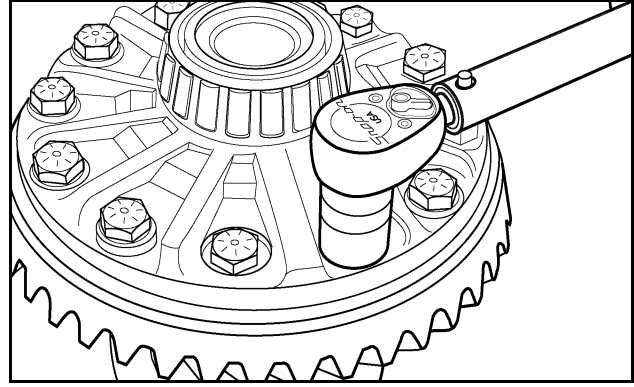
### STEP 46



Install the plate/disc stack into the differential housing. The end of the stack with 3 plates goes to the in board side.

Assemble the differential case halves. Make sure the marks line up on the case halves. Refer to the alignment marks made prior to disassembly. Install eight (8) new differential case screws. Tighten to a torque of 122 to 135 Nm (90 to 100 lb. ft.).

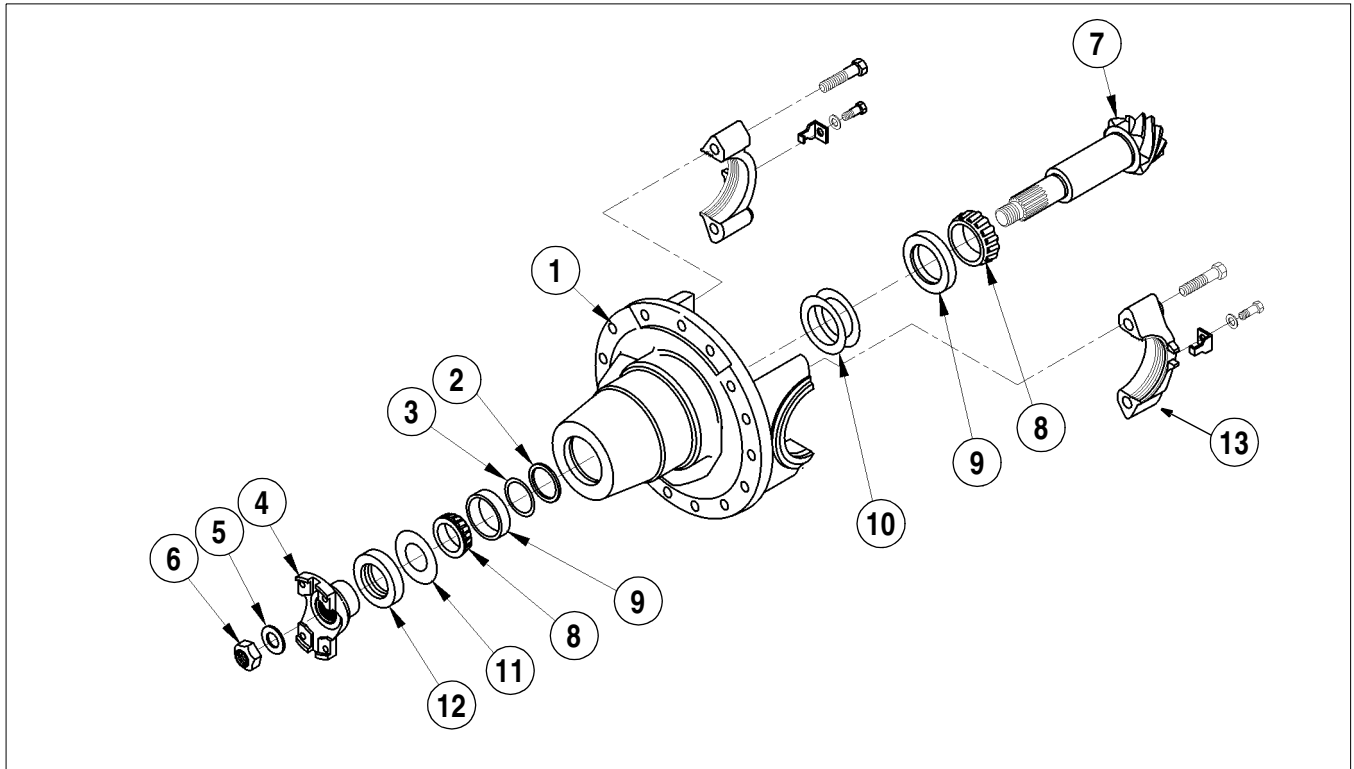
### STEP 47



Install the differential ring gear to the housing half. Install new ring gear bolts. Tighten the ring gear bolts to a torque of 163 to 190 Nm (120 to 140 lb. ft.). (Use a 13/16 inch socket).

**NOTE:** Make sure the discs and plates are kept in the same order as disassembly.

## DIFFERENTIAL CARRIER ASSEMBLY

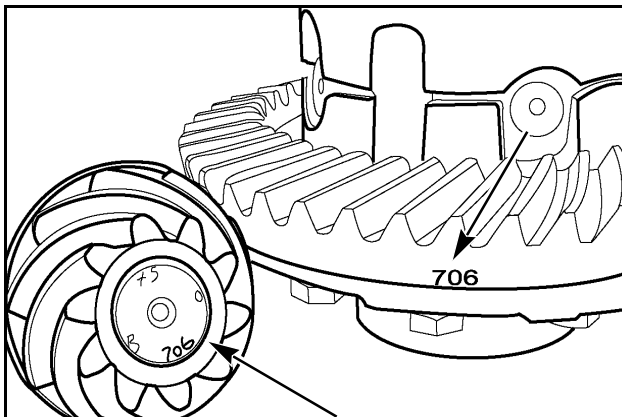


RH98K105

- |                                    |               |                 |                                 |
|------------------------------------|---------------|-----------------|---------------------------------|
| 1. DIFFERENTIAL CARRIER            | 4. INPUT YOKE | 7. PINION SHAFT | 10. PINION SHAFT POSITION SHIMS |
| 2. SPACER                          | 5. WASHER     | 8. BEARING CONE | 11. OIL BAFFLE                  |
| 3. PINION BEARING ADJUSTMENT SHIMS | 6. NUT        | 9. BEARING CUP  | 12. OIL SEAL                    |
|                                    |               |                 | 13. BEARING CAP                 |

### Pinion Position and Assembly

#### STEP 48



T98512

**NOTE:** On the pinion there is etched either a zero (0), or plus (+) or minus (-) number. This indicates the best running position for each gear set. The dimension is set by shimming behind the inner pinion bearing cup.

Verify that the numbers on the ring gear and pinion gears match. Use the following chart as a guide when determining shim pack thickness and setting pinion distance.

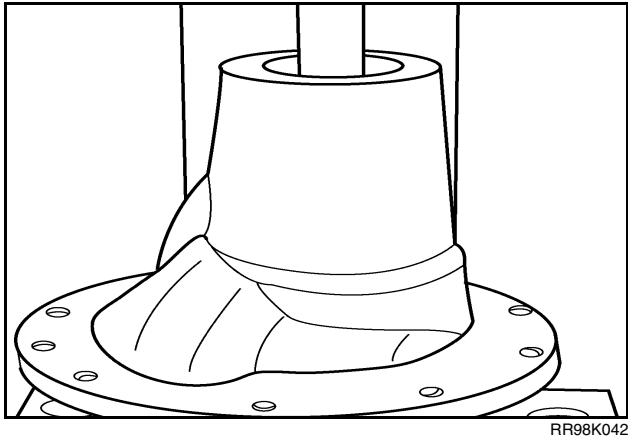
**Shim Pack Thickness Chart**

Old Pinion Marking	New Pinion Marking								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

Shim Thickness To Add Or Remove

## Setting The Pinion Depth

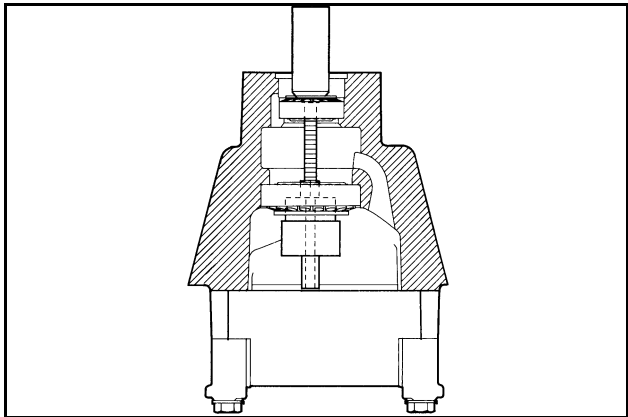
### STEP 49



RR98K042

Install the outer bearing cup.

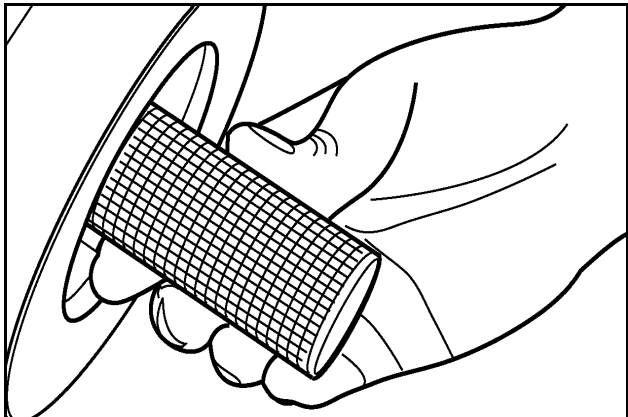
### STEP 50



RB99C113

The pinion depth setting tool, FNH 00400 or 30001109, must be assembled into the differential as shown above. Follow Steps 60 through 64 to assemble tool to differential housing.

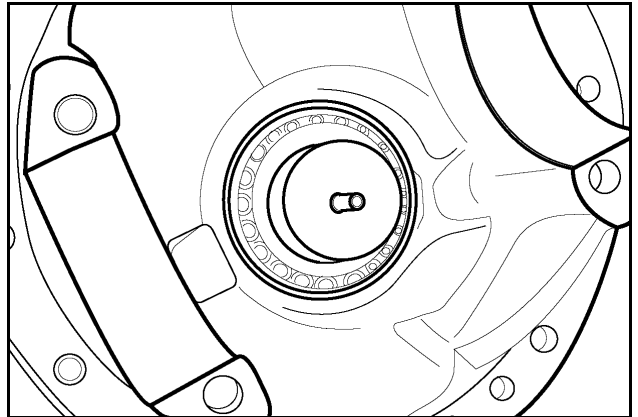
### STEP 51



T98516

Install the Handle FNH 00401 or 380001132 and Threaded Shaft FNH 00402 or 380001133 into the carrier housing.

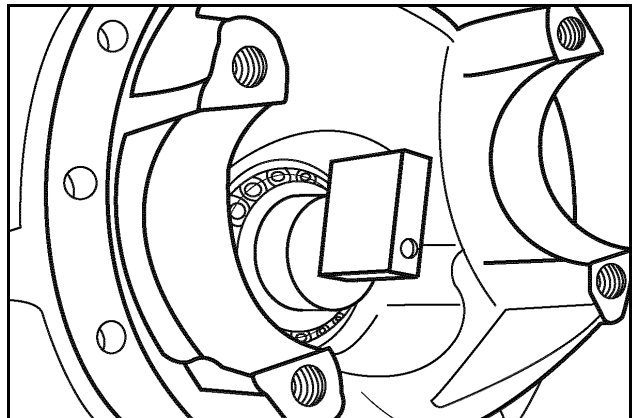
### STEP 52



T98517

Install Aligning Disc FNH 00405 or 380001136 and the Gauge Disc FNH 00403 or 380001134.

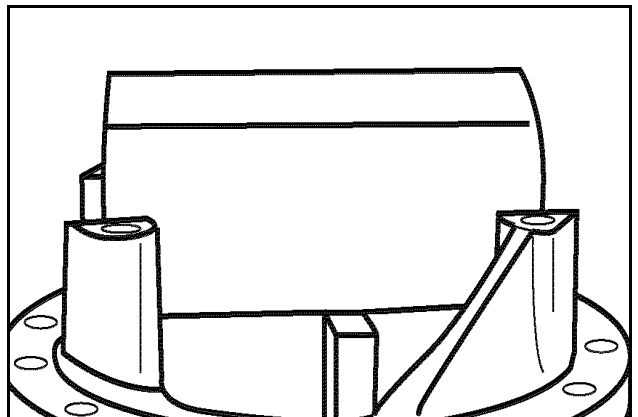
### STEP 53



T98518

Install Gauge Block FNH 00404 or 380001135 and finger tighten to hold the gauge assembly and bearing cones in position.

### STEP 54

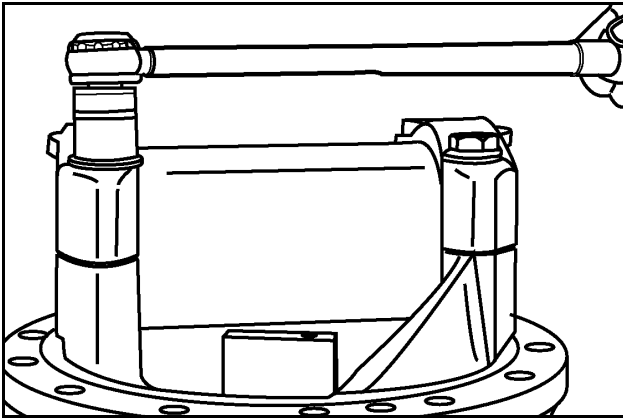


T98519

Install the Tube FNH 00406 or 380001137.



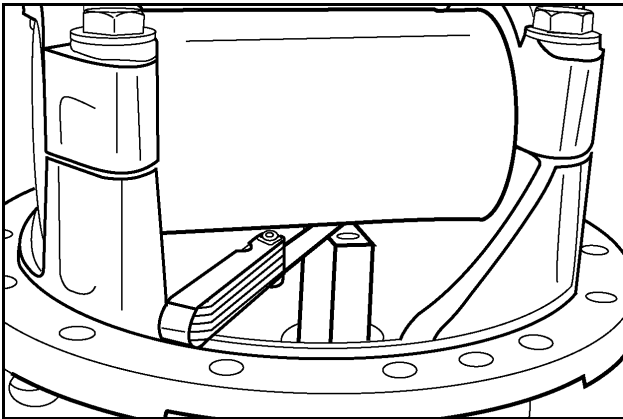
## STEP 55



T98522

Install the bearing caps and cap bolts. Tighten the bolts to a torque of 244 to 271 Nm (180 to 200 lb. ft.) (Use a 24 mm socket).

## STEP 56



T98523

Position Gauge Block FNH 00404 or 380001135 under Tube FNH 00406 or 380001137. Use a feeler gauge and measure the distance between the tube and the block. This dimension is the shim thickness needed, provided the pinion shaft has not "+" or "-" marking on the button end.

## STEP 57

If the pinion shaft has a "+" marking, subtract the amount shown from the measurement taken in Step 65. The remainder is your shim pack thickness.

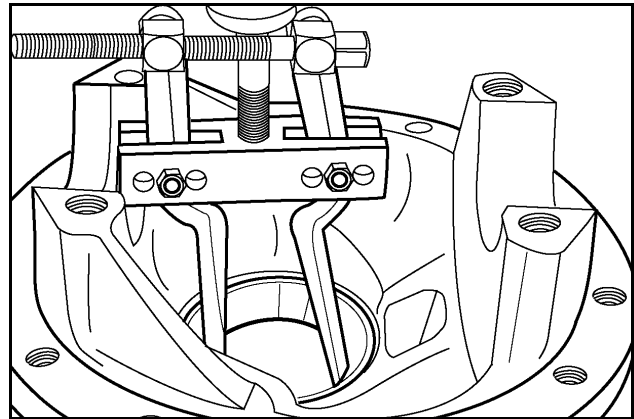
If the pinion shaft has a "-" marking, add the amount shown to the measurement taken in Step 65. The sum will be your shim pack thickness.

**NOTE:** The "+" and "-" markings on the pinion shaft are given in thousandths of an inch. Shims are available in thicknesses of 0.076 mm (0.003 inch), 0.127 mm (0.005 inch), 0.25 mm (0.010 inch). Acceptable tolerance is 0.050 mm (+/-0.002 inch) of number etched on pinion shaft (total shim calculation).

## STEP 58

Remove the depth setting tool FNH 00400 or 380001109 from the carrier housing.

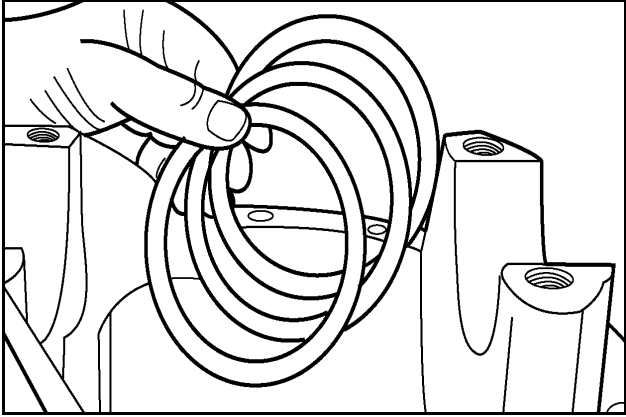
## STEP 59



T98489

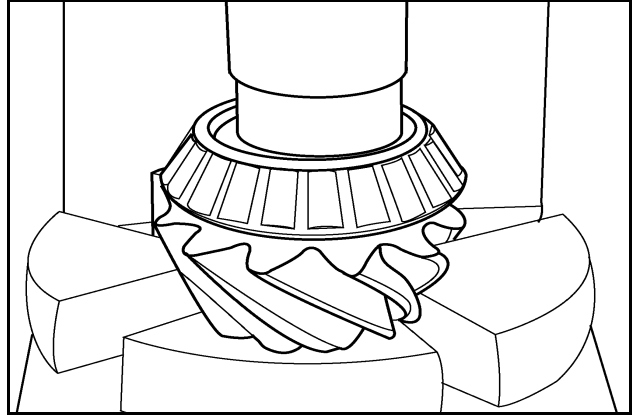
If necessary to adjust pinion position, remove the inner bearing cup.

**STEP 60**



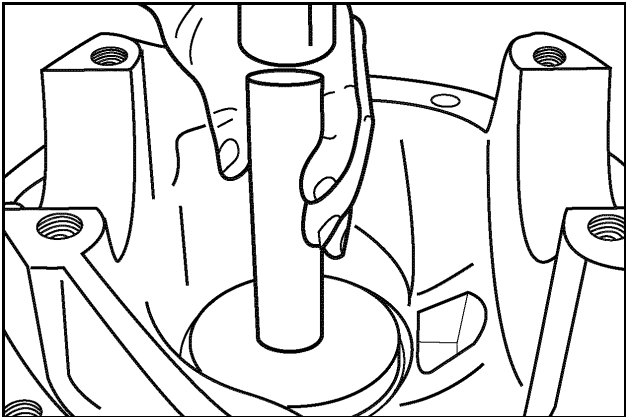
Install the proper amount of shims.

**STEP 62**



Assemble inner bearing cone on pinion. Drive bearing onto pinion using suitable press.

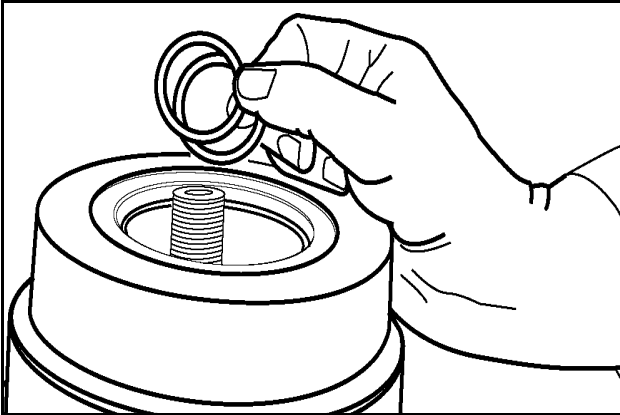
**STEP 61**



Install the inner bearing cup.

## Adjusting Bearing Preload

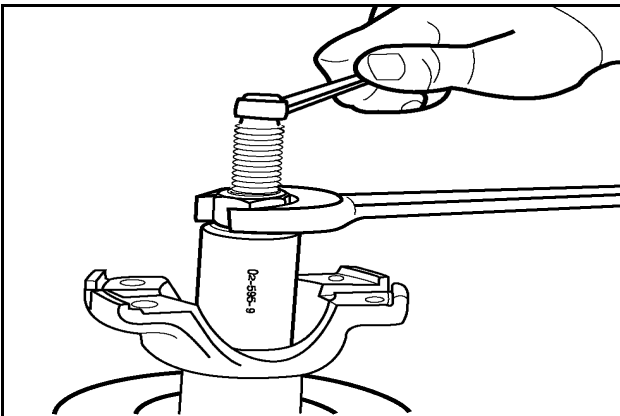
### STEP 63



T98610

Install the pinion into the carrier. Install a shim pack of 0.070 inch on the pinion shaft.

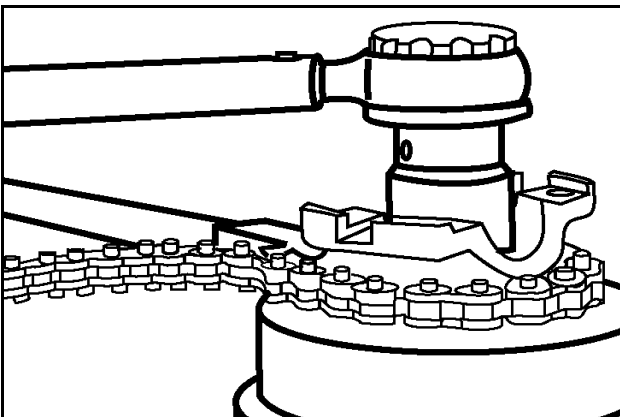
### STEP 64



T98528

Use the Companion Flange Installer CAS-1898-8 to push the yoke onto the shaft.

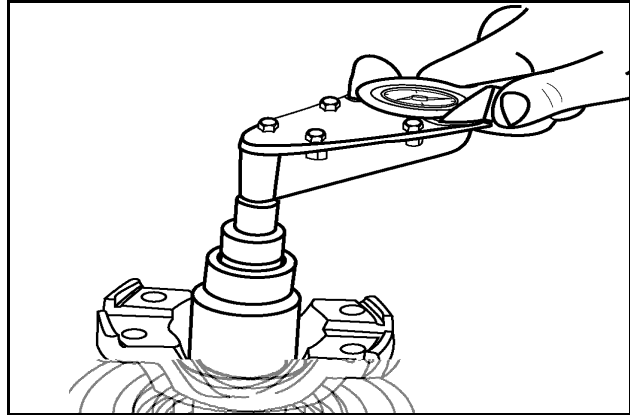
### STEP 65



T98530

Torque the pinion nut to 326 to 406 Nm (240 to 300 lb. ft.) (1-5/16 inch socket).

### STEP 66



T98531

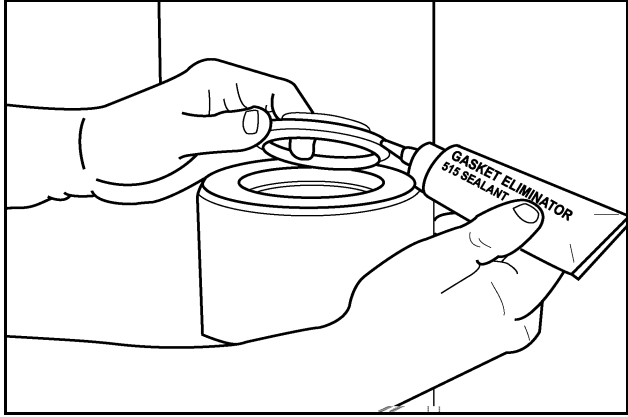
Using an inch pound torque wrench, measure the rolling torque needed to turn the pinion shaft. The torque must be 2.26 to 5.65 Nm (20 to 50 lb. inch). If the torque is correct continue to Step 76. If torque is not correct, do the following:

**NOTE:** Typically a change of 0.001 inch will change rolling torque 15 lb inch.

1. **To increase the torque** adjust the 0.070 inch shim pack to remove a small amount of thickness. For example, replace a 0.015 inch shim with a 0.014 inch shim. Repeat torque check procedure.
2. **To decrease the torque** adjust the shim pack to add a small amount of thickness. For example, replace a 0.014 inch shim with a 0.015 inch shim. Repeat torque check procedure.

**NOTE:** Shim kits contain the following size shims: 0.010 inch, 0.014 inch, 0.015 inch, 0.016 inch, 0.018 inch, 0.020 inch, 0.021 inch, 0.022 inch, 0.023 inch and 0.030 inch.

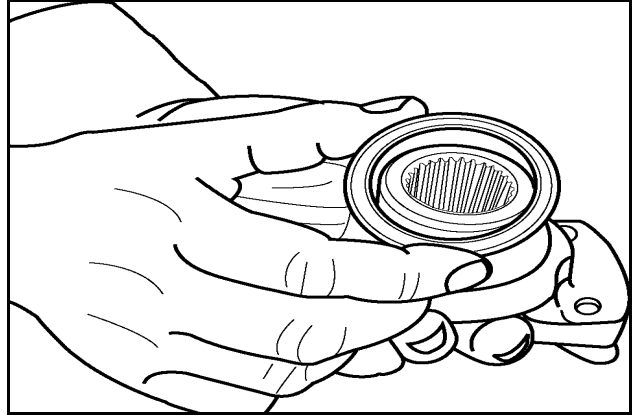
**STEP 67**



RR98K043

Remove nut and end yoke. Apply Loctite 515 to the housing face and to the outer diameter of oil seal.

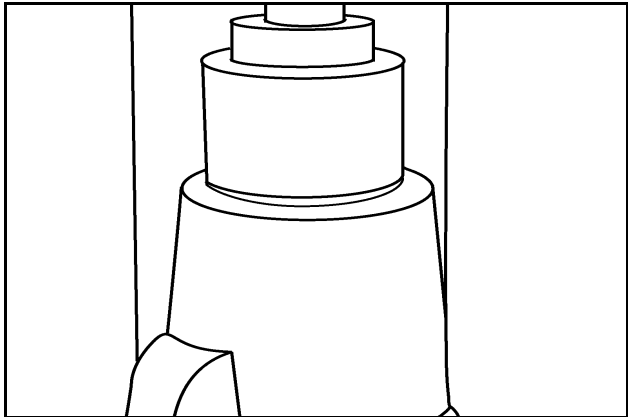
**STEP 69**



T98534

Use tool CAS-2596 or 380001108 and install a new dust shield (slinger) on the input yoke. Make sure sealing surface for oil seal is in good condition.

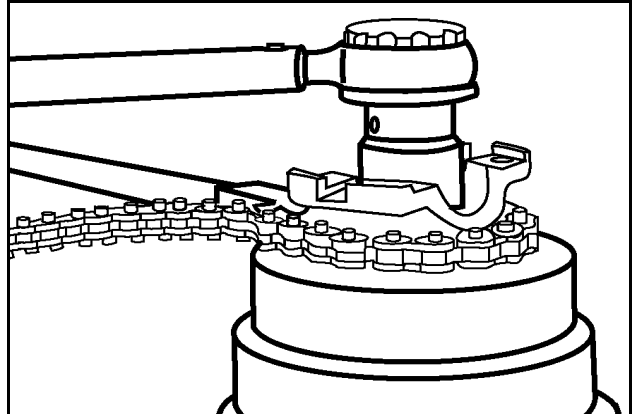
**STEP 68**



RR98K044

Use the Pinion Seal Installer FNH 00419 or 380001111 to install a new pinion shaft oil seal. Install the seal with the lip towards the pinion shaft.

**STEP 70**

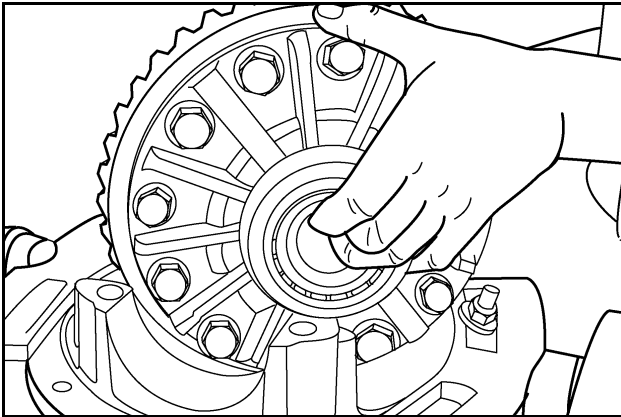


T98530

Tighten the pinion nut to a torque of 326 to 406 Nm (240 to 300 lb. ft.) (1-5/16 inch socket).

## DIFFERENTIAL INSTALLATION

### STEP 71

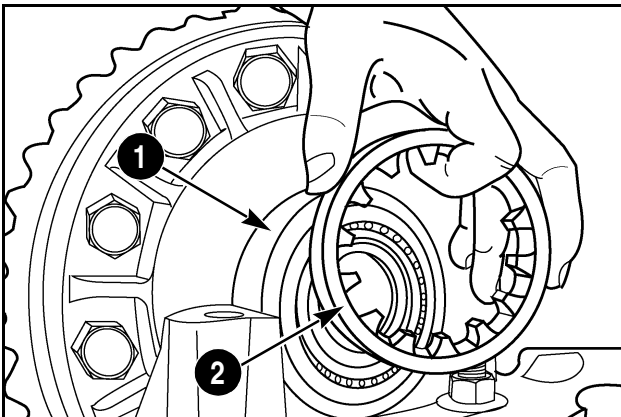


RR98K047

Install ring gear and differential assembly with bearing cups into carrier housing.

**IMPORTANT:** Care should be used when installing ring gear and differential into carrier housing so damage to ring gear, pinion bearings, or bearing bore does not occur.

### STEP 72



RR98K016

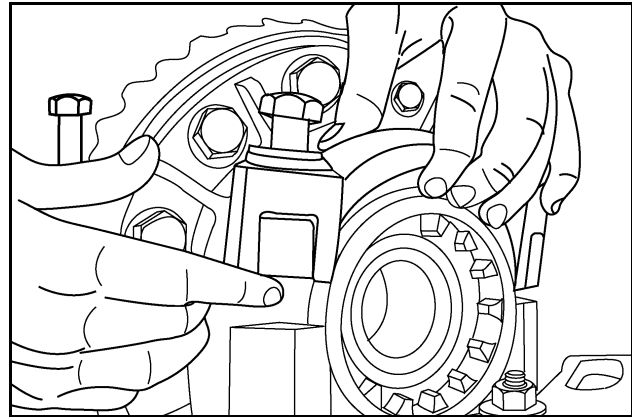
1. BEARING CUP

2. ADJUSTING RING

Install adjusting rings in place. Thread in adjusting rings until all slack is removed between bearing cups and bearings.

**NOTE:** Adjusting rings must be installed with side of nut having the deeper recess facing the bearing. Installed opposite, the adjusting ring would clamp against the bearing cage restricting movement.

### STEP 73

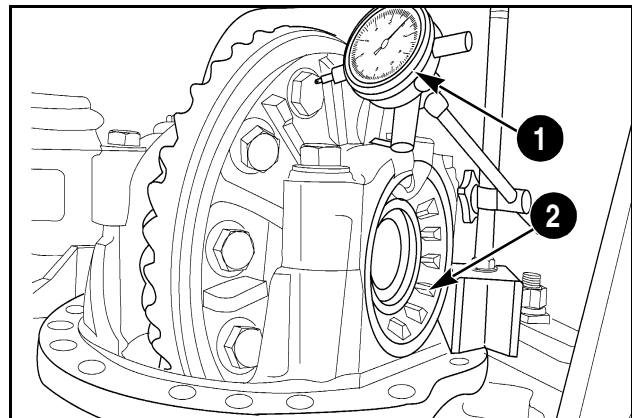


RR98K015

Be sure bearing cups are seated on bearing cones, then install differential bearing caps. Install bearing cap bolts (finger tight only) so adjusting nut can still be turned. (Do not torque cap bolts to specifications).

**NOTE:** Make sure the "match marked" bearing cap and "match marked" leg of the carrier are aligned.

### STEP 74



RD99C141

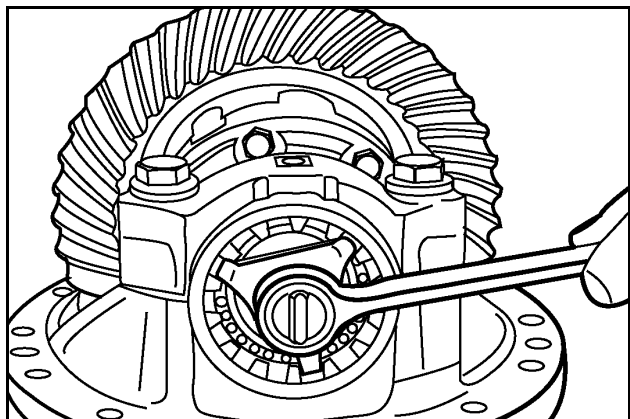
1. DIAL INDICATOR

2. ADJUSTING RING

Position a dial indicator on the housing lip and index indicator dial to back face of the ring gear. Zero the indicator.

Turn adjusting ring on the backside (flange side) of the ring gear in until the indicator stops moving. (Ring gear is moved into mesh with pinion).

## STEP 75

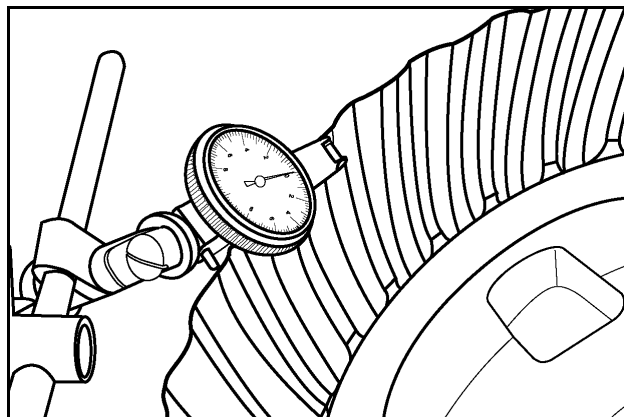


Next, tighten the adjustment ring on the tooth side (bottom side) of the ring gear in until the bearing cup is seated.

Use the Side Bearing Adjusting Wrench FNH 00409 or 380001110 to tighten the right hand and left hand rings to 115 to 129 Nm (85 to 95 lb. ft.).

## Checking Backlash

### STEP 76



Position dial indicator on lip of differential housing and indicate to side of one tooth on ring gear.

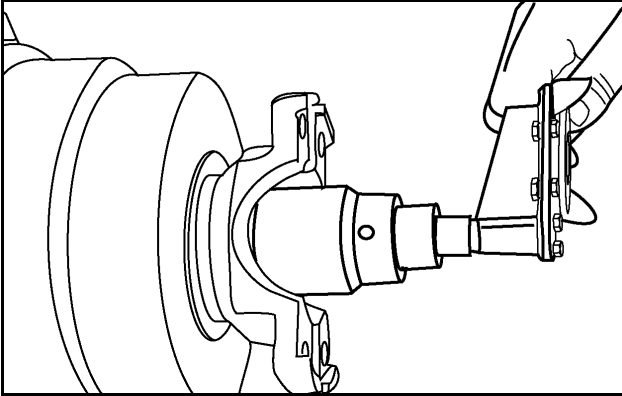
Move ring gear as far as it will go in one direction before it moves the pinion.

"0" the dial on the indicator face.

Move the ring gear in the opposite direction until it contacts the pinion gear and observe the dial face. The reading should be 0.127 to 0.254 mm (0.005 to 0.010 inch) (for 10 stud wheel end axle), or 0.127 mm to 0.203 mm (0.005 to 0.008 inch) (for 12 stud wheel end axle). Check the backlash at three different locations around the gear. There should be no more than 0.06 mm (0.003 inch) variation between readings.

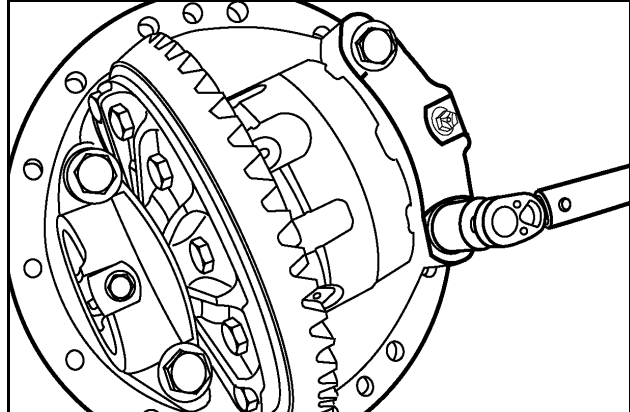
A reading larger than 0.008 to 0.010 inch is corrected by moving ring gear closer to pinion. A reading smaller than 0.005 inch is corrected by moving the ring gear away from the pinion. Move the ring gear by loosening on adjusting ring and then tightening the opposite adjusting ring the same amount. Both adjusting rings must be moved the same amount.

### STEP 77



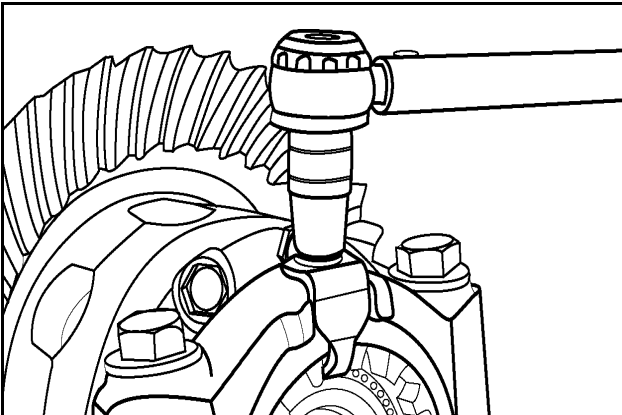
When backlash is adjusted properly, rotating torque at the pinion shaft should be 5 to 10 lb. inch higher than the torque you had when setting pinion shaft bearing preload.

### STEP 79



Tighten all of the bearing cap bolts to a torque of 240 to 270 Nm (180 to 200 lb. ft.).

### STEP 78



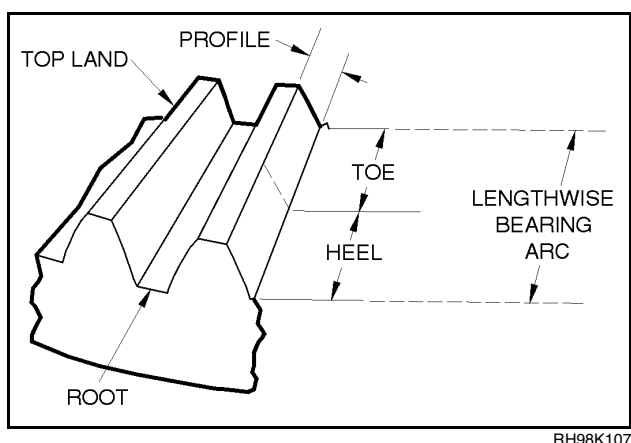
Install the adjusting ring clips, one on each adjusting ring. Tighten adjusting ring clip bolts to a torque of 27 to 40 Nm (20 to 30 lb. ft.).

## Ring Gear and Pinion Tooth Pattern Interpretation

When setting the pinion position, many of the service manuals required a final pinion position check by using gauges that verify the dimension from the center line to the differential carrier (center line of the ring gear) to the face of the pinion (button).

This surface (button) is not used on all new gears for verifying the pinion position. The service tools will be used to establish the proper amount of shims required prior to installing the pinion gear. The final pinion position will be verified by using the GEAR CONTACT PATTERN METHOD, as described here.

### Ring Gear and Pinion Tooth Contact Pattern

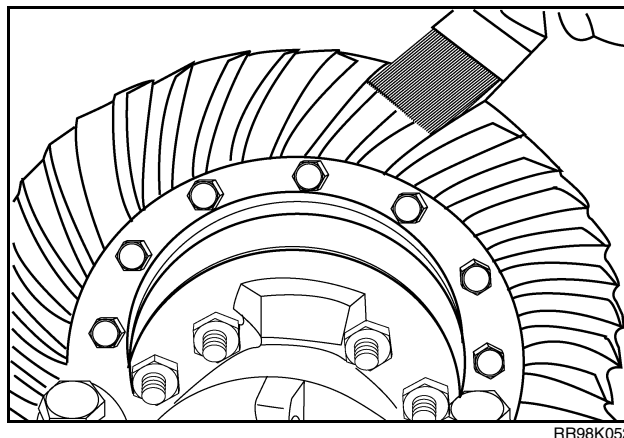


The toe of the gear tooth is the portion of the tooth surface at the end towards the center. The heel of the gear tooth is the portion of the tooth surface at the outer end. The top land of a gear tooth is the surface of the top of the tooth. Every gear has a characteristic pattern. The illustrations show typical patterns only, and explains how patterns shift as gear location is changed. When making pinion position changes, shims should be changed in the range of 0.05 mm (0.002 inch) to 0.10 mm (0.004 inch) until correct pattern has been obtained.

When a change in backlash is required, backlash should be changed approximately 1-1/2 times the amount needed to bring the gears into specification. For example, if the backlash needed to be changed by 0.10 mm (0.004 inch), the adjusting rings should be moved so that the backlash changes by 0.15 mm (0.006 inch) as a starting point. The actual amount of backlash change obtained will vary depending upon the ratio and gear size once everything is tightened to specification.

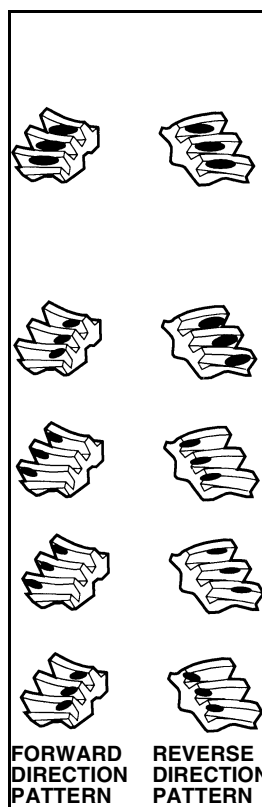
High backlash is corrected by moving the ring gear closer to the pinion. Low backlash is corrected by moving the ring gear away from the pinion.

1. Paint the ring gear teeth with a marking compound to both the forward and reverse side.



2. Rotate the ring gear one complete revolution in both directions.

### Pattern Interpretation (Ring Gear))



Normal or desirable pattern. The forward pattern should be centered on the tooth, but slightly toward the toe. There should be some clearance between the pattern and the top of the tooth.

Backlash correct. Thinner pinion bearing cup position shim required.

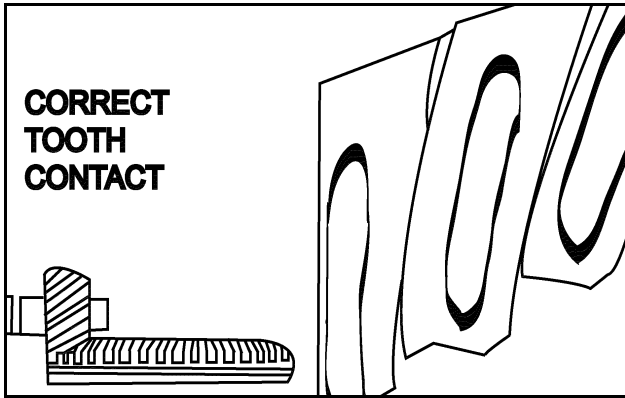
Backlash correct. Thicker pinion bearing cup position shim required.

Pinion position shim correct. Decrease backlash.

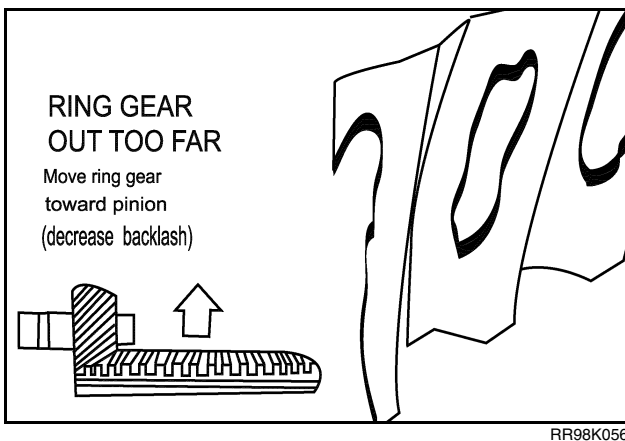
Pinion position shim correct. Increase backlash.



### Pattern Movements Summarized



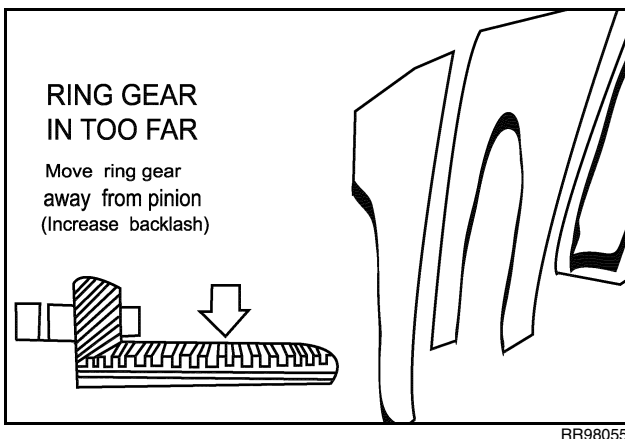
EXAMPLE OF CORRECT PATTERN



1. Decreasing backlash moves the ring gear closer to the pinion.

Forward Pattern (convex side of ring gear) moves lower and towards the toe.

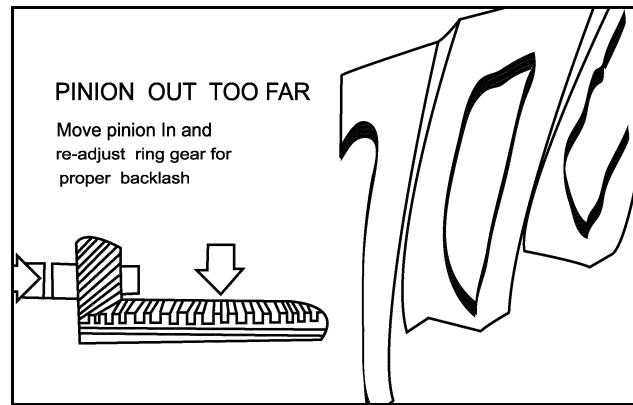
Reverse Pattern (concave side of ring gear) moves lower and towards the toe.



2. Increasing backlash moves the ring gear away from the pinion.

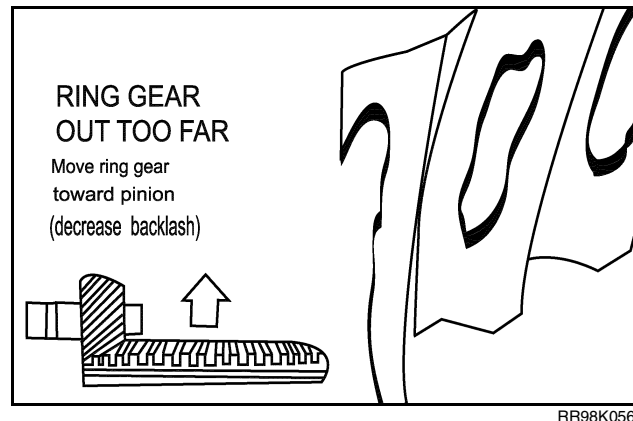
Forward Pattern moves slightly higher and toward heel.

Reverse Pattern moves higher and toward heel.



3. A thicker pinion position shim with the backlash constant moves the pinion closer to the ring gear. Forward Pattern moves deeper on the tooth (flank contact) and slightly toward the toe.

Reverse Pattern moves deeper on the tooth and toward the heel.



4. A thinner pinion position shim with the backlash constant moves the pinion away from the ring gear.

Forward Pattern moves toward the top of the tooth (face contact) and toward the heel.

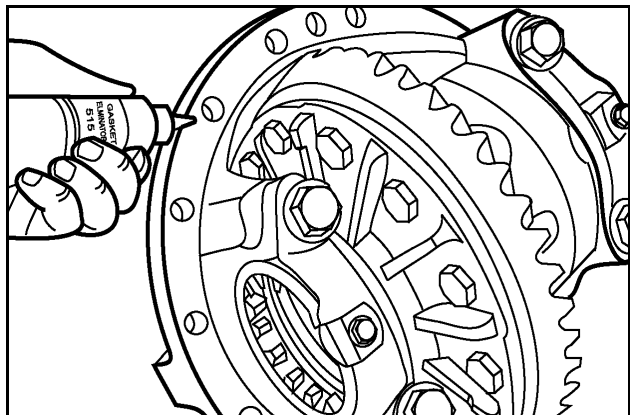
Reverse Pattern moves toward the top of the tooth and slightly toward the toe.

## Installation of Carrier Assembly to Axle Housing

### STEP 80

Thoroughly clean the inside of the axle housing. Remove any burrs and nicks from the carrier housing and axle housing mounting surface.

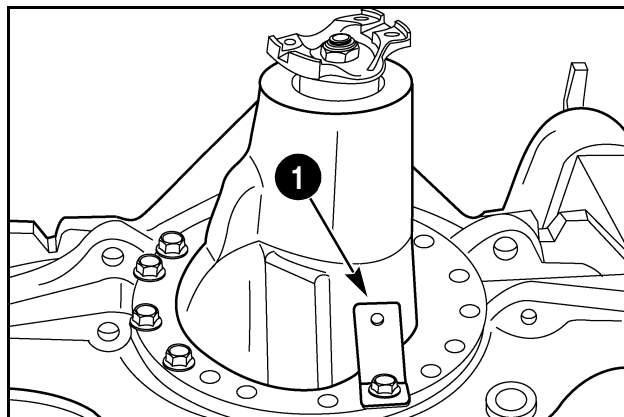
### STEP 81



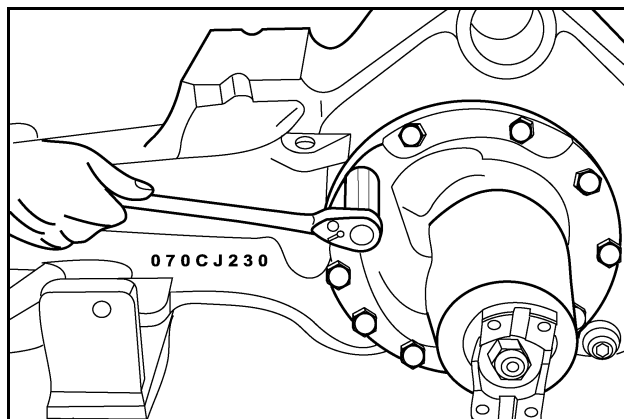
T98567

Apply Loctite 515 Gasket Eliminator to the axle housing mounting flange and around the outside of each bolt hole.

### STEP 82



RR99K241



RR98K057

Install the carrier assembly into the axle housing. Apply Loctite 271 to all bolt threads prior to installation. Install the hose clamp on the lower bolt (1) from where it was removed. Install washers and bolts and tighten to a torque of 135 to 155 Nm (100 to 115 lb. ft.).

### STEP 83

Assemble axle shafts and wheel end components, following procedures shown in axle disassembly information.

### STEP 84

Clean drain plugs and install in carrier housing and planetaries. Fill with the lubricant specified in the operator's manual to the proper levels.

Inspect wheel ends and housing for oil leaks. Take immediate corrective action when oil leaks are detected.



# **Section 25**

## **Chapter 9**

### **LOCKING FWD DIFFERENTIAL**

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## SPECIFICATIONS

Pinion Shaft Rolling Torque (Preload).....	2.26 to 4.52 Nm (20 to 40 lb. inch)
Differential Assembly Rolling Torque (without input seal).....	2.83 to 5.65 Nm (25 to 50 lb. inch)
Differential Ring Gear Backlash	
10 Stud Wheel End Axle .....	0.127 to 0.254 mm (0.005 to 0.010 inch)
12 Stud Wheel End Axle .....	0.127 to 0.203 mm (0.005 to 0.008 inch)

## SPECIAL TORQUES

Differential Adjusting Ring .....	74.6 to 88 Nm (55 to 65 lb. ft.)
Differential Adjusting Ring Clip Bolts .....	27 to 40 Nm (20 to 30 lb. ft.)
Differential Bearing Cap Bolts .....	240 to 270 Nm (180 to 200 lb. ft.)
Differential Front Ring Gear Bolts .....	163 to 190 Nm (120 to 140 lb. ft.)
Differential Housing Bolts .....	122 to 135 Nm (90 to 100 lb. ft.)
Differential Pinion Shaft Nut 10 Bolt .....	325 to 406 Nm (240 to 300 lb. ft.)
Differential Pinion Shaft Nut 12 Bolt .....	460 to 542 Nm (340 to 400 lb. ft.)
Seal Retainer Socket Head Screws .....	4.0 to 4.6 Nm (36 to 40 lb. inch)

## SPECIAL TOOLS

CAS-1898	Pinion Setting Tool Kit	CAS-2596	Yoke Dust Shield Installer
CAS-1898-9	Side Bearing Adjusting Wrench	CAS-1716-3	Handle
CAS-1899	Pinion Shaft Oil Seal Driver	380000808	Differential Locknut Wrench

## REMOVAL OF THE FRONT DIFFERENTIAL CARRIER ASSEMBLY

**NOTE:** Before starting service work, park the tractor on level ground, stop the engine and remove the key. Put blocks in front and behind the rear wheels.

### STEP 1

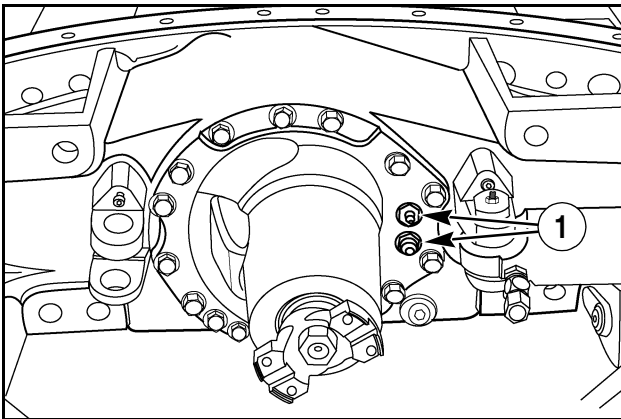
Remove the left hand and right hand axle shafts. (Refer to information in the FWD Planetary Hub, Steering Knuckle and Axle Drive Shaft Section of this Service Manual.)

### STEP 2

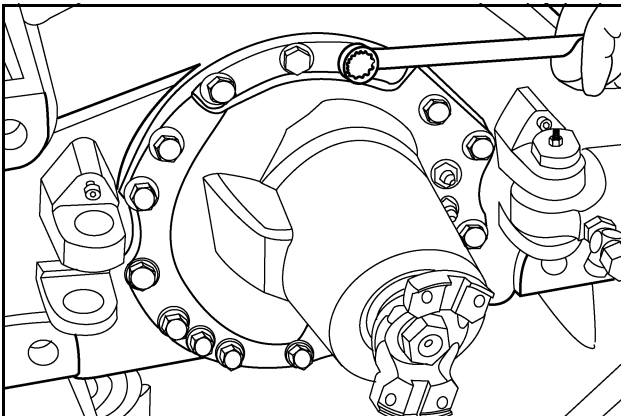
Remove the front axle from the tractor.

**NOTE:** Do not alter the tie rod adjustment.

### STEP 3



RD02K001

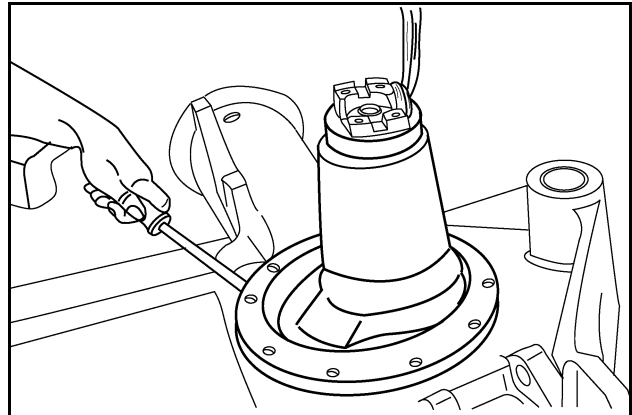


RD02K002

Remove the differential lock supply and return hoses and remove the fittings (1) from the differential carrier.

Remove the bolts and washers that hold the differential carrier to the axle housing (21 mm socket).

### STEP 4



RR98K029

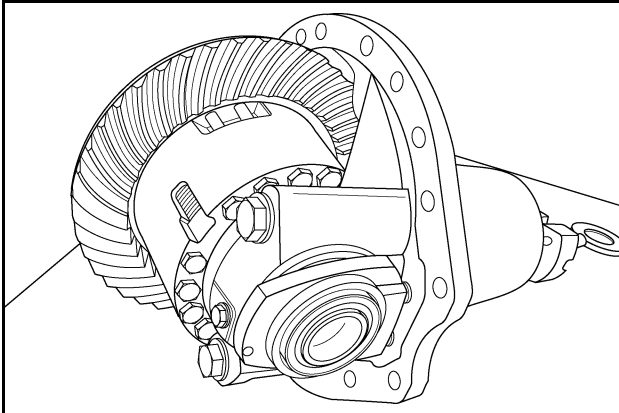
Support the differential carrier with a chain or lift strap and hoist. Carefully pry the differential carrier from the axle housing. When lifting the carrier assembly out of the axle assembly, make certain the carrier does not hit the axle housing.

### STEP 5

Remove the differential carrier from the axle housing and mount it in a suitable holding fixture.

## REMOVAL OF THE FRONT DIFFERENTIAL FROM THE CARRIER HOUSING

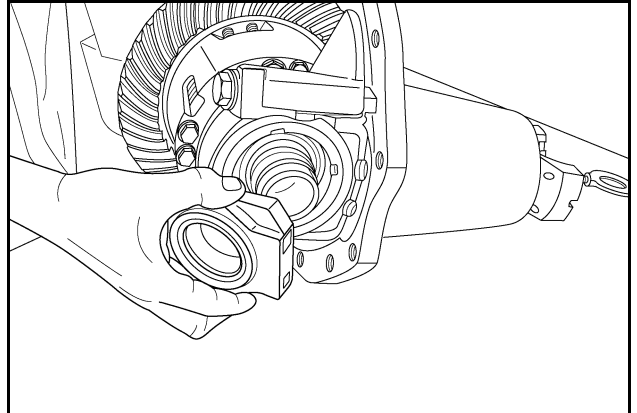
### STEP 6



RD06A137

Place the carrier housing on a clean work surface.

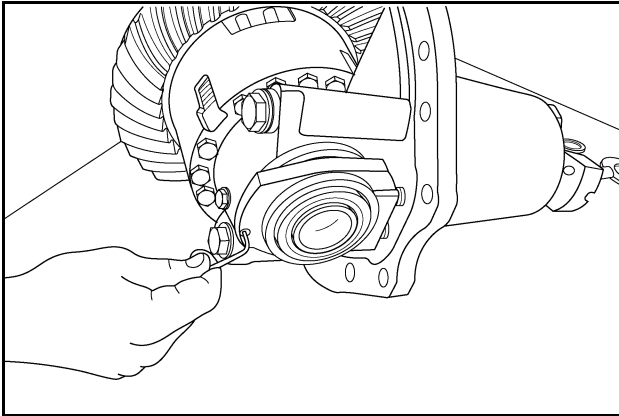
### STEP 9



RD06A140

Remove the seal retainer.

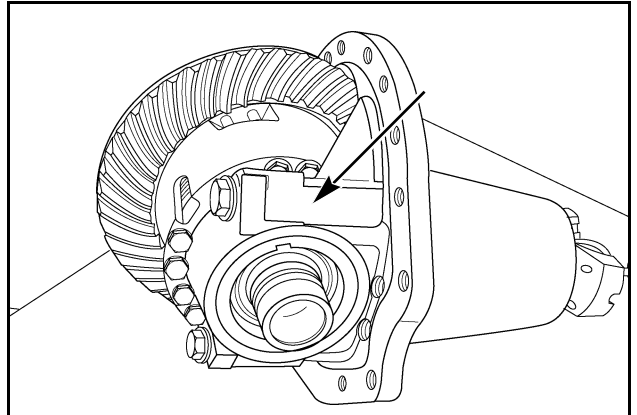
### STEP 7



RD06A138

Remove the three socket head screws from the seal retainer. (3 mm Allen wrench).

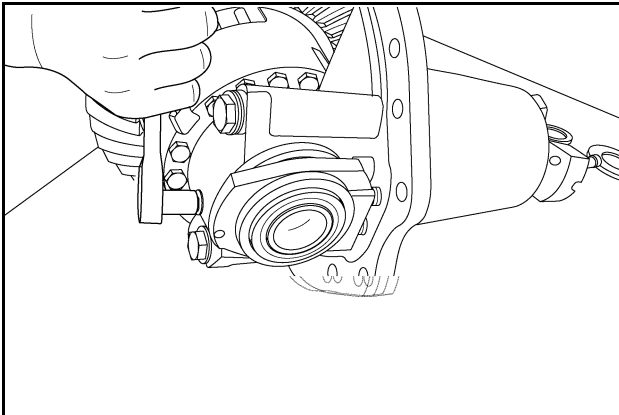
### STEP 10



RD06A141

Mark the bearing cap.

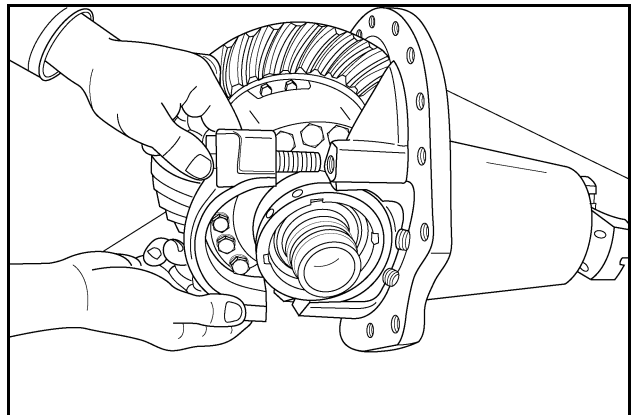
### STEP 8



RD06A139

Remove the bolt and washer locking the adjusting nut in place.

### STEP 11

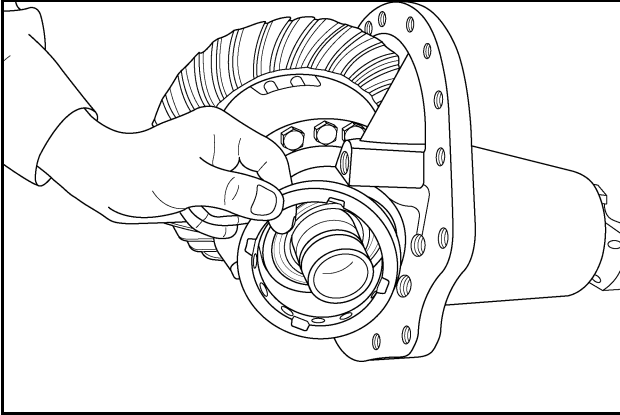


RD06A142

Remove bearing cap retaining bolts and washers then remove bearing cap. (24 mm or 15/16 inch socket).



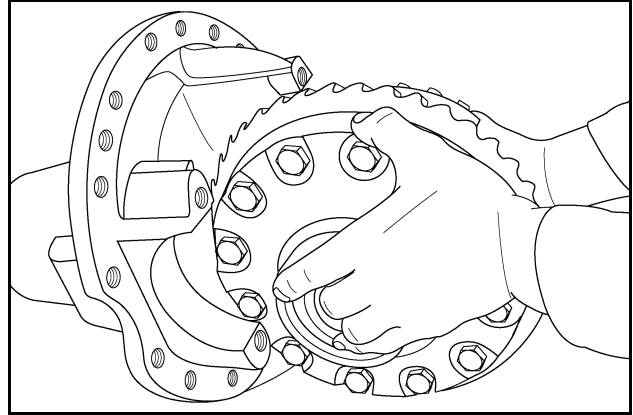
**STEP 12**



RD06A143

Remove the adjusting ring.

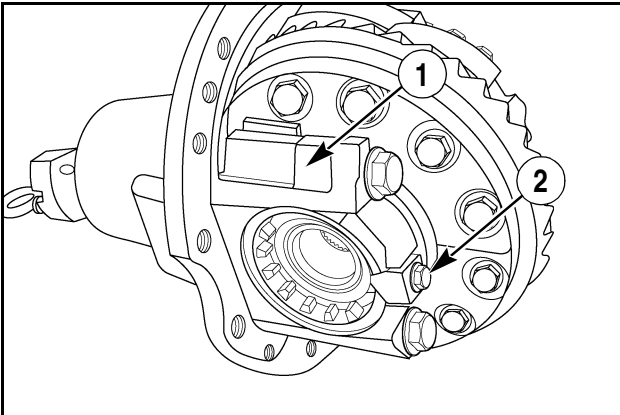
**STEP 15**



RD06A146

Remove the differential from the carrier.

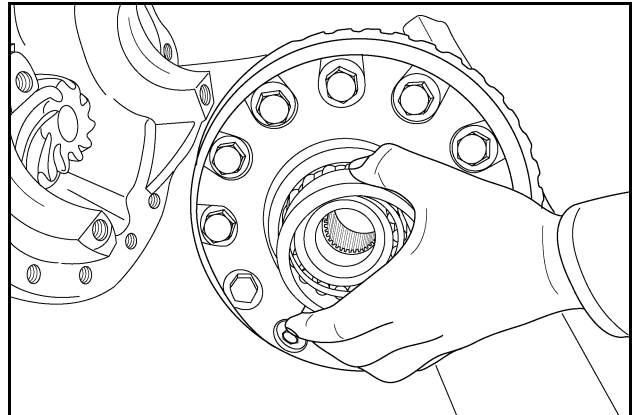
**STEP 13**



RD06A144

Mark the opposite bearing cap (1). Remove the bolt and adjusting ring retaining cup (2).

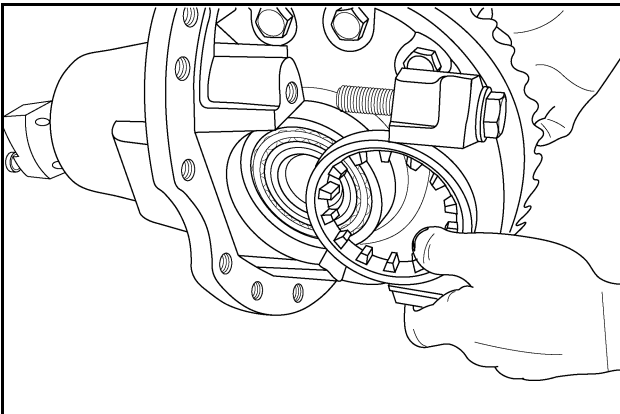
**STEP 16**



RD06A147

Remove the bearing cup. Repeat for the opposite side.

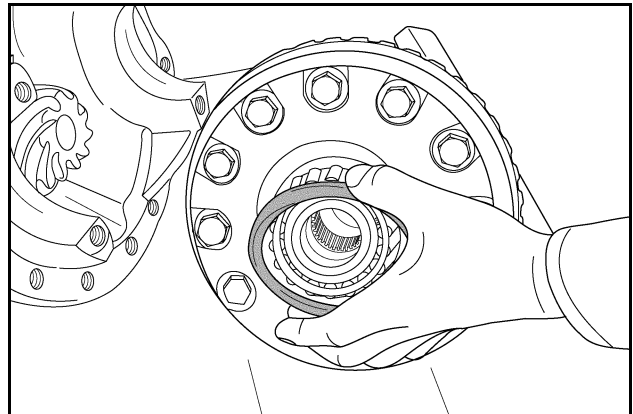
**STEP 14**



RD06A145

Remove the bolts, washers, bearing cap and adjusting ring.

**STEP 17**

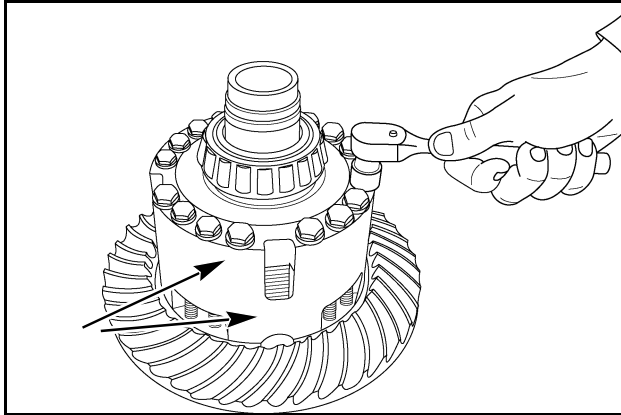


RD06A148

Remove the seal.

## DISASSEMBLY OF THE DIFFERENTIAL

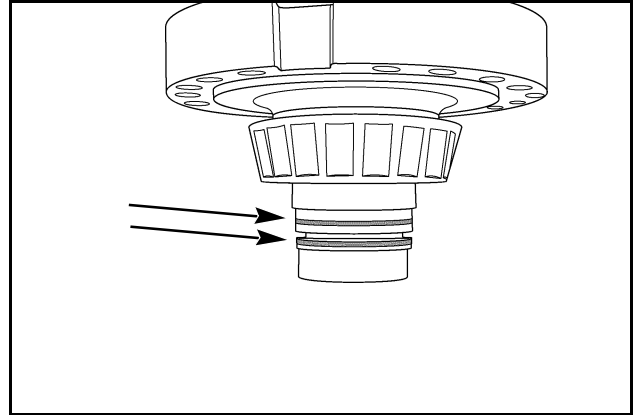
### STEP 18



RD06A149

Mark the housing halves (two places) for reassembly and remove the bolts.

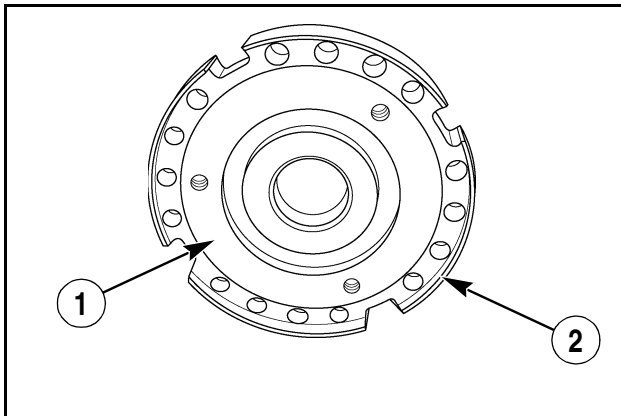
### STEP 21



RD06A153

Remove the seal rings from the shaft.

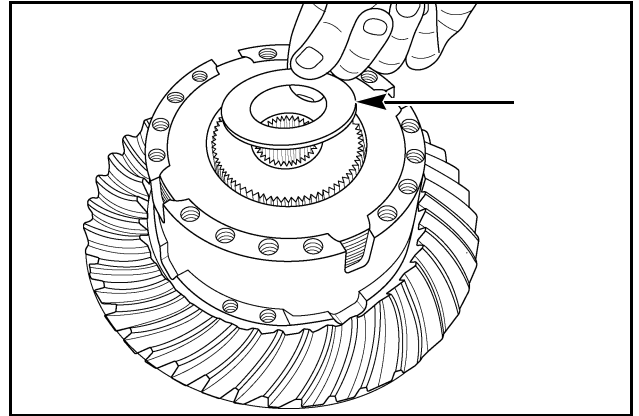
### STEP 19



RD06A151

Remove the piston (1) from the cap half of the case (2).

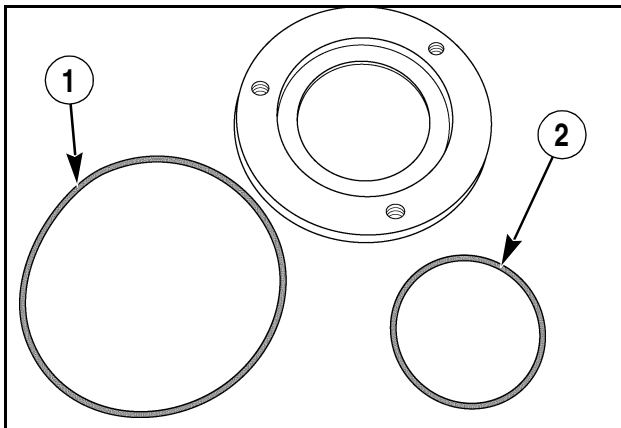
### STEP 22



RD06A154

Remove the thrust washer.

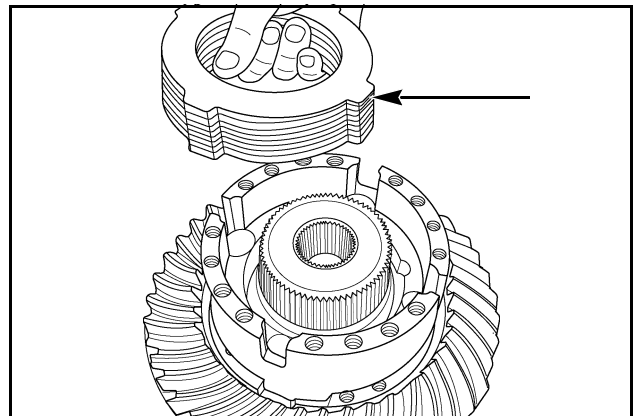
### STEP 20



RD06A152

Remove the outer (1) and inner (2) seal rings from the piston and discard the seals.

### STEP 23

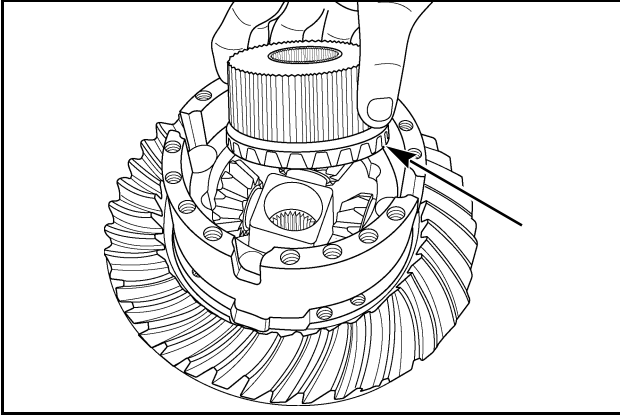


RD06A155

Remove the separator and friction plates.

**NOTE:** Separator and friction plates are replaced as complete assemblies.

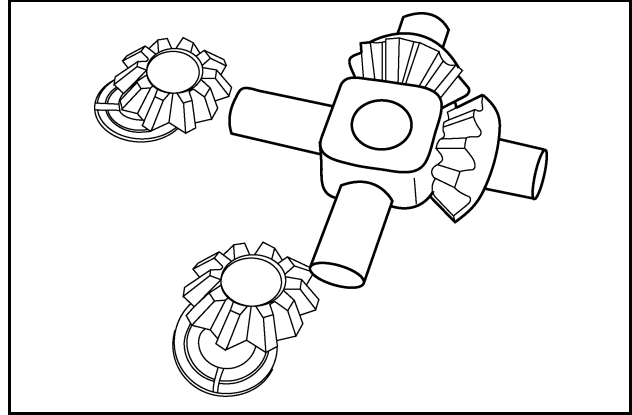
### STEP 24



RD06A156

Remove the differential gear.

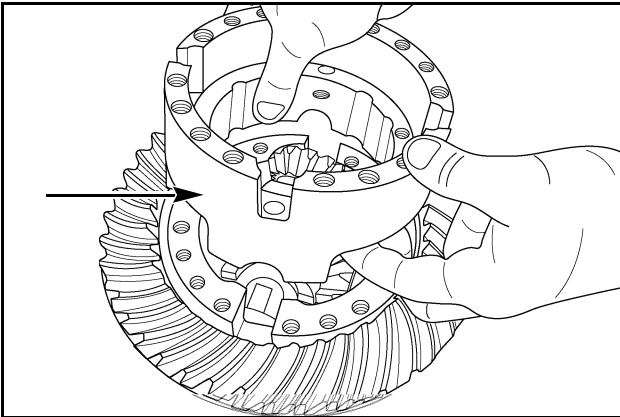
### STEP 27



RR99K236

Separate the pinion mate cross shaft, pinion mate gears and thrust washers.

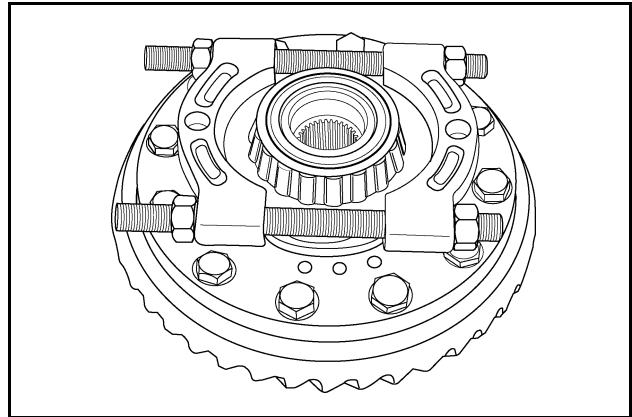
### STEP 25



RD06A157

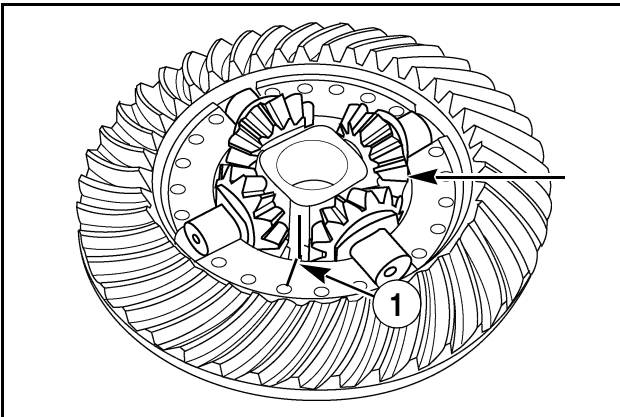
Remove the clutch housing.

### STEP 28



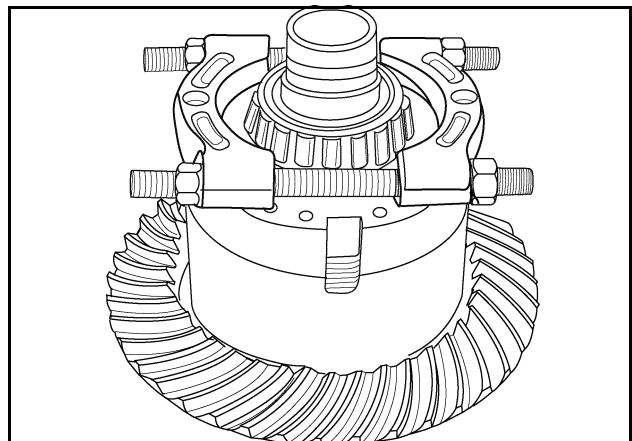
RD02H199

### STEP 26



RD02H196

Remove the pinion mate cross shaft, pinion mates (pinion gears) and thrust washer. Mark the assembly (1) so that it can be reinstalled in the same position during reassembly.

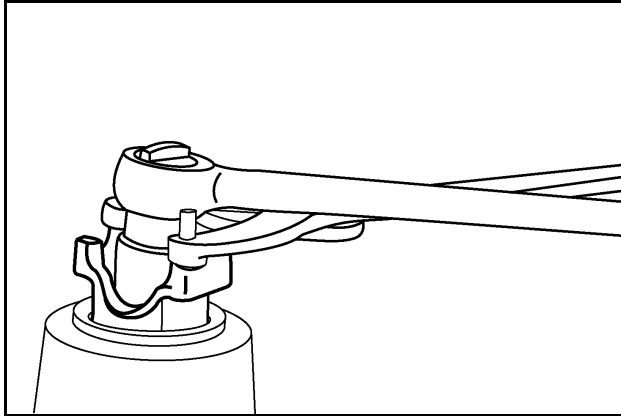


RD02H232

Remove the bearing cone from the flange half case and cap half case if replacement is required.

## PINION DISASSEMBLY

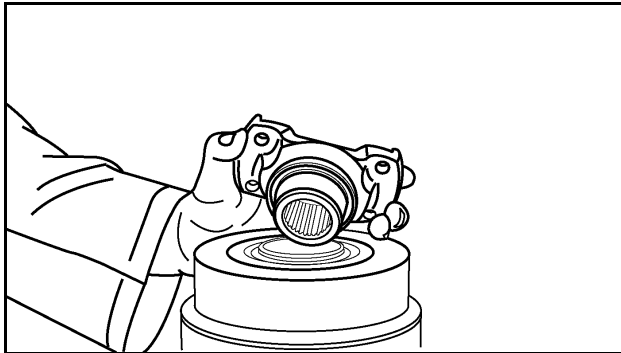
### STEP 29



RR98K021

Hold end yoke or flange with tool similar to the one shown, and remove nut and washer. Discard nut as new one must be used at reassembly. (1-5/16 inch socket).

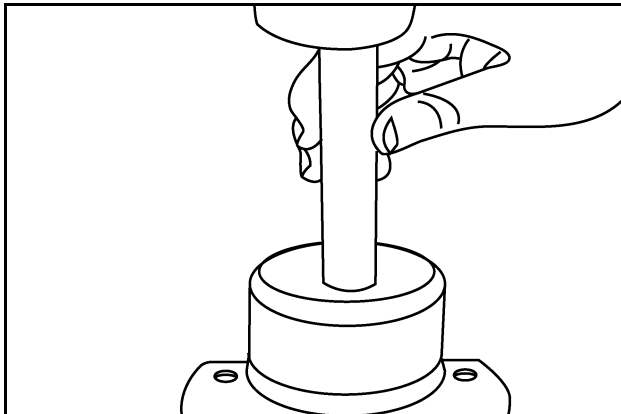
### STEP 30



T98483

Remove end yoke. If yoke or flange shows wear in the seal contact area, it should be replaced.

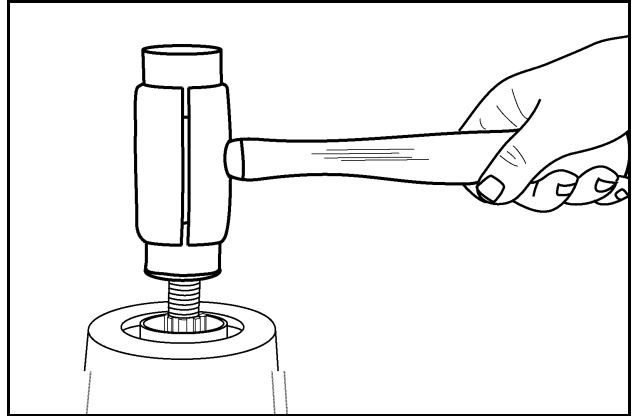
### STEP 31



RR98K012

If a new yoke dust shield is required, use CAS-2596 Yoke Dust Shield Installer with CAS-1716-3 Handle.

### STEP 32



RR98K019

Remove the pinion by tapping with a rawhide hammer. Support the pinion to prevent it from falling and being damaged.



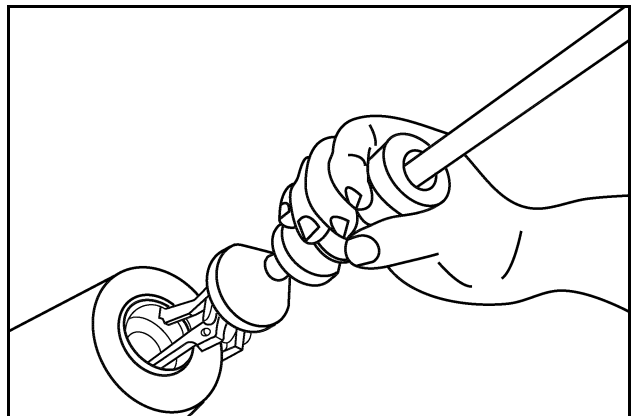
**WARNING:** Gear teeth may have sharp edges. When handling gear, use care to avoid personal injury.

M687

**NOTE:** On the spline end of the pinion, there are bearing preload shims. These shims may stick to the bearing, pinion or even fall out. The shims are to be collected and kept together since they will be used later in reassembly. Do not damage the shims. If the shims are damaged, replace with new ones: shims are available in thicknesses of 0.003 inch, 0.005 inch, 0.010 inch and 0.030 inch.

**NOTE:** If ring gear and/or pinion shaft needs to be replaced, ring gear and pinion shaft must be replaced as matched set.

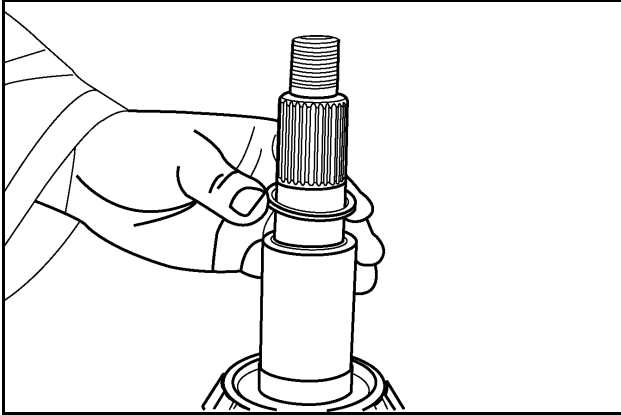
### STEP 33



RR98K020

Remove the pinion seal with a puller as shown. DISCARD SEAL. Replace with new seal during reassembly. Also, remove bearing cone and outer pinion oil slinger.

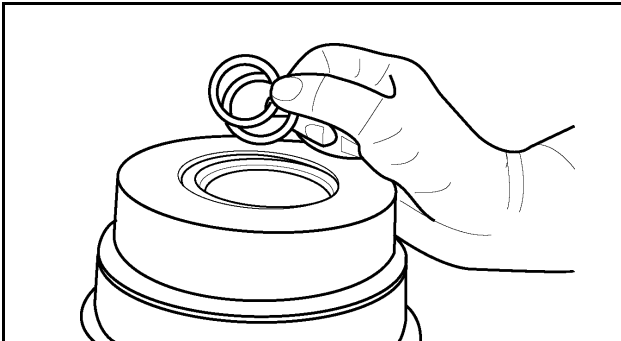
### STEP 34



T98492

Remove the spacer (ten bolt only) from the pinion shaft as shown.

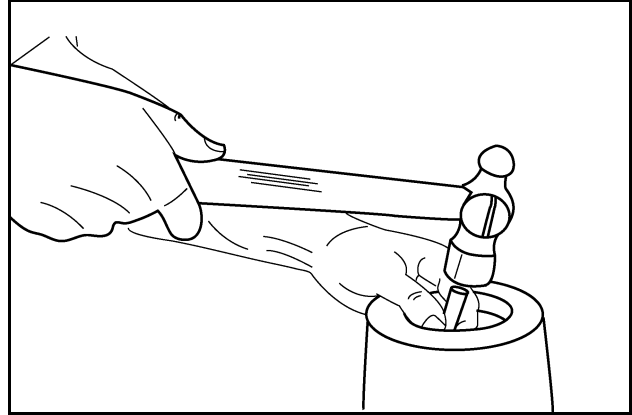
### STEP 35



T98490

Remove pinion adjustment shims from the pinion shaft.

### STEP 36

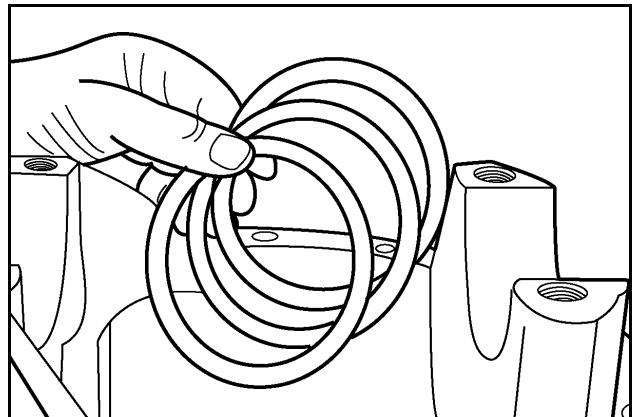


RR98K039

Remove the inner bearing cup.

**NOTE:** *Shims are located between the bearing cup and carrier bore. If shims are bent or nicked, they should be replaced at time of assembly. Wire the stacks together and measure each. If a stack is replaced, replace with the same thickness.*

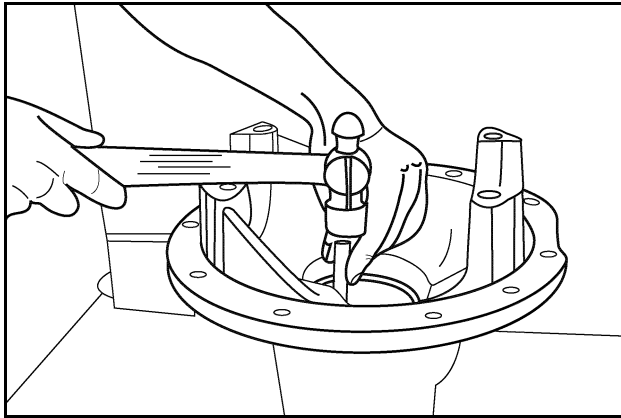
### STEP 37



T98491

Remove inner bearing adjustment shims.

### STEP 38

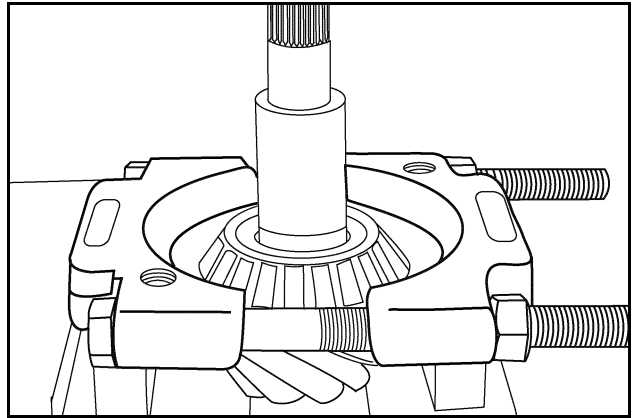


RR98K040

Turn nose of carrier down. Remove outer pinion bearing cup as shown. Locate driver on back edge cup; drive cup out of carrier if necessary.

**NOTE:** Do not damage the carrier bore.

### STEP 39



RR98K036

Install a split collet and press the bearing cone off of the pinion shaft.

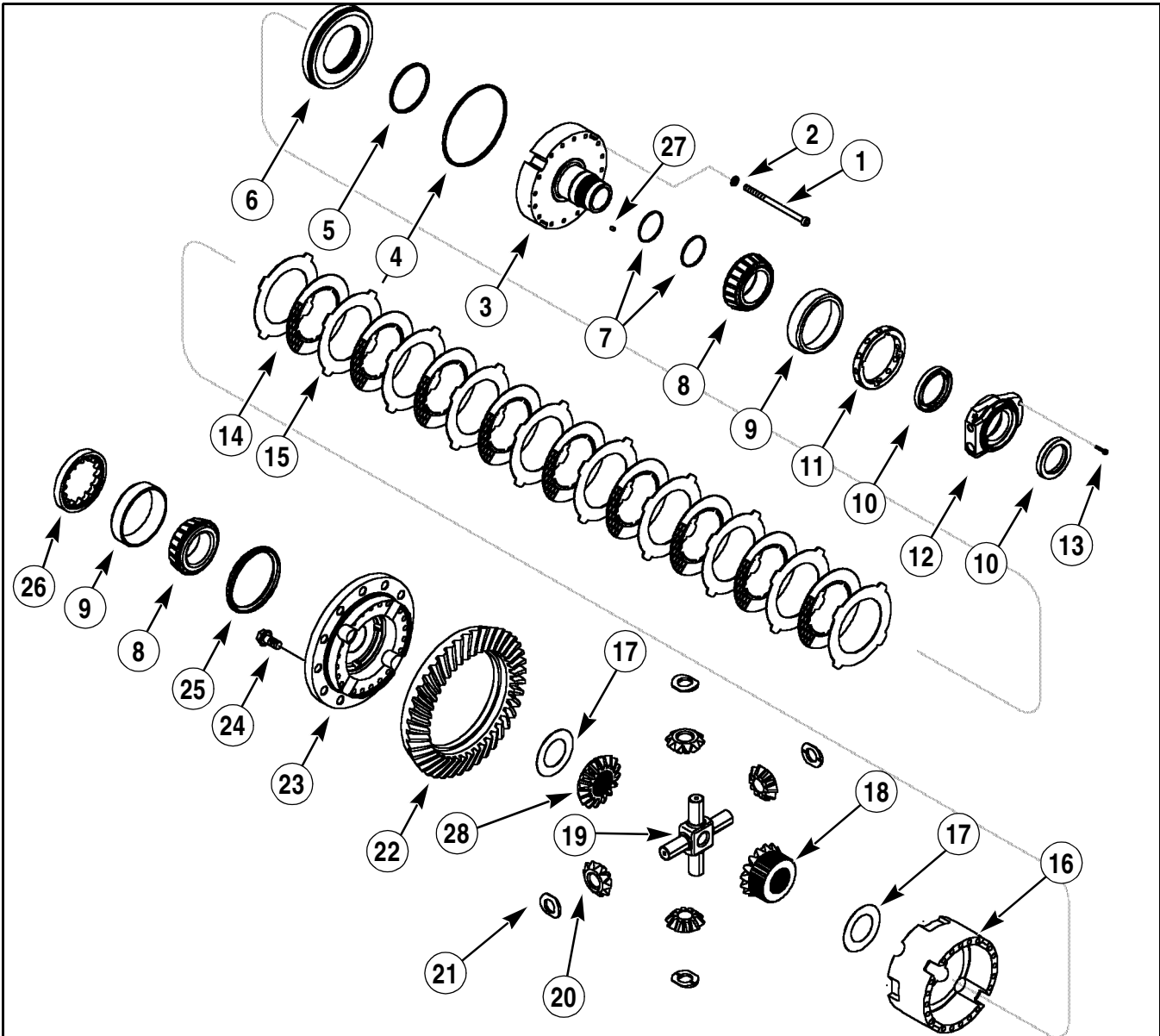


**WARNING:** Do not allow the shaft to fall. It can strike legs or feet and may cause serious injury. Gear teeth may have sharp edges. Use care when handling to avoid injury.M688

**NOTE:** It is recommended that whenever bearings are removed, they are to be replaced with new ones (regardless of hours).

**NOTE:** If replacement of a damaged bearing cup or cone is necessary, the cup and cone must be replaced as a set.

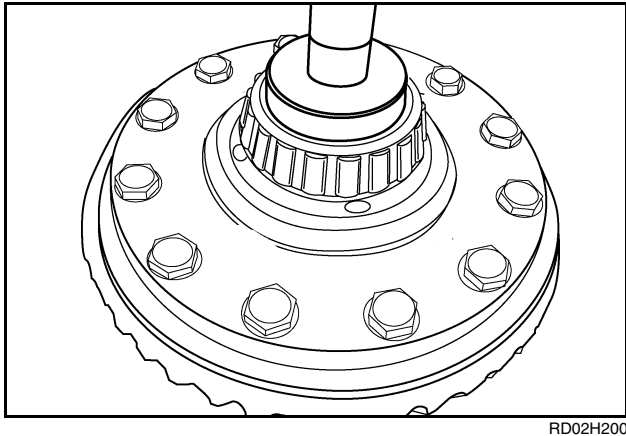
## ASSEMBLY OF THE DIFFERENTIAL



R106A036

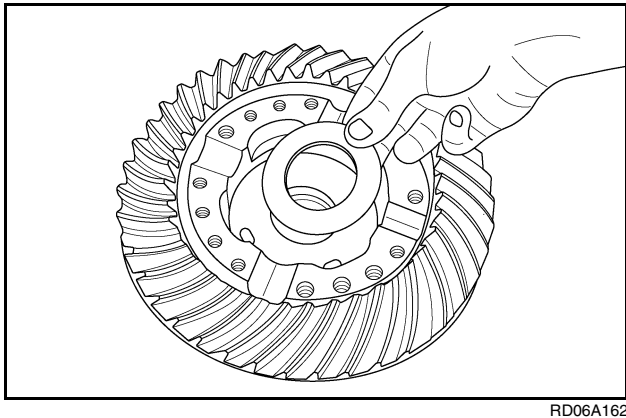
- |                    |                        |                         |
|--------------------|------------------------|-------------------------|
| 1. BOLT            | 10. SEAL               | 19. DIFF. CROSS SHAFT   |
| 2. WASHER          | 11. ADJUSTING NUT      | 20. DIFFERENTIAL PINION |
| 3. CASE, CAP HALF  | 12. SEAL RETAINER      | 21. DIFF. THRUSTWASHER  |
| 4. OUTER SEAL RING | 13. SOCKER HEAD SCREW  | 22. GEAR                |
| 5. INNER SEAL RING | 14. SEPERATOR PLATE    | 23. CASE, FLANGE HALF   |
| 6. PISTON          | 15. FRICTION PLATE     | 24. BOLT                |
| 7. SEAL            | 16. CLUTCH HOUSING     | 25. SEAL                |
| 8. BEARING CONE    | 17. THRUST WASHER      | 26. ADJUSTING RING      |
| 9. BEARING CUP     | 18. DIFFEERENTIAL GEAR | 27. PLUG                |
|                    |                        | 28. SIDE GEAR           |

### STEP 36



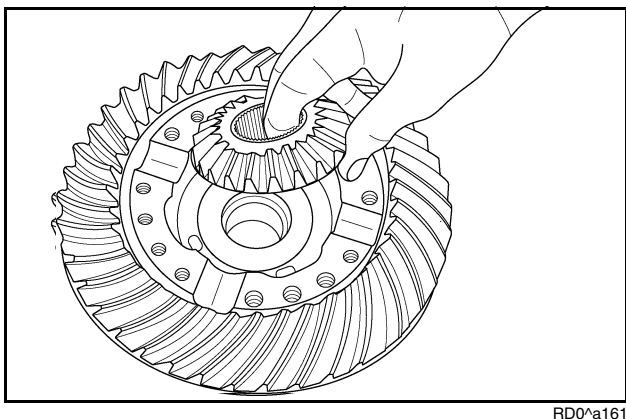
Press bearing cone on each trunnion of each differential case half (if they were removed).

### STEP 37



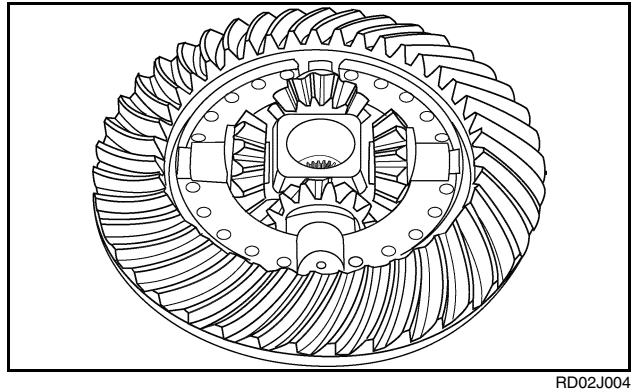
Install the thrust washer into the flange half case.

### STEP 38



Apply grease to the shoulder of the side gear, then install side gear into the flange half case.

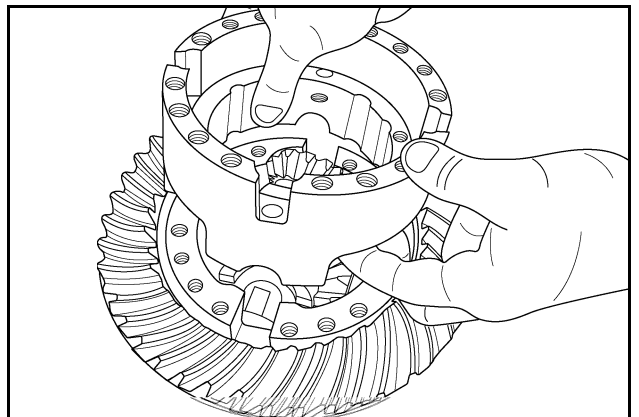
### STEP 39



Lubricate the pinion mate gear ID's. Install the pinion mate gears, thrust washers and cross shaft into the flange half case.

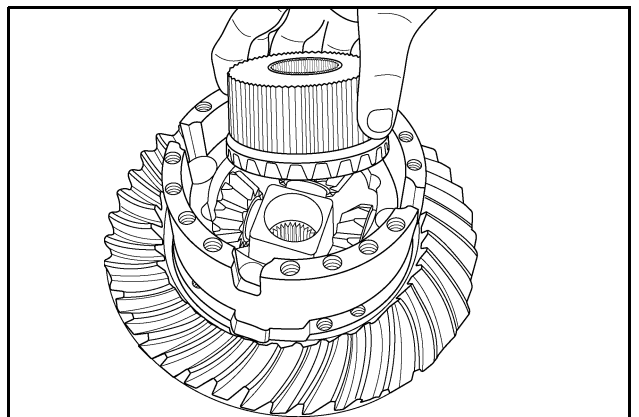
**NOTE:** Make sure the cross shaft is installed in the same order as disassembly. Refer to the alignment marks.

### STEP 40



Refer to the alignment marks. Place the clutch housing onto the flange half case.

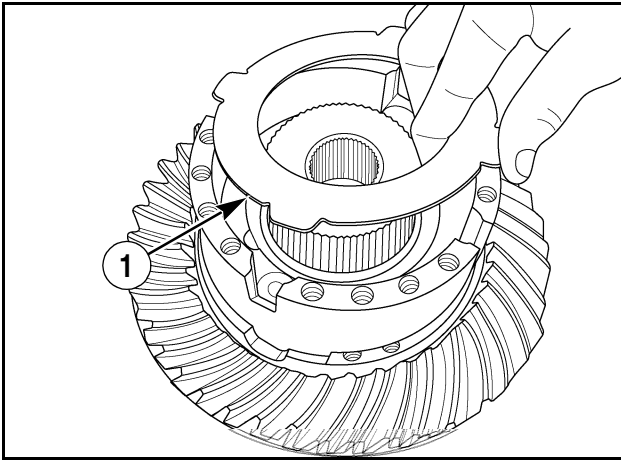
### STEP 41



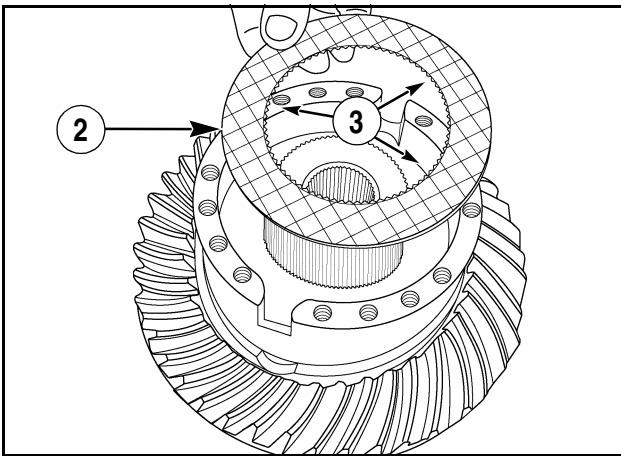
Install the splined differential side gear.



## STEP 42



RD06A163



RD06A164

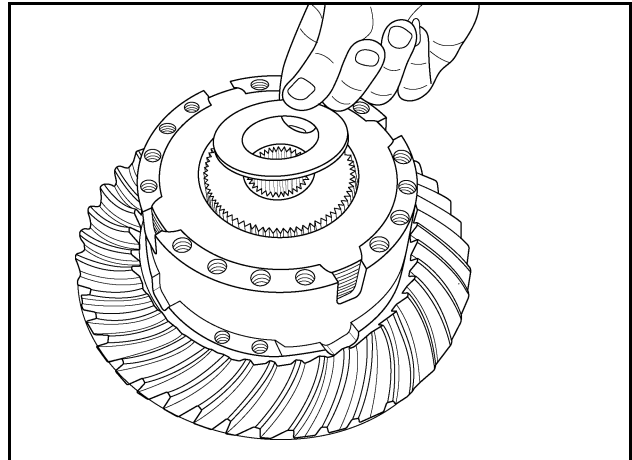
Starting with a separator plate (1), alternate with a friction plate (2) until all plates are installed. There are ten separator plates and nine friction plates.

Apply friction modifier (B91246) to all the disc and plate friction surfaces.

**NOTE:** If reinstalling, make sure the discs and plates are kept in the same order as disassembly.

**IMPORTANT:** When installing the friction plates, make sure the gaps (3) in the teeth are all aligned.

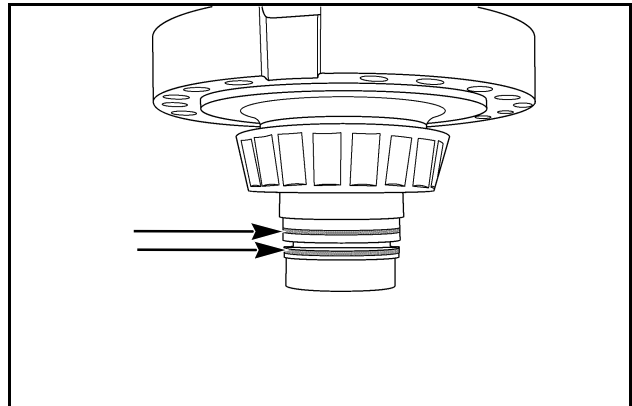
## STEP 43



RD05A154

Install the thrust washer.

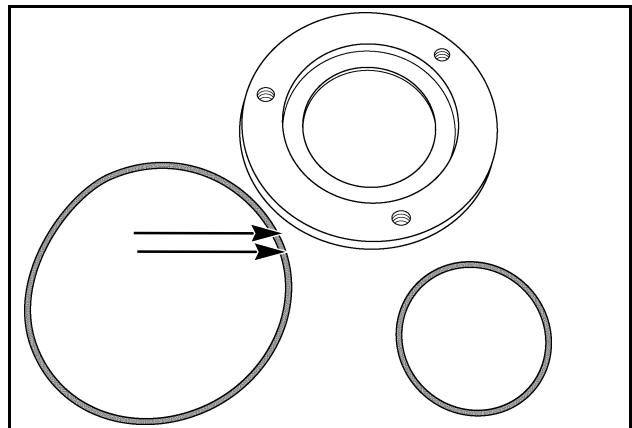
## STEP 44



RD06A153

Install new seal rings.

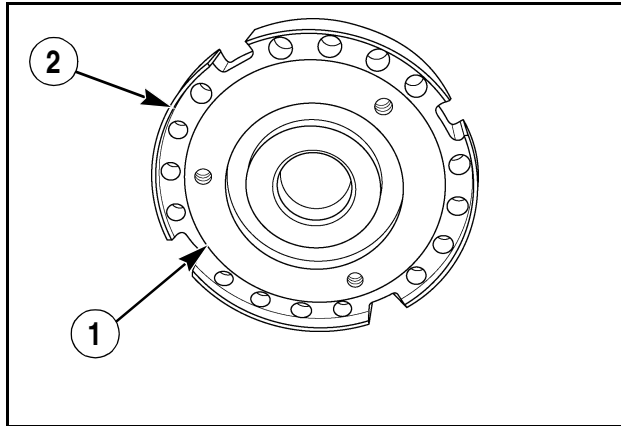
## STEP 45



RD06A152

Lubricate with petroleum jelly and install new seal rings on the piston.

### STEP 46

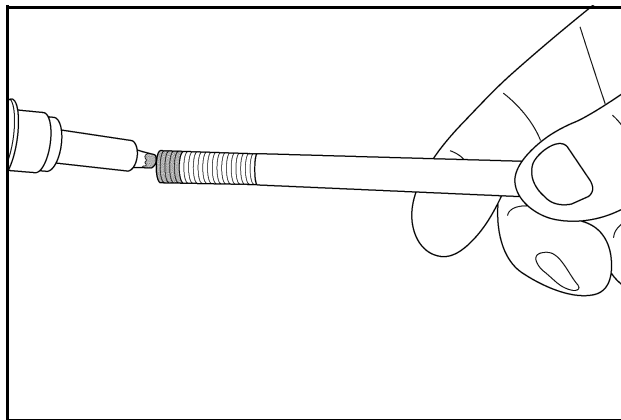


RD06A151

Install the piston (1) into the cap half of the case (2).

**NOTE:** Use care when installing the piston to avoid damaging the seal rings.

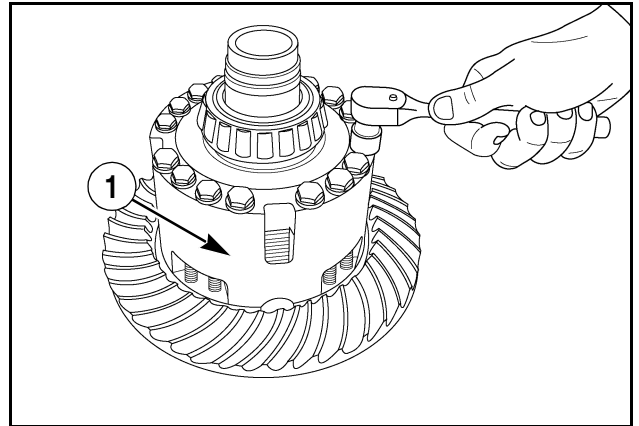
### STEP 47



RD06A165

Clean the mounting bolts and install Loctite® 242 to the threads.

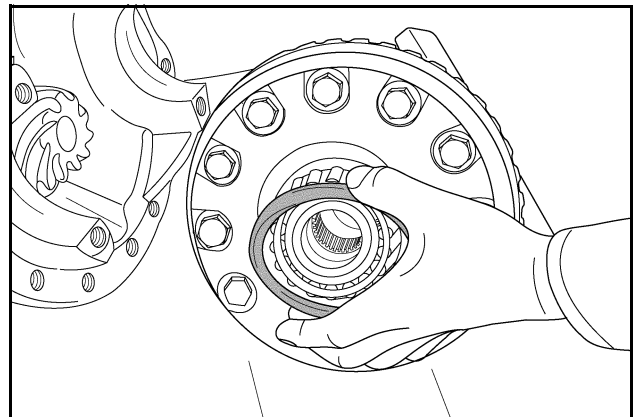
### STEP 48



RD06H149

Align the assembly marks (1), place the flange half on the clutch carrier, install the mounting bolts and torque to 60 to 65 Nm (44 to 48 lb. ft.).

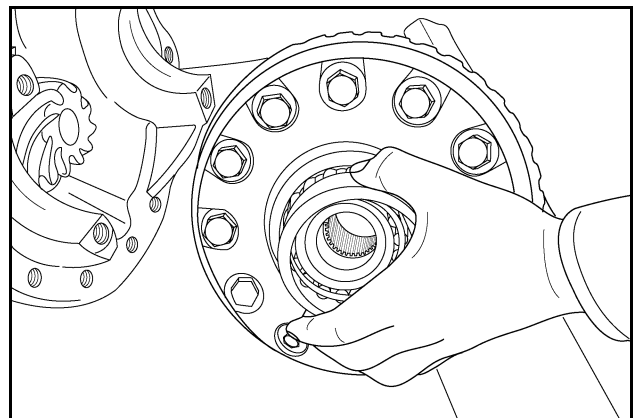
### STEP 49



RD06A148

Install a new seal.

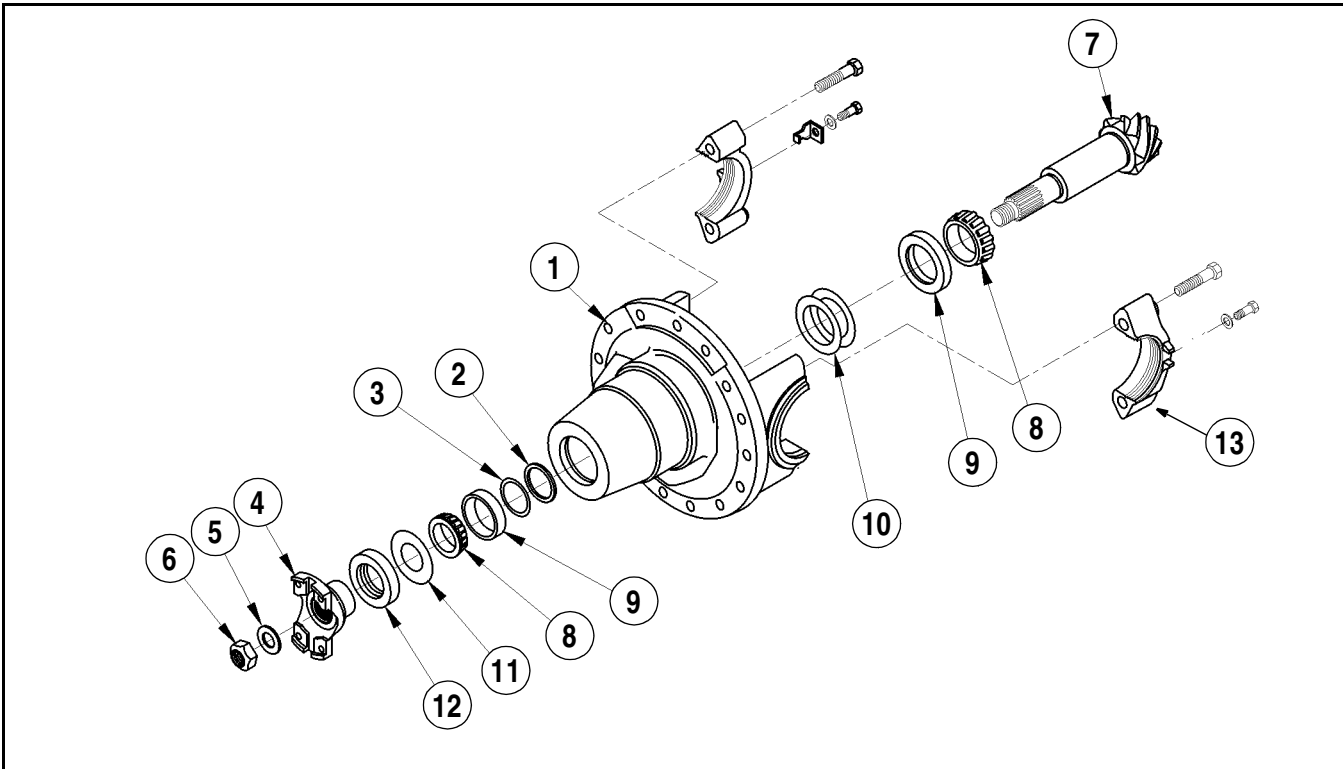
### STEP 50



RD06A147

Install the bearing cup.

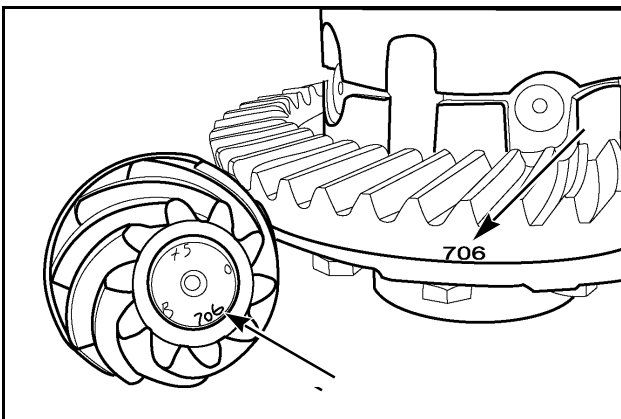
## DIFFERENTIAL CARRIER ASSEMBLY



- |                                    |               |                 |                                 |
|------------------------------------|---------------|-----------------|---------------------------------|
| 1. DIFFERENTIAL CARRIER            | 4. INPUT YOKE | 7. PINION SHAFT | 10. PINION SHAFT POSITION SHIMS |
| 2. SPACER (10 BOLT ONLY)           | 5. WASHER     | 8. BEARING CONE | 11. OIL BAFFLE                  |
| 3. PINION BEARING ADJUSTMENT SHIMS | 6. NUT        | 9. BEARING CUP  | 12. OIL SEAL                    |
|                                    |               |                 | 13. BEARING CAP                 |

### Pinion Position and Assembly

#### STEP 47



**NOTE:** On the pinion there is etched either a zero (0), or plus (+) or minus (-) number. This indicates the best running position for each gear set. The dimension is set by shimming behind the inner pinion bearing cup.

Verify that the numbers on the ring gear and pinion gears match. Use the following chart as a guide when determining shim pack thickness and setting pinion distance.

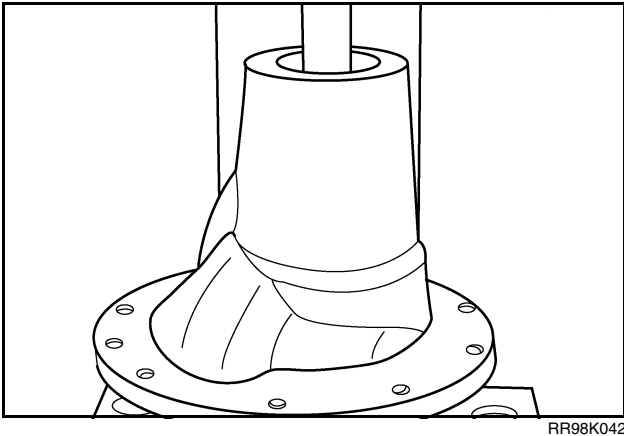
## Shim Pack Thickness Chart

Old Pinion Marking	New Pinion Marking								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

Shim Thickness To Add Or Remove

## SETTING THE PINION DEPTH

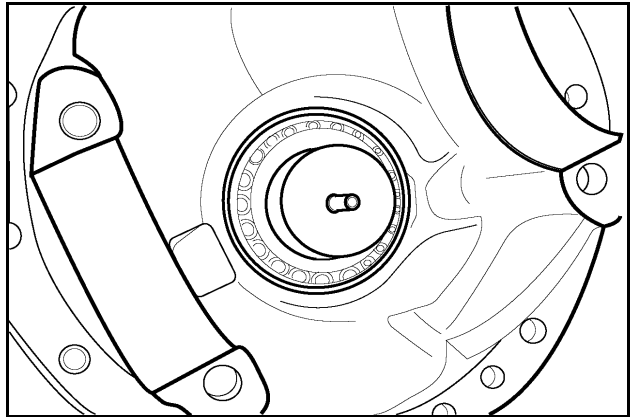
### STEP 48



RR98K042

Install the outer bearing cup.

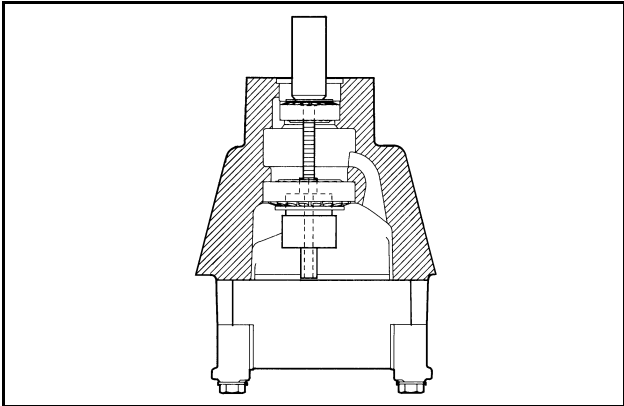
### STEP 51



T98517

Install Aligning Disc CAS-1898-5 and the Gauge Disc CAS-1898-3.

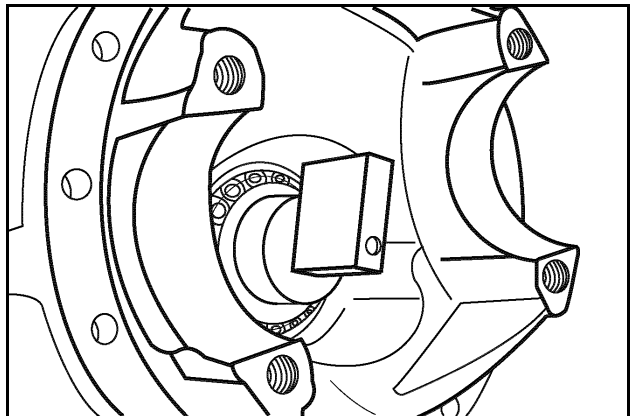
### STEP 49



RB99C113

The pinion depth setting tool, CAS-1898, must be assembled into the differential as shown above. Follow Steps 50 through 54 to assemble tool to differential housing.

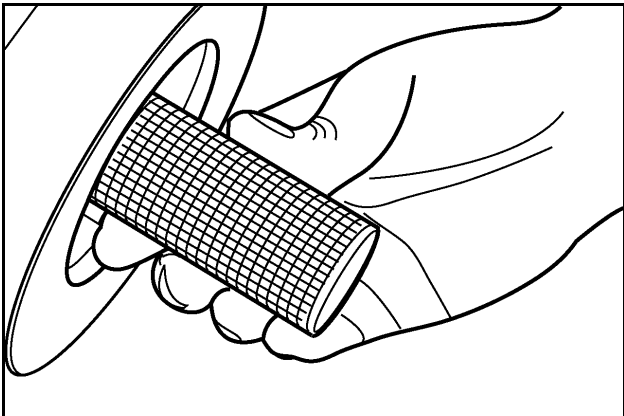
### STEP 52



T98518

Install Gauge Block CAS-1898-4 and finger tighten to hold the gauge assembly and bearing cones in position.

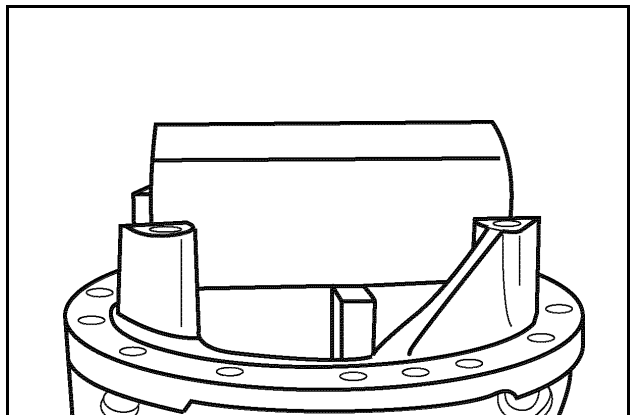
### STEP 50



T98516

Install the Handle CAS-1898-1 and Threaded Shaft CAS-1898-2 into the carrier housing.

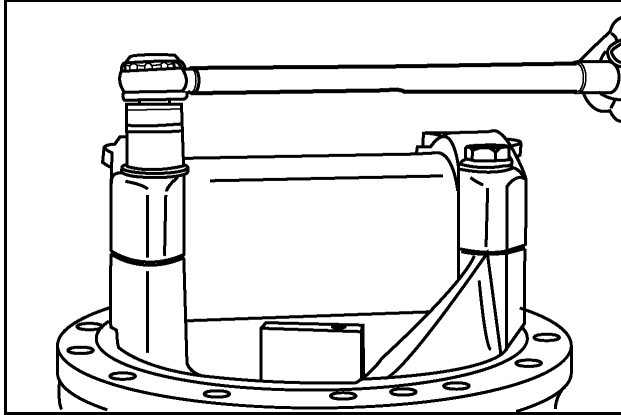
### STEP 53



T98519

Install the Tube CAS-1898-6.

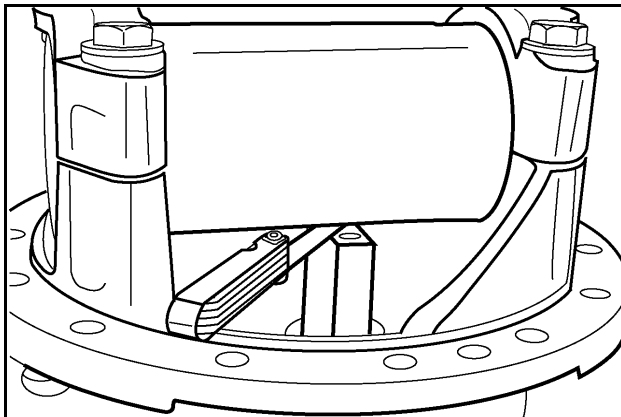
### STEP 54



T98522

Install the bearing caps and cap bolts. Tighten the bolts to a torque of 244 to 271 Nm (180 to 200 lb. ft.) (Use a 24 mm socket).

### STEP 55



T98523

Position Gauge Block CAS-1898-4 under Tube CAS-1898-6. Use a feeler gauge and measure the distance between the tube and the block. This dimension is the shim thickness needed, provided the pinion shaft has not "+" or "-" marking on the button end.

### STEP 56

If the pinion shaft has a "+" marking, subtract the amount shown from the measurement taken in Step 55. The remainder is your shim pack thickness.

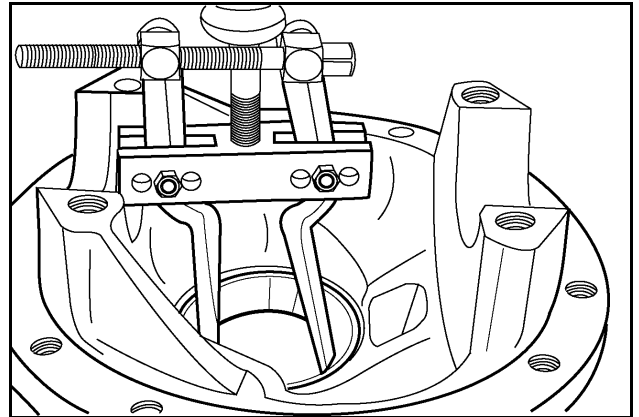
If the pinion shaft has a "-" marking, add the amount shown to the measurement taken in Step 55. The sum will be your shim pack thickness.

**NOTE:** The "+" and "-" markings on the pinion shaft are given in thousandths of an inch. Shims are available in thicknesses of 0.076 mm (0.003 inch), 0.127 mm (0.005 inch), 0.25 mm (0.010 inch). Acceptable tolerance is 0.050 mm (+/-0.002 inch) of number etched on pinion shaft (total shim calculation).

### STEP 57

Remove the depth setting tool CAS-1898 from the carrier housing.

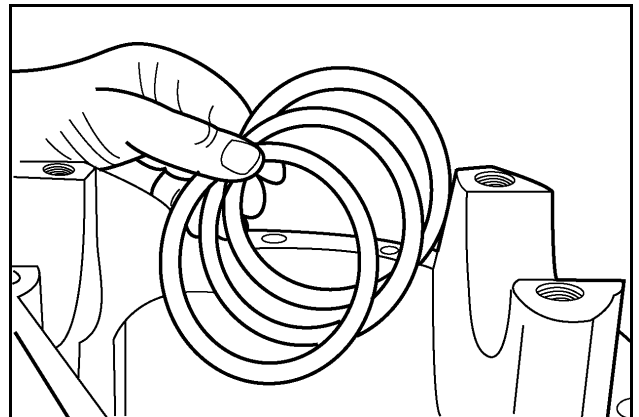
### STEP 58



T98489

If necessary to adjust pinion position, remove the inner bearing cup.

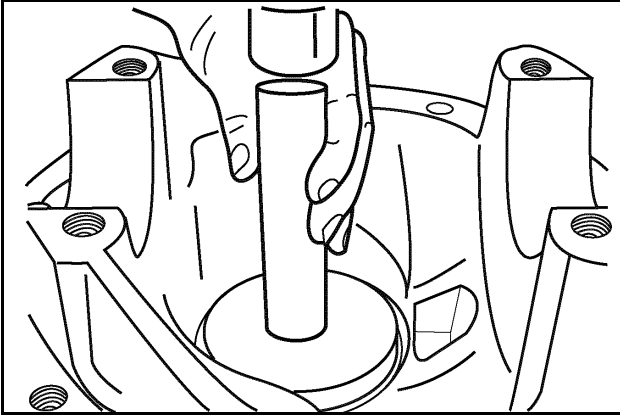
### STEP 59



T98491

Install the proper amount of shims.

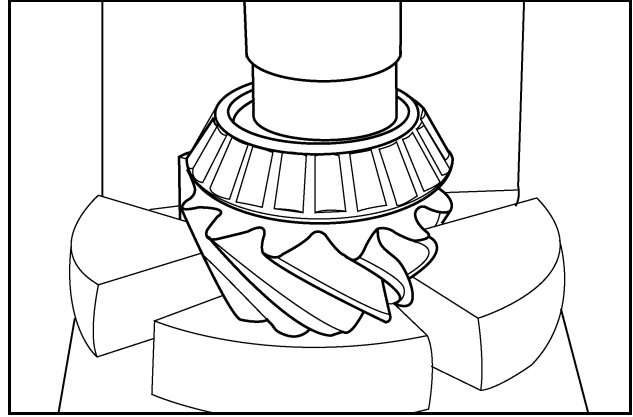
**STEP 60**



T98513

Install the inner bearing cup.

**STEP 61**

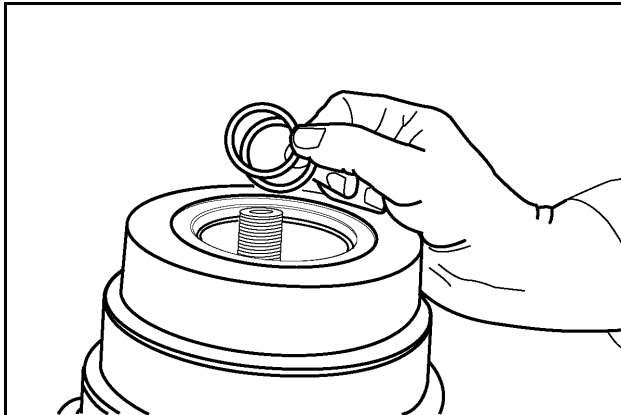


RR98K037

Assemble inner bearing cone on pinion. Drive bearing onto pinion using suitable press.

## ADJUSTING BEARING PRELOAD

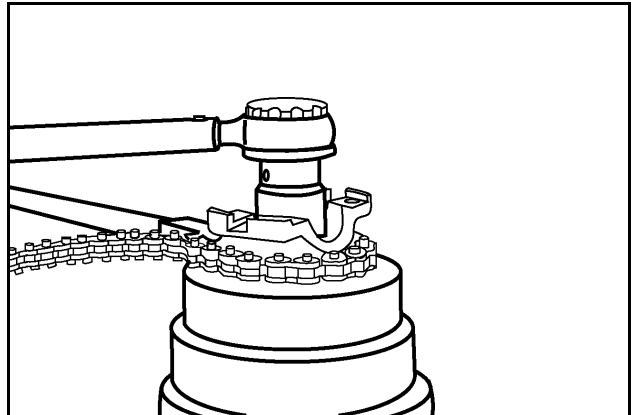
### STEP 62



T98610

Install the pinion into the carrier. Install a shim pack of 0.070 inch on the pinion shaft.

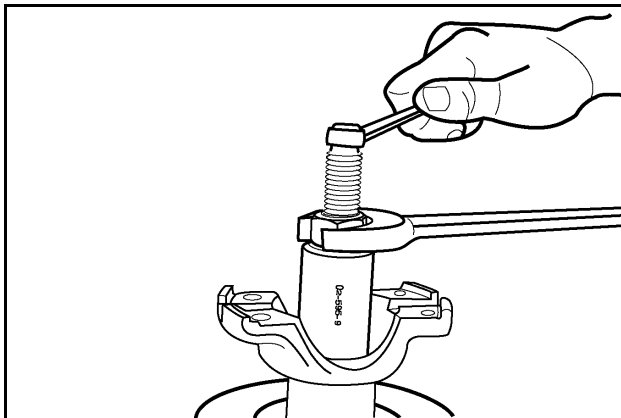
### STEP 64



T98530

Torque the pinion nut to 326 to 406 Nm (240 to 300 lb. ft.) (1-5/16 inch socket).

### STEP 63

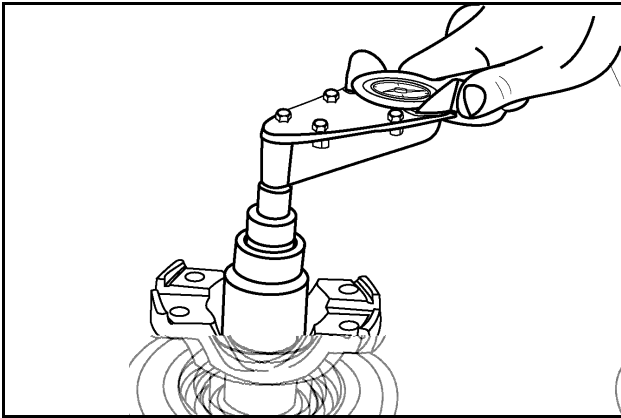


T98528

Use the Companion Flange Installer CAS-1898-8 to push the yoke onto the shaft.



## STEP 65



T98531

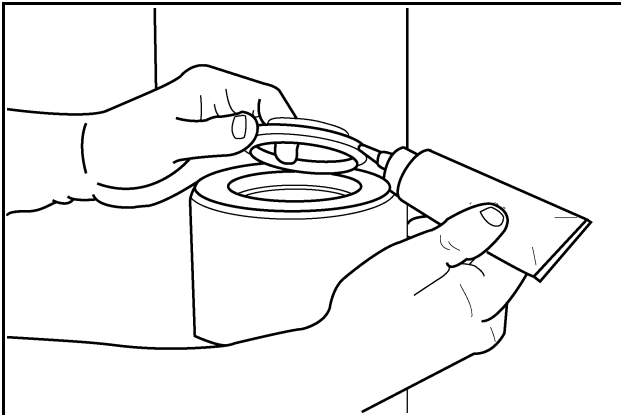
Using an inch pound torque wrench, measure the rolling torque needed to turn the pinion shaft. The torque must be 2.26 to 4.5 Nm (20 to 40 lb, inch). If the torque is correct continue to Step 66. If torque is not correct, do the following:

**NOTE:** Typically a change of 0.001 inch will change rolling torque 15 lb. inch.

1. **To increase the torque** adjust the 0.070 inch shim pack to remove a small amount of thickness. For example, replace a 0.015 inch shim with a 0.014 inch shim. Repeat torque check procedure.
2. **To decrease the torque** adjust the shim pack to add a small amount of thickness. For example, replace a 0.014 inch shim with a 0.015 inch shim. Repeat torque check procedure.

**NOTE:** Shim kits contain the following size shims: 0.010 inch, 0.014 inch, 0.015 inch, 0.016 inch, 0.018 inch, 0.020 inch, 0.021 inch, 0.022 inch, 0.023 inch and 0.030 inch.

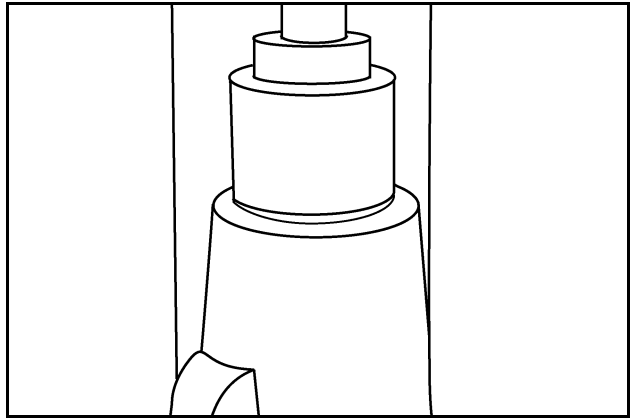
## STEP 66



RR98K043

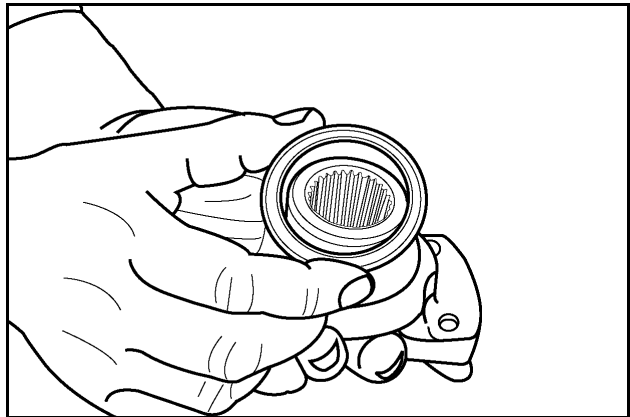
Remove nut and end yoke. Apply Permatex® D to the housing face and to the outer diameter of oil seal.

## STEP 67



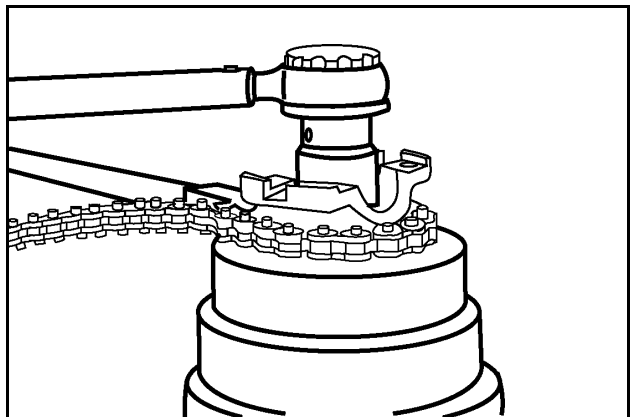
RR98K044

Use the Pinion Seal Installer CAS-1899 to install a new pinion shaft oil seal. Install the seal with the lip towards the pinion shaft.



T98534

Use tool CAS-2596 and install a new dust shield (slinger) on the input yoke. Make sure sealing surface for oil seal is in good condition.

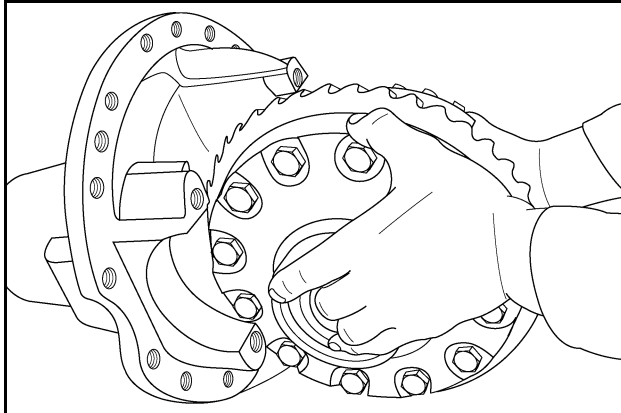


T98530

Tighten the pinion nut to a torque of 326 to 406 Nm (240 to 300 lb. ft.) (1-5/16 inch socket).

## DIFFERENTIAL INSTALLATION

### STEP 68

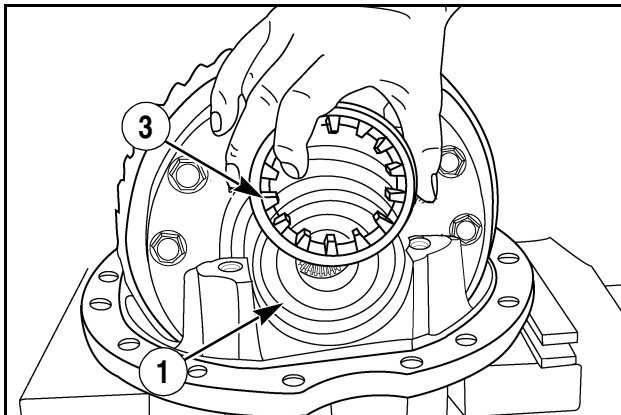


RD06A146

Install ring gear and differential assembly with bearing cups into carrier housing.

**IMPORTANT:** Care should be used when installing ring gear and differential into carrier housing so damage to ring gear, pinion bearings, or bearing bore does not occur.

### STEP 69



RD02J018

1. BEARING CUP

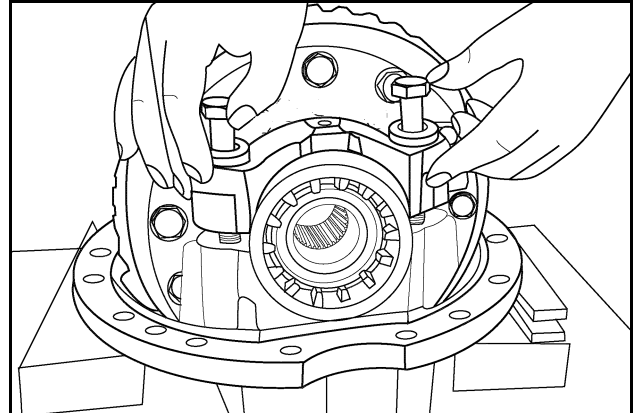
2. ADJUSTING RING

Install adjusting rings in place. Thread in adjusting rings until all slack is removed between bearing cups and bearings.

**NOTE:** Adjusting rings must be installed with side of nut having the deeper recess facing the bearing. Installed opposite, the adjusting ring would clamp against the bearing cage restricting movement.

**NOTE:** Right hand adjusting ring shown.

### STEP 70

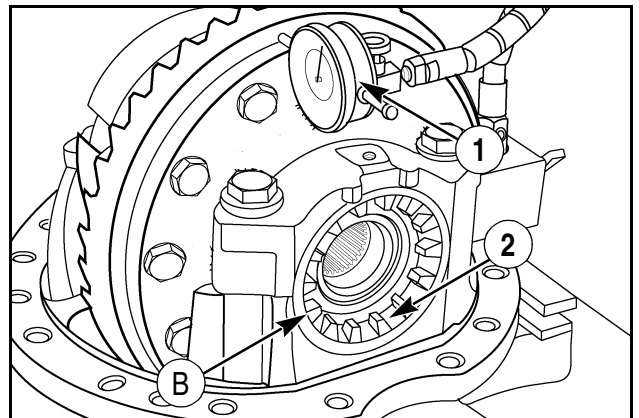


RD02J019

Be sure bearing cups are seated on bearing cones, then install differential bearing caps. Install bearing cap bolts (finger tight only) so adjusting nut can still be turned. (Do not torque cap bolts to specifications).

**NOTE:** Make sure the "match marked" bearing cap and "match marked" leg of the carrier are aligned.

### STEP 71



RD02J020

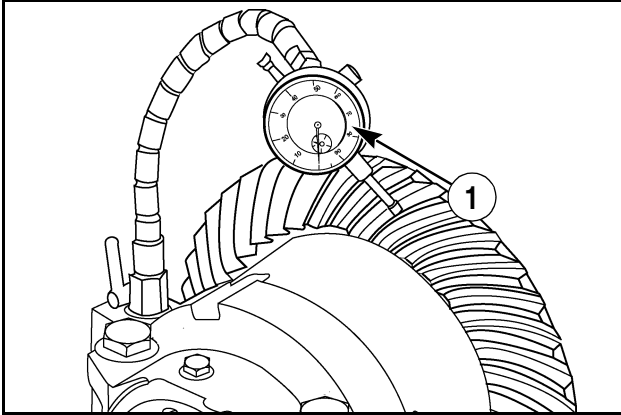
1. DIAL INDICATOR

2. ADJUSTING RING

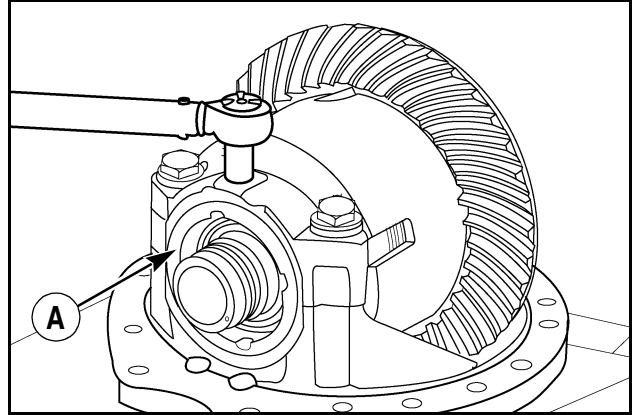
Position a dial indicator on the housing lip and index indicator dial to back face of the ring gear. Zero the indicator.

Mesh ring gear and pinion to zero backlash by loosening adjusting nut (A) (not shown) and tightening adjusting nut (B). (Ring gear is moved into mesh with pinion).

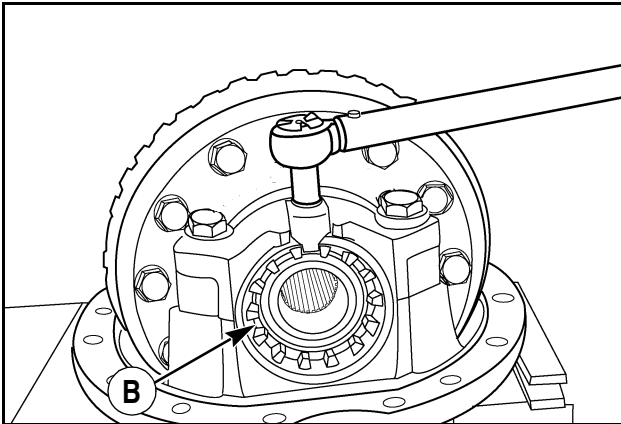
# STEP 72



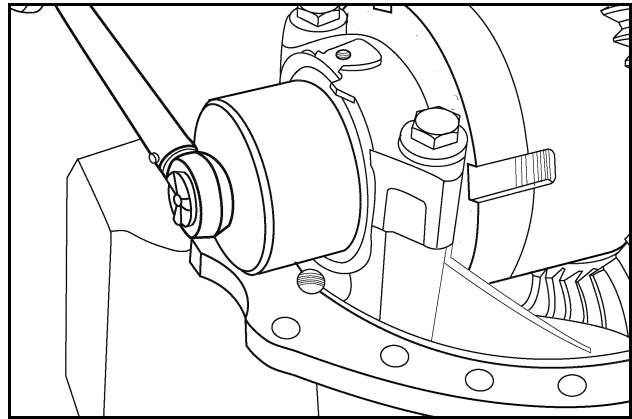
RD02J023



RD02J024



RD02J025



RD02J116

Position dial indicator (1) on lip of differential housing and indicate to side of one tooth on ring gear.

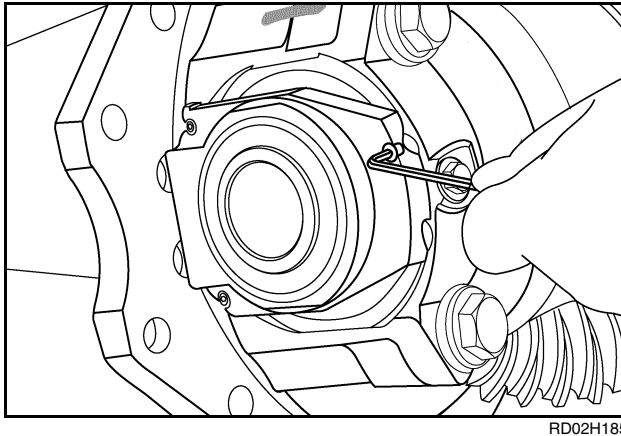
Loosen adjusting nut (B) until backlash is approximately 0.127 mm (0.005 inch). Continue loosening adjusting nut (B) until adjusting ring cap bolt, washer and clip can be installed. Torque bolt to 27 to 40 Nm (20 to 30 lb. ft.). Tighten all of the bearing cap bolts to a torque of 240 to 270 Nm (180 to 200 lb. ft.).

Tighten adjusting nut (A) to a torque of 75 to 88 Nm (55 to 65 lb. ft.) (with the differential locknut wrench tool). Which will result in a bearing preload of 1.13 to 2.26 Nm (10 to 20 lb. inch). (When measured through the pinion will read 2.5 to 5 lb. inch more than the original pinion torque setting).

Install the bolt and washer for adjusting nut (A) and torque to 27 to 40 Nm (20 to 30 lb. ft.). Advance to next hole if required.

Final backlash to be 0.076 to 0.3 mm (0.003 to 0.012 inch) (0.127 to 0.2 mm[0.005 to 0.008 inch] preferred).

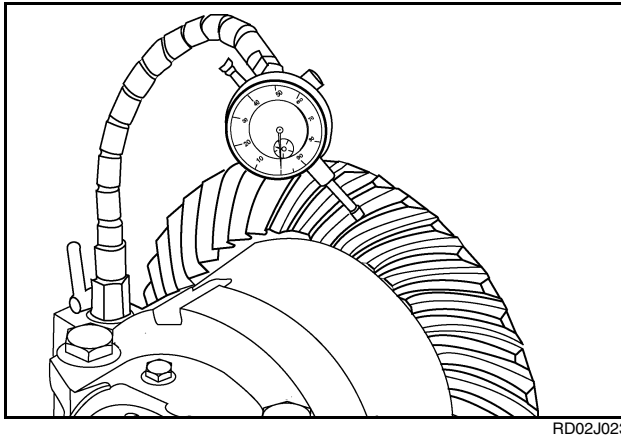
### STEP 73



Install the seal retainer and retain with the three socket head screws. Torque the screws to 4.0 to 4.5 Nm (36 to 40 lb. inch).

## Checking Backlash

### STEP 74



Position dial indicator on lip of differential housing and indicate to side of one tooth on ring gear.

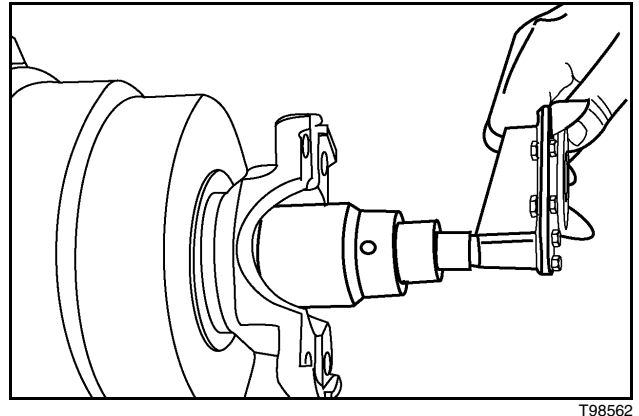
Move ring gear as far as it will go in one direction before it moves the pinion.

"0" the dial on the indicator face.

Move the ring gear in the opposite direction until it contacts the pinion gear and observe the dial face. The reading should be 0.127 to 0.254 mm (0.005 to 0.010 inch) (for 10 stud wheel end axle), or 0.127 mm to 0.203 mm (0.005 to 0.008 inch) (for 12 stud wheel end axle). Check the backlash at three different locations around the gear. There should be no more than 0.06 mm (0.003 inch) variation between readings.

A reading larger than 0.008 to 0.010 inch is corrected by moving ring gear closer to pinion. A reading smaller than 0.005 inch is corrected by moving the ring gear away from the pinion. Move the ring gear by loosening on adjusting ring and then tightening the opposite adjusting ring the same amount. Both adjusting rings must be moved the same amount.

### STEP 75



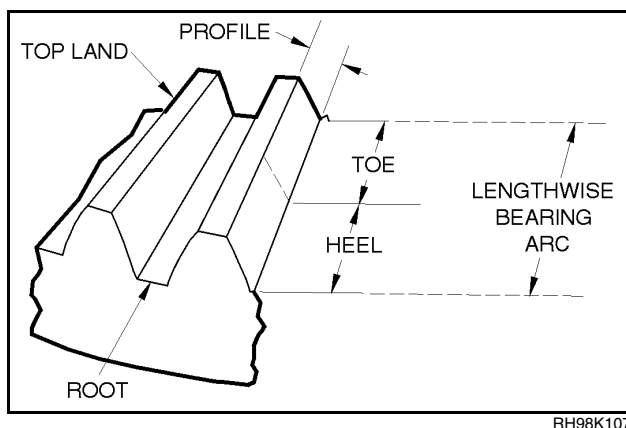
When backlash is adjusted properly, rotating torque at the pinion shaft should be 2.5 to 5 lb. inch higher than the torque you had when setting pinion shaft bearing preload.

## Ring Gear and Pinion Tooth Pattern Interpretation

When setting the pinion position, many of the service manuals required a final pinion position check by using gauges that verify the dimension from the center line to the differential carrier (center line of the ring gear) to the face of the pinion (button).

This surface (button) is not used on all new gears for verifying the pinion position. The service tools will be used to establish the proper amount of shims required prior to installing the pinion gear. The final pinion position will be verified by using the GEAR CONTACT PATTERN METHOD, as described here.

### Ring Gear and Pinion Tooth Contact Pattern

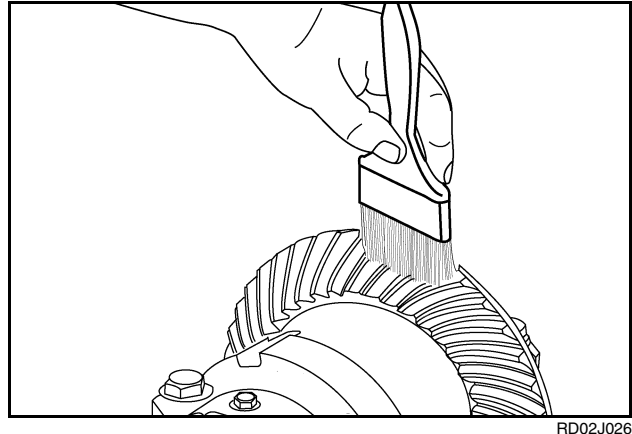


The toe of the gear tooth is the portion of the tooth surface at the end towards the center. The heel of the gear tooth is the portion of the tooth surface at the outer end. The top land of a gear tooth is the surface of the top of the tooth. Every gear has a characteristic pattern. The illustrations show typical patterns only, and explains how patterns shift as gear location is changed. When making pinion position changes, shims should be changed in the range of 0.05 mm (0.002 inch) to 0.10 mm (0.004 inch) until correct pattern has been obtained.

When a change in backlash is required, backlash should be changed approximately 1-1/2 times the amount needed to bring the gears into specification. For example, if the backlash needed to be changed by 0.10 mm (0.004 inch), the adjusting rings should be moved so that the backlash changes by 0.15 mm (0.006 inch) as a starting point. The actual amount of backlash change obtained will vary depending upon the ratio and gear size once everything is tightened to specification.

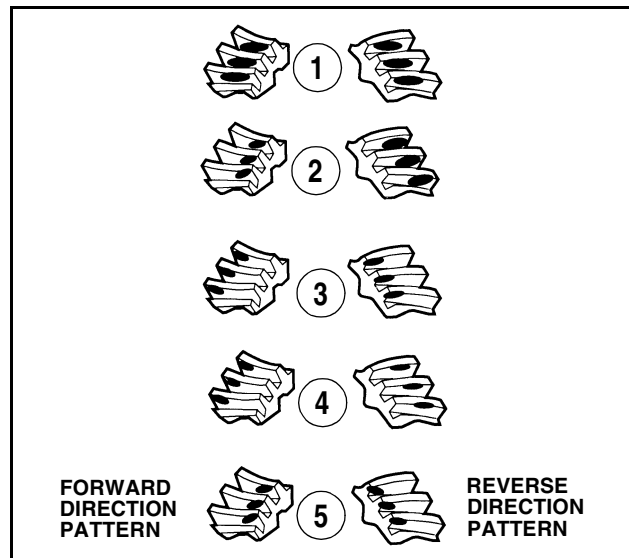
High backlash is corrected by moving the ring gear closer to the pinion. Low backlash is corrected by moving the ring gear away from the pinion.

1. Paint the ring gear teeth with a marking compound to both the forward and reverse side.



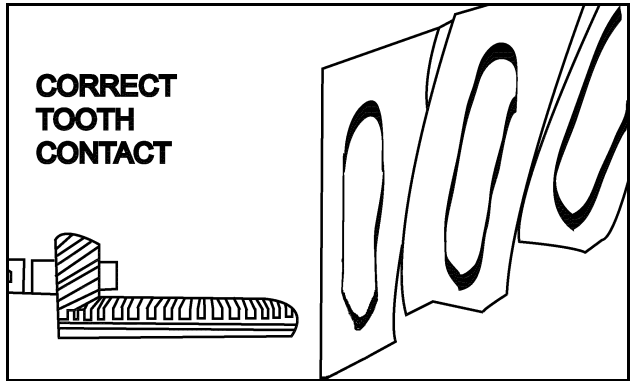
2. Rotate the ring gear one complete revolution in both directions.

### Pattern Interpretation (Ring Gear)



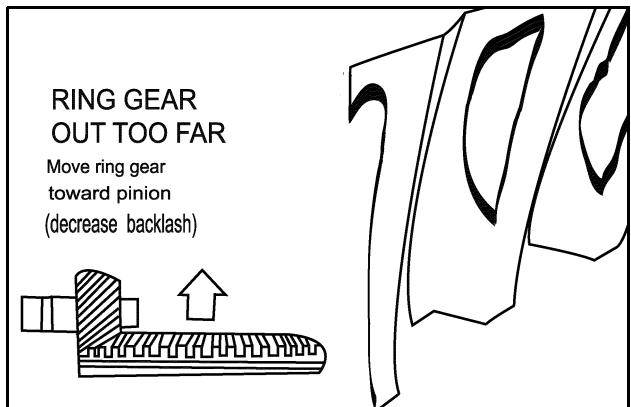
1. Normal or desirable pattern. The forward pattern should be centered on the tooth, but slightly toward the toe. There should be some clearance between the pattern and the top of the tooth.
2. Backlash correct. Thinner pinion bearing cup position shim required.
3. Backlash correct. Thicker pinion bearing cup position shim required.
4. Pinion position shim correct. Decrease backlash.
5. Pinion position shim correct. Increase backlash.

## Pattern Movements Summarized



RR98K050

EXAMPLE OF CORRECT PATTERN

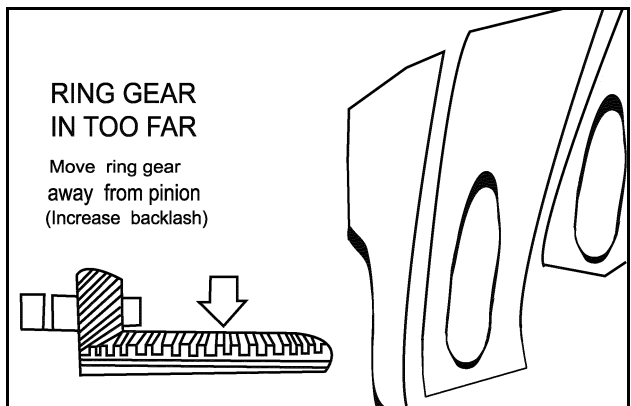


RR98K056

1. Decreasing backlash moves the ring gear closer to the pinion.

Forward Pattern (convex side of ring gear) moves lower and towards the toe.

Reverse Pattern (concave side of ring gear) moves lower and towards the toe.

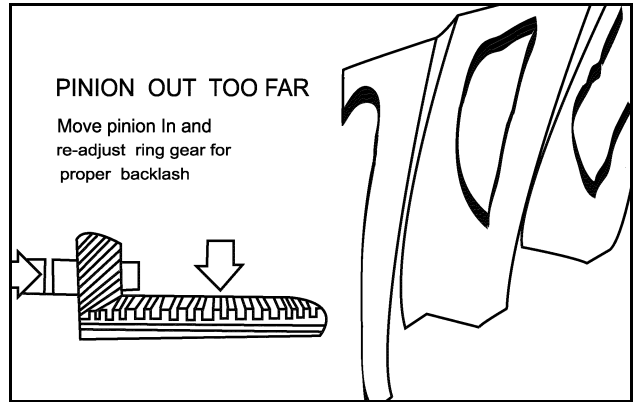


RR98055

2. Increasing backlash moves the ring gear away from the pinion.

Forward Pattern moves slightly higher and toward heel.

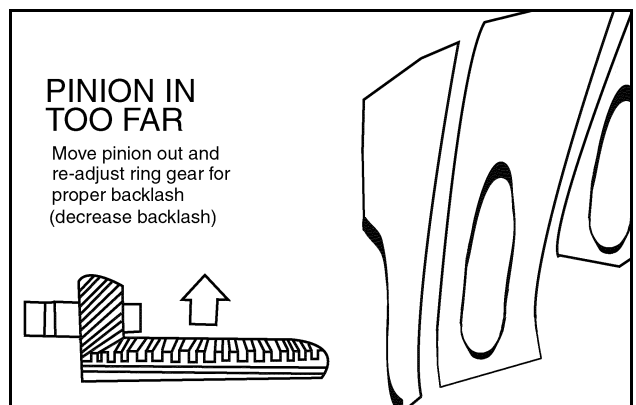
Reverse Pattern moves higher and toward heel.



RR98K054

3. A thicker pinion position shim with the backlash constant moves the pinion closer to the ring gear. Forward Pattern moves deeper on the tooth (flank contact) and slightly toward the toe.

Reverse Pattern moves deeper on the tooth and toward the heel.



RR98K056

4. A thinner pinion position shim with the backlash constant moves the pinion away from the ring gear.

Forward Pattern moves toward the top of the tooth (face contact) and toward the heel.

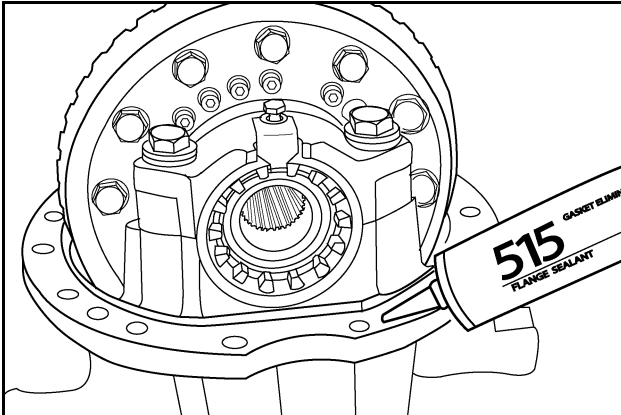
Reverse Pattern moves toward the top of the tooth and slightly toward the toe.

## Installation of Carrier Assembly to Axle Housing

### STEP 76

Thoroughly clean the inside of the axle housing. Remove any burrs and nicks from the carrier housing and axle housing mounting surface.

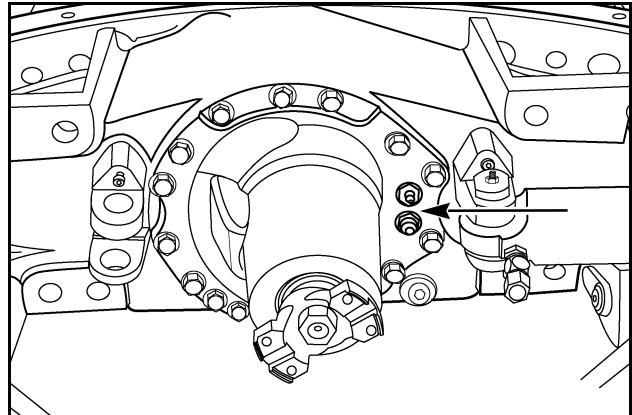
### STEP 77



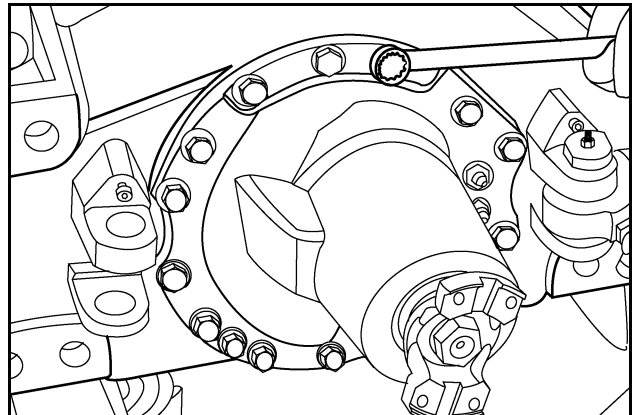
RD02J029

Apply Loctite 515 Gasket Eliminator to the axle housing mounting flange and around the outside of each bolt hole.

### STEP 78



RD02K001



RD02K002

Install new O-rings as required and install the differential lock supply and return fittings.

Install the carrier assembly into the axle housing. Coat all bolt threads with Loctite 271 prior to installation. Install washers and bolts and tighten to a torque of 135 to 155 Nm (100 to 115 lb. ft.).

### STEP 79

Assemble axle shafts and wheel end components, following procedures shown in the FWD Planetary Hub, Steering Knuckle and Axle Drive Shaft Section of this Service Manual.

### STEP 80

Clean drain plugs and install in carrier housing and planetaries. Fill with the lubricant specified in the operators manual to the proper levels.

Inspect wheel ends and housing for oil leaks. Take immediate corrective action when oil leaks are detected.

# **Section 25**

## **Chapter 10**

### **FWD PLANETARY HUB, STEERING KNUCKLE AND AXLE DRIVE SHAFT**



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## SPECIFICATIONS

FWD Differential Oil Capacity (10 Bolt) .....	12.3 Liters (13 U.S. Quarts)
FWD Differential Oil Capacity (12 Bolt) .....	11.6 Liters (12.3 U.S. Quarts)
Differential Oil Type.....	Case 135 H EP Gear Lubricant, SAE 85W-140 w/ Limited Slip Additive B91246
Planetary Hub Oil Capacity (10 Bolt) .....	1.3 Liters (2.8 U.S. Pints)
Planetary Hub Oil Capacity (12 Bolt) .....	3.2 Liters (6.8 U.S. Pints)
Planetary Hub Oil Type.....	Case 135 H EP Gear Lubricant, SAE 85W-140

## SPECIAL TORQUES

Planetary Ring Gear Retaining Plate Bolt.....	110 to 125 Nm (82 to 92 lb. ft.)
Planetary Hub Cover Bolt .....	10 to 16 Nm (8 to 12 lb. ft.)
King Pin Bearing Cap Bolt.....	156 to 170 Nm (115 to 125 lb. ft.)
Steering Cylinder Socket End Clamp Nut.....	95 to 108 Nm (70 to 80 lb. ft.)
Steering Cylinder Tapered Socket Stud Nut .....	272 Nm (200 lb. ft.)
Drain/Fill Plugs .....	38 to 41Nm (28 to 30 lb. ft.)
Tie Rod Tapered Socket Stud Nut .....	372 Nm (275 lb. ft.)
Tie Rod Tube Nut.....	374 to 442 Nm (276 to 326 lb. ft.)
Rolling Torque of Kingpin Bearings.....	34 to 74 Nm (25 to 55 lb. ft.)
Rolling Torque of Planetary Hub Bearings .....	11.4 to 16 Nm (100 to 140 lb. in.)

## SPECIAL TOOLS

Retaining Ring Offset Pliers.....	Part No. 380000805
10 Bolt Installation Tool Kit.....	Part No. 380001910
12 Bolt Installation Tool Kit (Old).....	Part No. 380001912
12 Bolt Installation Tool (New).....	Part No. 380040197

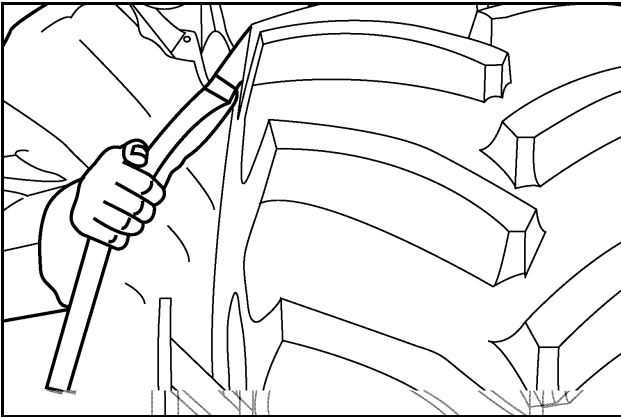
### NOTE: DEALER:

If you have 12 Bolt Installation Kit No. 380001912, you will need the following parts to upgrade your kit to install the new axle seal and dust seal.

- No. 380002591 Seal Installer
- No. 380002592 Dust Seal Installer
- No. 380002617 Seal Installer Screw Assembly

## PLANETARY HUB DISASSEMBLY

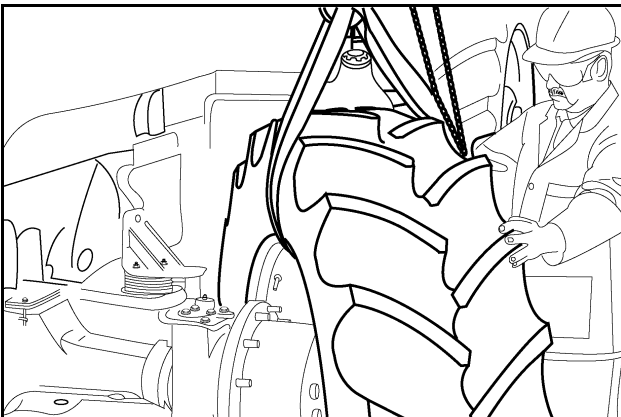
### STEP 1



96RS34A

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Turn the engine off and remove the key. Place blocks in front of and behind the rear wheels. Remove the front fenders from the front axle, if equipped.

### STEP 2



98RS8A

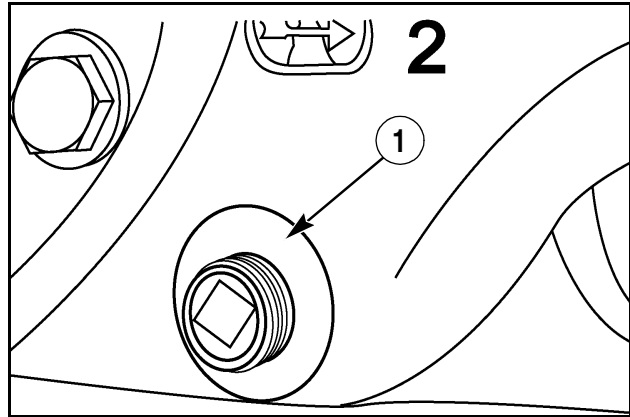
Raise the front axle. Install axle stands. Remove the front tires.



**WARNING:** The tires on this tractor are very heavy. Use a wheel remover or chain hoists to remove and install the tires. Use additional help as required.

SM188A

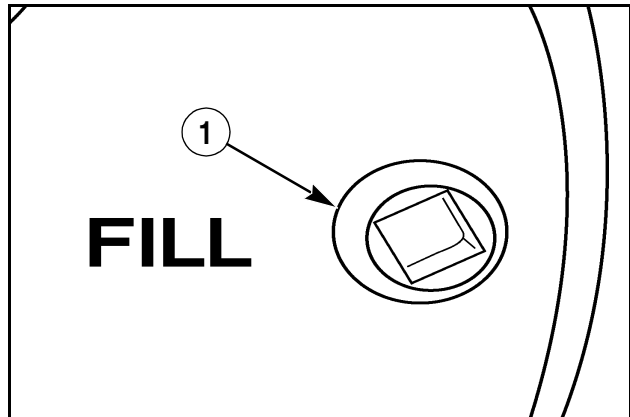
### STEP 3



RR98K131

Allow the axle to cool before servicing. Slowly open the axle fill plug to release any internal axle pressure. Remove the axle drain plug (1). Drain the axle oil into a suitable, clean container.

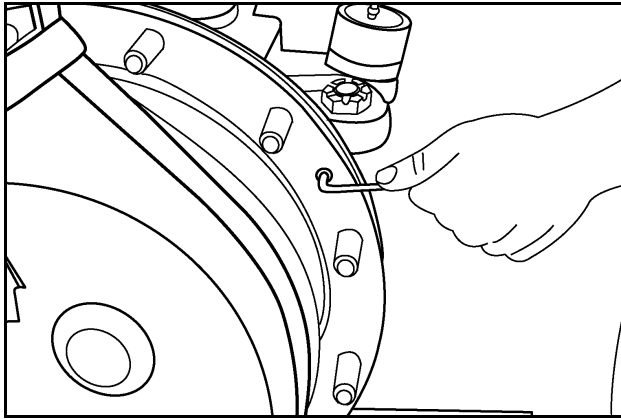
### STEP 4



RR98K083

Before draining the oil from the planetary hub, position the hub cover so the planetary hub drain/fill plug (1) is at the highest position. Make sure the axle fill plug has been loosened to release any internal axle pressure. Loosen the planetary hub plug and rotate the hub cover so the plug is at the lowest position. Remove the planetary hub fill plug and drain the oil into a suitable container.

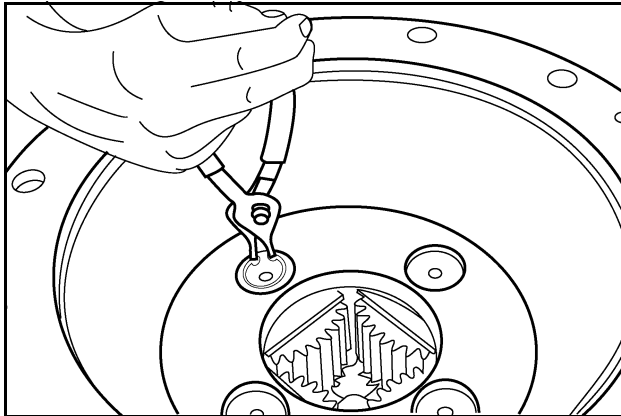
### STEP 5



RR98K084

Properly support the planetary hub cover. Remove the three (3) Allen head bolts. Separate and remove the hub cover from the planetary hub.

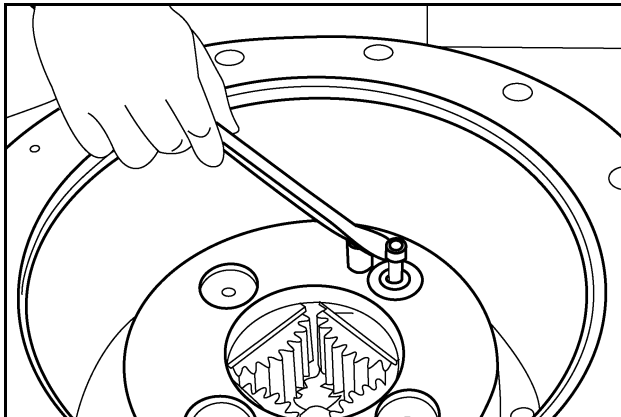
### STEP 6



RR98K08

Remove the retaining rings that secure the planetary gear pins to the planetary hub cover.

### STEP 7



RR98K087

Remove the planetary gear pins by threading a suitable bolt into the pin and prying up on the bolt head.

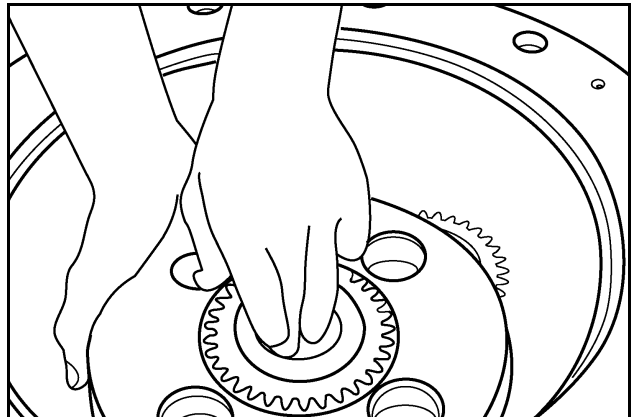
### STEP 8



RR98K089

Remove the thrust washers from the top of the planetary gear.

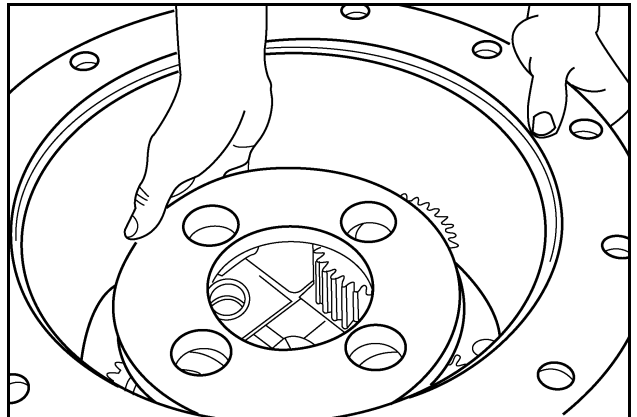
### STEP 9



RR98K088

Remove the planetary gear through the center opening of the gear plate. Remove the upper level of needle bearings in the planetary gear. Remove the spacer and the lower level of needle bearings. Inspect all components for damage or wear.

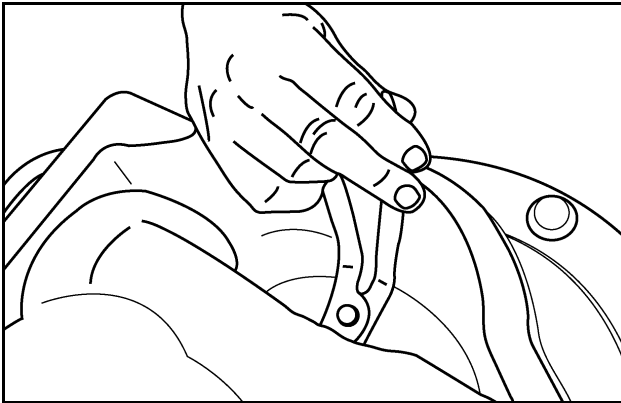
### STEP 10



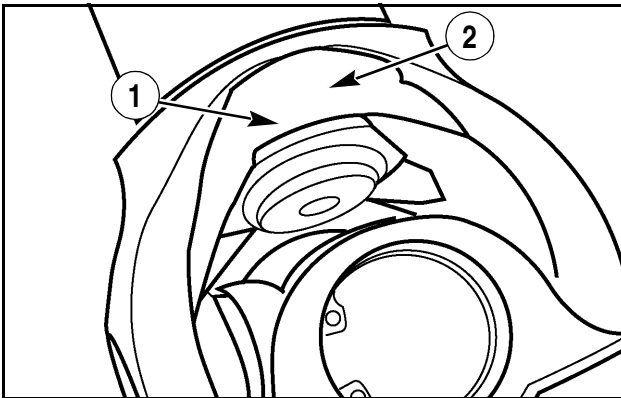
RR98K090

Remove the lower thrust washers and inspect for damage or wear.

## STEP 11



RD02J001

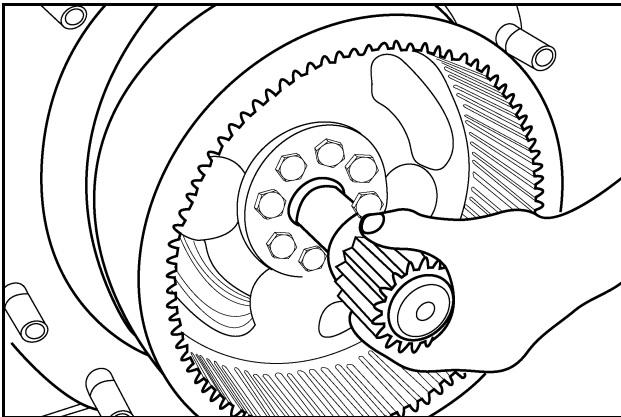


RD02J002

Swivel the steering knuckle to gain access to the planetary input sun gear shaft. Use 380000805 Retaining Ring Offset Pliers to remove the snap ring (1). Remove the washer (2) from the planetary input sun gear shaft.

**NOTE:** Axle shaft removed for photographic purpose.

## STEP 12

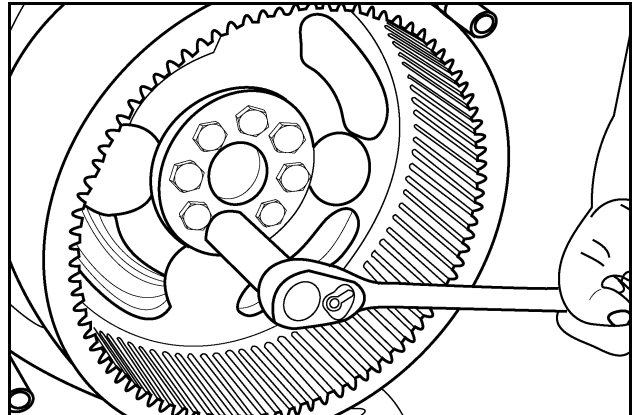


RR98K092

Use two prybars at the steering knuckle to remove the planetary gear shaft from the yoke retaining ring.

**NOTE:** Remove the thrust washer on the planetary gear shaft for tractors equipped with ten bolt hubs.

## STEP 13

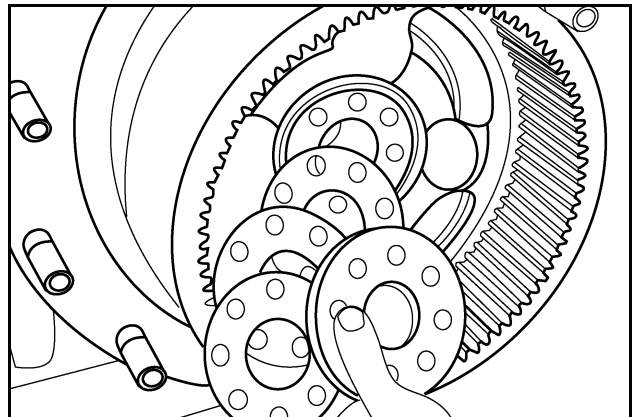


RR98K093

Remove the eight retaining plate bolts. Discard the bolts.

**NOTE:** NEW BOLTS need to be installed during reassembly.

## STEP 14

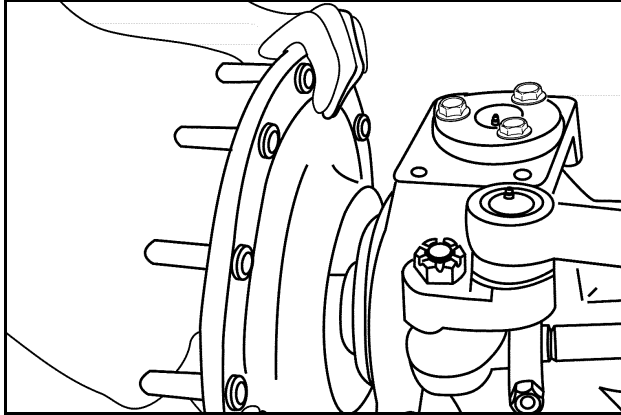


RR98K094

Remove the retaining plate and shims. Slide the planetary ring gear assembly off the splines of the steering knuckle. The outer planetary hub bearing will be removed with the planetary ring gear hub.

**NOTE:** Twelve bolt planetary hub assembly shown. Remove the thrust washer used on the ten bolt planetary hub assembly, after the removal of the shims.

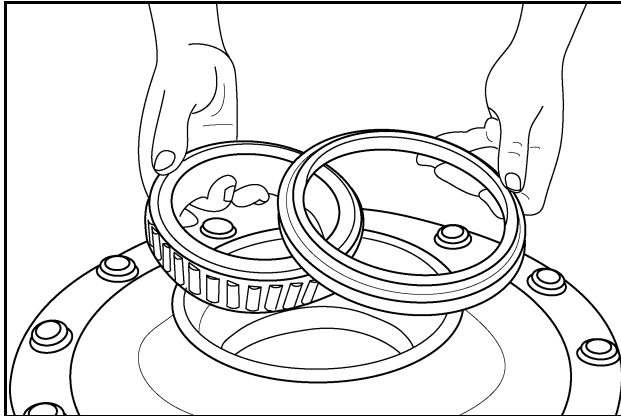
### STEP 15



Remove the planetary hub.

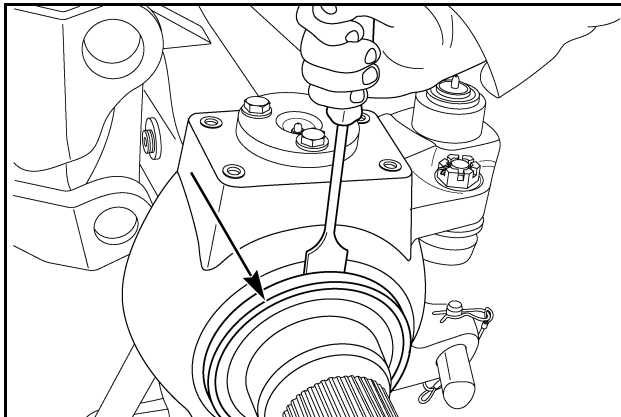
**NOTE:** The hub seal may separate into two pieces during removal.

### STEP 16



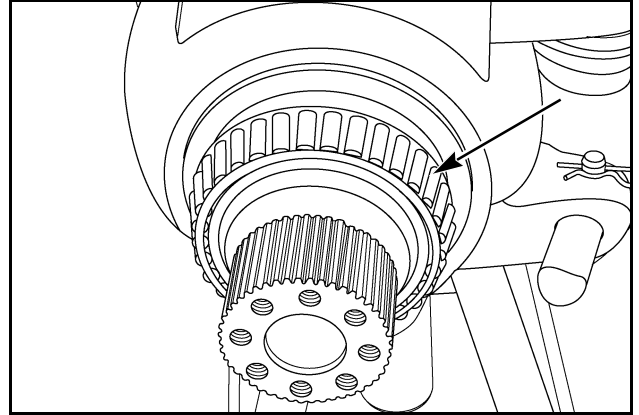
Twelve bolt hub. Remove the oil seal and the inner planetary hub bearing cone from the planetary hub.

### STEP 17



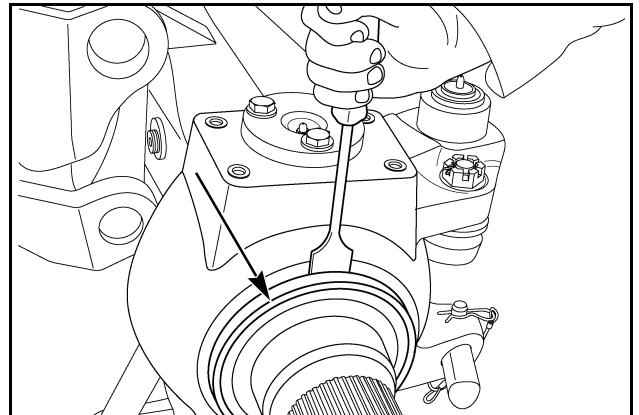
Twelve bolt. Remove the dust seal.

### STEP 18



Ten bolt. Remove the bearing.

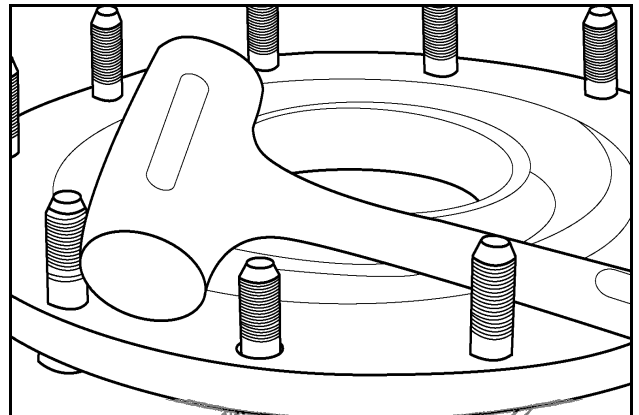
### STEP 19



Ten bolt hub. Remove the oil seal.

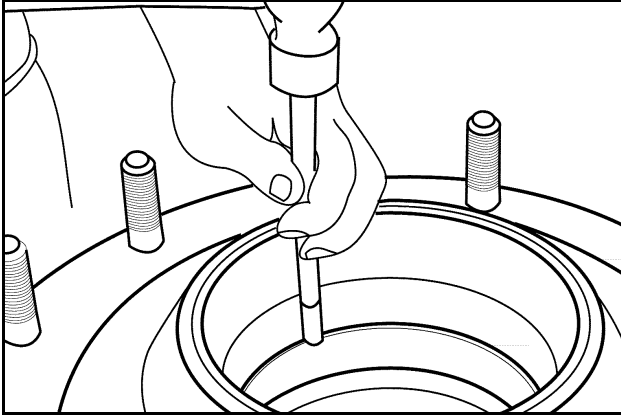
**NOTE:** Seal may separate when hub is removed.

### STEP 20



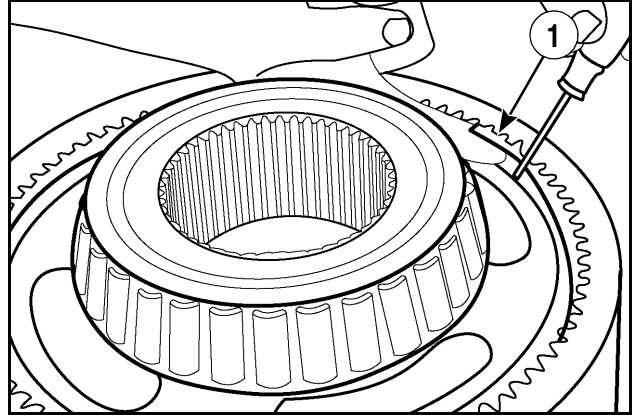
Remove damaged wheel studs as needed.

**STEP 21**



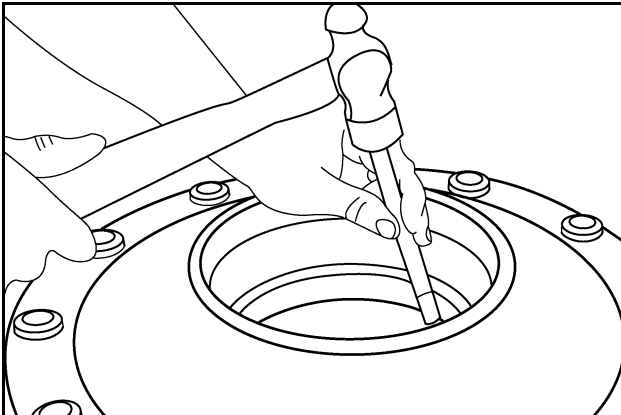
Use a driver to remove the inner planetary hub bearing cup.

**STEP 23**



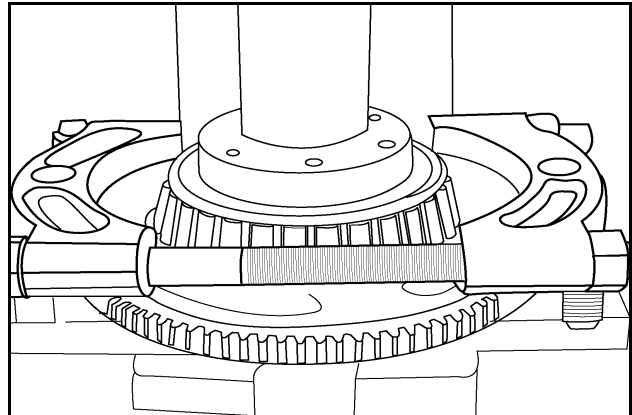
Remove the wire retaining ring (3) and remove the gear hub.

**STEP 22**



Use a driver to remove the outer planetary hub bearing cup.

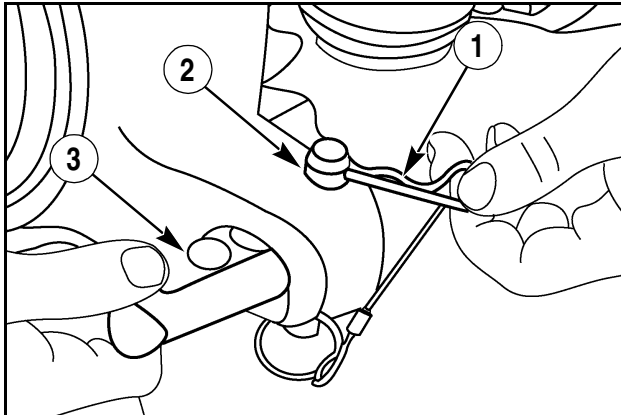
**STEP 24**



Place the planetary gear hub in a press. Use the proper step plate adapter to remove the outer planetary hub bearing from the planetary gear hub. Repeat the preceding procedure for the opposite planetary hub, if necessary.

## STEERING KNUCKLE AND KINGPIN DISASSEMBLY

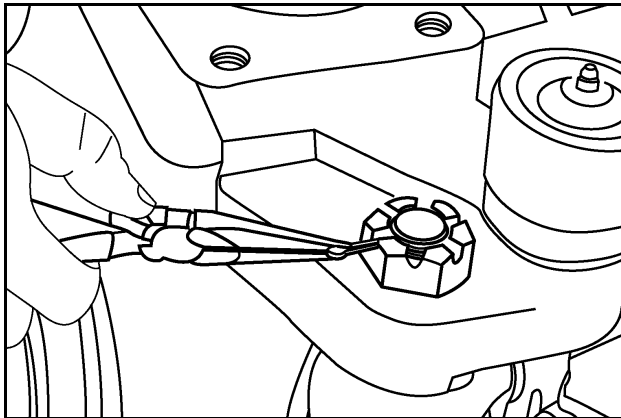
### STEP 25



RR98K105

Place an identifying mark on the wheel stop before removing the clevis locking pin. Remove the clevis retaining pin (1), the clevis locking pin (2), and the wheel stop (3).

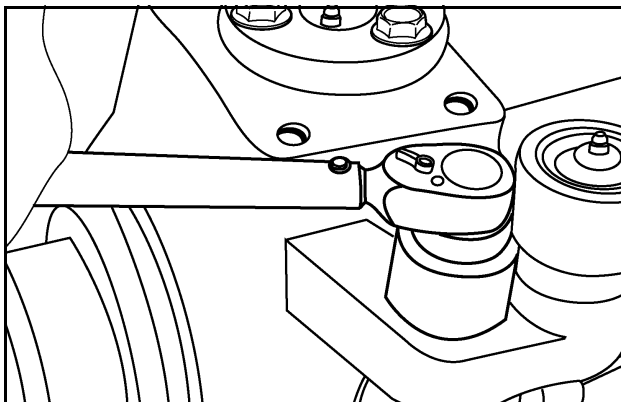
### STEP 26



RR98K106

Remove the cotter pin from the slotted nut on the steering cylinder socket end.

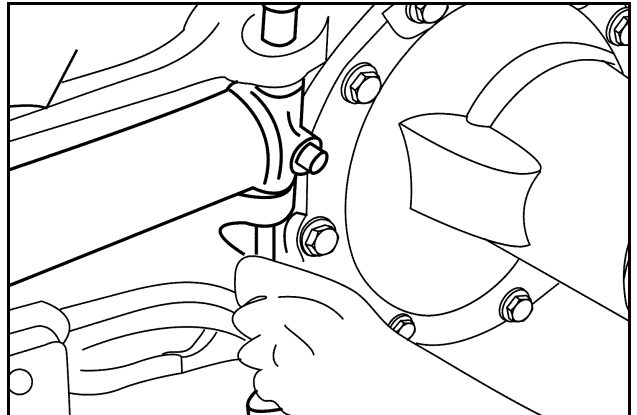
### STEP 27



RR98K10

Loosen, do not remove, the steering cylinder socket end nut.

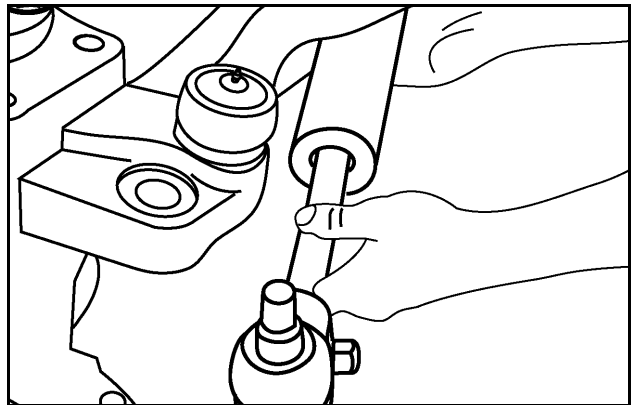
### STEP 28



RR98K108

Remove the cotter pin from the lower end of the steering cylinder clevis pin at the axle housing. Remove the clevis pin. Remove and discard the clevis pin bushing O-rings.

### STEP 29

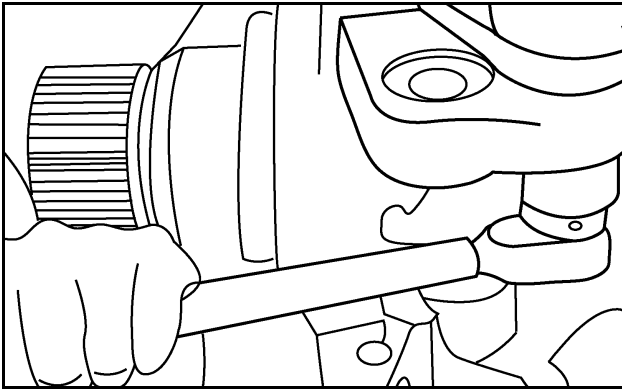


RR98K109

With the slotted nut in place on the steering cylinder socket end, unseat the steering cylinder socket end from the steering knuckle, using a soft metal hammer. Remove the slotted nut and remove the cylinder. Remove the opposite steering cylinder using the same procedure, if necessary.



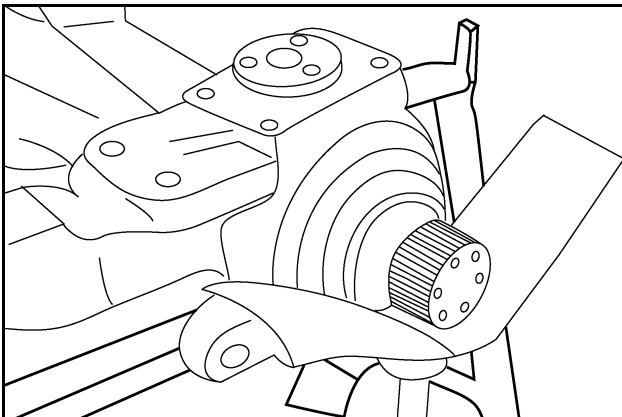
### STEP 30



RR98K110

Remove the cotter pin from the tie rod socket end slotted nut. Loosen the slotted nut. Unseat the tie rod socket end from the steering knuckle, using a soft metal hammer. Remove the slotted nut and the tie rod end. Remove the opposite tie rod end using the same procedure, if necessary.

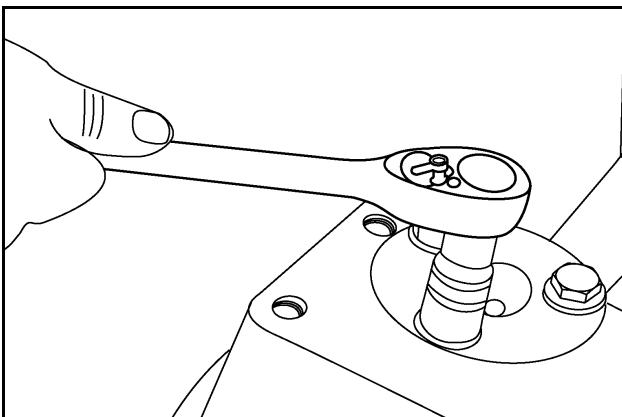
### STEP 31



RR99K243

Properly support the steering knuckle to retain the position of the upper king pin bearing cap, when it is removed.

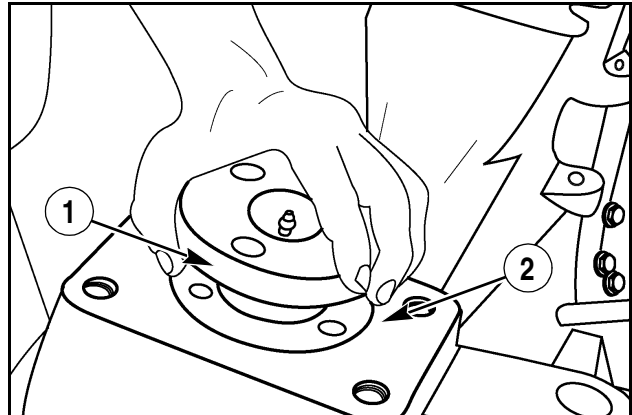
### STEP 32



RR98K111

Remove the three upper king pin bearing cap bolts.

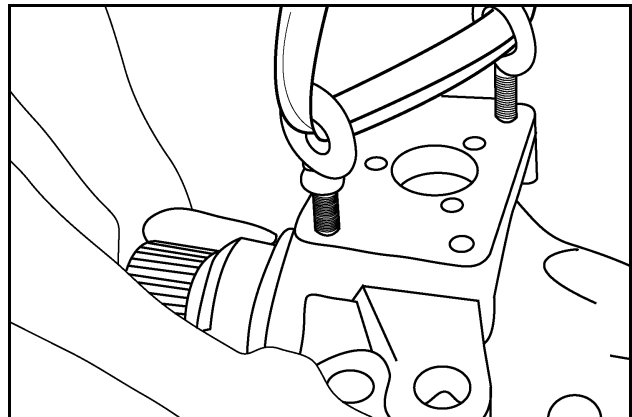
### STEP 33



RR98K112

Remove the upper king pin bearing cap (1) and the shims (2).

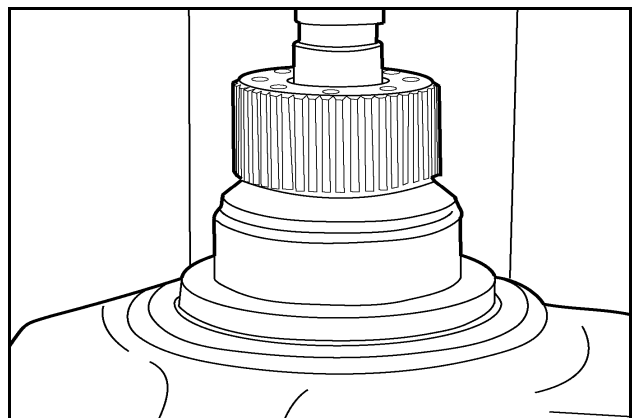
### STEP 34



RR98K114

Install lifting eyes and properly support the steering knuckle. Remove the lower king pin bearing cap and shims.

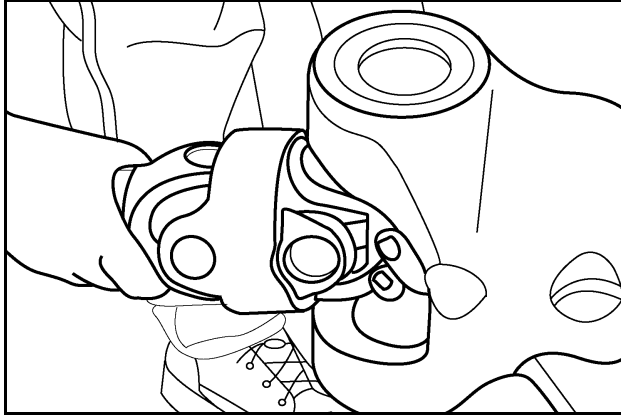
### STEP 35



RR98K115

Remove the planetary input sun gear shaft oil seal from the steering knuckle. Press the planetary input sun gear shaft bushing from the steering knuckle, if replacement is necessary.

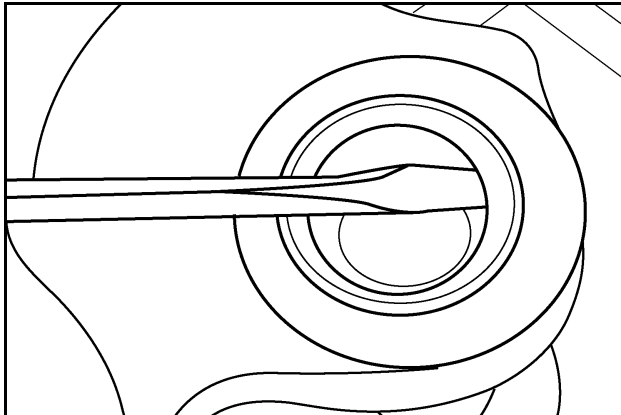
### STEP 36



RD02J013

Remove the axle drive shaft.

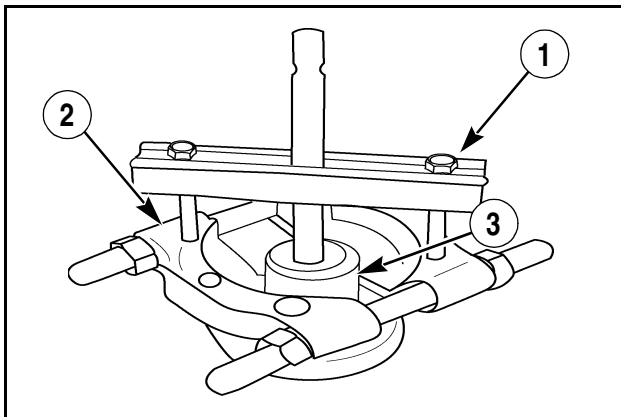
### STEP 37



RR99K245

Remove the upper axle kingpin seal.

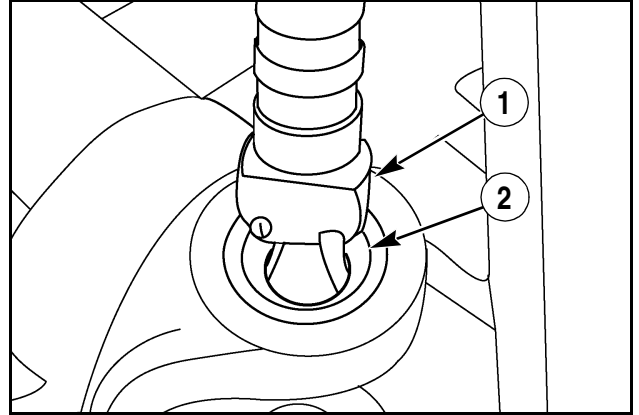
### STEP 38



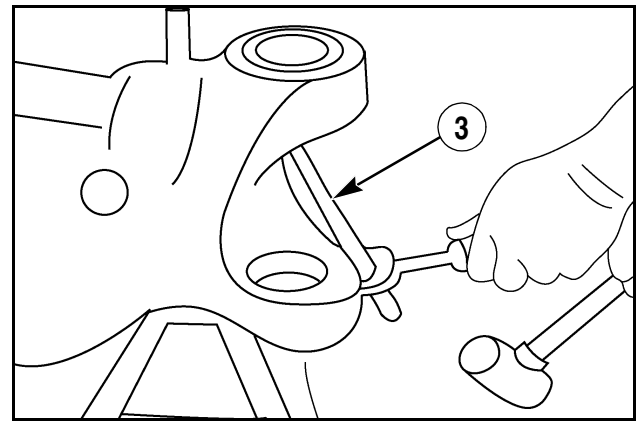
RR99K248

Use a puller (1) with a bearing puller (2) to remove the inner ring (3) from the upper kingpin bearing cap, if necessary. Use care not to damage the grease seal area on the kingpin bearing cap.

### STEP 39



RR99K247



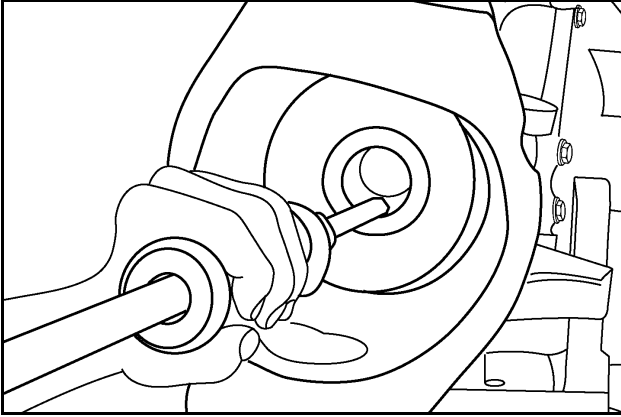
RR99K249

Use a suitable puller (1), or a blind hole puller, to remove the upper king pin bearing outer ring (2) from the axle housing.

If the outer ring cannot be removed with the blind hole puller, pierce the grease retainer and drive the outer ring out with a punch (3). A new grease retainer plate will be required for assembly. Use the same procedure for the removal of the lower king pin bearing outer ring.

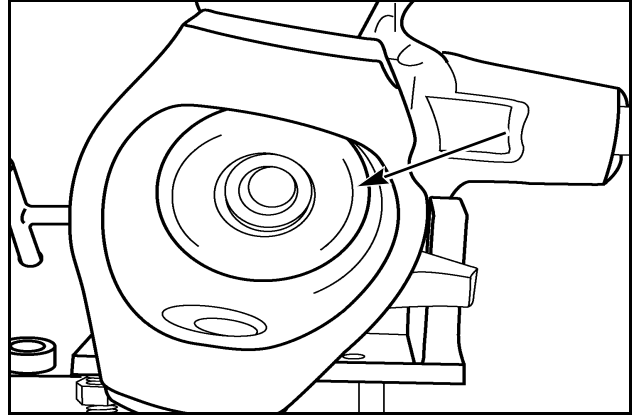
**NOTE:** Piercing the lower grease retainer and using an extension and socket to remove the outer ring, may be required.

**STEP 40**



Remove the outer and the inner axle shaft seals with a slide hammer and a suitable puller.

**STEP 41**



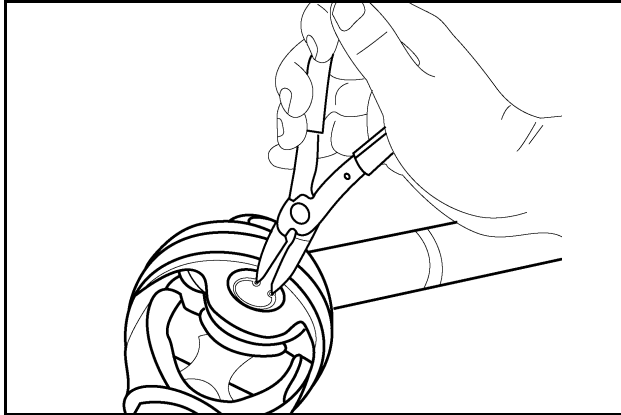
Inspect the axle shaft bushing in the differential housing. Use a suitable puller to remove the bushing, if necessary.

**STEP 42**

Repeat the removal procedure for the steering knuckle and kingpins on the opposite side of the FWD axle, if necessary.

## AXLE DRIVE SHAFT DISASSEMBLY

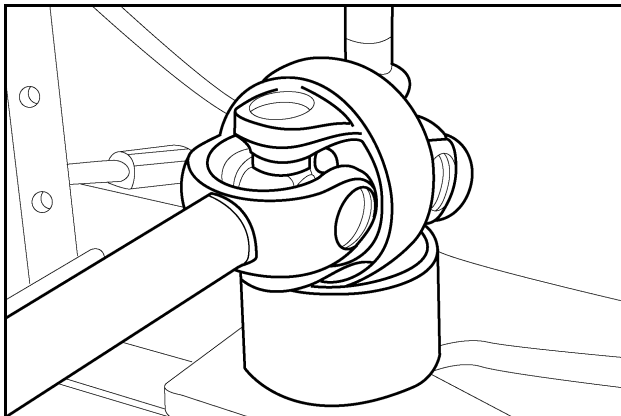
### STEP 43



RD02J015

Remove the universal joint retaining rings from the centering yoke on front axle drive shaft.

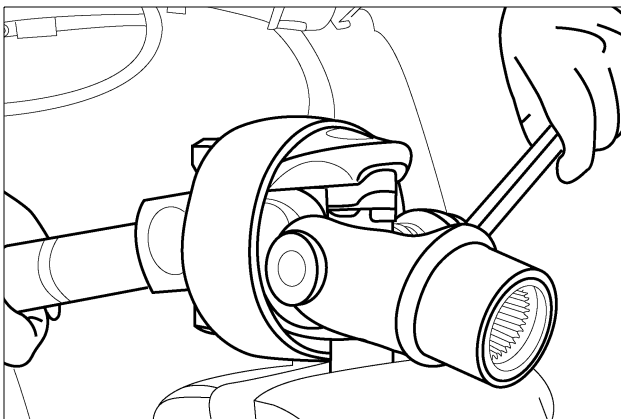
### STEP 44



RD02J014

Place the axle shaft in a press. Apply pressure to the upper universal joint cap until the opposite universal joint cap is out of, or nearly out of, the yoke.

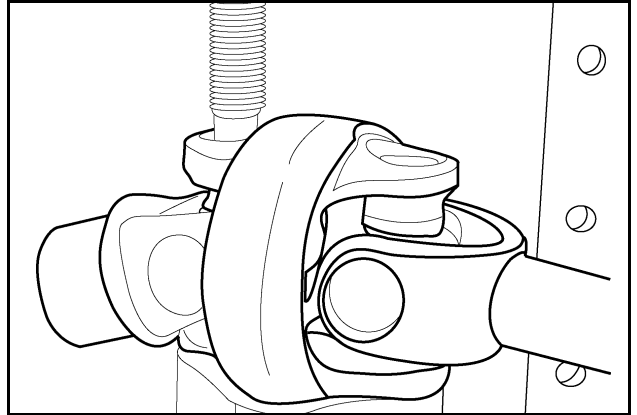
### STEP 45



RD02J016

Place the universal joint cap in a vise. Use a lever to remove the cap from the yoke.

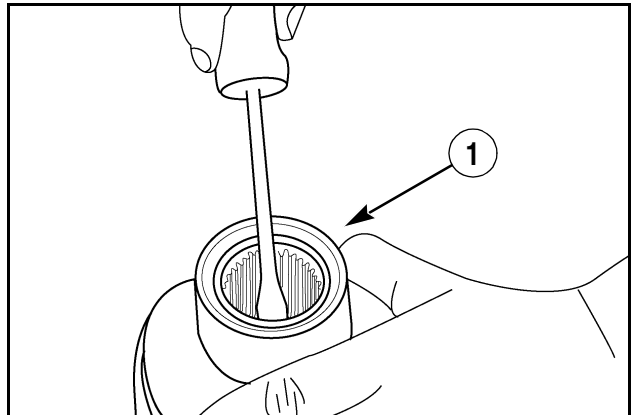
### STEP 46



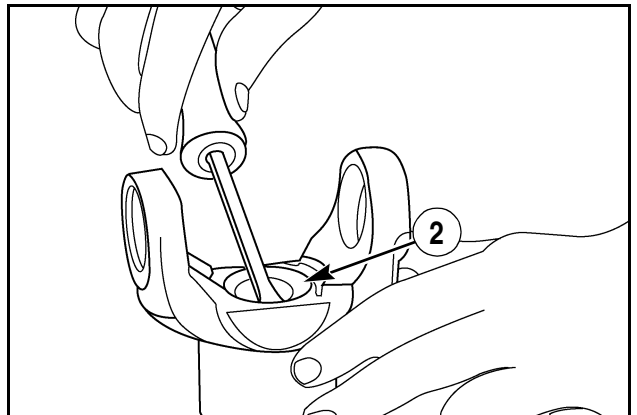
RD02J030

Place the axle shaft in a press. Press the other universal cap from the yoke and remove the outer axle drive shaft yoke from the centering yoke. Repeat the preceding procedure to remove the remaining universal joint and the inner drive shaft yoke, from the centering yoke. Remove and disassemble the opposite FWD drive shaft, if necessary.

### STEP 47



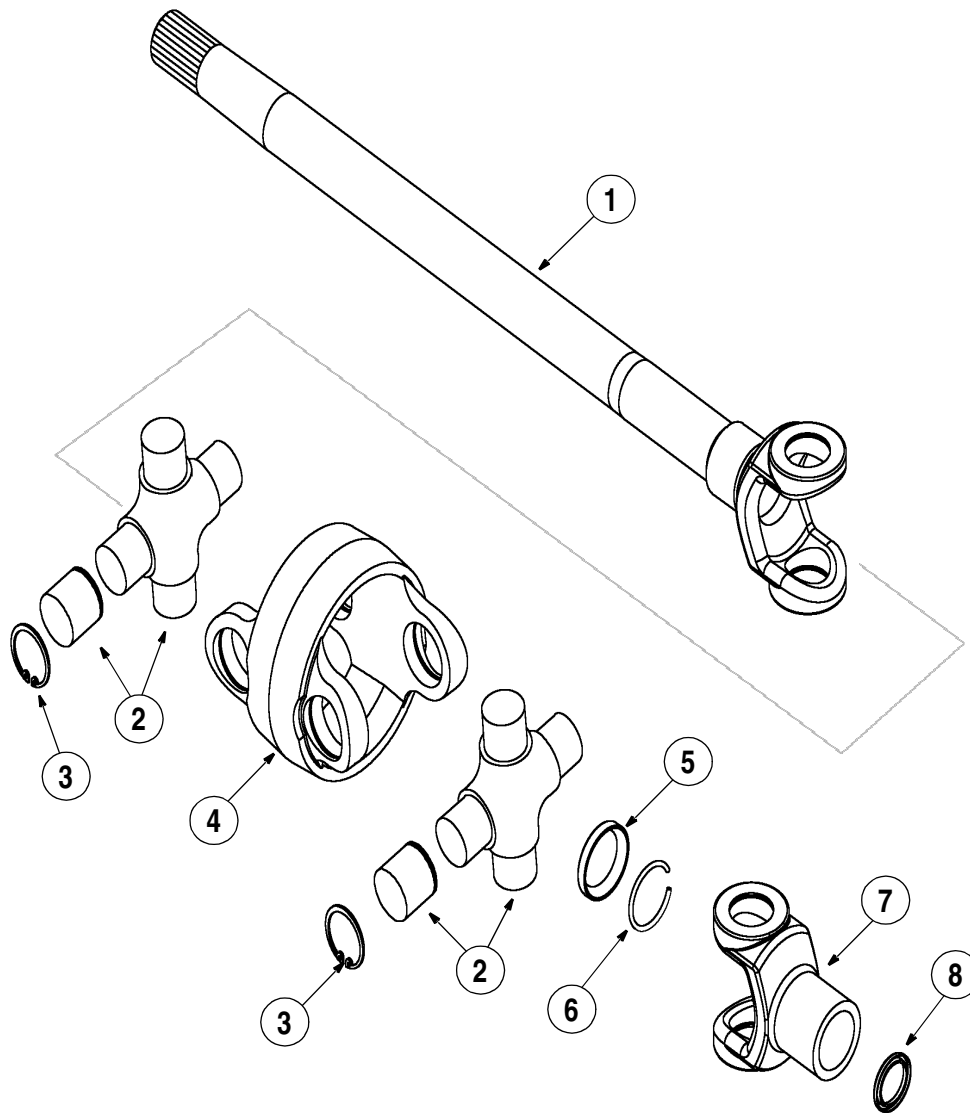
RR98K077



RR98K078

Remove and discard the outer drive shaft yoke seal (1), the inner yoke seal, and the retaining ring (2).

## AXLE SHAFT ASSEMBLY

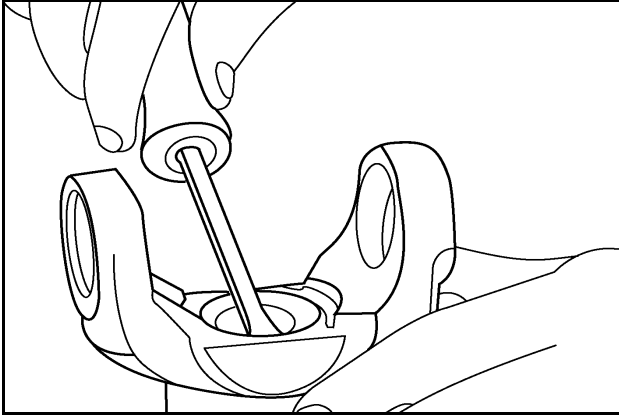


- 1. AXLE SHAFT
- 2. UNIVERSAL JOINT
- 3. RETAINING RING
- 4. YOKE

- 5. YOKE INNER SEAL
- 6. RETAINING RING
- 7. YOKE
- 8. YOKE OUTER VSEAL

RI02H044

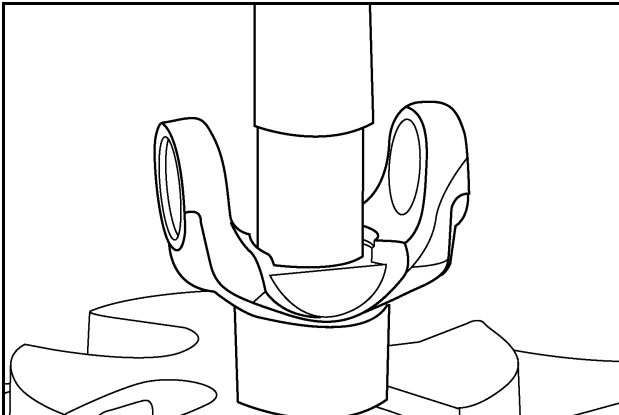
**STEP 48**



RR98K078

Install a new retaining ring into the drive shaft yoke.

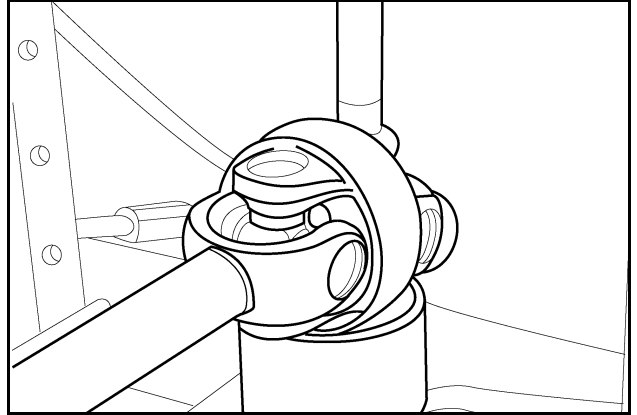
**STEP 49**



RR98K080

Use a press and seal installers to install a new inner and outer yoke seal. Install the yoke seals with the lip of the seal facing away from the yoke.

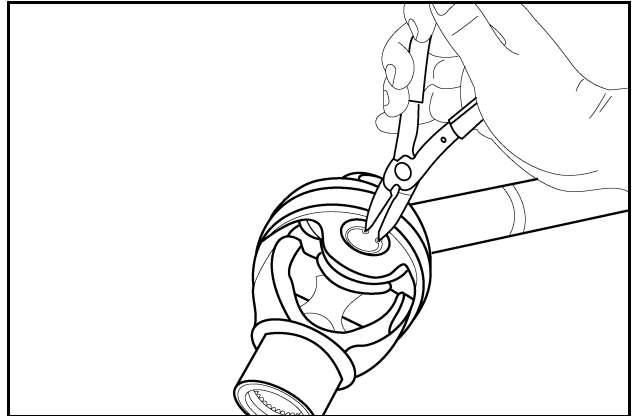
**STEP 50**



RD02J014

Install new universal joints by reversing the disassembly procedure. Use a press to seat the universal bearing caps into the axle shaft yokes and the centering yoke.

**STEP 51**



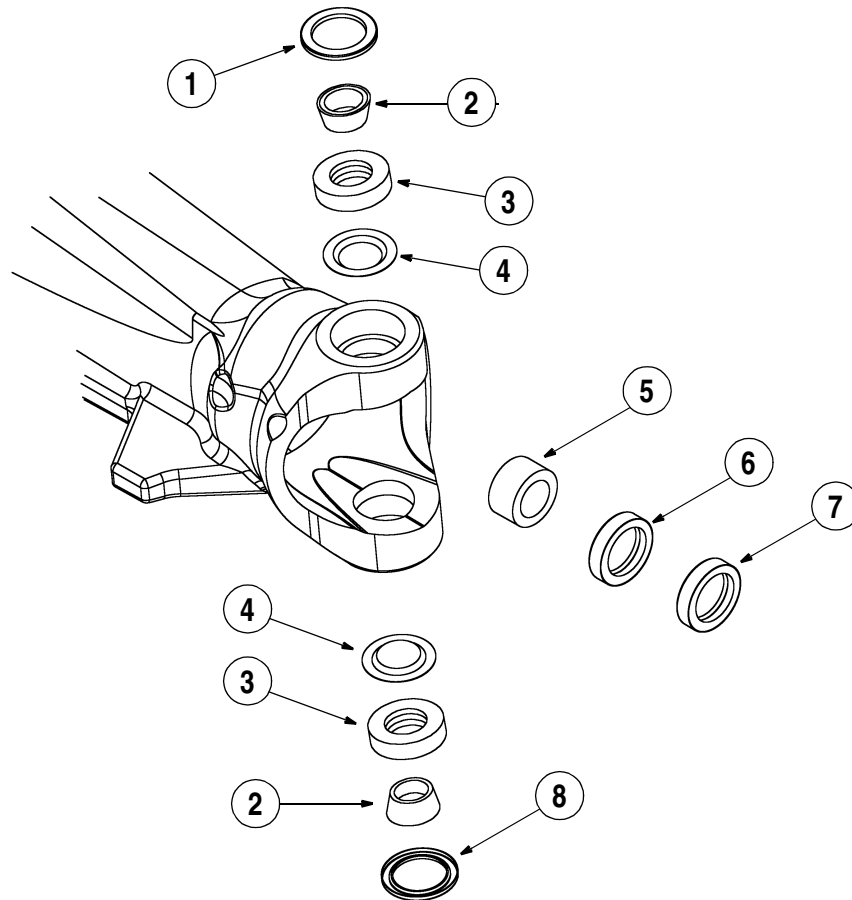
RD02J015

Press the universal joint cap below the retaining ring groove and install the retaining ring. Repeat this procedure for each universal joint cap.

**STEP 52**

Repeat the assembly procedure for the opposite FWD axle drive shaft, if removed.

## KINGPIN ASSEMBLY

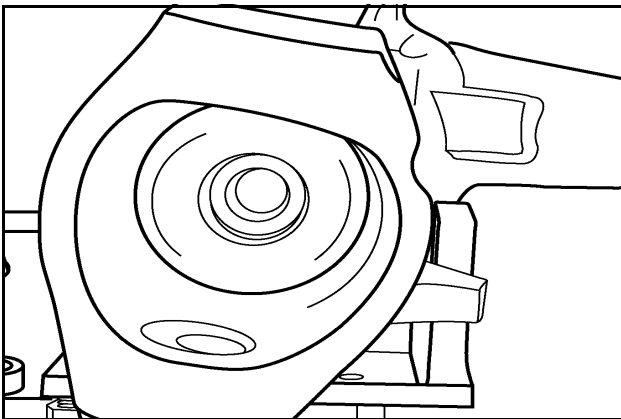


1. UPPER KINGPIN GREASE SEAL
2. KINGPIN BEARING INNER RING
3. KINGPIN BEARING OUTER RING
4. GREASE RETAINING PLATE

5. AXLE SHAFT BUSHING
6. AXLE SHAFT INNER OIL SEAL
7. AXLE SHAFT OUTER OIL SEAL
8. LOWER KING PIN GREASE SEAL

RI99M007

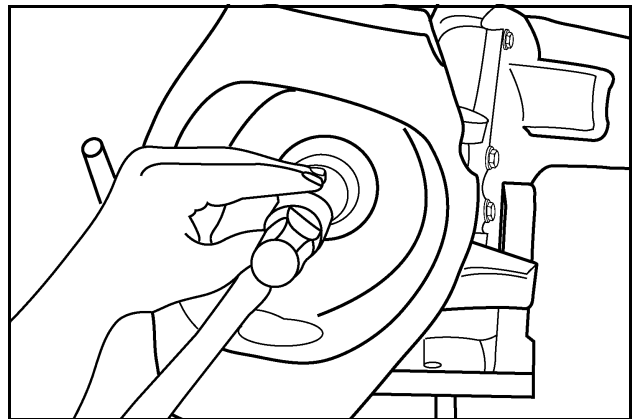
### STEP 53



RR98K062

Use a suitable installer to install a new axle shaft bushing, if necessary. The bushing counterbore faces outward. Install the bushing until it bottoms in the axle housing.

### STEP 54

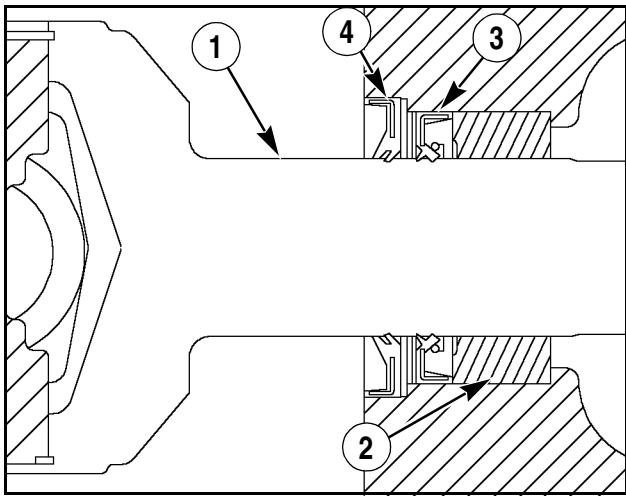
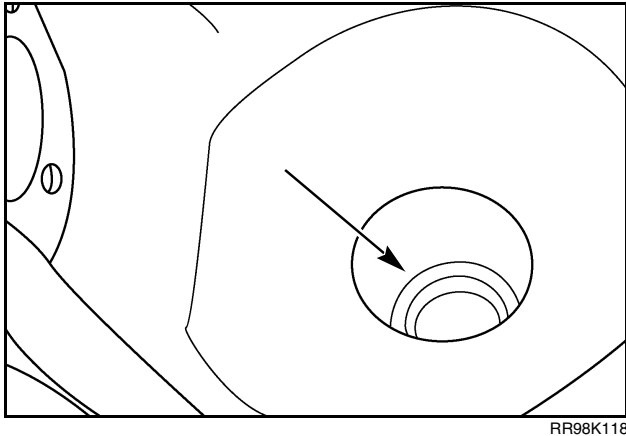


RR98K063

Use seal installers to install new inner and outer axle shaft oil seals.

**NOTE:** The outer oil seal is installed flush with the axle housing.

## STEP 55

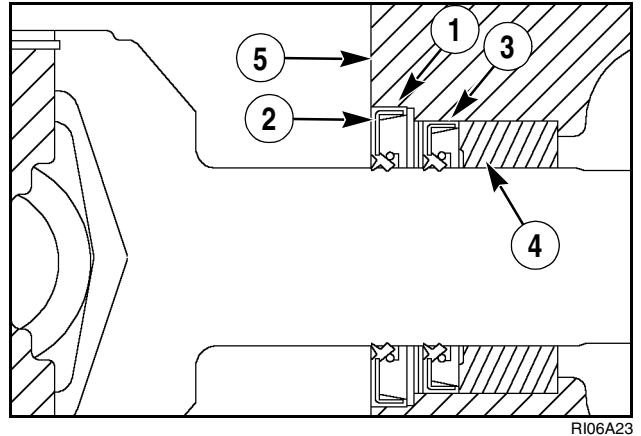


- 1. AXLE SHAFT
- 2. BUSHING

- 3. INNER OIL SEAL
- 4. OUTER SEAL

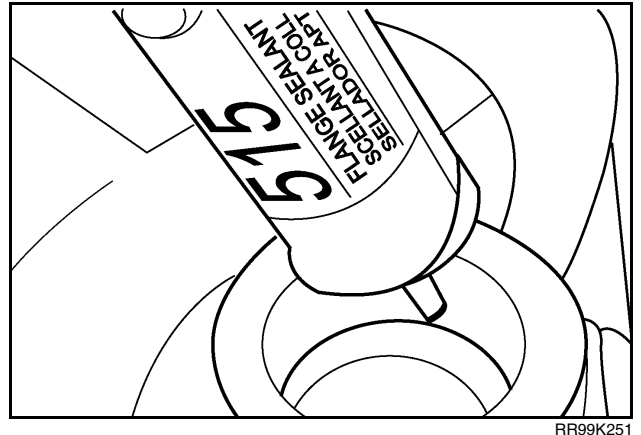
**NOTE:** Seals are installed at the factory as show above. Inner seal (3) lip facing toward the differential and outer seal (4) facing toward the planetary hub.

## STEP 56



**NOTE:** Lubricate the inner diameter of the seals with SAE 85W-140 gear lubricant. Install the axle shaft seals (1)(2) with the lips facing toward the differential. The inner seal (1) should be pressed flush with the bushing (4). The outer seal (2) should be pressed flush with the casting surface (5).

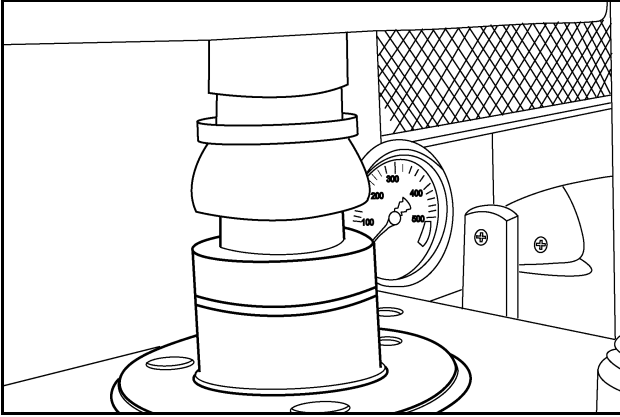
## STEP 57



Apply Loctite ® 515 to the bottom face of axle housing bore. Install the grease retaining plate so that the grease cavity is below the bore.



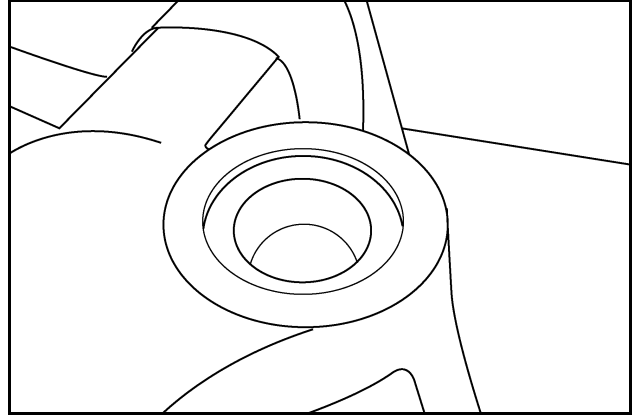
## STEP 58



RR99K254

Place the kingpin bearing cap in a press and install a new inner ring. Use a flat plate to evenly start the inner ring on the kingpin bearing cap.

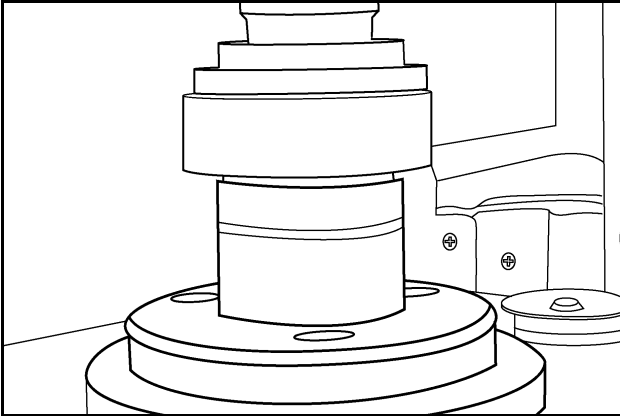
## STEP 61



RR99K253

Make sure the outer ring is fully seated in the housing. Apply a layer of grease to the bearing surface.

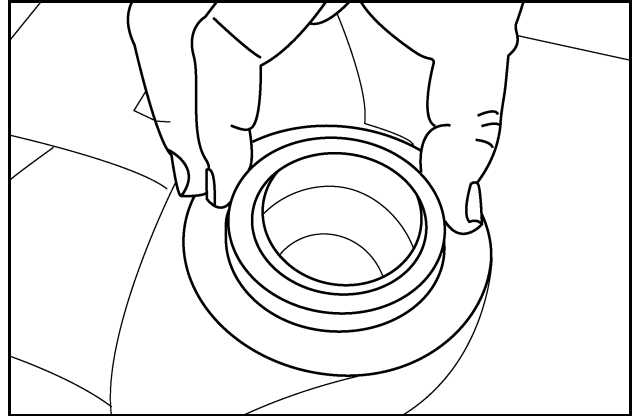
## STEP 59



RR99K255

Complete the seating of the inner ring on the king pin bearing cap by using the outer ring as the installer.

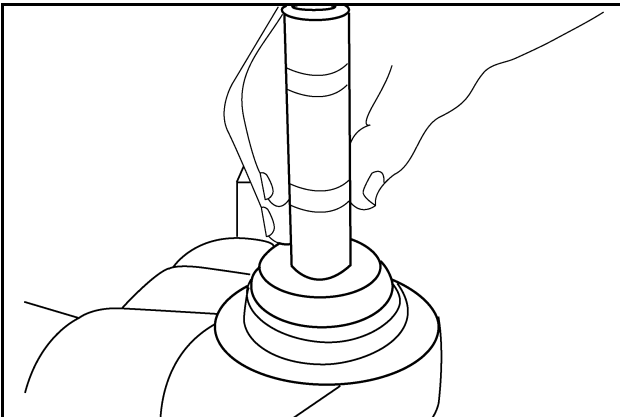
## STEP 62



RR99K256

Lubricate the inner diameter of a new king pin seal with grease. Position the new king pin oil seal in the axle housing.

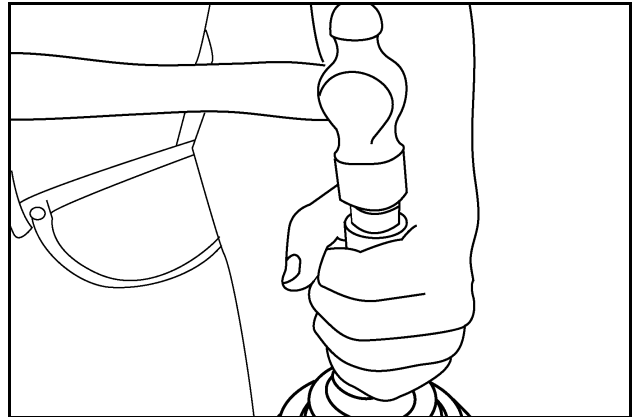
## STEP 60



RR99K252

Use a bearing installer to install the king pin outer ring into the axle housing.

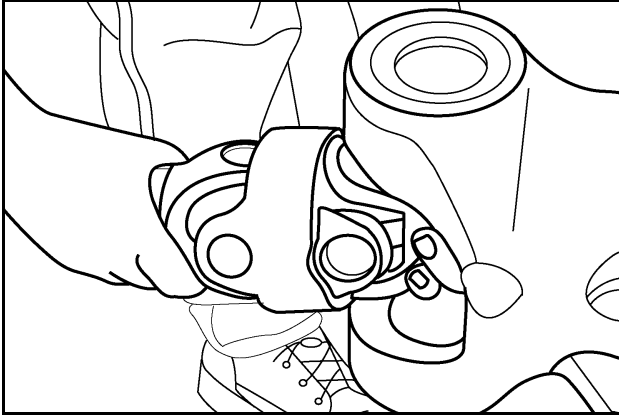
## STEP 63



RR98K069

Use CAS1716-3 Handle and CAS2597 Kingpin Seal Installer to install the seal.

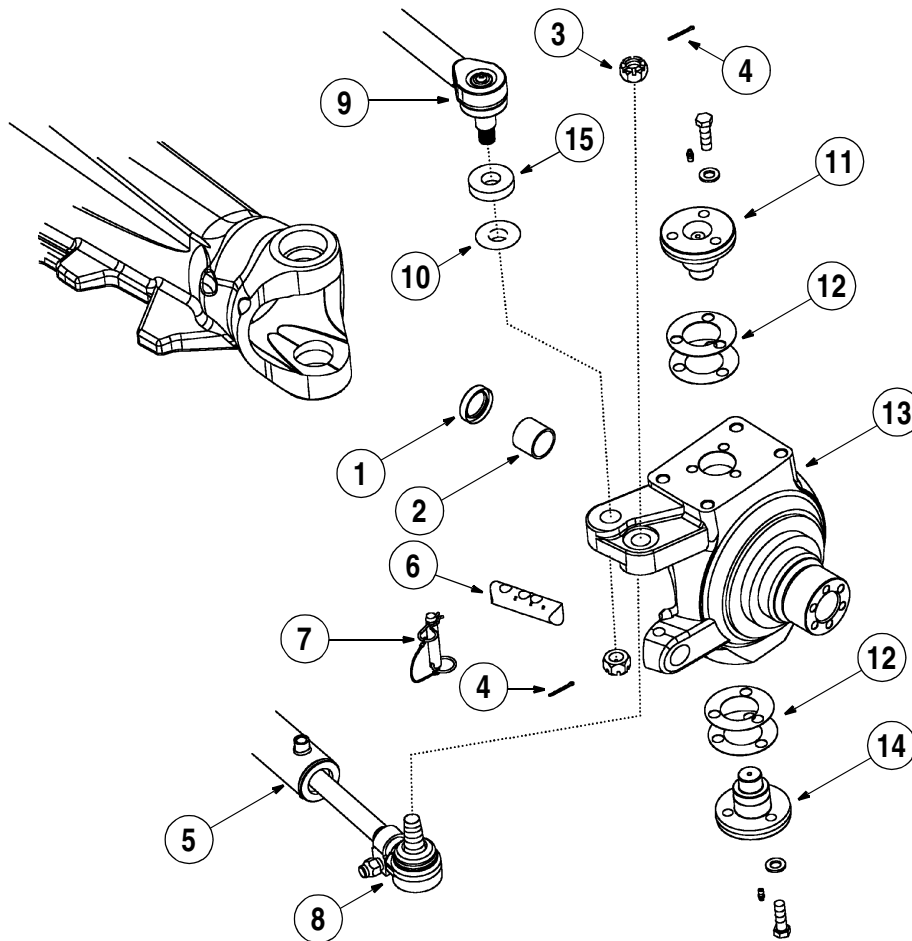
**STEP 64**



RD02J013

Install the FWD axle drive shaft into the axle housing. Make sure the axle shaft splines engage the differential side gears. Use care so as not to damage the axle shaft seals. Repeat the kingpin assembly procedure on the opposite side of the MFD axle, if necessary.

## STEERING KNUCKLE ASSEMBLY



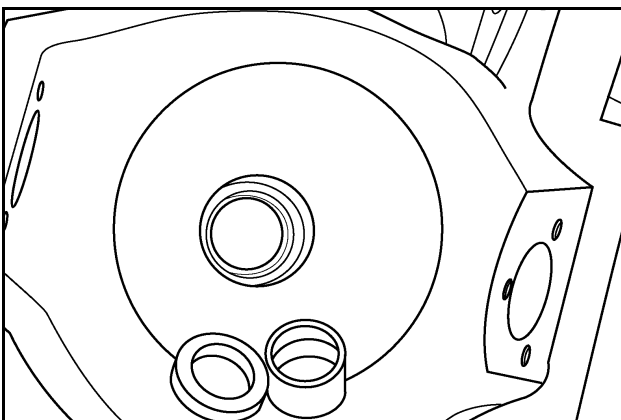
RI99M006

- 1. PLANETARY GEAR SHAFT SEAL
- 2. PLANETARY GEAR SHAFT BUSHING
- 3. NUT
- 4. COTTER PIN
- 5. STEERING CYLINDER

- 6. WHEEL STOP
- 7. CLEVIS PIN
- 8. STEERING CYLINDER SOCKET END
- 9. TIE ROD SOCKET END
- 10. WASHER

- 11. UPPER KINGPIN BEARING CAP
- 12. SHIMS
- 13. STEERING KNUCKLE
- 14. LOWER KINGPIN BEARING CAP
- 15. TIE ROD SEAL

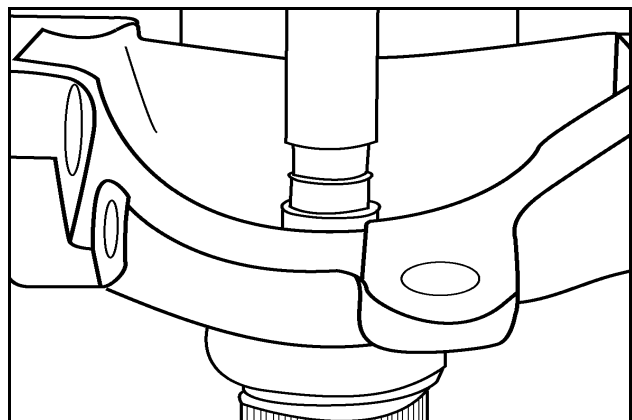
### STEP 65



RR98K116

Inspect and clean the bores of the steering knuckle. Apply Loctite® 609 to the planetary gear shaft bushing bore and the outer diameter of the bushing.

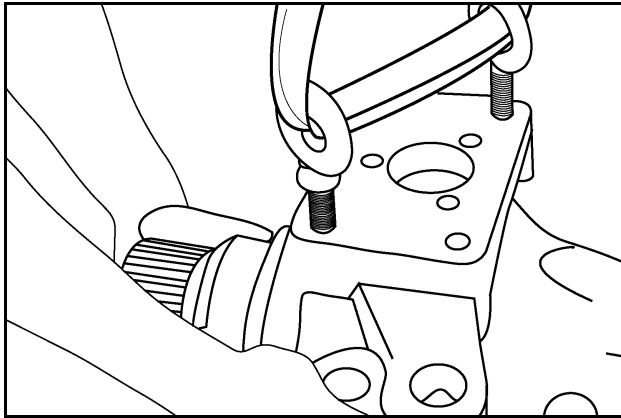
### STEP 66



RR98K117

Use a bushing installer to press the bushing in flush with the machined bore in the knuckle. Wipe away the excess Loctite ® 609.

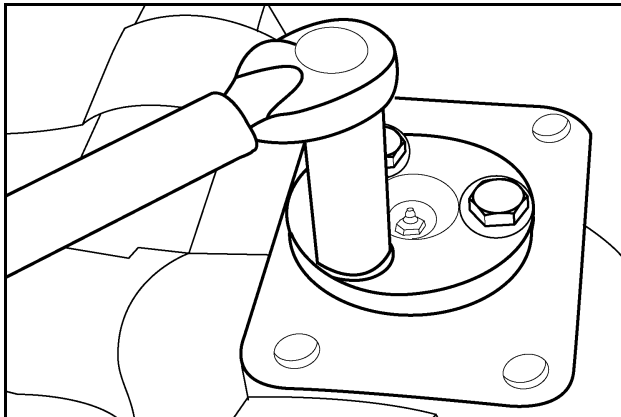
### STEP 67



RR98K114

Install lifting eyes and properly support the steering knuckle. Guide the axle shaft outer yoke into the steering knuckle.

### STEP 68



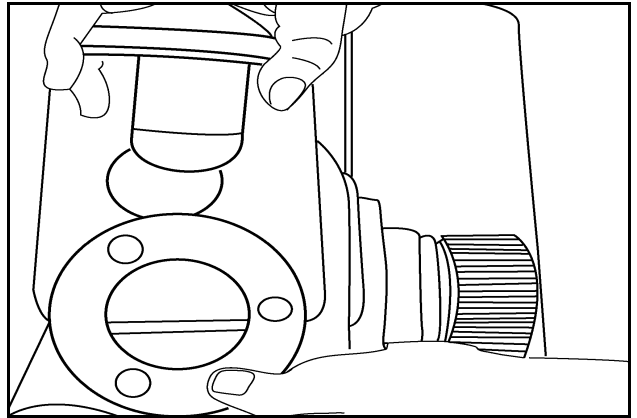
RR99K258

Use the following procedure to make sure the kingpin bearings are seated.

1. Apply a layer of grease to the inner ring bearing surface.
2. Properly support the steering knuckle. Install the lower king pin bearing cap **WITHOUT** shims.
3. Install the upper king pin bearing cap **WITHOUT** shims.
4. Tighten all bolts to a torque of 156 to 170 Nm (115 to 125 lb. ft.).

**DO NOT** rotate the steering knuckle.

### STEP 69

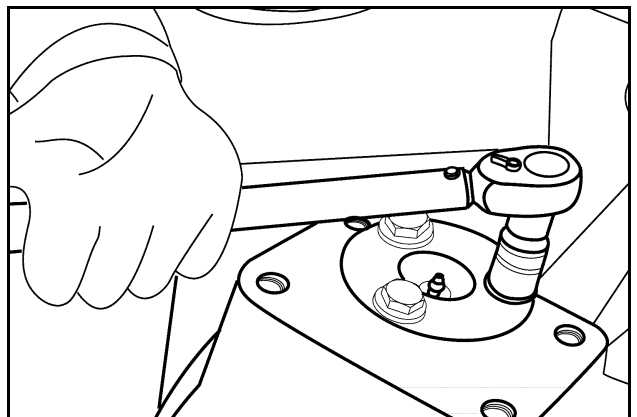


RR99K244

Remove the king pin bearing caps after verifying that the bearings are fully seated and install the king pin shims.

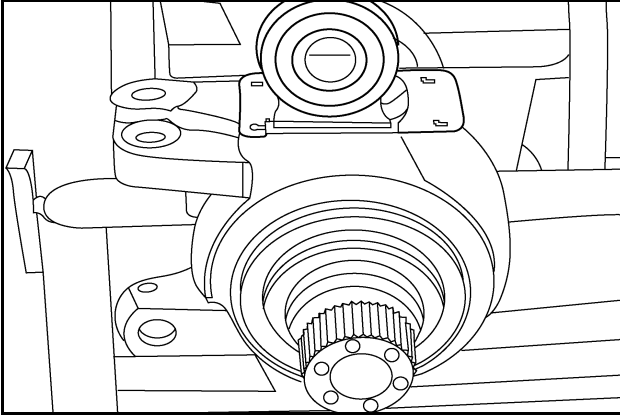
**NOTE:** The same thickness king pin shims can be used on top and bottom to serve as a starting point to determine the new shim packs required.

### STEP 70



RR98K070

Install the king pin caps. Evenly tighten the bolts in a crossing pattern to a torque of 156 to 170 Nm (115 to 125 lb. ft.).

**STEP 71**

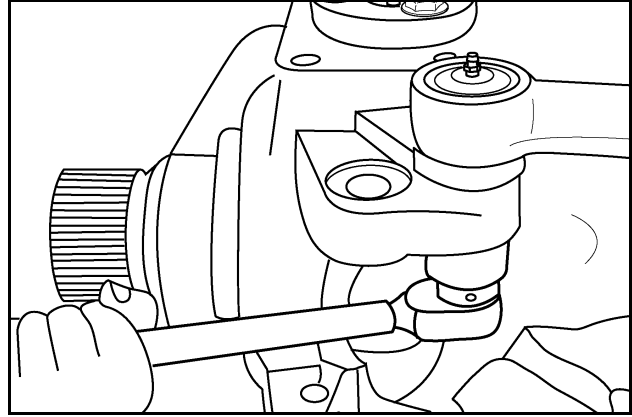
RR99K247

Place an inclinometer on the top machined surface of the knuckle and level the assembly to within  $\pm 2$  degrees of zero.

Rotate the steering knuckle clockwise and counterwise several times before the torque to rotate measurement is taken. Select a kingpin bearing cap bolt and place a torque wrench on the bolt. Record the torque required to rotate the knuckle in the clockwise direction, and the torque required to rotate the knuckle in the counterclockwise direction. Average the two readings. The torque must be in the range of 34 to 74 Nm (25 to 55 lb. ft.).

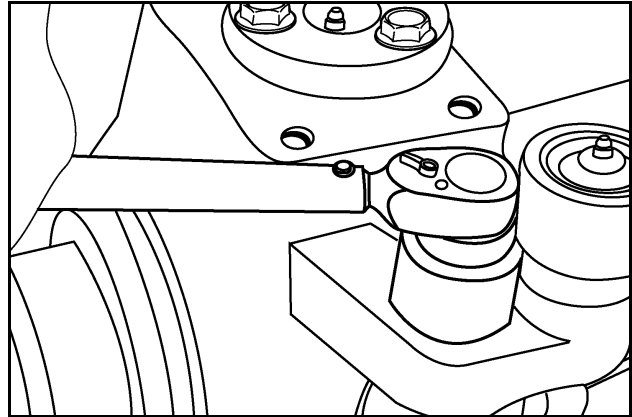
Add shims to decrease the torque effort or subtract shims to increase torque effort as required. Always shim the upper and lower king pins evenly. Repeat the procedure until the torque required to rotate the steering knuckle is within the specification.

When the final adjustments are complete, apply antiseize lubricant to the king pin bore of the steering knuckle. Lubricate the king pin through the grease fitting on the kingpin bearing cap. Repeat the installation procedure for the opposite steering knuckle, if removed.

**STEP 72**

RR98K130

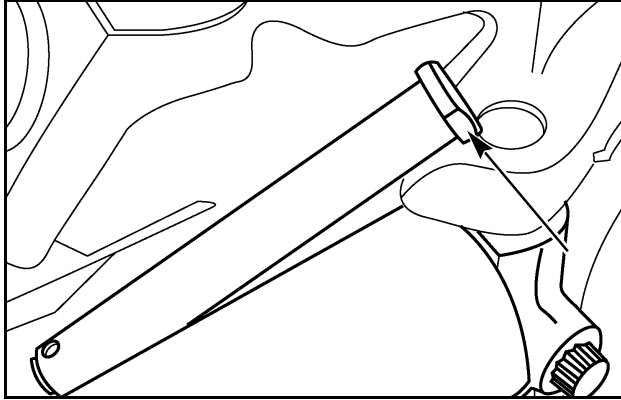
Clean the tie rod end stud and the tapered bore in the steering knuckle. Install the tie rod seal and washer. Install the tie rod and tighten the slotted nut to a torque of 372 Nm (275 lb. ft.). If necessary, advance the slotted nut until the cotter pin can be installed. Install the opposite tie rod end, if removed.

**STEP 73**

RR98K107

Clean the steering cylinder tapered bore and steering cylinder socket stud. Install and tighten the steering cylinder slotted nut to a torque of 272 Nm (200 lb. ft.). If necessary, advance the slotted nut until the cotter pin can be installed.

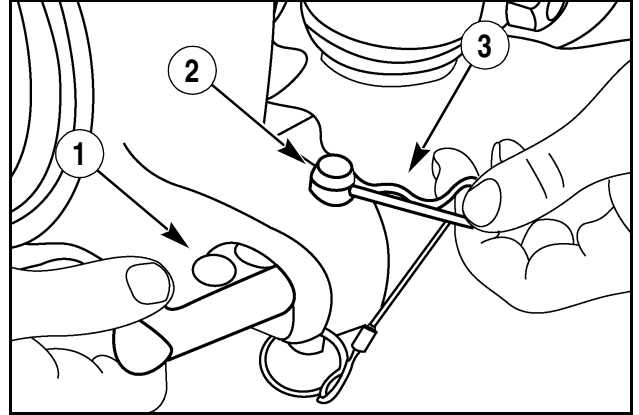
## STEP 74



RR98K071

Lubricate the two steering cylinder clevis pin bushing O-rings with grease. Make sure an O-ring is installed on each side of the steering cylinder at the clevis pin bushings. Make sure the flat on the head of the clevis pin is turned toward the axle housing. Install the clevis pin. Insert a cotter pin through the clevis pin. Install the steering cylinder on the opposite side of the FWD axle, if removed.

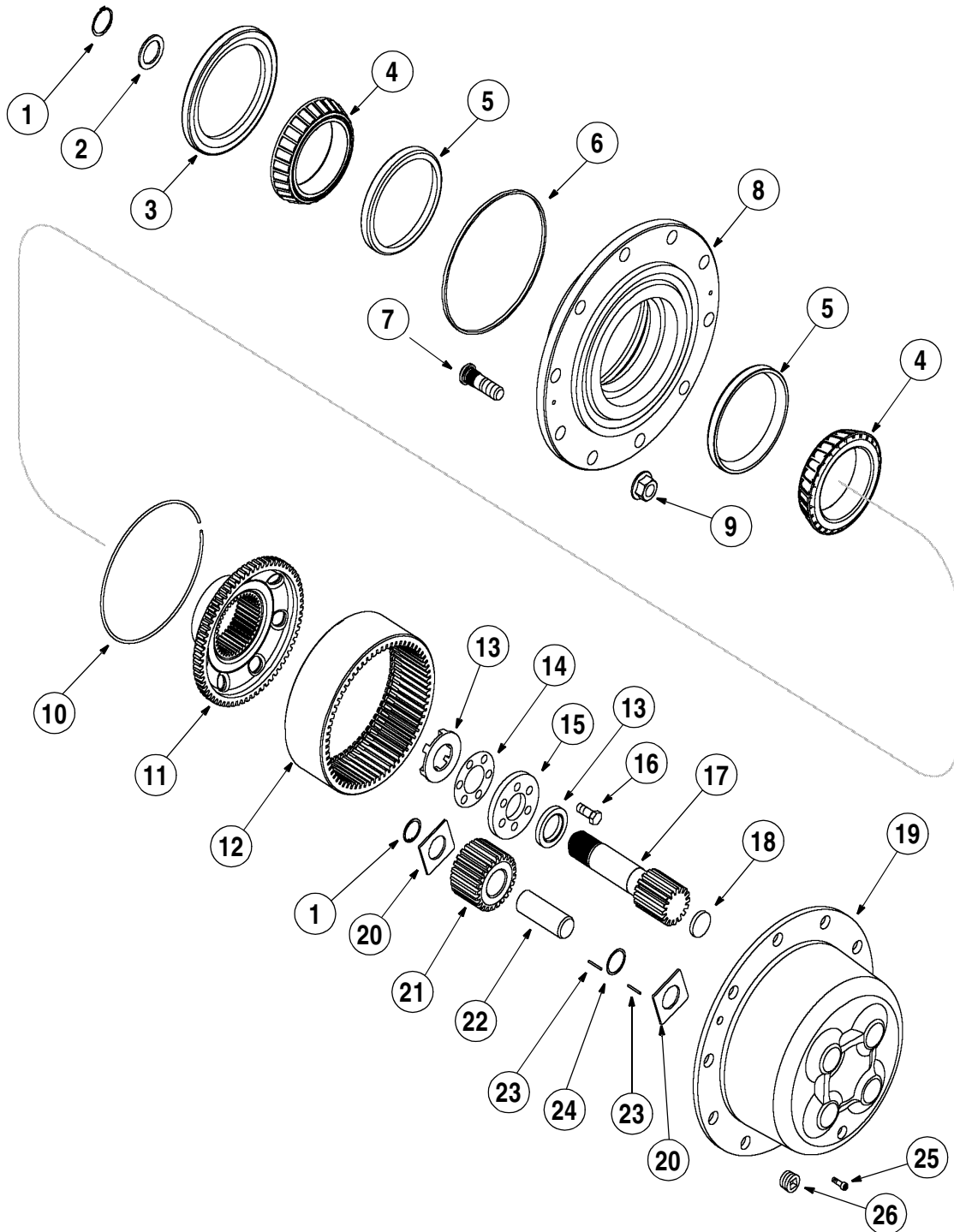
## STEP 75



RR98K105

Use the identifying mark made during disassembly to position the wheel stop. Install the wheel stop (1), the clevis locking pin (2), and the clevis retaining pin (3). Install the wheel stop on the opposite side of the FWD axle, if removed.

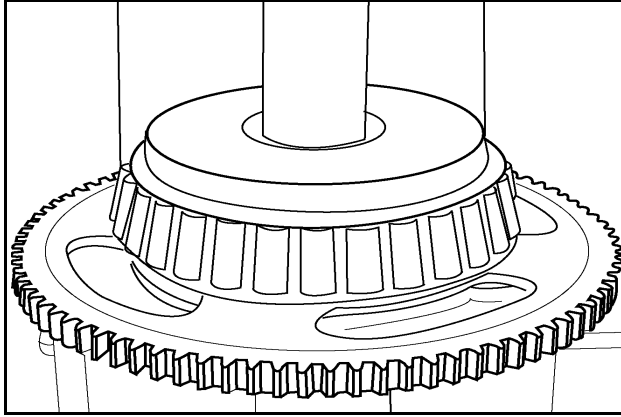
## PLANETARY HUB ASSEMBLY



RI05M071

- |                                 |                                      |                         |
|---------------------------------|--------------------------------------|-------------------------|
| 1. RETAINING RING               | 10. WIRE RETAINING RING              | 19. PLANETARY HUB COVER |
| 2. WASHER                       | 11. PLANETARY GEAR HUB               | 20. THRUST WASHER       |
| 3. PLANETARY HUB SEAL           | 12. PLANETARY RING GEAR              | 21. GEAR                |
| 4. BEARING CONE                 | 13. THRUST WASHER (10 BOLT HUB ONLY) | 22. PIN                 |
| 5. BEARING CUP                  | 14. SHIM                             | 23. NEEDLE BEARING      |
| 6. DUST SEAL (TWELVE BOLT ONLY) | 15. RETAINING PLATE                  | 24. SPACER              |
| 7. STUD                         | 16. BOLT                             | 25. HUB RETAINING BOLT  |
| 8. PLANETARY HUB                | 17. PLANETARY GEAR SHAFT             | 26. PLUG                |
| 9. NUT                          | 18. BUTTON                           |                         |

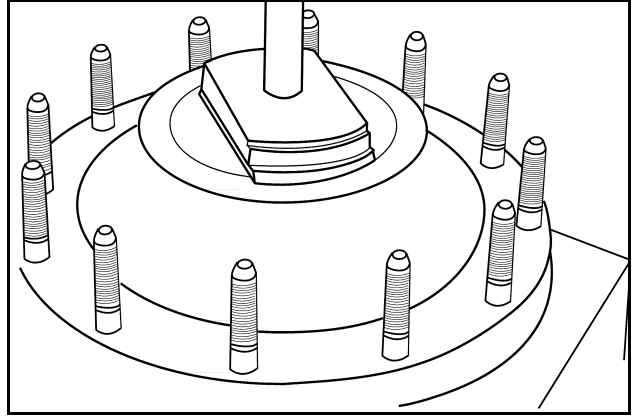
### STEP 76



RR98K104

Lubricate the inner diameter of the outer planetary hub bearing cone with Case 135 H EP SAE 85W-140 Gear Lubricant. Place the planetary gear hub in a press. Use the proper step plate adapter to install the bearing cone on the gear hub.

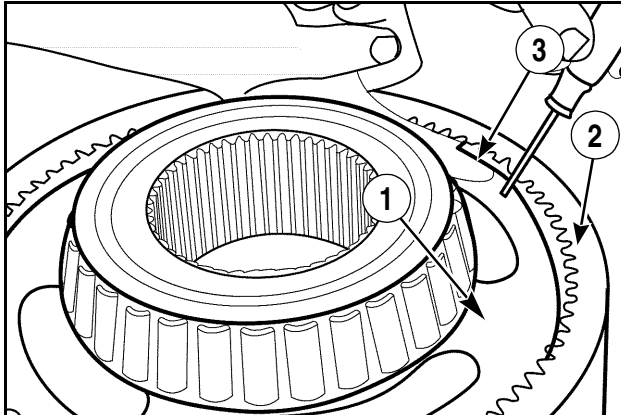
### STEP 78



RD02J038

Clean and inspect the planetary hub. Lubricate the outer bearing cup with Case 135 H EP SAE 85W-140 Gear Lubricant. Place the hub in a press. Use a suitable bearing cup installer to install the outer bearing cup in the hub.

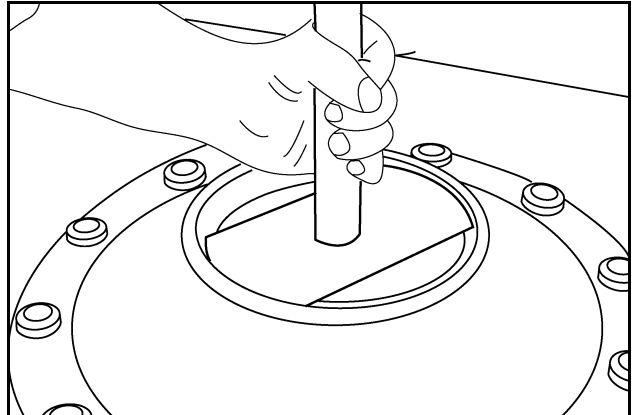
### STEP 77



RD02J037

install the planetary gear hub (1) in the planetary ring gear (2). Install the wire retaining ring (3) in the ring gear groove.

### STEP 79

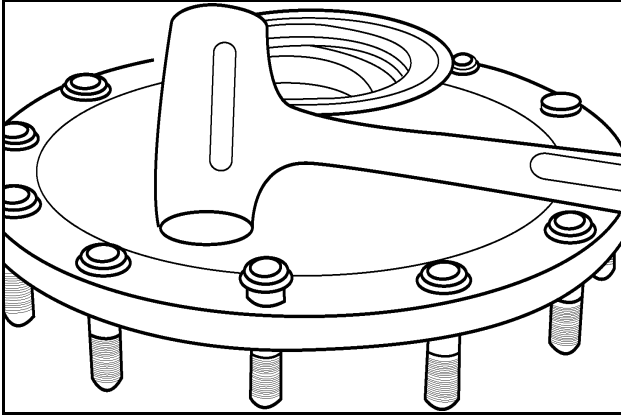


RR98K125

Turn the planetary hub over. Lubricate the inner bearing cup with CASE 135 H EP SAE 85W-140 Gear Lubricant. Use a suitable bearing cup installer to press the inner bearing cup into the hub.



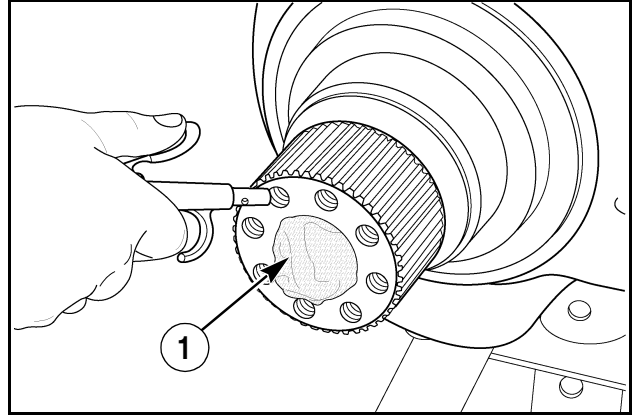
### STEP 80



RR98K081

Install new wheel studs, if necessary.

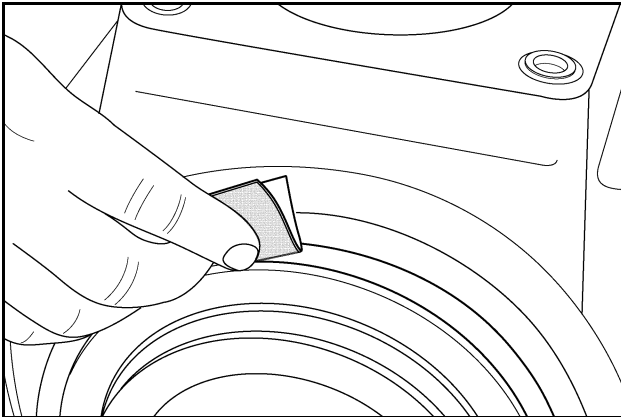
### STEP 83



RD05J176

Place a shop towel in the center of the steering knuckle (1) and clean the bolt holes with compressed air. Remove the towel.

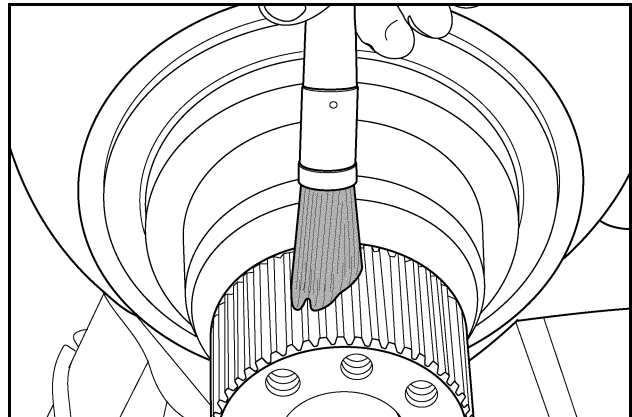
### STEP 81



RD05J173

**TWELVE BOLT AXLE ONLY.** Thoroughly clean the dust seal seating area.

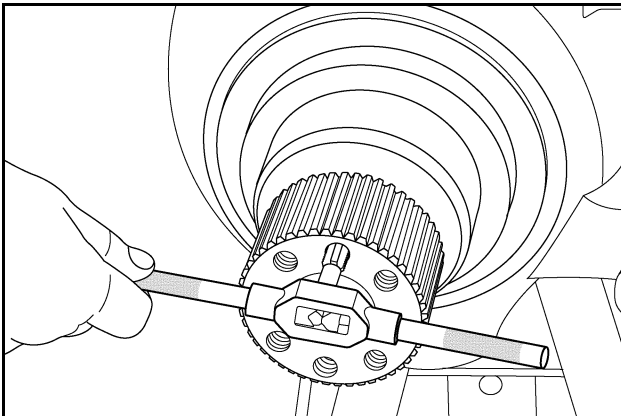
### STEP 84



RD05J174

Thoroughly clean the steering knuckle.

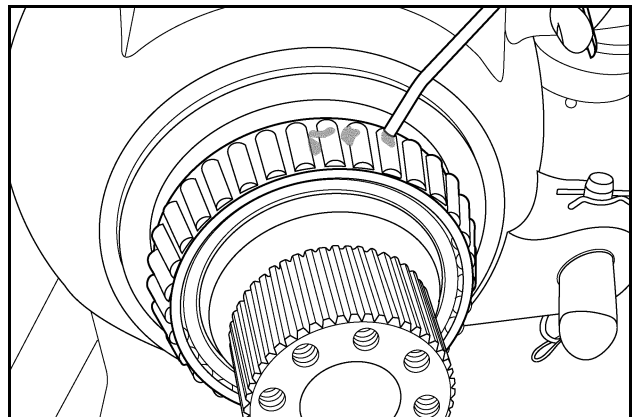
### STEP 82



RD05J175

Clean the bolt holes in the steering knuckle with a tap and Loctite® Safety Solvent.

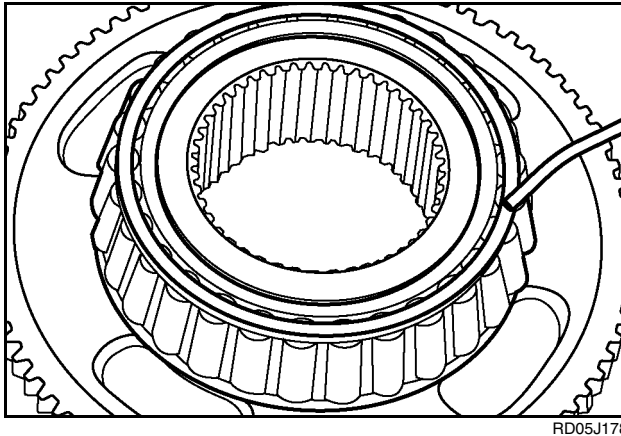
### STEP 85



RD05J179

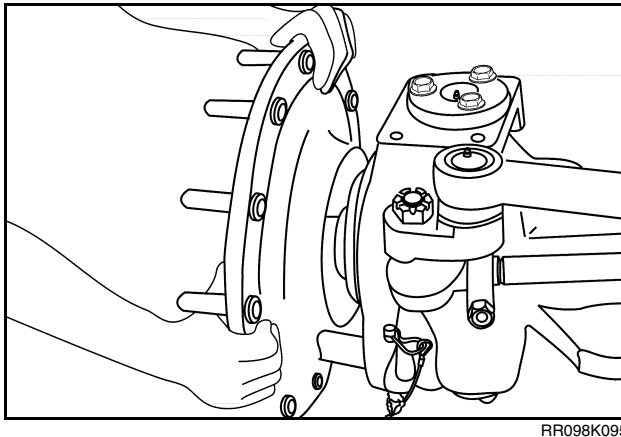
Install the bearing and **LIGHTLY** coat the bearing with a light multipurpose oil.

### STEP 86



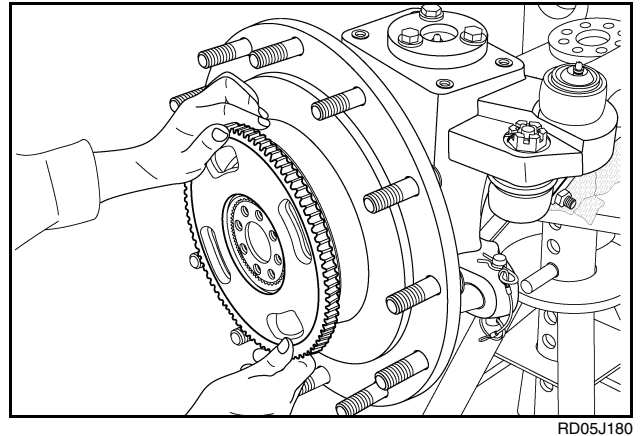
LIGHTLY coat the outer hub bearing with a light multipurpose oil.

### STEP 87



Install the planetary hub.

### STEP 88

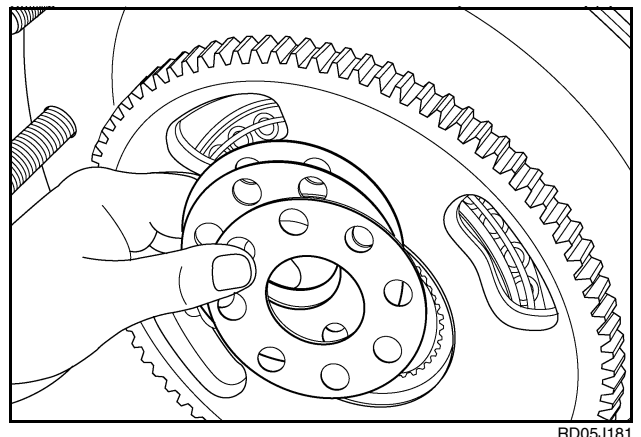


Install the planetary gear hub.

**NOTE:** If any of the hub components have been replaced (other than the hub oil seal), the procedure for shimming the planetary hub and adjusting the rolling torque must be followed. Reuse some of the removed shims, if possible. If only the hub oil seal has been replaced, reuse all removed shims (if not damaged) and check the rolling torque of the planetary hub to make sure it is within the specification.

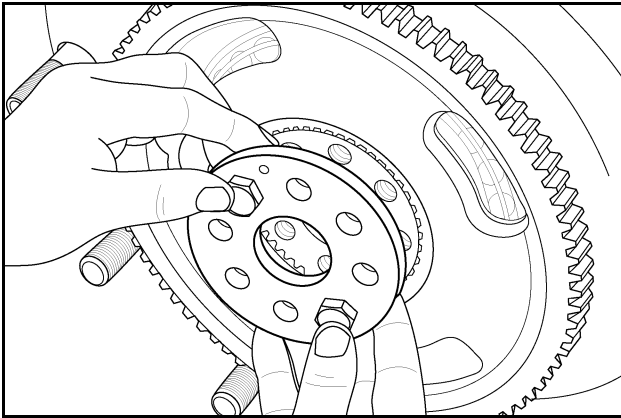
**NOTE:** The rolling torque of the planetary hub bearings must be taken **WITHOUT** the hub seal installed.

### STEP 89



Install the hub shim pack.

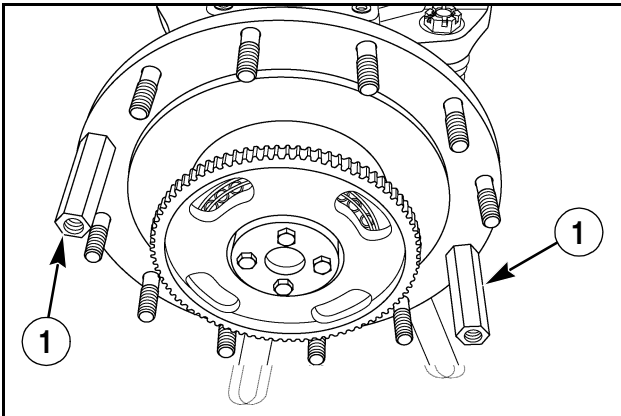
### STEP 90



RD05J182

Install the retaining plate with four bolts. Torque bolts to 110 to 125 Nm (82 to 92 lb. ft.)

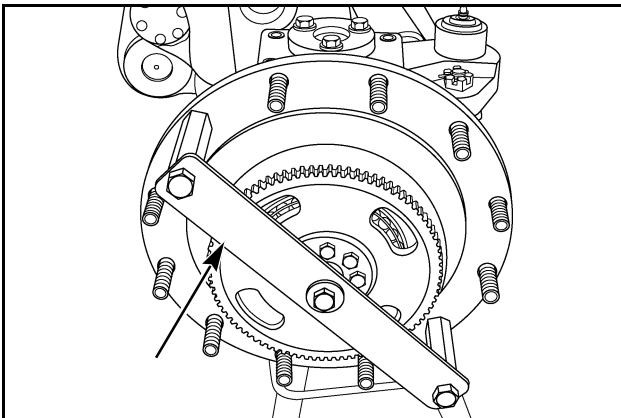
### STEP 91



RD05J183

Install the spacers (1).

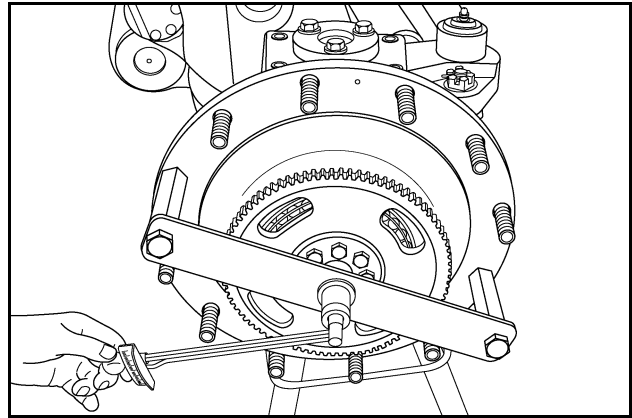
### STEP 92



RD05J185

Install the spanner plate. Rotate the hub several times in both directions to set the bearings.

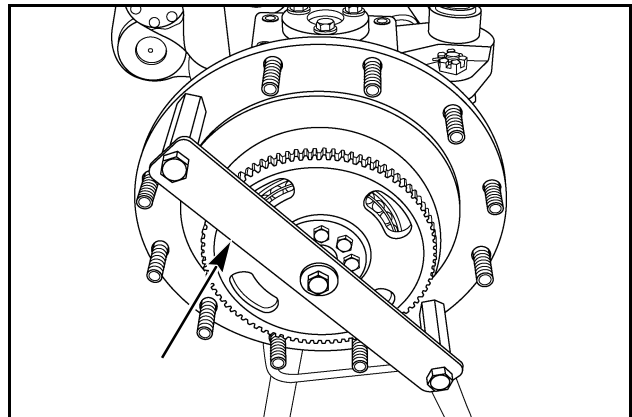
### STEP 93



RD05J184

The rolling torque reading should be 11.4 to 16 Nm (100 to 140 lb. in.). If required, add shims to decrease the torque value, or subtract shims to increase the torque value.

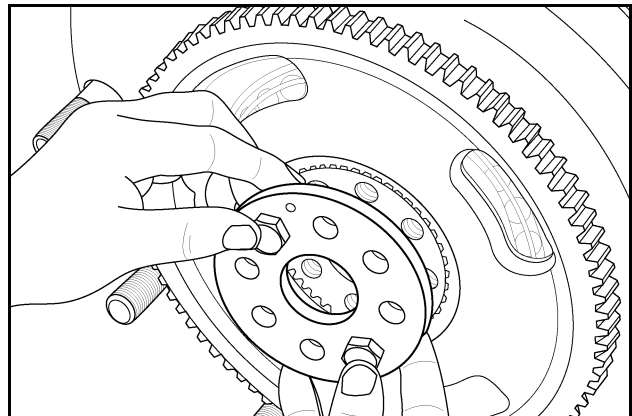
### STEP 94



RD05J185

Once the rolling torque has been established, remove the spanner plate.

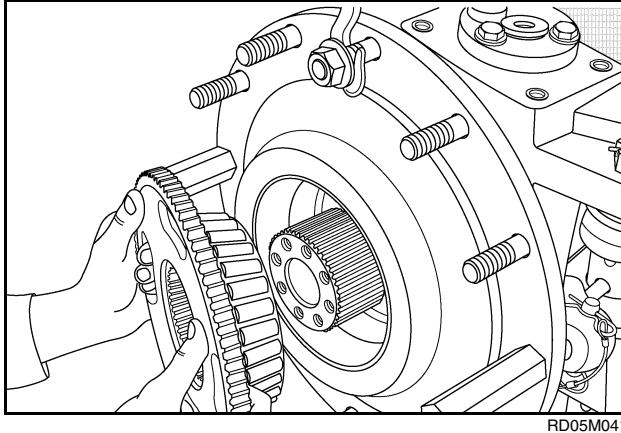
### STEP 95



RD05J182

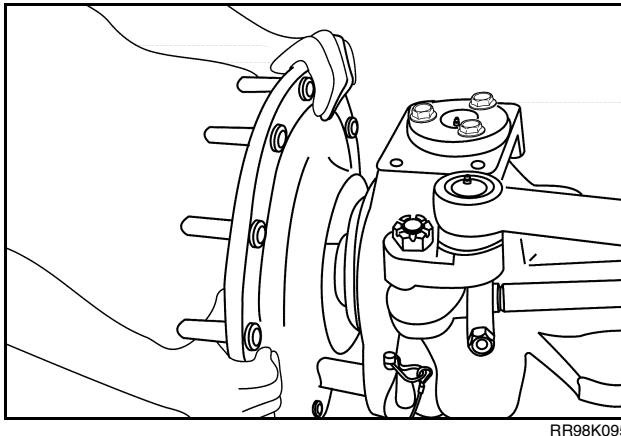
Remove the retaining plate and shim pack.

### STEP 96



Remove the planetary gear hub.

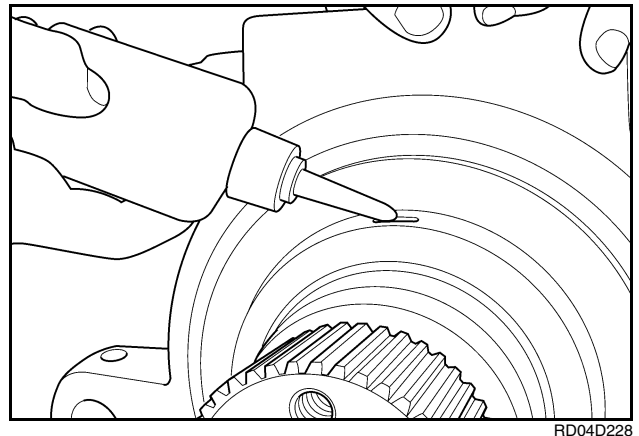
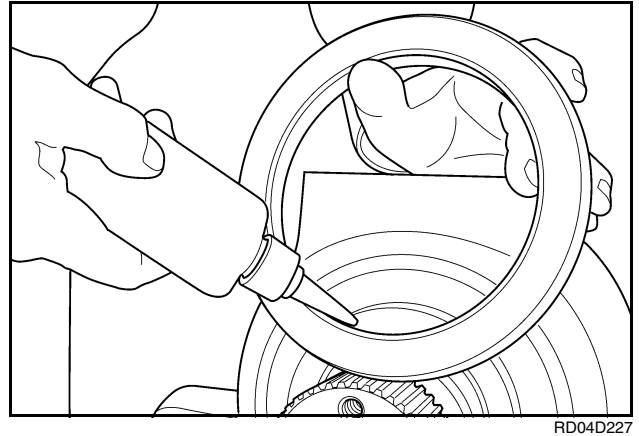
### STEP 97



Remove the planetary hub.

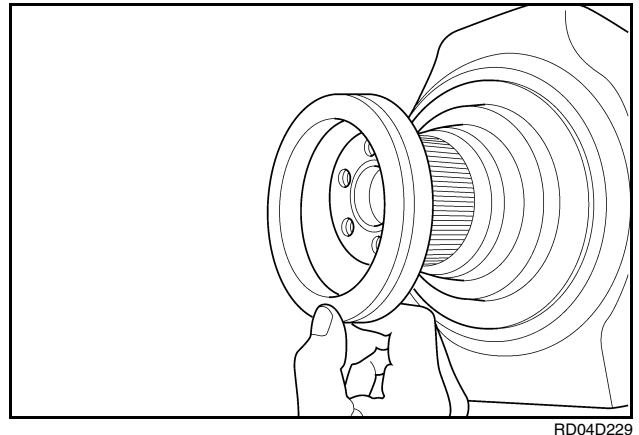
## Ten Bolt Axle Only

### STEP 98



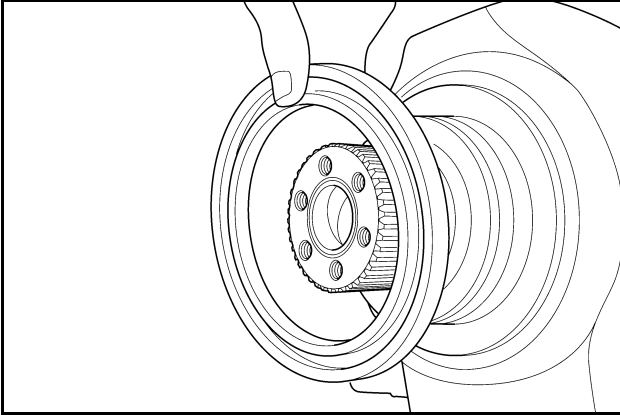
Clean the spindle in the area of seal and bearing mounting so they are free of oil, grease and dirt. Apply Loctite® 680 to the seal ID and to the spindle OD where the seal is to be mounted. Spread the Loctite® evenly around the entire spindle and seal.

### STEP 99

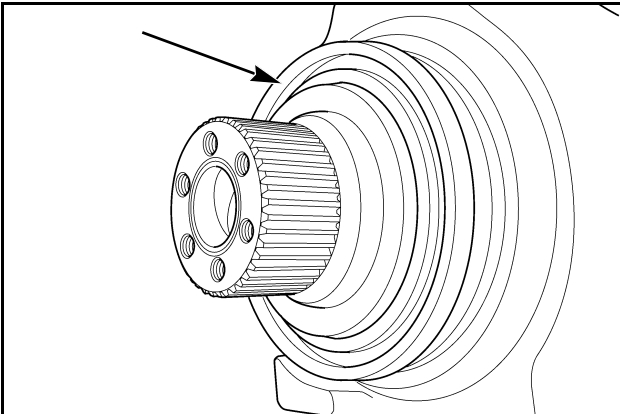


Install the pilot tool onto the spindle.

### STEP 100



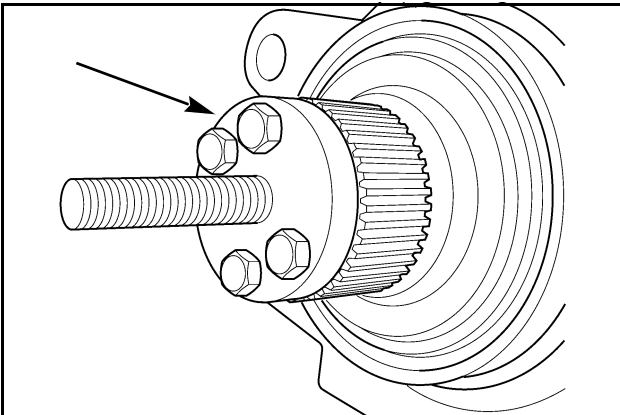
RD04D230



RD04D231

With the rubber facing away from the spindle, install the seal over the pilot tool.

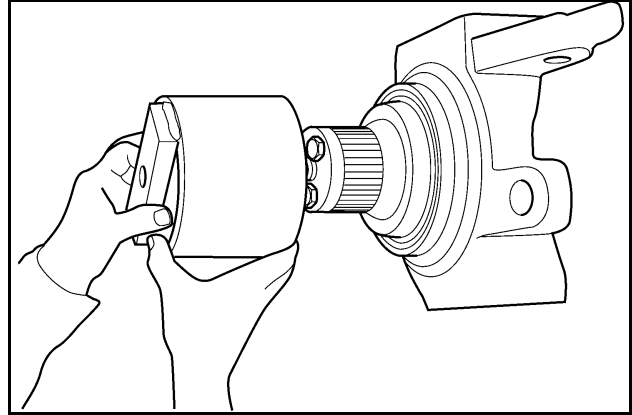
### STEP 101



RD04D232

Install the flanged tool with threaded rod onto the spindle end face. Using four of the retainer plate mounting bolts, secure the tool as shown.

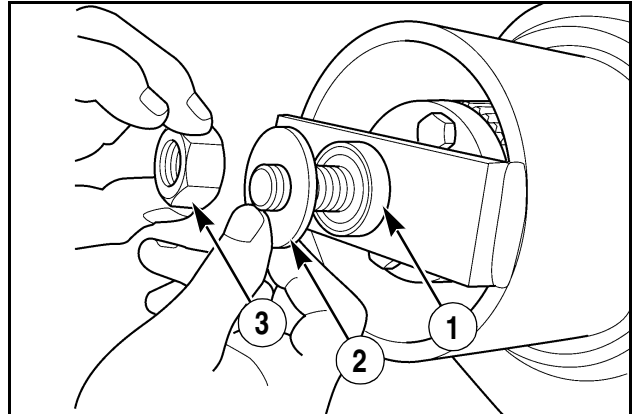
### STEP 102



RD04D233

Install the seal driver tool over the pilot tool so that it is resting on the seal.

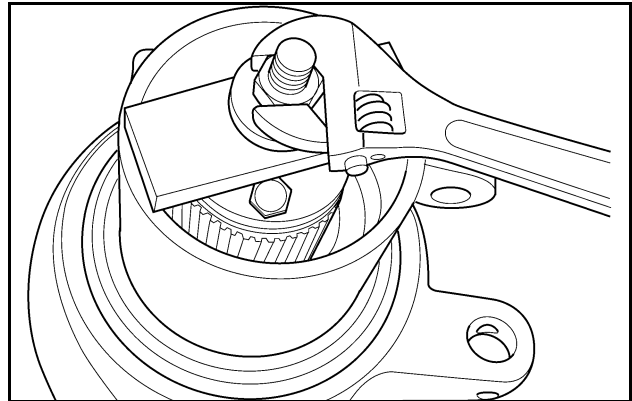
### STEP 103



RD04D234

Install the thrust bearing (1), flat washer (2) and nut (3) onto the threaded rod.

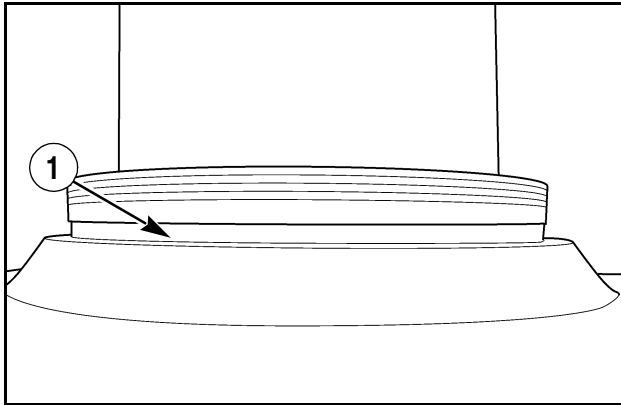
### STEP 104



RD04D235

Use a wrench to tighten the nut.

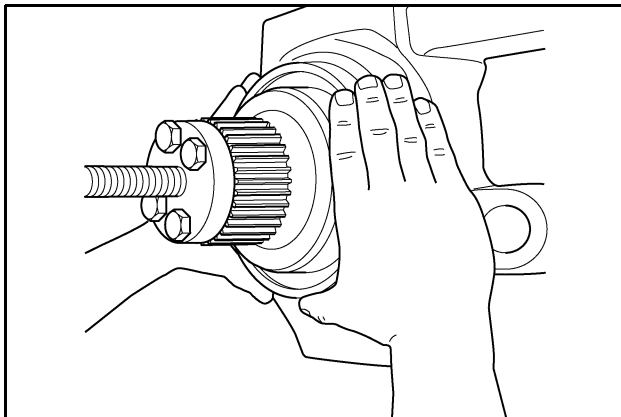
### STEP 105



RD04D236

While tightening the nut, make sure the seal is squarely aligned on the spindle. Continue advancing the nut until a noticeable increase in torque is noted. There may be a very small gap (1) (0.025 to 0.50 MM.) between the seal and the spindle shoulder. This is a normal condition.

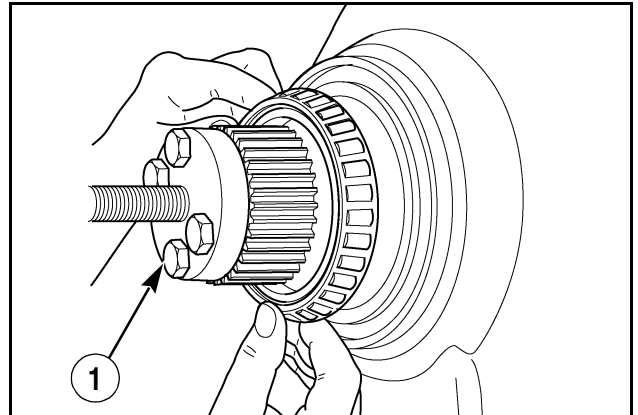
### STEP 106



GRAPHIC\_ID\_NUMBER

Once the seal is installed, use both hands to rotate the outer portion of the seal. The seal should turn, but may require some effort.

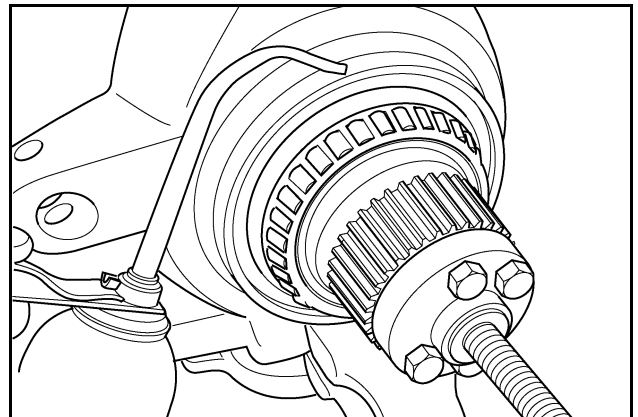
### STEP 107



RD04D238

Remove all the installation tools except the for the flanged tool (1). Install the bearing cone onto the spindle.

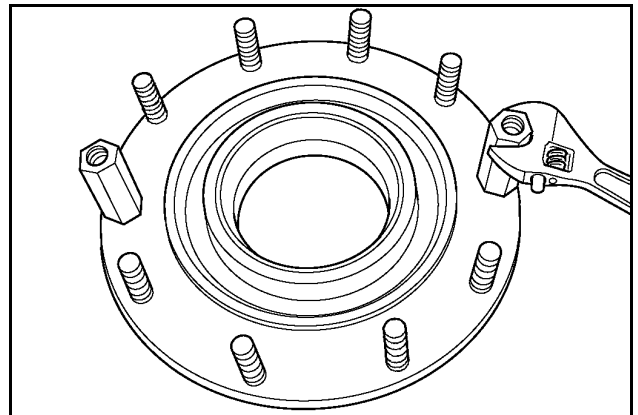
### STEP 108



RD04D239

Apply a THIN film of oil on the OD of the seal. Spread the oil evenly around the entire seal area.

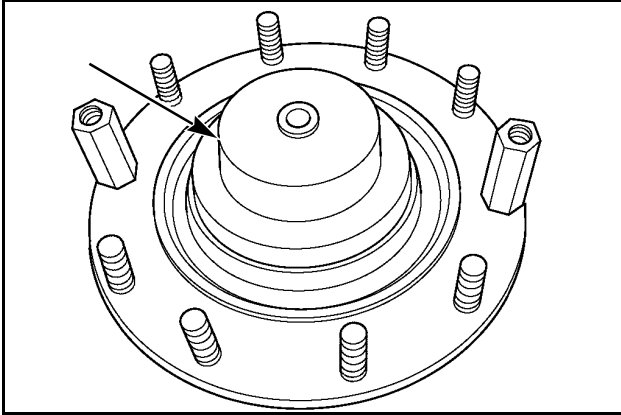
### STEP 109



RD04D240

Install the hexagon adapters to the wheel studs 180 degrees apart. Tighten the adaptors.

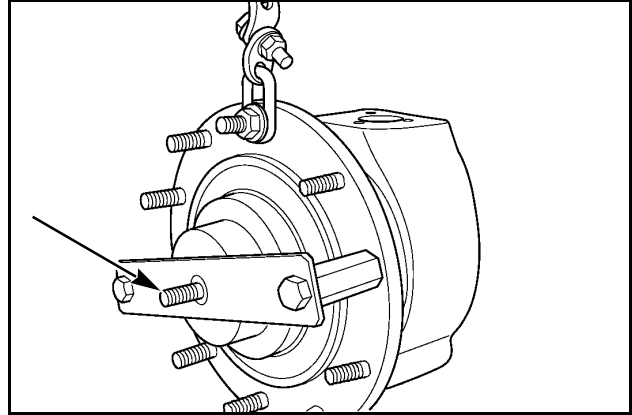
### STEP 110



RD05D241

Place the large aluminum pilot tool onto the bearing cup with the small pilot diameter facing up.

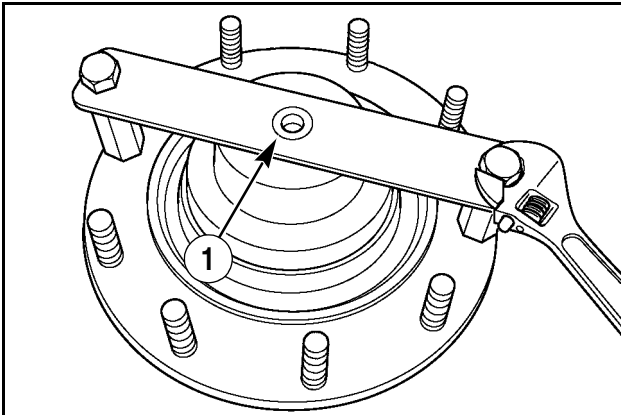
### STEP 113



RD04D245

Push the hub (by hand) onto the spindle until contact with the seal is made. The threaded rod should be exposed.

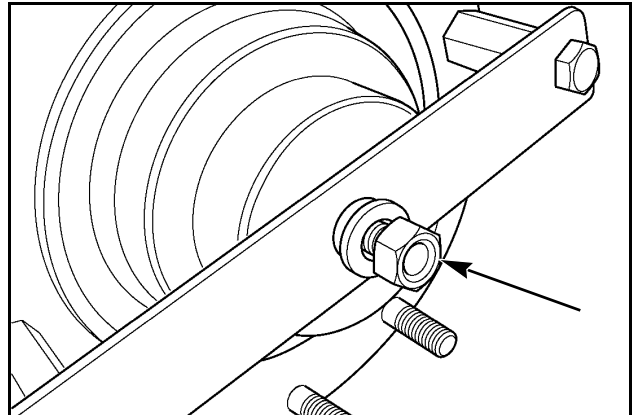
### STEP 111



RD05D242

Align the flat bar with the small pilot diameter (1) and fasten to the adapters using the bolts provided.

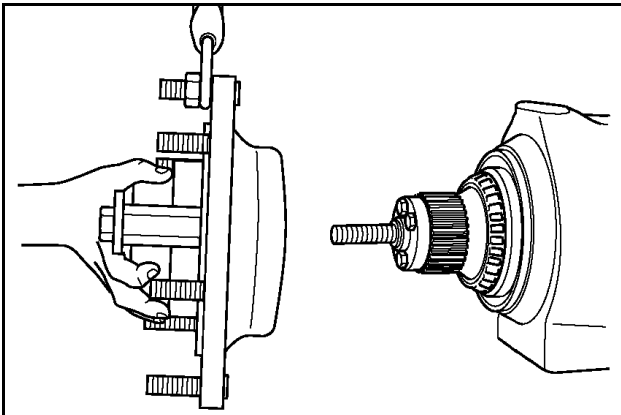
### STEP 114



RD04D246

Install a washer and nut onto the threaded rod.

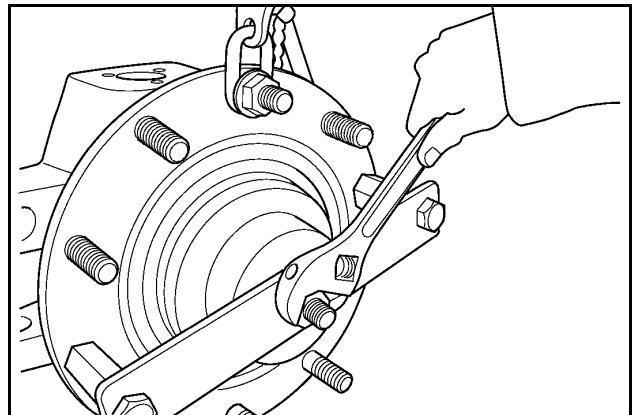
### STEP 112



RD04D243

Use a hoist (or other suitable means) and lift the hub with mounted alignment tools and align with the spindle.

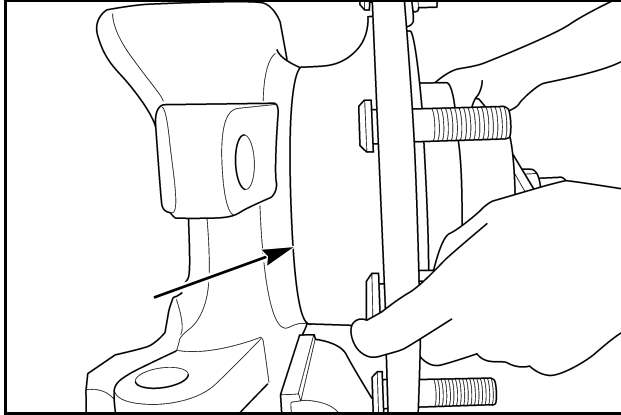
### STEP 115



RD04D247

Tighten until a noticeable increase in torque is required to turn the nut. At this point the seal should be fully seated.

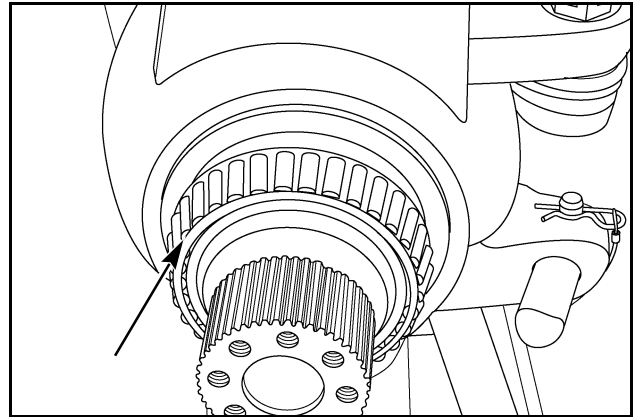
### STEP 116



There should be a small gap (approximately 1 MM.) between the spindle and the hub. Make sure that the hub can be rotated by hand.

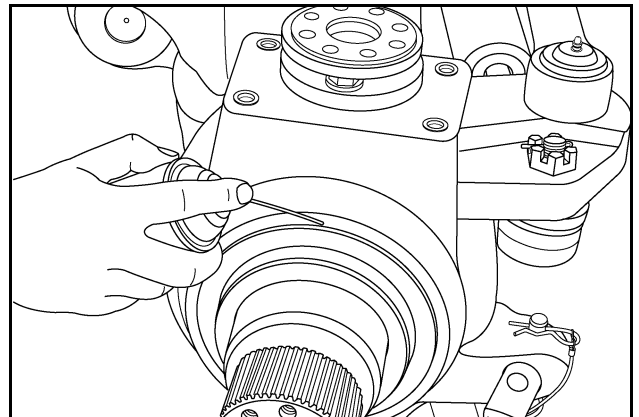
### Twelve Bolt Axle Only

### STEP 117



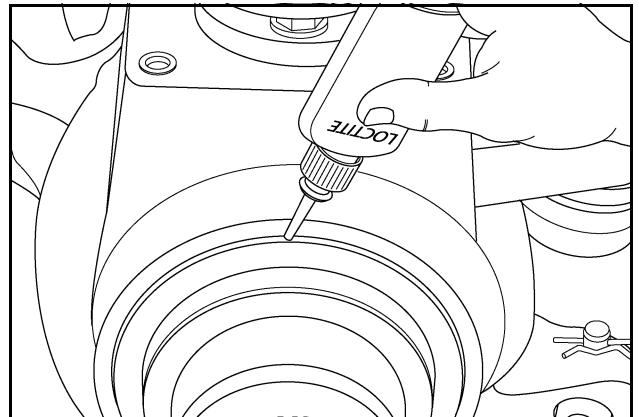
Remove the inner bearing.

### STEP 118



Thoroughly clean and dry the dust seal seating area.

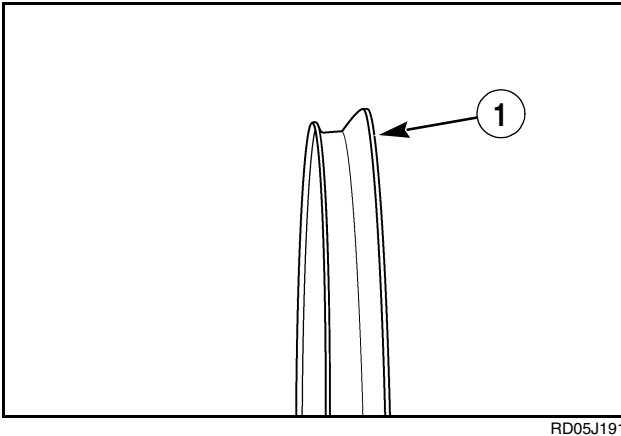
### STEP 119



Apply a thin bead of Loctite® 680 to the dust seal seating area.



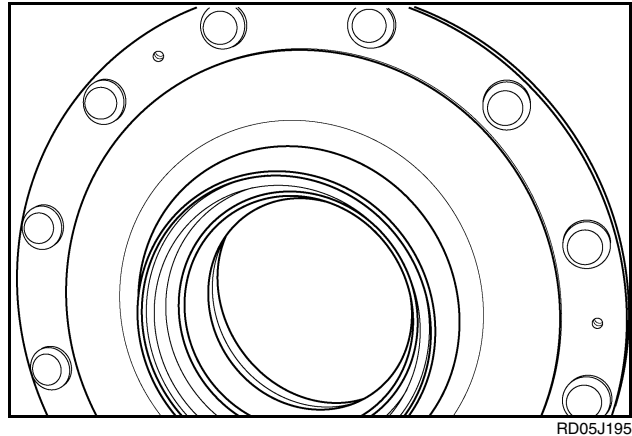
## STEP 120



RD05J191

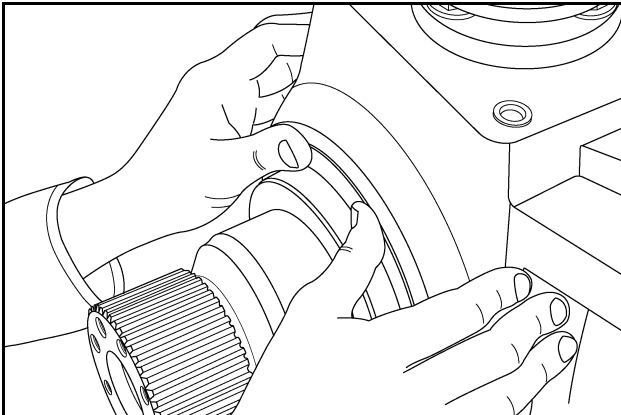
When installing the dust seal make sure the larger lip (1) is facing outboard.

## STEP 122



RD05J195

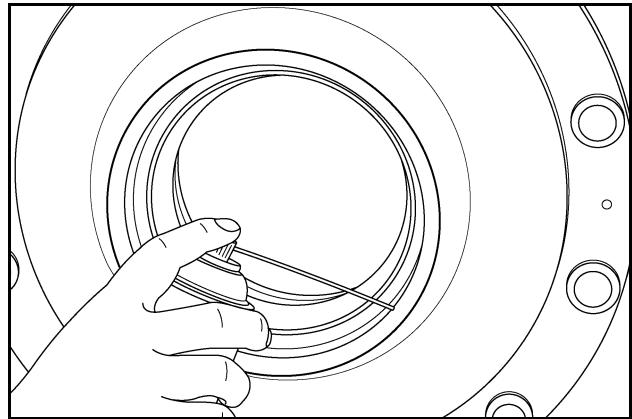
Place the hub in a suitable vise.



RD05J188

Hand press the dust seal into place.

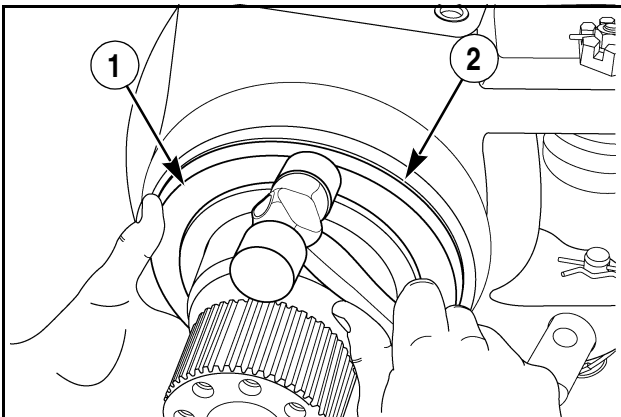
## STEP 123



RD05J194

Thoroughly clean and dry the seal counterbore.

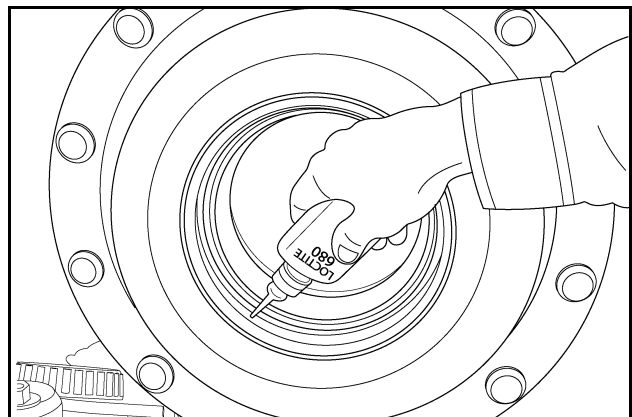
## STEP 121



RD05J190

Place dust seal installation ring (1) against the seal (2) and LIGHTLY tap around the ring to set the seal against the machined surface.

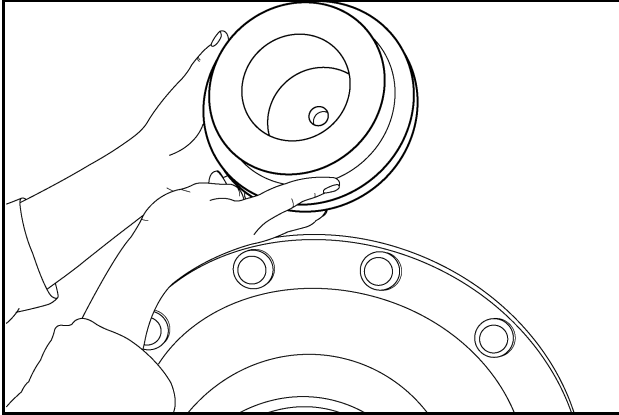
## STEP 124



RD05J196

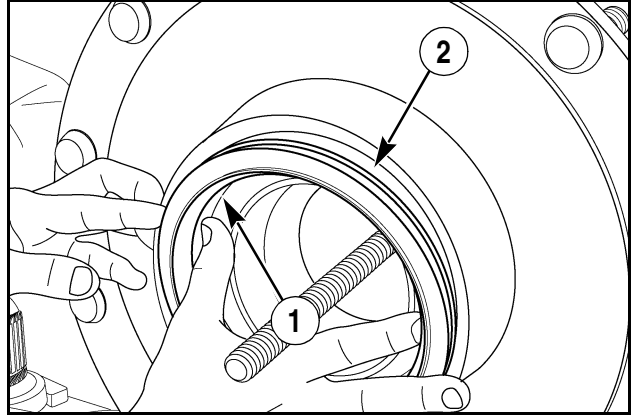
Apply a thin bead of Loctite® 680 to the seal counterbore.

**STEP 125**



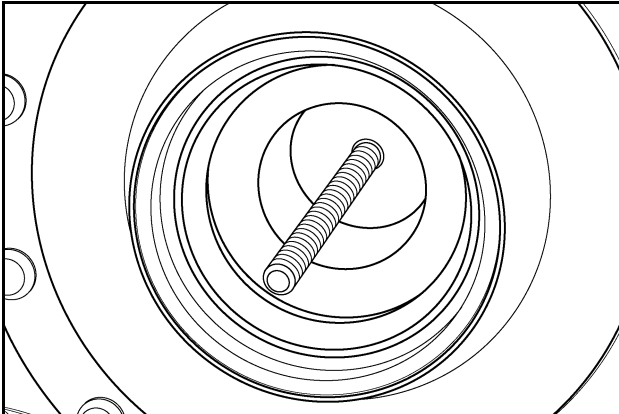
Place the centering cup into the opposite side of the hub.

**STEP 128**



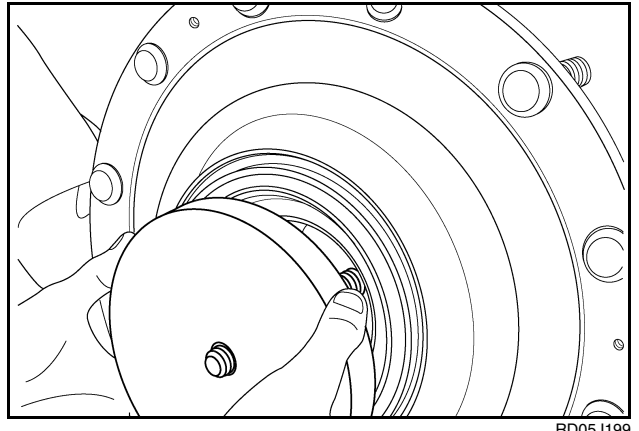
While holding the bearing (1) set the oil seal (2) into place.

**STEP 126**



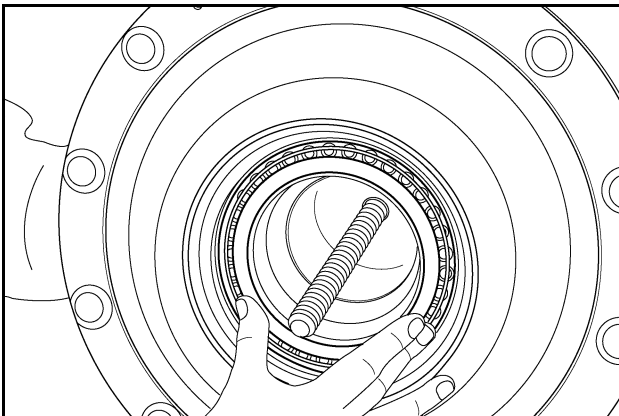
Install the threaded rod.

**STEP 129**



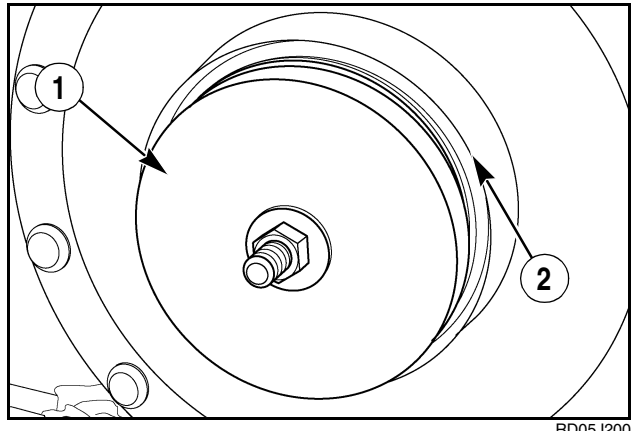
Place the seal driver over the threaded rod.

**STEP 127**



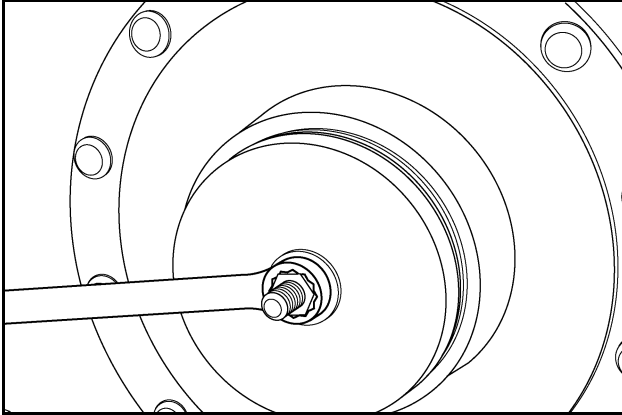
Set the inboard bearing into the hub cone.

**STEP 130**



Install a washer and nut and hand tighten. Make sure the seal driver (1) is centered on the seal (2).

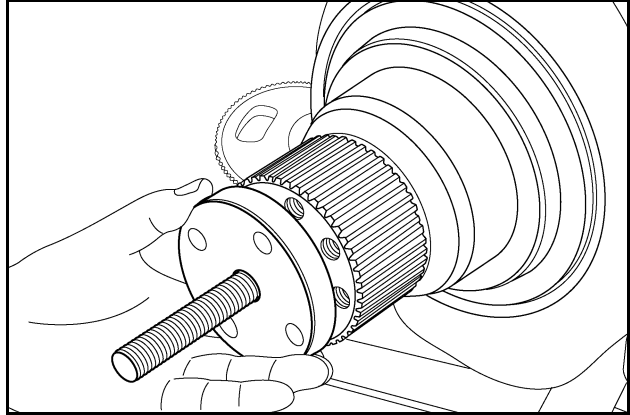
### STEP 131



RD05M026

Slowly draw seal into the hub.

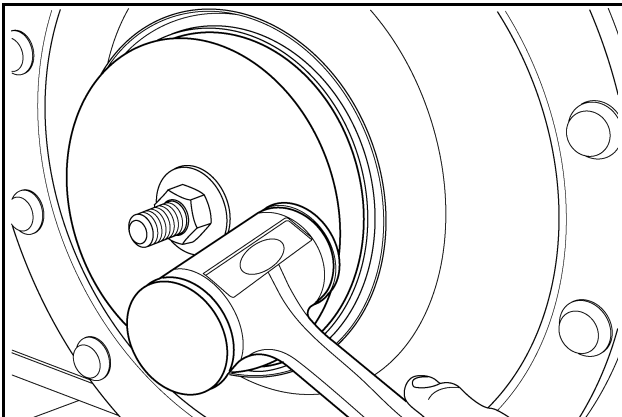
### STEP 134



RD05M030

Bolt the seal installation adapter over the end of the steering knuckle.

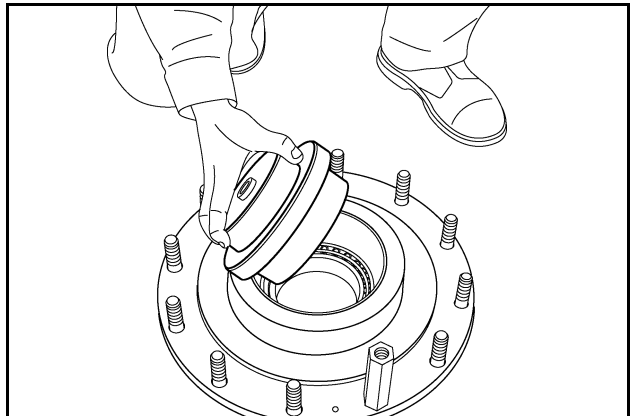
### STEP 132



RD05M027

If seal is not being drawn into the bore straight, tap on the installation tool to "square" the seal in the bore. Once seal is seated in the bore, remove the installation tools.

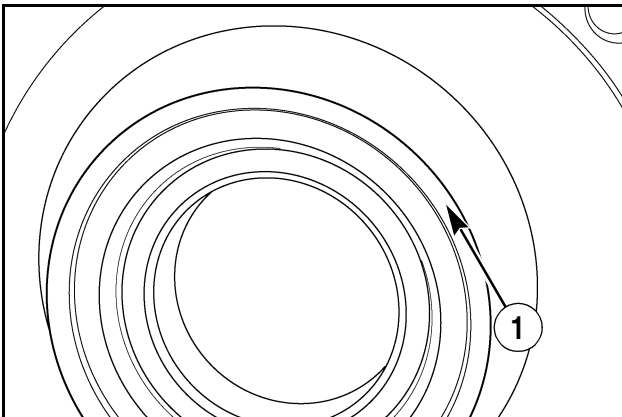
### STEP 135



RD05M031

Place the installation hub on the wheel hub.

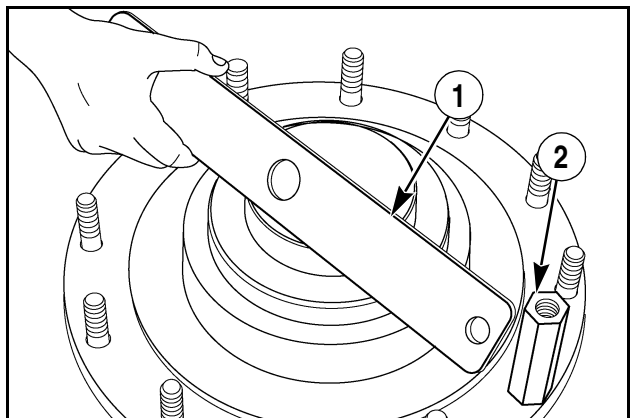
### STEP 133



RD02M029

Inspect the seal (1) to make sure it is fully seated in the bore. Remove the hub from the vise.

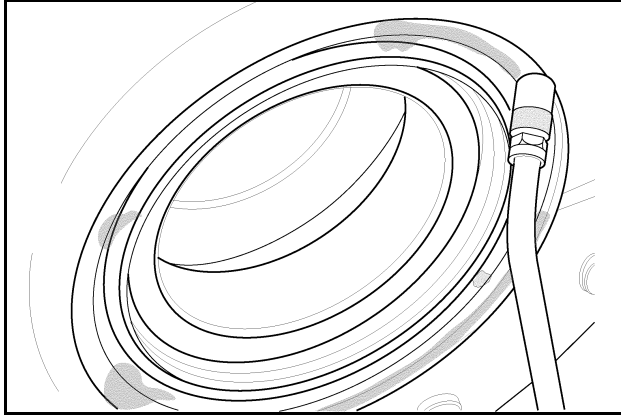
### STEP 136



RD05M032

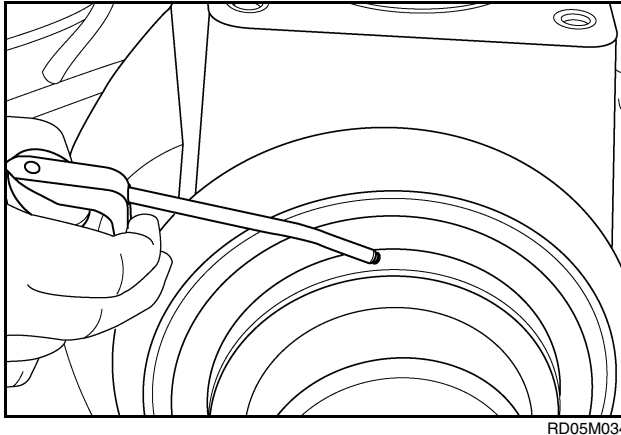
Bolt the spanner plate (1) to the spacers (2).

### STEP 137



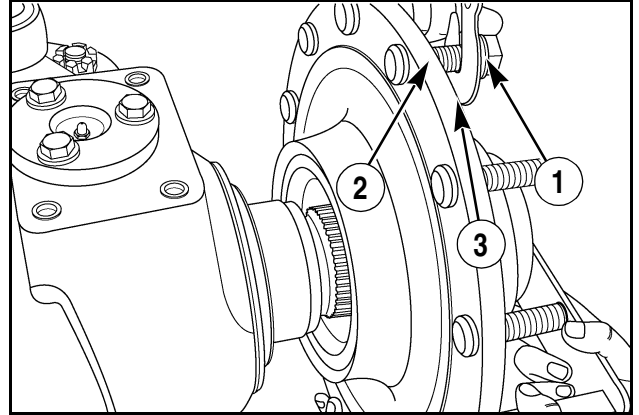
Apply a light coating of multipurpose grease to the dust sealing area on the wheel hub

### STEP 138



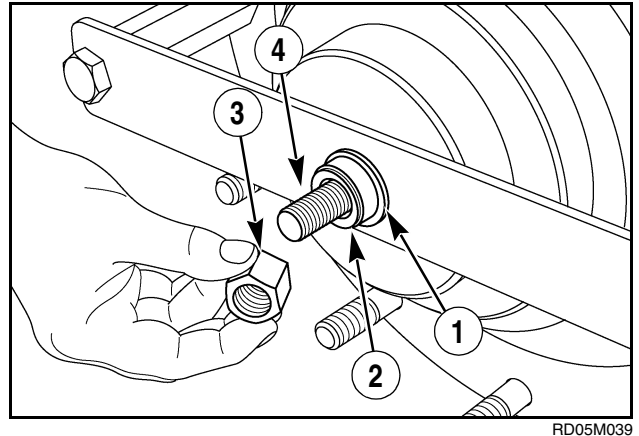
Apply a VERY LIGHT coating of light multipurpose oil to oil seal sealing area of the steering knuckle, or to the ID of the hub seal.

### STEP 139



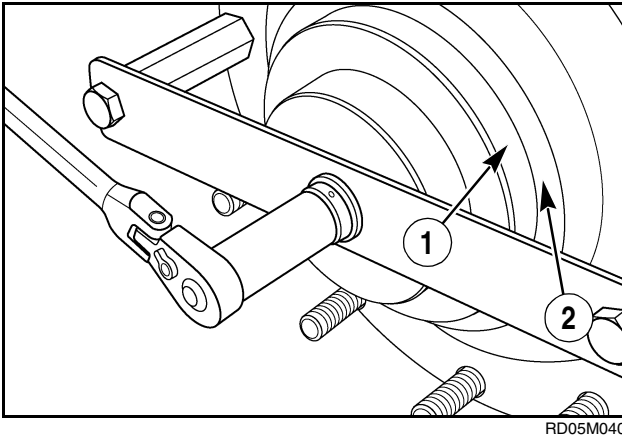
Install a wheel nut (1) on one of the hub wheel studs (2) and place a lifting device (3) on the stud. With an assistant, carefully guide the hub into place on the steering knuckle. Take care not to damage the seal or bearing.

### STEP 140



Install a washer (1), driver bearing (2) and nut (3).

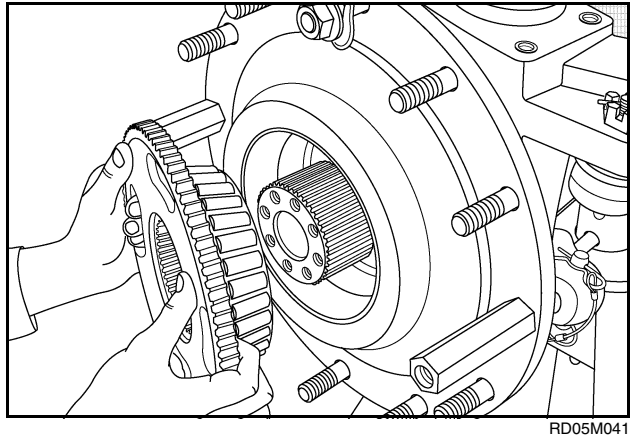
### STEP 141



Press the seal in until the shoulder (1) of the seal installation tool is bottomed against the hub (2). Remove the seal installation tool.

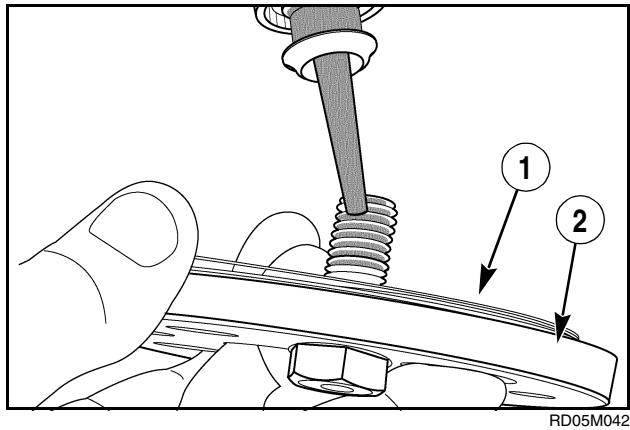
### All Axles

### STEP 142



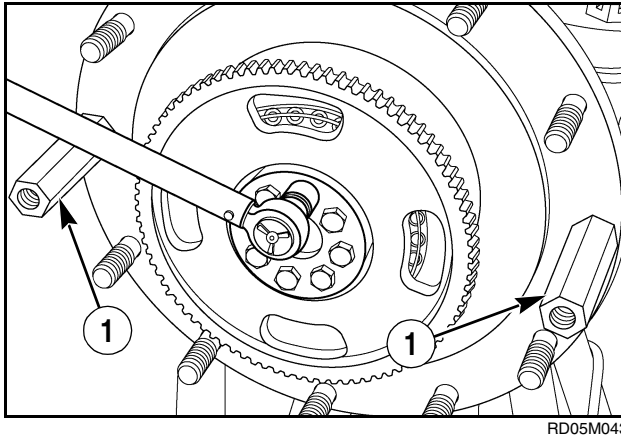
Install the planetary gear hub and bearing.

### STEP 143



Place the shim pack (1) on the retaining plate (2) and apply a bead of Loctite ® 271 to the new bolts.

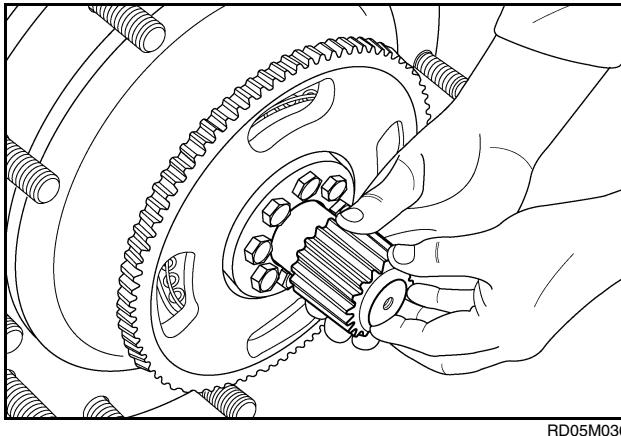
### STEP 144



Tighten the bolts to a torque of 110 to 125 Nm (82 to 92 lb. ft.) Remove the spacers (1).

**NOTE:** Twelve bolt planetary hub assembly shown. Install the thrust washer used on the ten bolt planetary hub assembly, before the installation of the shims.

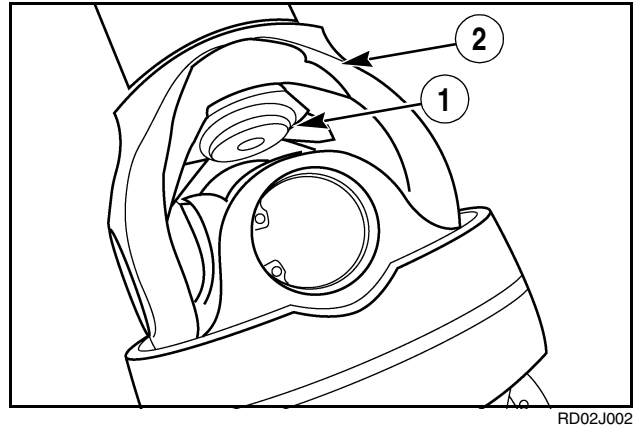
### STEP 145



Install the sun gear shaft.

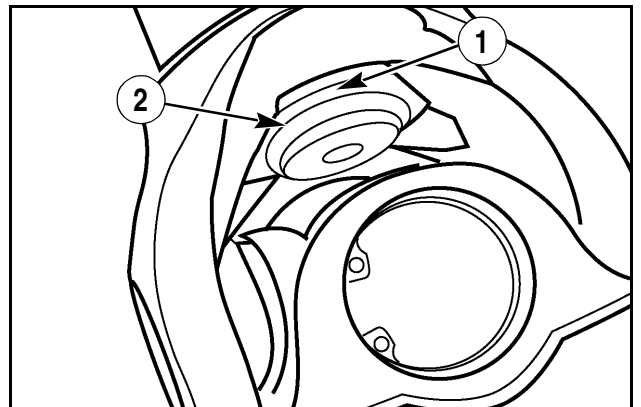
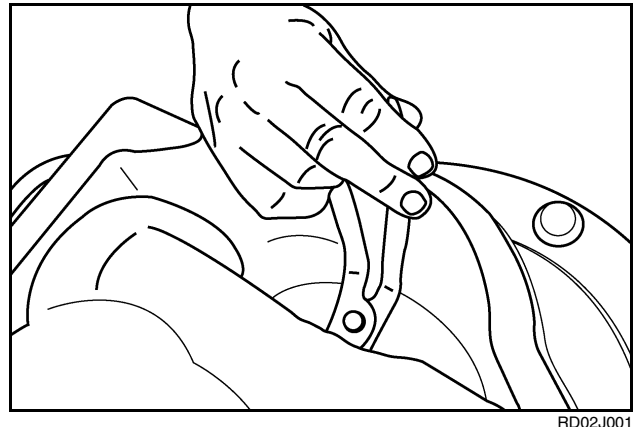
**NOTE:** On tractors equipped with 10 bolt hubs, install the thrust washer on the planetary gear shaft before installing the gear shaft,

### STEP 146



When installing the sun gear shaft (1) into the axle drive shaft yoke (2), the drive shaft will have to be lifted by hand to align the splines. Make sure the retaining ring in the spline of the outer yoke of the axle shaft is fully engaged in the ring groove on the sun gear shaft.

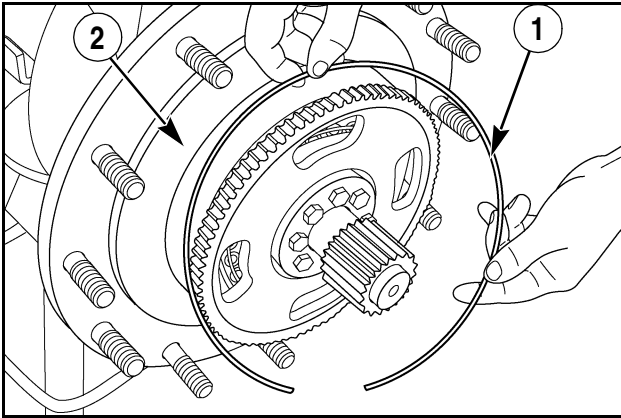
### STEP 147



Swivel the steering knuckle to gain access to the planetary gear shaft. Install the washer (1) on the planetary gear shaft. Use 380000805 Retaining Ring Pliers to install the retaining ring (2).

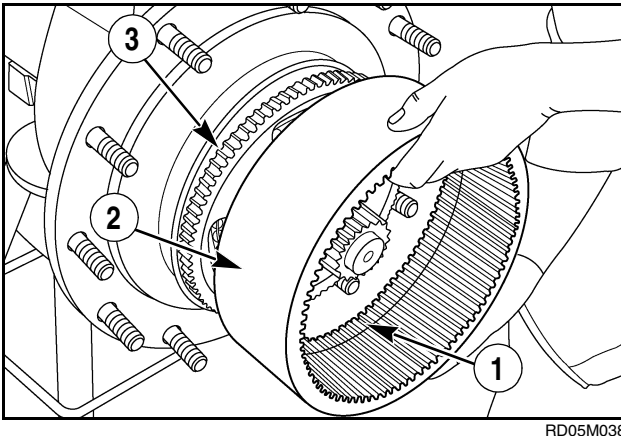
*Axle shaft removed for photographic purpose.*

### STEP 148



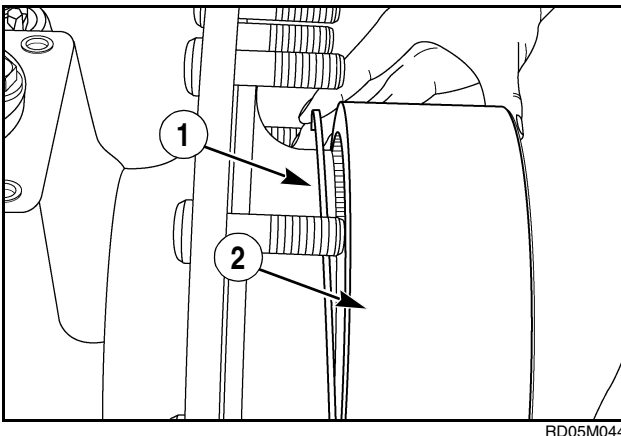
Place the wire retaining ring (1) over the hub (2).

### STEP 149



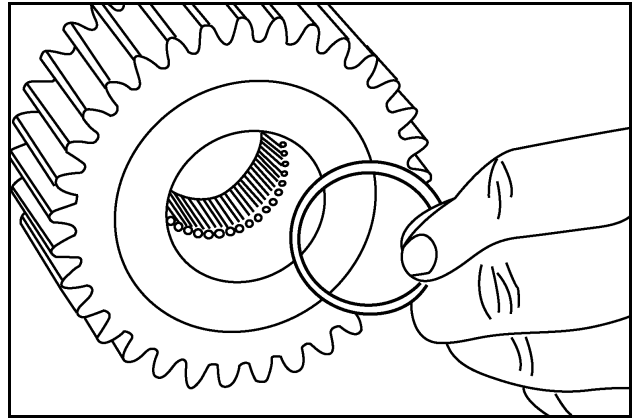
Making sure the wire retaining ring groove (1) is facing inward, place the planetary ring gear (2) over the planetary gear hub (3).

### STEP 150



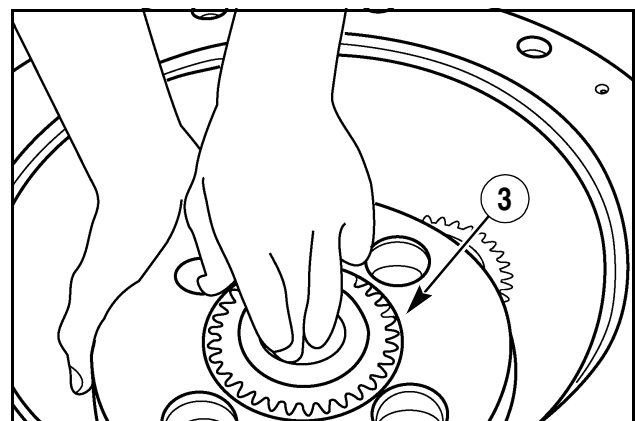
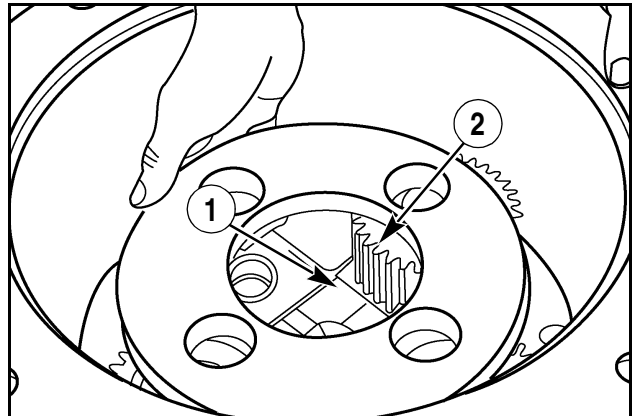
Install the wire retaining ring (1) in the planetary hub (2) ring groove.

### STEP 151



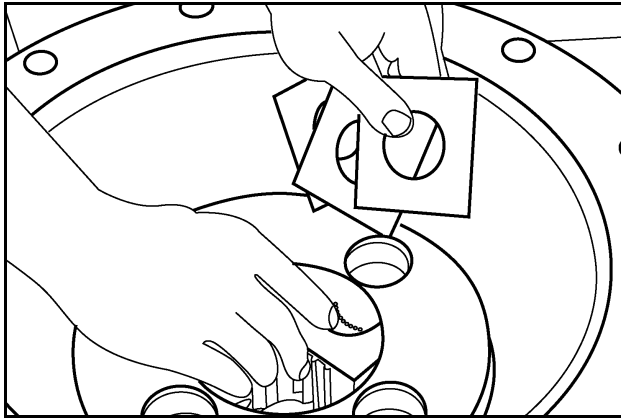
Apply petroleum jelly to the inner diameter of the planetary gear. Install the needle bearings in one side of the gear. Install the spacer. Install the needle bearings in the other side of the gear.

### STEP 152



Install the lower thrust washers (1) and the planetary gear (2) through the center opening (3) in the planetary gear hub cover.

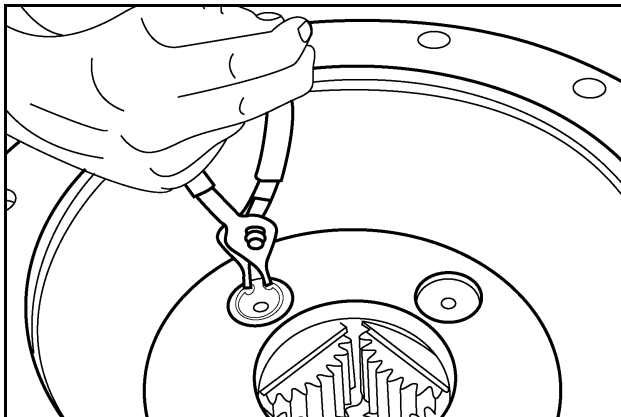
### STEP 153



RR98K089

Install the upper thrust washers on the planetary gear.

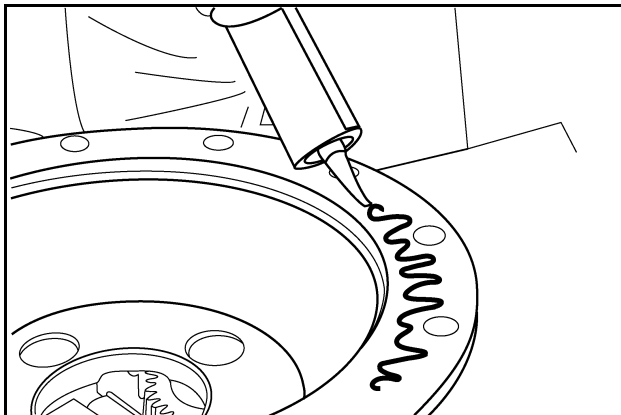
### STEP 154



RR98K086

Install the planetary gear pin and the retaining ring. Repeat the proceeding procedures to install the rest of the planetary gears in the planetary hub.

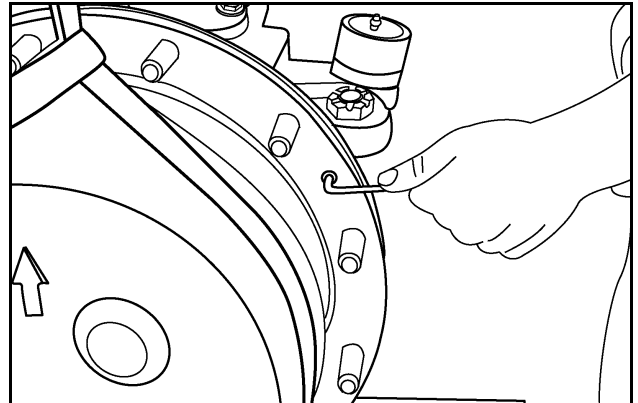
### STEP 155



RR98K091

Clean the planetary hub cover flange surface. Apply a bead of Loctite® 515 Gasket Eliminator to the planetary hub cover.

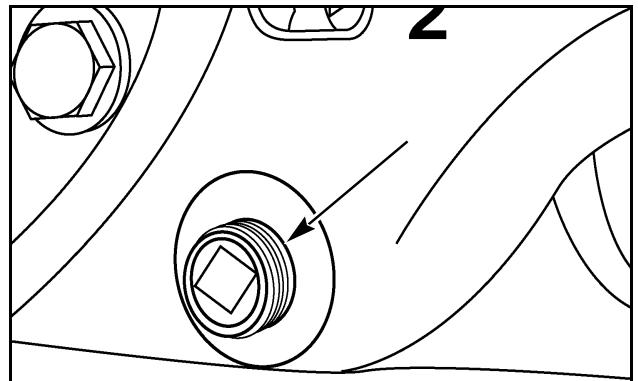
### STEP 156



RR98K084

Properly support the planetary hub cover and install on the hub. Install the three Allen head bolts. Tighten the bolts to a torque of 10 to 16 Nm (7 to 12 lb. ft.).

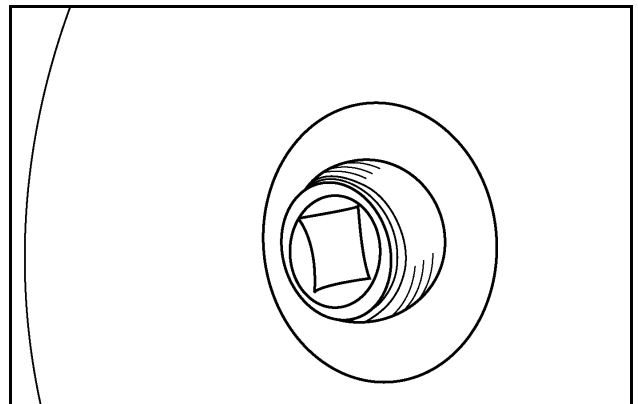
### STEP 157



RR98K131

Install the axle drain plug. Tighten the plug to a torque of 38 to 41 Nm (28 to 30 lb. ft.).

### STEP 158

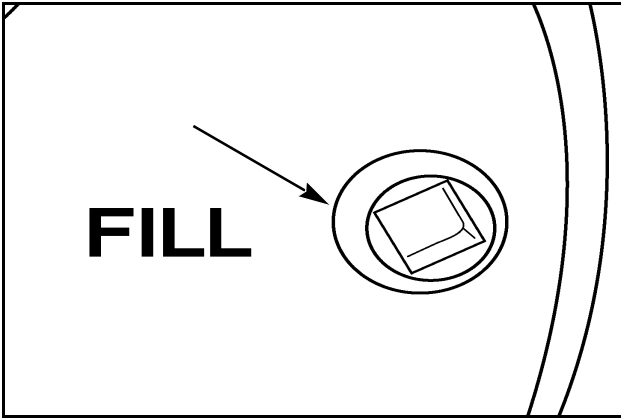


RR98K074

Remove the axle fill plug located on the front of the axle housing. Add Case 135 H EP Gear Lubricant until the oil level is even with the bottom of the hole. After a few minutes, recheck the oil level. Install the fill plug. Tighten the plug to a torque of 38 to 41 Nm (28 to 30 lb. ft.).



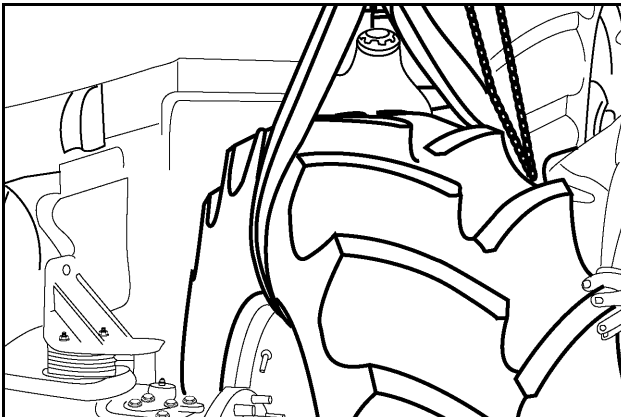
### STEP 159



RR98K083

Move the planetary hub cover so that the fill plug is in the horizontal position. Fill the planetary hub with Case 135 H EP Gear Lubricant until the oil is level with the bottom edge of the hole. After a few minutes, recheck the oil level. Tighten the planetary fill plug to a torque of 38 to 41 Nm (28 to 30 lb. ft.).

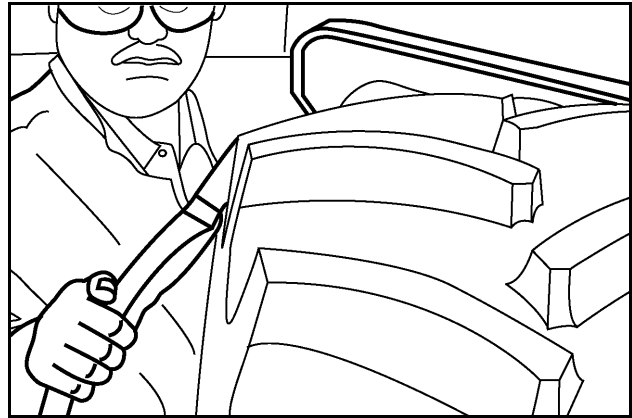
### STEP 160



98RS8A

Properly support and install the front tires.

### STEP 161



96RS34A

Install the front fenders, if equipped. Remove the wheel blocks in front of and behind the rear wheels. Make sure the transmission lever is in PARK. Start the tractor and check the operation of the FWD axle and the planetary hubs. Place the transmission shift lever in PARK. Turn the engine off and remove the key.

# **Section 25**

# **Chapter 11**

**SUSPENSION FWD AXLE**

## TABLE OF CONTENTS

SPECIAL TORQUES .....	25-11-2
SUSPENSION FWD AXLE .....	25-11-3
Disassembly .....	25-11-3
Assembly .....	25-11-13
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## SPECIAL TORQUES

Shoulder bolt for cylinder mounting pin .....	27 to 30 Nm (20 to 22 lb. ft.)
Shoulder bolt for upper cradle swing arm pin .....	41 to 45 Nm (30 to 33 lb. ft.)
Retaining plate bolts .....	58 to 64 Nm (43 to 47 lb. ft.)
Sensor to mounting bracket screws.....	4 to 4.5 Nm (36 to 40 lb. in.)
Link to sensor shaft nut .....	20 to 25.5 Nm (180 to 200 lb. in.)
Sensor mounting bracket to axle housing bolts .....	22 to 24 Nm (16 to 18 lb. ft.)
Ball joint to axle housing.....	19 to 20 Nm (165 to 180 lb. in.)

## SUSPENSION FWD AXLE

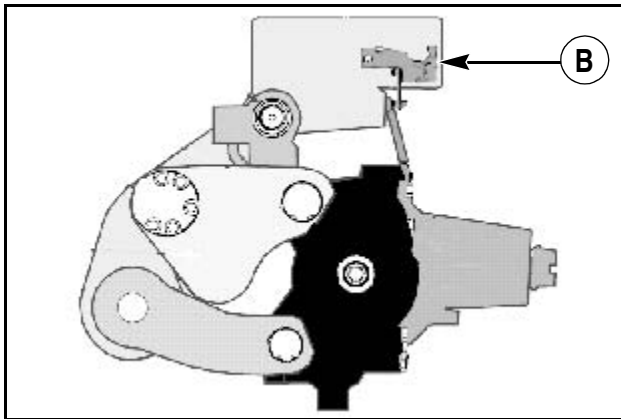
### Disassembly

**ATTENTION:** Take time to familiarize yourself with potential pinch and crush points on this axle before service work is started.

**IMPORTANT:** Before beginning disassembly, the axle housing must be secured to prevent rollover and falls that could cause damage or injury.

**IMPORTANT:** Carelessness and inattention on the part of the technicians or others working on or around this axle can create an increased risk of injury.

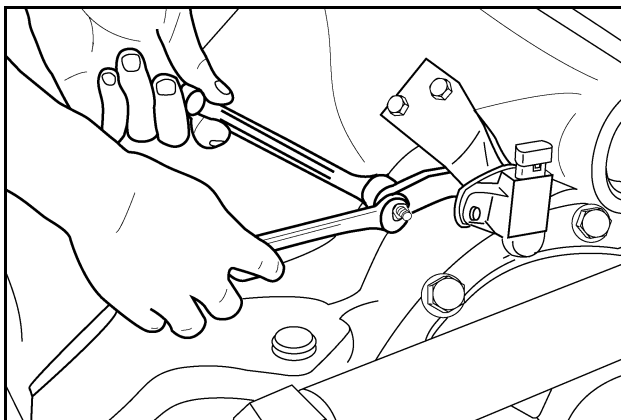
#### STEP 1



RD02M104

Disassembly of the following parts is from location "B".

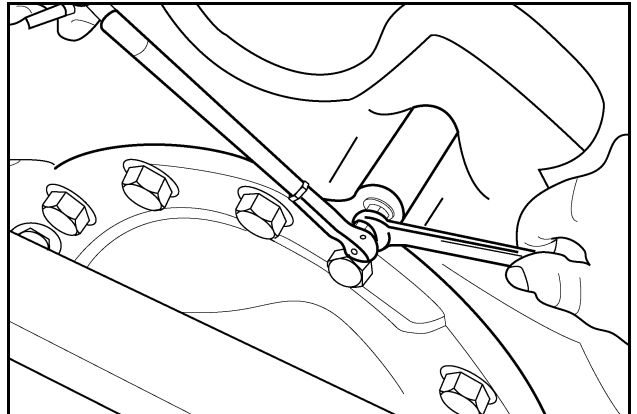
#### STEP 2



RD02M001

Remove the angle sensor linkage from the sensor.

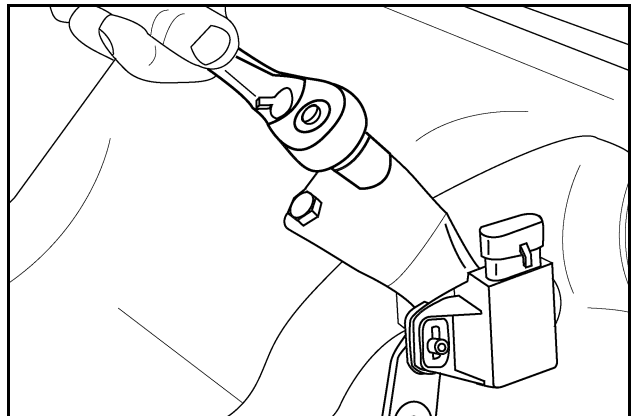
#### STEP 3



RD02M002

Remove the angle sensor linkage from the axle.

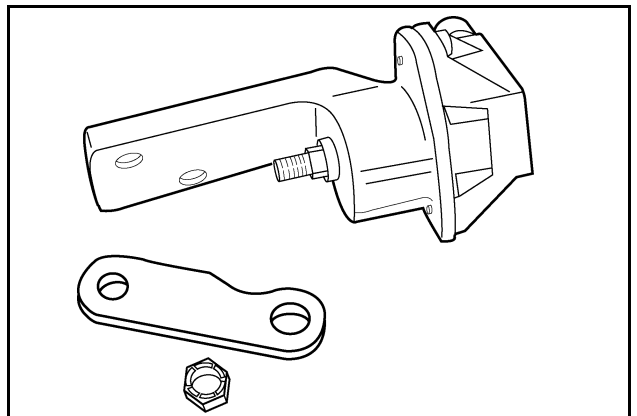
#### STEP 4



RD02M003

Remove the angle sensor from the axle.

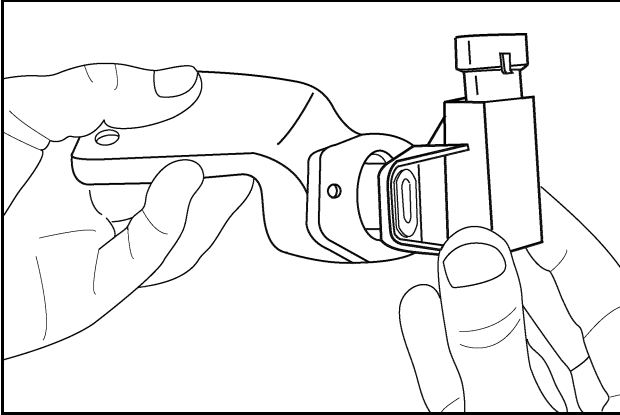
#### STEP 5



RD02M005

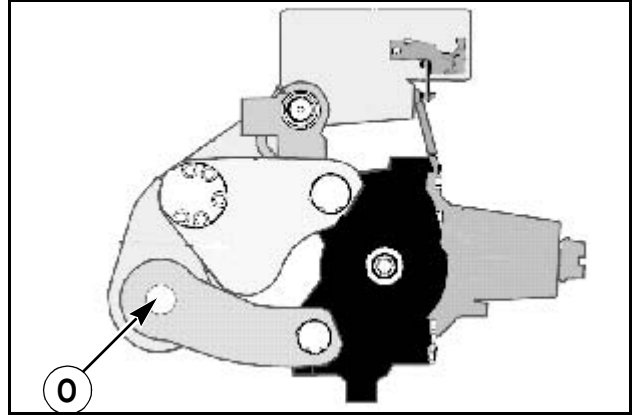
Remove the arm from the sensor.

### STEP 6



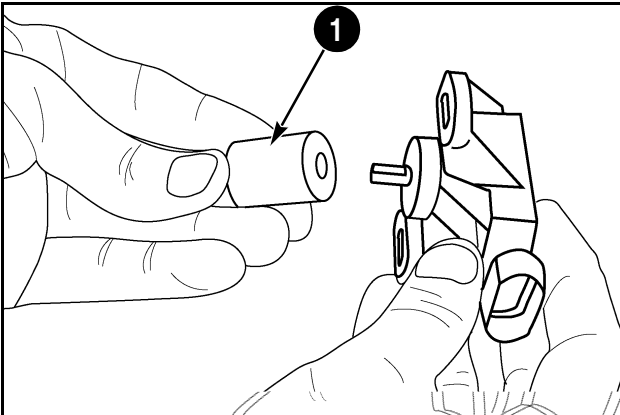
Remove the two sensor mounting screws and remove the sensor from the bracket.

### STEP 9



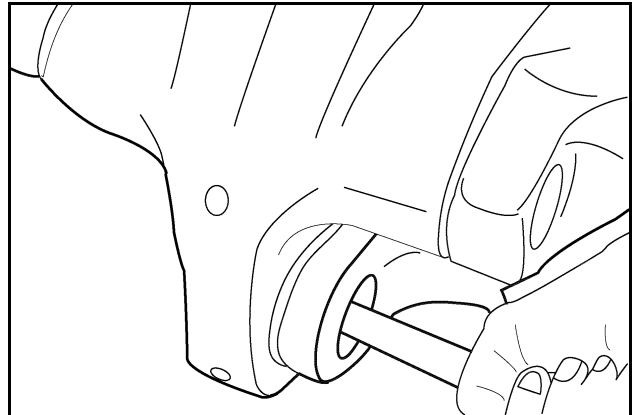
Disassembly of the following parts is from location "O".

### STEP 7



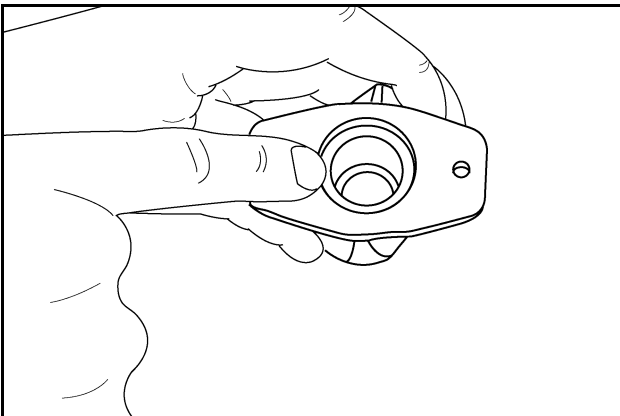
Loosen the set screw (1) and remove the sensor shaft.

### STEP 10



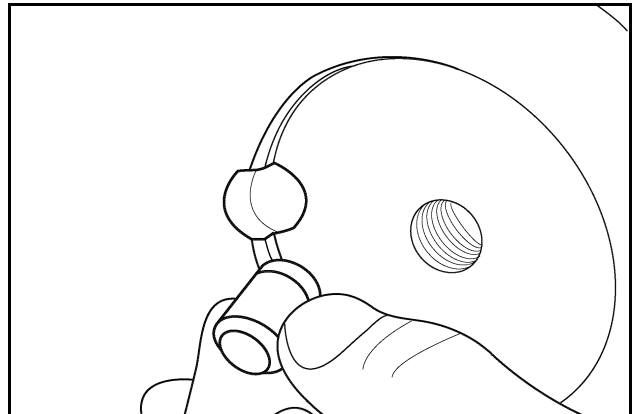
Install a slide hammer into the swing arm cradle pin.

### STEP 8



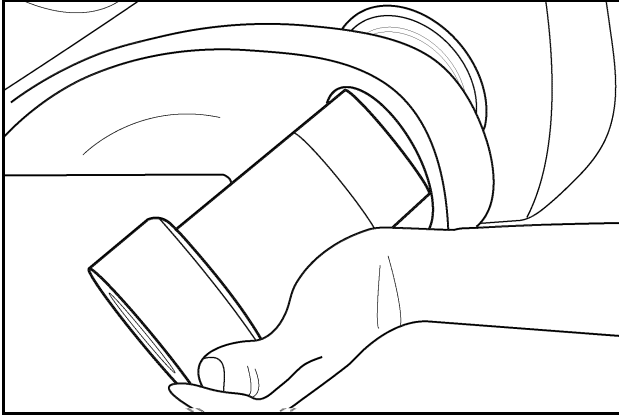
Inspect the bushing for wear or damage. Replace the bushing if necessary.

### STEP 11



Move the pin out a small amount and remove the dowel pin.

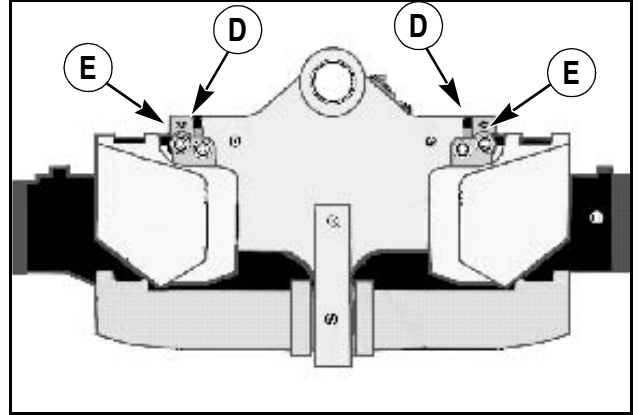
**STEP 12**



RD02M015

Remove the swing arm cradle pin.

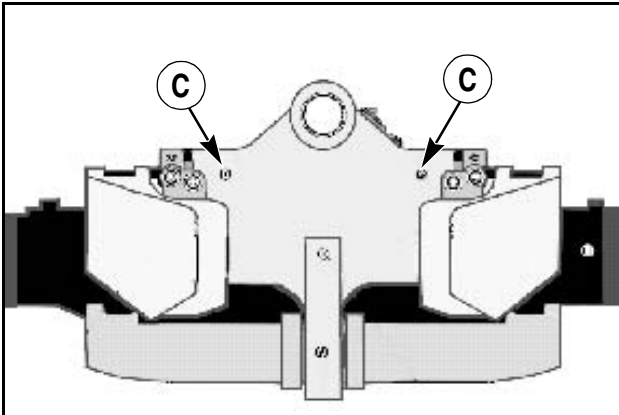
**STEP 14**



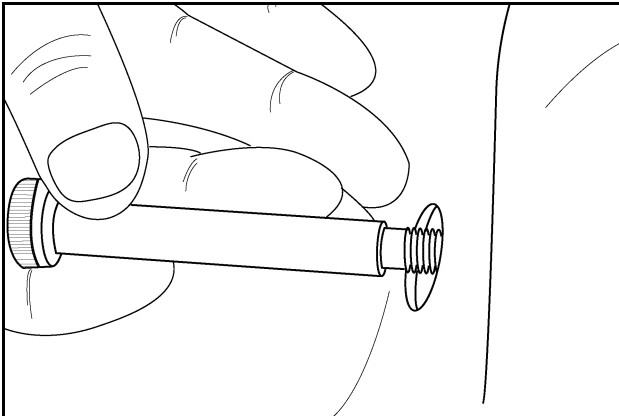
RD02M105

The following parts are removed from locations "D" and "E".

**STEP 13**



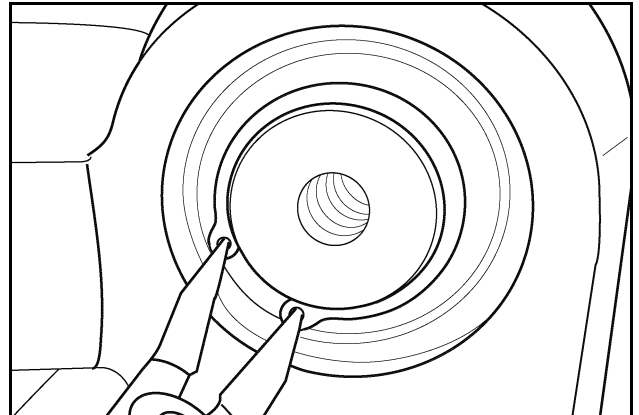
RD02M105



RD02M017

Remove the two shoulder bolts from location "C".

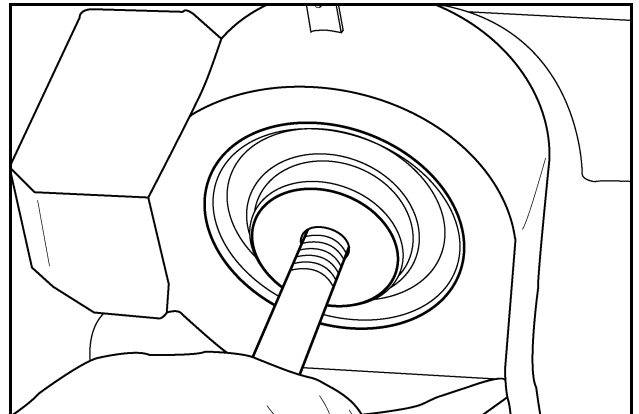
**STEP 15**



RD02M018

Remove the snap ring from the cylinder pins.

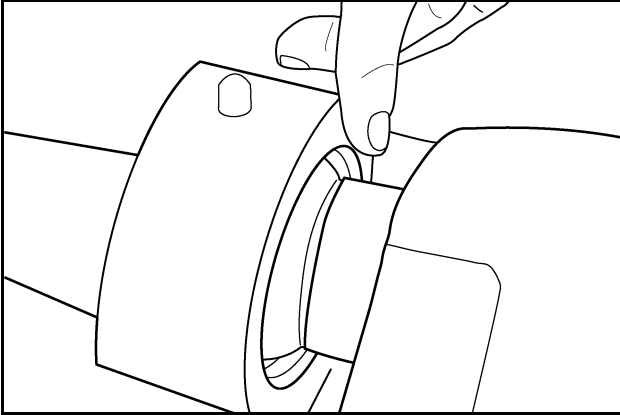
**STEP 16**



RD02M019

Install a slide hammer into the cylinder pin.

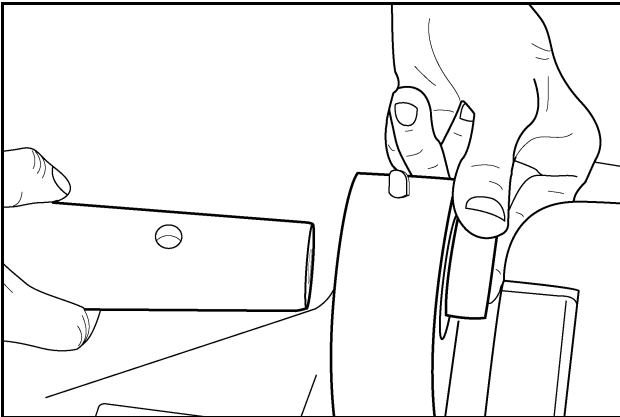
### STEP 17



RD02M020

Slide the pin partially out. Do not let the spacer fall out.

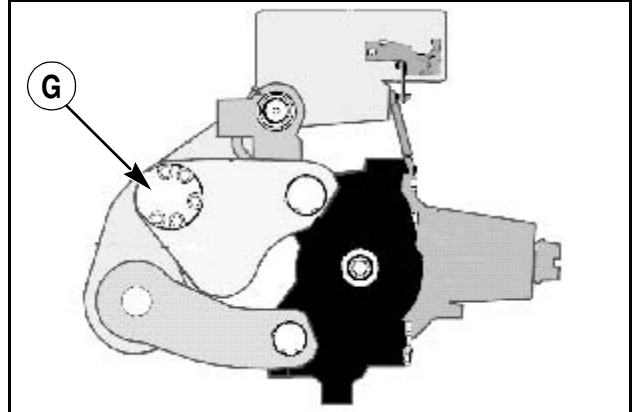
### STEP 18



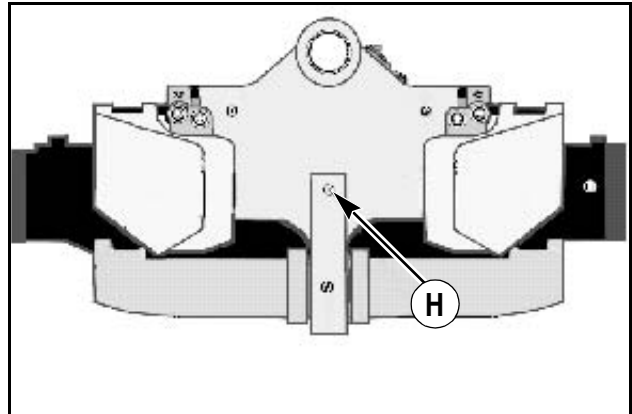
RD02M021

Remove the pin and spacer.

### STEP 19



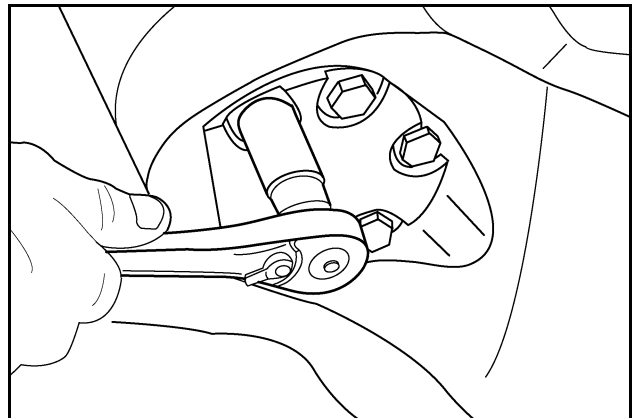
RD02M104



RD02M105

The following parts are removed from location "G" and "H".

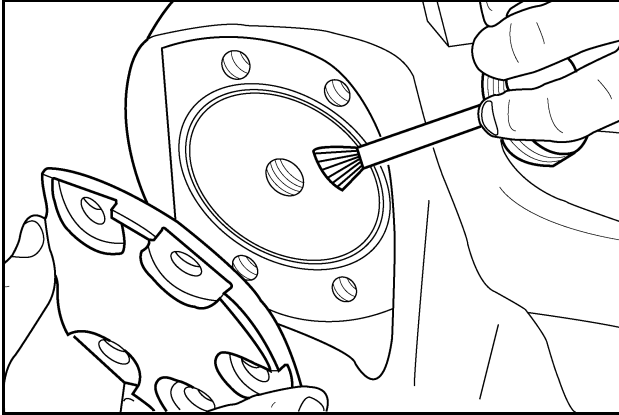
### STEP 20



RD02M022

Remove the five bolts from each retaining plate.

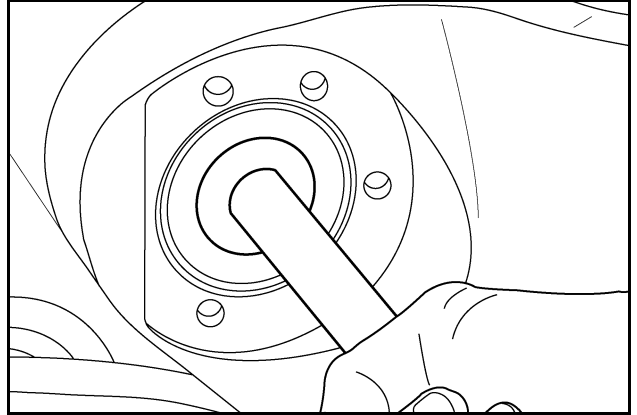
**STEP 21**



RD02M023

Remove both retaining plates.

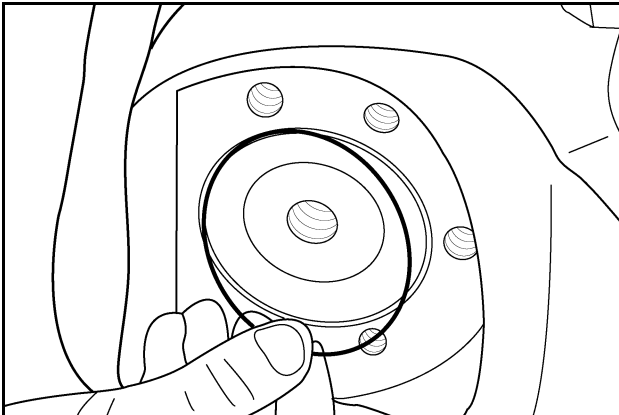
**STEP 24**



RD02M027

Install a slide hammer into the upper swing arm pin.

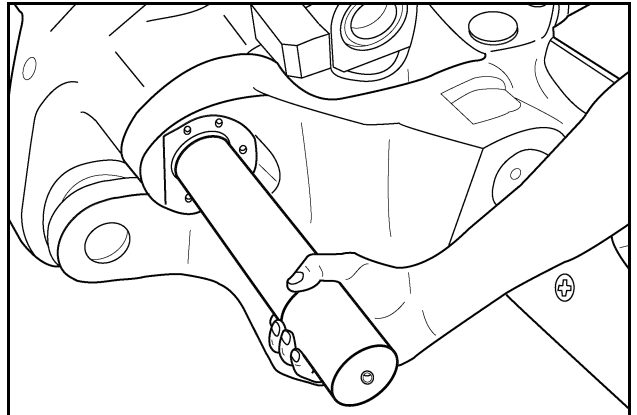
**STEP 22**



RD02M024

Remove and discard the O-rings.

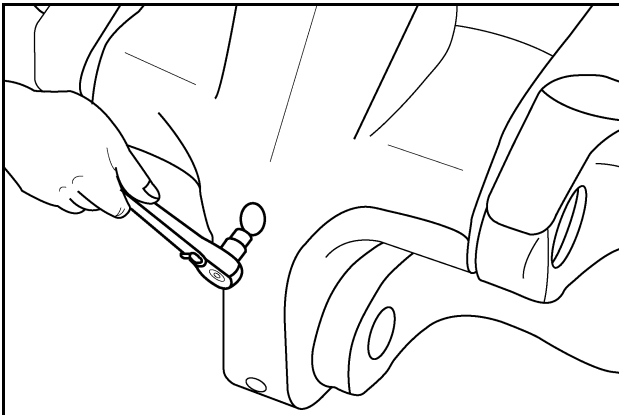
**STEP 25**



RD02M028

Remove the pin.

**STEP 23**

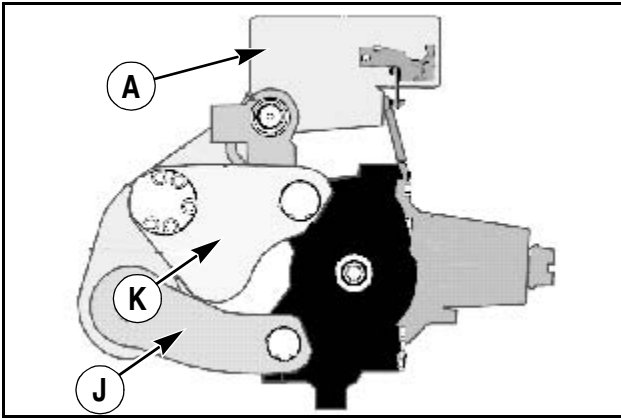


RD02M025

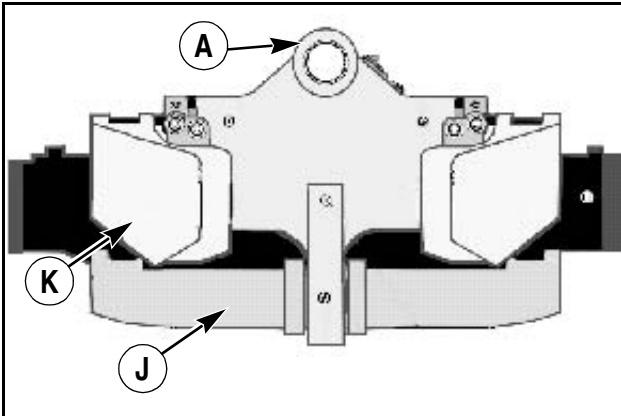
Loosen and remove the shoulder bolt.



## STEP 26



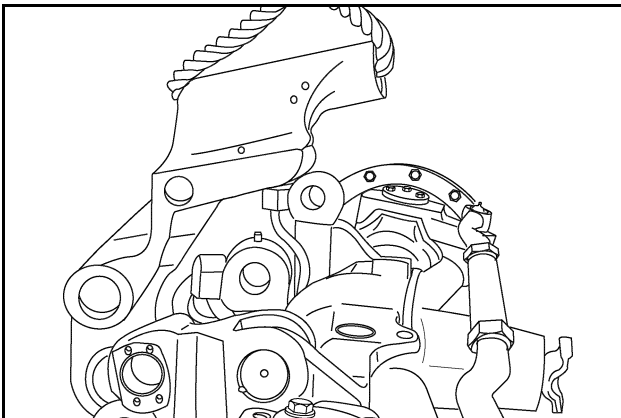
RD02M104



RD02M105

The following parts are removed from locations "A", "K", and "J".

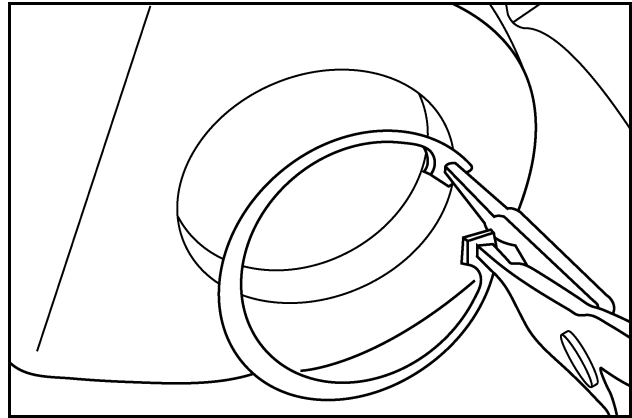
## STEP 27



RD02M029

Install a sling and carefully lift the cradle off the axle assembly.

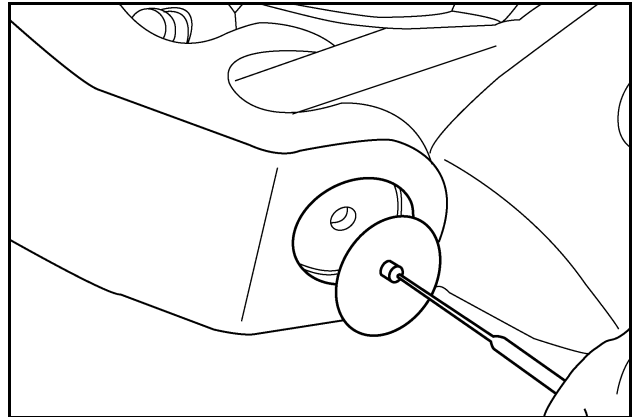
## STEP 28



RD02M030

Remove the snap ring from the lower suspension swing arm.

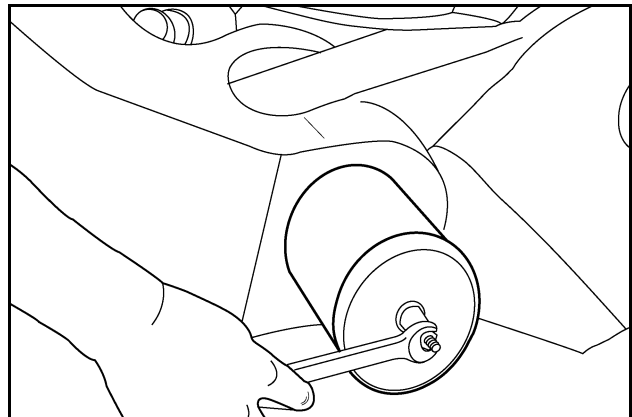
## STEP 29



RD02M031

Use a magnet and remove the lower swing arm thrust washer. Note that there is a dowel pin in the shaft.

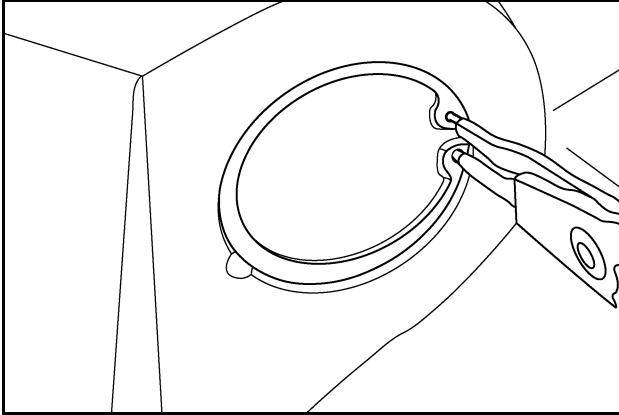
## STEP 30



RD02M032

Use a puller to remove the lower swing arm pin. Be sure to catch the dowel pin when removing the puller.

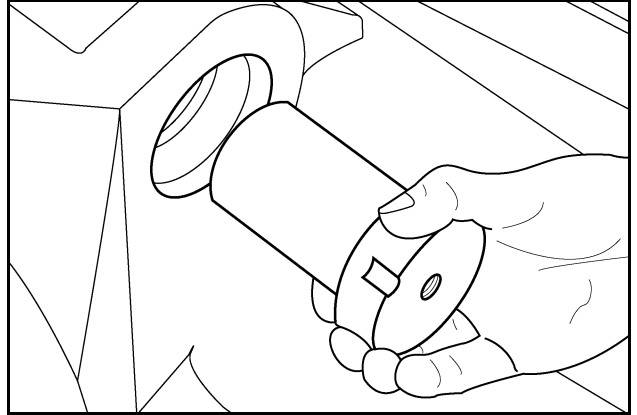
**STEP 31**



RD02M033

Remove the snap ring from the upper suspension swing arm.

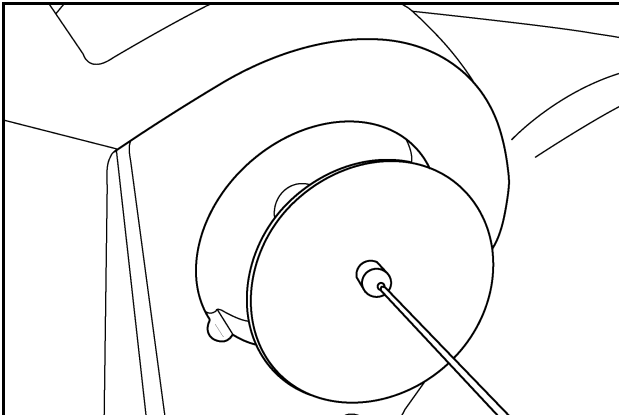
**STEP 34**



RD02M036

Remove the upper pin.

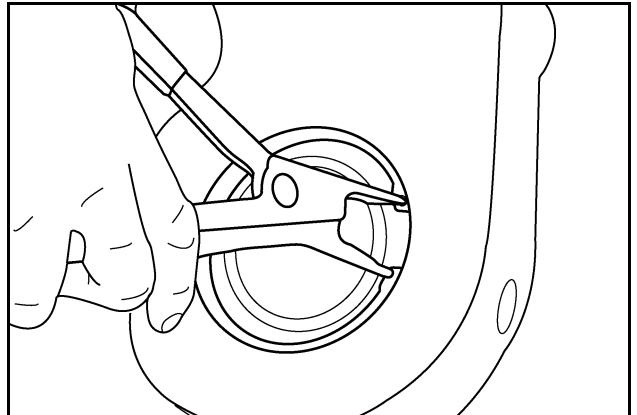
**STEP 32**



RD02M034

Use a magnet and remove the upper swing arm thrust washer. Note that there is a dowel pin in the shaft.

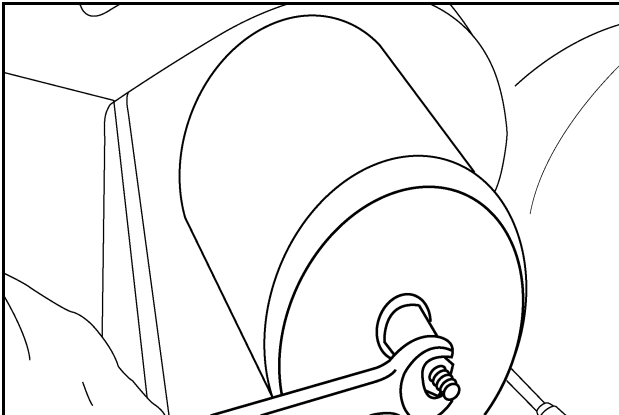
**STEP 35**



RD02M037

Remove the snap ring from the suspension cradle.

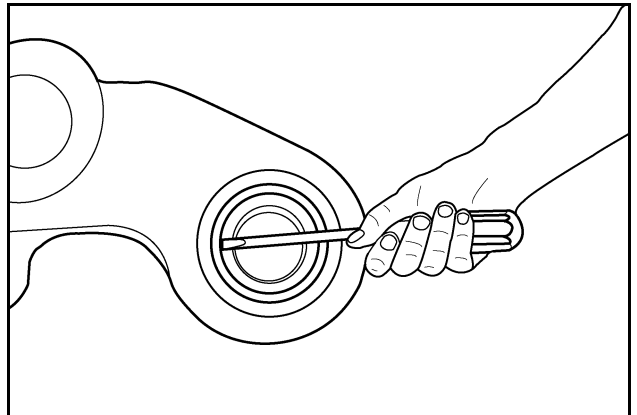
**STEP 33**



RD02M035

Use a puller to remove the upper swing arm pin. Be sure to catch the dowel pin when removing the puller.

**STEP 36**

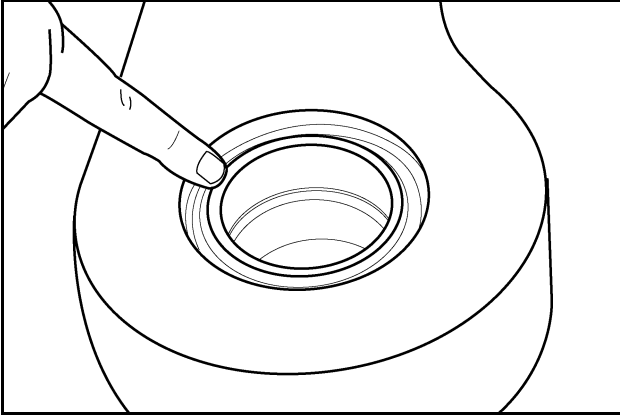


RD02M038

Remove and discard the seals from both sides.

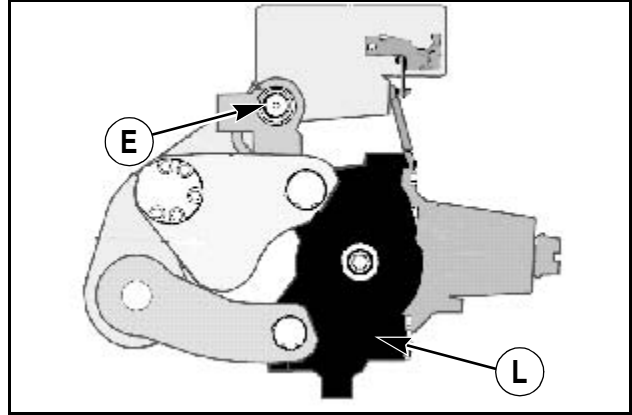
**NOTE:** *Seals are different sizes.*

### STEP 37



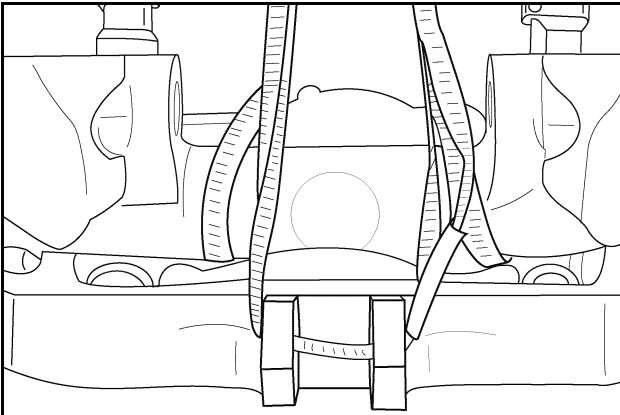
Inspect the bushing for wear or damage. Remove and replace if necessary.

### STEP 40



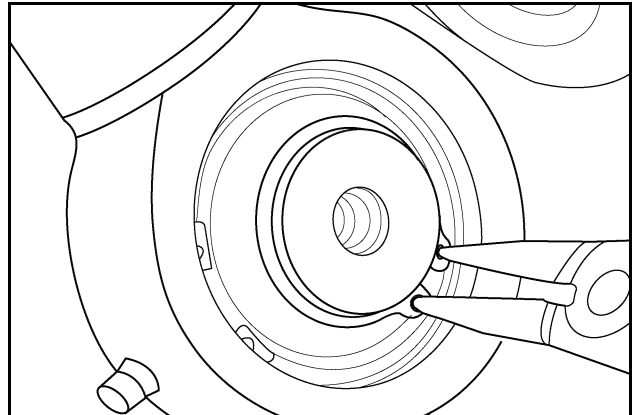
The following parts are removed from locations "E" and "L".

### STEP 38



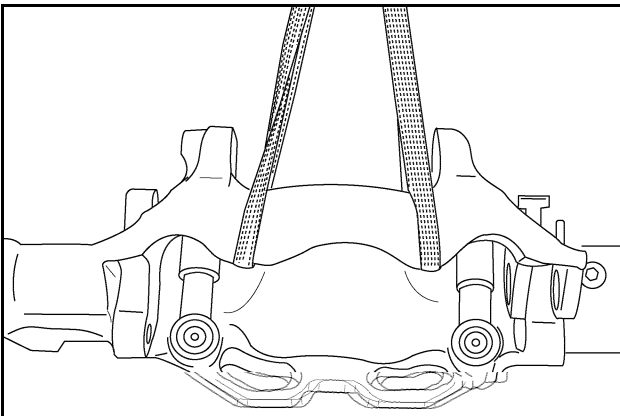
Connect a strap to the lower swing arm. Carefully remove the swing arm from the axle assembly.

### STEP 41



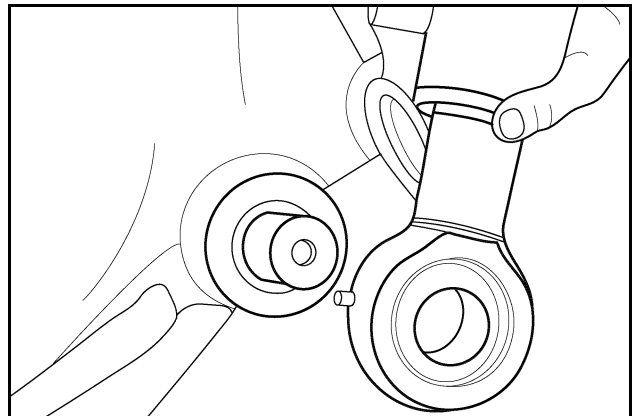
Remove the snap rings from the cylinder mounting pins.

### STEP 39



Install a strap securely to the upper swing arm and remove the arm.

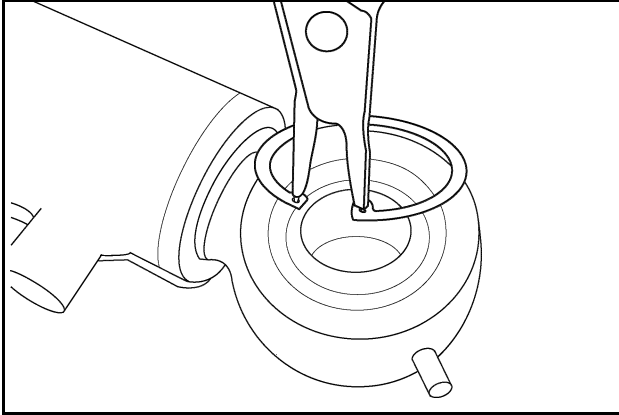
### STEP 42



Remove the cylinders.

**IMPORTANT:** Be sure the axle housing is secure to prevent injury.

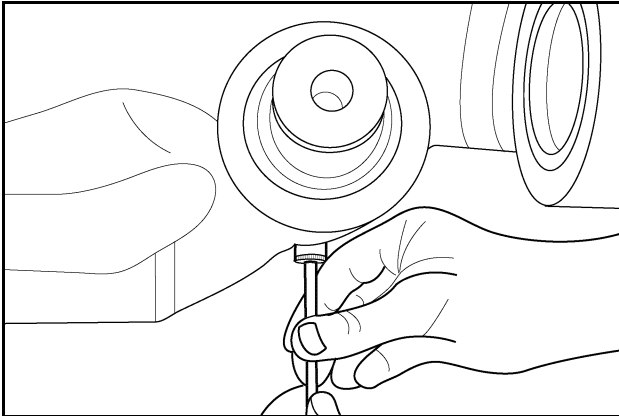
**STEP 43**



RD02M044

Remove the snap rings that retain the spherical bearings and remove the bearings. Inspect the bearings for wear or damage. The cylinder must be replaced if either is present.

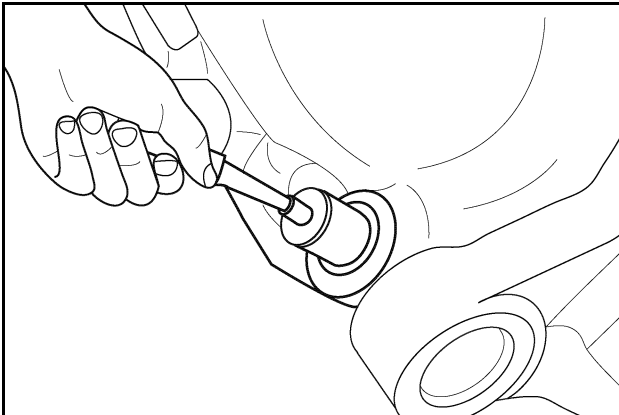
**STEP 44**



RD02M045

Remove the shoulder bolts from the cylinder mounting pins.

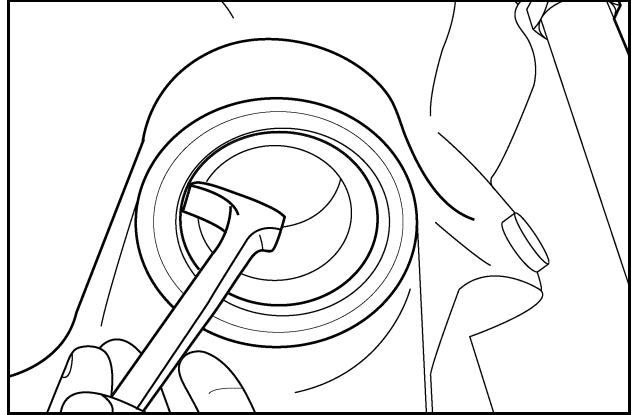
**STEP 45**



RD02M046

Use a puller or slide hammer and remove the mounting pins from the housing.

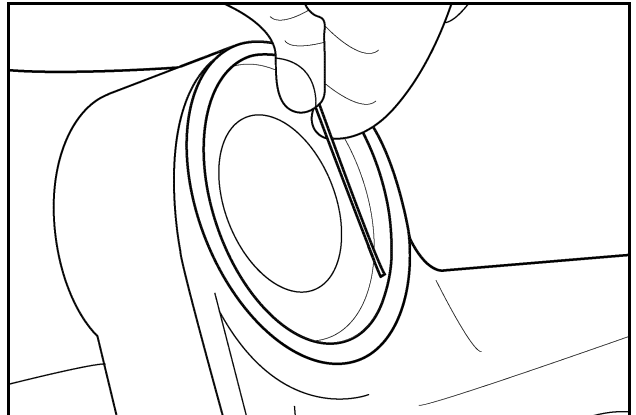
**STEP 46**



RD02M047

Remove the seals from the housing. Inspect the bores for damage.

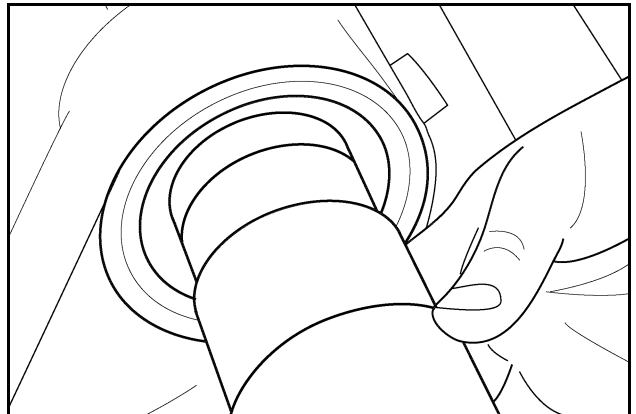
**STEP 47**



RD02M048

Remove the thrust washers.

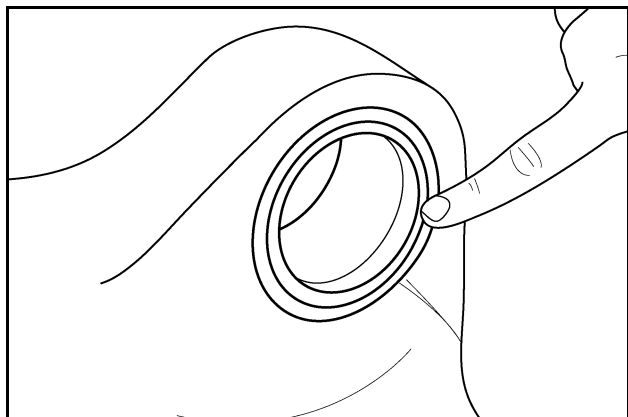
**STEP 48**



RD02M049

Use a driver and remove the bushing from the bores.

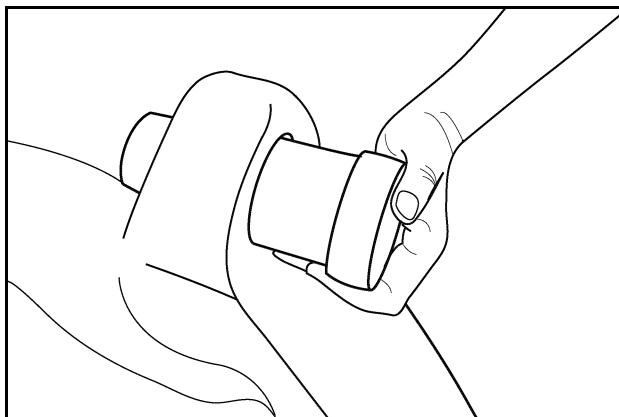
**STEP 49**



RD02M050

Remove the seals from the upper swing arm.

**STEP 50**

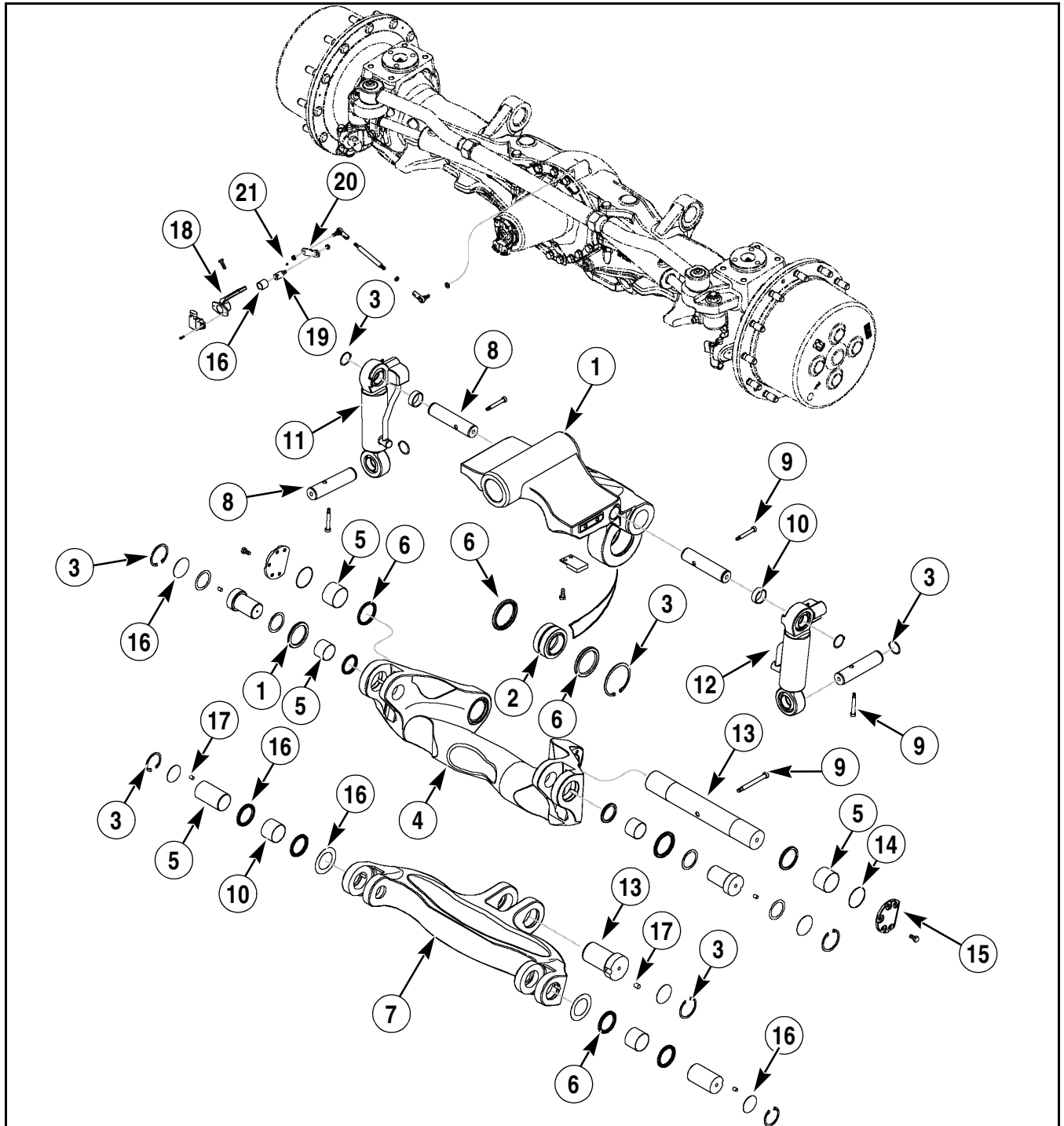


RD02M051

Use a driver to remove the bushings from the swing arm bores.

## Assembly

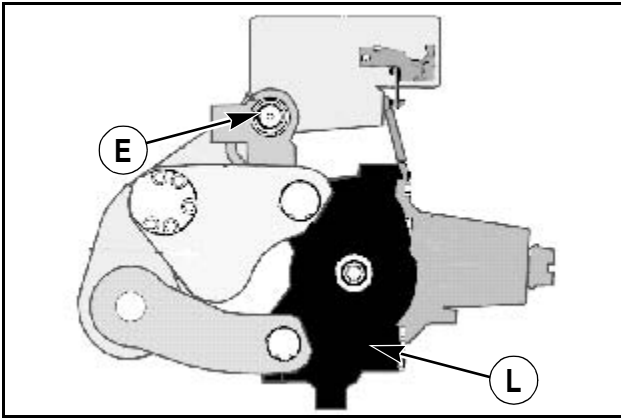
**NOTE:** For ease of assembly, it is recommended that the axle be assembled with the housing upside down.



- |                     |                  |                     |
|---------------------|------------------|---------------------|
| 1. CRADLE           | 8. AXLE PIN      | 15. PLATE           |
| 2. BEARING          | 9. SHOULDER BOLT | 16. THRUST WASHER   |
| 3. SNAP RING        | 10. SPACER       | 17. DOWEL           |
| 4. UPPER SWING ARM  | 11. LH CYLINDER  | 18. BRACKET         |
| 5. BUSHING          | 12. RH CYLINDER  | 19. SENSOR          |
| 6. SEAL             | 13. PIN          | 20. CONNECTING LINK |
| 7. LOWER SWING LINK | 14. O-RING       | 21. SET SCREW       |

RI02M063

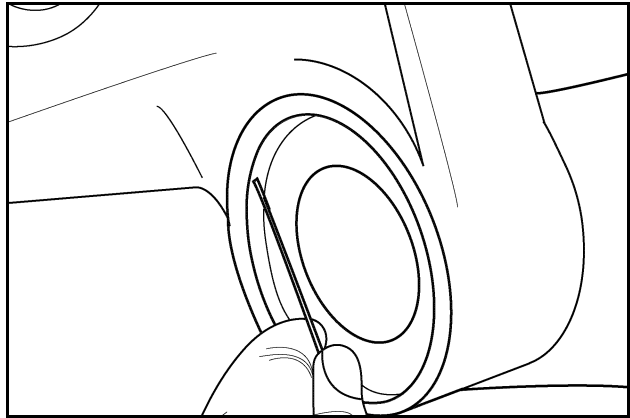
### STEP 51



RD02M104

The following parts are assembled in location "L" and "E".

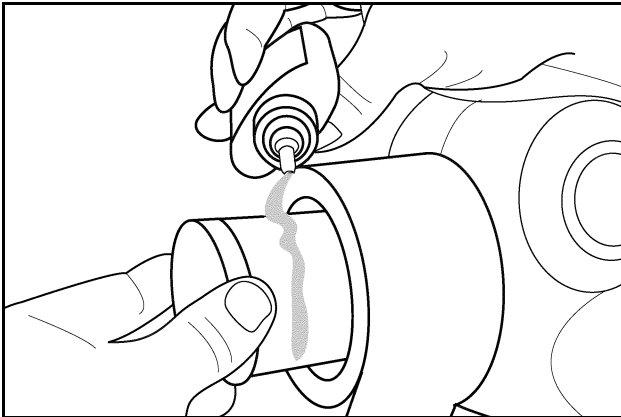
### STEP 54



RD02M055

Apply grease to the counter bore. Install the thrust washer.

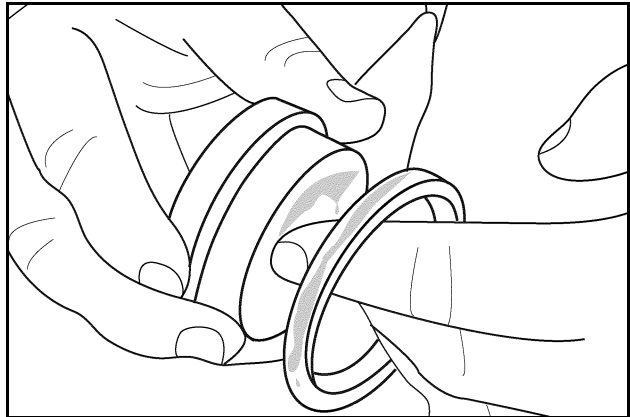
### STEP 52



RD02M052

Apply Loctite 609 to the new bushing.

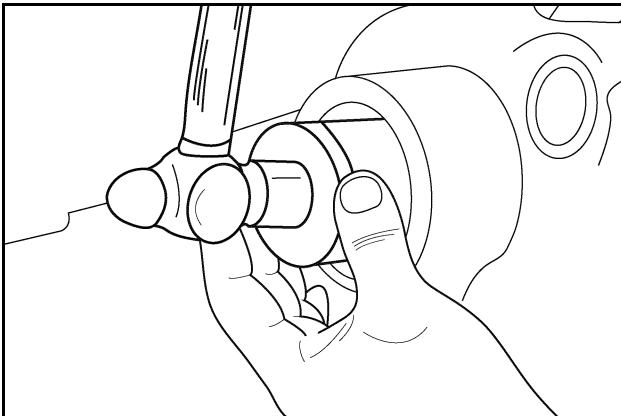
### STEP 55



RD02M056

Apply Loctite 609 to the new seal case. Install an appropriate driver.

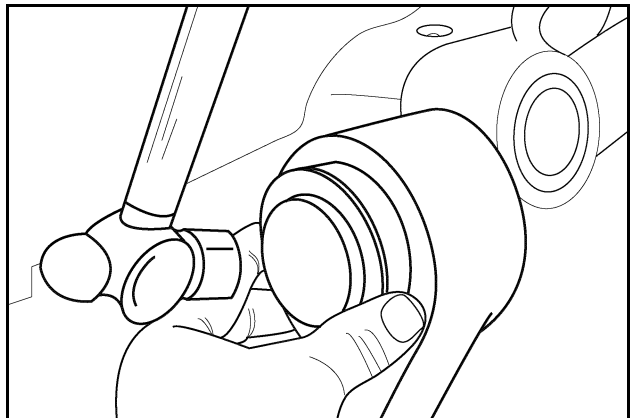
### STEP 53



RD02M053

Use an appropriate driver and install the bushing until it is flush with the bore.

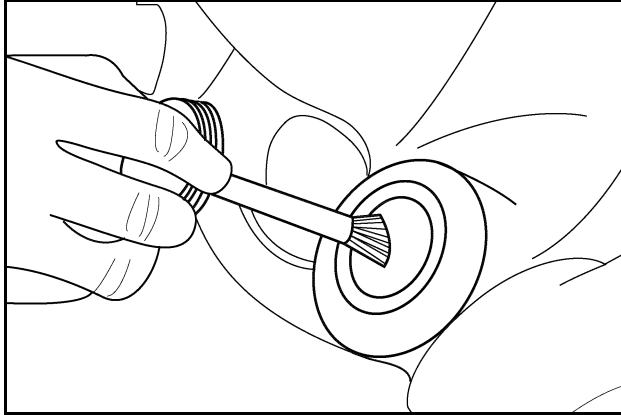
### STEP 56



RD02M057

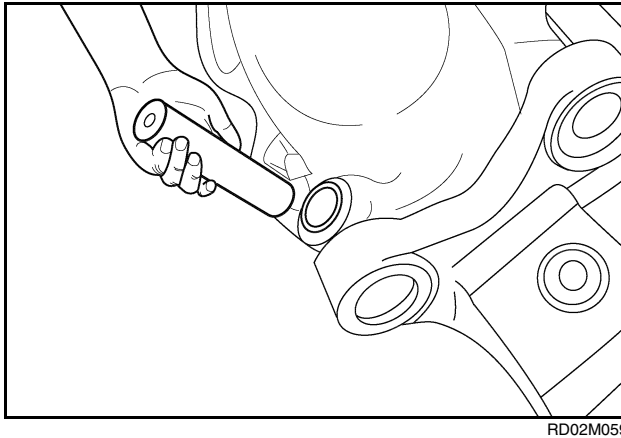
Install the seal into the bore. Be sure that the thrust washer does not obstruct the seal when installing the seal.

### STEP 57



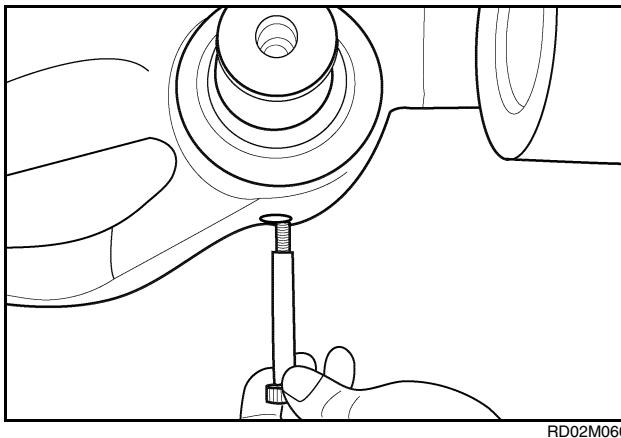
Apply grease to the housing bore.

### STEP 58



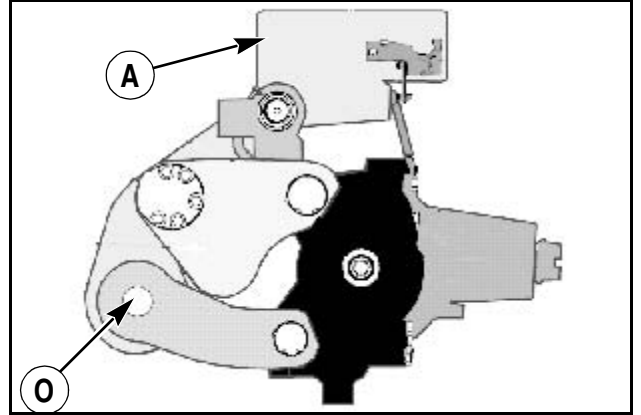
Install the cylinder mounting pin into the bore.

### STEP 59



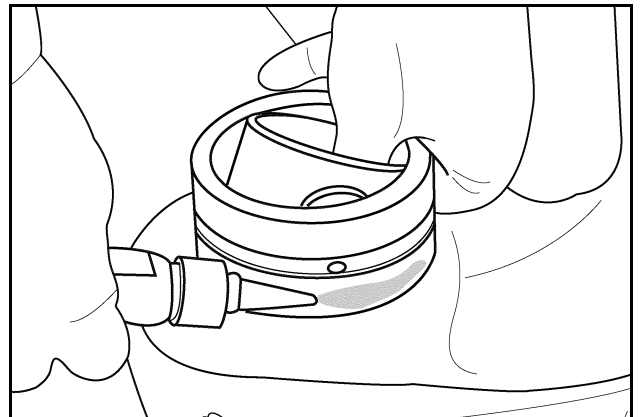
Install the shoulder bolt. Tighten to a torque of 27 to 30 Nm (20 to 22 lb. ft.).

### STEP 60



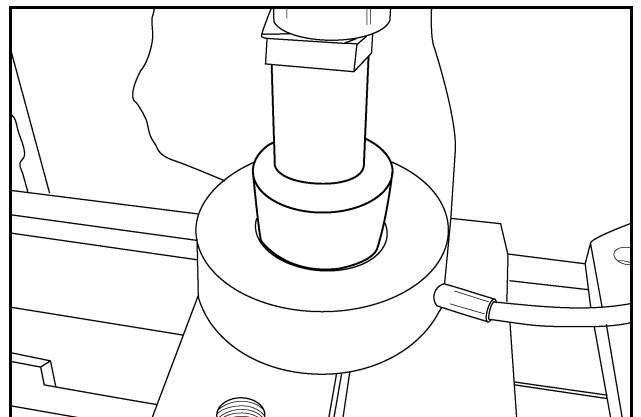
The following parts are assembled in locations "A" and "O".

### STEP 61



Apply Loctite 609 to the OD of the new bushing.

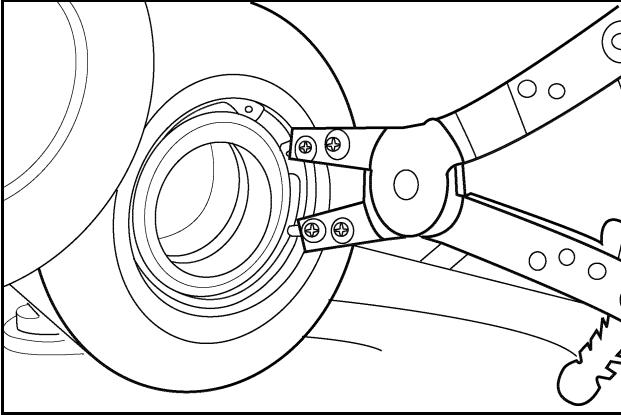
### STEP 62



Place the cradle on a press. Press the bushing into the bore using appropriate drivers.



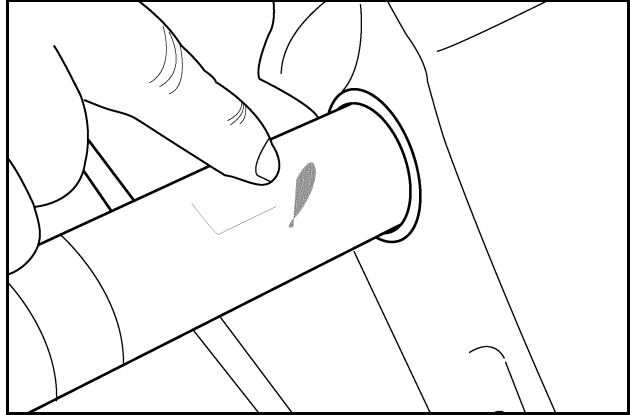
### STEP 63



RD02M064

Install the snap ring.

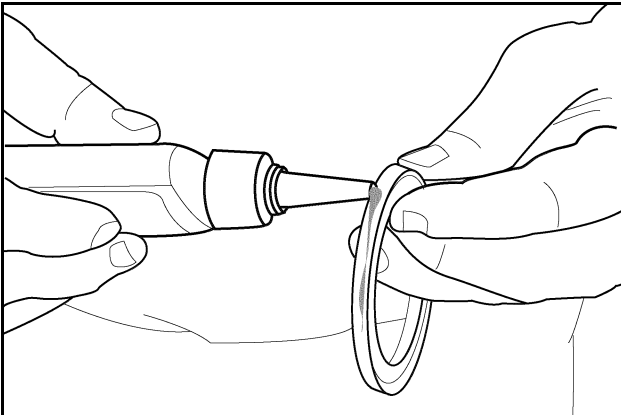
### STEP 66



RD02M068

Apply grease to the pin.

### STEP 64

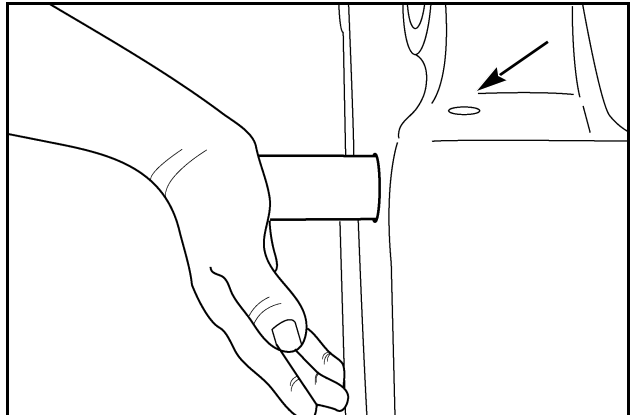


RD02M065

Apply Loctite 609 to a new seal case.

**NOTE:** The cradle uses 2 seals which are different sizes.

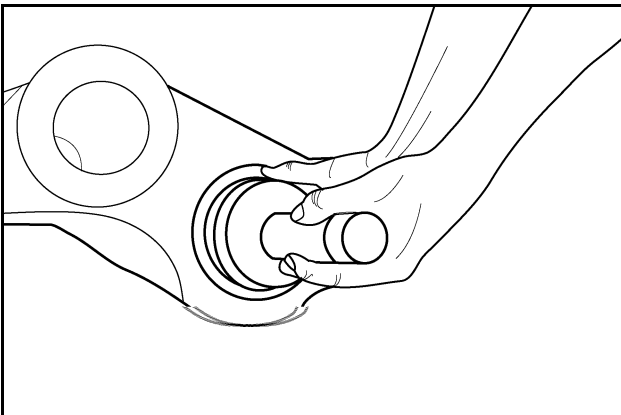
### STEP 67



RD02M069

Install the pin into the housing. Align the bolt hole in the pin with the shoulder bolt bore in the housing.

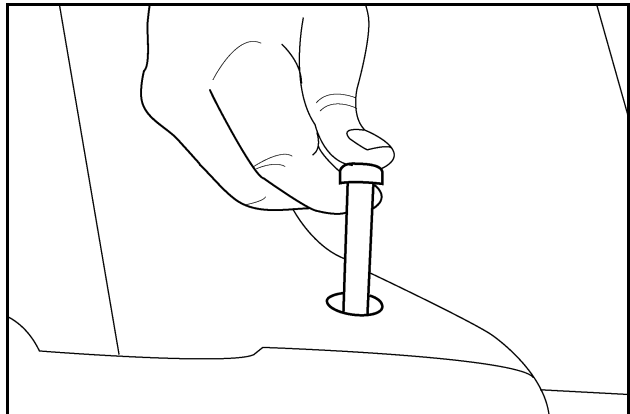
### STEP 65



RD02M067

Install the seal squarely in the bore. Use an appropriate seal driver and seat the seal. Repeat the procedure for the other side.

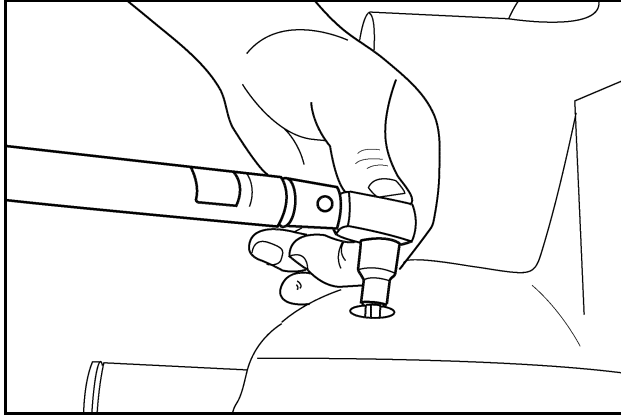
### STEP 68



RD02M070

Install the shoulder bolt into the pin.

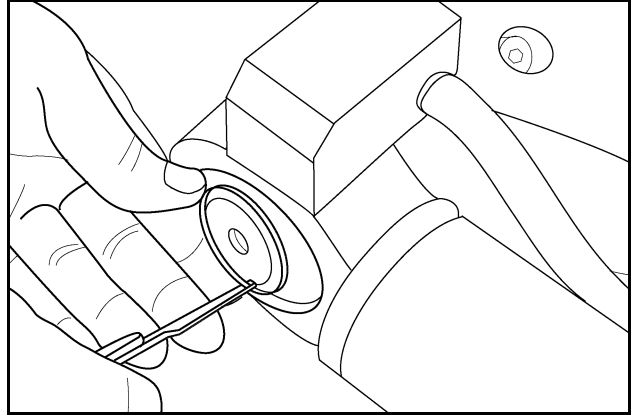
### STEP 69



RD02M071

Tighten the shoulder bolt to a torque of 27 to 30 Nm (20 to 22 lb. ft.).

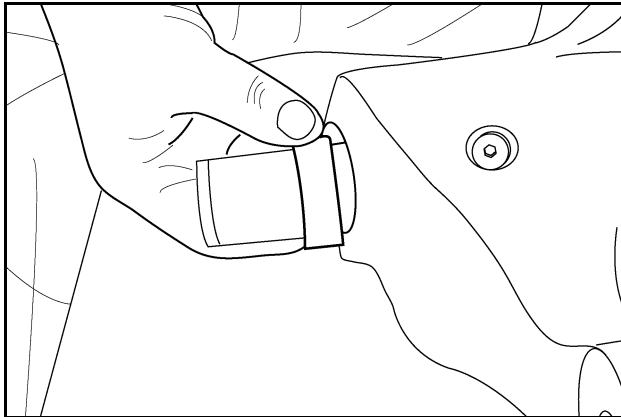
### STEP 72



RD02M074

Install the snap rings.

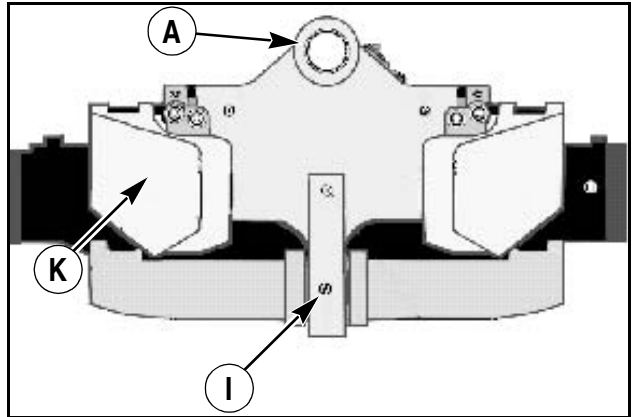
### STEP 70



RD02M072

Install the cylinder spacer on to the pin.

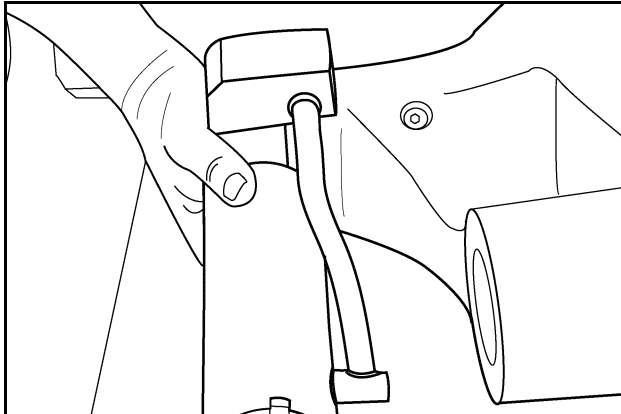
### STEP 73



RD02M105

The following parts are assembled at locations "A" "I" and "K".

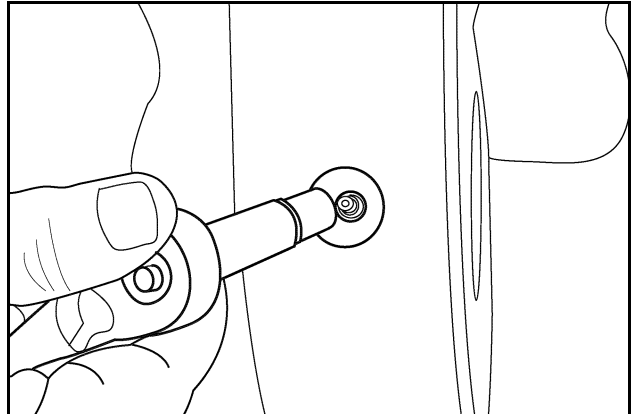
### STEP 71



RD02M073

Install the lift cylinders.

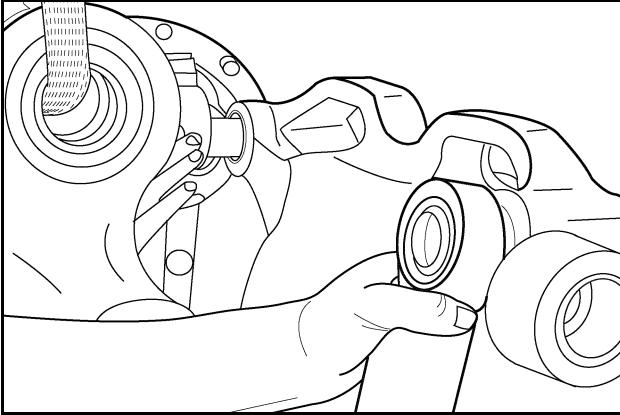
### STEP 74



RD02M075

Install the grease fitting into the cradle.

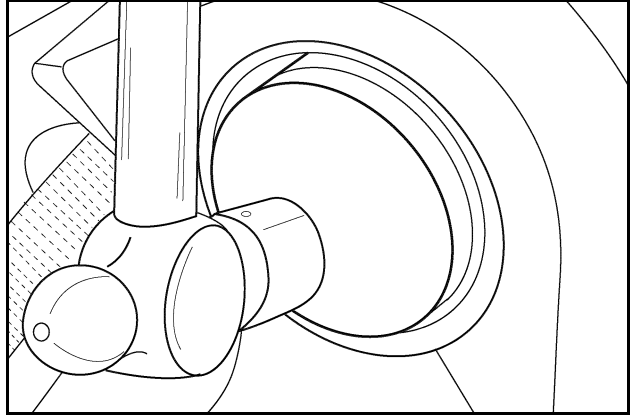
### STEP 75



RD02M076

Apply grease to the cylinder pins. Use a suitable lifting device and position the cradle so that the cylinders can be installed onto the pins.

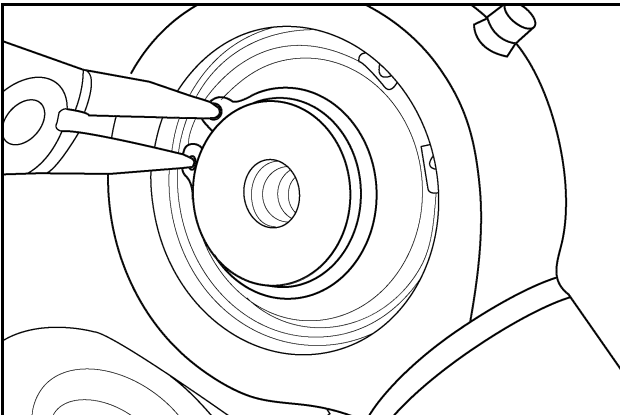
### STEP 78



RD02M078

Install the bushing into the bore.

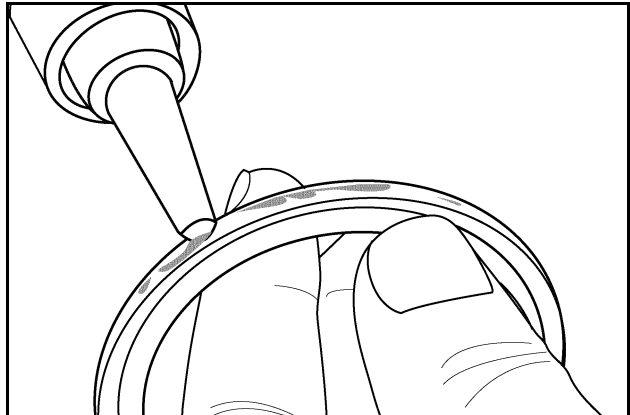
### STEP 76



RD02M042

Install the snap ring onto the cylinder pins.

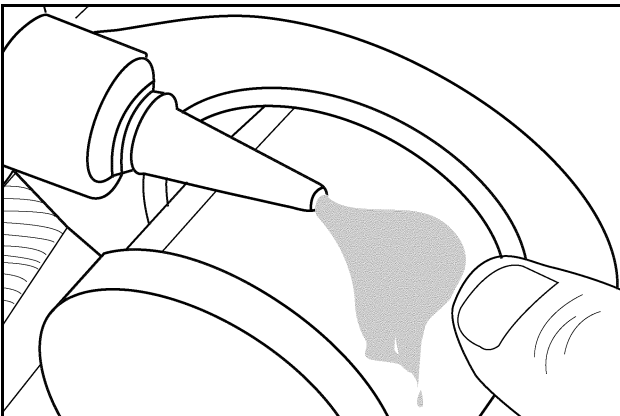
### STEP 79



RD02M079

Apply Loctite to a new seal case.

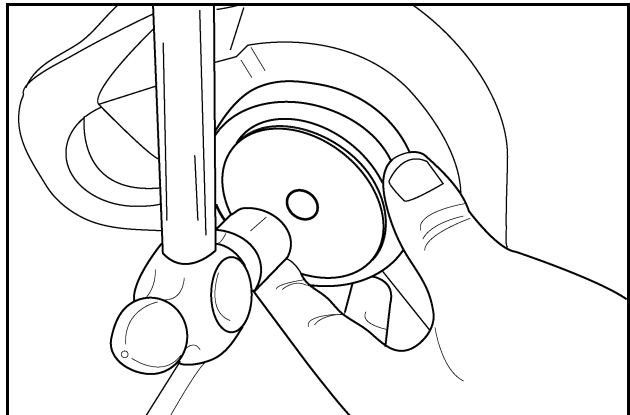
### STEP 77



RD02M077

Place the bearing on an appropriate driver. Apply Loctite 609 to the OD of the bearing.

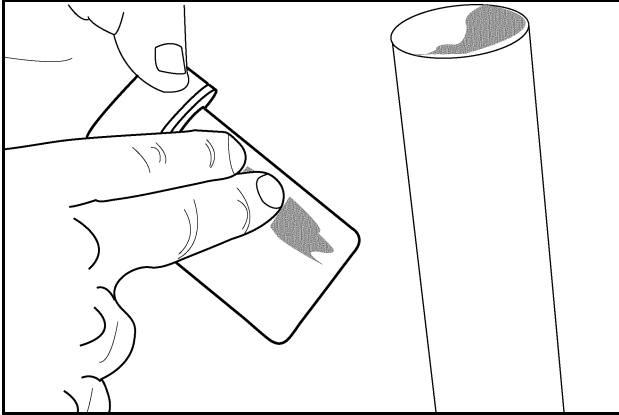
### STEP 80



RD02M080

Use an appropriate driver and install the new seal into the bore.

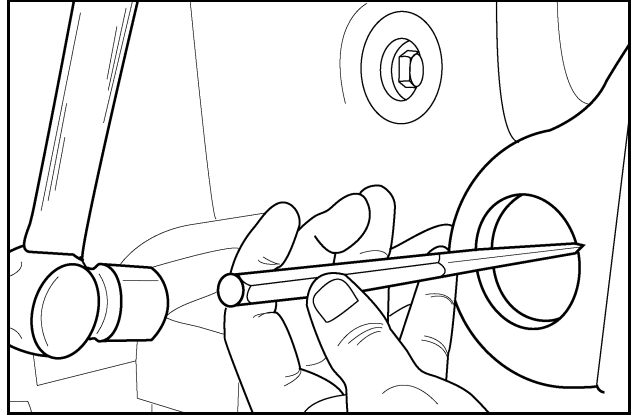
**STEP 81**



RD02M081

Apply grease to the swing arm pins.

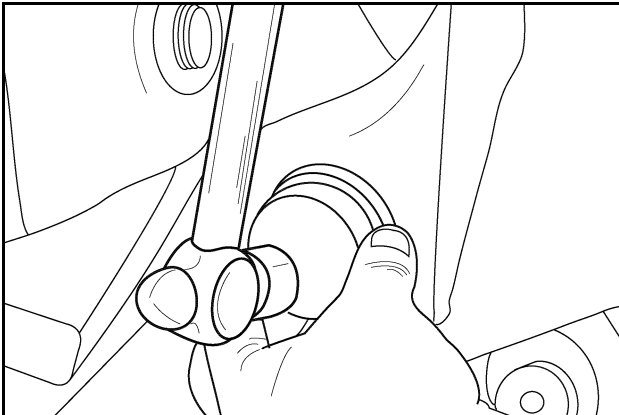
**STEP 84**



RD02M084

Install the dowel pin.

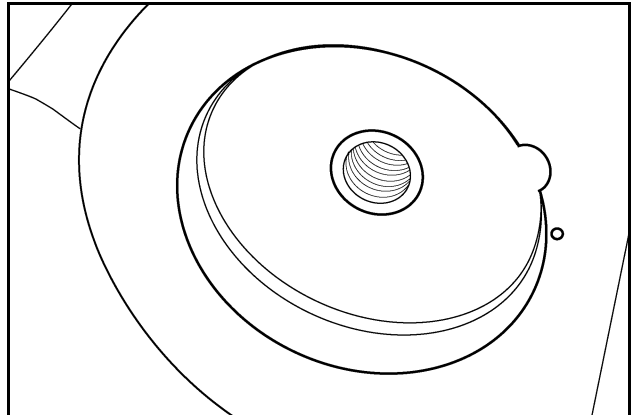
**STEP 82**



RD02M082

Align the cradle and upper swing arm and install the pin.

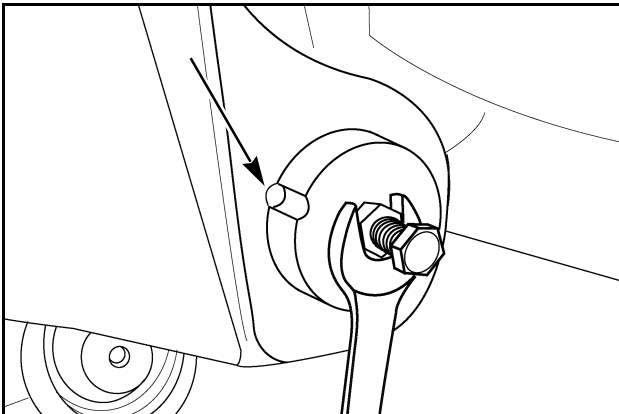
**STEP 85**



RD02M085

Continue to drive the pin until seated.

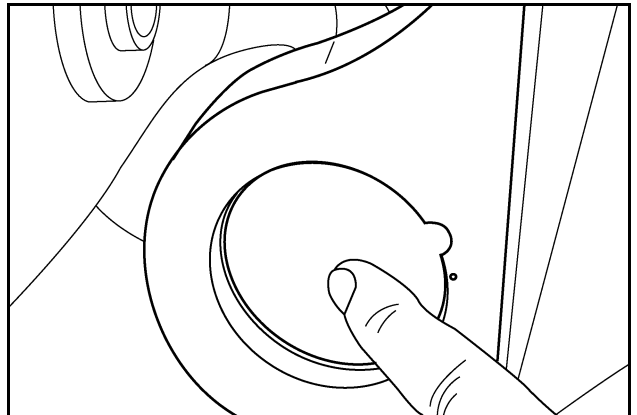
**STEP 83**



RD02M083

Align the dowel pin slot.

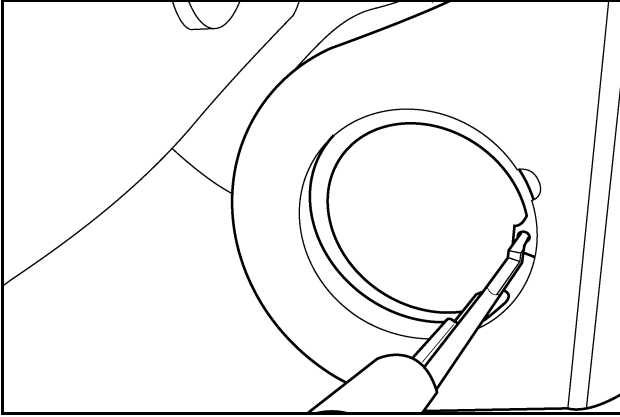
**STEP 86**



RD02M086

Install the thrust washer.

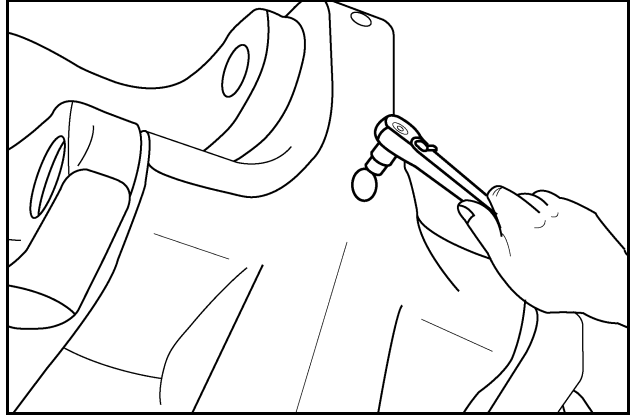
**STEP 87**



RD02M087

Install the snap ring.

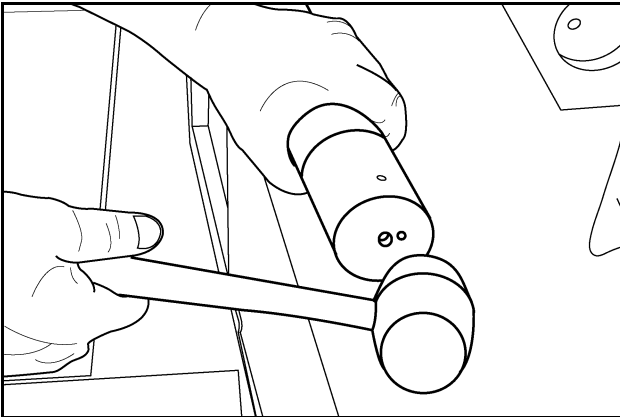
**STEP 90**



RD02M025

Tighten the shoulder bolt to a torque of 41 to 45 Nm (30 to 33 lb. ft.).

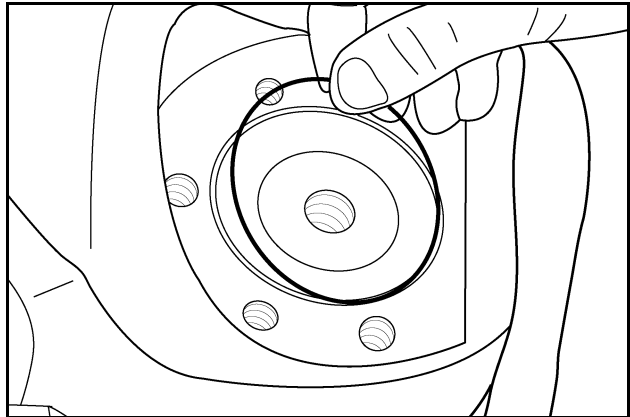
**STEP 88**



RD02M088

Install the upper cradle swing arm pin. Align the bolt hole in the pin with the shoulder bolt bore in the housing.

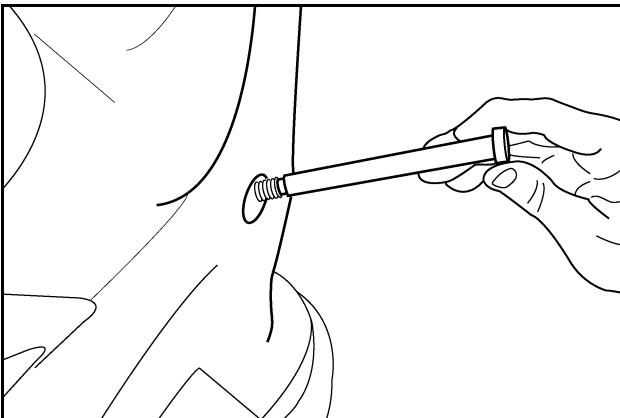
**STEP 91**



RD02M024

Install a new O-ring in the receiver groove.

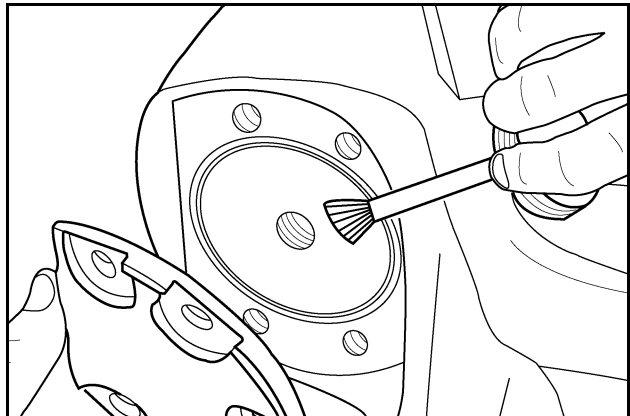
**STEP 89**



RD02M026

Install the shoulder bolt into the pin.

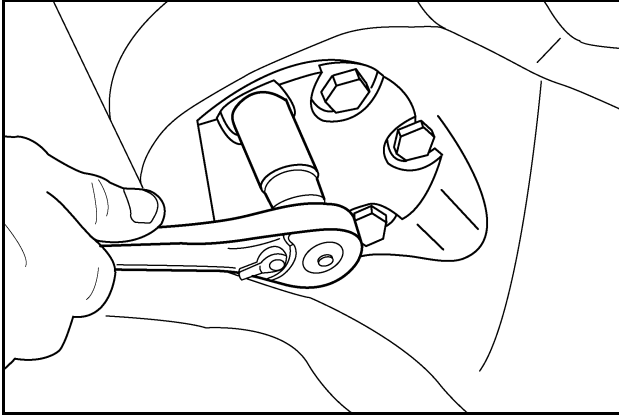
**STEP 92**



RD02M023

Apply Anti-Seize to the end of the pin. Install the retaining plate.

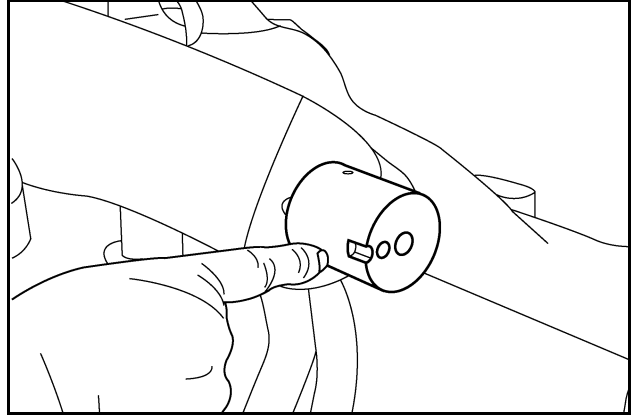
### STEP 93



RD02M089

Tighten the plate bolts to a torque of 58 to 64 Nm (43 to 47 lb. ft.).

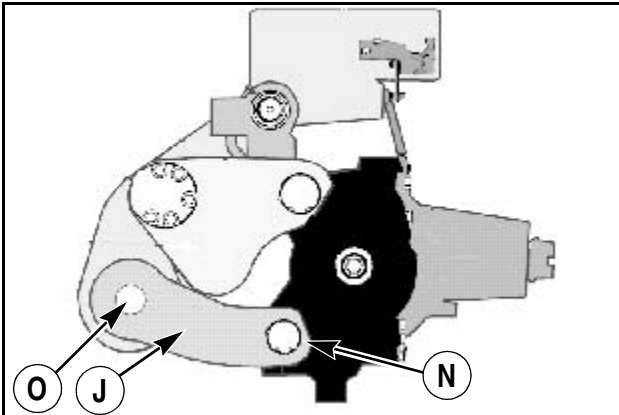
### STEP 96



RD02M091

Install the lower swing arm pins.

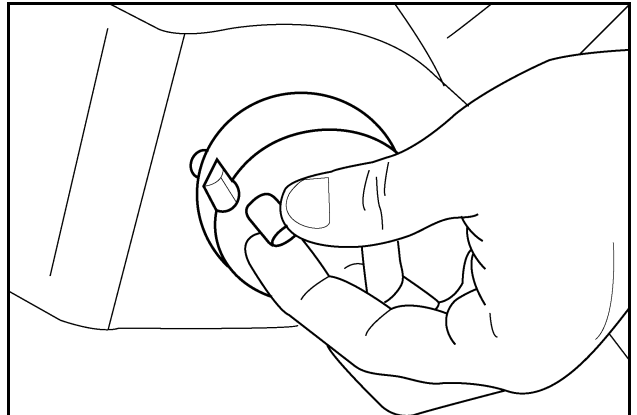
### STEP 94



RD02M104

The following parts are assembled at locations "J", "N" and "O".

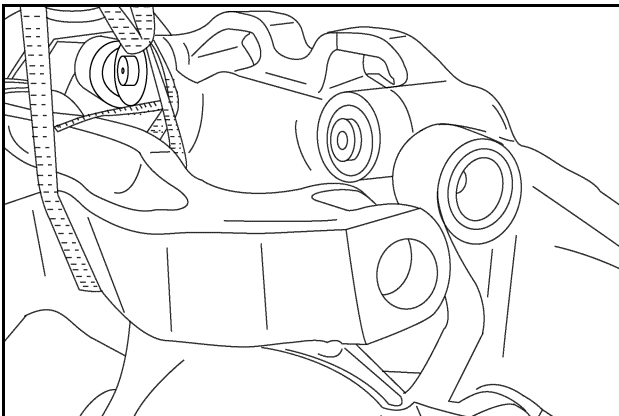
### STEP 97



RD02M093

Install the dowel pin. Drive the pion in until seated.

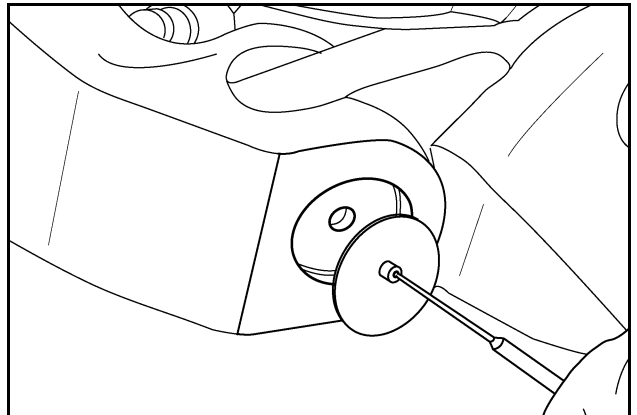
### STEP 95



RD02M090

Move the lower swing arm assembly into position.

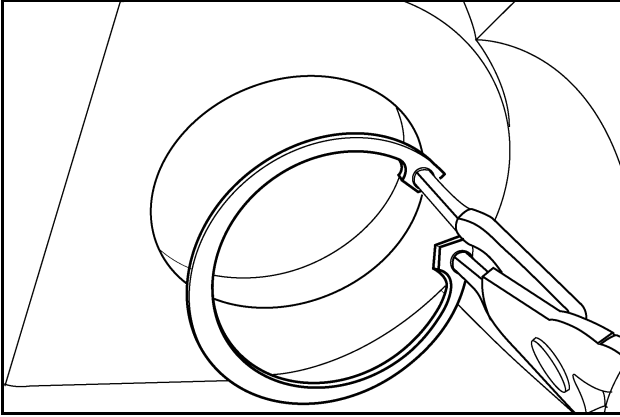
### STEP 98



RD02M949

Install the thrust washer.

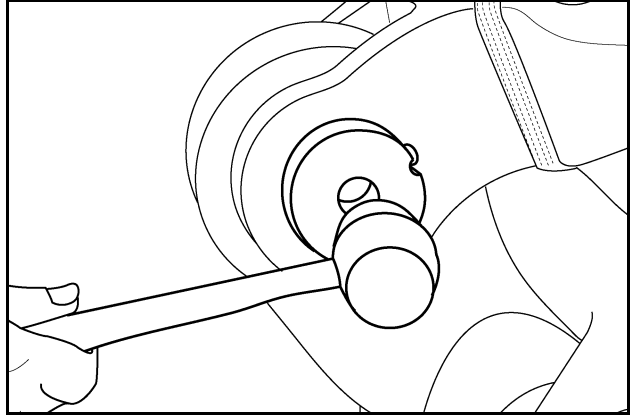
**STEP 99**



RD02M0495

Install the snap ring.

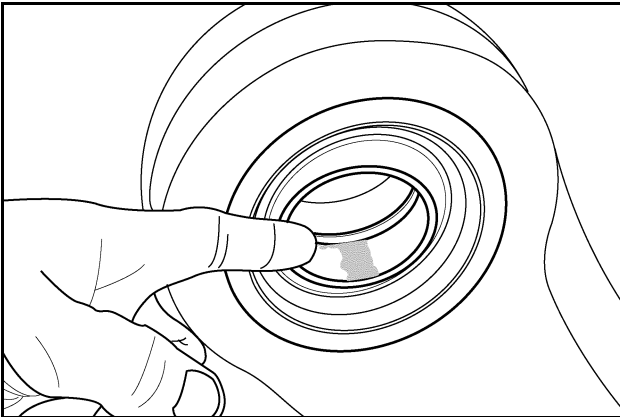
**STEP 102**



RD02M098

Install the pin.

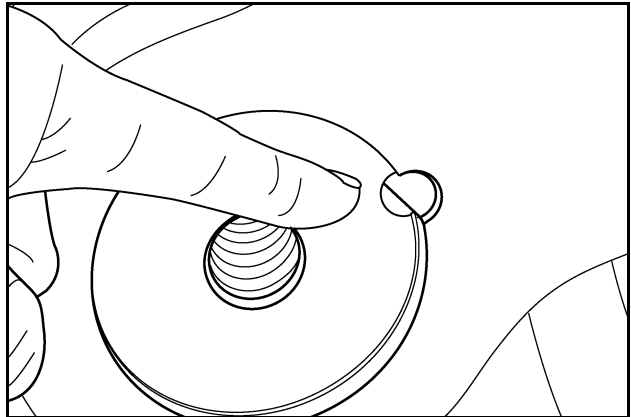
**STEP 100**



RD02M096

Apply grease to the ID of the bearing.

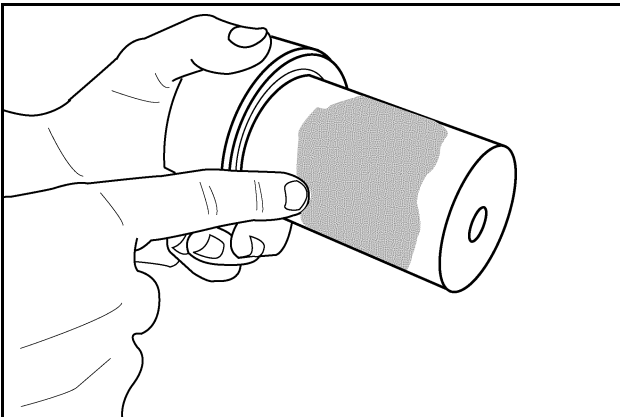
**STEP 103**



RD02M099

Align the dowel pin slot.

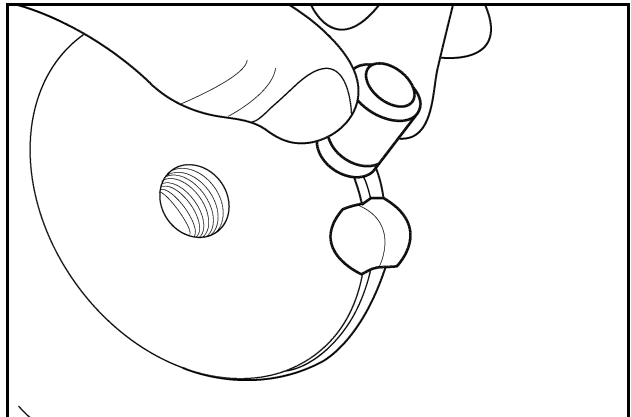
**STEP 101**



RD02M097

Apply grease to the lower swing arm/cradle pin.

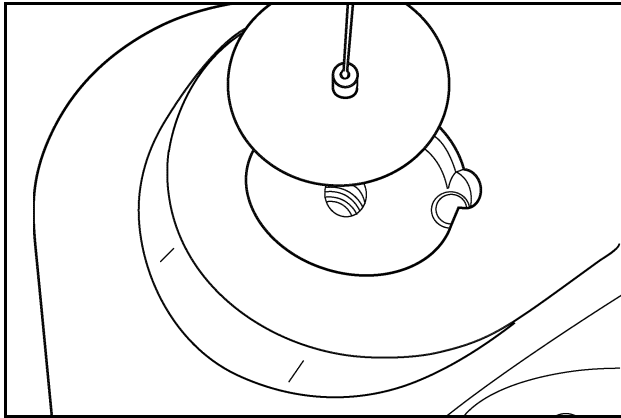
**STEP 104**



RD02M014

Install the dowel pin. Drive the pin in until seated.

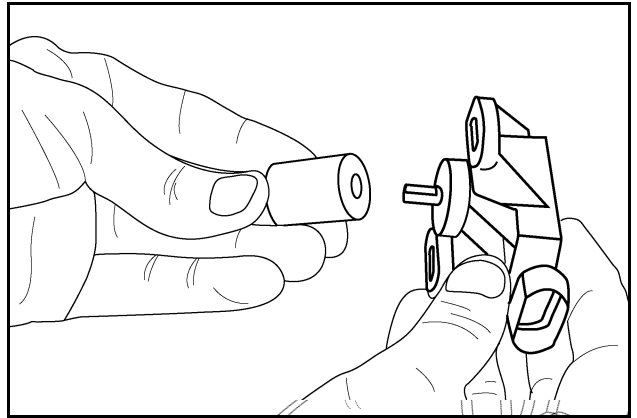
**STEP 105**



RD02M012

Install the thrust washer.

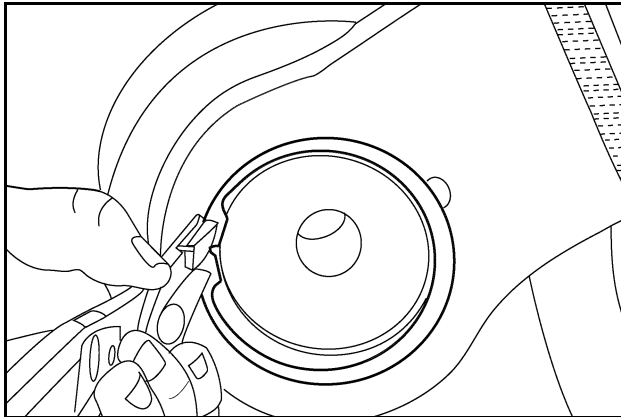
**STEP 108**



RD02M009

Install the sensor shaft.

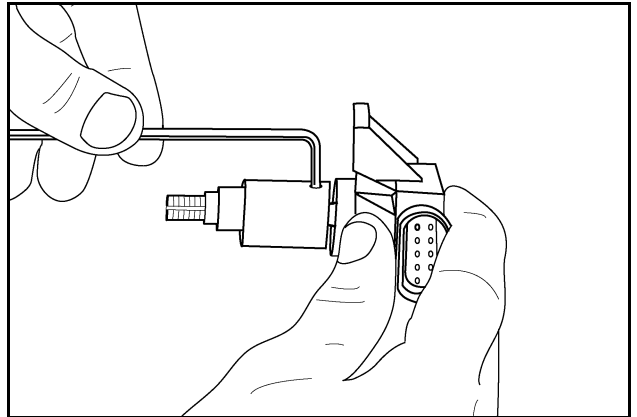
**STEP 106**



RD02M100

Install the snap ring.

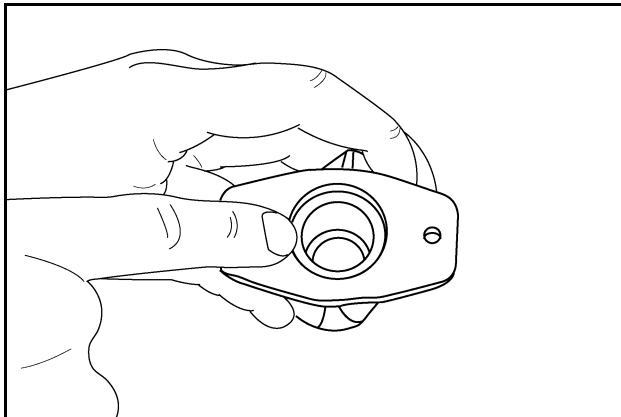
**STEP 109**



RD02M008

Align the set screw with the flat on the shaft. Tighten the screw.

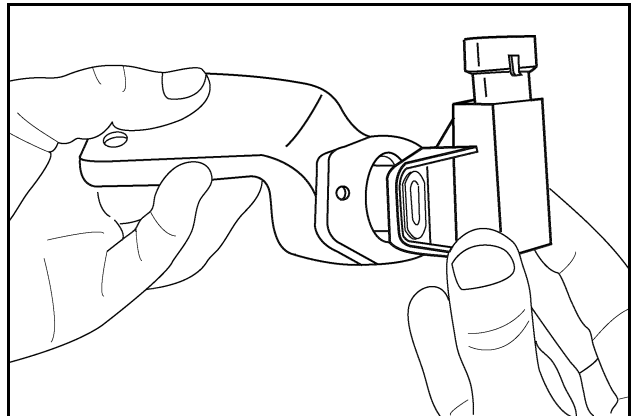
**STEP 107**



RD02M010

Install the bushing into the sensor housing.

**STEP 110**

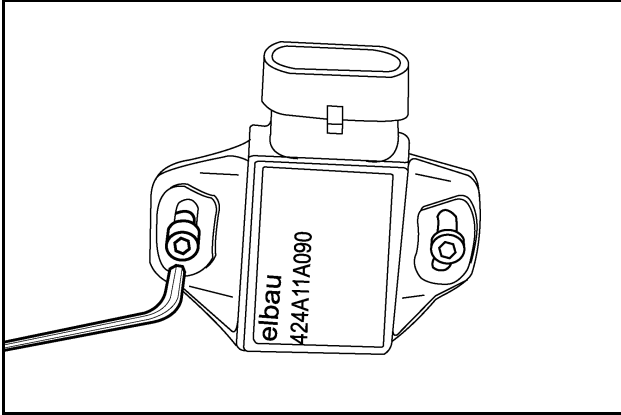


RD02M007

Install the sensor onto the mounting bracket.



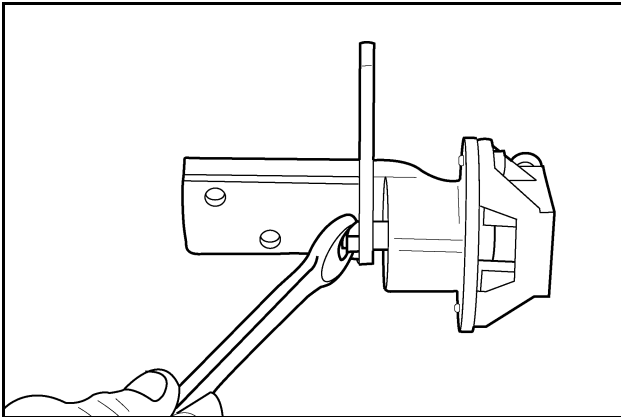
### STEP 111



RD02M006

Tighten the mounting screws to a torque of 4 to 4.5 Nm (36 to 40 lb. in.).

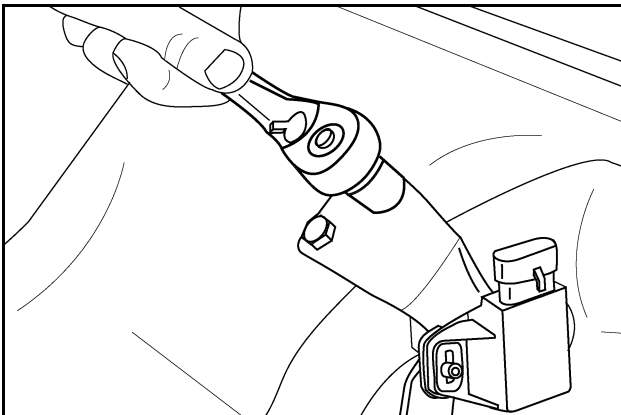
### STEP 112



RD02M004

Install the short link with the cutout facing up towards the bracket. Tighten the nut to a torque of 20 to 22.5 Nm (180 to 200 lb. in.).

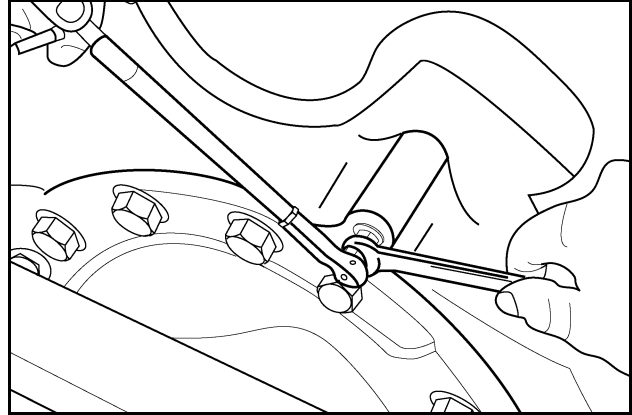
### STEP 113



RD02M003

Install the bracket on the housing. Tighten the bolts to a torque of 22 to 24 Nm (16 to 18 lb. ft.).

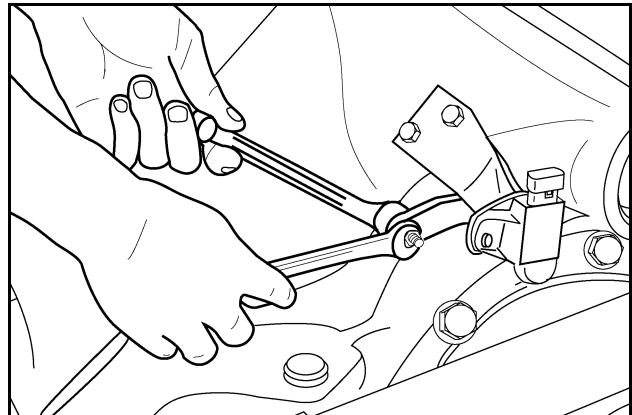
### STEP 114



RD02M002

Apply Loctite 243 to the male threads of the ball joint. Install the ball joint onto the axle and tighten to a torque of 19 to 20 Nm (165 to 180 lb. in.).

### STEP 115

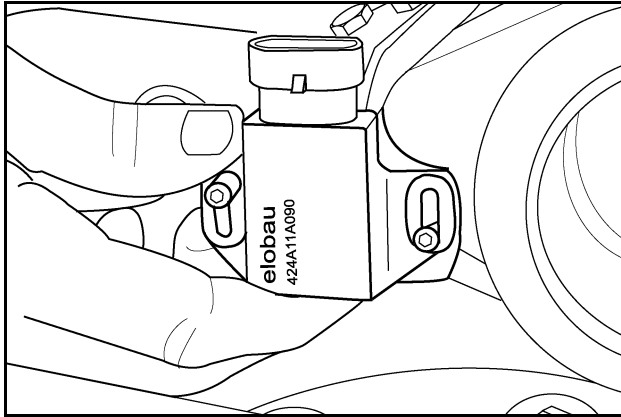


RD02M001

With the unit in the collapsed position, install remaining ball joint onto the sensor arm. Tighten the nut to a torque of 20 to 22.5 Nm (180 to 200 lb. in.).

## Position Sensor Adjustment

### STEP 116

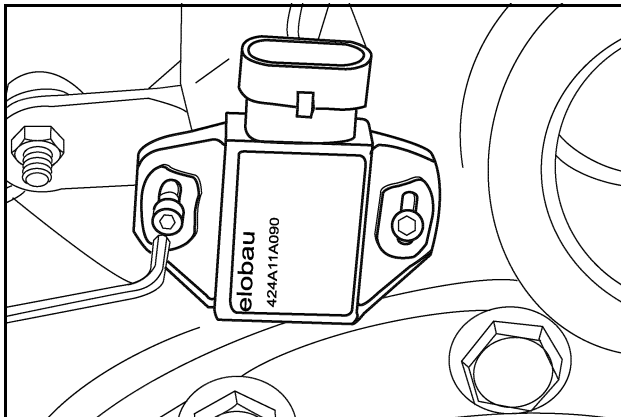


RD02M101

The angle position sensor must be checked at the fully collapsed and fully extended positions. Adjust the sensor as follows:

1. Apply 10 to 30 volts DC to pin 2.
2. Measure the signal current at pin 3. (4 to 20 mA)
3. Adjust the sensor slots to achieve 4 to 6 mA when axle is compressed and 18 to 20 mA when the axle is extended.

### STEP 117



RD02M103

When adjustment is complete, tighten the sensor screws to a torque of 4 to 4.5 Nm (36 to 40 lb. in.).

**NOTE:** The axle must be calibrated after installing onto the tractor. See calibration information in the Suspension FWD Axle How it Works Section of this Repair Manual.



# **Section 25**

## **Chapter 12**

### **SUPERSTEER AXLE VERTICAL CONTROL LINKAGE**

## TABLE OF CONTENTS

SPECIAL TORQUES .....	25-12-3
VERTICAL LINK DISASSEMBLY AND REPAIR .....	25-12-3
Vertical Link Removal .....	25-12-3
Roller Replacement .....	25-12-4
Articulation Bearing Removal and Installation .....	25-12-5
Vertical Link Assembly .....	25-12-6

## SPECIAL TORQUES

M20 x 70 mm Socket Head Screws.....	295 to 530 Nm (215 to 315 lb. ft.)
Special Hex Head Bolts.....	220 to 280 Nm (160 to 205 lb. ft.)
M24 x 355 mm Mounting Bolts.....	710 to 915 Nm (525 to 675 lb. ft.)

## VERTICAL LINK DISASSEMBLY AND REPAIR

### STEP 1

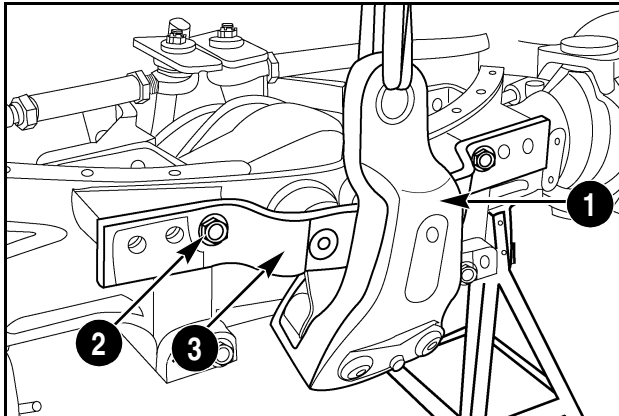
For Supersteer axle removal, refer to the Chapter for Supersteer axle removal in this manual.

### STEP 2

For Planetary Hub, Steering Knuckle and Axle Drive Shaft removal and service, refer to the Chapter for your axle in this manual.

### Vertical Link Removal

### STEP 3

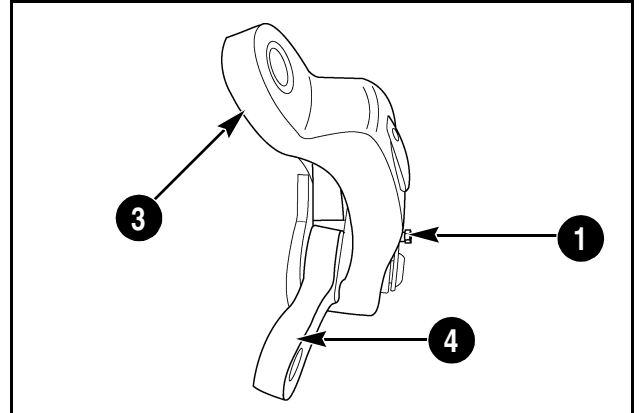


RD02K003

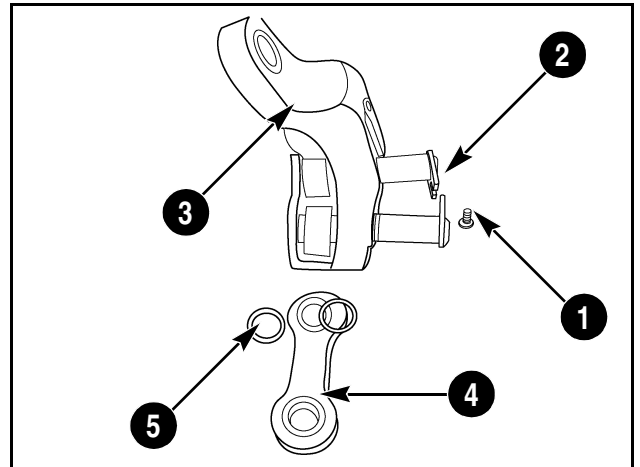
With the axle removed from the tractor, support the vertical link assembly (1) with a lift strap and hoist. Remove the two bolts and washers (2) from the retainer plate (3) and remove the vertical link assembly (1) and retainer plate (3) from the axle.

**NOTE:** Support the retainer plate (3) when removing the vertical link assembly (1) from the axle.

### STEP 4



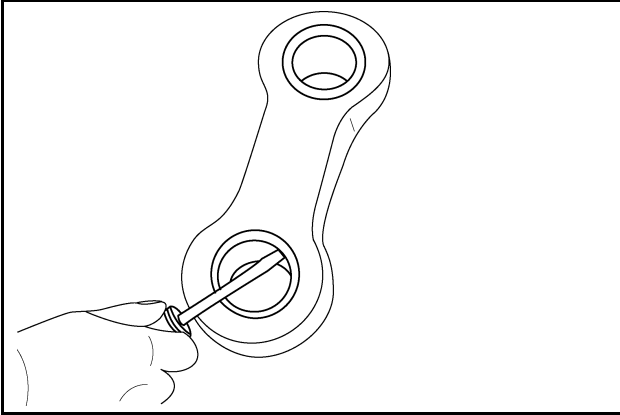
RD02K005



RD02K006

Remove the bolt and washer (1) holding the linkage pins (2) to the vertical link. Pull the linkage pins out enough to remove the two axle links from the vertical link.

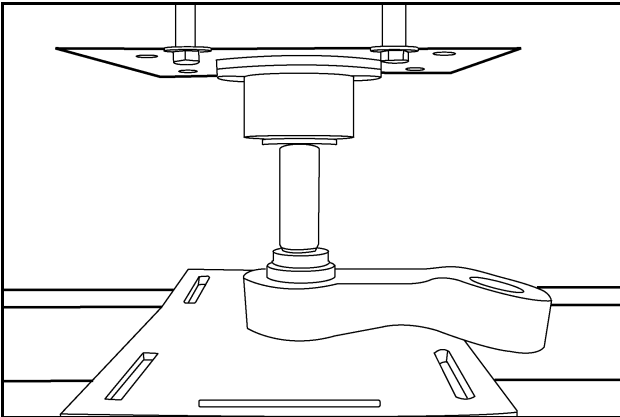
## STEP 5



RD02K007

If the bushings need replaced in the axle links and the vertical link, remove the bushing seals.

## STEP 6

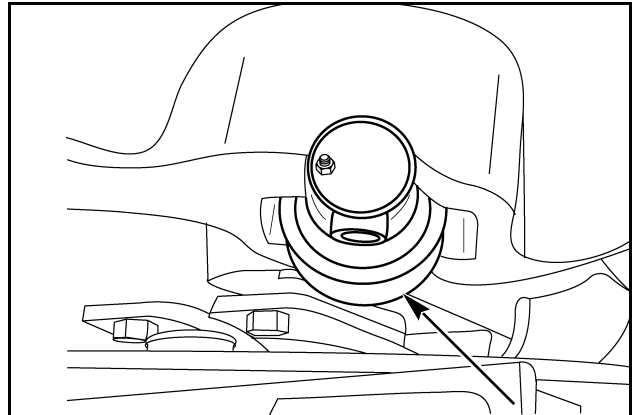


RD02K008

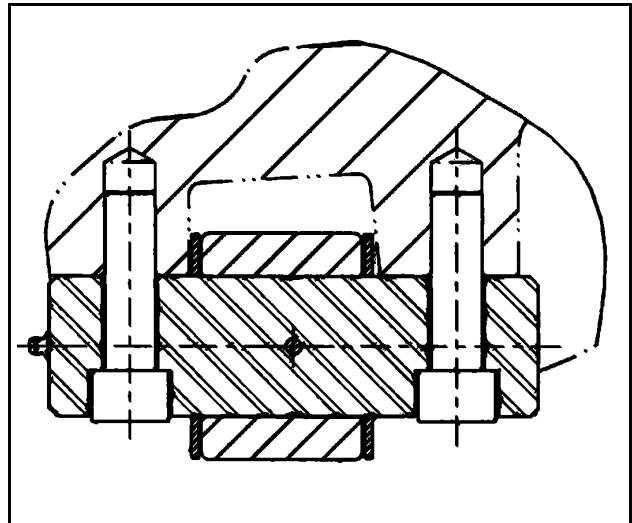
Use a press to remove the bushings from the axle links and vertical link if required.

## Roller Replacement

## STEP 7



RD02K009



RH02K003

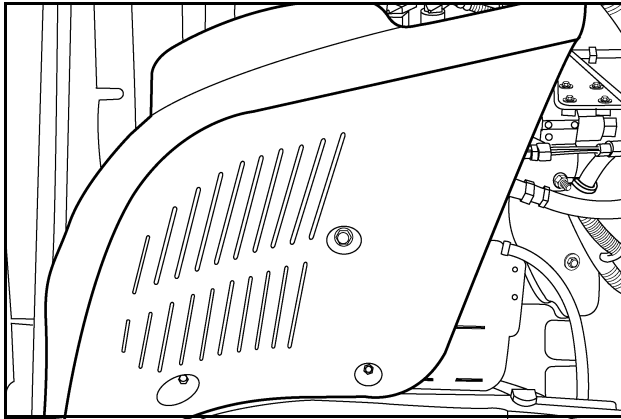
If the rollers need replaced, remove the two M20 x 70 mm socket head screws and remove the roller pin, washers and roller.

Remove the roller from the [pin and install a new roller on the pin (if required).

Install the roller pin, washers and roller to the frame with the two M20 x 70 mm socket head screws. Torque the screws to 295 to 530 Nm (215 to 390 lb. ft.).

## Articulation Bearing Removal and Installation

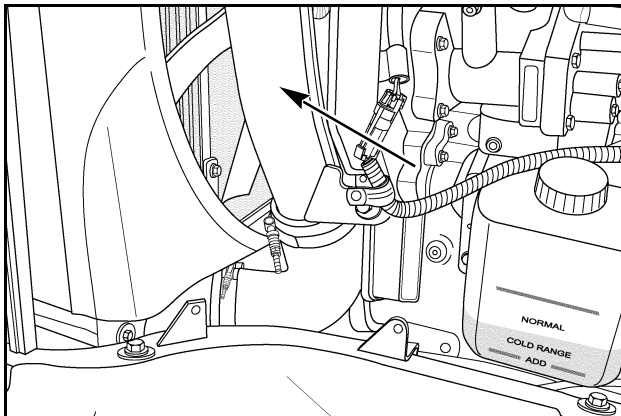
### STEP 8



RD02K011

Remove the safety guard to gain access for removal of the air to air aftercooler pipe.

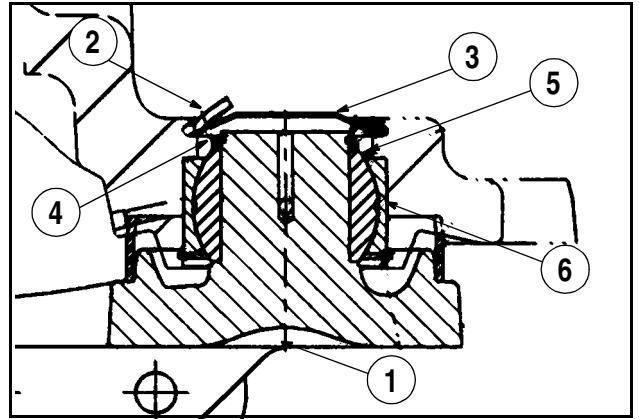
### STEP 9



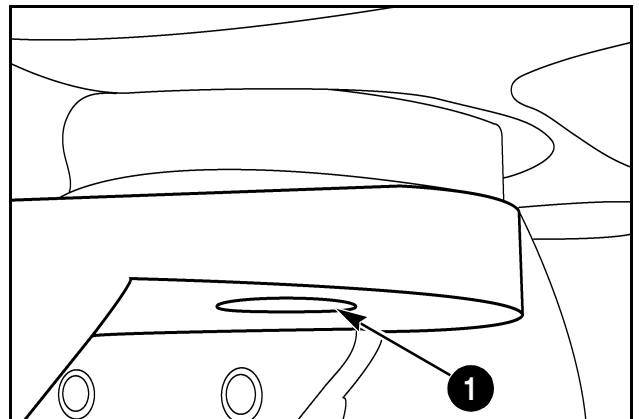
RD05N023

Remove the air to air aftercooler pipe to access the articulation bearing dust cap retainer ring.

### STEP 10



RH02K005



RD02K010

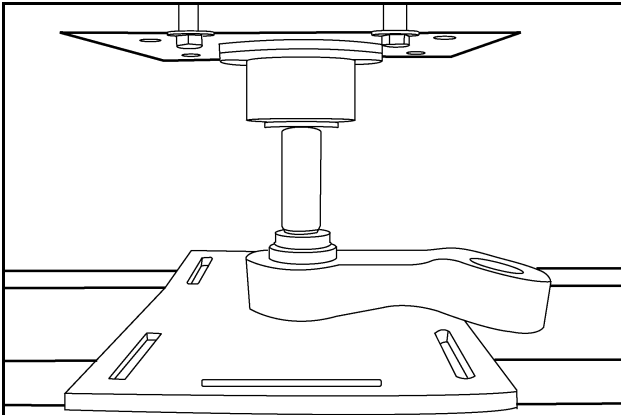
Support the bottom of the front axle rear support (1) to keep it from falling when the retaining ring (4) is removed.

1. Remove the dust cap retainer ring (2).
2. Remove the dust cap (3).
3. Remove the retaining ring (4).
4. Lower the front axle rear support (1) just enough to remove the bearing spacer (5) and the bearing (6).
5. Install the bearing (6) and bearing spacer (5).
6. Raise the front axle rear support (1) and install the retaining ring (4). Remove the support.
7. Install dust cap (3) and dust cap retainer ring (2).
8. Lubricate the bearing.



## Vertical Link Assembly

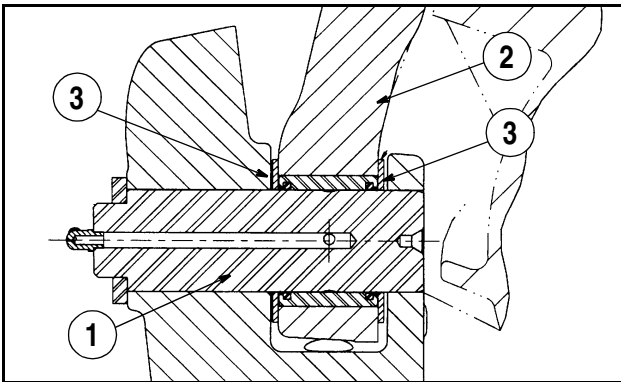
### STEP 11



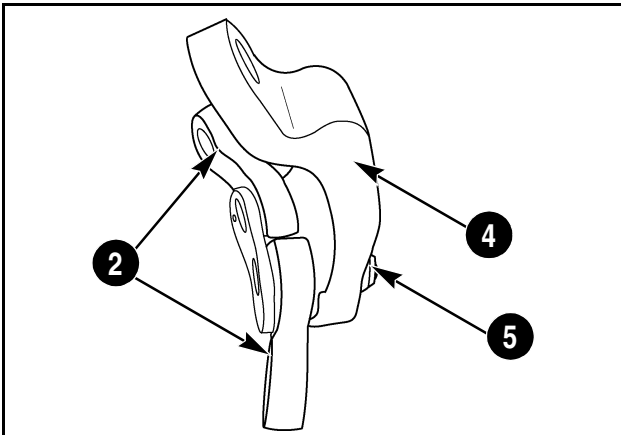
RD02K008

Press the bushings into the axle links and vertical link (if required). Install the bushing seals into the vertical link and axle links.

### STEP 12



RH02K002

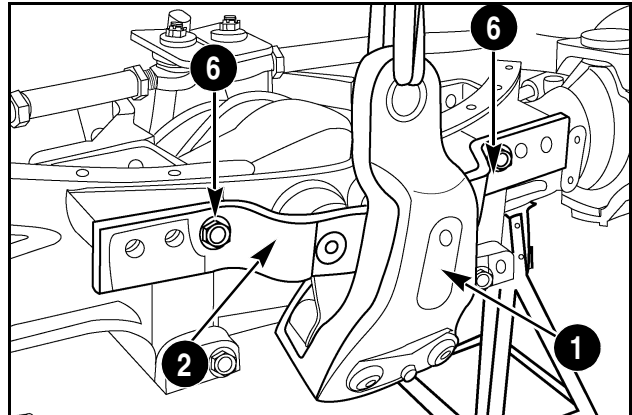


RD02K004

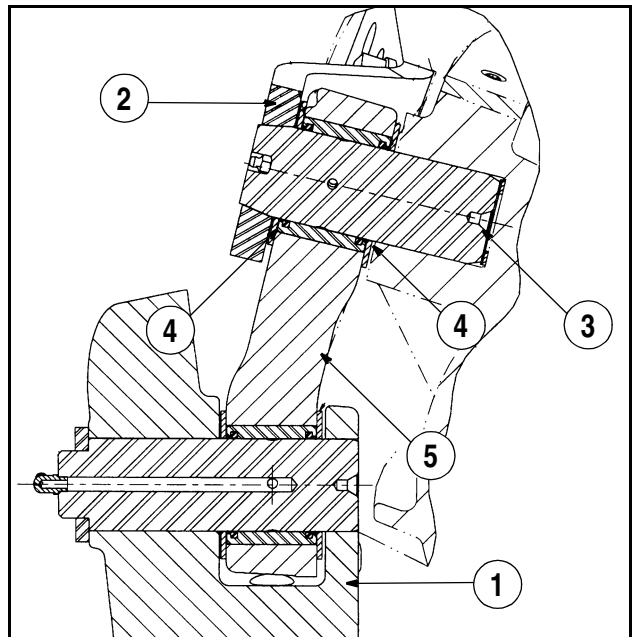
Assemble the bottom linkage pins (1), axle links (2) and 55.5 x 88 x 3 mm washers (3) to the vertical link (4) with the bolt and 17.5 x 30 x 4 mm washer (5). Torque the bolt to 220 to 280 Nm (160 to 205 lb. ft.).

**NOTE:** The washers (3) must be on each side of the axle links (2).

### STEP 13



RD02K003



RH02K002

Support the vertical link assembly (1) with a lift strap and hoist. Install a 55.5 x 88 x 3 mm washer (4) on the linkage pins (3) in the axle. Slip the axle links (5) over the linkage pins (3) and install another 55.5 x 88 x 3 mm washer (4) onto the linkage pin (3). Install the retainer plate (2) and retain with the two M24 x 355 mm hex head bolts and 26 x 44 x 5 mm washers (6). Torque the bolts 710 to 915 Nm (525 to 675 lb. ft.).

Lubricate all of the linkage pins.

### STEP 14

To install the Supersteer axle to the tractor. (Refer to Supersteer Axle Removal and Installation Section of this Repair Manual.)

# **Section 27**

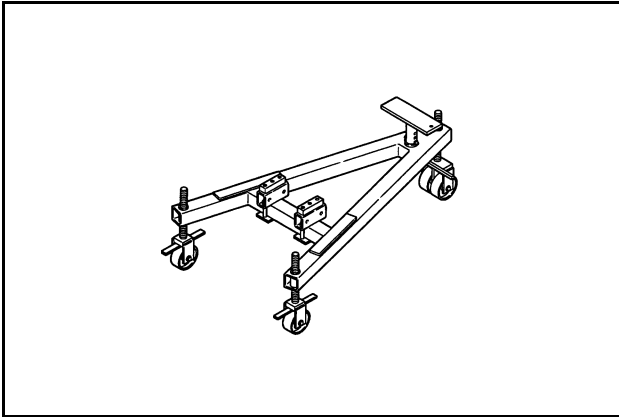
## **Chapter 1**

### **REAR AXLE AND PLANETARIES**

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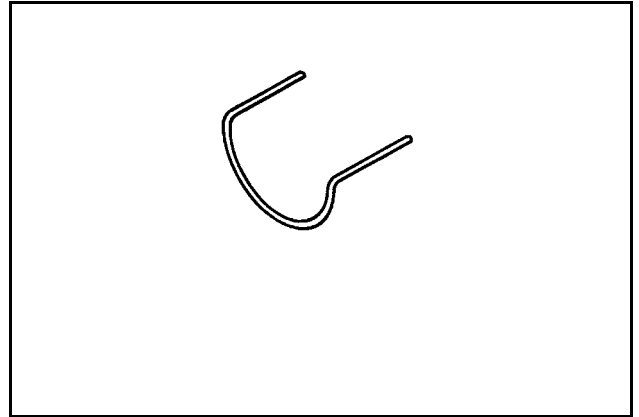
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## SPECIAL TOOLS



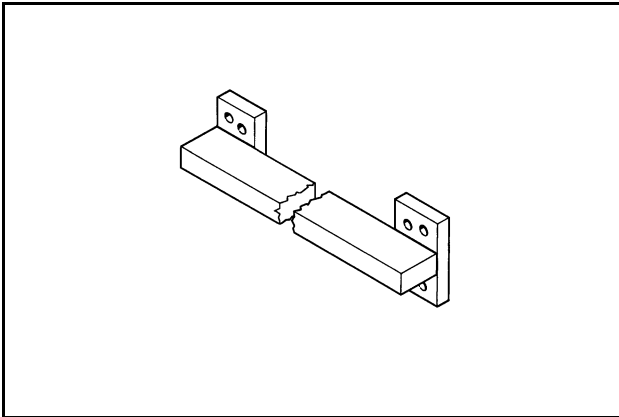
RH02D122

**Rear Housing Handler 17-527**



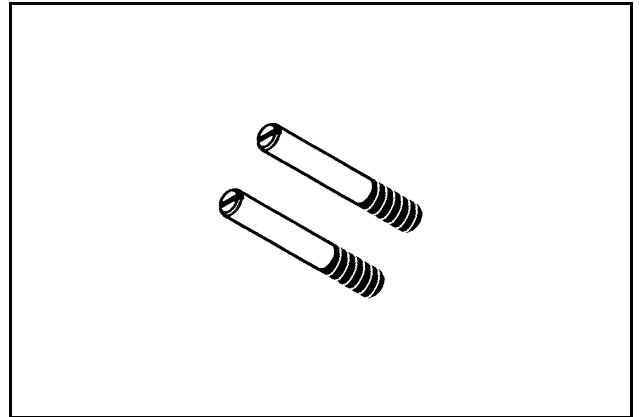
RH02D124

**Brake Disc Alignment Tool 89-581-5**



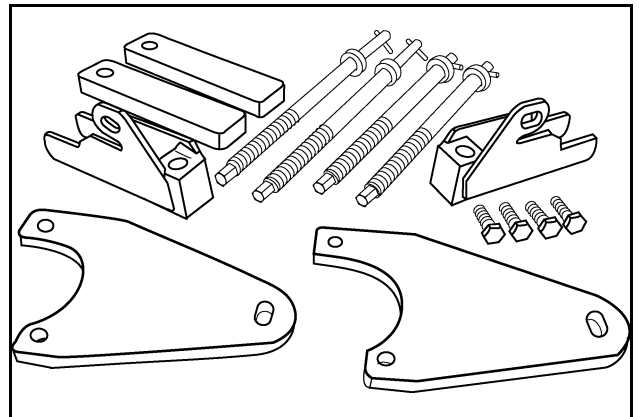
RH02D123

**Pushing Bridge 89-525-18**



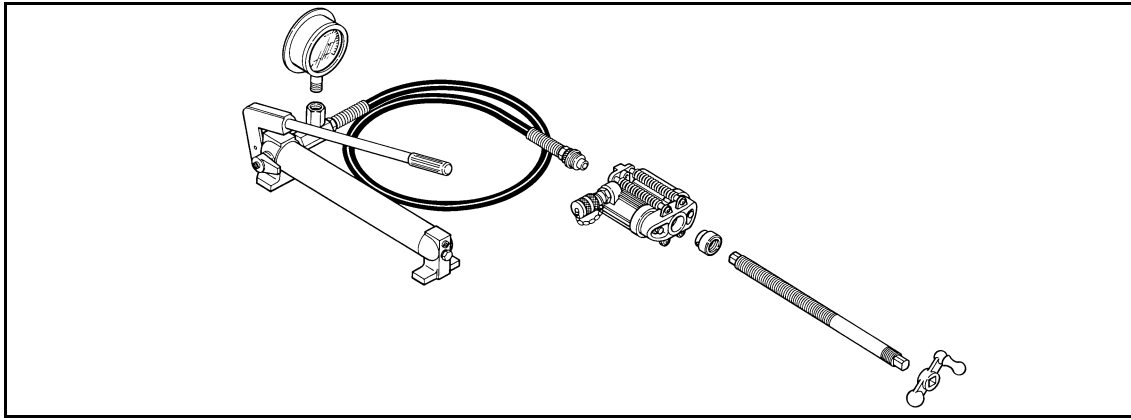
CAS2601

**Alignment Guide Pins (studs) CAS2601**

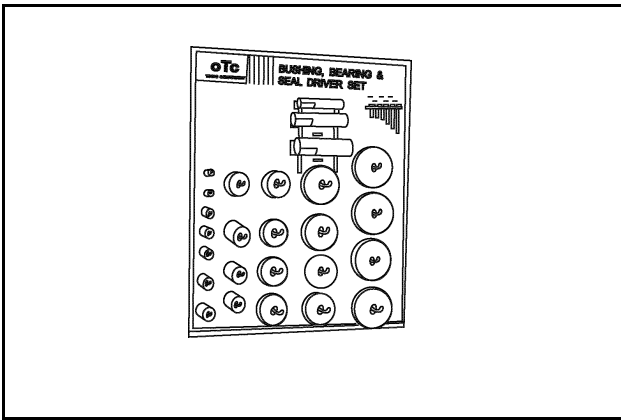


RD02E109

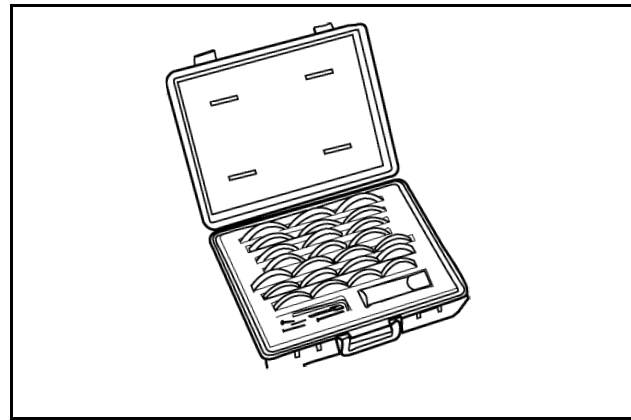
**Cab Raising Bracket Kit CAS2577**



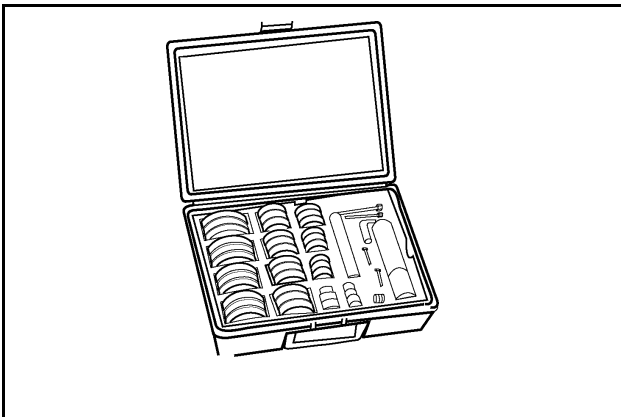
**Puller Set with 30-Ton Ram CAS10030**



**Bushing Bearing And Seal Driver Set CAS 10387**  
**Tool Organizer Board CAS10390**



**Universal Driver Set (3-1/16 Inch To 4-1/2 Inch Diameter) CAS10389**



**Universal Driver Set (1/2 Inch To 4-1/2 Inch Diameter) CAS10388**

## SPECIAL TORQUES

Axle Mounting Bolts ..... 220 to 250 Nm (171 to 193 lb. ft.)

## SPECIFICATIONS

Axle Rolling Torque Without Outer Seal

Set Torque 4 inch Axle .....	250 to 300 lb. in. (28.0 to 34.0 Nm)
4.5 inch Axle .....	290 to 420 lb. in. (28.0 34.0 Nm)
Final Torque With New Bearings 4 inch Axle .....	100 to 170 lb. in. (33.0 to 47.0 Nm)
4 inch Axle .....	140 to 210 lb. in. (16.0 to 16.0 Nm)
4 inch HD Axle .....	140 to 230 lb. in. (16.0 to 26.0 Nm)
Final Torque With Used Bearings 3-1/2 inch Axle .....	50 to 85 lb. in. (5.6 to 9.6 Nm)
4 inch Axle .....	70 to 105 lb. in. (8.0 to 12.0 Nm)
4.5 inch Axle .....	79 to 123 lb. in. (9.0 to 14.0 Nm)

## GENERAL INFORMATION



**WARNING:** THIS SAFETY ALERT SYMBOL INDICATES IMPORTANT SAFETY MESSAGES IN THIS MANUAL. WHEN YOU SEE THIS SYMBOL, CAREFULLY READ THE MESSAGE THAT FOLLOWS AND BE ALERT TO THE POSSIBILITY OF PERSONAL INJURY OR DEATH. N171B

### Cleaning

Before any service work is done, steam clean the complete outside surface of the housing.

**NOTE:** Do not use caustic soda for steam cleaning.

Clean all metal parts, except bearings, in mineral spirits or by steam cleaning.

After cleaning, dry and lubricate all parts. Clean oil passages with compressed air.

### Inspection

Visually inspect all parts when disassembled.

Replace all parts that have wear or damage. The replacement of parts as necessary will prevent early failure.

### Gears

Check all gears for wear and damage.

Replace worn or damaged gears.

### Oil Seals, O-rings And Gaskets

Always install new oil seals, O-rings and gaskets. Put oil or petroleum jelly on seals and O-rings.

### Bearings

Check bearings for smooth action. If a bearing has a loose fit or rough action, replace the bearing.

If necessary, wash bearings with clean solvent and permit to air dry.

**NOTE:** DO NOT DRY WITH COMPRESSED AIR.

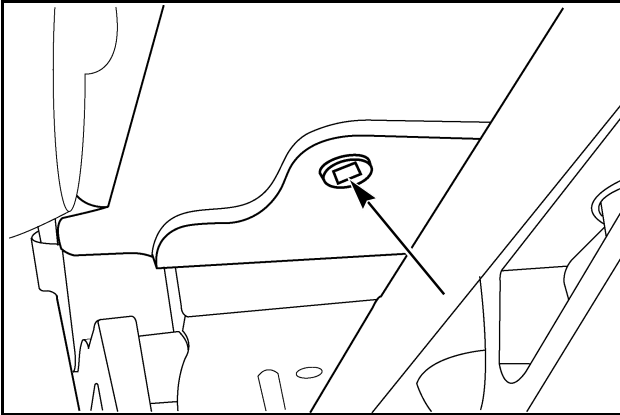
Lubricate bearings after cleaning to prevent rust.



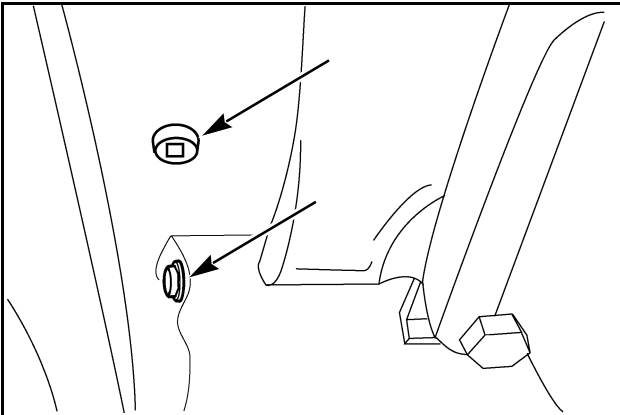
**WARNING:** Always wear heat protective gloves to prevent burning your hands when handling heated parts. SM121A

## REAR AXLE REMOVAL

### STEP 1



91S16



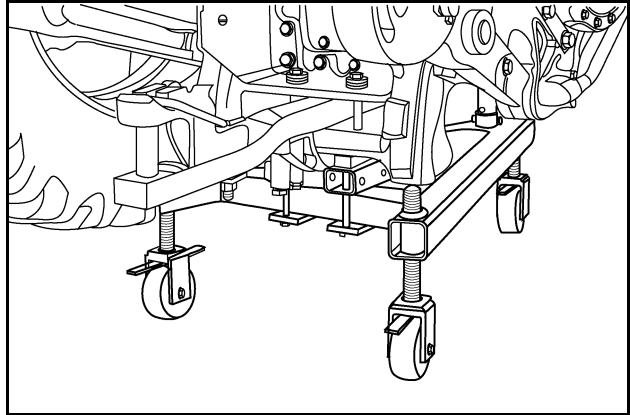
91S10

Drain the rear axle as follows:

1. Put a container under the transmission housing.
2. Remove the drain plug and drain the fluid from the transmission housing.
3. Remove the drain plug from under the axle housings and remove the fluid.

**NOTE:** The transmission holds approximately 174 liters (46 gallons) of oil.

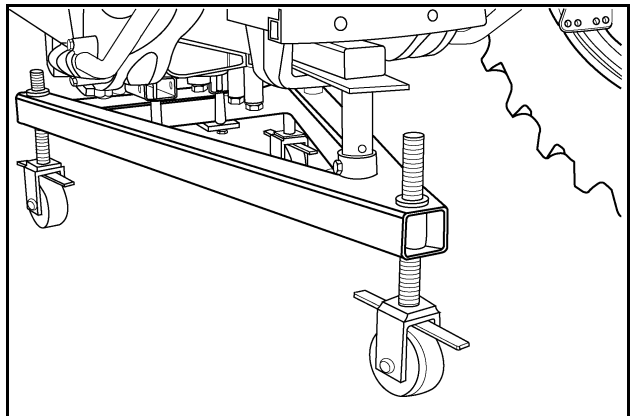
### STEP 2



13S23

Move the rear housing handler CAS17-527 into position under the tractor.

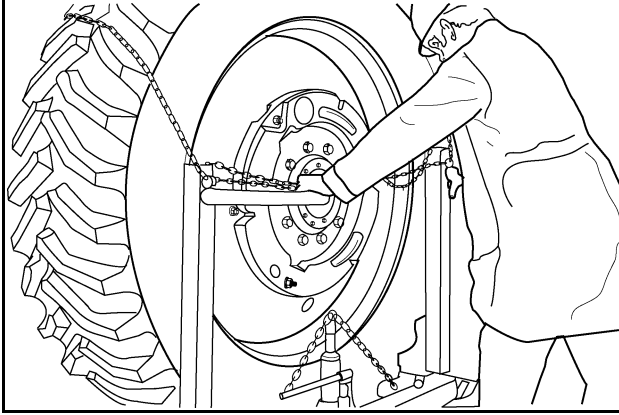
### STEP 3



13S29

Raise the front lift of the rear housing handler. Turn the rear threaded rods until the rear frame is supported.

### STEP 4



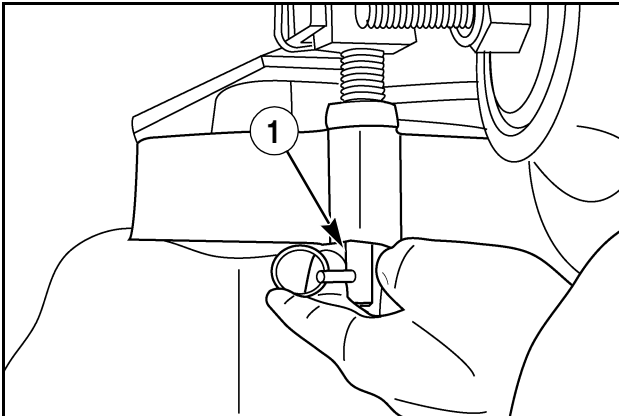
86S1

Remove the wheel and tire assemblies from both axles.

### STEP 5

Raise the rear of the cab. See Cab Raise Procedure in this Service Manual.

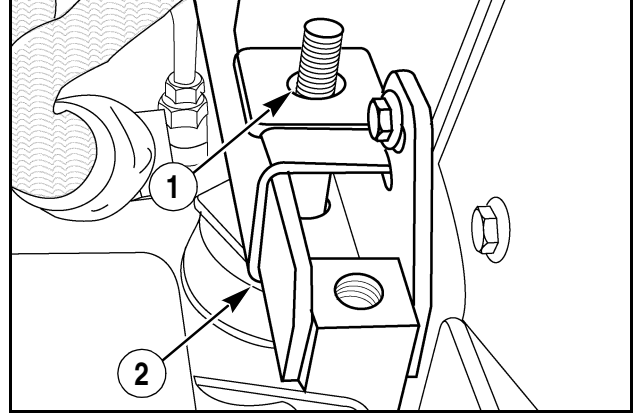
### STEP 6



77S36X

Properly support the cab by placing blocking between the cab rails and the transmission. Make sure that no wires or hydraulic lines are pinched. Lower the cab and remove the cab jacking bolt (1)

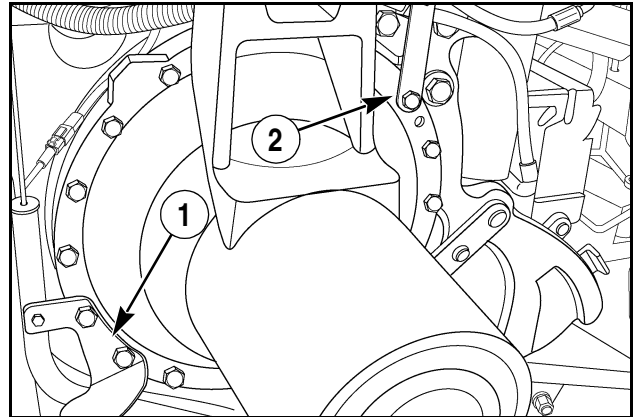
### STEP 7



RD02F104

Remove the cab mounting bolt (1) from the cab mount. Lifting bracket (2) can be left in place.

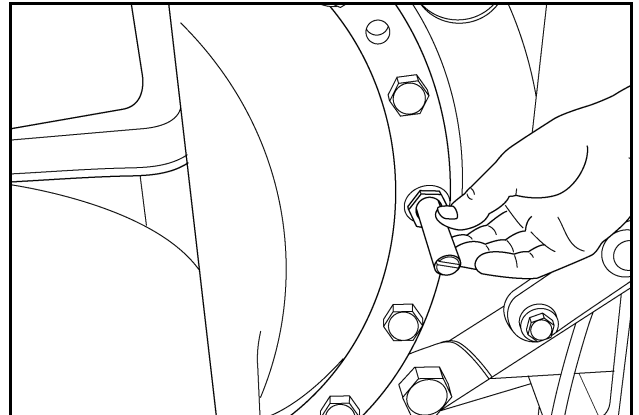
### STEP 8



RD06A002

Remove the axle bolts that retain the draft pin wiring tub bracket (1) and the hitch cylinder hose bracket (2). Move the brackets out of the way.

### STEP 9

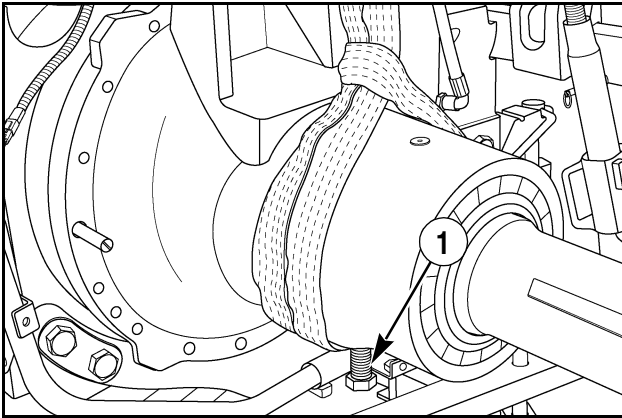


RD06A003

Remove a bolt from front and rear of the axle housing and install a guide dowel in each bolt location.



## STEP 10

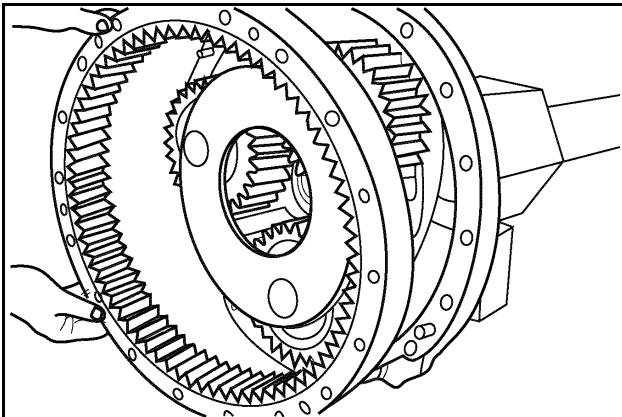


Install a lifting strap at the axle balance point. Install a bolt (1) on each side of the axle, this will prevent the lifting strap from possibly sliding off. Put tension on the lift strap. Remove the remaining bolts and remove the axle.

**NOTE:** It will be necessary to break loose the axle flange sealant by hitting the axle end with a soft faced mallet.

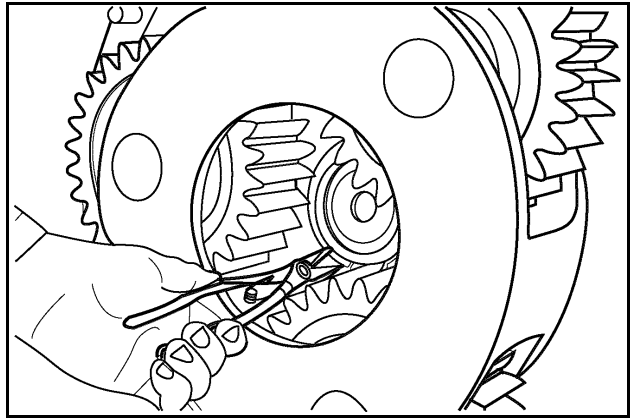
**NOTE:** The following steps show three gear planetary, the four gear will be similar.

## STEP 11



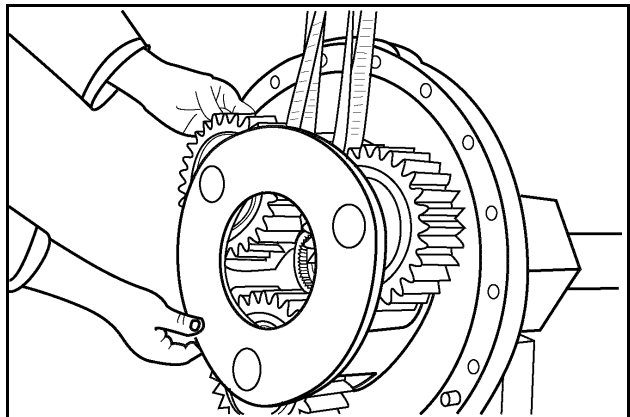
Remove the ring gear from the axle housing.

## STEP 12



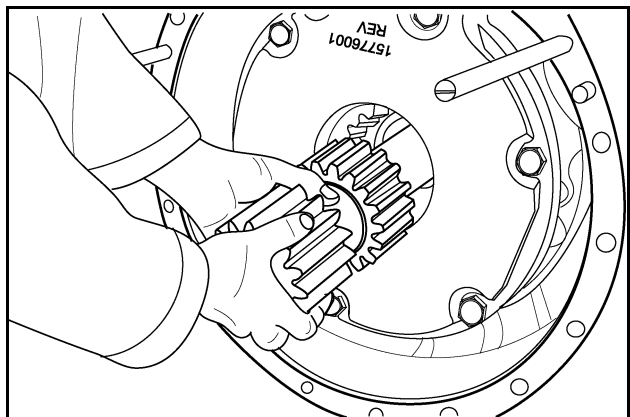
Remove the retaining ring from the axle shaft.

## STEP 13



Use a sling and hoist to remove the planetary assembly from the axle.

## STEP 14

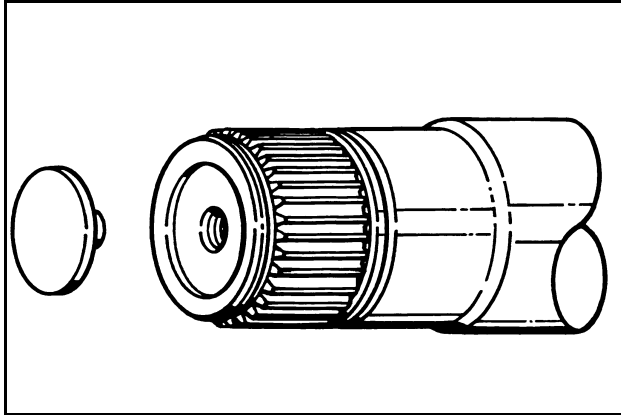


Remove the sun gear from the brake discs. Clean and inspect for heavy wear or damage. Replace if necessary.

**NOTE:** If the sun gear is replaced, new planet gears must also be installed.

## AXLE HOUSING DISASSEMBLY

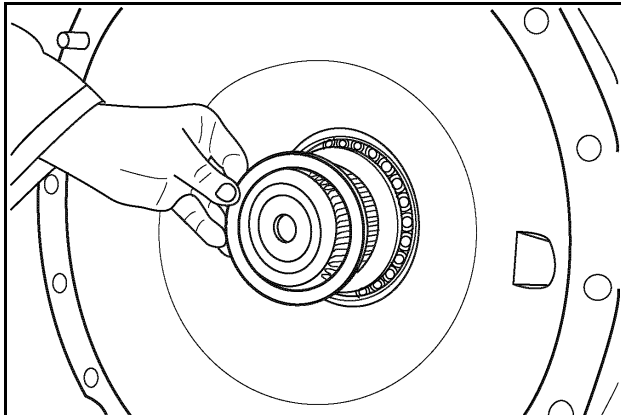
### STEP 15



512L0

Remove the nylon wear insert from the axle shaft end. Remove the retaining ring from the axle shaft. Press on the thrust ring to relieve pressure on the retaining ring before removing retaining ring from shaft.

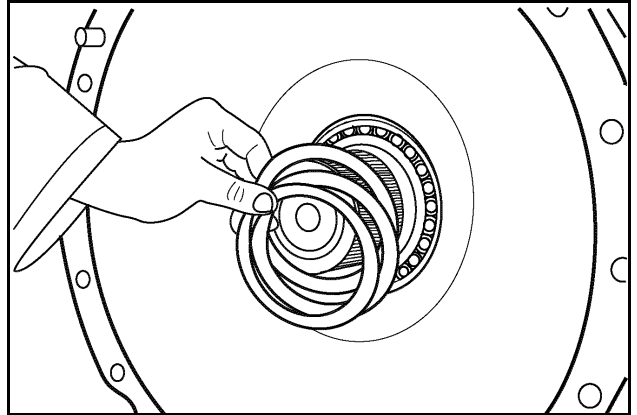
### STEP 16



T97980

Remove the thrust ring from the axle shaft.

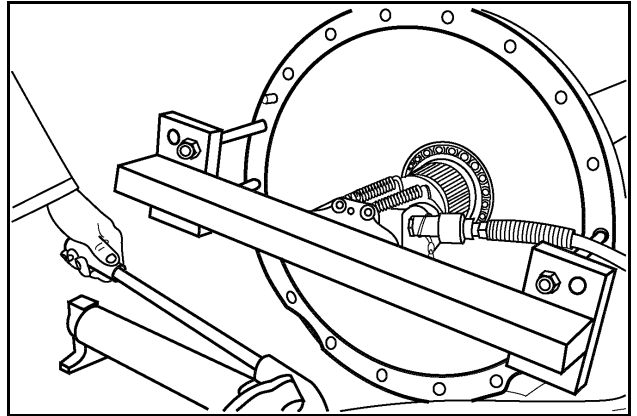
### STEP 17



T97981

Remove the shims from the axle shaft.

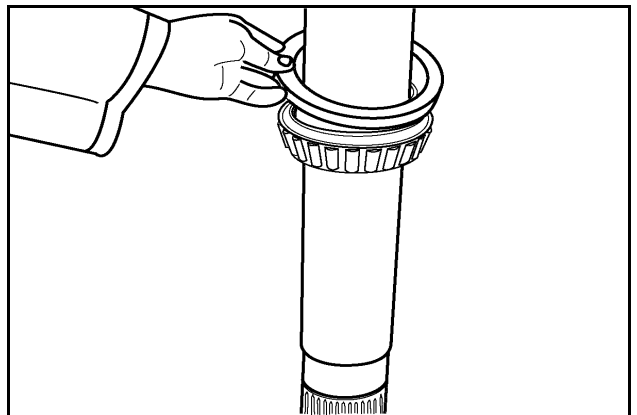
### STEP 18



T97984

Install a pulling bridge and a 30-ton ram on the axle housing. Press the axle assembly out of the axle housing.

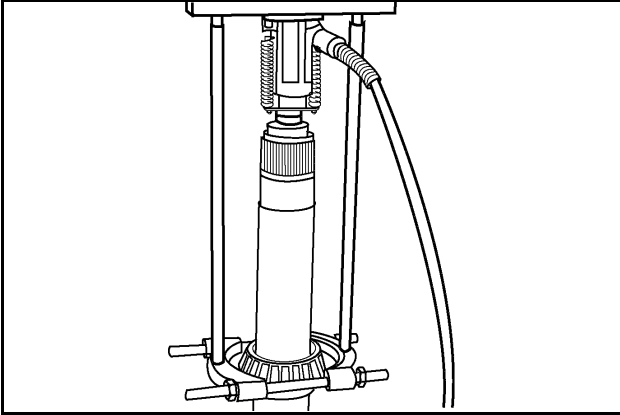
### STEP 19



T97985

Remove the seal and, if equipped, the wear sleeve, from the axle shaft.

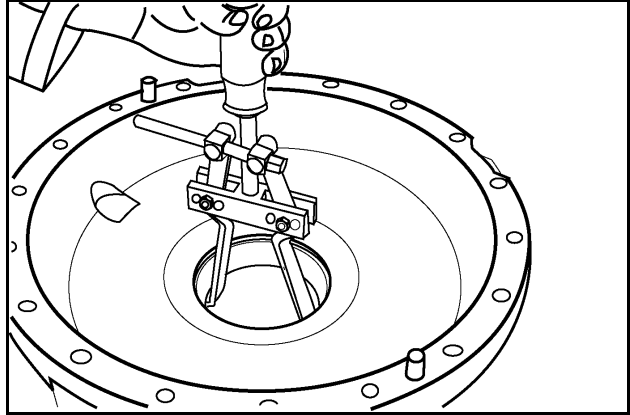
### STEP 20



T97986

Use a puller to remove the bearing from the axle shaft.

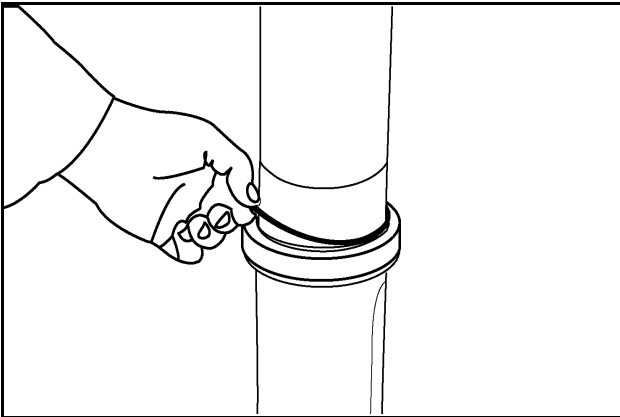
### STEP 23



T97994

Use a puller to remove the inner bearing cup from the axle housing.

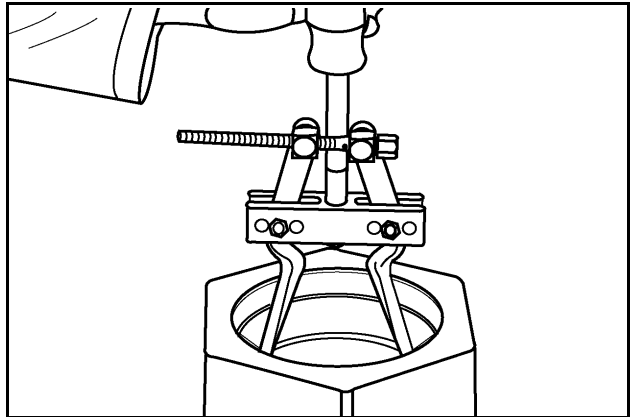
### STEP 21



T97988

Remove and discard the O-ring used on 4-in. axles from the axle bushing.

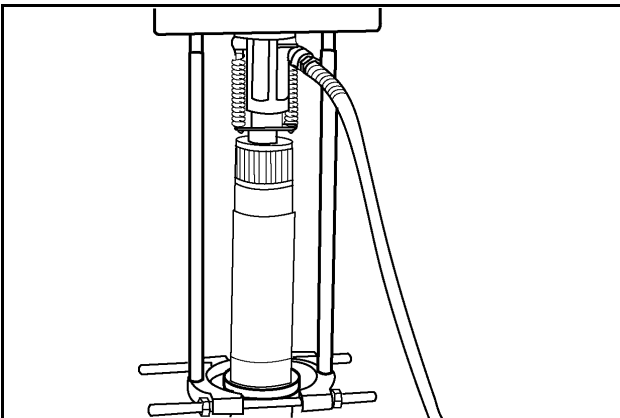
### STEP 24



T97997

Use a puller to remove the outer bearing cup from the axle housing.

### STEP 22



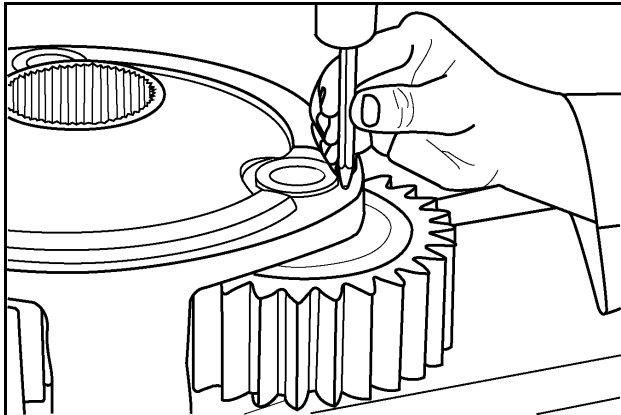
T97991

Use a puller to remove the bushing from the axle shaft.

**NOTE:** Remove the O-ring from the inside diameter of the bushing on 115 mm (4.5 in.) diameter axle.

## PLANETARY DISASSEMBLY

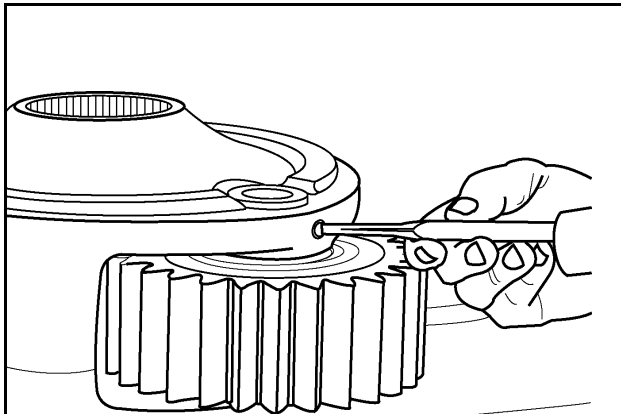
### STEP 25



T98000

If the planetary gears are to be used again, make marks so that the gears are assembled in their original location in the gear carrier.

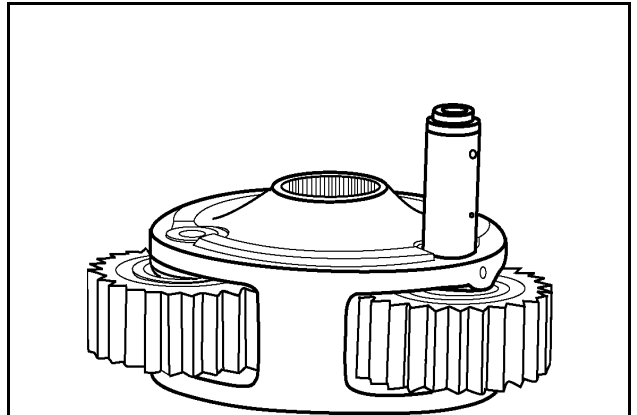
### STEP 26



T97999

Drive the roll pin into the planet gear shaft.

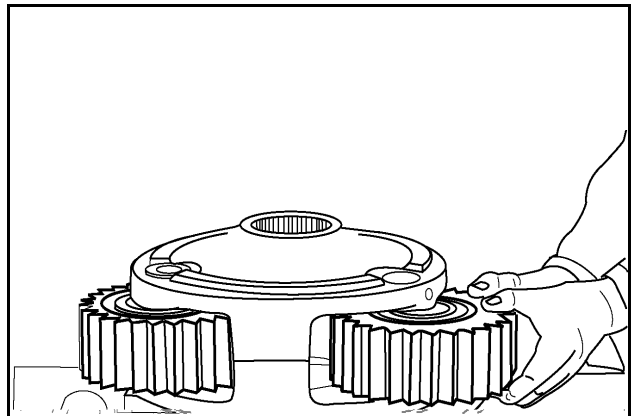
### STEP 27



T98002

Remove the planet gear shaft from the planetary gear carrier.

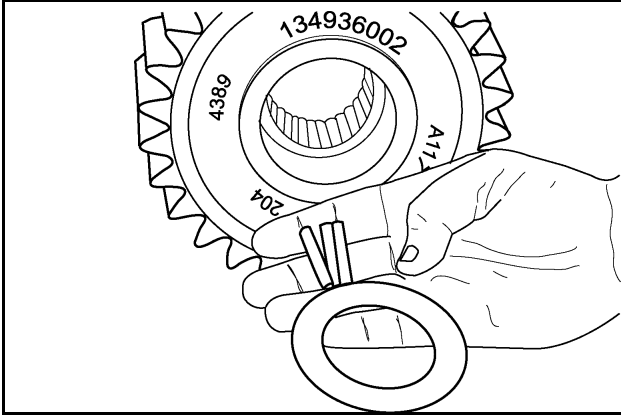
### STEP 28



T98003

Remove the planetary gear and bearing assembly from the gear carrier.

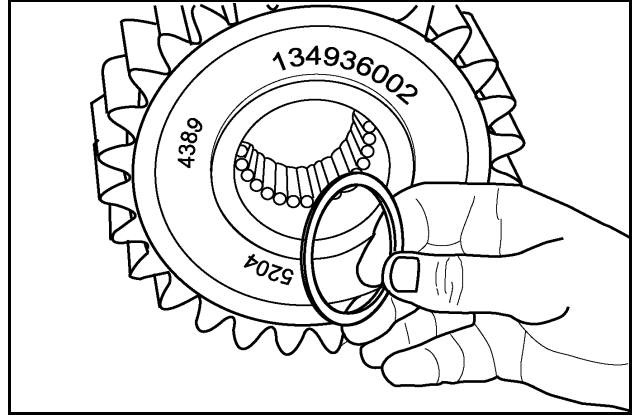
### STEP 29



RD98C193

Remove the thrust washer and needle bearings from one side of the planet gear.

### STEP 30



RD98C194

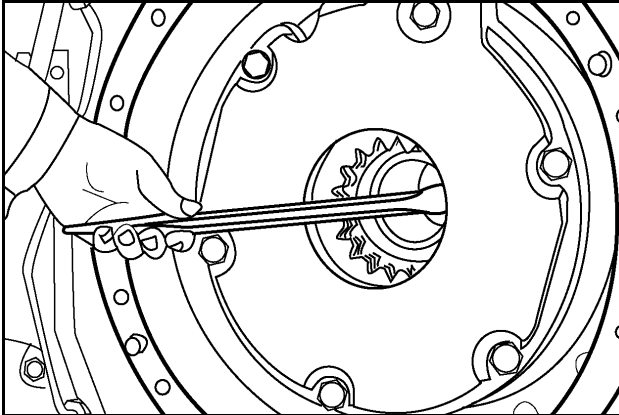
Remove the thrust ring. Turn the planet gear over and remove the other thrust washer and needle bearings.

### STEP 31

Repeat Steps 22 through 27 for the other planet gear assemblies.

## DIFFERENTIAL CARRIER SEAL REPLACEMENT

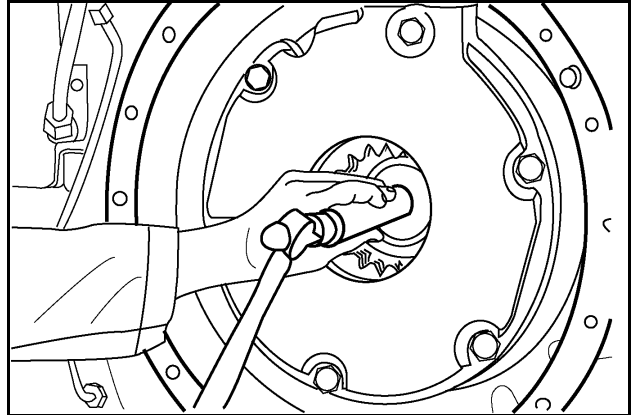
### STEP 32



T98027

Remove the seal from the differential carrier.

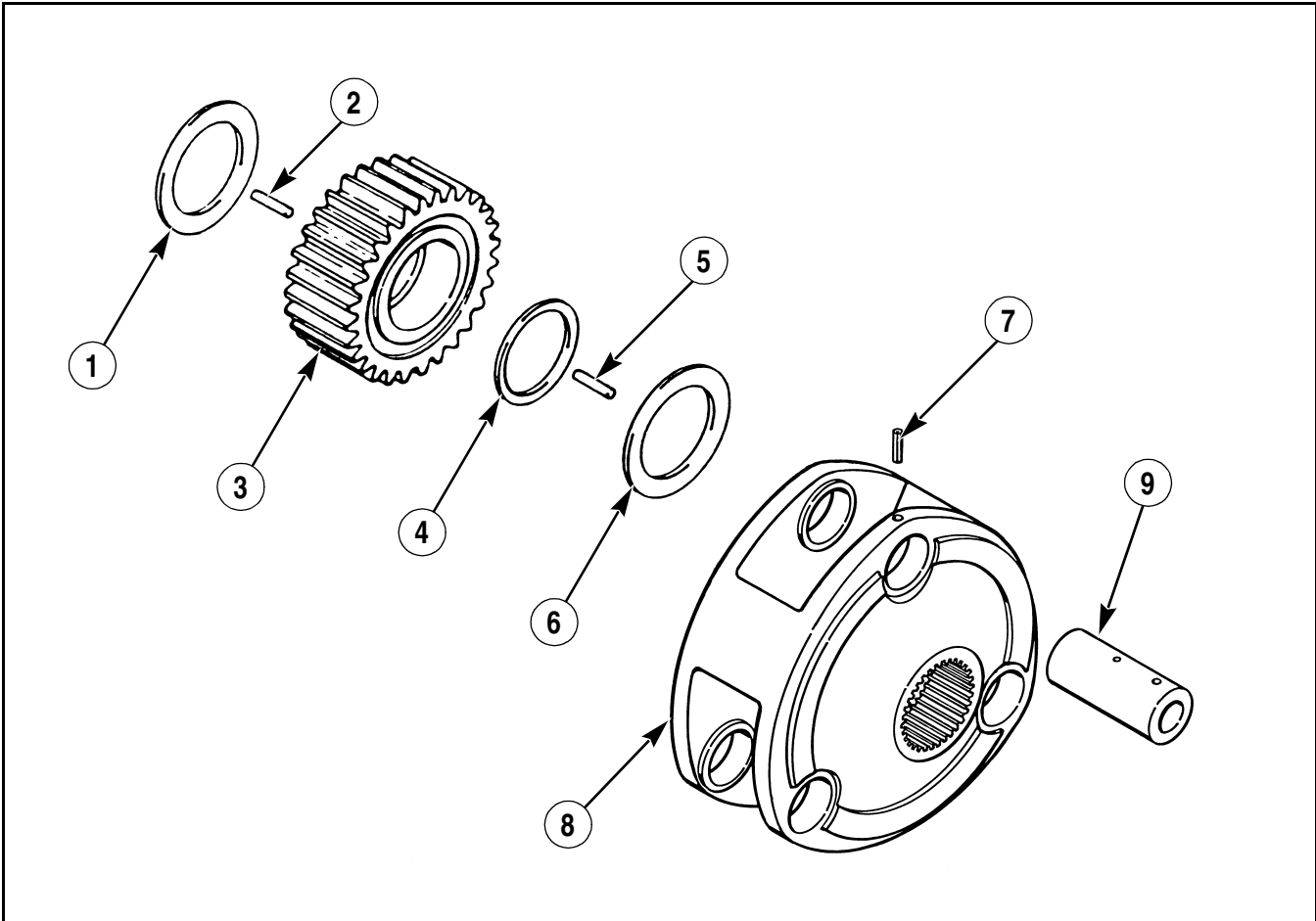
### STEP 33



T98028

Use a driver to install a new seal until the seal is flush with the surface of the differential carrier.

## PLANETARY ASSEMBLY - THREE PIN



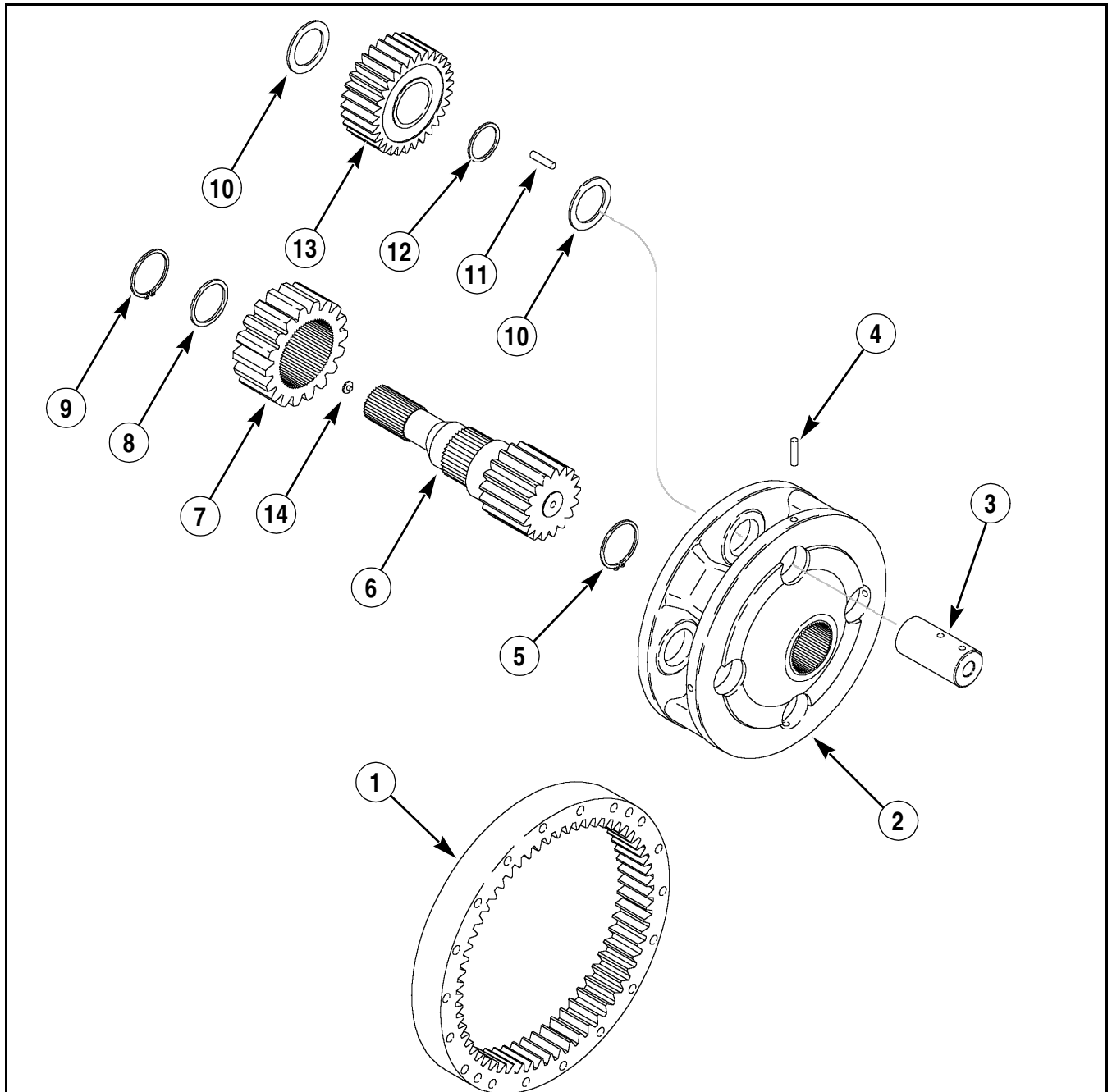
107194A

1. THRUST WASHER  
2. NEEDLE BEARING  
3. PLANET GEAR

4. THRUST RING  
5. NEEDLE BEARING  
6. THRUST WASHER

7. ROLL PIN  
8. PLANET GEAR CARRIER  
9. BEARING SHAFT

## PLANETARY ASSEMBLY - FOUR PIN

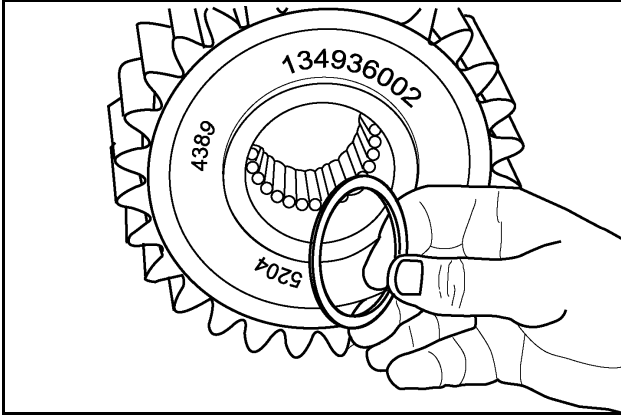


RI06A014

- |                  |                  |                                    |
|------------------|------------------|------------------------------------|
| 1. RING GEAR     | 6. GEAR SHAFT    | 11. NEEDLE BEARING                 |
| 2. GEARS CARRIER | 7. HUB           | 12. NYLON SPACER                   |
| 3. SHAFT         | 8. WASHER        | 13. PLANETARY GEAR                 |
| 4. PIN           | 9. RETAINER RING | 14. NYLON SPACER (RIGHT HAND ONLY) |
| 5. RETAINER RING | 10. WASHER       |                                    |



### STEP 34



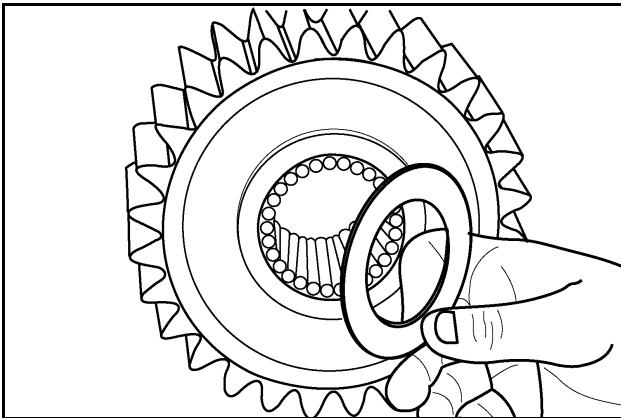
RD98C0194

Lubricate the needle bearings with petroleum jelly to keep them in place and install the bearings on one side. Turn the planet gear around and install the thrust ring. Install the remaining needle bearings lubricated with petroleum jelly.

Models 215 and 245 will have two rows of 29 bearings in each gear.

Model 275 and 305 will have two rows of 33 bearings in each gear.

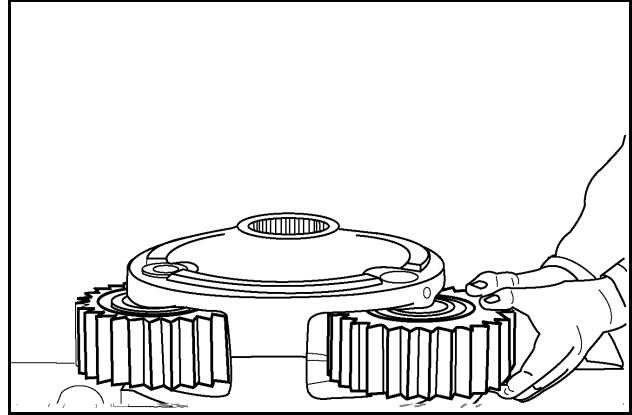
### STEP 35



RDC195

Install the thrust washer on both sides of the planet gear.

### STEP 36

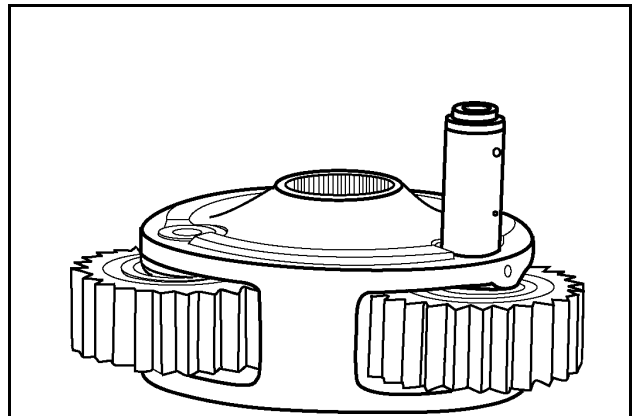


T98003

Put the planet gear assembly into position in the gear carrier. Make sure that the assemblies are installed in their original locations.

**NOTE:** *Three-gear planetary shown.*

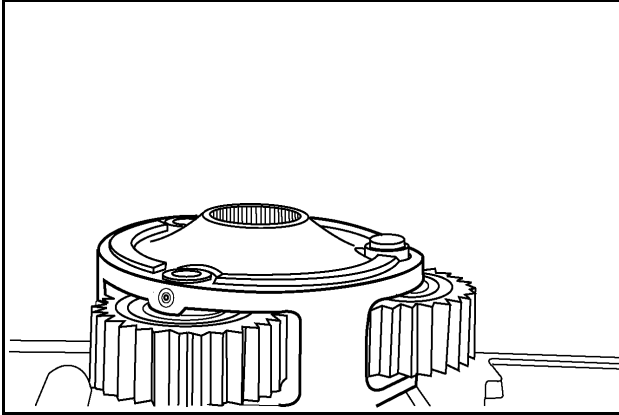
### STEP 37



T98002

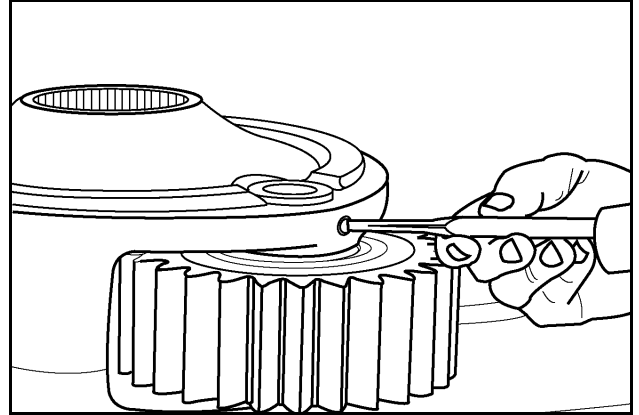
Align the holes in the bearing shaft with the roll pin hole in the planetary gear carrier.

### STEP 38



Slide the bearing shaft through the planet gear bearings until the roll pin hole can be seen in the planet gear carrier.

### STEP 39

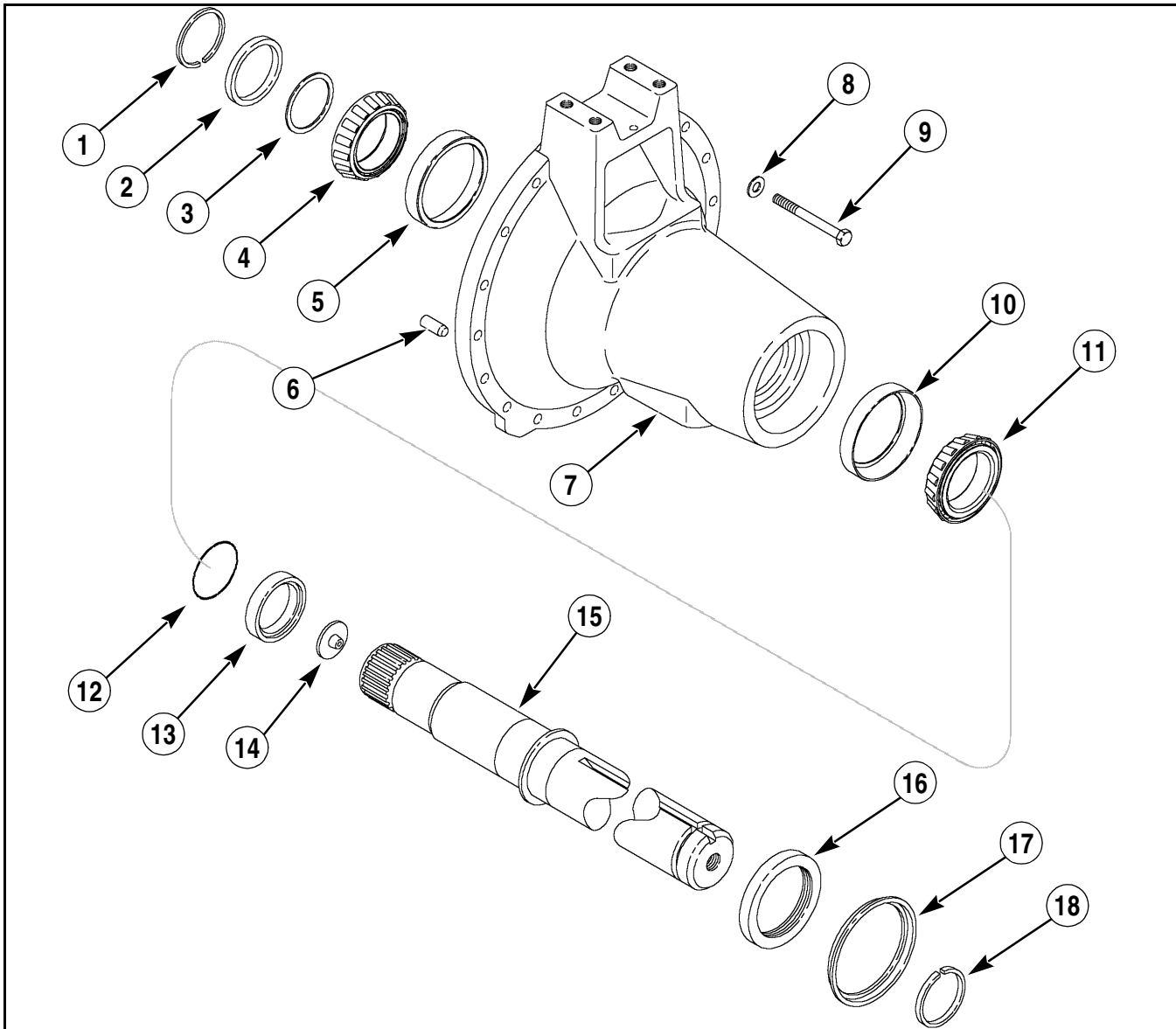


Install the roll pin in the bearing shaft until the end of the pin is flush with planet gear carrier housing.

### STEP 40

Repeat the procedure for the other planet gears in the remaining planetary assembly.

## AXLE HOUSING ASSEMBLY



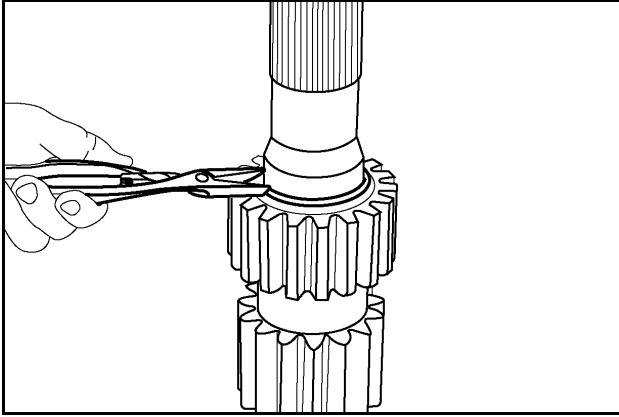
RI06A013

- 1. RETAINING RING
- 2. THRUST RING
- 3. SHIMS
- 4. BEARING CONE
- 5. BEARING CUP
- 6. DOLL PIN

- 7. AXLE HOUSING
- 8. WASHER
- 9. BOLT
- 10. BEARING CONE
- 11. BEARING CUP
- 12. O-RING

- 13. AXLE BUSHING
- 14. AXLE WEAR INSERT
- 15. AXLE SHAFT
- 16. OIL SEAL
- 17. WEAR SLEEVE, IF NEEDED
- 18. RETAINING RING

### STEP 41

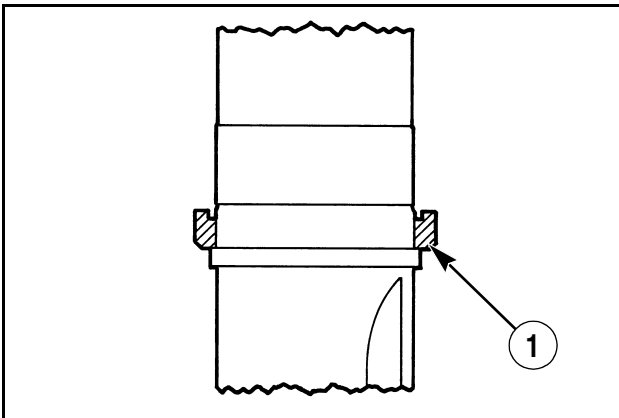


T97967

Install the retaining ring in the groove of the sun gear shaft.

### 4-Inch Axle

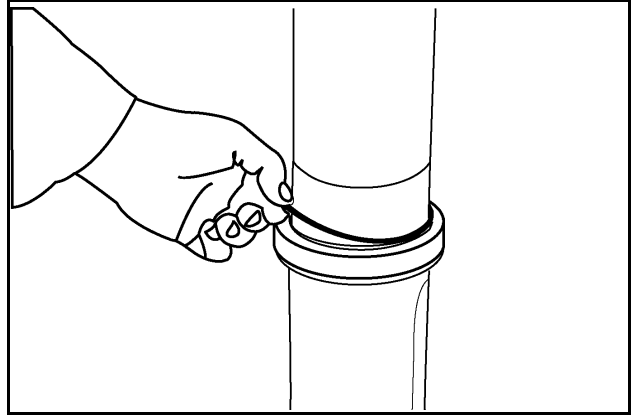
### STEP 42



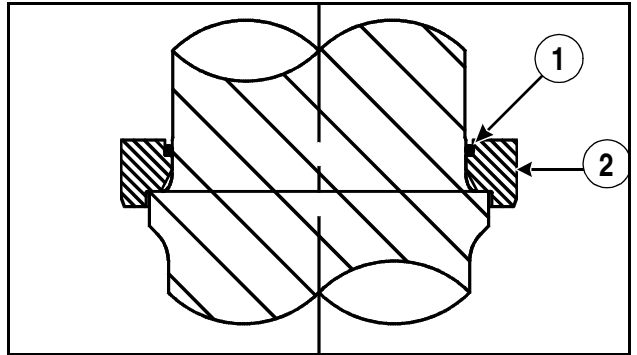
399L7

Press the bushing (1) onto the axle shaft with 89 000 N (20 000 lb.) force so that it is seated tightly on the shoulder.

### STEP 43



T97988

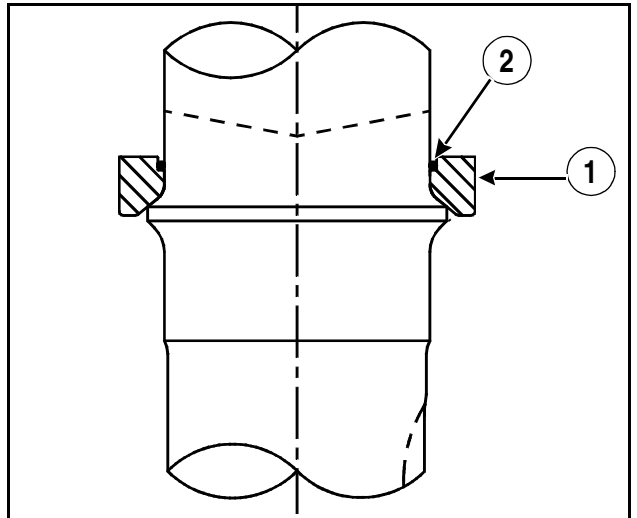


115RING

Lubricate a new O-ring (1) with transmission fluid or petroleum jelly and install in the groove of the axle bushing (2).

### 4-Inch Heavy Duty Axle

### STEP 44

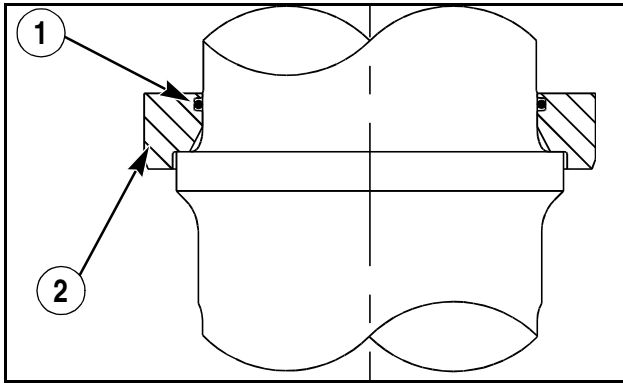


4BSHG

Press the axle bushing (1) onto the axle shaft with 222 500 N (50,000 lb.) force so that it is seated tightly on the shoulder. Lubricate a new O-ring (2) with transmission fluid or petroleum jelly and install in the groove chamfer of the axle bushing.

## 4.5-Inch Axle

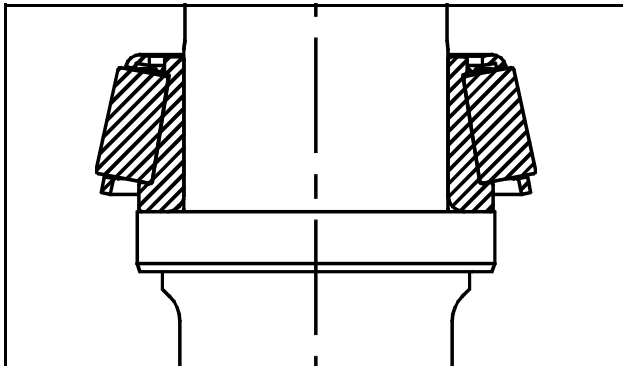
### STEP 45



115BSHG

Lubricate a new O-ring (1) with transmission fluid or petroleum jelly and install into the groove in the axle bushing (2). Press the axle bushing with O-ring installed on the axle shaft with 89000 N (20 000 lb.) force so that it is seated tightly on the shoulder.

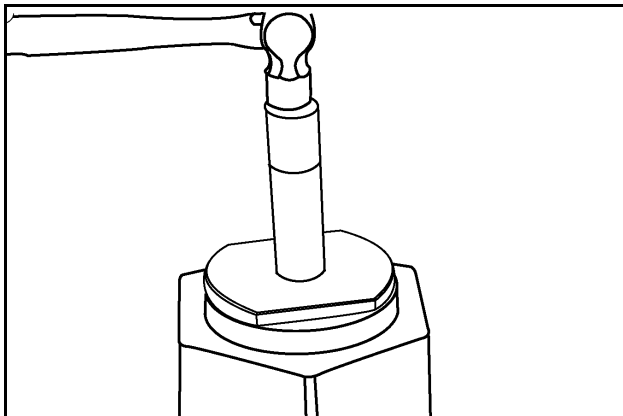
### STEP 46



115BRG2

Press the outer axle bearing on the axle shaft so it is tight against the bushing.

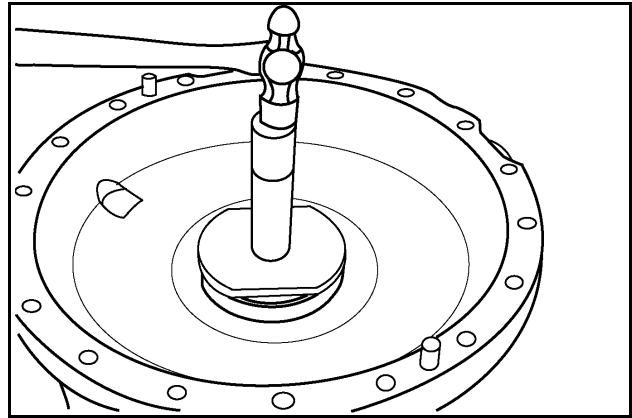
### STEP 47



T97998

Put antiseize compound on the OD of the outer bearing cup. Use a driver to install the bearing cup in the axle housing until the cup is seated.

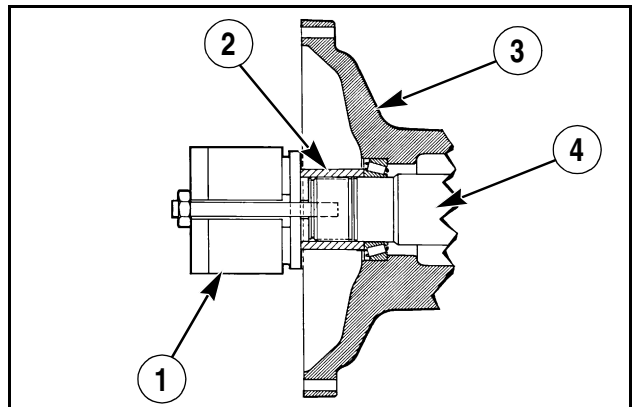
### STEP 48



T97995

Put antiseize compound on the OD of the inner bearing cup. Use a driver to install the bearing cup into the axle housing until the cup is seated.

### STEP 49



376L0

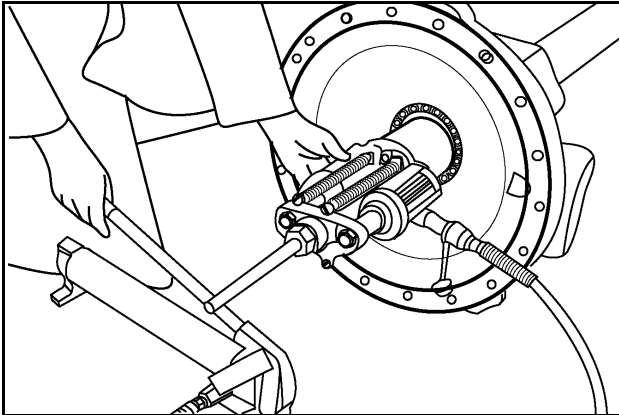
- |           |                 |
|-----------|-----------------|
| 1. RAM    | 3. AXLE HOUSING |
| 2. SPACER | 4. AXLE SHAFT   |

Install the axle shaft assembly as follows:

1. Install the axle shaft assembly in the axle housing.
2. Apply a light coat of oil to the bearing cone ID and position the bearing on the axle shaft.
3. Install the proper spacer over the inner bearing cone.
4. Position a 30-ton ram over the spacer and install an M20 threaded rod through the ram and into the axle end.
5. Secure in position with a washer and nut.

## 4-Inch Standard Axle

### STEP 50

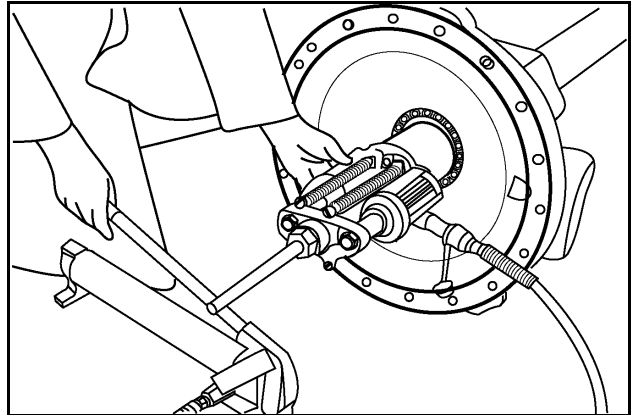


Press the inner bearing onto the axle shaft with about 93 450 N (21 000 lb.) force while oscillating and rotating the axle until a rolling torque of 28 to 34 Nm (250 to 300 lb. in.) is obtained. The torque may be checked with a torque wrench on the nut installed on the threaded rod.

**NOTE:** It may be necessary to make calculations to determine the force to use with your ram. See *How To Determine Ram Pressure* on page 22.

## 4-Inch Heavy Duty Axle

### STEP 51

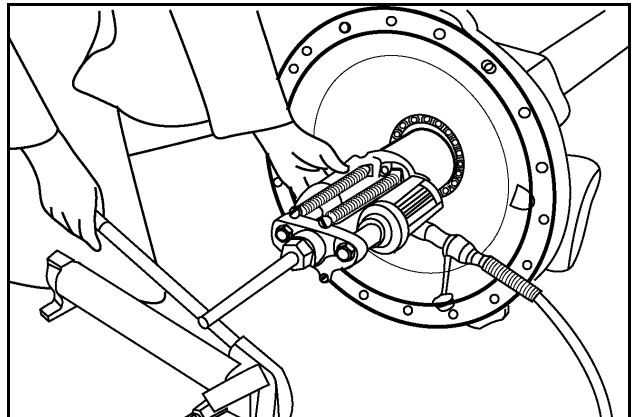


Press the inner bearing onto the axle shaft with about 93 450 N (21 000 lb.) force while oscillating and rotating the axle until a rolling torque of 28 to 34 Nm (250 to 300 lb. in.) is obtained. The torque may be checked with a torque wrench on the nut installed on the threaded rod.

**NOTE:** It may be necessary to make calculations to determine the force to use with your ram. See *How To Determine Ram Pressure* on page 22.

## 4.5-Inch Axle

### STEP 52

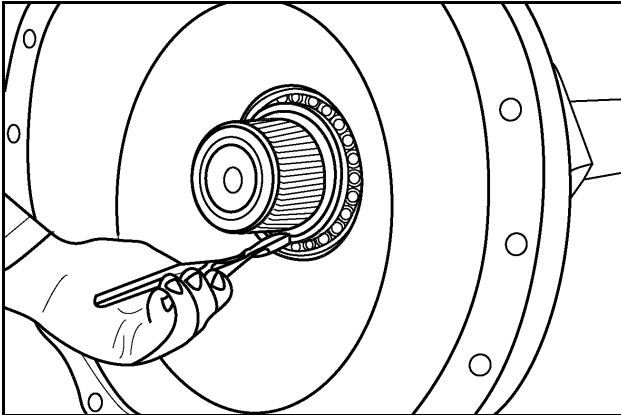


Press the inner bearing onto the axle shaft with about 111 250 (25 000 lb.) force while oscillating and rotating the axle until a rolling torque of 33 to 47 Nm (290 to 420 lb. in.) is obtained. The torque may be checked with a torque wrench on the nut installed on the threaded rod.

**NOTE:** It may be necessary to make calculations to determine the force to use with your ram. See *How To Determine Ram Pressure* on page 22.

For All Axles

STEP 53

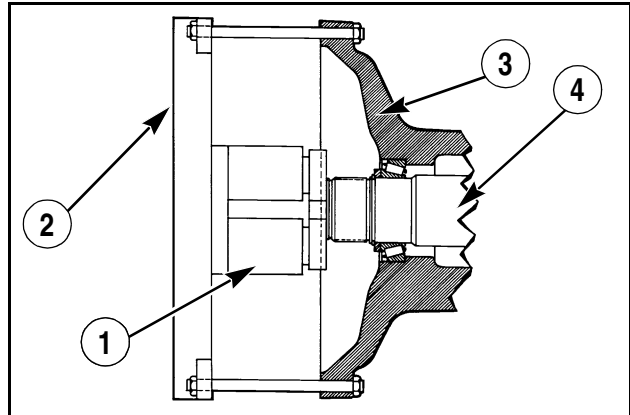


T97976

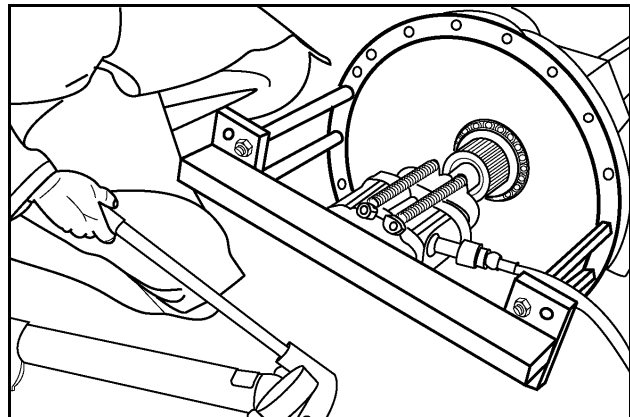
Determine shim pack requirements as follows:

1. Remove threaded rod, ram, and spacer.
2. Do not rotate the axle.
3. Measure the distance from the bearing to the far side of the bearing snap ring groove.
4. Select a shim pack whose total height when combined with the thrust ring and retaining ring is equal to the distance obtained in step 3.
5. Install the shim pack, thrust ring, and retaining ring on the axle. Be sure the thickest shim is next to the bearing.
6. Be sure the retaining ring is fully seated in the groove.

STEP 54



375L0



T98043R

- |           |                 |
|-----------|-----------------|
| 1. RAM    | 3. AXLE HOUSING |
| 2. BRIDGE | 4. AXLES        |

Install the pushing bridge and a 30-ton ram onto the axle assembly. Back press the 4-inch axle 75 650 N (17,000 lbs.). Back press the 4.5-inch axle 97 900 N (22,000 lbs.). Check to assure the snap ring is tight in the groove and will not rotate.

**NOTE:** It may be necessary to make calculations to determine the force to use with your ram. See *How To Determine Ram Pressure* on page 22.

## HOW TO DETERMINE RAM PRESSURE

### STEP 55

Do the following to determine what the pressure gauge must show for your ram:

1. Determine the effective area of your ram.
2. Determine the minimum and maximum pressure gauge readings desired.

Example: Find the effective area of twin rams, each ram having a piston diameter of 1.5 inch.

The formula for the effective area is:

$$\text{Effective Area} = (2d + 2d) \times 0.7854$$

d = diameter of each ram (1.5 inch)

$$2d = d \times d \text{ or } 1.5 \times 1.5 = 2.25 \text{ sq. in. for each ram}$$

$$\text{Effective Area} = (2.25 + 2.25) \times 0.7854 = 3.534 \text{ sq. in.}$$

EXAMPLE: Find the pressure gauge reading for the specified minimum and maximum pound force using a ram with 3.534 sq in effective area.

The formula for the pressure gauge reading is:

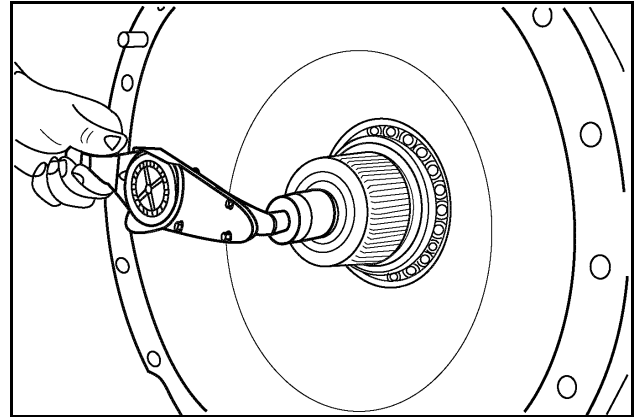
$$\text{reading (psi)} = \frac{\text{force in lb}}{\text{effective area}}$$

$$\text{Pressure Gauge Reading} = \frac{17000 \text{ lb}}{3.534} = 4810 \text{ psi}$$

$$\text{Pressure Gauge Reading} = \frac{21000 \text{ lb}}{3.534} = 5942 \text{ psi}$$

$$\text{Pressure Gauge Reading} = \frac{22000 \text{ lb}}{3.534} = 6225 \text{ psi}$$

### STEP 56



T97977

Check the axle assembly rolling torque. The final specifications should be as follows:

#### 98 inch (4-Inch Dia) Standard Axle

New Bearings ..16.0 to 24.0 Nm (140 to 210 lb. in.)

Used Bearings .... 8.0 to 12.0 Nm (70 to 105 lb. in.)

#### 98 & 120 Inch (4-Inch Dia) Heavy Duty Axles

New Bearings ..16.0 to 26.0 Nm (140 to 230 lb. in.)

Used Bearings.....8.0 to 13.5 Nm (70 to 119 lb. in.)

#### 120, Inch (4-1/2-Inch Dia) Axle

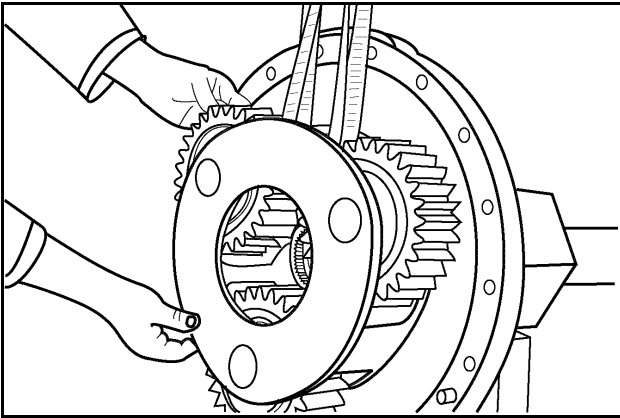
New Bearings ..18.0 to 28.0Nm (160 to 250 lb. in.)

Used Bearings .... 9.0 to 14.0 Nm (79 to 123 lb. in.)

**NOTE:** The rolling torque can be adjusted by adding or subtracting shims. Changing the shim pack thickness by 0.025 mm (0.001 inch) will change the rolling torque approximately 2.3 Nm (20 lb. in.) for the 4-inch axle and 2.8 Nm (25 lb. in.) for the 4-1/2-inch axle. Repeat above Steps until the axle rolling torque is within specifications.



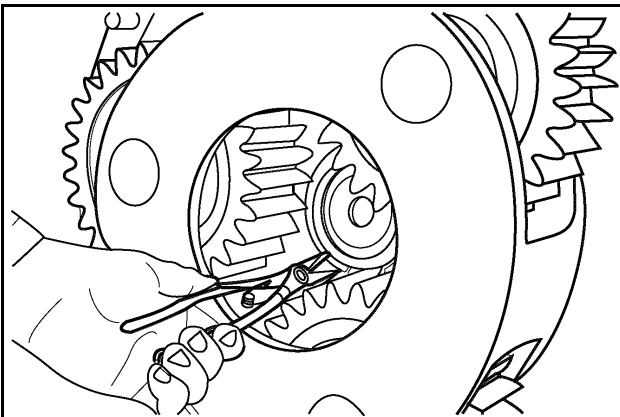
**STEP 57**



T97975

Put the planetary in place on the inner axle shaft (three planetary gears shown).

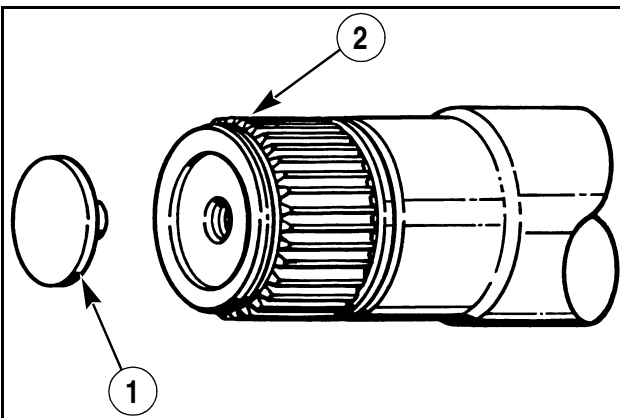
**STEP 58**



T97974

Install the planetary assembly retaining ring in the groove on the axle shaft.

**STEP 59**

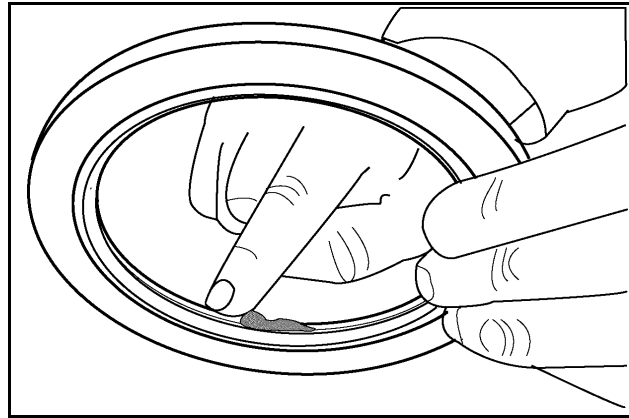


512L0

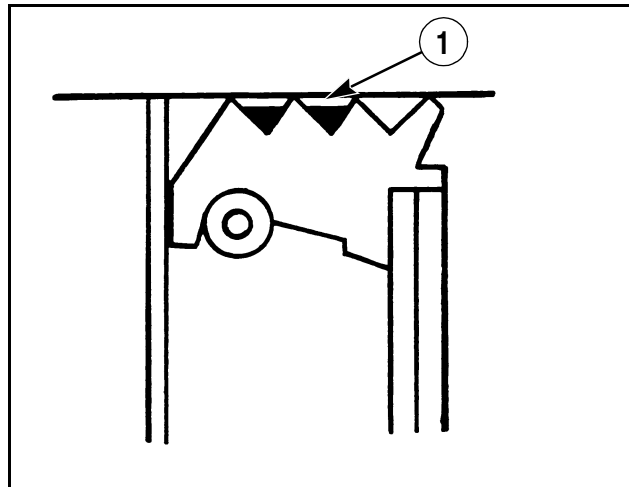
1. NYLON WEAR INSERT      1. AXLE END

Install a new nylon wear insert in the axle.

**STEP 60**

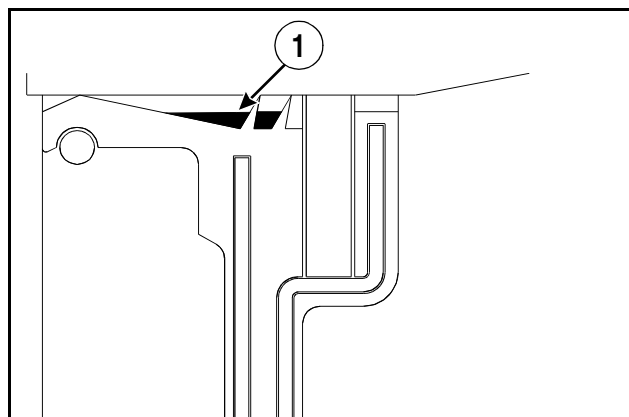


T98015



280L7

**4 Inch Axle**

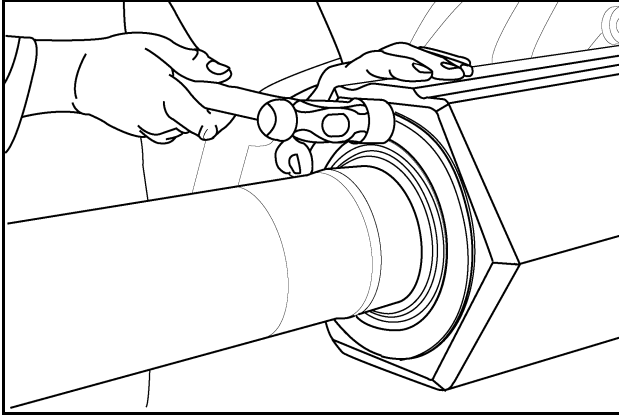


115SEAL

**4-1/2 Inch Axle**

Fill the inner two grooves of the axle seal approximately half full with 251H EP Lithium grease (1).

### STEP 61

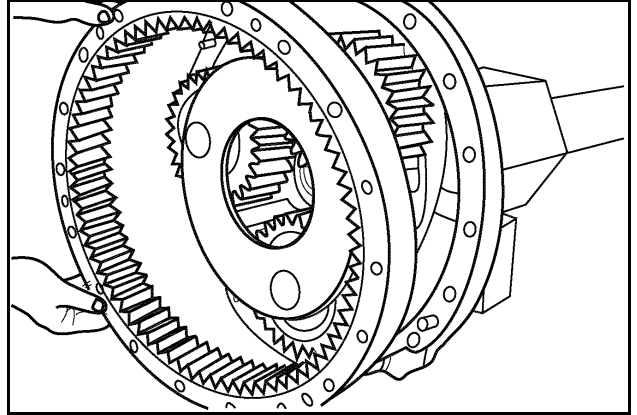


Apply Loctite 515 gasket eliminator on the OD of the seal. Install the seal over the axle shaft and into the axle housing. The edge of the seal must be flush with the axle housing.

**IMPORTANT:** Use flat bar (not shown) between driver and seal to install seal flush with housing.

**NOTE:** Do not apply Loctite 515 to seal OD on the 4-1/2-inch axle.

### STEP 63

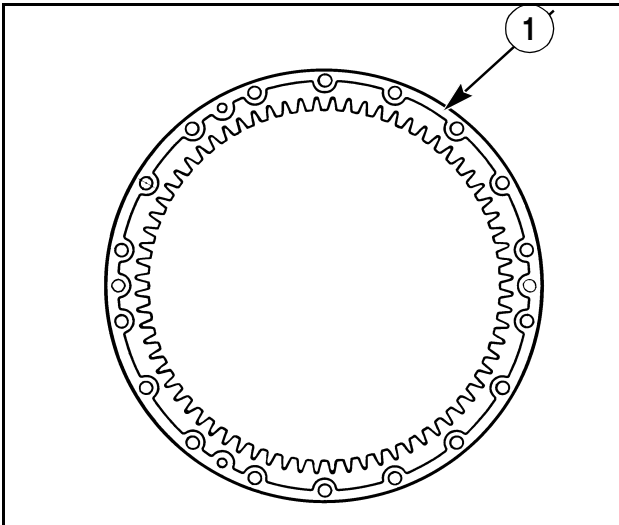


Install the ring gear on the axle housing assembly.

### STEP 64

Repeat Steps 50 through 71 for the remaining axle if being serviced.

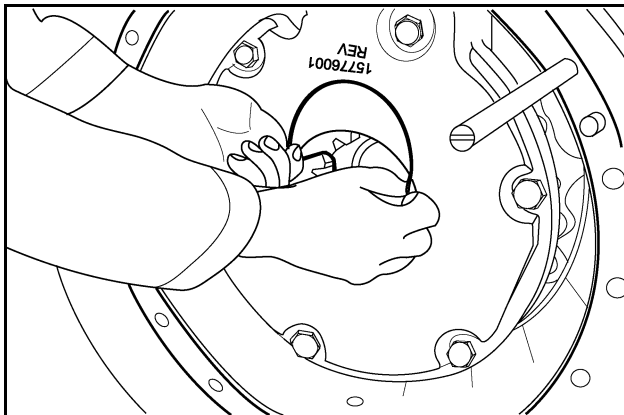
### STEP 62



Remove any foreign material from the ring gear. Put a bead of Loctite 515 gasket eliminator (1) on the axle side of the ring gear.

## AXLE INSTALLATION

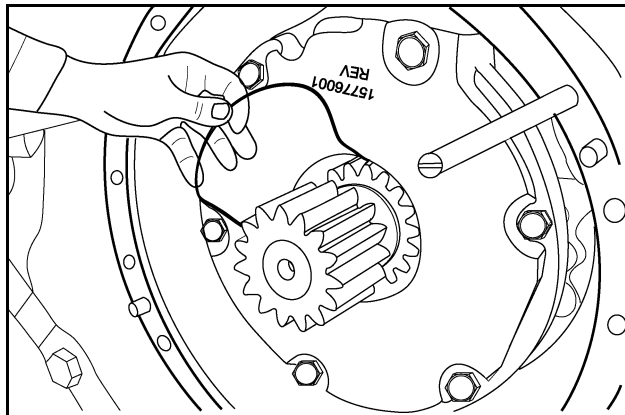
### STEP 65



87S13

Use a brake aligning tool to align the teeth of the brake discs.

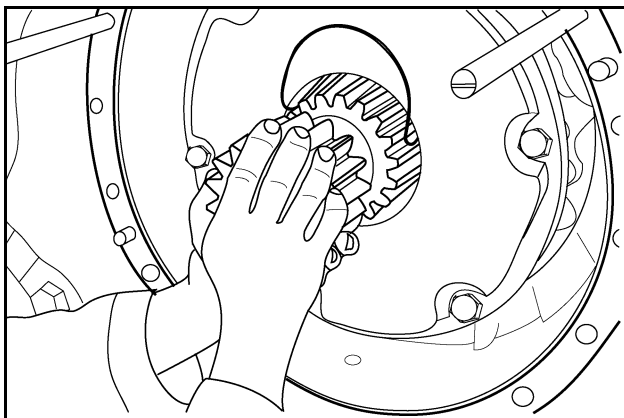
### STEP 67



87S19

Remove the brake aligning tool from the brake discs.

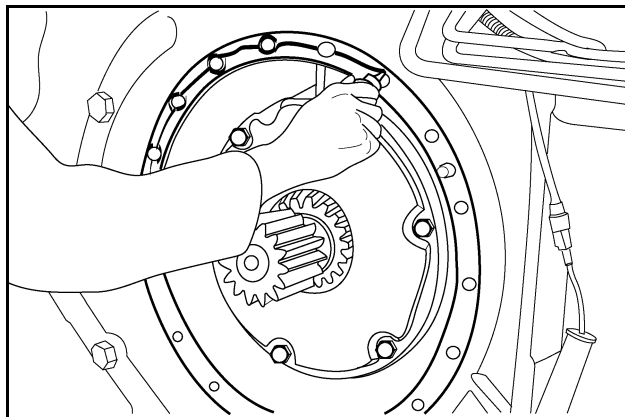
### STEP 66



87S15

Install the sun gear shaft through the brake discs and into the rear frame.

### STEP 68

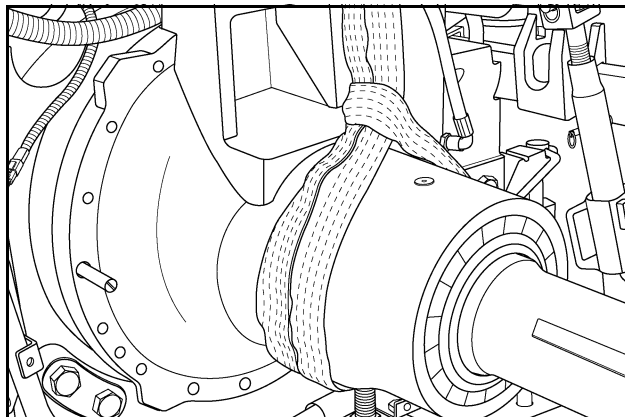


92S5

If removed, install the guide pins in the rear frame. Apply Loctite® 515 gasket eliminator on the mounting surface in the rear frame.

**NOTE:** If equipped, make sure the locator button is installed on the RH sun gear shaft.

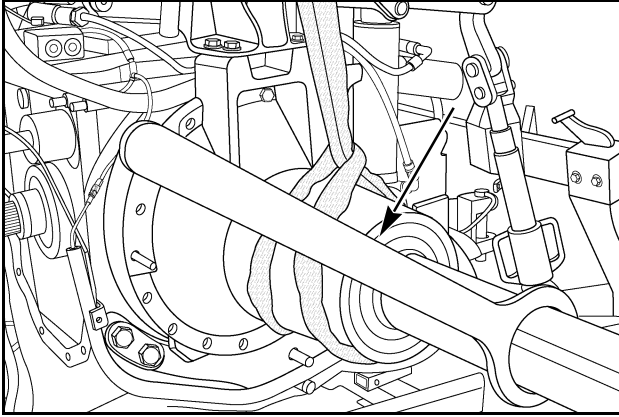
### STEP 69



RD06A004

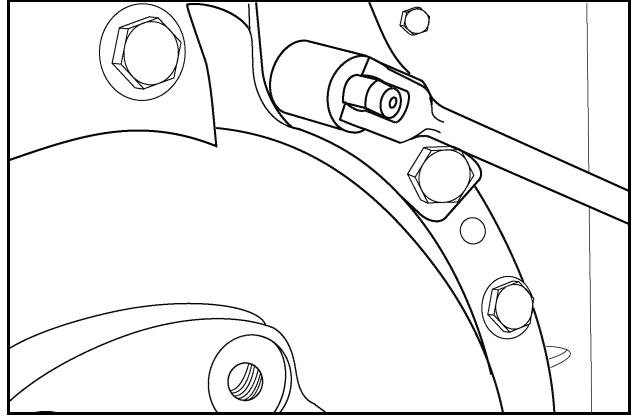
Use a lift strap and hoist to move the axle assembly into position.

### STEP 70



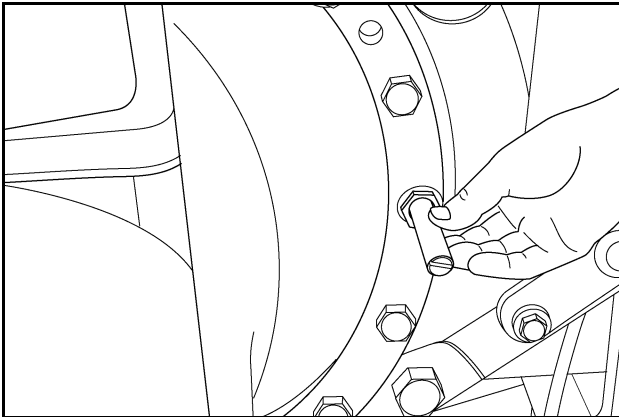
Use a suitable tool and rotate the axle until the sun and planet gears engage.

### STEP 73



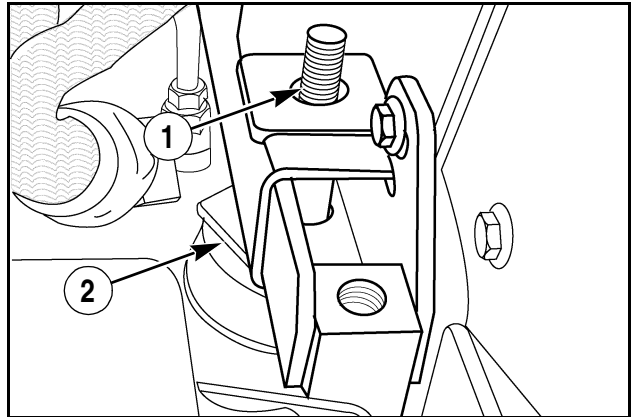
Tighten the axle housing mounting bolts to a torque of 232 to 262 Nm (171 to 193 lb. ft.).

### STEP 71



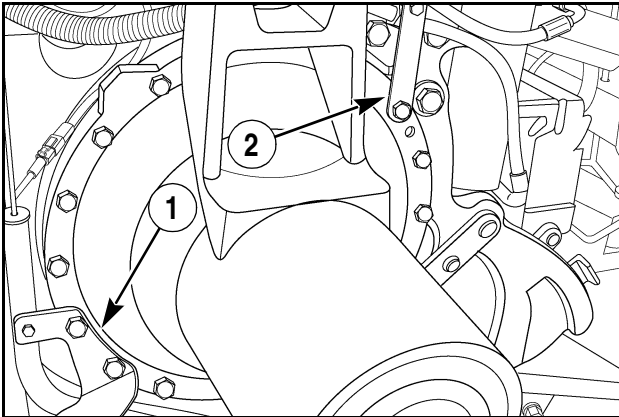
Install a few axle housing mounting bolts and tighten until the axle housing contacts the rear housing flange. Remove the aligning dowels.

### STEP 74



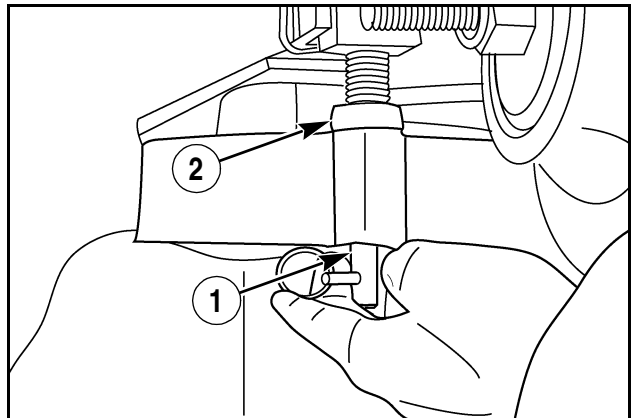
Install the cab mount bolt (1). While holding the plate (2) torque the bolt to 47 to 61 Nm (35 to 45 lb. ft.).

### STEP 72



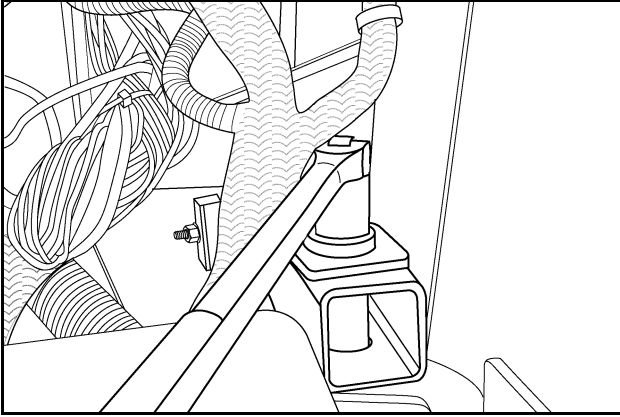
Move the draft pin wiring tube bracket (1) and hitch cylinder hose bracket (2) into position. Install the remaining axle bolts.

### STEP 75



Install the cab jacking bolt (1) and bearing (2). Raise the cab and remove blocking. Lower the cab, remove cab raising equipment.

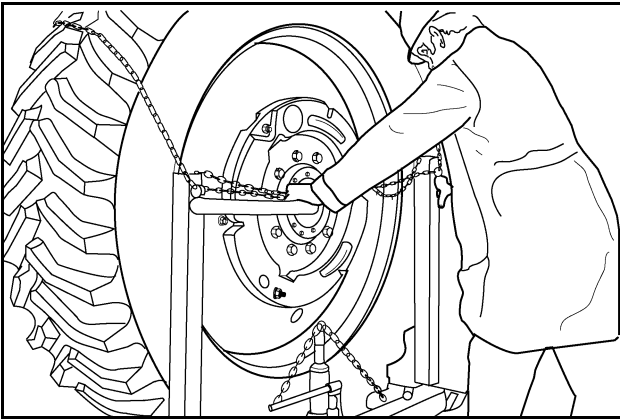
### STEP 76



RD02F026

Install the washer and nut. Torque cab mounting nut to 190 to 244 Nm (140 to 180 lb. ft.)

### STEP 77



86S1

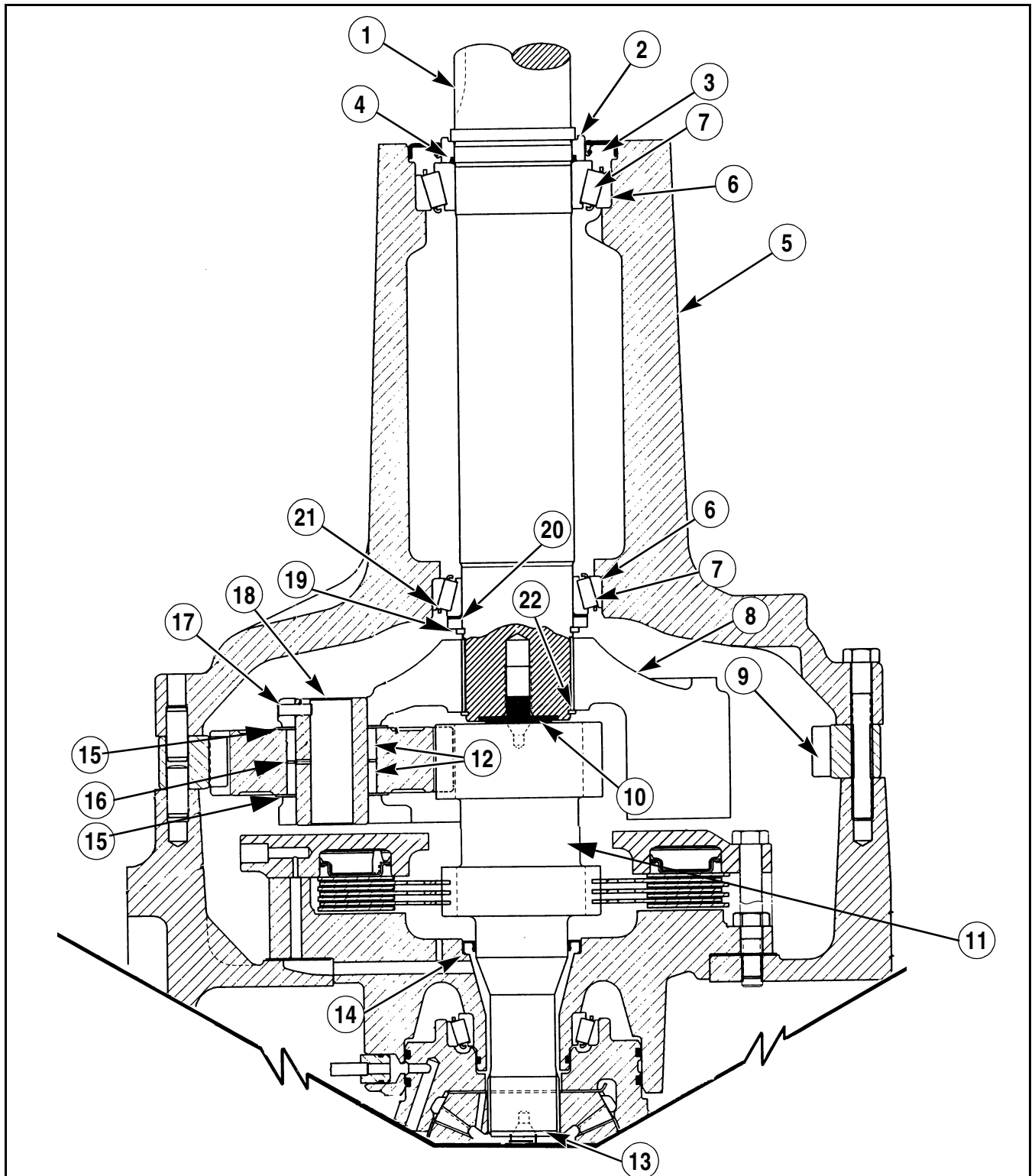
Install the wheel and tire assemblies on the rear axles.

### STEP 78

Remove the rear housing handler from the tractor.

### STEP 79

Fill the transmission with fluid. See the Operator's Manual for the correct fluid type. Run the tractor and check the fluid level. Add as necessary.

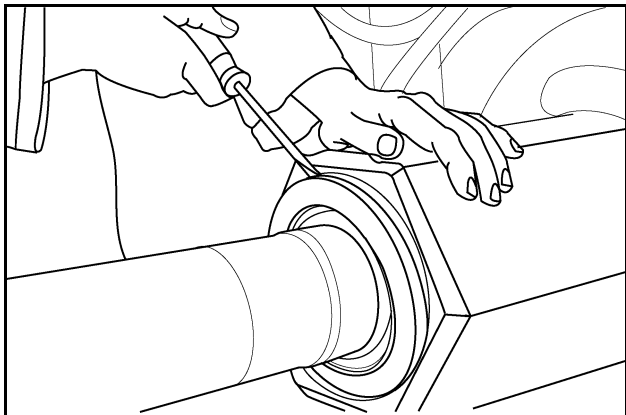


RH98C007

- |                 |                        |                                      |                    |
|-----------------|------------------------|--------------------------------------|--------------------|
| 1. AXLE SHAFT   | 7. BEARING CONE        | 13. LOCATOR BUTTON (RIGHT HAND ONLY) | 19. RETAINING RING |
| 2. BUSHING      | 8. PLANET GEAR CARRIER | 14. SEAL                             | 20. THRUST WASHER  |
| 3. SEAL         | 9. RING GEAR           | 15. THRUST WASHER                    | 21. SHIMS          |
| 4. RING         | 10. WEAR INSERT        | 16. THRUST RING                      | 22. RETAINING RING |
| 5. AXLE HOUSING | 11. SUN GEAR SHAFT     | 17. ROLL PIN                         |                    |
| 6. BEARING CUP  | 12. NEEDLE BEARINGS    | 18. PLANET GEAR SHAFT                |                    |

## AXLE SEAL WEAR SLEEVE INSTALLATION (4-Inch Axle Only)

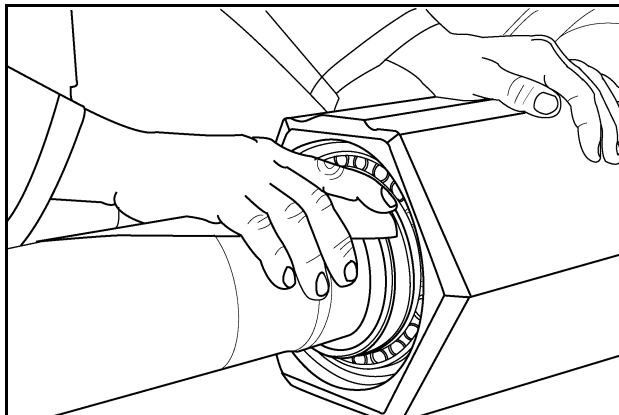
### STEP 80



93S28

Remove the old seal from the axle housing.

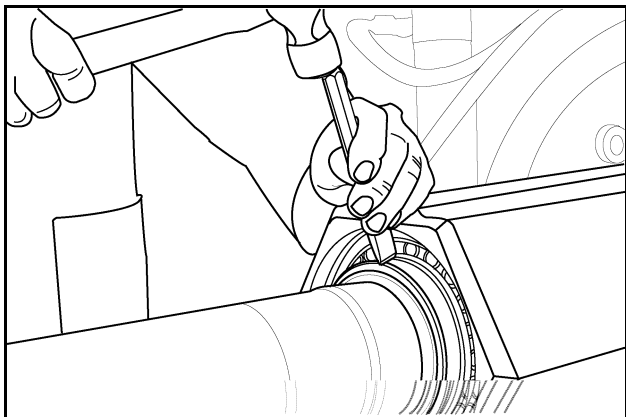
### STEP 82



94S6

Clean the axle bushing of any foreign material and remove any scratches. Make sure that the axle bearing is not contaminated.

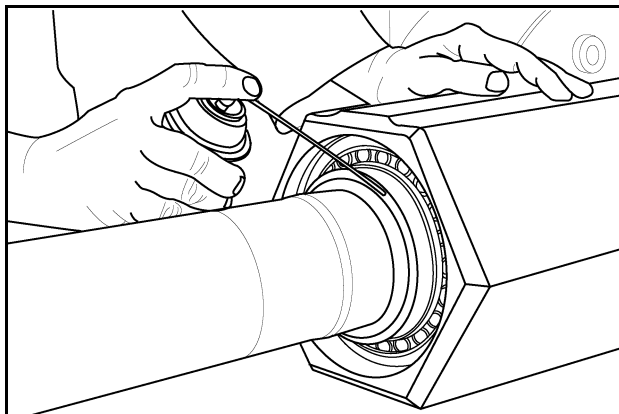
### STEP 81



93S32

Remove the old wear sleeve, if equipped. Check wear sleeve dimensions. If a thick sleeve was installed, a puller may be required to remove the sleeve.

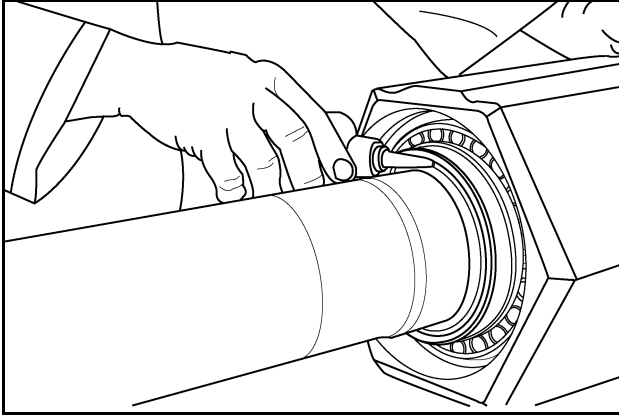
### STEP 83



94S2

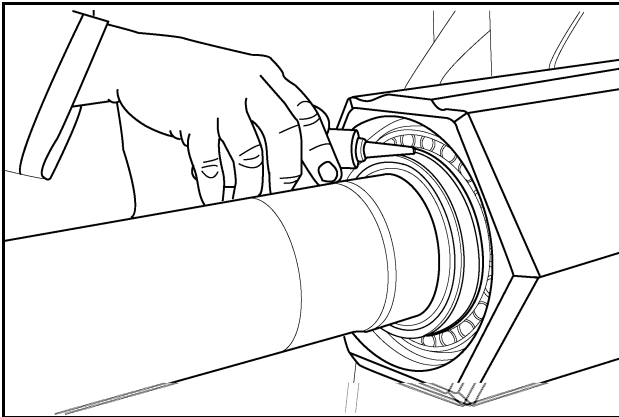
Clean the OD of the axle and the ID of the new wear sleeve with Loctite safety solvent.

### STEP 84



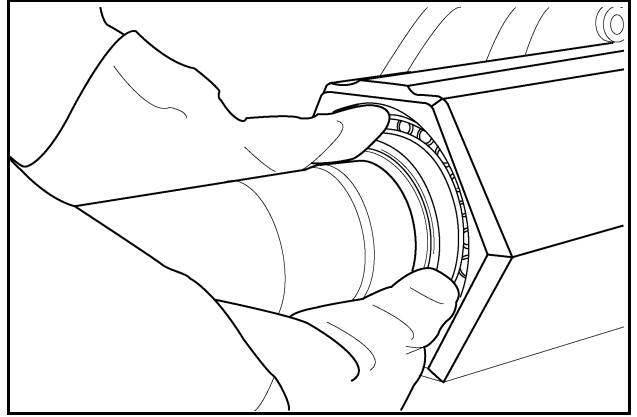
Apply Loctite 290 to seal the area between the axle bushing and axle.

### STEP 85



Apply Loctite 609 to the OD of the axle bushing.

### STEP 86



Install the wear sleeve as follows:

1. Heat the new wear sleeve in a bearing oven to 191° to 204°C (375° to 400°F).



**WARNING:** Always wear heat protective gloves to prevent burning your hands when handling heated parts.

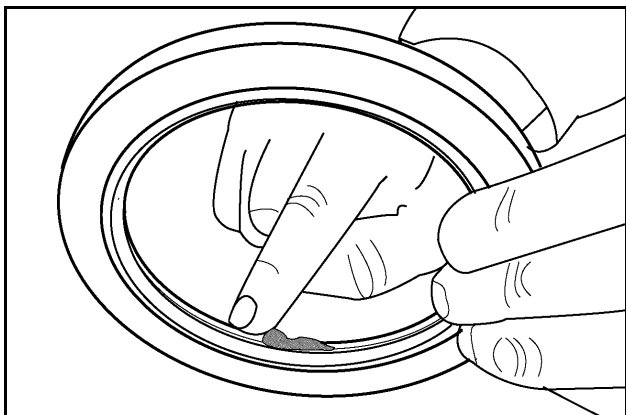
SM121A

2. Install the sleeve onto the axle bushing with the OD chamfer to the outside. The wear sleeve must just touch or be no more than 0.51 mm (0.020 inch) away from the axle bearing.

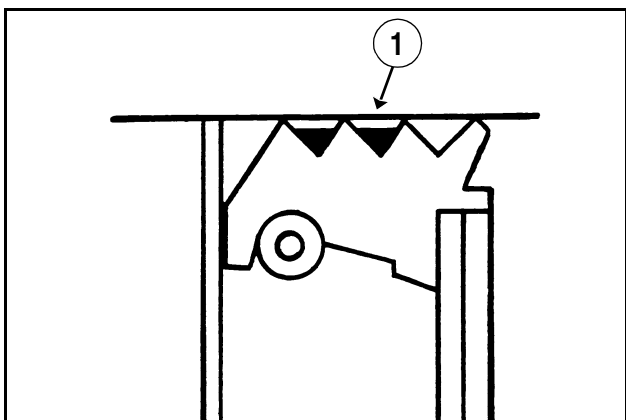
**NOTE:** If the wear sleeve is driven onto the axle bushing, make sure that the sleeve does not touch and preload the axle bearing.



**STEP 87**



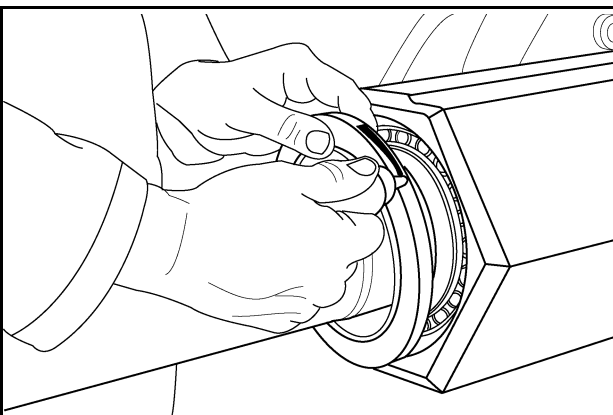
T98015



280L7

Fill the inner two grooves of the axle seal approximately half full with 251H EP Lithium grease (1).

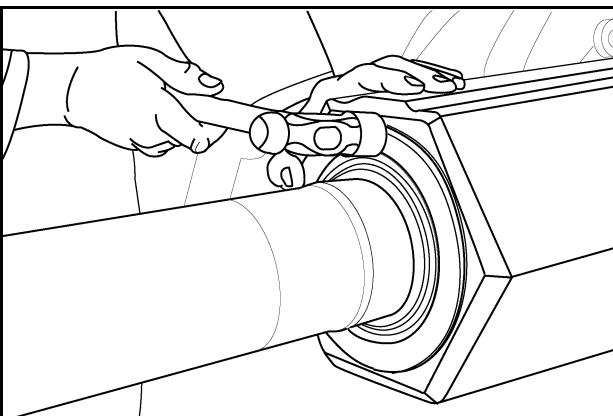
**STEP 88**



94S34

Apply Loctite 515 gasket eliminator to the OD of the axle shaft.

**STEP 89**



95S3

Start the axle seal over the axle and into the axle housing. The edge of the seal must be flush with the axle housing.

**IMPORTANT:** Place a flat bar (not shown) between the drive and seal to install the seal flush with the axle housing.

# **Section 31**

## **Chapter 1**

**POWER TAKE OFF CONTROL SYSTEM**

**How it Works**

## TABLE OF CONTENTS

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PTO SYSTEM CONTROL .....	31-1-7
PTO CONTROL MODES .....	31-1-8
PTO VALVE OIL SUPPLY .....	31-1-10
PTO DIFFERENTIAL LOCK VALVE .....	31-1-11
TROUBLESHOOTING .....	31-1-12

## POWER TAKE OFF

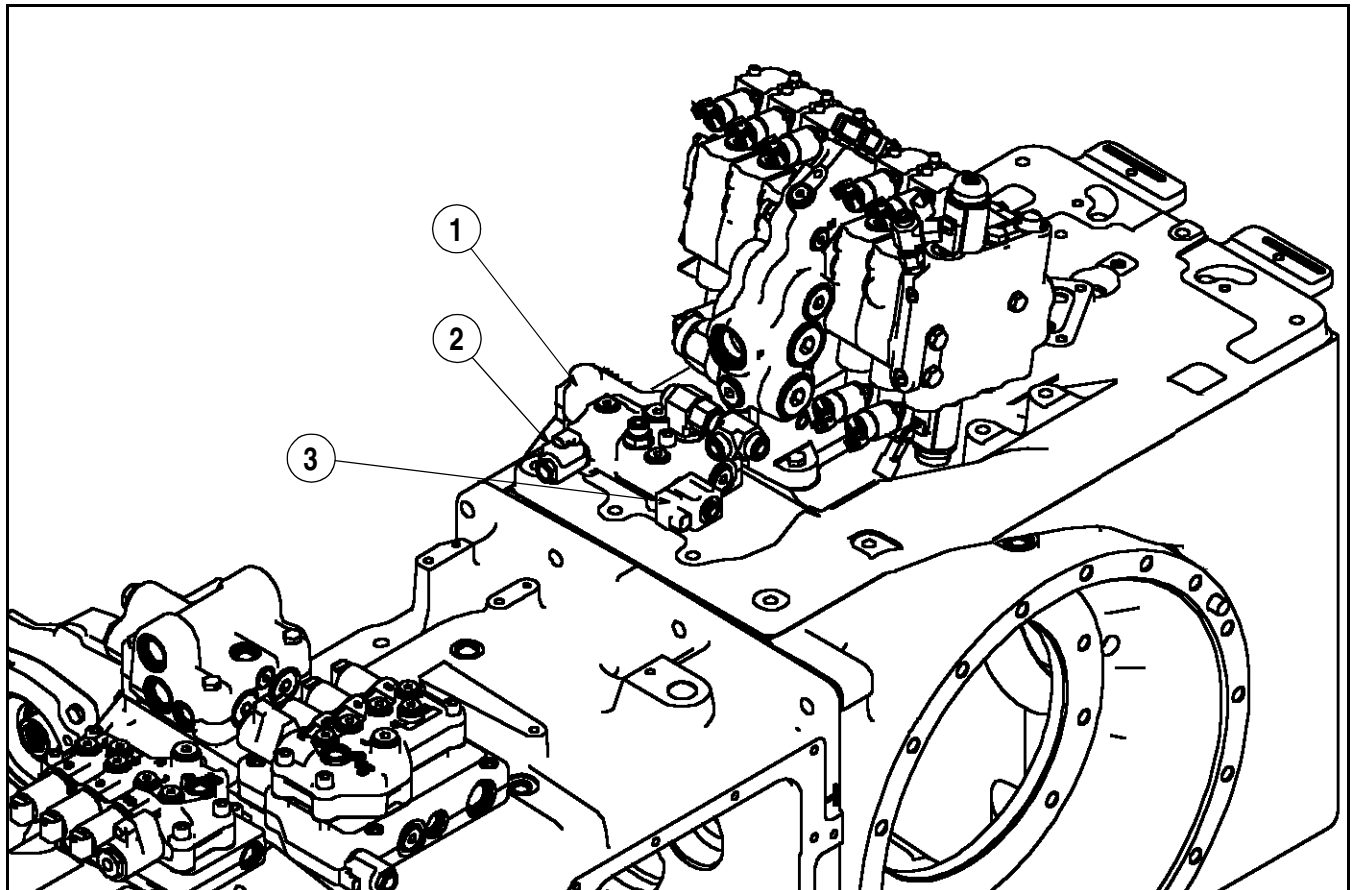
**General Description** - The PTO system consists of the of the PTO control switch, engine RPM speed circuit, PTO shaft speed circuit, dual speed sensor, PTO control valve, PTO clutch, PTO control module, arm rest control module, and Instrument cluster unit, (through the Data Bus).

The PTO valve is mounted externally on top of the rear frame transmission housing. The control valve is supplied with regulated circuit pressure from the priority regulator valve. This pressurized supply is directed to the PTO clutch for engagement purposes. If the PTO is activated, the valve ports the pressurized supply to the PTO clutch.

The PTO control module is located under the SMV cover at the back of the cab. The PTO controller supplies current to the PTO valve solenoid to activate the PTO clutch based on commands from the operator (PTO switch) and signals supplied to it from the PTO shaft speed sensor during modulation and operation.

Diagnosing system faults is accomplished by reading appropriate faults codes through the tractor monitor display or with the service tool. Refer to fault code section for a complete list of fault codes related to the PTO, FWD, and Differential Lock system.

**NOTE:** In addition to the components listed above the transmission speed circuit, true ground speed sensor, brake pedal switches, FWD switch, differential lock switch, and electronic hitch control module are used in the control of the FWD and differential lock. These components are discussed later in this manual.



R102E086

1. PTO/DIFF LOCK VALVE
2. PTO CLUTCH SOLENOID
3. DIFF LOCK CLUTCH SOLENOID

## ELECTRONIC PTO CONTROL

**General Description** - The PTO system consists of the PTO control switch, engine RPM speed circuit, PTO shaft speed circuit, dual speed sensor, PTO control valve, PTO clutch, PTO control module, arm rest control module, and instrument control unit, (through the Data Bus).

**PTO Control Switch** - This switch provides the operator interface with the PTO system. The PTO switch has a yellow cover for easy identification. To activate the PTO, pull the switch rearward and lift at the same time. To stop the PTO, move the top of the control switch rearward and down.

**NOTE:** *PTO OFF operator commands (open circuit) are sent to the Arm Rest Control Module (PTO OFF switch is hard wired to the Arm Rest Control Module), then relayed to the PTO controller via the Data Bus.*

PTO ON operator commands (B+, contact closed) are sent to the PTO controller directly (PTO ON switch is hard wired to the PTO Control Module).

If both switch contact signals are present at the same time the PTO control module deactivates the PTO valve and declares a switch circuit fault.

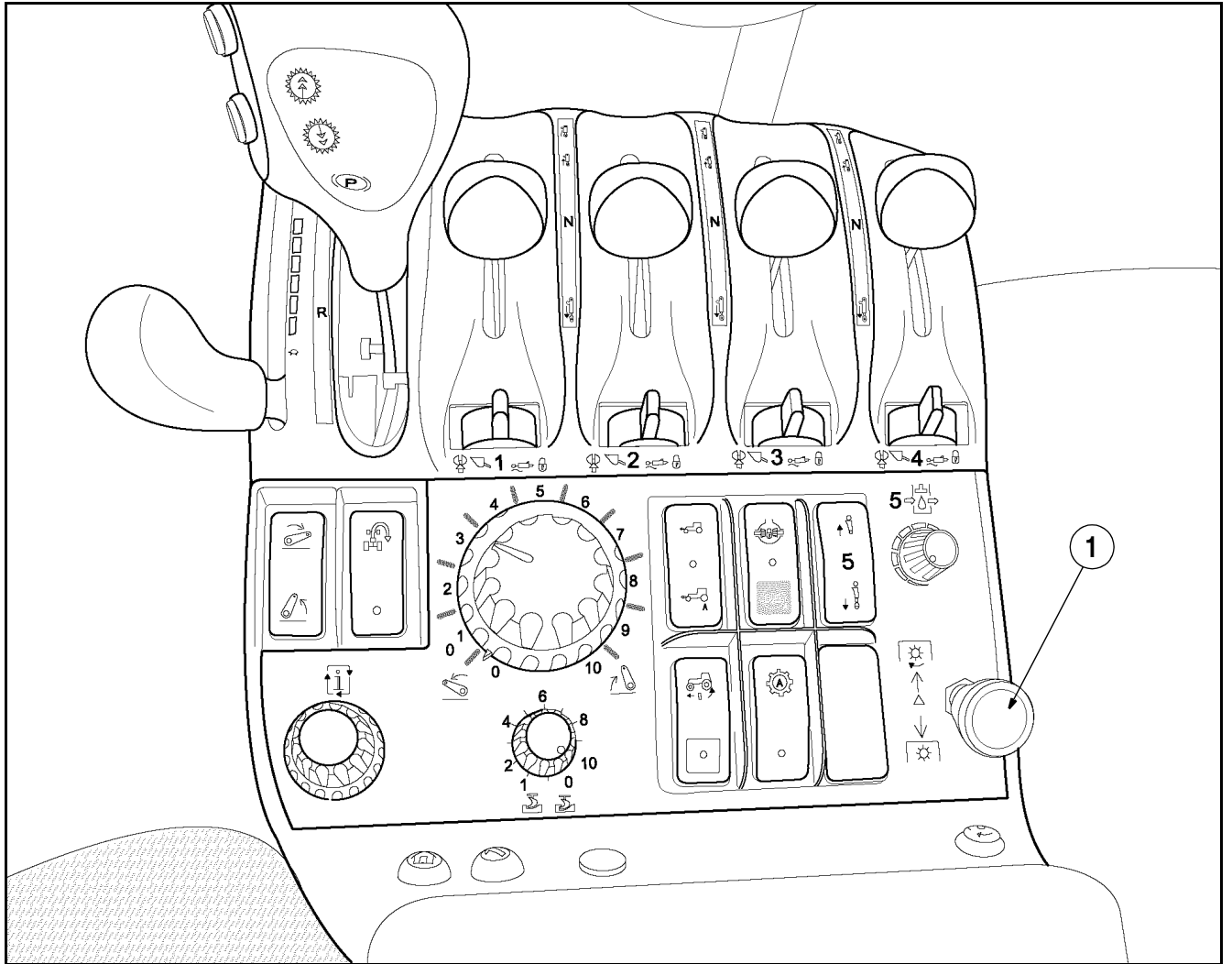
**Engine RPM Speed Circuit** - Engine RPM is used by the PTO controller as a source of information to control clutch engagement and modulation (clutch engagement rate) and to monitor clutch slip percentage. This allows smooth engagement, and stops PTO operation if the clutch slips at an excessive rate. The engine RPM is calculated by the PTO controller using a signal from the alternator (W terminal).

**PTO Shaft Speed Circuit** - PTO shaft speed is used in conjunction with engine RPM by the PTO controller to control clutch modulation (clutch engagement rate) and to monitor clutch slip percentage. This allows smooth engagement and stops PTO operation if the clutch slips at an excessive rate. The PTO shaft speed is calculated by the PTO controller from a sensor signal located in the top cover of the rear frame transmission housing.

**Dual Speed Sensor** - If the tractor is equipped with a dual speed PTO, the dual speed sensor is used by the PTO controller to determine the PTO shaft speed. This sensor is located on the PTO output shaft bearing support of dual speed PTO units.

**PTO Control Valve** - The PTO/differential lock control valve directs regulated supply circuit oil to/from the PTO clutch, based on operator commands and information gathered by the PTO controller. This valve also controls the amount of lubrication oil which is directed to the PTO clutch. Increased lubrication oil is supplied to the PTO clutch whenever the clutch is engaging or totally engaged.

**PTO Clutch** - The PTO clutch is a hydraulically actuated multiple disc wet clutch located at the back of the rear frame transmission housing. Access to the PTO clutch can be gained by removing the hitch upper link mounting plate. When the PTO switch is activated hydraulic pressure is applied to the PTO clutch piston from the control valve. This pressure locks the discs together. The PTO clutch has the necessary capacity and lubrication to provide for modulated engagements of typical PTO powered implements.



1. PTO CONTROL SWITCH

RD05J060

**PTO Control Module** - The PTO control module is located under the SMV cover at the back of the cab. The PTO control module provides the electrical current to apply the PTO clutch when instructed by the operator. All PTO operator commands are sent to the Arm Rest Control Module (PTO switch is hard wired to the Arm Rest Control Module), then relayed to the PTO controller via the Data Bus. The PTO controller communicates with other control units via the Data Bus to monitor PTO clutch slip, and control modulation.

The control module incorporates a green status light which is visible to the technician. The status light flashes at a rate of 1 cycle per second to indicate the module is operating correctly.

**PTO System Fault Codes** - PTO system fault codes are stored in the non-volatile memory (memory is maintained even if the battery is disconnected) of the PTO control module for various control system faults. The engine hours at which the fault occurred is available through the Electronic Service Tool (EST) and stored with the associated code. A maximum of ten (10) fault codes can be stored in each controller at any time and may be retrieved in sequence with the last code stored as the first code retrieved. PTO control system codes are displayed on the tractor instrumentation. Refer to fault code section of this manual for complete listing of PTO fault codes.

**Arm Rest Control Module** - MFD and differential lock operator commands are sent to the arm rest control module then relayed to the PTO controller via the Data Bus. The arm rest controller provides control switch position information to the PTO controller for these functions. The PTO OFF signal is also provided to the PTO controller from the arm rest control module. The PTO ON operator command signal is hard wired directly to the PTO controller.

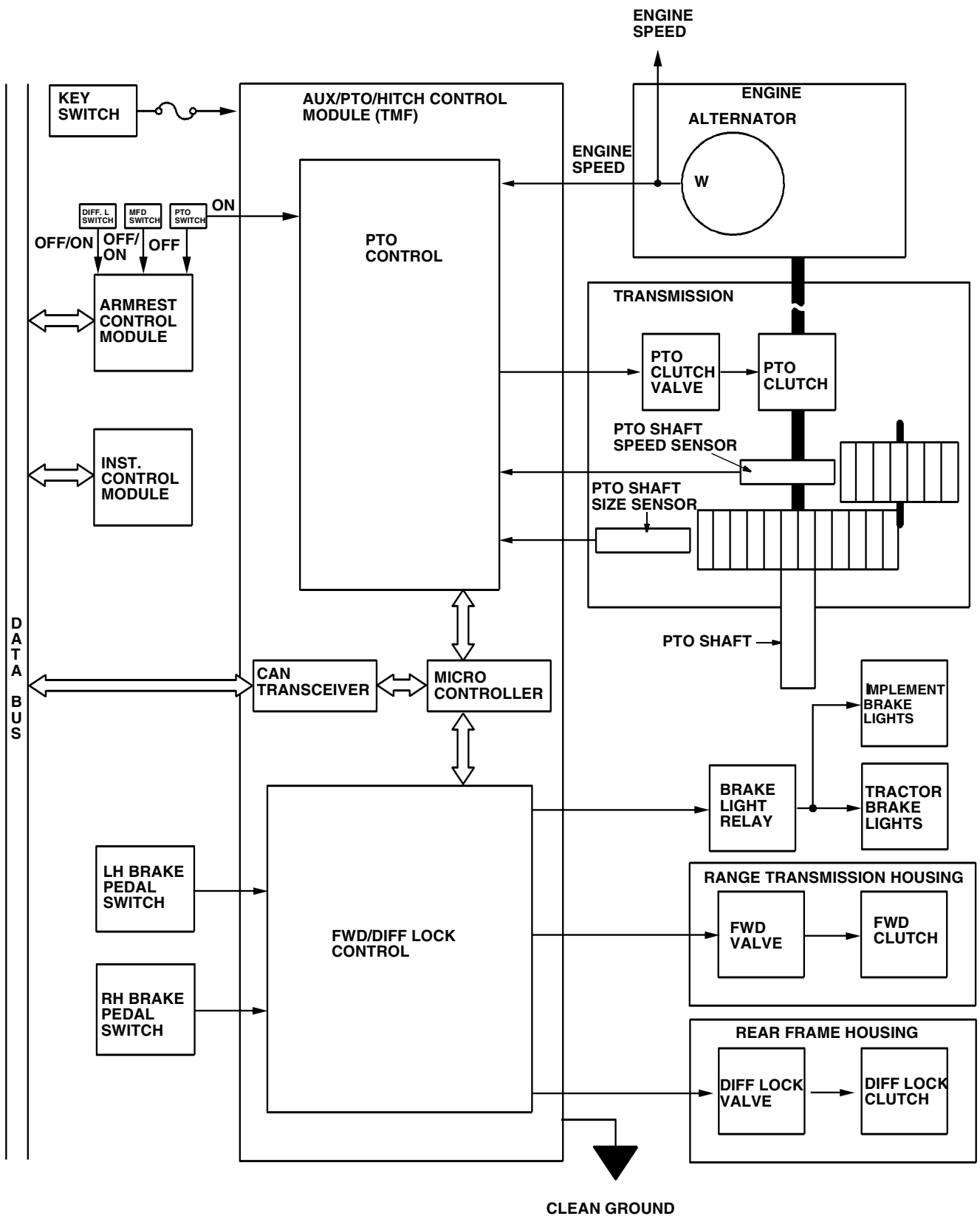
**Instrumentation Cluster Control Module** - PTO control system information is sent to the tractor instrumentation and relayed to the PTO controller. Operator, diagnostic and programming information are communicated between the PTO controller and the tractor instrumentation by way of the Data Bus. The tractor instrumentation displays lighted icons and messages to notify the operator what PTO systems are activated.

**Operational Modes** - The PTO control system operates in one of four (4) modes based on operator commands and the signals received from the other tractor systems.

Fill Mode  
Modulation Mode  
Ramp Mode  
ON

In addition to the sequential electrical modes of operation listed above, the PTO control module conducts a hardware reset and built-in test (BIT), and transmits PTO controller status and data on the Data Bus within a specific time frame to ensure proper operation after start up.

## PTO SYSTEM CONTROL



RI01J013



## PTO CONTROL MODES

**OFF** - When the PTO switch is placed in the OFF position, the PTO clutch will be deactivated. The PTO switch OFF signal is directed to the armrest controller and communicated to the PTO control module through the Data Bus.

**NOTE:** *PTO switch ON signal is directed to the PTO control module directly (hard wired to PTO controller).*

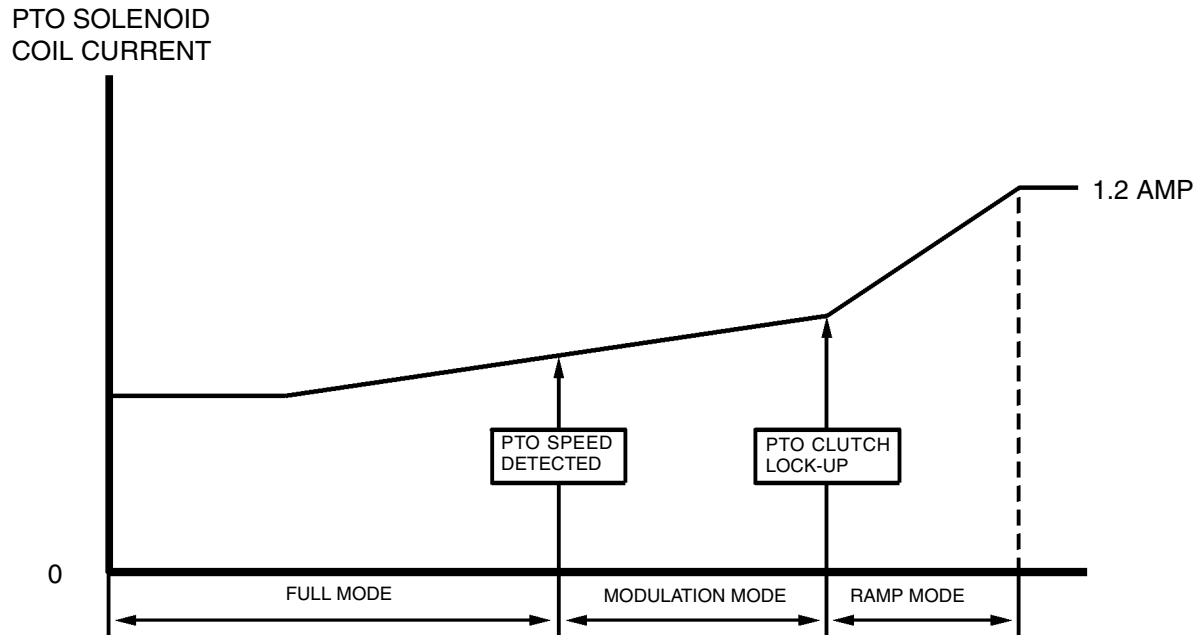
**Fill Mode** - The PTO switch ON signal is hard wired to the PTO controller. When the PTO switch is placed in the ON position the PTO will begin the FILL mode of operation. The fill mode of operation is the length of time the PTO circuit is activated, but there is no shaft speed. When shaft clutch shaft speed is detected the PTO enters the modulation mode of operation.

**Modulation Mode** - As the PTO shaft begins to rotate the PTO is placed in the Modulation mode of operation. During the modulation mode amperage to the PTO valve coil is increased gradually to control the slip rate of the PTO output shaft. Current supplied to the PTO proportional current control solenoid is increased until the PTO clutch is filled.

**Ramp Mode** - Ramp mode begins at the completion of the modulation mode. The PTO controller increases the current supplied to the PTO proportional control solenoid at a constant rate until target coil current is reached. Target coil current will be large enough to saturate the solenoid coil. At the end of the ramp mode the control module activates PTO excessive slip detection.

**Lock Up** - PTO lock up occurs when the PTO clutch slips 2% or less for a period of 100 milliseconds.

**NOTE:** *If the PTO does not lock up within a period of 6 seconds from the time of activation, the control module will shut off current supply to the PTO proportional current control solenoid output and flash the PTO output lamp. An excessive slip fault code will be stored in the controller memory. The operator may try to re-initiate the sequence by turning the PTO switch from ON to OFF to ON again.*



RI98G150

**Excessive PTO Slip Detection** - Excessive slip is defined as one of the following:

1. Slip is greater than 15% for 100 milliseconds continuously.
2. Slip of 3-15% for a period of 2 seconds continuously.
3. Slip is greater than 3% for 100 milliseconds continuously and then increases to more than 15% for 10 milliseconds continuously.

If the control module detects excessive slip, it will shut off current supply to the PTO proportional current control solenoid output and flash the PTO output lamp. An excessive slip fault code will be stored in the controller memory. The operator may try to re-initiate the sequence by turning the PTO switch from ON to OFF to ON again.

**Missing PTO Signal Abort** - If the PTO frequency signal has not been detected by the PTO control module after 6 seconds from activation, the control module will shut off current supply to the PTO proportional current control solenoid output and flash the PTO output lamp. A fault code will be stored in the controller memory. The operator may try to re-initiate the sequence by turning the PTO switch from ON to OFF to ON again.

## **PTO VALVE OIL SUPPLY**

### **PTO Differential Lock Valve**

The PTO differential lock valve is a closed center valve supplying regulated circuit pressure to the PTO and differential lock control circuits. Regulated circuit oil is supplied to the PTO valve through the priority/regulator valve. Pressure is regulated to approximately 2240 to 2450 kPa (325 to 355 PSI) and can be adjusted if required.

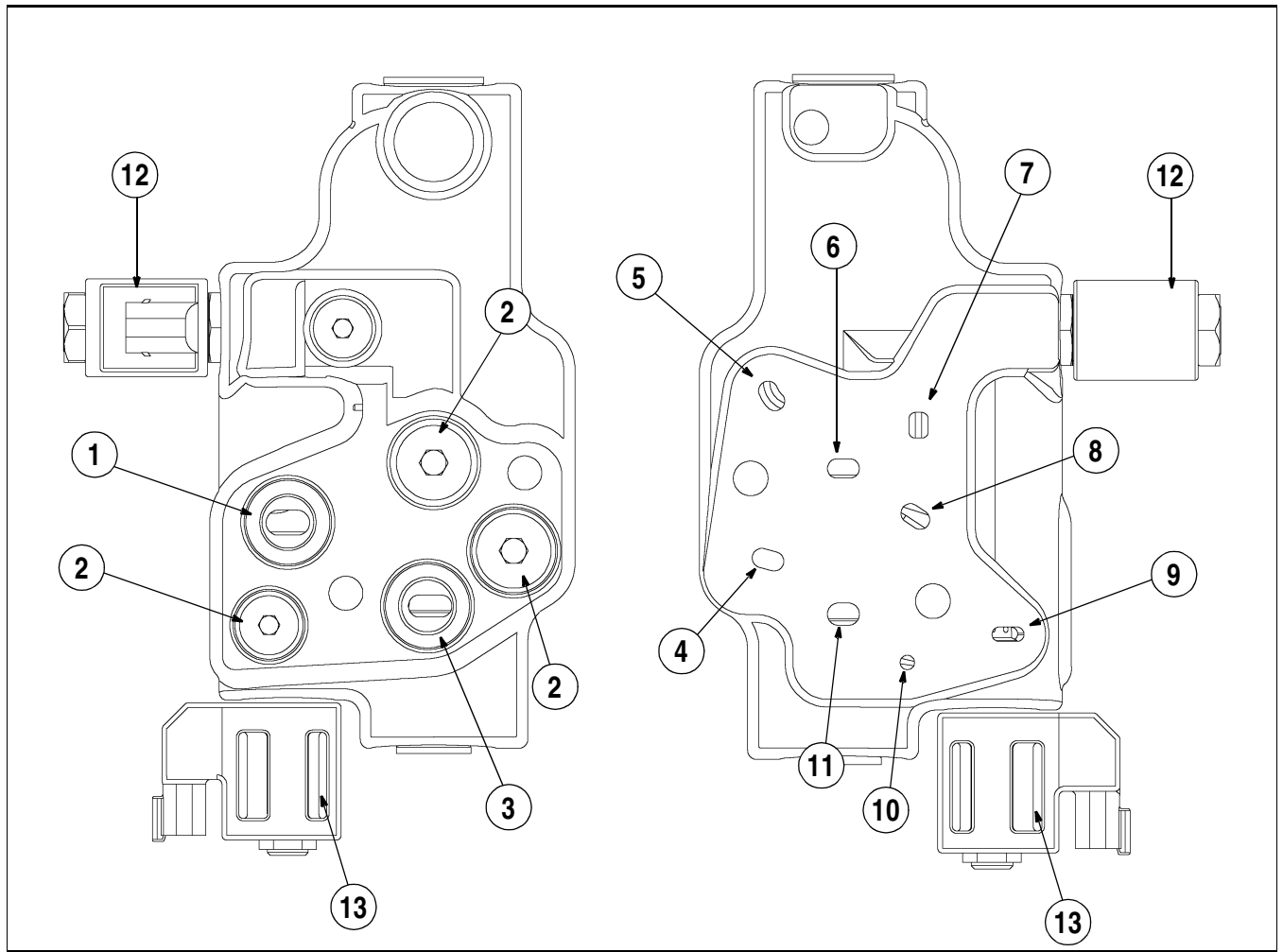
### **PTO Proportional Current Control Solenoid Cartridge Valve**

The PTO solenoid is controlled by an arm rest mounted switch. The switch communicates directly with the PTO controller (PTO switch is hard wire to PTO controller) to supply current to the PTO solenoid cartridge valve. The valve supplies regulated pressure to the PTO clutch based on commands from the operator (PTO switch) and signals supplied to it from the engine RPM circuit, PTO shaft speed sensor, and dual shaft speed sensor. The PTO clutch is applied with hydraulic pressure.

### **PTO Clutch Disengaged**

When the PTO switch is moved to the disengaged position, the PTO solenoid cartridge valve is de-energized and is shifted to a neutral position. This blocks the regulated supply to the top of the modulation piston and drains this area to tank. Regulated supply is also lost at the bottom of the modulator spool. The outer modulator spring pushes the modulator piston back up against the plug as the inner modulator spool lifts the modulator spool.

## PTO DIFFERENTIAL LOCK VALVE



RT98A023

RI02B035 AND B036

### PORT IDENTIFICATION

- |                      |  |
|----------------------|--|
| 1. VALVE INLET PORT  | 8. REMOTE VALVE PILOT SUPPLY                     |
| 2. PLUGGED PORT      | 9. DIF LOCK SUPPLY                               |
| 3. LUBE INLET PORT   | 10. TANK   |
| 4. PTO LUBE          | 11. MESH LUBE                                    |
| 5. TANK              | 12. PTO PROPORTIONAL CURRENT<br>CONTROL SOLENOID |
| 6. PTO CLUTCH SUPPLY | 13. DIFF LOCK SOLENOID                           |
| 7. BLOCKED PASSAGE   |  |

## TROUBLESHOOTING

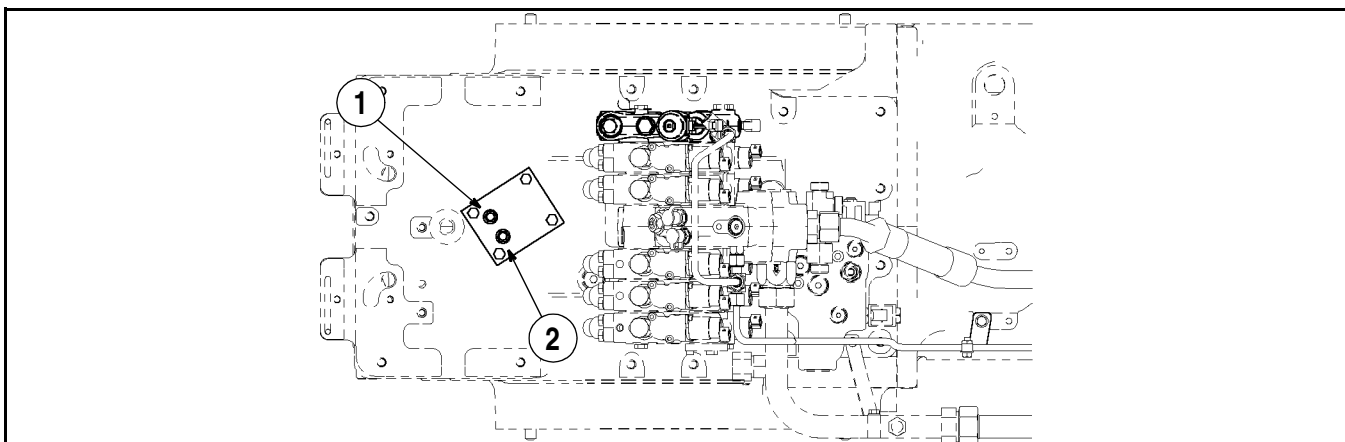
### Problem - PTO clutch will not disengage

1. Check for PTO fault codes.
  - A. If fault codes are found, follow procedures outlined in PTO system fault code troubleshooting in this section.
2. Place the PTO switch in the OFF position. Check tractor monitor for PTO icon in the instrumentation display.
  - A. If the PTO icon is not displayed, this is an indication the electrical control circuit is functioning correctly. Go to step 4.
  - B. If the PTO icon is displayed, this indicates a problem in the PTO electrical control circuit. Check fault codes, controller, and data bus function.
3. Place the PTO switch in the OFF position. Check for voltage at PTO valve coil.
  - A. If voltage is not found, the electrical circuit is functioning properly.
  - B. If voltage is found, troubleshoot the PTO electrical circuit.
    1. Check wires 597A (LU) and 598A (BK) ground.
    2. Check all connections for excessive resistance

Place the PTO switch in the ON position. Check for voltage at the PTO valve coil.

- C. If voltage is found, the electrical circuit is functioning properly.
  - D. If voltage is not found, troubleshoot the PTO electrical circuit.
    1. Check wires 597A (LU) and 598A (BK) ground.
    2. Check all connections for excessive resistance.
4. Install a 500 PSI gauge with hose into the PTO pressure test port. Use a 19mm socket to remove the plug. Install diagnostic fitting from fitting kit 380040106. With PTO OFF pressure should be 0 PSI.
    - A. PTO solenoid cartridge valve may be sticking in the engaged position. Check PTO solenoid cartridge for proper operation.
    - B. PTO modulation spool may be sticking in the engaged position. Remove PTO modulation spool, clean and reinstall.
  5. Check and repair the PTO clutch as needed.

**NOTE:** See electrical schematic sections 44 and 45.



R102C034

1. PTO CLUTCH PRESSURE PORT

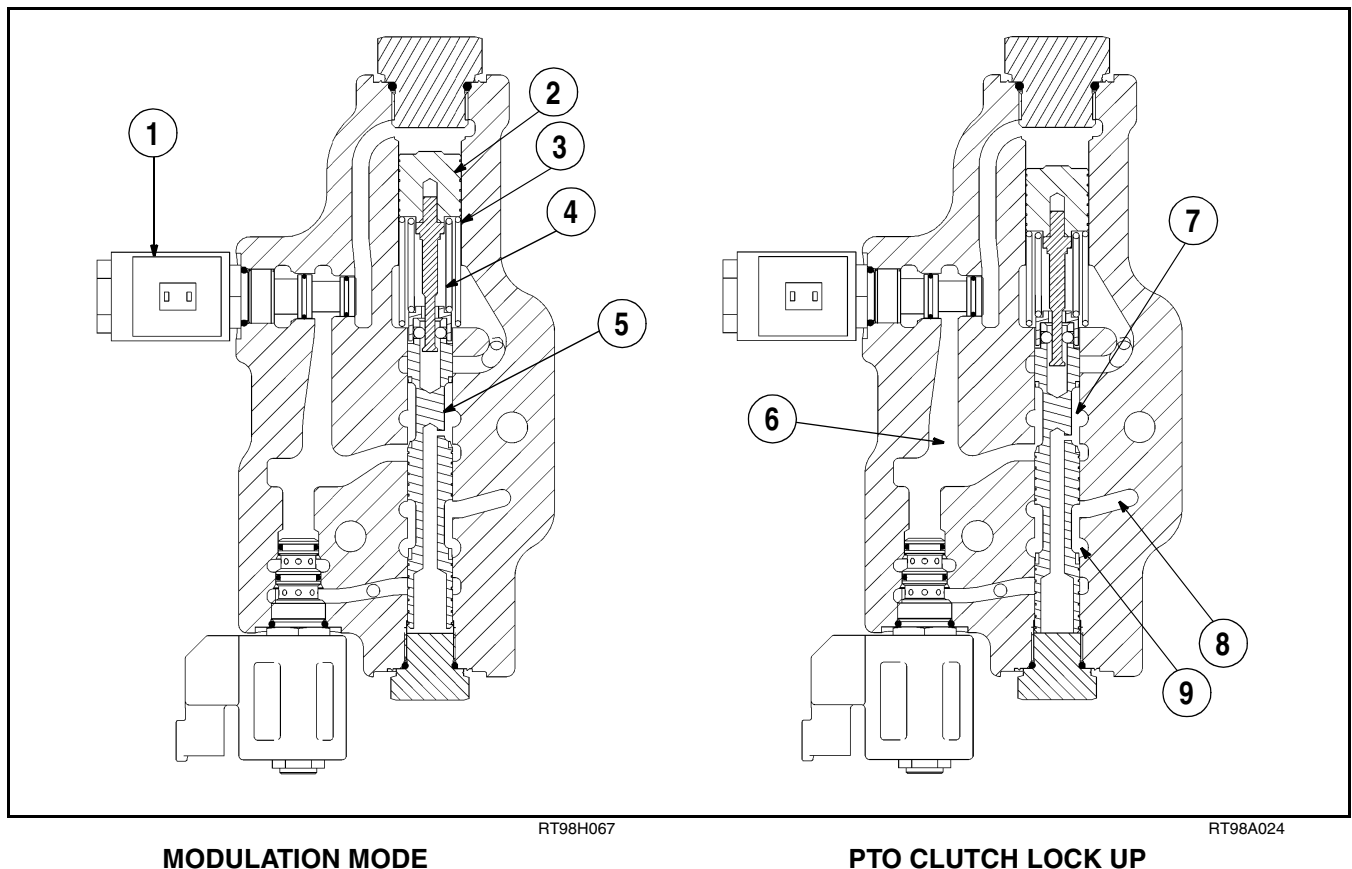
2. PTO LUBE PRESSURE PORT

## PTO Clutch Engaged

When the PTO switch is actuated, the PTO controller sends a fixed current signal to the PTO solenoid. The solenoid spool shifts, metering oil to the top of the modulator piston (2). As pressure builds the piston moves down against the force of both the inner and outer modulator springs (3 and 4). As the piston moves down the center stem of the piston moves into the bore of the modulator spool (5). The piston assembly does not directly shift the modulator spool. The inner modulator spring force begins to shift the modulator spool. As the modulator spool first begins to move, the metered lubrication oil supply to the PTO clutch is increased to prevent clutch wear as the clutch is gradually engaged.

As the modulator spool shifts down it simultaneously blocks the PTO clutch return and begins increasing the clutch supply pressure. The pressure available to the PTO clutch is also ported through a cross drilled and end drilled holes to the bottom of the modulator spool. The balance between the increasing inner modulator spring force against the increasing clutch pressure causes the pressure to gradually increase.

The engagement time for the PTO can range from approximately 2-6 seconds and is completely controlled by the PTO controller based on monitored conditions (load, engine RPM, PTO shaft RPM).



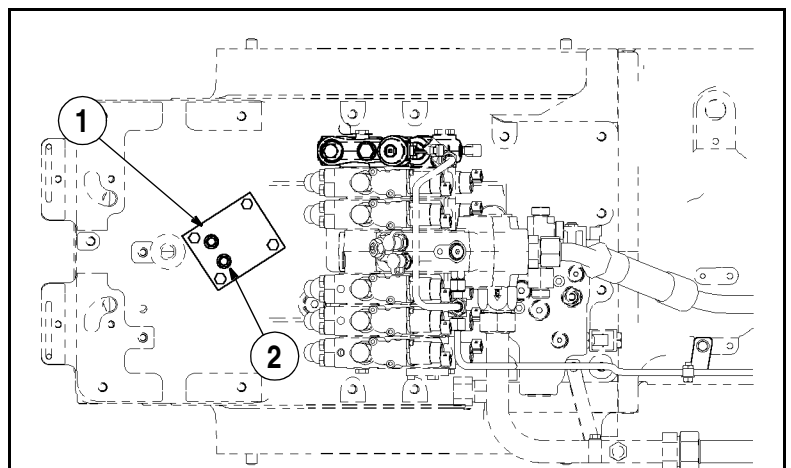
1. PTO SOLENOID
2. MODULATOR PISTON
3. PRELOAD SPRING (OUTER)
4. MODULATION SPRING
5. MODULATOR SPOOL

6. VALVE INLET/SUPPLY PASSAGE
7. PTO CLUTCH OUTLET PORT
8. LUBE SUPPLY
9. LUBE OUTLET

## TROUBLESHOOTING

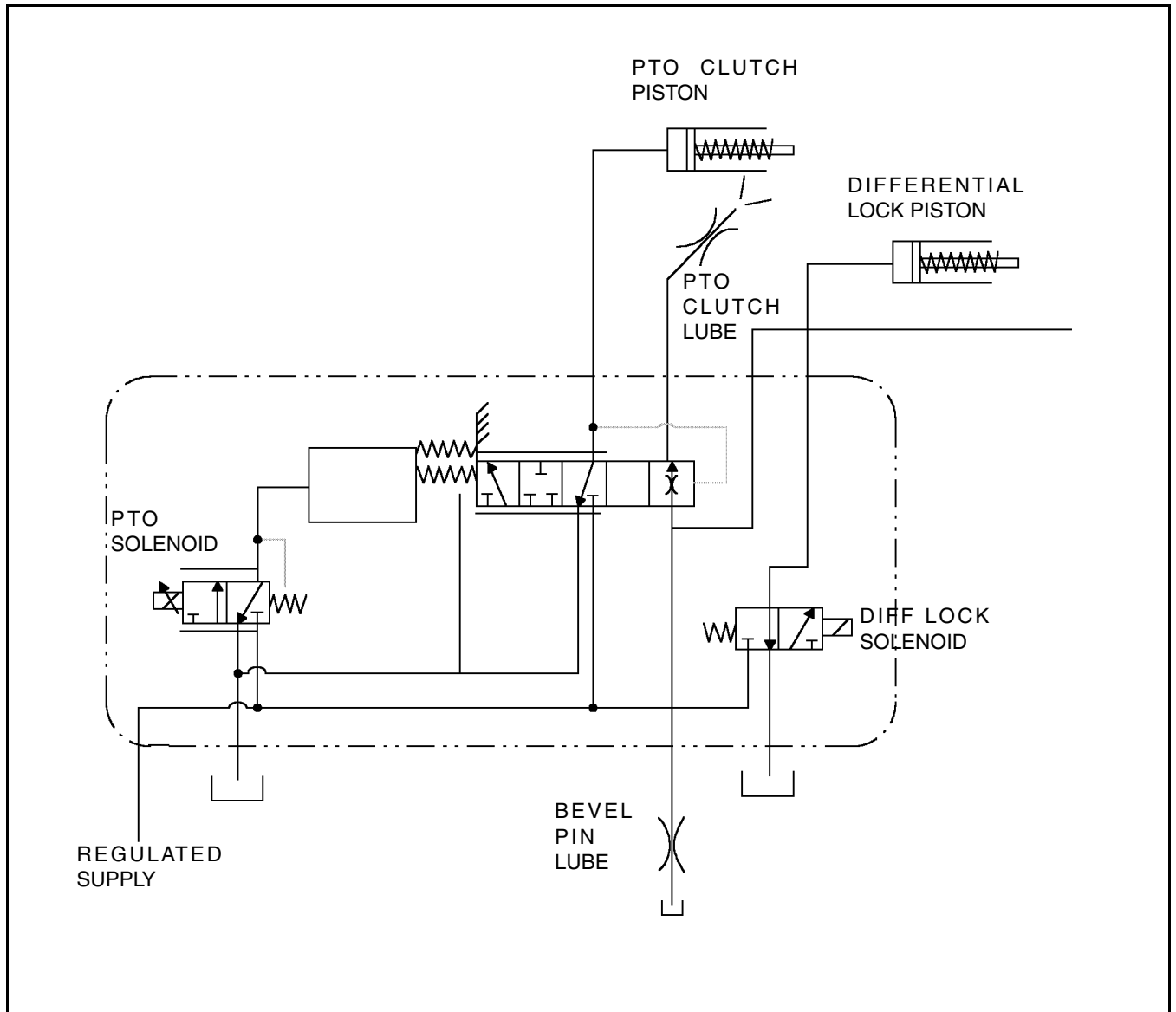
### Problem - PTO will not engage

1. Check for PTO fault codes.
  - A. If fault codes are found, follow procedures outlined in PTO fault code troubleshooting in this section.
2. Place the PTO switch in the ON position. Check tractor monitor for PTO icon in the instrumentation display.
  - A. If the PTO icon is displayed, this is an indication the electrical control circuit is functioning correctly. Go to Step 4.
  - B. If the PTO icon is not displayed, this indicates a problem in the PTO electrical control circuit. Check fault codes, controller, and data bus function.
3. Place the PTO switch in the ON position. Check for voltage at the PTO valve coil.
  - A. If voltage is found, the electrical circuit is functioning properly.
  - B. If voltage is not found, troubleshoot the PTO electrical circuit.
4. Check wires 597A (LU) and 598A (BK) ground.
5. Check all connections for excessive resistance
6. Check solenoid coil for improper installation (loose etc.).
7. Place the PTO switch in the OFF position. Check for voltage at PTO valve coil.
  - A. If voltage is not found, the electrical circuit is functioning properly.
  - B. If voltage is found, troubleshoot the PTO electrical circuit.
8. Check wires 597A (LU) and 598A (BK) ground.
9. Check all connections for excessive resistance.
10. Install a 500 PSI gauge with hose into the PTO pressure test port. Use a 19mm socket to remove the plug. Install diagnostic fitting from fitting kit 380040106. Place the PTO switch in the ON position. The pressure should read from 2240 to 2450 kPa (325 to 345 PSI).
  - A. PTO solenoid cartridge valve may be sticking in the disengaged position. Check PTO solenoid cartridge for proper operation.
  - B. PTO modulation spool may be sticking in the disengaged position. Remove PTO modulation spool, clean and reinstall.
11. Check and repair the PTO clutch as needed.



RI02C034

1. PTO CLUTCH PRESSURE PORT    2. PTO LUBE PRESSURE PORT



RH02A059



## **Problem PTO engages too rapidly**

1. Check for PTO fault codes.
  - A. If fault codes are found, follow procedures outlined in PTO fault code troubleshooting in this section.
  - B. If no fault codes are found, go to step 2.
2. PTO clutch not filling and modulating properly.
  - A. Solenoid cartridge valve spool opening too far.
3. Replace solenoid cartridge.
  - B. PTO spool assembly sticking, or damaged.
4. Replace PTO spool.
  - C. PTO clutch plates damaged.
5. Repair PTO clutch.
  - D. PTO clutch piston hanging or damaged.
6. Repair PTO clutch.

## Problem PTO engages then stops

1. Check for PTO faults codes.
  - A. If fault codes are found, follow procedures outlined in PTO fault code troubleshooting in this section.
  - B. If no fault codes are found, go to step 3.
2. PTO clutch slipping excessively.
  - A. Load on PTO too heavy.
  - B. Reduce load
3. PTO clutch pressure too low.
  - A. PTO solenoid not energizing properly.
4. Check wires 597A (LU) and 598A (BK) ground for excessive resistance.
5. Check for loose connections.
6. Solenoid partial short. Check solenoid coil resistance.
7. Controller current supply is weak. Internal controller failure.
  - B. Clutch hydraulic circuit leaking. Check regulated pressure circuit.
8. Inspect PTO solenoid cartridge valve seals.
9. Inspect PTO clutch for leaking seals.
10. Internal tube supply leaking.
11. Engine speed signal too high.
  - A. Check wire 216D (Y).
  - B. Check connections.
12. PTO shaft speed signal too low.
  - A. Check sensor resistance.
  - B. Check sensor wires 295A (W) and 174AA (BK) single speed and 294A, 294B(W) and 174C and D for dual speed.
  - C. Check connections.

**NOTE:** See electrical schematic sections 44 and 45.



# **Section 31**

## **Chapter 2**

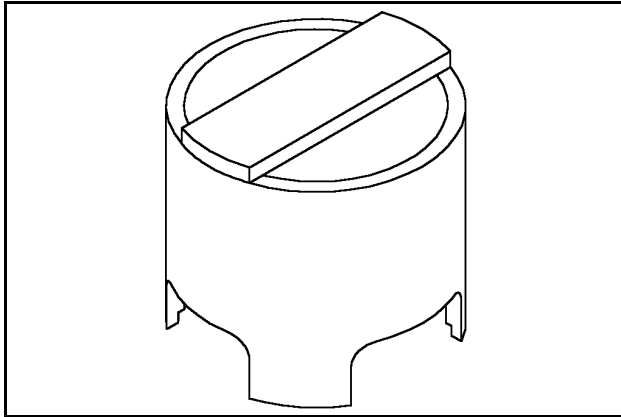
### **PTO CLUTCH ASSEMBLY**

**Single, Reversible and Dual Speed**

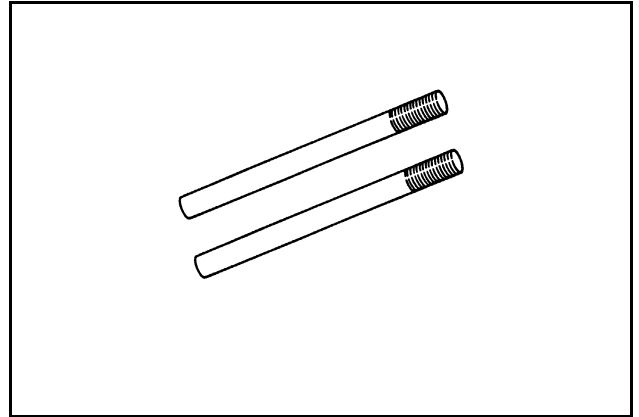
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## SPECIAL TOOLS



**380002454 PTO Clutch Brake Spring Compressor**



**CAS-1995-6 Guide Pins**

## SPECIAL TORQUES

Reversible PTO Output Shaft Rolling Torque .....	2 to 18 in. lbs.
Cover for PTO Clutch Assembly Bolts .....	490 to 550 Nm (361 to 406 lb. ft.)
Output Shaft Housing Bolts .....	90 to 100 Nm (66 to 74 lb. ft.)
PTO Driven Gear Bearing Cage Bolts .....	51 to 58 Nm (38 to 43 lb. ft.)
PTO Manifold Plate Mounting Bolts .....	51 to 58 Nm (38 to 43 lb. ft.)
PTO Clutch Assembly Mounting Bolts .....	51 to 58 Nm (38 to 43 lb. ft.)
PTO Speed Sensor .....	16 to 22 Nm (12 to 16 lb. ft.)

## PTO CLUTCH ASSEMBLY

### General

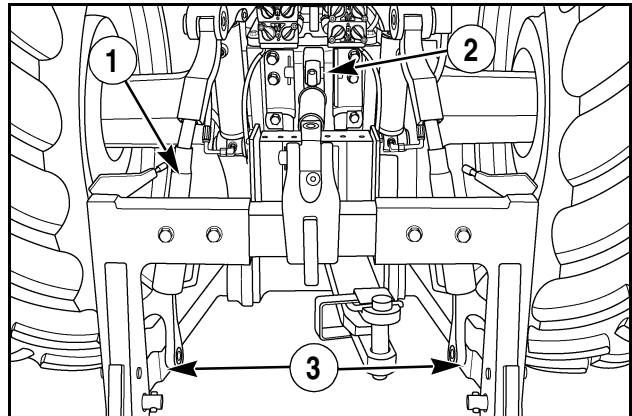
- Thoroughly clean the top, sides and rear of the PTO components to prevent any dirt or debris from entering the final drive.
- If the PTO clutch and or brake is to be serviced, the complete PTO clutch assembly must be removed from the final drive housing.
- If the PTO driven gear needs servicing, the following components will have to be removed: cab (see Cab Removal Section), hitch rock shaft (see Hitch Removal Section) and final drive top cover (see Final Drive Section).

## PTO CLUTCH SERVICE

### Removal

#### STEP 1

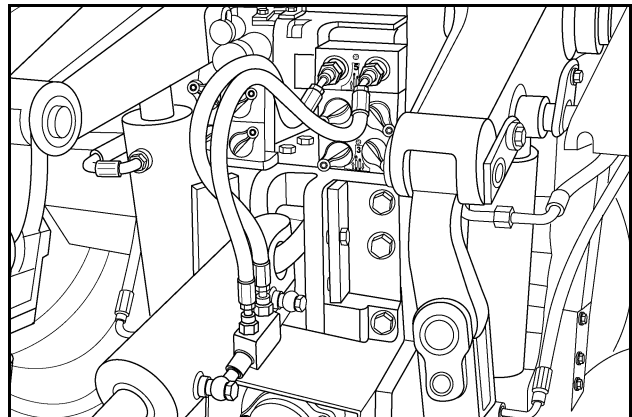
If unit is equipped with a quick coupler, properly support the coupler (1), remove the third link (2) at the rear frame, remove the pins (3) and lift the coupler from the draft arms.



RD05A013

#### STEP 2

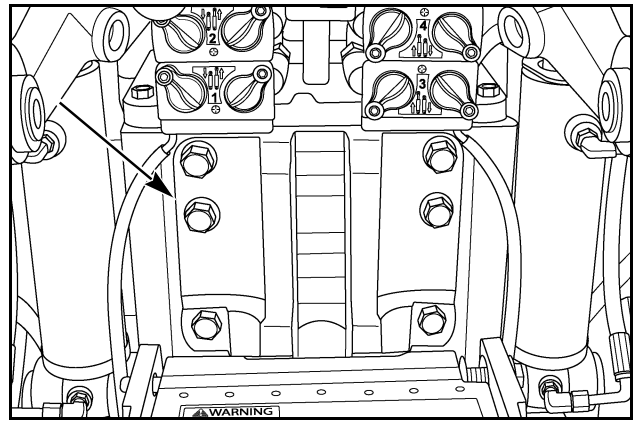
If equipped with a hydraulic cylinder-assisted third link, note the position of the hoses and remove from the quick couplers.



RD05A017

### STEP 3

Remove the third link support/PTO clutch cover plate and gasket. Discard gasket.

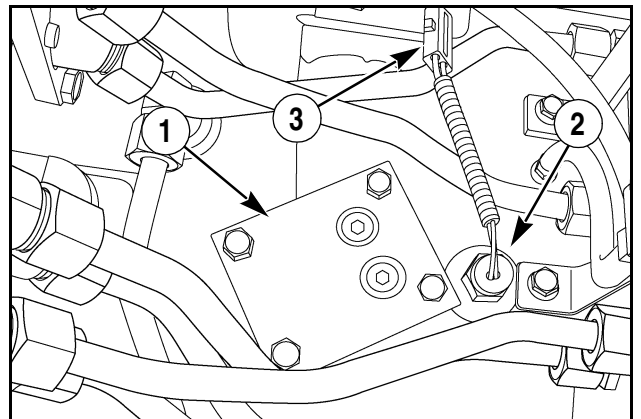


RD05A014

### STEP 4

The PTO manifold plate (1) and speed sensor (2) are located on the rear frame cover plate between the remote valves and remote valve couplers. Disconnect the wire harness (3) from the speed sensor and remove the sensor (2). Remove the PTO manifold plate (3).

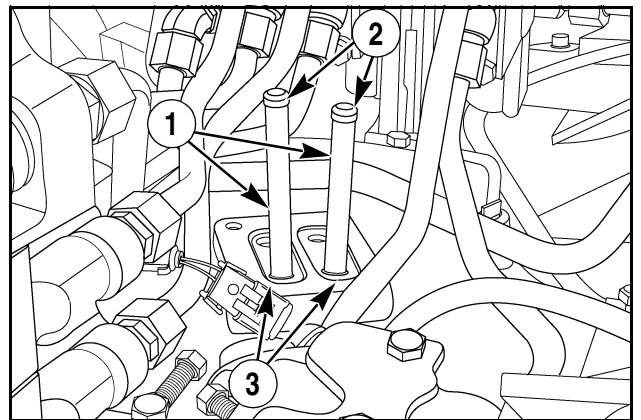
**NOTE:** Hitch rock shaft removed for photographic purposes.



RD05A011

### STEP 5

Remove the PTO jumper tubes (1). Remove the O-rings (2) from both ends of each tube and discard. Remove the manifold plate O-ring seals (3) and discard.

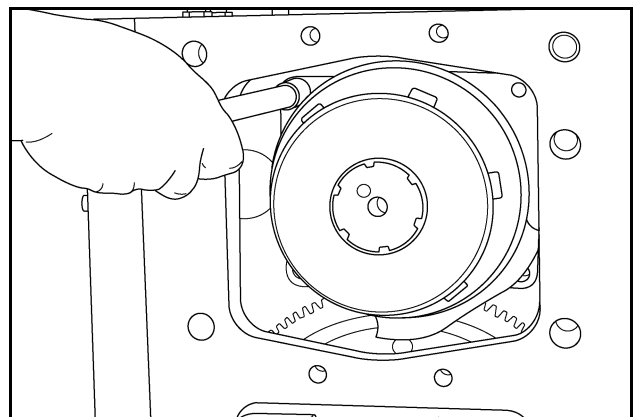


RD05A012

### STEP 6

Remove the two upper PTO assembly mounting bolts.

**NOTE:** Hitch components and draw bar rear support are removed for photographic purposes.

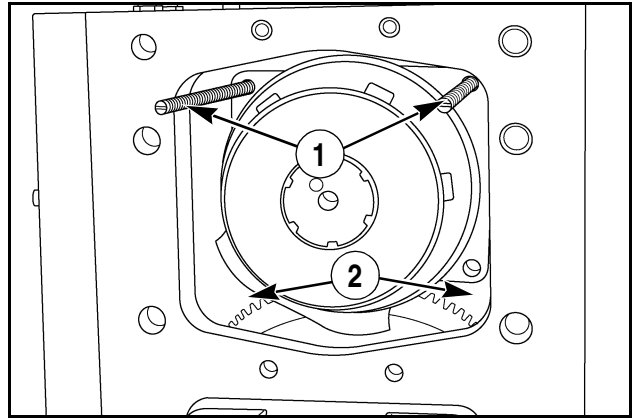


RD05A046



## STEP 7

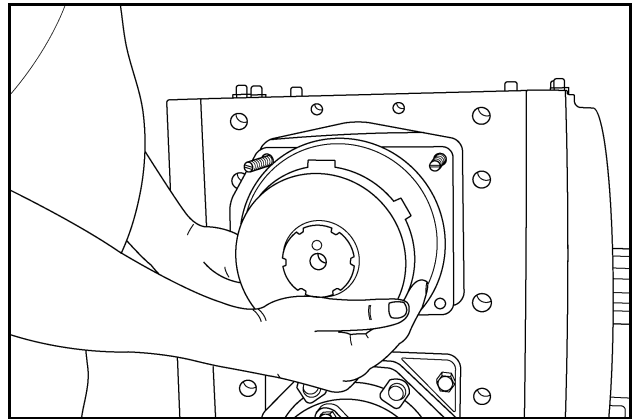
Install two CAS-1995-6 guide pins (1) then remove the two lower mounting bolts (2).



RD05A047

## STEP 8

Remove the PTO assembly.

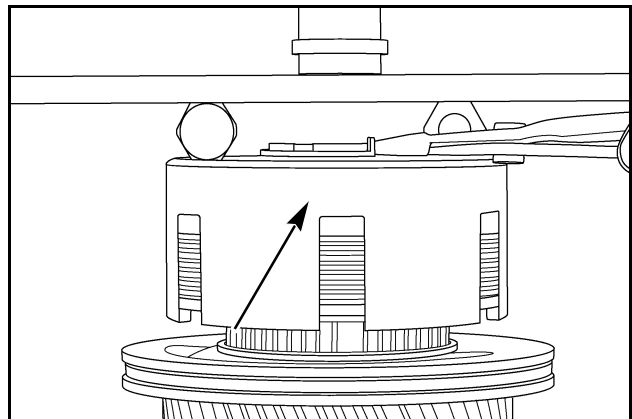


RD05A048

## Disassembly

## STEP 9

Place the PTO assembly in a press. Press down on the carrier just enough to free the snap ring. Remove the snap ring.

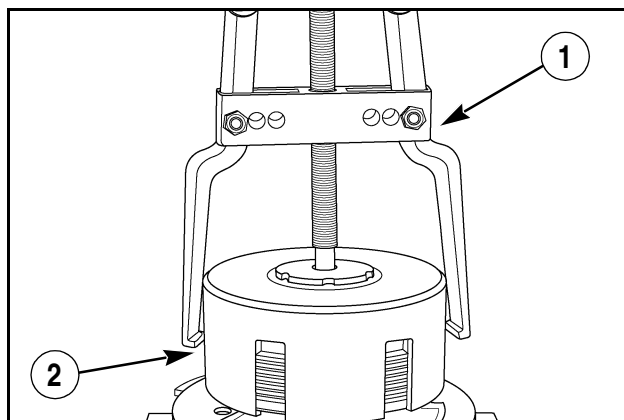


RD05A019

## STEP 10

Place a puller (1) on the clutch carrier with the jaws under the tabs of a separator plate (2). Once the carrier is free from the shaft, place on a clean work surface.

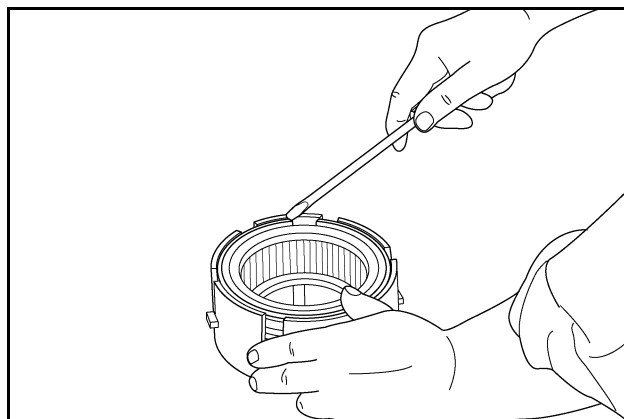
**NOTE:** Use care, separator plate tabs may bend when removing clutch carrier.



RD05A020

## STEP 11

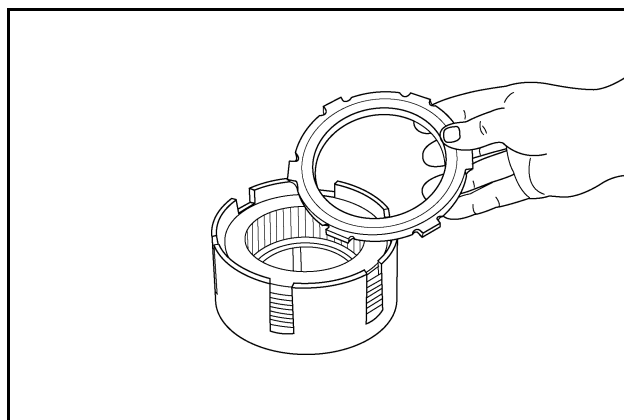
Remove the snap ring.



RD05A022

## STEP 12

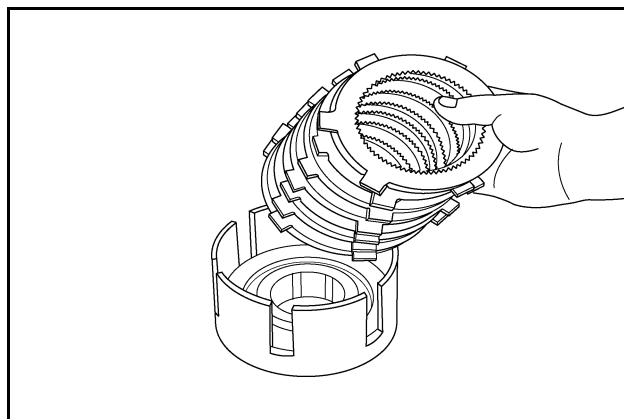
Remove the clutch backing disc.



RD05A024

## STEP 13

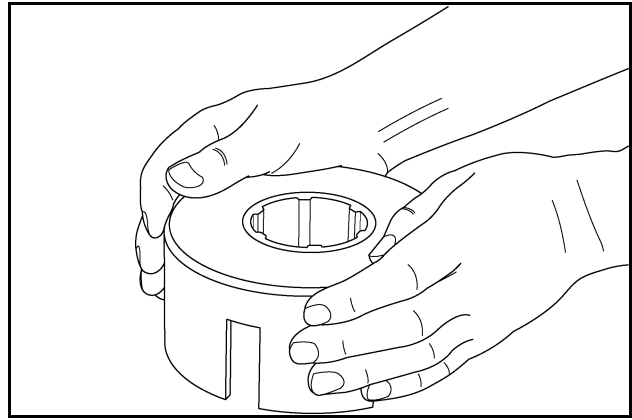
Remove the eight friction plates and eight separator plates and discard.



RD05A025

## STEP 14

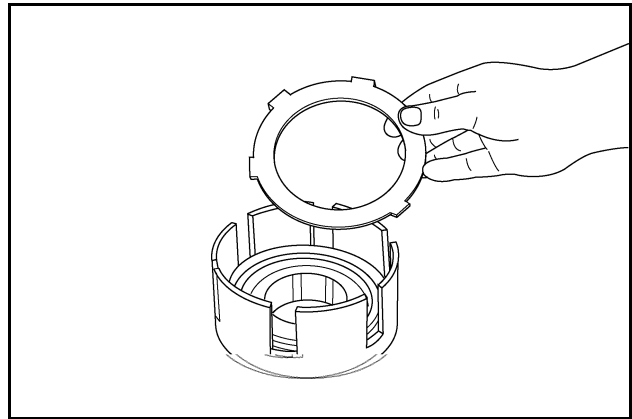
Turn the carrier over as shown and tap the carrier on a hard surface to dislodge the piston.



RD05A027

## STEP 15

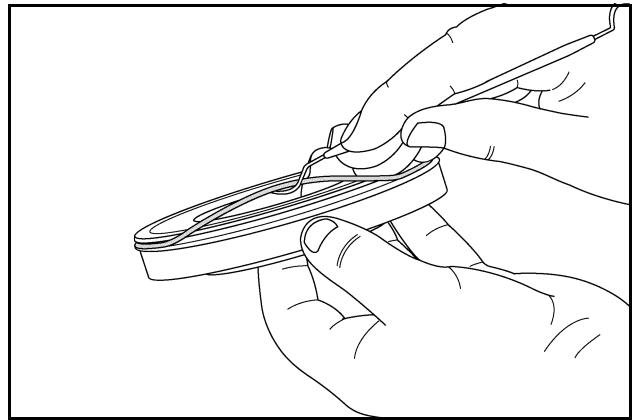
Remove the piston.



RD05A028

## STEP 16

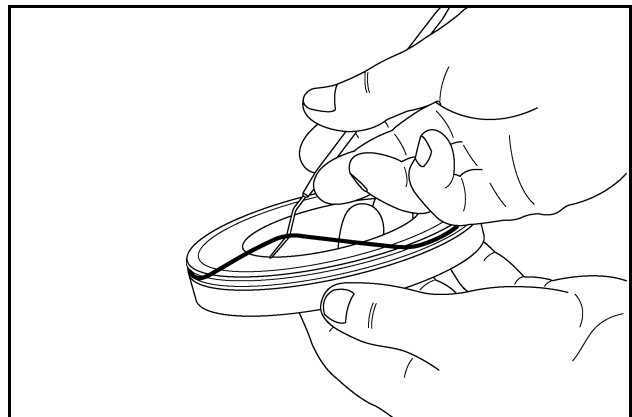
Remove the seal ring and discard.



RD05A029

## STEP 17

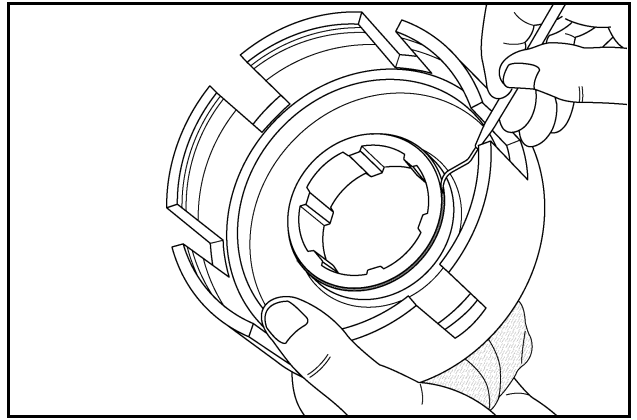
Remove the O-ring and discard.



RD05A030

## STEP 18

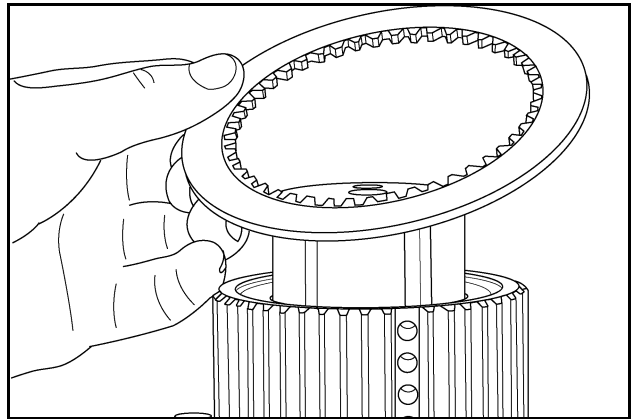
Remove the seal and O-ring from the clutch carrier and discard.



RD05A031

## STEP 19

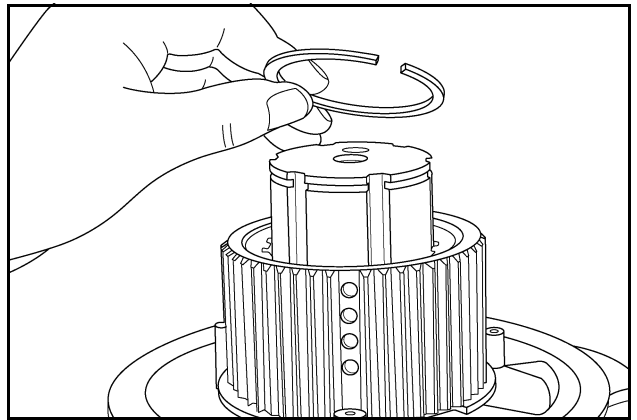
Remove the brake pusher disc.



RD05N141

## STEP 20

Remove the Belleville washer retaining ring.

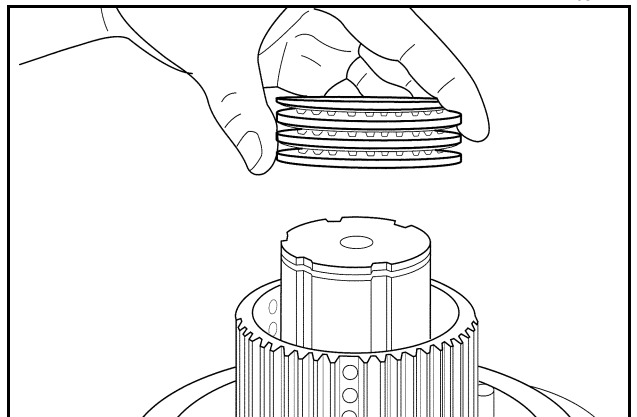


RD05N144

## STEP 21

Remove the seven Belleville washers. Remove the second retaining ring.

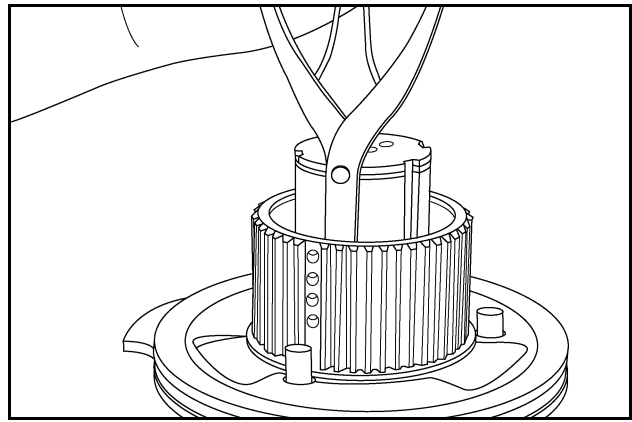
**IMPORTANT:** *Note the position of the washers so that they are reinstalled in the same way.*



RD05N143

## STEP 22

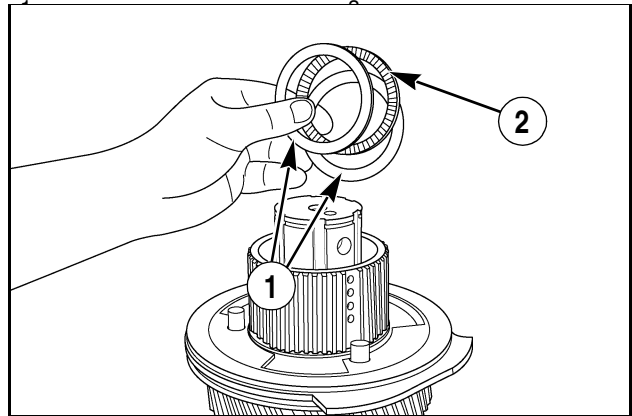
Once all Belleville washers are removed, remove the third retaining ring.



RD05N142

## STEP 23

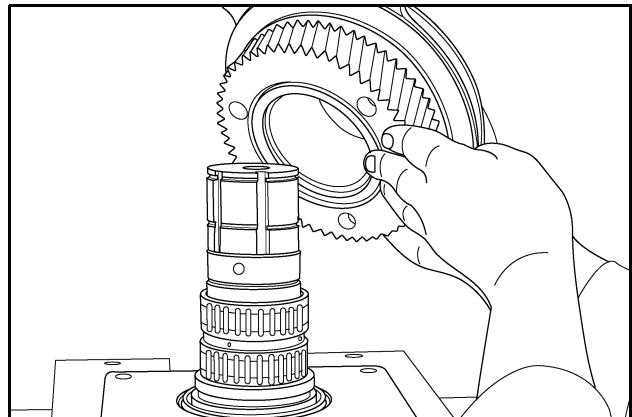
Remove the thrust washers (1) and thrust bearing (2).



RD05N145

## STEP 24

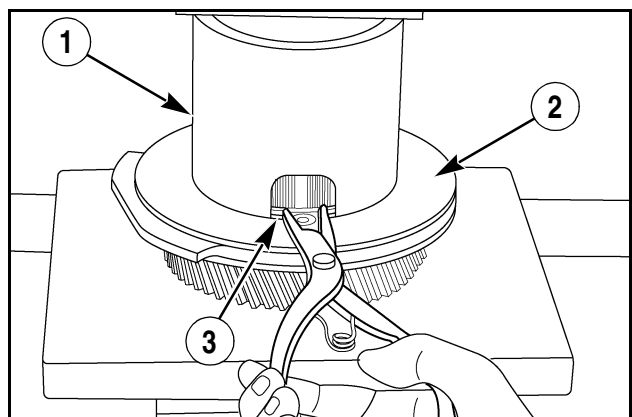
Lift the hub off the shaft, taking care not to damage the bearings.



RD05B032

## STEP 25

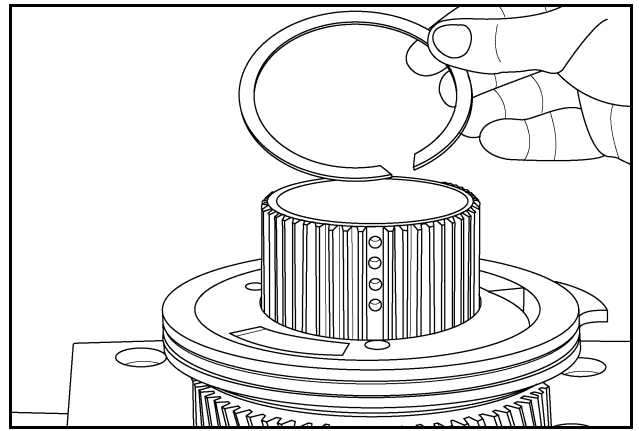
Place Special Tool 380002454 (1) over the hub so that the feet of the tool are sitting on the three brake adjuster pins (2). Compress the three brake adjuster pins until they are flush with the brake pusher plate (2). Reset the tool so that the gap in the snap ring (3) is centered in the opening of the tool (1). Compress the brake pusher plates (2) just enough to relieve the pressure on the snap ring.



RD05D015

## STEP 26

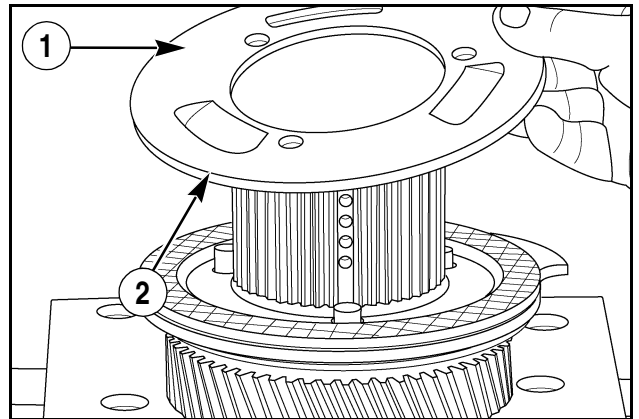
Remove the snap ring.



RD05N146

## STEP 27

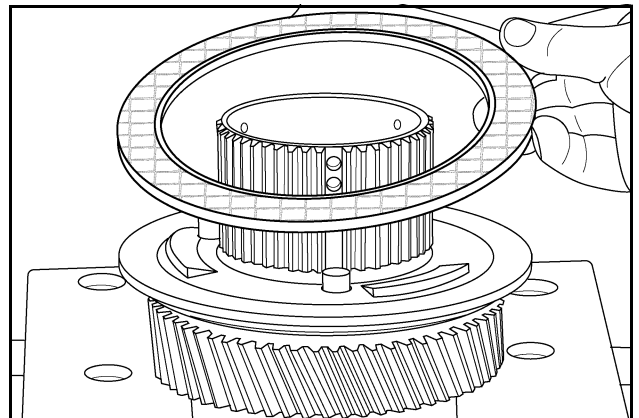
Remove the top brake holder plate (1). Note the tabs (2) on the holder plate are facing towards the friction plate.



RD05N147

## STEP 28

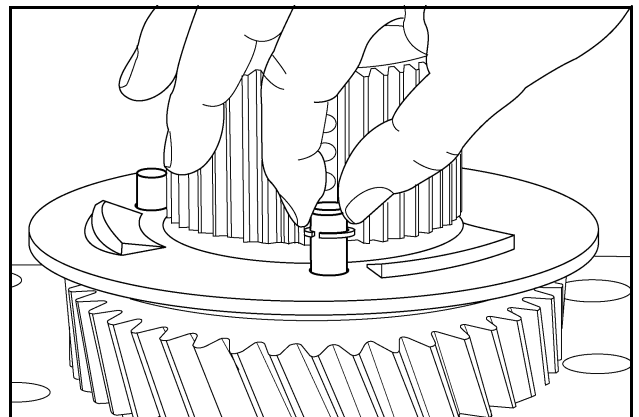
Remove the brake friction plate.



RD05N148

## STEP 29

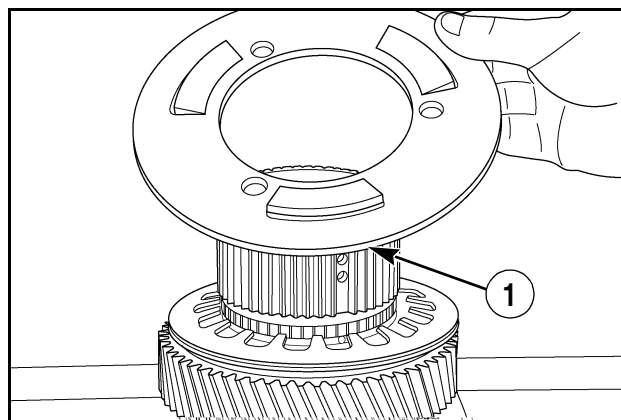
Remove the three brake adjuster pins.



RD05N149

### STEP 30

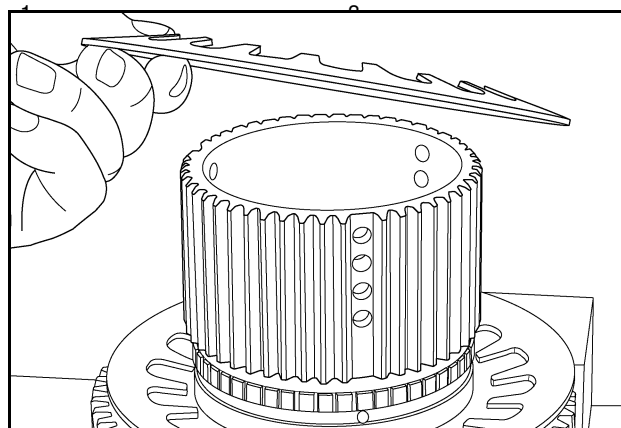
Remove the second brake holder plate. Note the tabs (1) on the holder plate are facing towards the friction plate.



RD05N150

### STEP 31

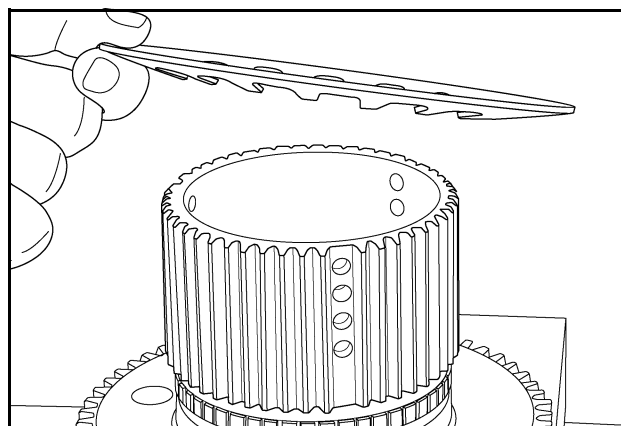
Remove the first brake apply disc spring.



RD05N151

### STEP 32

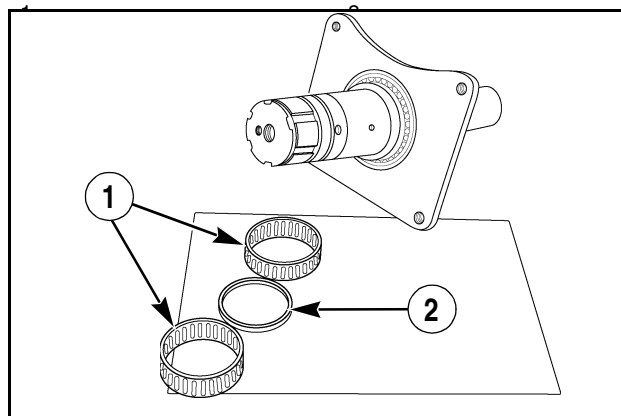
Remove the second brake apply disc spring.



RD05N152

### STEP 33

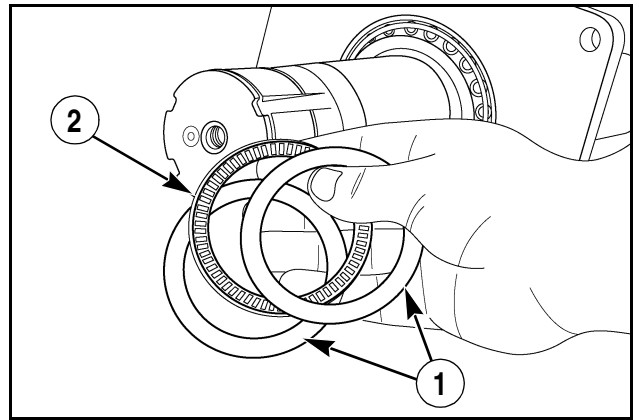
Remove the two needle bearings (1) and needle bearing support ring (2) from the PTO drive shaft assembly.



RD05B033

### STEP 34

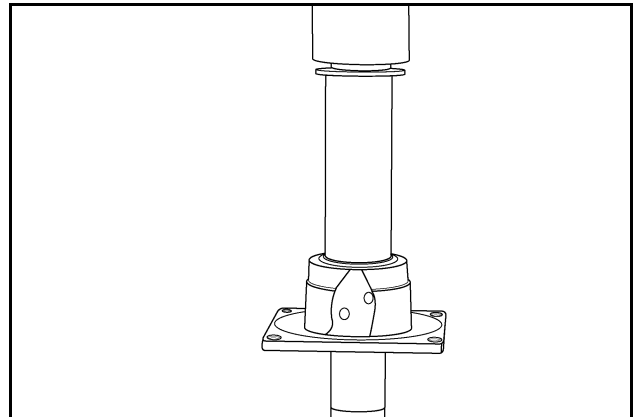
Remove the two needle bearing thrust washers (1) and the needle bearing (2).



RD05B034

### STEP 35

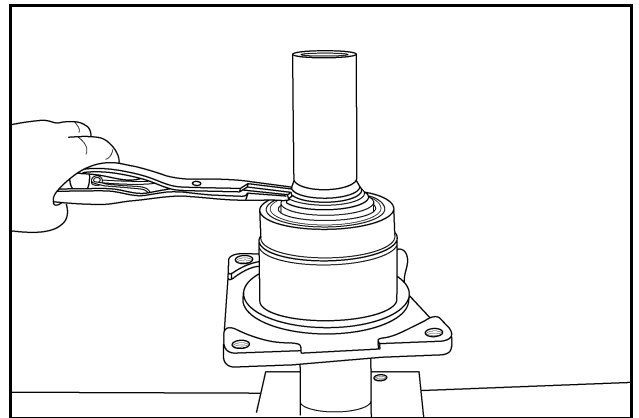
Place the drive shaft assembly in a press as shown and press down on the inner race of the bearing. Press only far enough to remove tension on the snap ring.



RD05B036

### STEP 36

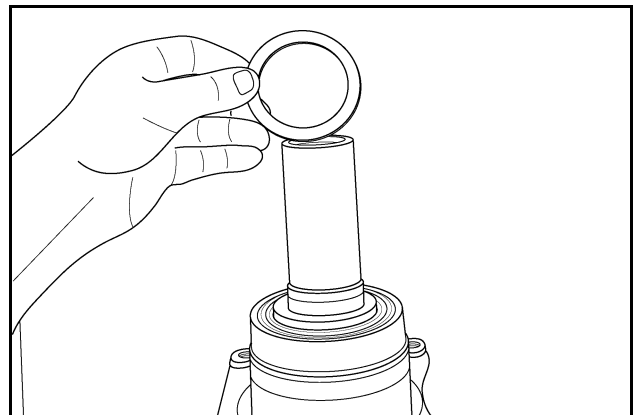
Remove the snap ring.



RD05B037

### STEP 37

Remove bearing spacer.

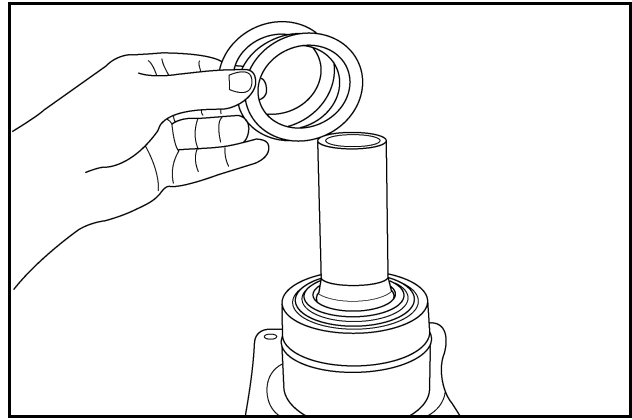


RD05B038



## STEP 38

Remove shim pack.

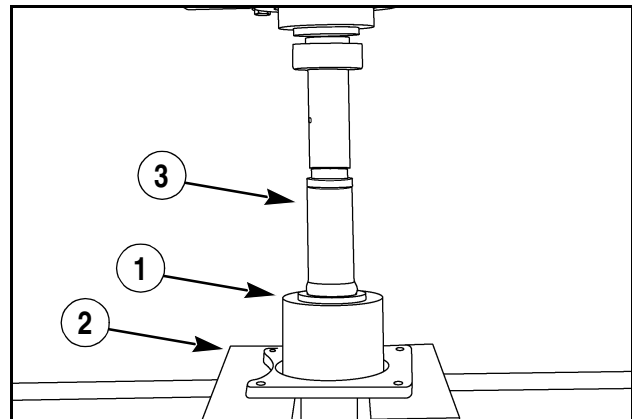


RD05B039

## STEP 39

Place the bearing cage (1) between two support blocks (2) and press the drive shaft assembly (3) free of the bearing cage.

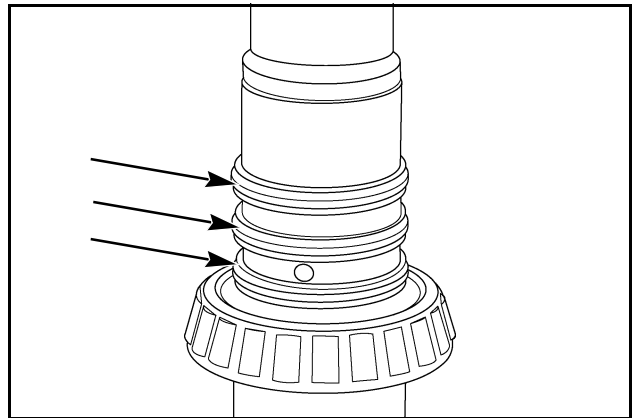
**IMPORTANT:** *Do not allow the shaft to fall to the floor.*



RD05B040

## STEP 40

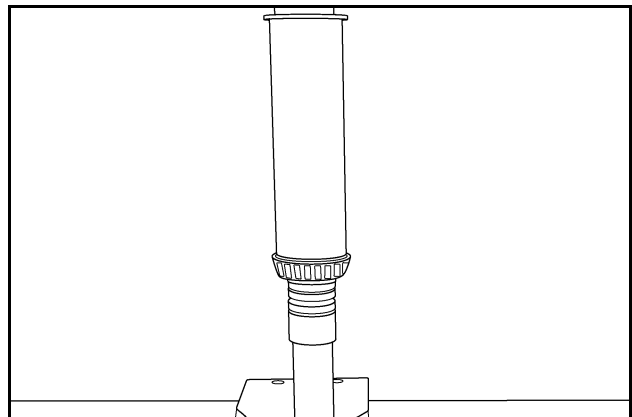
Remove the three seal rings and discard.



RD05D001

## STEP 41

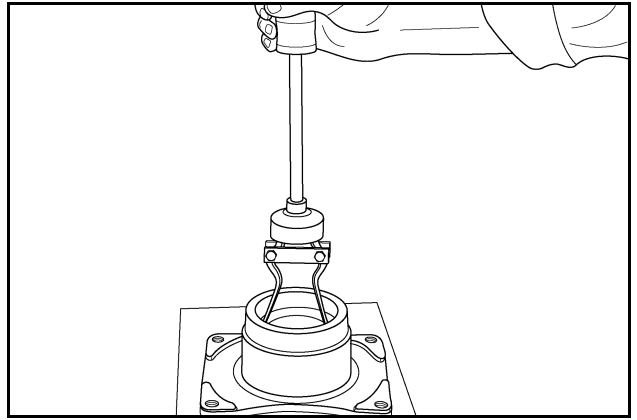
Press the bearing from the shaft.



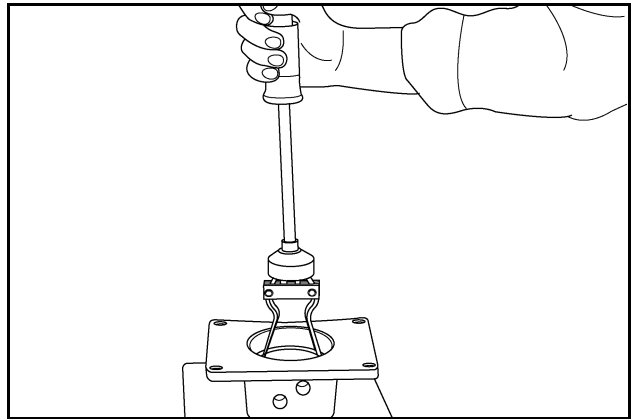
RD05D002

## STEP 42

Remove bearing cones from each side of the bearing cage.



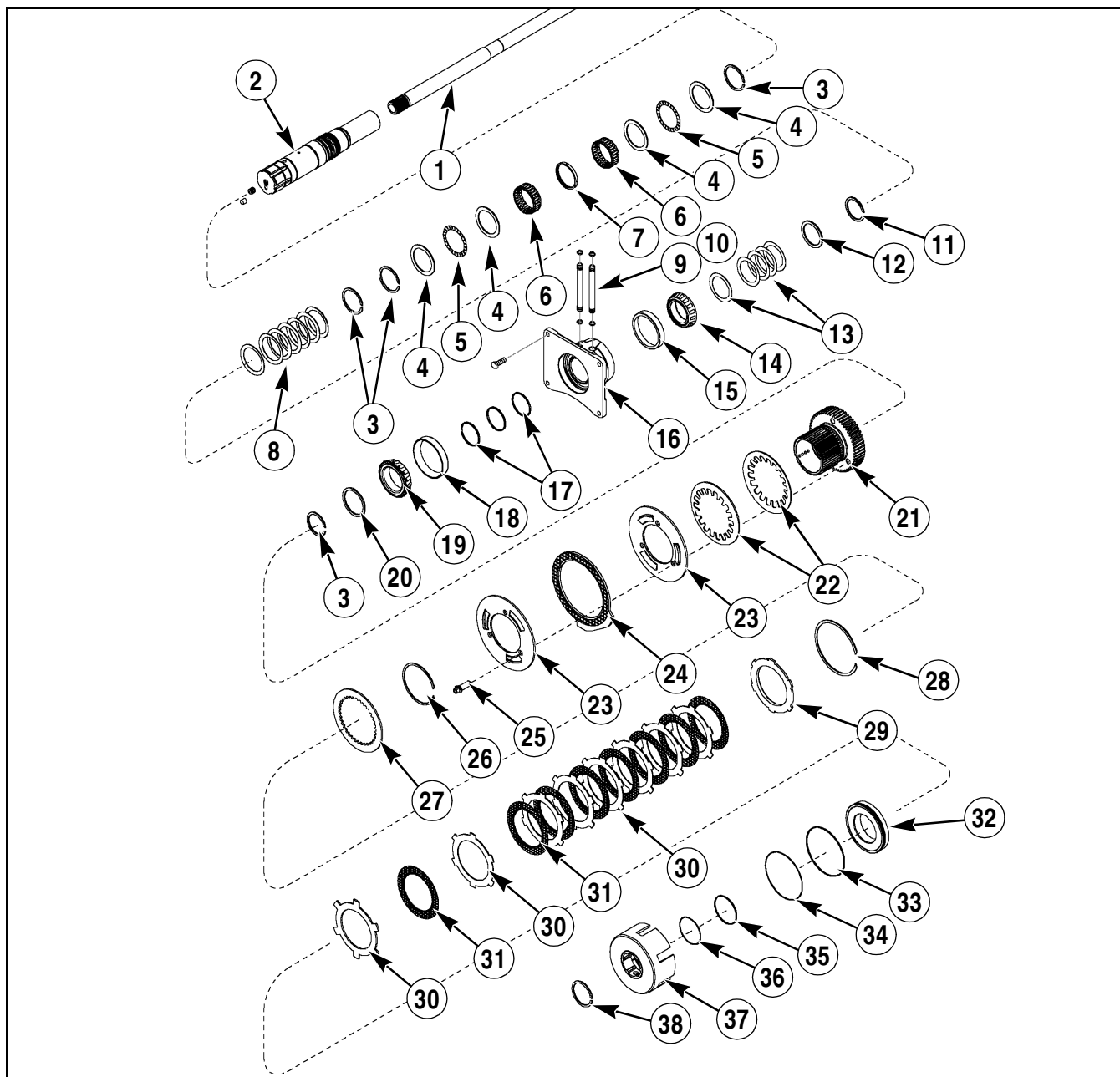
RD05D008



RD05D010

## Assembly

### Exploded View of PTO Clutch

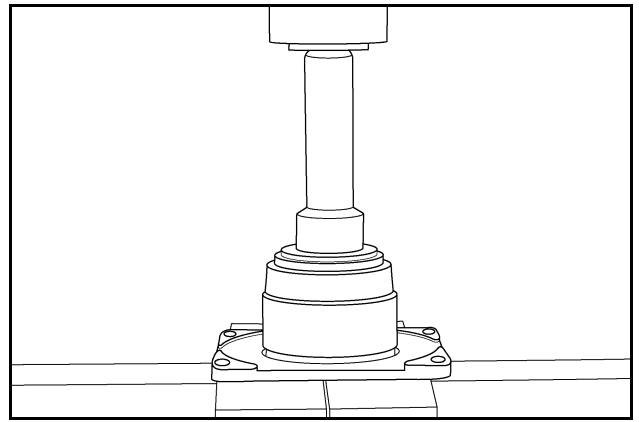


RI05D013

- |                            |                        |                               |
|----------------------------|------------------------|-------------------------------|
| 1. COUNTERSHAFT            | 15. BEARING CUP        | 29. CLUTCH BACKING DISC       |
| 2. PTO DRIVE SHAFT         | 16. BEARING CAGE       | 30. PTO CLUTCH SEPARATOR DISC |
| 3. RETAINING RING          | 17. SEAL RING          | 31. PTO CLUTCH FRICTION DISC  |
| 4. THRUST WASHER           | 18. BEARING CUP        | 32. PISTON                    |
| 5. THRUST BEARING          | 19. BEARING CONE       | 33. O-RING                    |
| 6. NEEDLE BEARING          | 20. SPACER             | 34. SEAL RING                 |
| 7. NEEDLE BRG SUPPORT RING | 21. PTO DRIVE GEAR     | 35. SEALING RING              |
| 8. BELLEVILLE WASHERS      | 22. SPRING             | 36. O-RING                    |
| 9. JUMPER TUBE             | 23. PLATE              | 37. CARRIER                   |
| 10. O-RING                 | 24. BRAKE DISC         | 38. RETAINING RING            |
| 11. RETAINING RING         | 25. BRAKE ADJUSTER PIN |                               |
| 12. SPACER                 | 26. NO. 400 CIRCLIP    |                               |
| 13. SHIM PACK              | 27. BRAKE DISC PUSHER  |                               |
| 14. BEARING CONE           | 28. SNAP RING          |                               |

### STEP 43

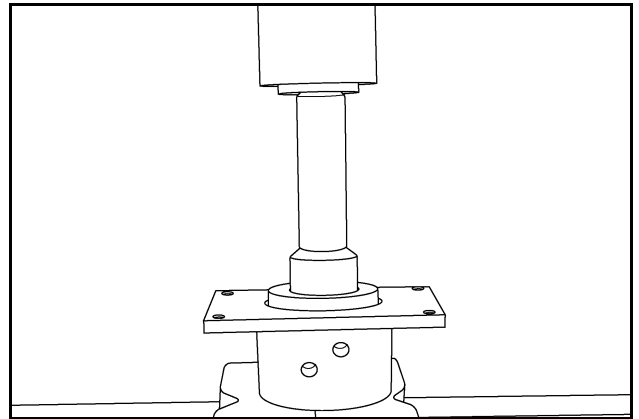
Press bearing cup into bearing carrier.



RD05D011

### STEP 44

Press second cup into bearing carrier.

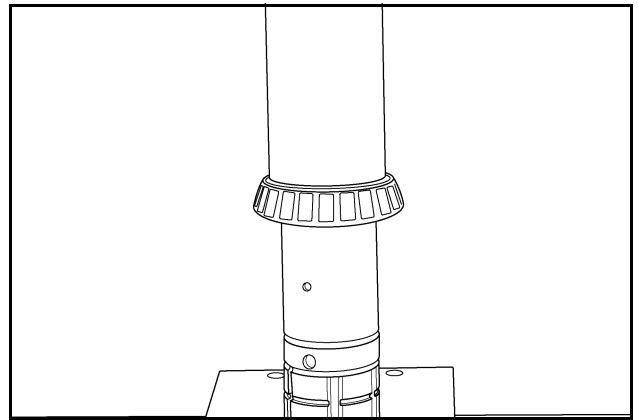


RD05D012

### STEP 45

Press bearing onto the PTO drive shaft. Make sure the bearing is seated against the bearing spacer.

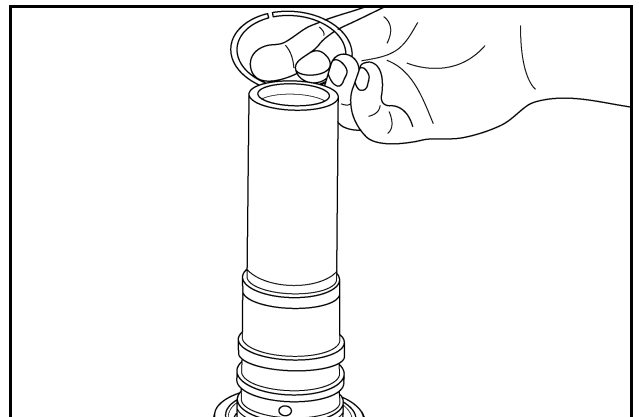
**NOTE:** *DO NOT press on the bearing cage. DO NOT overpress or deflection of the retaining ring will occur. This will affect the shimming.*



RD05D006

### STEP 46

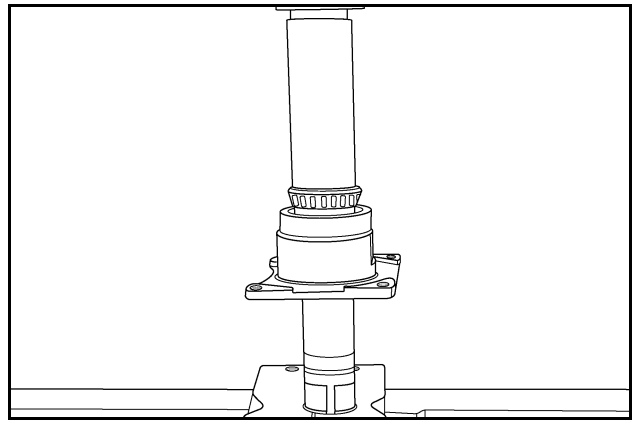
Apply petroleum jelly or Lubriplate® to the seal rings and install. Make sure each seal is properly locked after placing in the groove.



RD05B042

## STEP 47

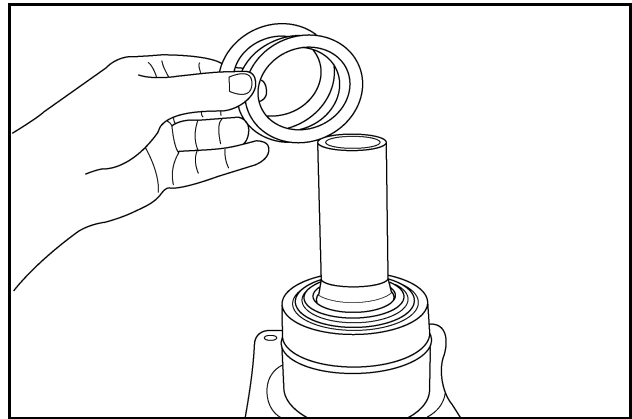
Apply petroleum jelly or Lubriplate® to the seal ring bore and chamfer of the bearing cage. Place the bearing cage over the shaft and press the bearing until a slight drag is felt on the cage as it is turned.



RD05B041

## STEP 48

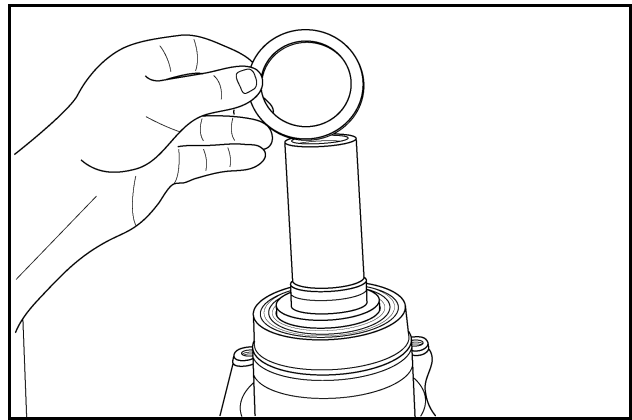
Install the shim pack.



RD05B039

## STEP 49

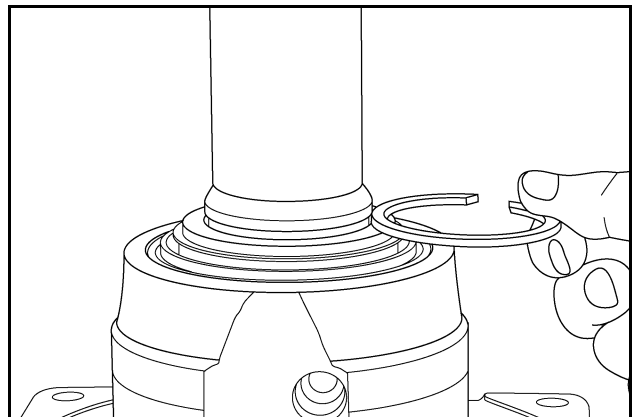
Install the bearing spacer.



RD05B038

## STEP 50

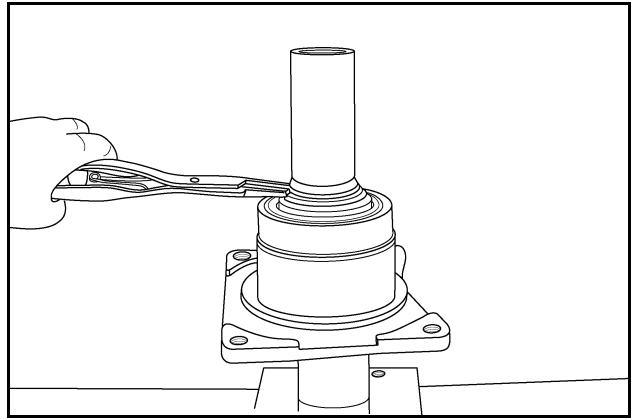
Adjust the shim pack until a slight drag is felt on the retaining ring when it is placed in the groove. REDUCE the shim pack by 0.002 inch.



RD05D013

## STEP 51

Install the retaining ring.

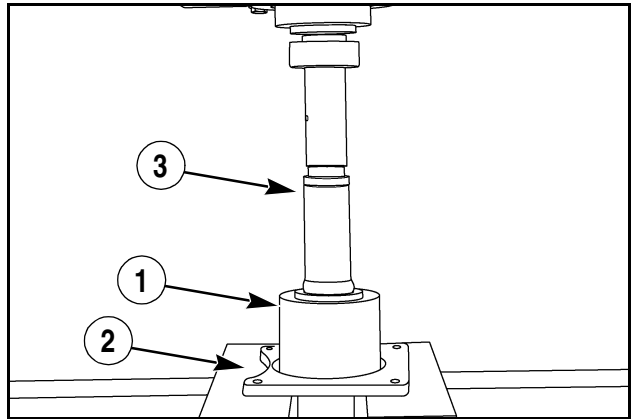


RD05B037

## STEP 52

Back press the bearing cone against the shims, spacer and retaining ring. Back pressing is accomplished by supporting the bearing cage (1) on the rear flange face (2) and pressing down against the front of the shaft (3) where the internal spline is.

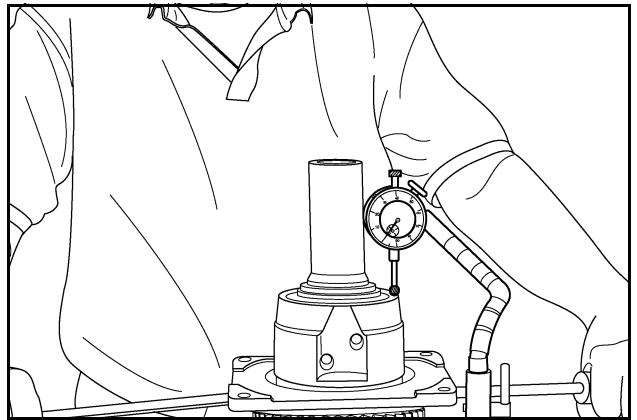
**NOTE:** *DO NOT overpress or deflection of the spacer and retaining ring will occur. This will affect the shimming.*



RD05B040

## STEP 53

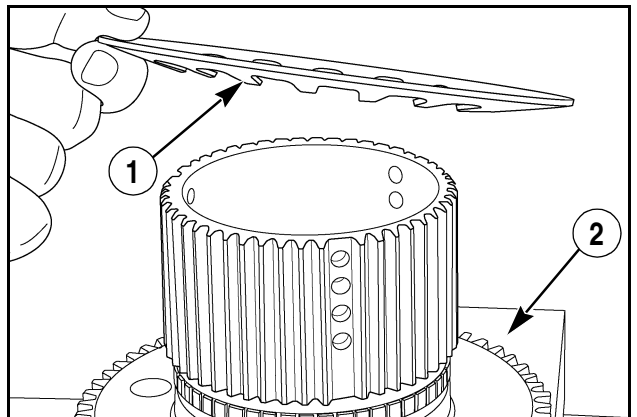
Check end play. End play should be between 0.001 to 0.005 inches. If end play is not correct, disassemble and adjust the shim pack, assemble and check end play again.



RD05D022

## STEP 54

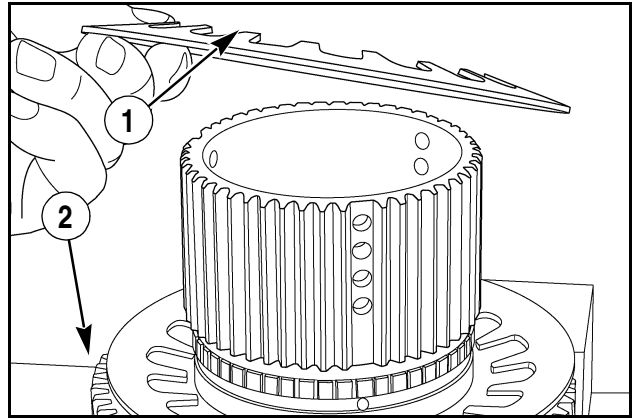
Install the first brake apply disc spring. Make sure spring fingers (1) are pointed toward the hub gear (2).



RD05N152

## STEP 55

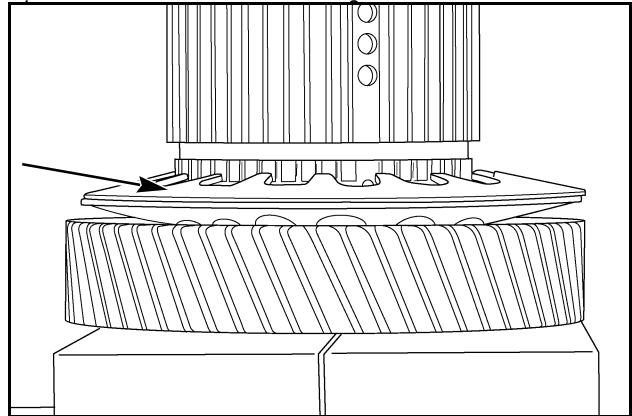
Install the second brake apply disc spring. Make sure spring fingers (1) are pointed away from the hub gear (2).



RD05N151

## STEP 56

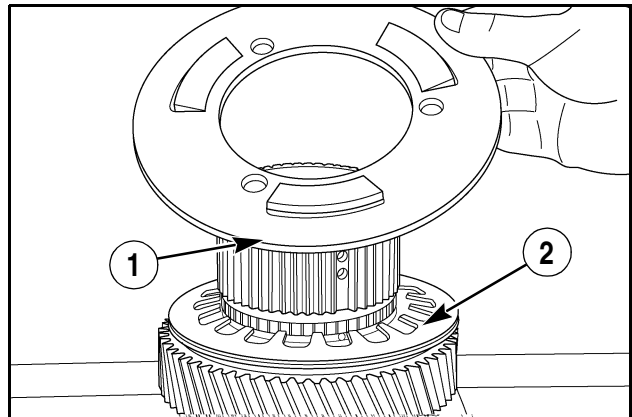
Discs should be installed as shown.



RD05N158

## STEP 57

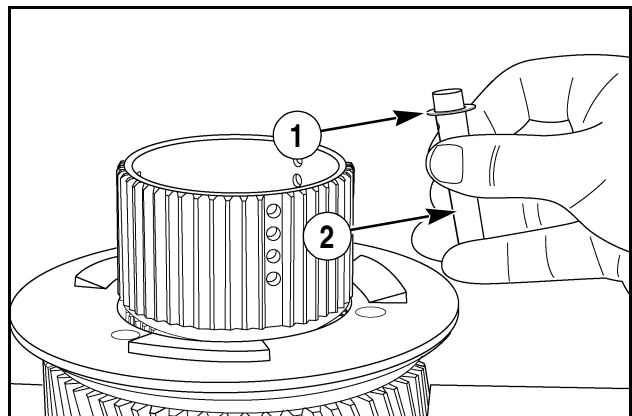
Install the first brake holder plate. Make sure the tabs (1) are pointed away from the disc spring (2).



RD05N150

## STEP 58

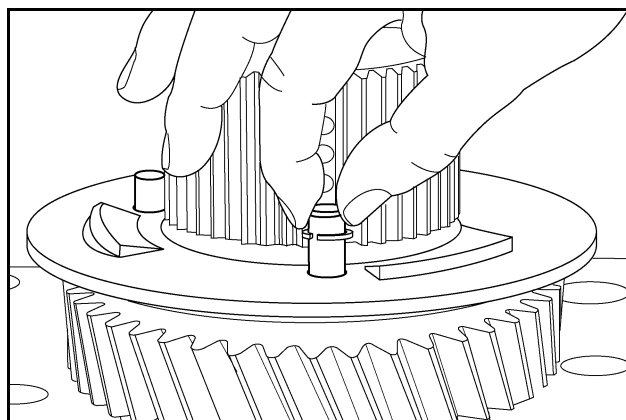
Set the retainer ring (1) on the brake adjuster pin (2) so that it is approximately 1/2 inch from the end of the pin. Repeat with the other pins.



RD05N155

## STEP 59

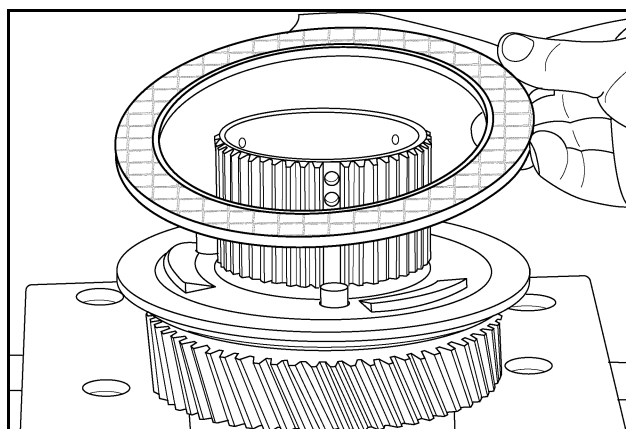
Install the three adjusting pins.



RD05N149

## STEP 60

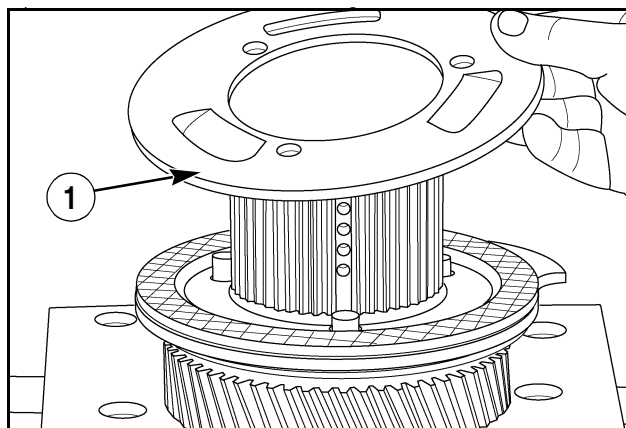
Install the brake friction plate.



RD05N148

## STEP 61

Install the second brake holder plate with the tabs (1) facing down. Align the holes in the plate with the brake adjuster pins. Make sure the tabs on the second plate are NOT aligned with the tabs of the first plate.



RD05N147

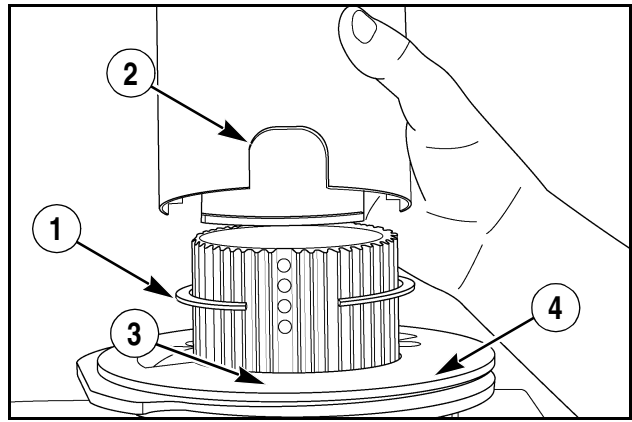


**STEP 62**

Place the retaining ring (1) over the clutch pack hub. Using Special Tool 380002454, compress the brake holder plates until the retaining ring is fully seated into the groove.

**NOTE:** Make sure the cutouts (2) of the tool are NOT over the brake adjuster pins (3). Tool has to push the brake adjuster pins flush with the holder plate (4) to allow the retaining ring to seat into the groove.

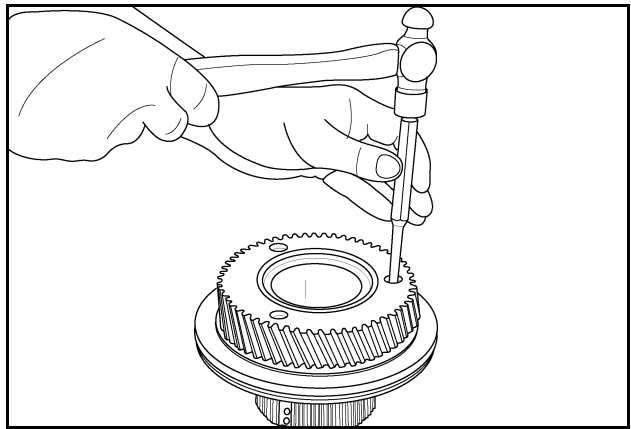
**IMPORTANT:** Before removing the compression tool, make sure the retaining ring is fully seated into the ring groove and is not touching the adjuster pins.



RD05D016

**STEP 63**

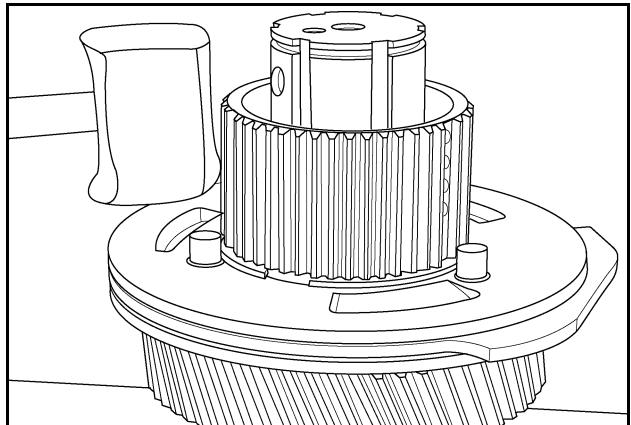
Turn the hub over and GENTLY tap the brake adjuster pin as shown. If pin does not move, the retaining ring will be set into the pin groove.



RD05D018

**STEP 64**

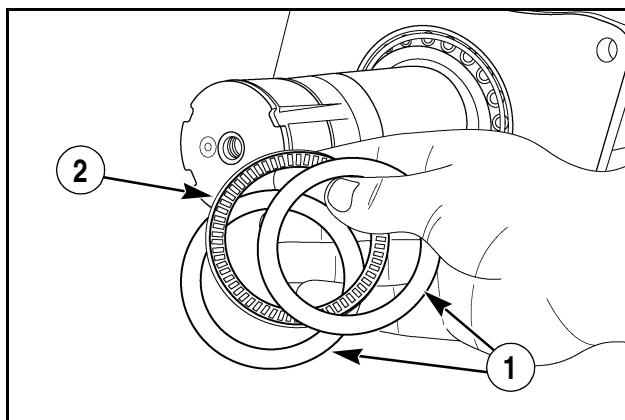
If needed, turn the assembly over and gently drive brake adjuster pins down until the retaining ring is locked into the groove on the pin.



RD05N156

### STEP 65

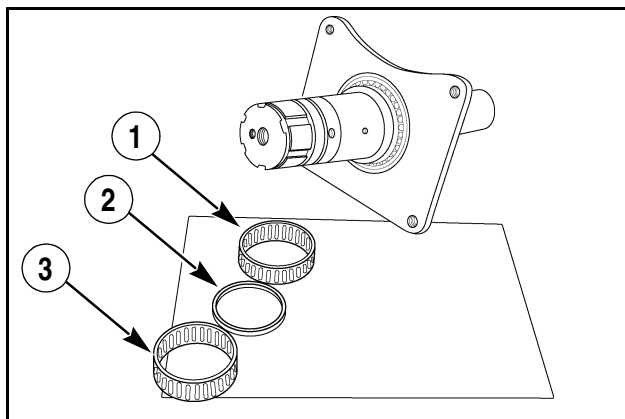
Install thrust washer (1), bearing (2) and thrust washer (1).



RD05B034

### STEP 66

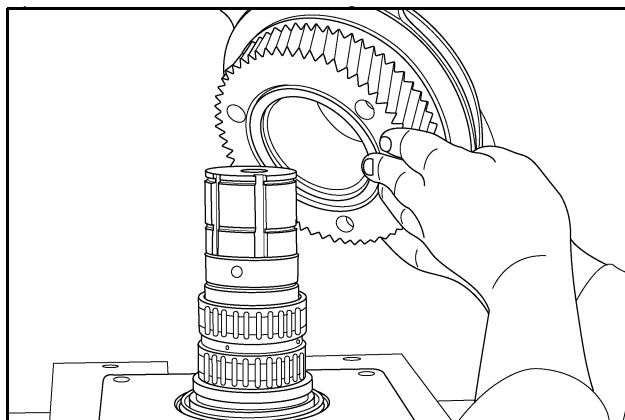
Install needle bearing (1), bearing spacer (2) and needle bearing (3).



RD05B033

### STEP 67

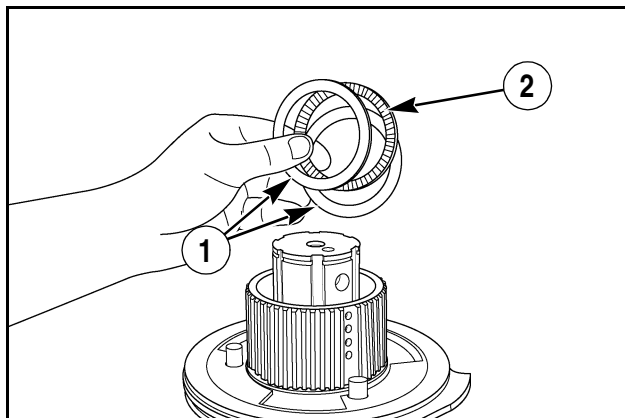
Place the gear /hub assembly over the shaft.



RD05B032

### STEP 68

Install a thrust washer (1), bearing (2) and thrust washer (1).

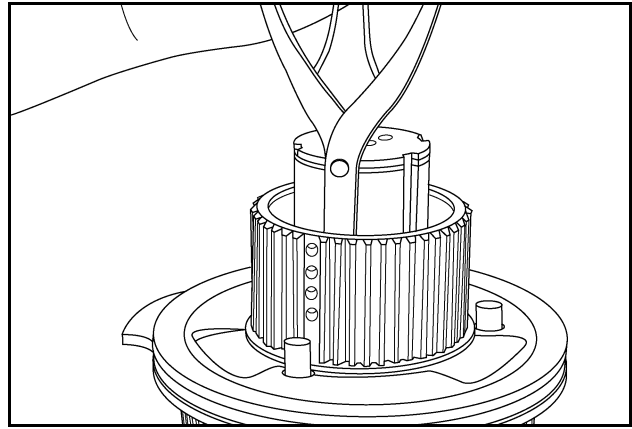


RD05N145

## STEP 69

Install the first retaining ring.

**NOTE:** *There should be three retaining ring grooves left after installing this retaining ring.*

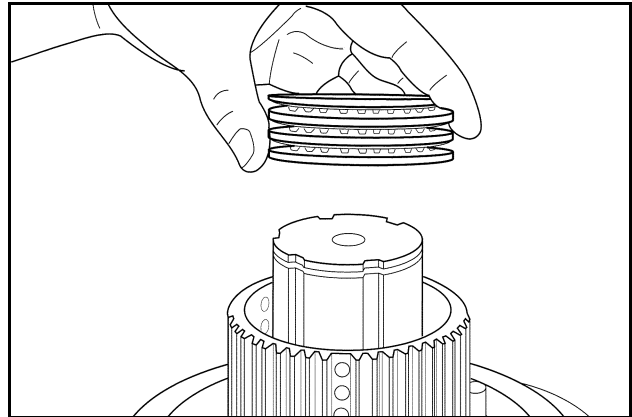


RD05N142

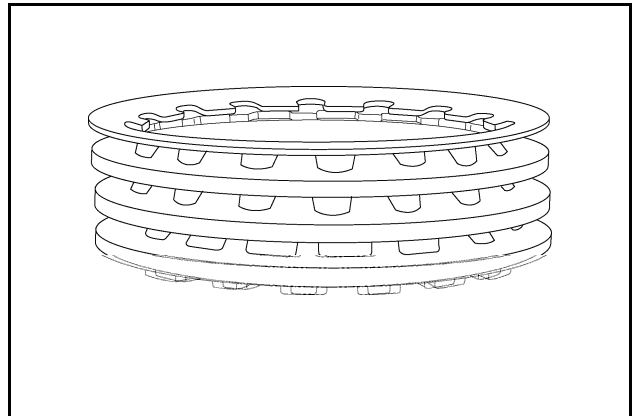
## STEP 70

Install the second retaining ring. Install the seven Belleville washers.

**NOTE:** *When installing the Belleville washers, make sure they are orientated as shown below.*



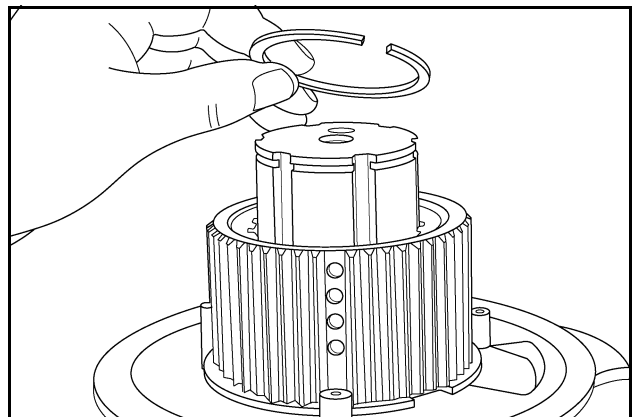
RD05N143



RD05N157

## STEP 71

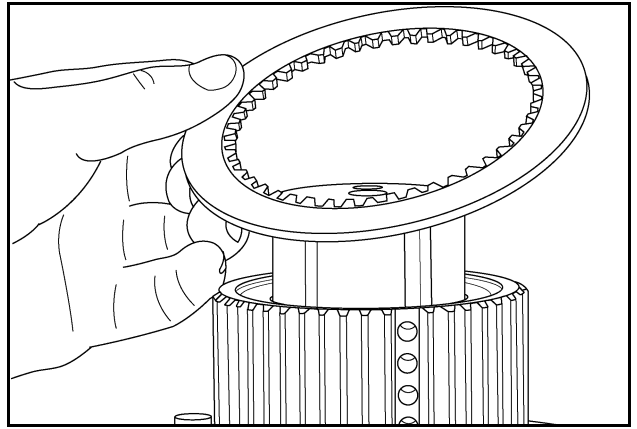
Install the Belleville washer retaining ring.



RD05N144

## STEP 72

Install the brake pusher plate.

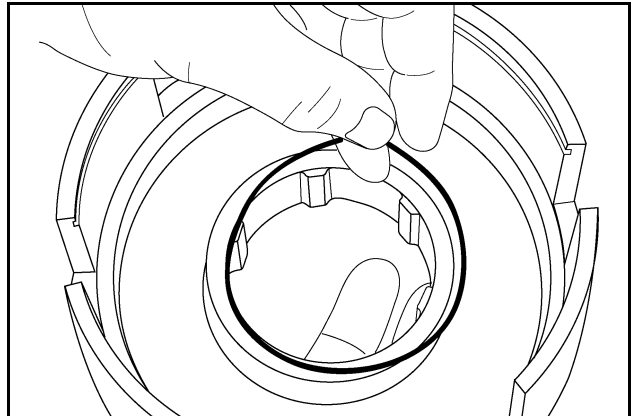


RD05N141

## STEP 73

Apply petroleum jelly to the carrier seal groove. Apply petroleum jelly to a new O-ring and install.

**NOTE:** Make sure the O-ring is not twisted when installed.

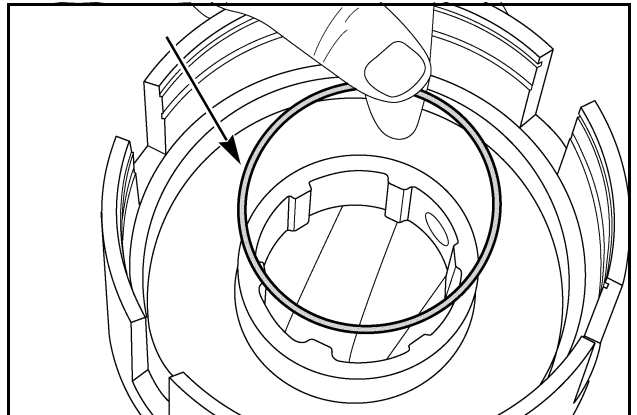


RD05B028

## STEP 74

Apply petroleum jelly and install a new seal and install the seal ring.

**IMPORTANT:** DO NOT stretch new seal any more than required.

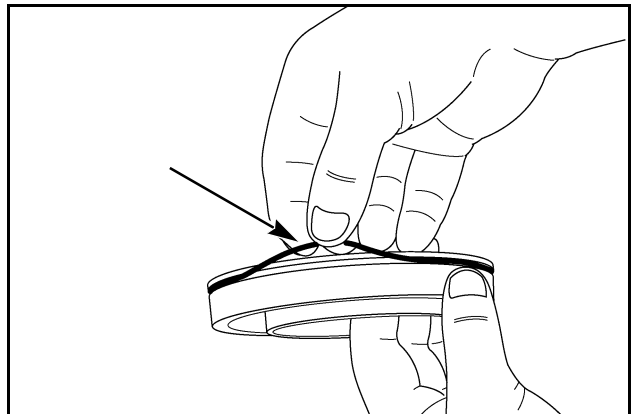


RD05B029

## STEP 75

Apply petroleum jelly to a new O-ring and install on the piston.

**NOTE:** Make sure the O-ring is not twisted when installed.

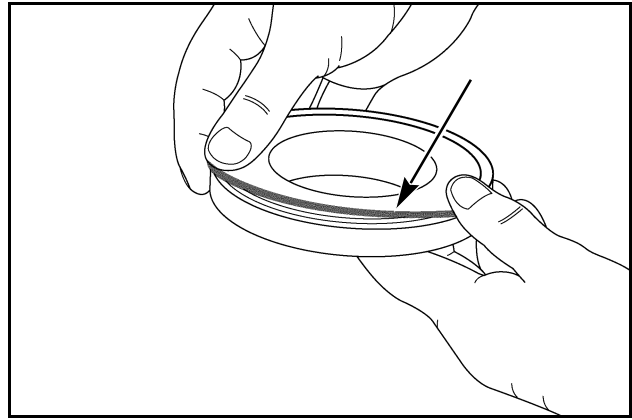


RD05A032

## STEP 76

Apply petroleum jelly to a new seal and install.

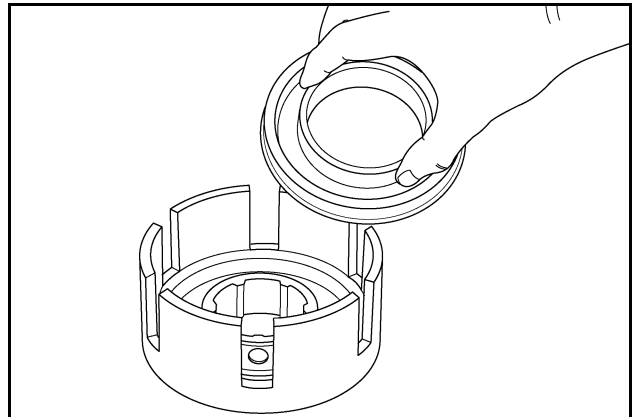
**IMPORTANT:** *DO NOT stretch new seal any more than required.*



RD05A033

## STEP 77

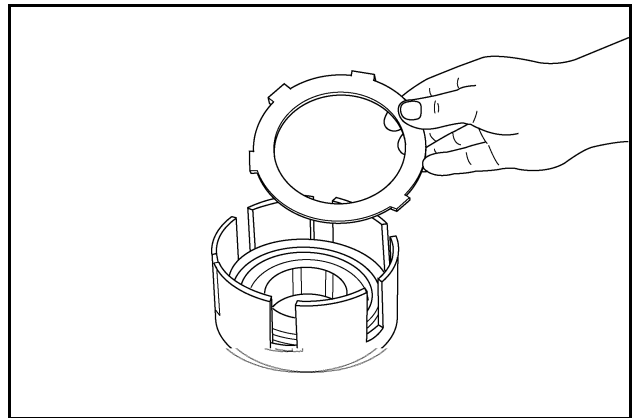
Making sure all sealing surfaces are well-lubed, install the piston into the clutch carrier.



RD05A028

## STEP 78

Install the first separator plate.



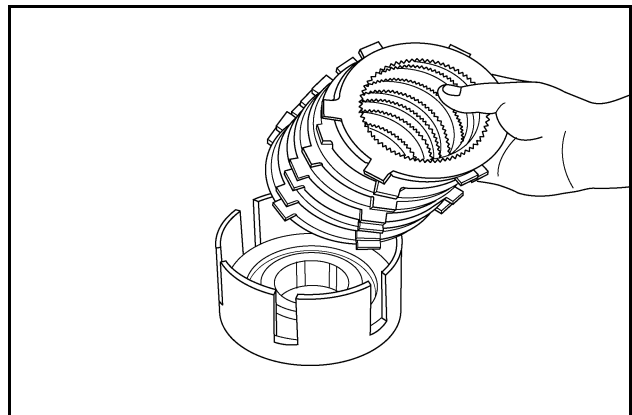
RD05A026

## STEP 79

Alternate the friction plates and separator plates as shown. Starting with a friction plate, install the eight friction plates and seven separator plates.

**NOTE:** *Friction and separator plates come as complete sets.*

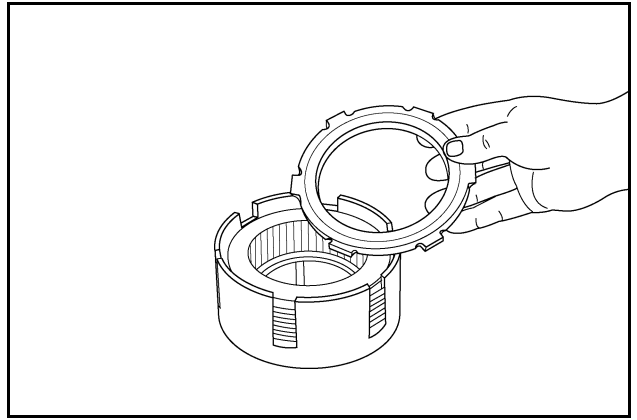
**NOTE:** *Dip all friction plates in CLEAN transmission fluid before assembly.*



RD05A025

## STEP 80

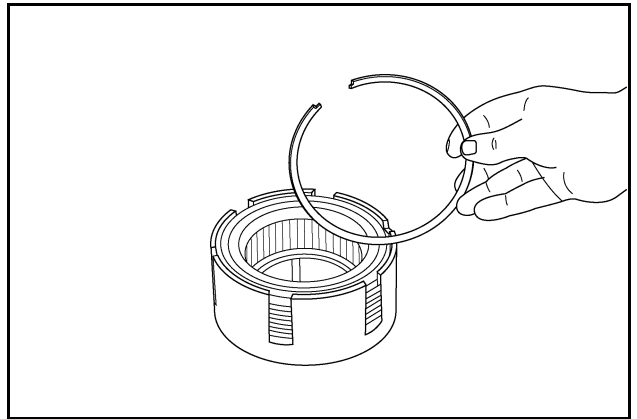
Install the clutch backing disc.



RD05A024

## STEP 81

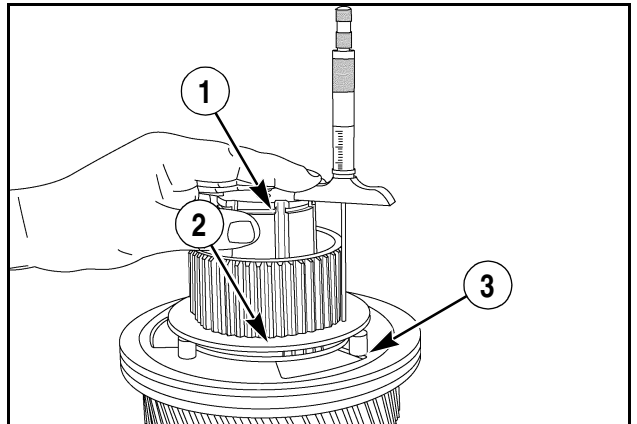
Install the snap ring.



RD05A023

## STEP 82

With a depth micrometer, measure the distance from the top of the hub (1) to the top of the pusher plate (2) at each pin (3). Average the three measurements. Record this measurements to obtain "A".

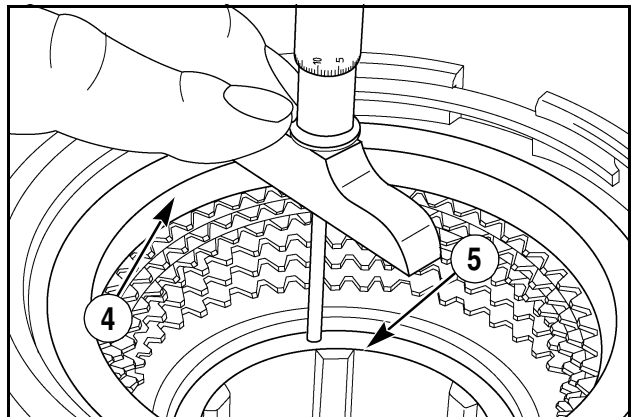


RD05N153

With a depth micrometer, measure the distance from the backing plate (4) to the top of the hub (5) at three locations. Average these measurements. Record this measurement to obtain "B".

If "A" - "B" is less than or equal to 11.235 MM, use the 3.5 MM brake pusher plate (2).

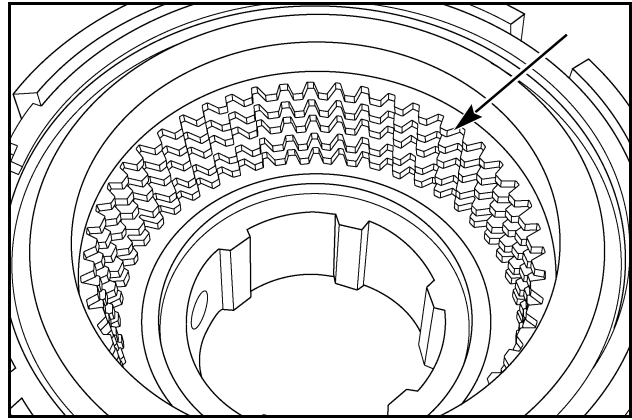
If "A" - "B" is greater than 11.235 MM, use the 3.0 MM brake pusher plate (2).



RD05N154

## STEP 83

Align the teeth of the friction plates as shown.



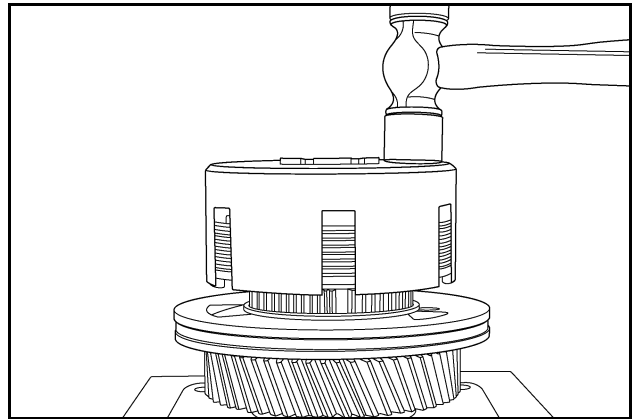
RD05B027

## STEP 84

Place the clutch pack assembly over the hub, making sure all friction plate teeth are engaged in the splines.

**NOTE:** *It may be necessary to rotate and LIGHTLY tap the end of the clutch carrier to align the friction brake teeth with the splines.*

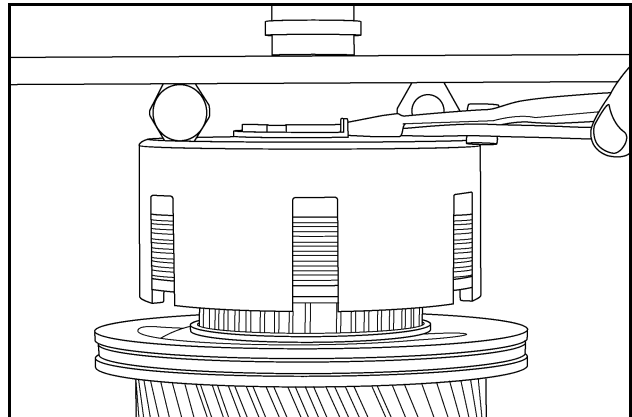
**IMPORTANT:** *BE SURE not to break any friction brake teeth during installation.*



RD05D024

## STEP 85

Press down on the clutch carrier and install the snap ring.

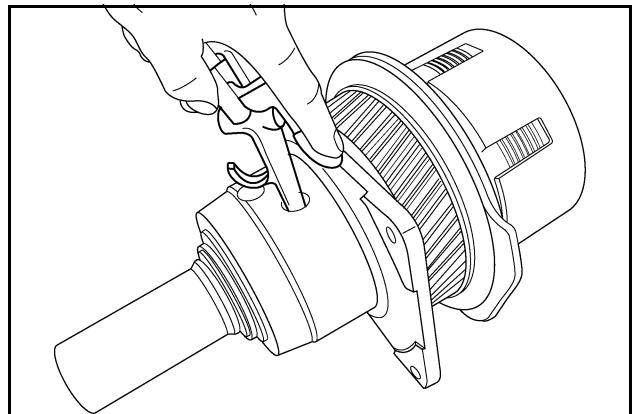


RD05A019

## STEP 86

Air test the piston pressure port for seal ring leakage.

**NOTE:** *Some air leakage will occur. If leakage is excessive, sealing ring may have been damaged during assembly and will need to be replaced.*

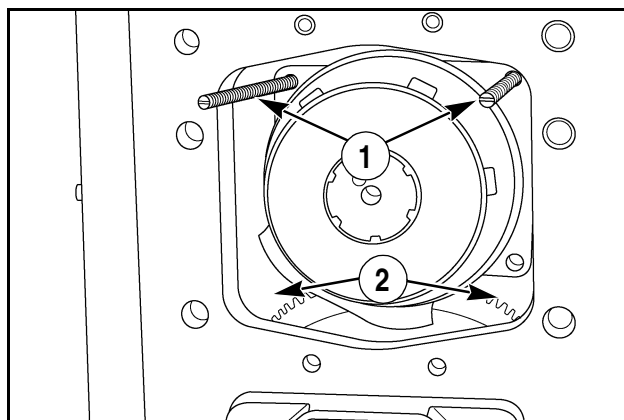


RD05D025

## STEP 87

Place the clutch assembly on the CAS-1995-6 guide pins (1) and slide into place. Install the two lower mounting bolts (2).

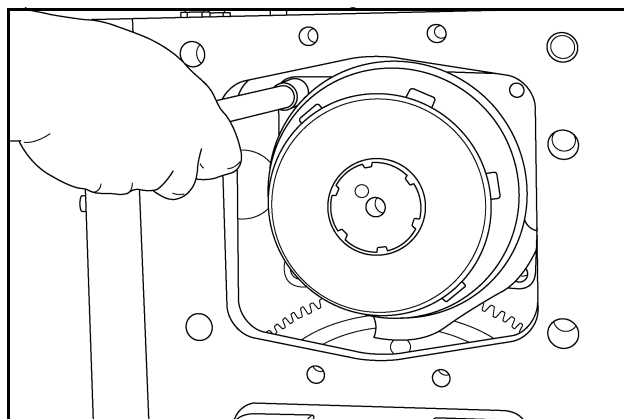
**NOTE:** *Clutch assembly may have to be rotated slightly to align the splines of the clutch drive shaft with the countershaft.*



RD05A047

## STEP 88

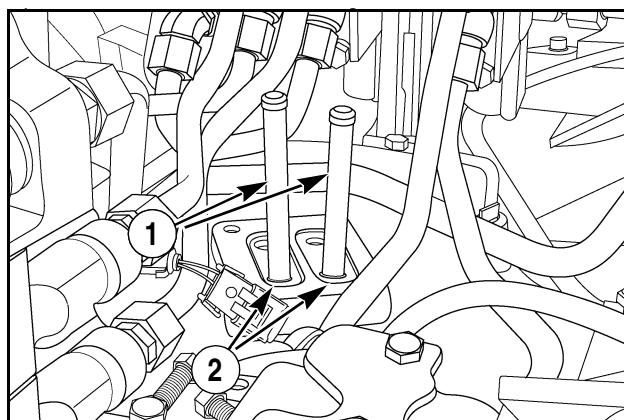
Remove the guide pins and install the two upper mounting bolts.



RD05A046

## STEP 89

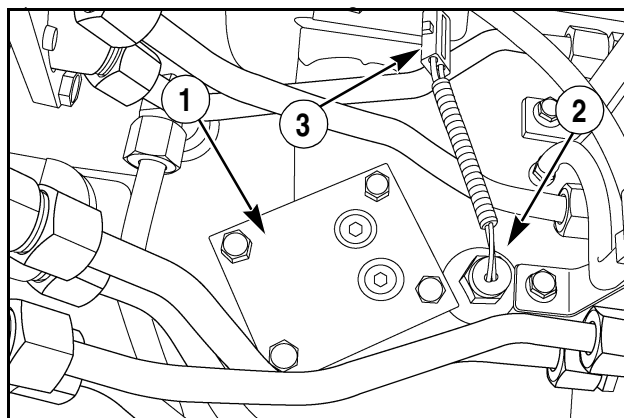
Install new O-rings on both ends of the jumper tubes (1) and push into place. Install new O-ring seals (2).



RD05A012

## STEP 90

Install the PTO manifold plate (1) and speed sensor (2). Reconnect the speed sensor wire harness (3).

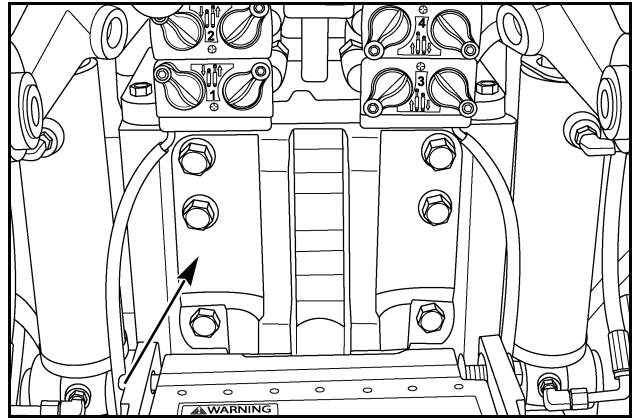


RD05A011



## STEP 91

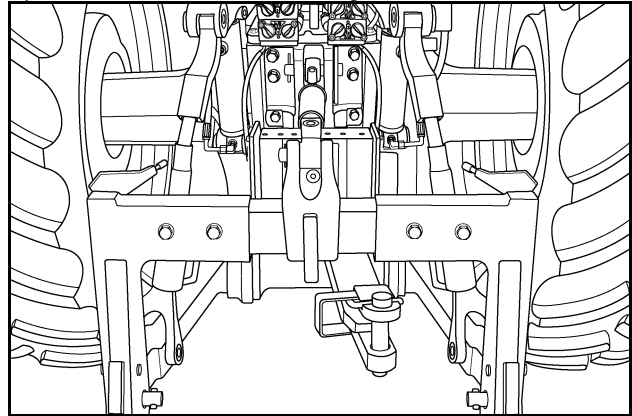
Install the third link support/PTO clutch cover plate with a new gasket.



RD05A014

## STEP 92

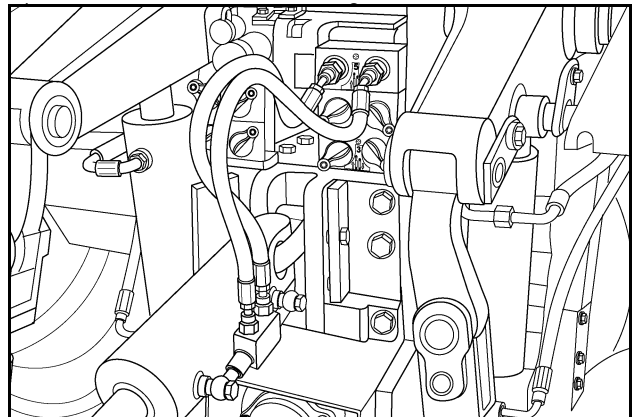
If equipped, install the quick coupler.



RD05A013

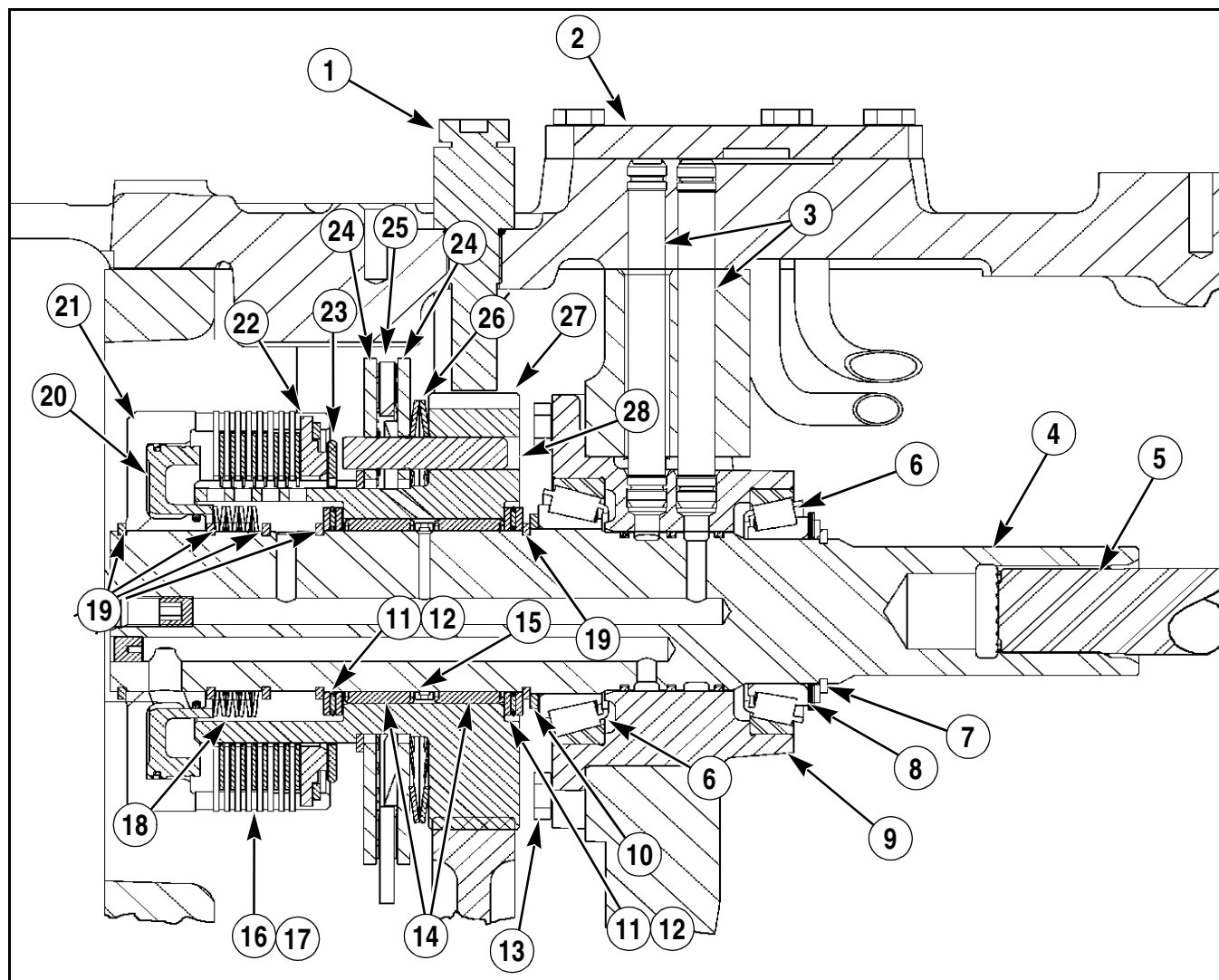
## STEP 93

If equipped with a hydraulic cylinder-assisted third link, note the position of the hoses and install into the quick couplers.



RD05A017

## Cross Section of PTO Clutch and Output Shaft Assembly



RI05C001

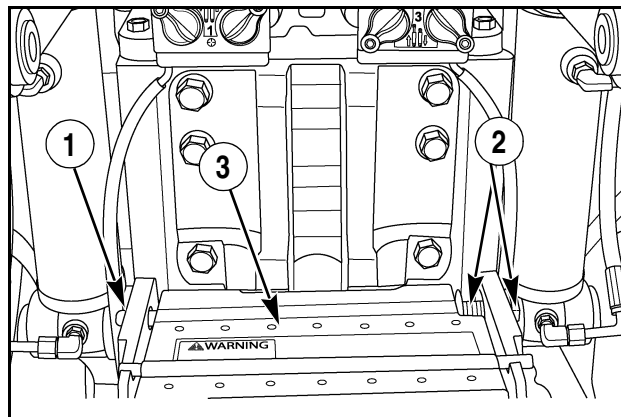
- |                                 |                                 |                                 |
|---------------------------------|---------------------------------|---------------------------------|
| 1. SPEED SENSOR                 | 11. NEEDLE BRG THRUST WASHER    | 21. CLUTCH CARRIER              |
| 2. PTO MANIFOLD PLATE           | 12. NEEDLE THRUST BEARING       | 22. CLUTCH BAKING DISC          |
| 3. PTO JUMPER TUBE              | 13. BOLT M10 X 30 CL 10.9       | 23. BRAKE PUSHER DISC           |
| 4. PTO DRIVE SHAFT ASSEMBLY     | 14. NEEDLE BEARING              | 24. PTO BRAKE HOLDER PLATE      |
| 5. PTO INTERMEDIATE DRIVE SHAFT | 15. NEEDLE BEARING SUPPORT RING | 25. PTO BRAKE FRICTION PLATE    |
| 6. TAPPER ROLLER BEARING / CONE | 16. MFD CLUTCH SEPERATOR DISC   | 26. BRAKE APPLY DISC SPRING     |
| 7. COUNTERSHAFT RETAINER RING   | 17. MFD CLUTCH FRICTION DISC    | 27. PTO DRIVE GEAR              |
| 8. SHIM PACK                    | 18. BELLEVILLE WASHER           | 28. BRAKE ADJUSTER PIN ASSEMBLY |
| 9. PTO DRIVE GEAR BEARING CAGE  | 19. RETAINER RING               |                                 |
| 10. MFD CLUTCH BEARING SPACER   | 20. PISTON                      |                                 |

## SINGLE SPEED REVERSIBLE SHAFT PTO

### Disassembly

#### STEP 94

Remove cotter pin and washer (1). Remove pivot rod, washers and spring (2). Remove the PTO top shield (3).

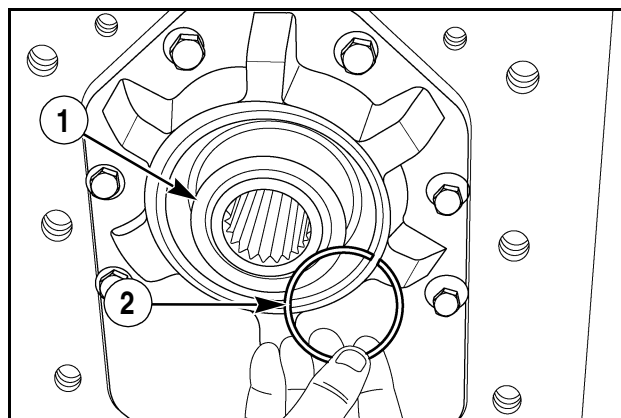


RD05A014

#### STEP 95

Push quick disconnect coupler (1) to expose the locking ring (2) and remove the ring.

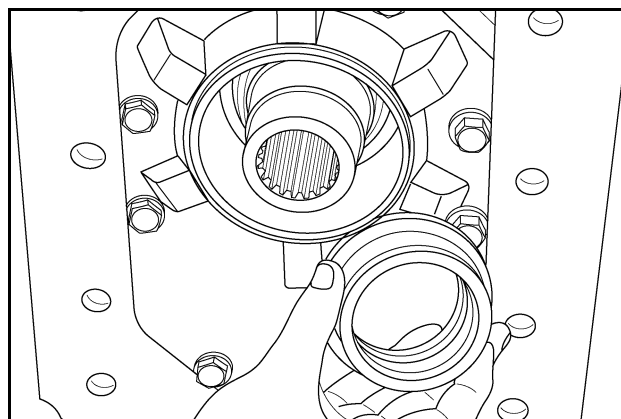
**NOTE:** Hitch components and draw bar rear support are removed for photographic purposes.



RD05B016

#### STEP 96

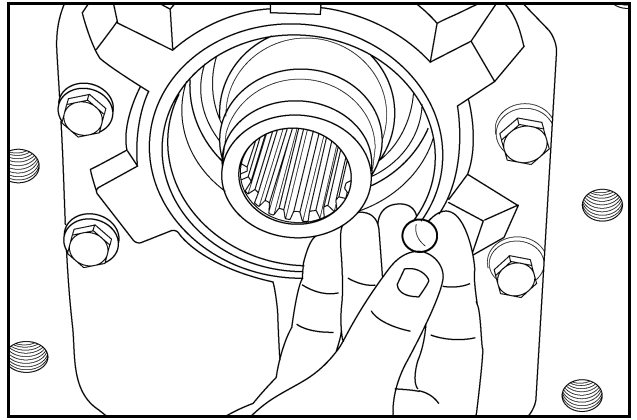
Remove the coupler.



RD05B015

### STEP 97

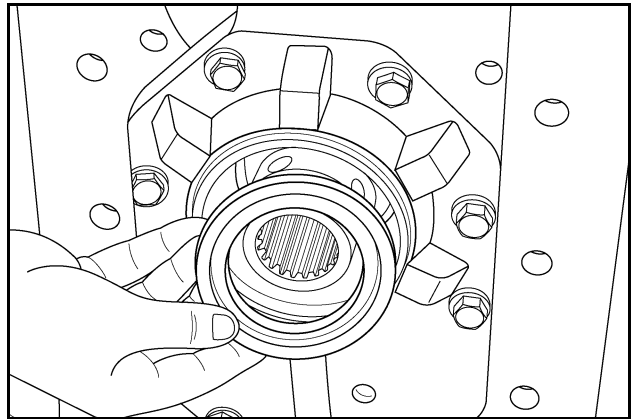
Remove the four coupler retaining balls.



RD05B014

### STEP 98

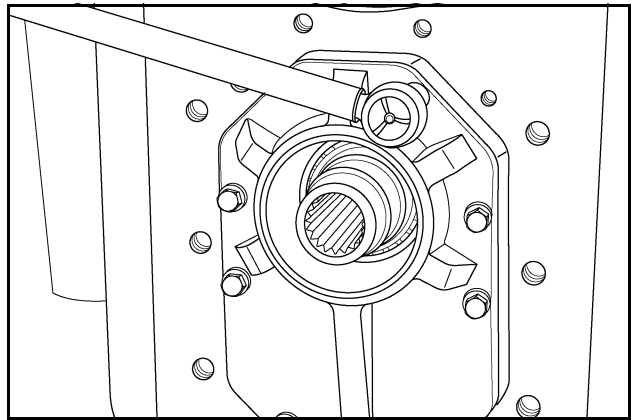
Remove the shaft seal and discard.



RD05B018

### STEP 99

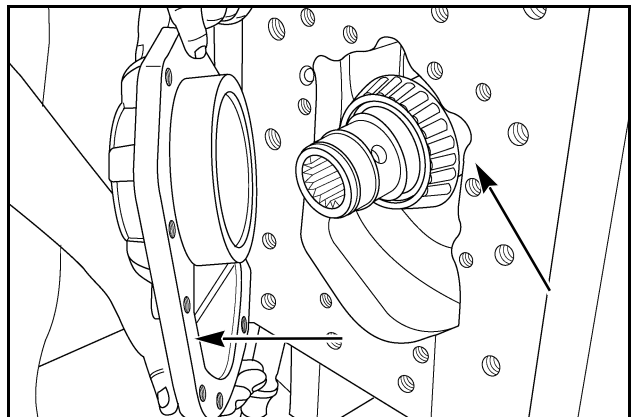
Remove the eight mounting bolts.



RD05B011

### STEP 100

Remove the housing cover. Clean both mounting surfaces.

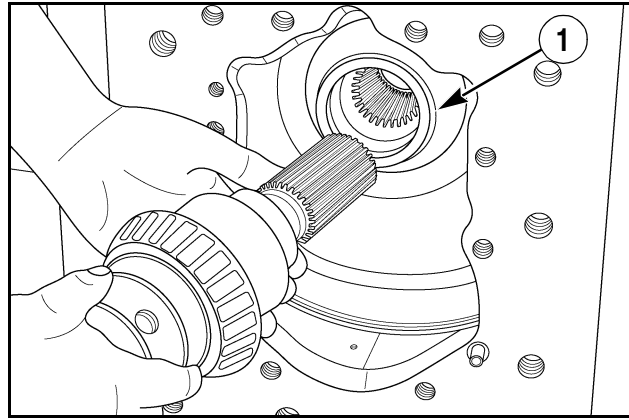


RD05A060

## STEP 101

Remove the output sleeve shaft.

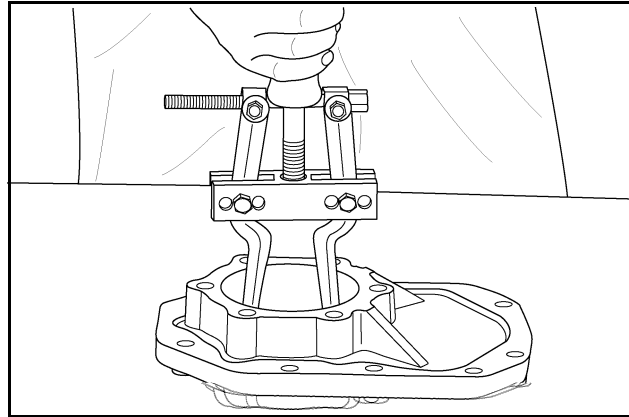
**NOTE:** If bearing and cup on the PTO driven gear (1) needs service, see *Single Speed Reversible Shaft Driven Gear Section*.



RD05A059

## STEP 102

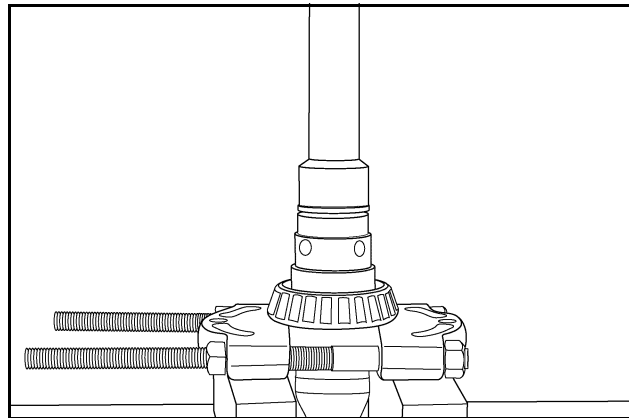
Remove the bearing cone from the housing.



83LS9

## STEP 103

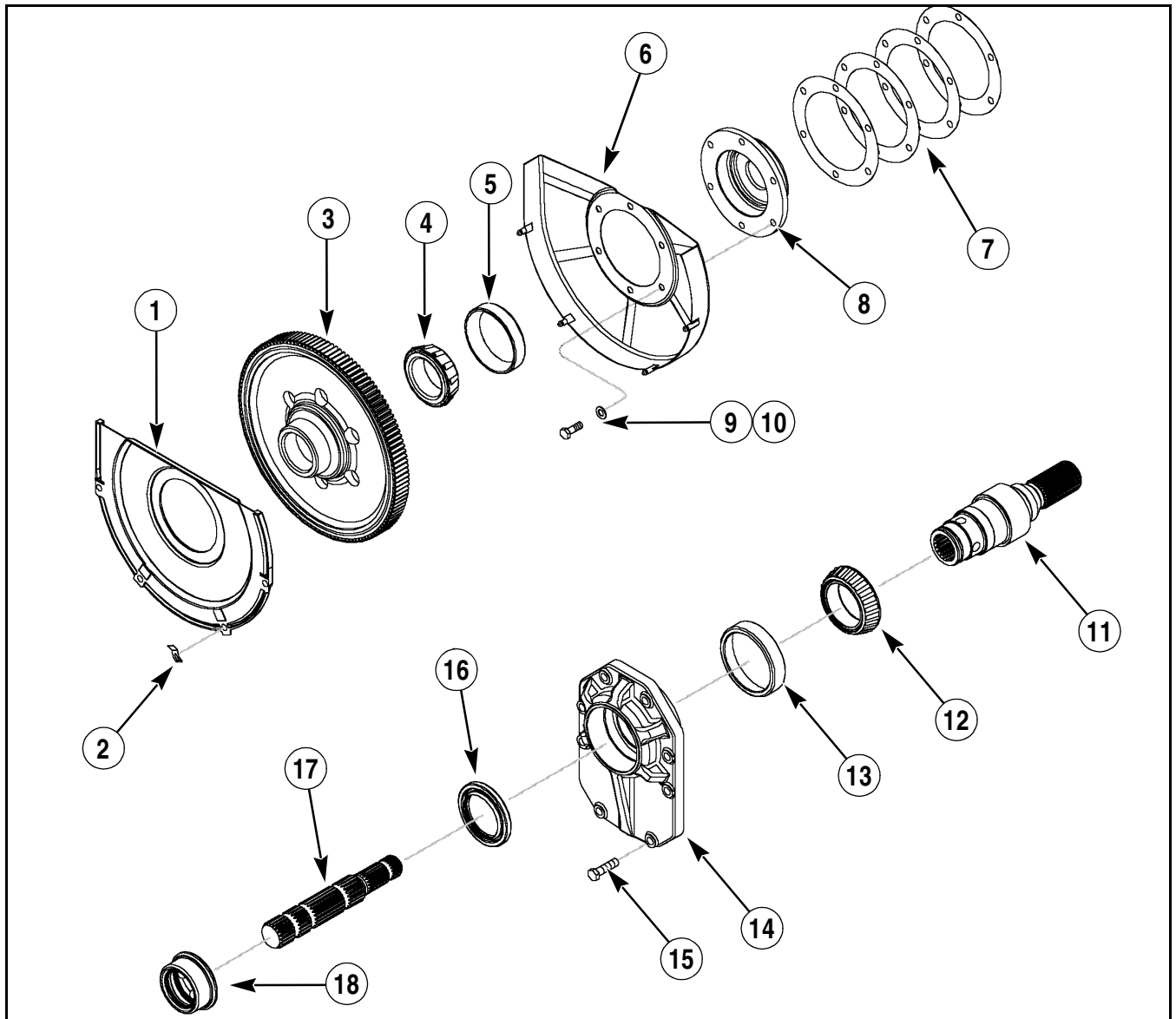
Press the bearing from the output sleeve shaft.



RD05B020

## Assembly

### Exploded View of PTO Output Shaft and Driven Gear Assembly



1. OIL SHIELD COVER
2. RETAINING CLIP
3. PTO DRIVEN GEAR
4. BEARING
5. BEARING CUP
6. OIL SHIELD

7. SHIMS
8. BEARING CAGE
9. BOLT, M10 X 30; 10.9
10. WASHER, 11 X 20 X 2MM
11. TRANSMISSION SLEEVE
12. BEARING

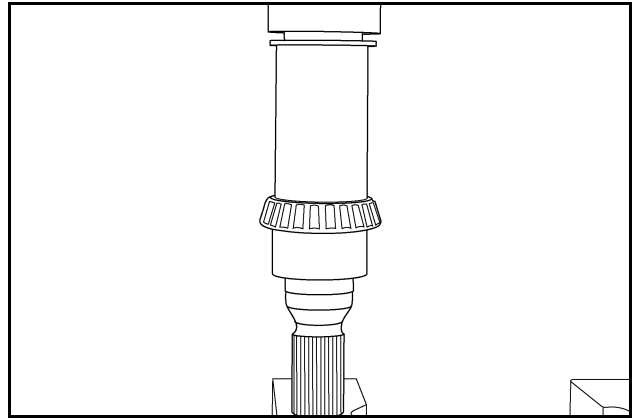
13. BEARING CONE
14. COVER
15. BOLT
16. OIL SEAL
17. REVERSIBLE OUTPUT SHAFT
18. QUICK COUPLER

RI05D011

## STEP 104

Press bearing onto the output sleeve shaft. Be sure the bearing is fully seated.

**IMPORTANT:** Do not press on the bearing cage as permanent damage to the bearing will occur.

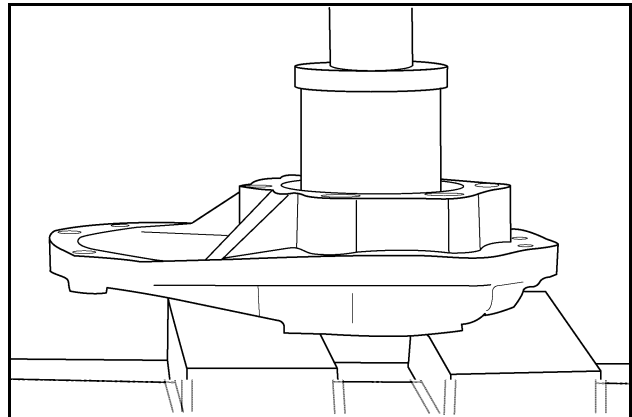


RD05B022

## STEP 105

Press bearing cone into housing. Be sure cone is fully seated.

**IMPORTANT:** Before final reassembly, the rolling torque needs to be checked. See Reversible PTO Output Shaft Bearing Adjustment Section.

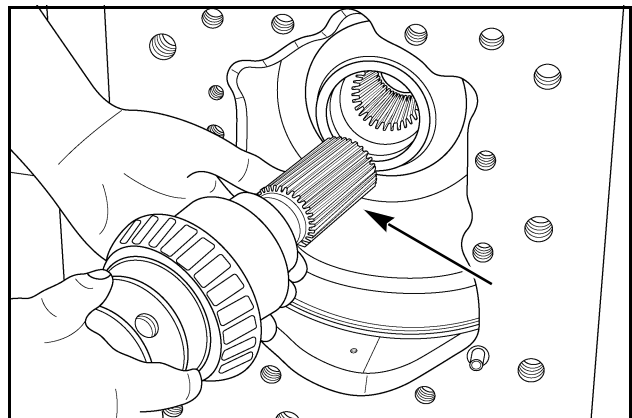


83LS3

## STEP 106

Apply grease to the splines and install the output shaft sleeve.

**IMPORTANT:** USE ONLY Multi-Purpose #2 Lithium Grease Grade 251H EP.

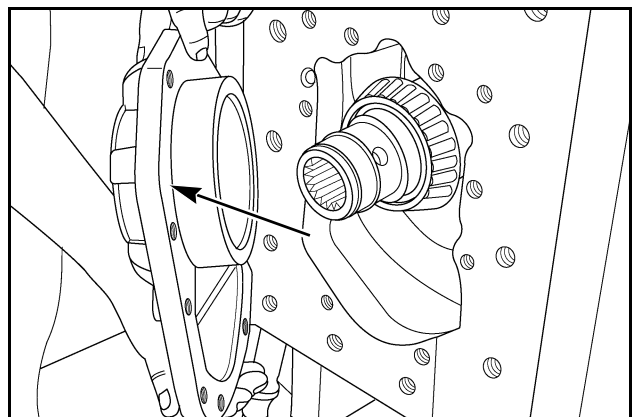


RD05A059

## STEP 107

Place a bead of Loctite® 515 around the sealing surface of the housing cover.

**NOTE:** Make sure the Loctite® is applied around each bolt hole.

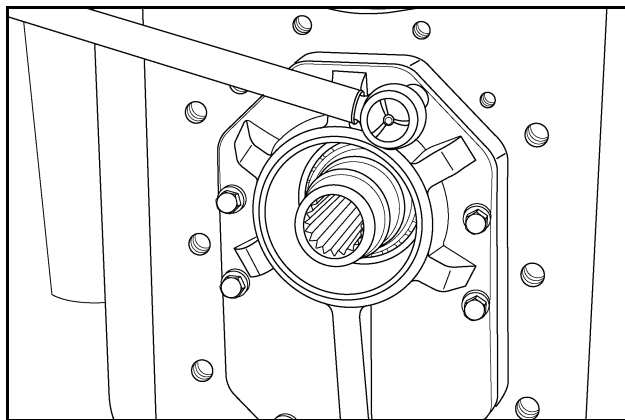


RD05A060

## STEP 108

Install the eight mounting bolts and torque to 95 Nm (70 lb. ft.).

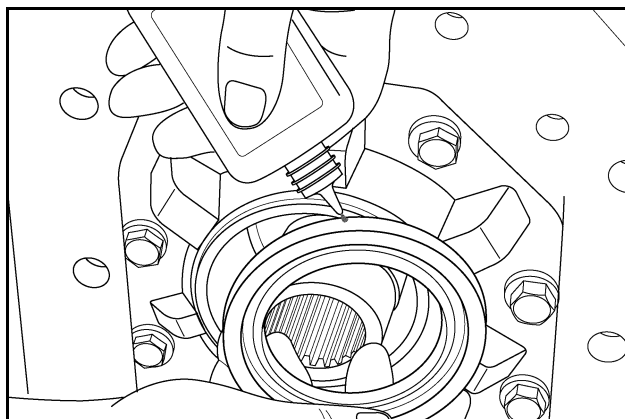
**IMPORTANT:** Before installing the seal, check the rolling torque of the output shaft. See Reversible PTO Output Shaft Bearing Adjustment Section.



RD05B011

## STEP 109

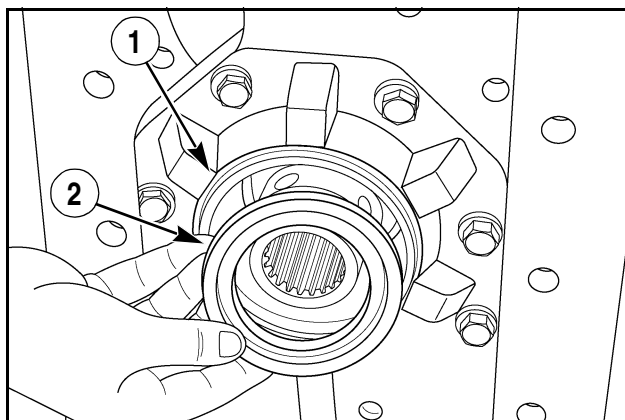
Apply Loctite® 721 to the O.D. of the seal and seal bore.



RD05B017

## STEP 110

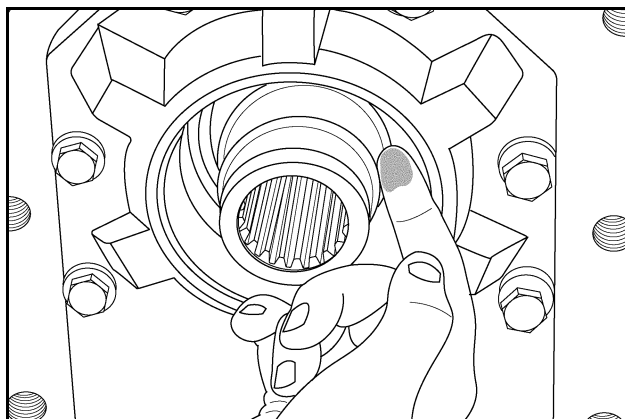
Press the seal in until the face of the seal (1) is 41 MM from the outer face of the housing (2).



RD05B018

## STEP 111

Place petroleum jelly or grease in each coupler retainer ball hole.

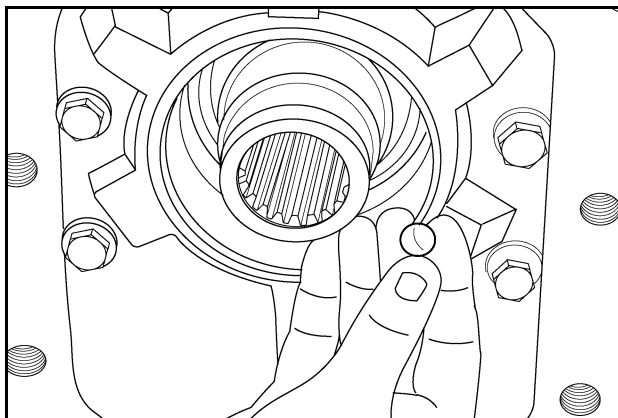


RD05B013



## STEP 112

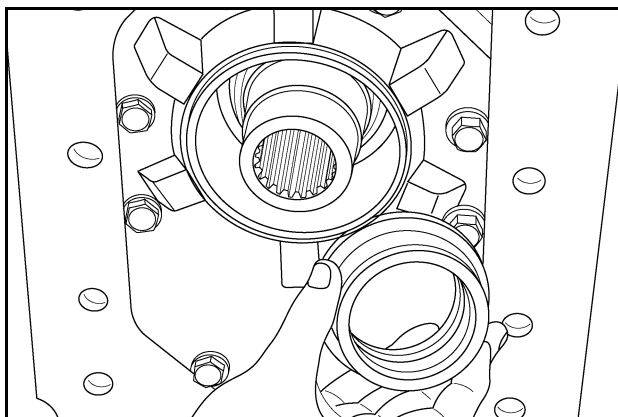
Install a ball in each of the four holes.



RD05B014

## STEP 113

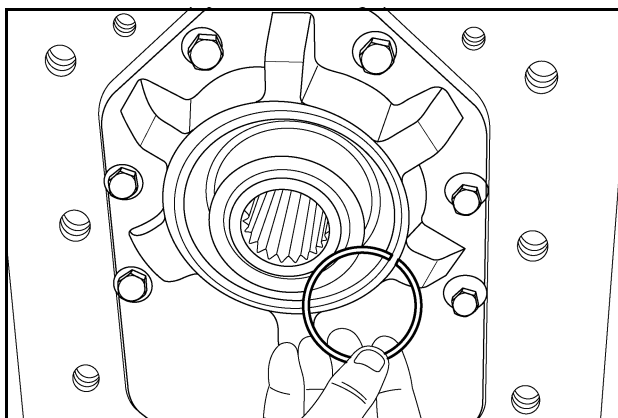
Slide the coupler over the shaft.



RD05B015

## STEP 114

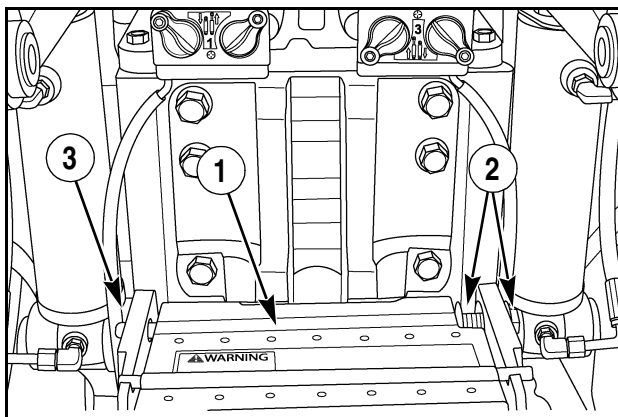
Push the coupler inward to expose the ring groove and install the locking ring.



RD05B016

## STEP 115

Set the PTO top cover (1) in place, install the pivot rod with washers and spring (2). Install the final washer with a new cotter pin (3).



RD05A014

## SINGLE SPEED REVERSIBLE SHAFT PTO DRIVEN GEAR

### Removal

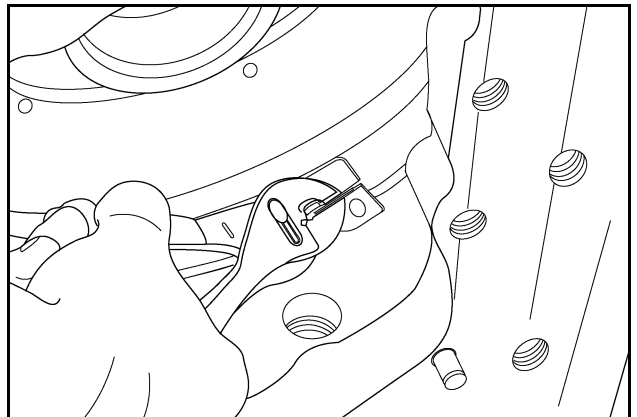
Before servicing the PTO Driven Gear, the following will be necessary:

- Remove the cab (See Cab Removal Section).
- Remove the rockshaft (See Hitch Removal Section).
- Remove the final drive top cover (See Final Drive Section).
- Remove PTO clutch assembly (See PTO Assembly Section).
- Remove PTO drive assembly (See PTO Assembly Section).

#### STEP 116

Remove the four oil shield retaining clips.

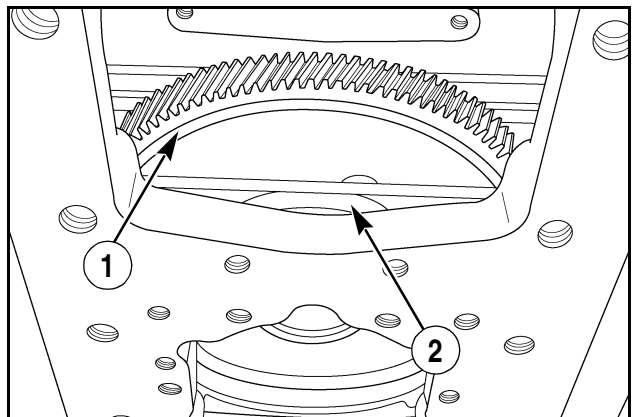
**NOTE:** Hitch components and draw bar rear support are removed for photographic purposes.



RD05B019

#### STEP 117

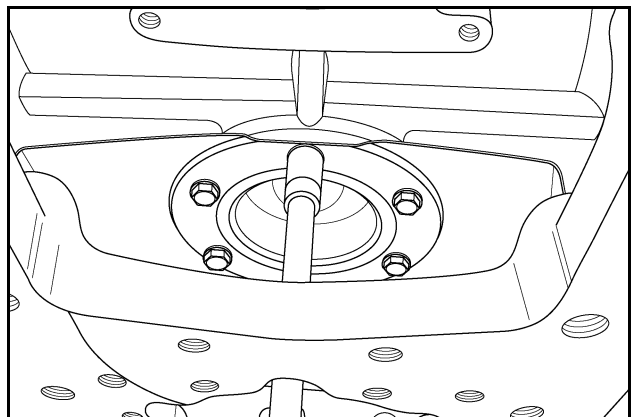
Lift the gear (1) and rear half of the shield (2) out as a unit through the top of the final drive housing.



RD05A058

#### STEP 118

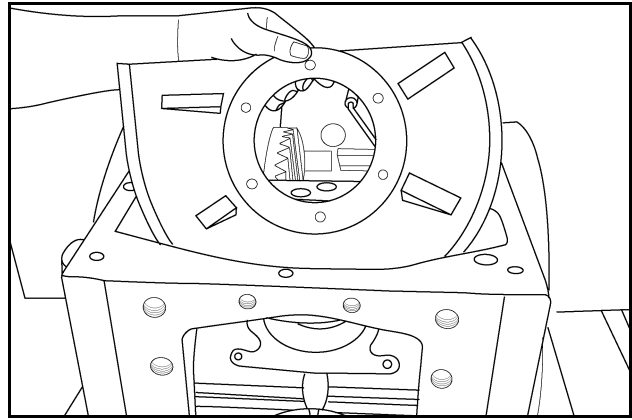
Remove the six PTO driven gear bearing cage retaining bolts.



RD05A055

### STEP 119

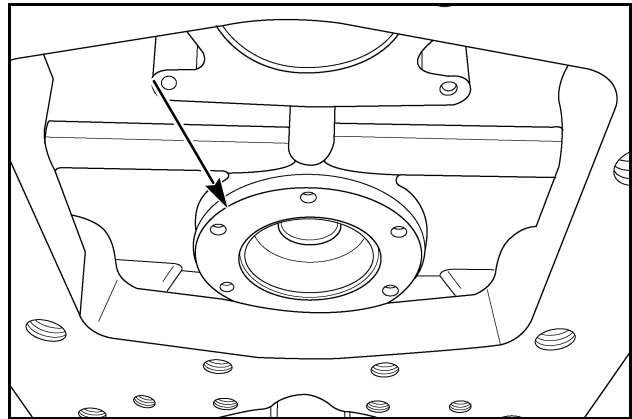
Remove the front half of the oil shield.



RD05A054

### STEP 120

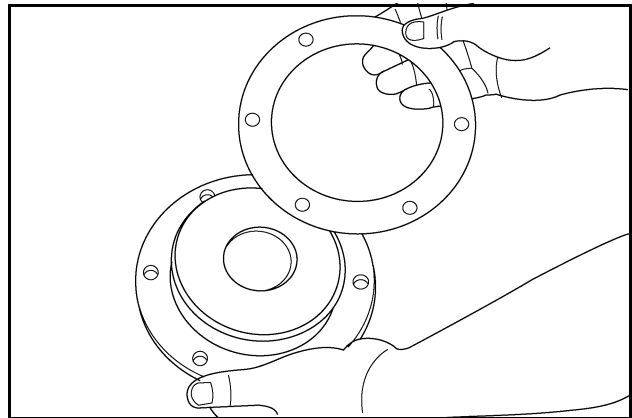
Remove bearing cage and shim pack from the housing.



RD05A053

### STEP 121

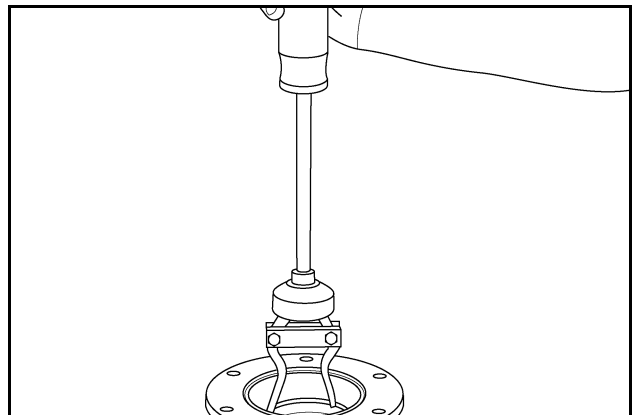
Remove the shim pack from the bearing cage. Measure the thickness of the shim pack and note for reinstallation.



RD05A052

### STEP 122

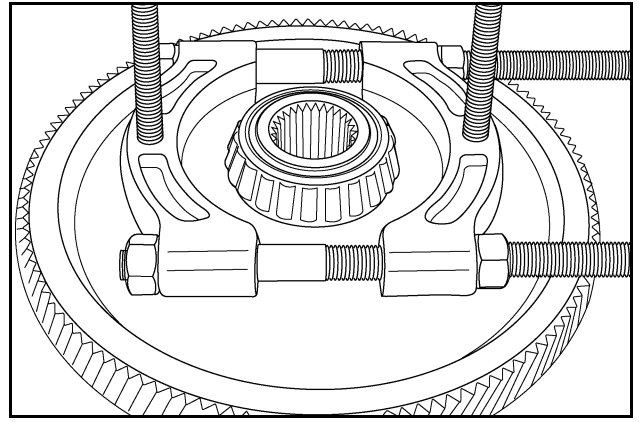
Remove the bearing cone from the bearing cage.



RD05B030

## STEP 123

Remove the bearing from the gear.



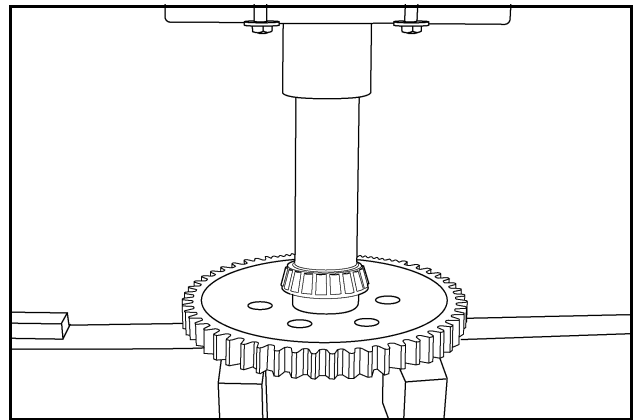
## Assembly

**NOTE:** Thoroughly clean and inspect all components and replace as necessary.

## STEP 124

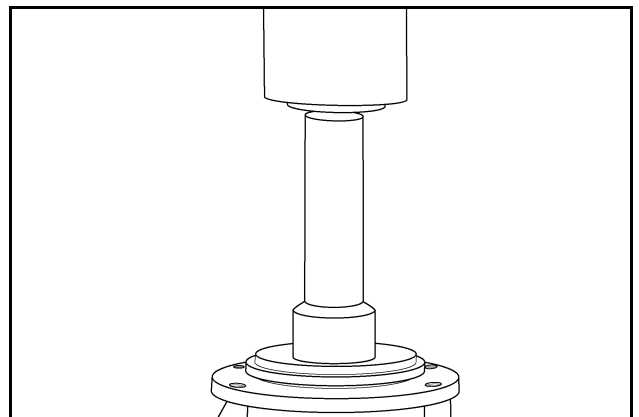
Press the bearing onto the gear, making sure it is properly seated.

**IMPORTANT:** Do not press on the bearing cage as permanent damage to the bearing will occur.



## STEP 125

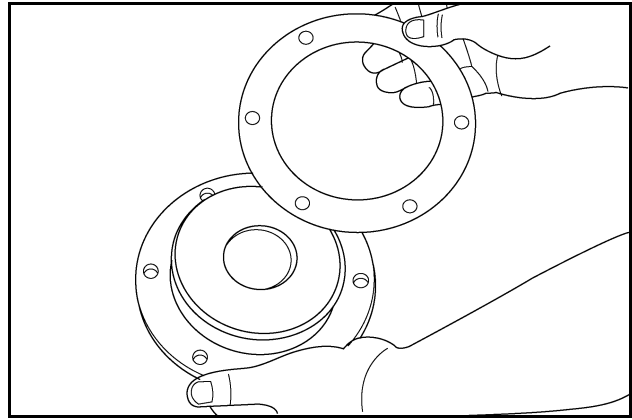
Press the bearing cone into the bearing gear cage, making sure it is properly seated.



## STEP 126

Install the original shim pack on the bearing cage.

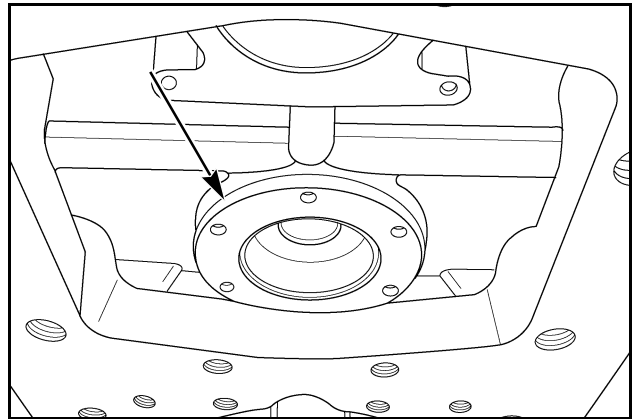
**NOTE:** *If starting with all new parts, start with a shim pack of 0.025".*



RD05A052

## STEP 127

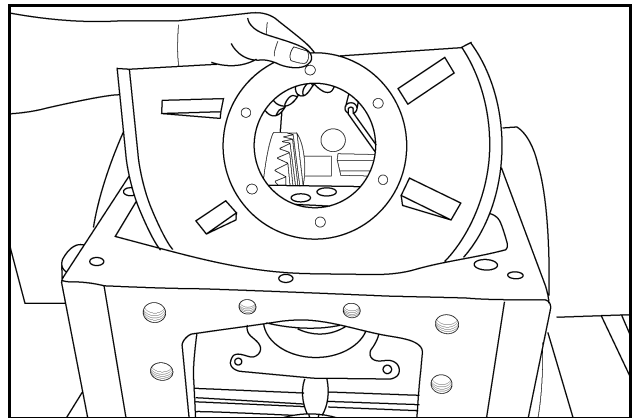
Install the bearing cage with shim pack.



RD05A053

## STEP 128

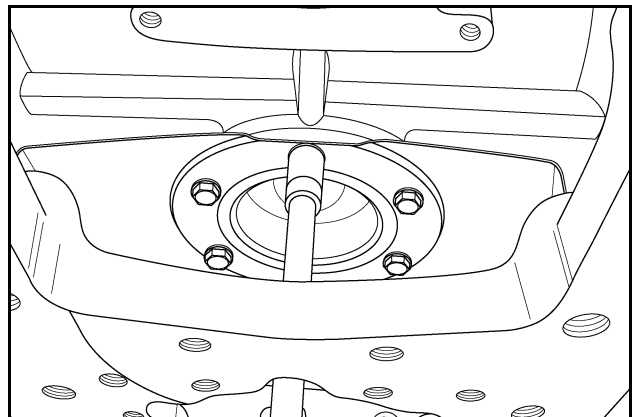
Install the front portion of the PTO oil shield.



RD05A054

## STEP 129

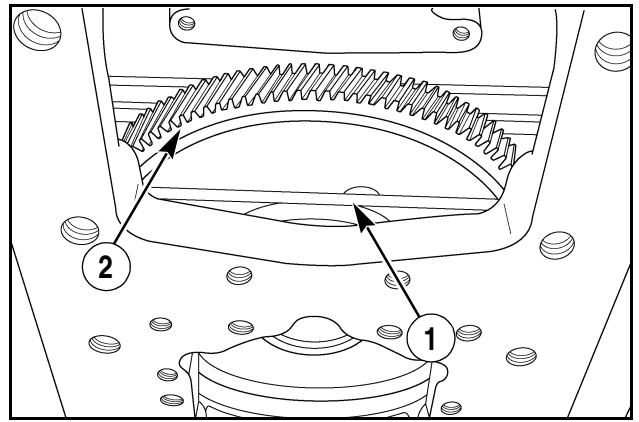
Install the six bearing carrier bolts and torque to 55 Nm (41 lb. ft.).



RD05A055

### STEP 130

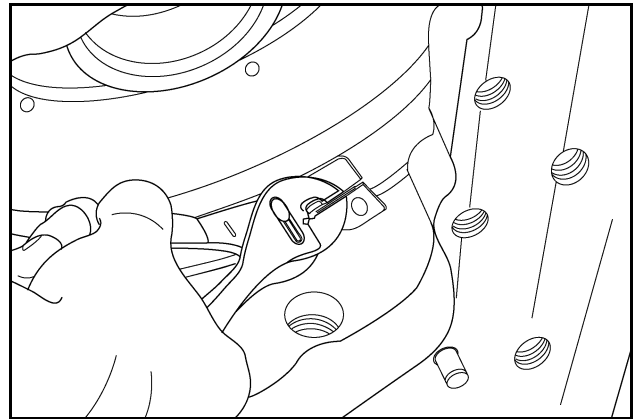
Place the rear half of the PTO oil shield (1) over the gear (2) and lower them into place.



RD05A058

### STEP 131

Install the four shield retaining clips.

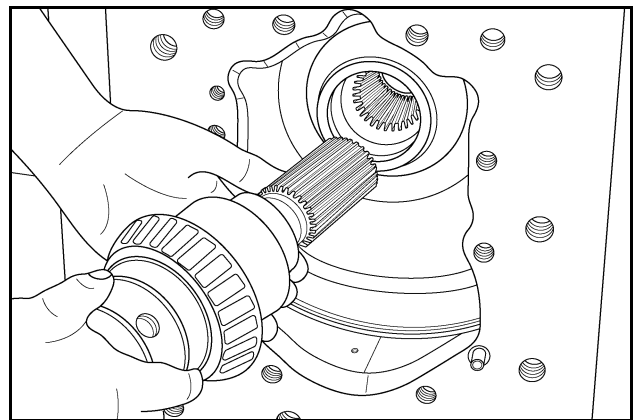


RD05B019

## Reversible PTO Output Shaft Bearing Adjustment

### STEP 132

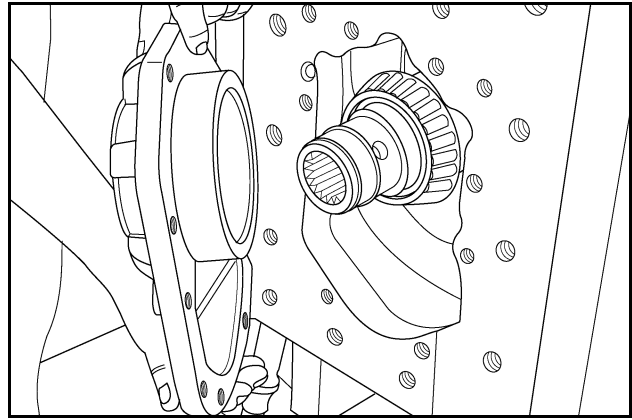
Install the output shaft sleeve.



RD05A059

## STEP 133

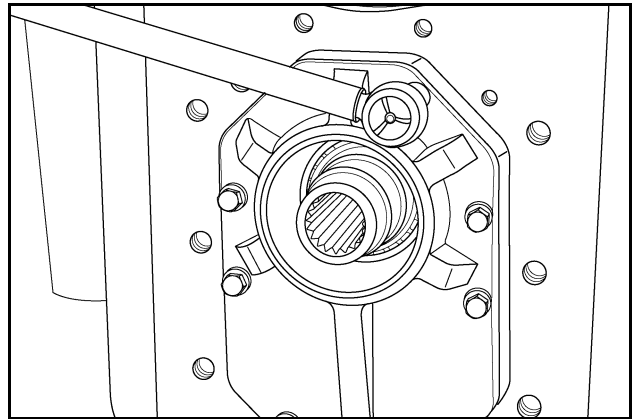
Install the output shaft cover. DO NOT apply Loctite® 515 at this time.



RD05A060

## STEP 134

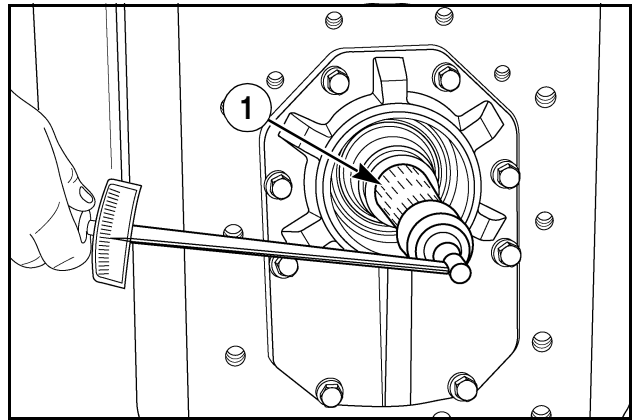
Install the mounting bolts and torque to 95 Nm (70 lb. ft.). DO NOT install the seal at this time, the following rolling torque measurements are taken without the seal.



RD05B011

## STEP 135

- Install the output shaft (1).
- Place a socket over the end of the output shaft and rotate the shaft several revolutions in both directions to seat the bearing.
- Check the rolling torque using a inch-pound torque wrench.
- The required rolling torque range is 2-18 lb. in. If the torque is too low, disassemble and add shim(s) to the bearing cage. If torque is too high, disassemble and remove shim(s) from the bearing cage.
- After adding or removing shims, recheck rolling torque.
- When the rolling torque is to specification, remove the PTO output shaft cover.
- To continue the assembly, see Reversible PTO Section.

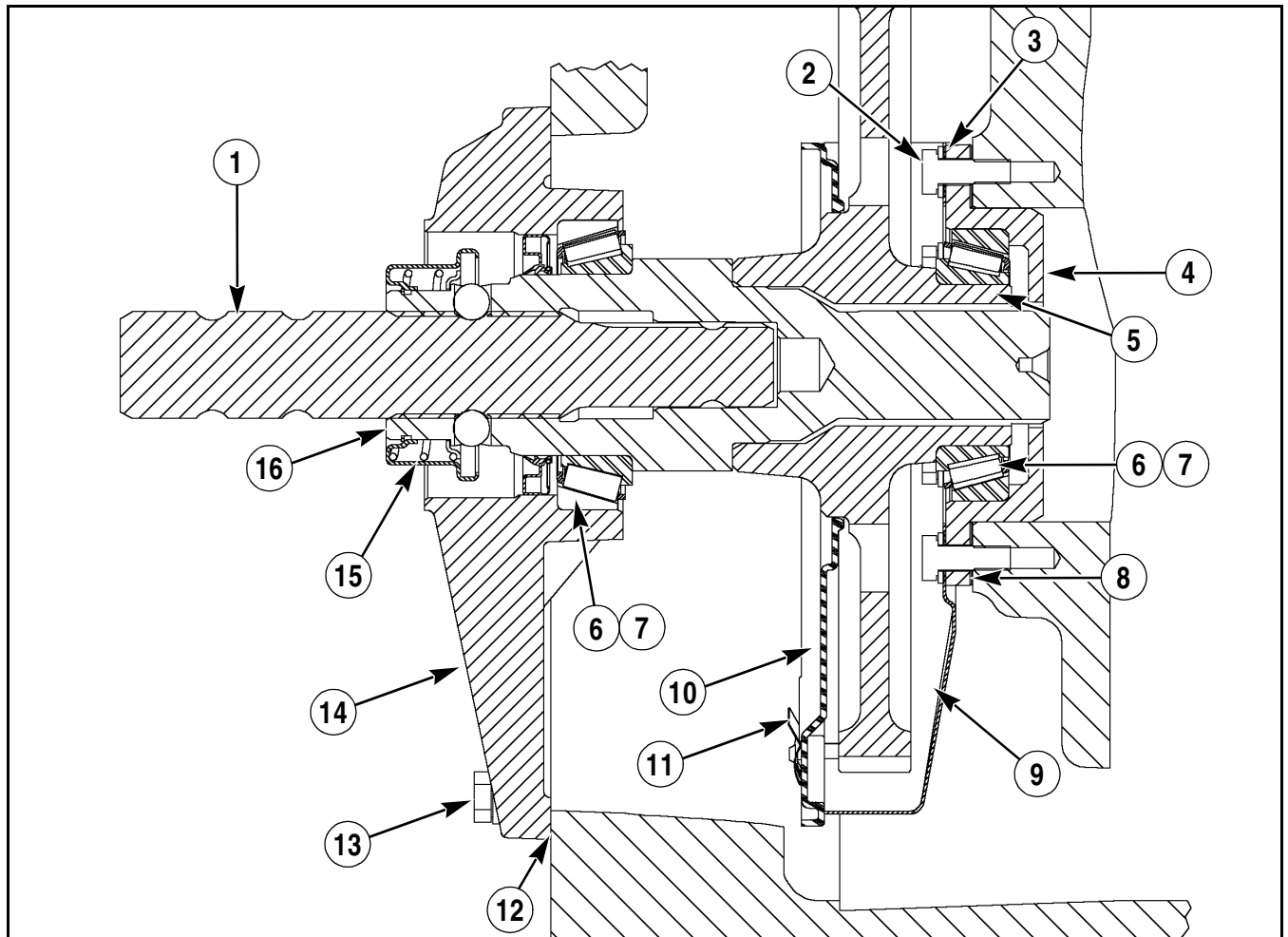


RD05B012

**NOTE:** The proper method for measuring the rolling torque is to apply a continuous force on the torque wrench and maintain a slow, constant rotation, then average the torque wrench readings.

## SINGLE SPEED REVERSIBLE SHAFT PTO

### Cross Section of PTO Output Shaft Assembly



1. PTO OUTPUT SHAFT, REVERSIBLE
2. BOLT, M10 X 30 CL. 10.9
3. WASHER, 11 X 21 X 2.5 MM
4. PTO DRIVEN GEAR BRG CAGE
5. PTO DRIVEN GEAR
6. BEARING

7. BEARING CUP
8. SHIMS
9. PTO DRIVEN GEAR OIL SHIELD
10. PTO OIL SHIELD COVER
11. OIL SHIELD RETAINING CLIP
12. APPLY LOCTITE® AS REQUIRED

13. BOLT, M12 X 45 CL. 10.9
14. PTO HOUSING COVER
15. QUICK DISCONNECT COUPLER
16. PTO OUTPUT SHAFT SLEEVE

R105C002



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# **Section 33**

## **Chapter 1**

### **BRAKE VALVE**

## TABLE OF CONTENTS

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Removal .....	33-2-3
Disassembly .....	33-2-4
Assembly .....	33-2-6
Installation .....	33-2-8

## SPECIAL TORQUES

Allen head plate to valve body retaining screw.....	35 to 40 Nm (26 to 30 lb. ft.)
---	--------------------------------

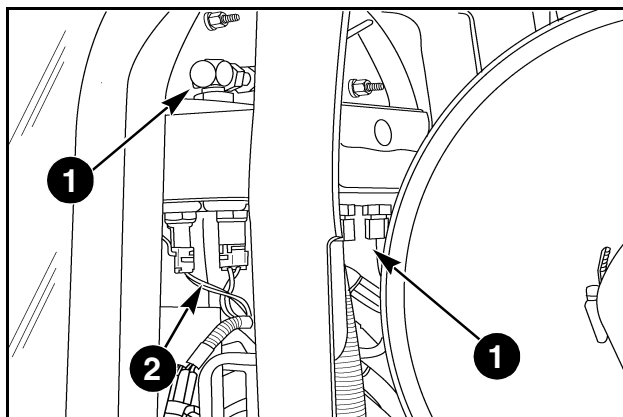
## BRAKE VALVE

### Removal

**NOTE:** Park the tractor on a hard, level surface and place the transmission in PARK. Remove the keys and block the rear wheels.

**NOTE:** Before removing the brake valve, remove the fixed hood. (See Hood Removal Section in this manual).

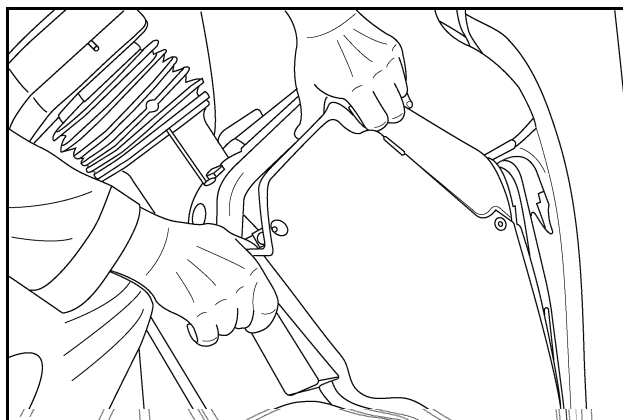
#### STEP 1



RD02K118

Tag and remove the four brake valve lines (1). Tag and remove the two brake switch connectors (2).

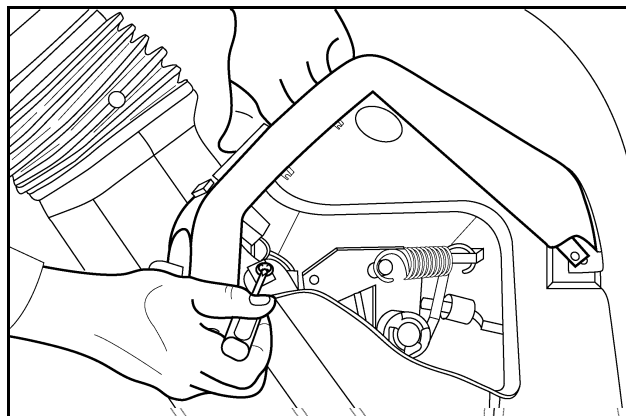
#### STEP 2



102R-5

Remove steering column side cover.

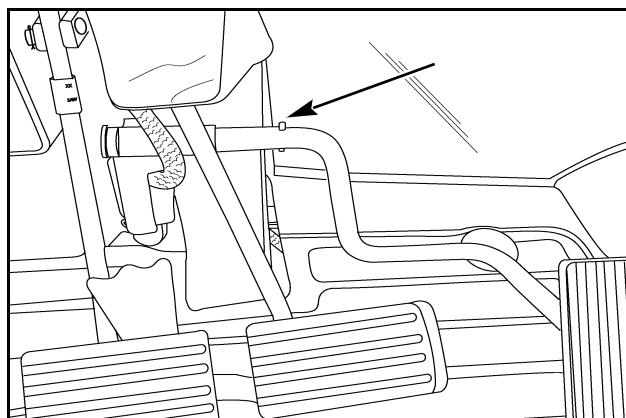
#### STEP 3



102R-4

Remove top cover from steering column.

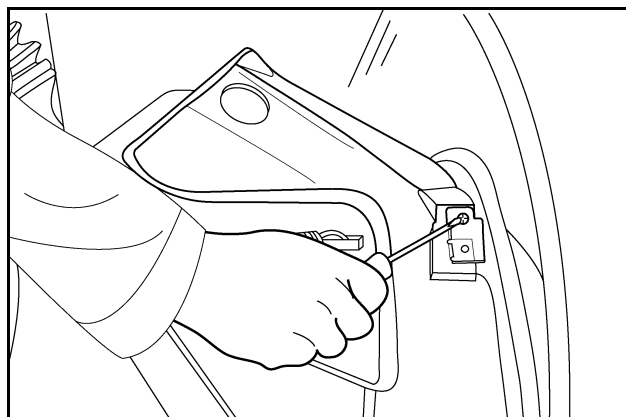
#### STEP 4



RD02K120

If equipped, remove the foot throttle by removing the roll pin and sliding the throttle arm off the pivot shaft.

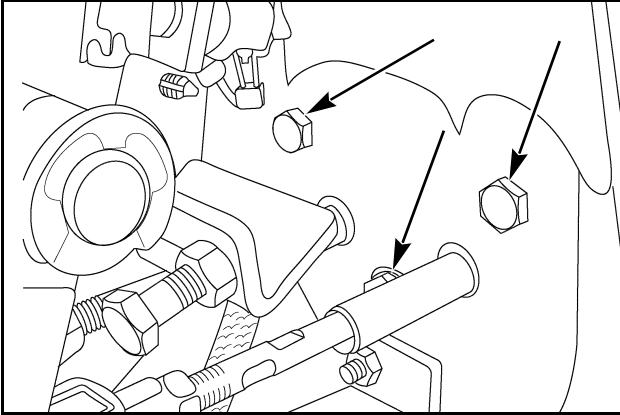
#### STEP 5



101R-35A

Remove right front air duct.

## STEP 6

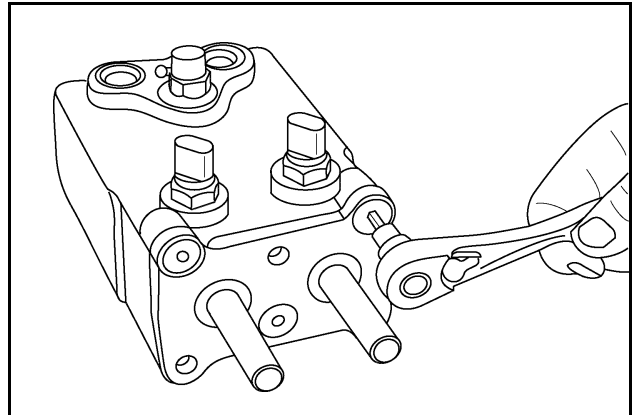


RD02K119

Remove the three brake valve mounting bolts. Remove the brake valve and gasket from the firewall.

## Disassembly

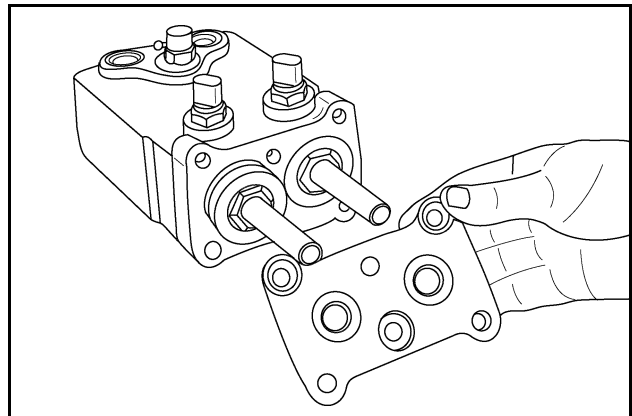
## STEP 7



RD02K106

Place the valve on a clean surface and remove the three Allen head screws.

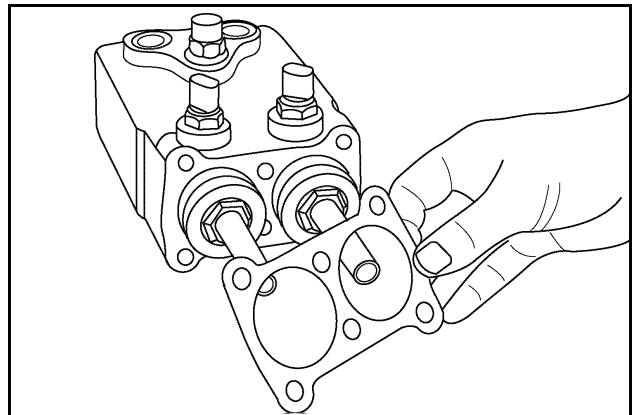
## STEP 8



RD02K107

Remove the firewall brake plate.

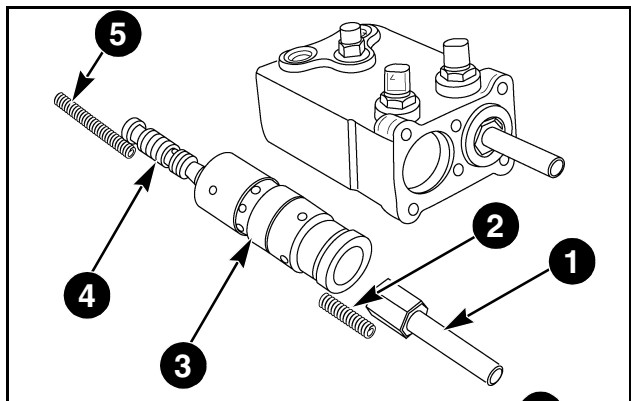
## STEP 9



RD02K112

Remove and discard the brake valve gasket.

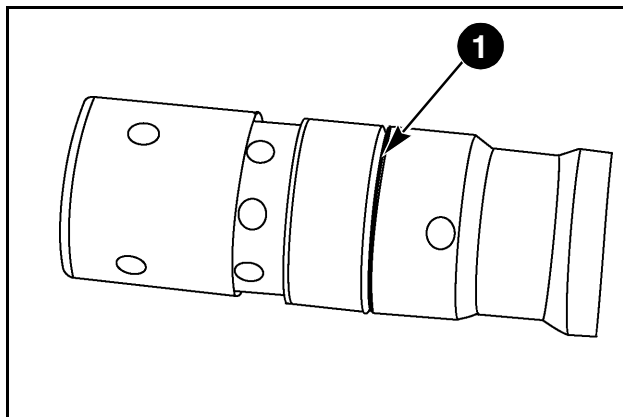
### STEP 10



RD02K108

Remove the poppet (1) and outer feathering spring (2) from the sleeve (3). Remove the sleeve from the body. Remove the spool (4) and return spring (5) from the spool. Inspect all parts for damage or wear. Repeat steps for the second spool assembly.

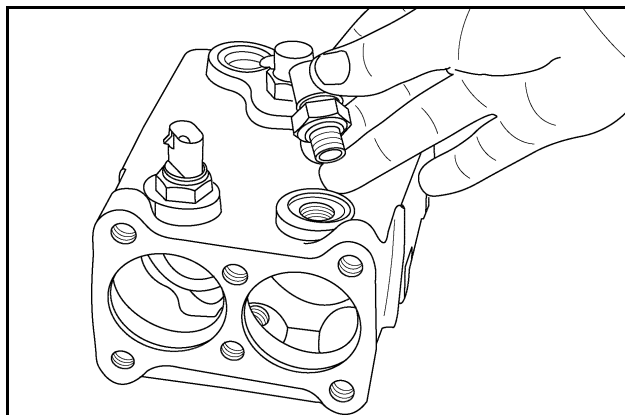
### STEP 11



RD02K109

Remove and discard the spool seal and O-ring. Repeat for second spool.

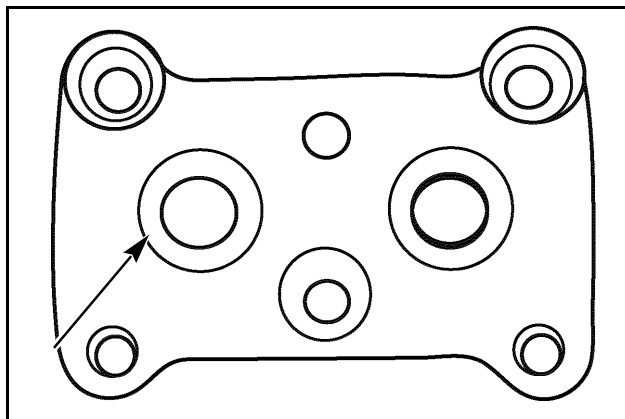
### STEP 12



RD02K110

Remove both brake switches. Discard O-rings. Inspect for damage or wear.

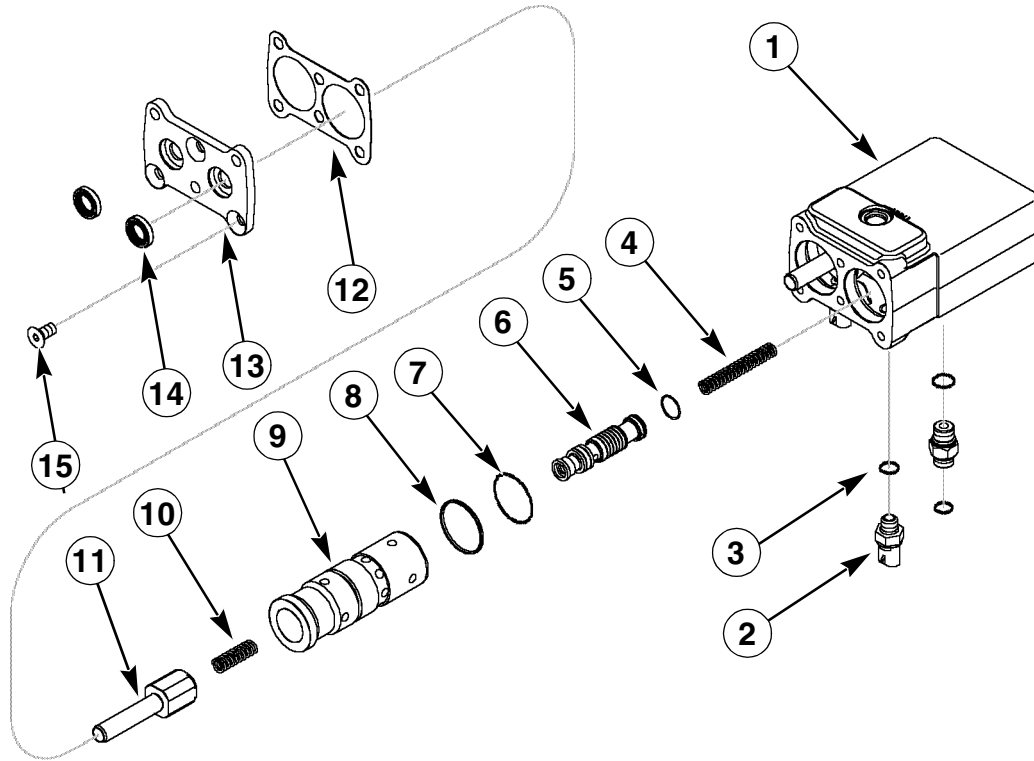
### STEP 13



RD02K111

Remove and discard the two poppet sleeve seals.

## Assembly



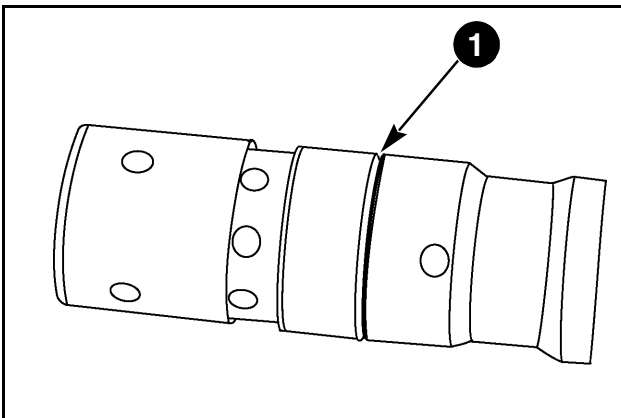
1. BODY
2. SWITCH
3. O RING
4. SPRING
5. RETAINING RING

6. SPOOL
7. O-RING
8. SEALRING
9. SLEEVE
10. SPRING

11. POPPET
12. GASKET
13. PLATE
14. SEAL
15. SCREW

RI02K072

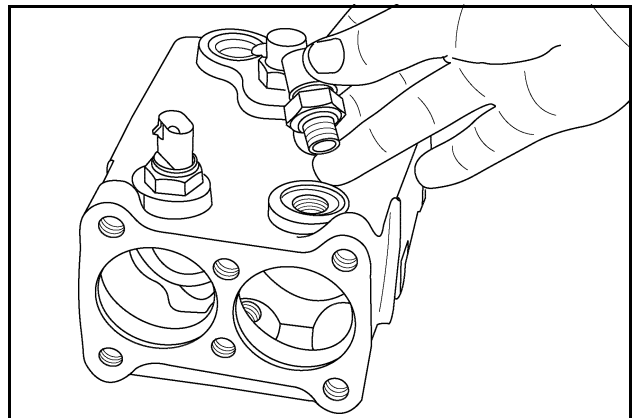
### STEP 14



RD02K109

Install a new backing O-ring, then a new seal.

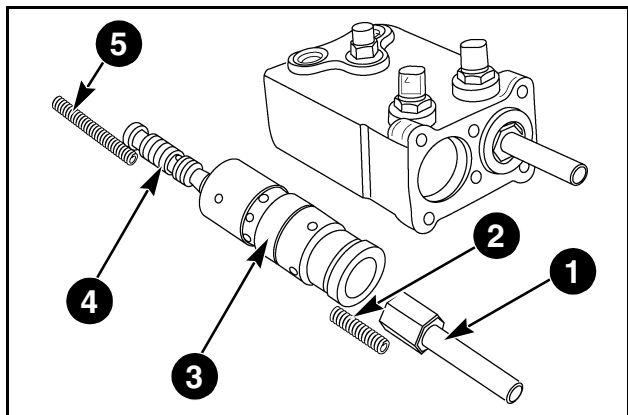
### STEP 15



RD02K110

Install new O-rings and install the brake switches.

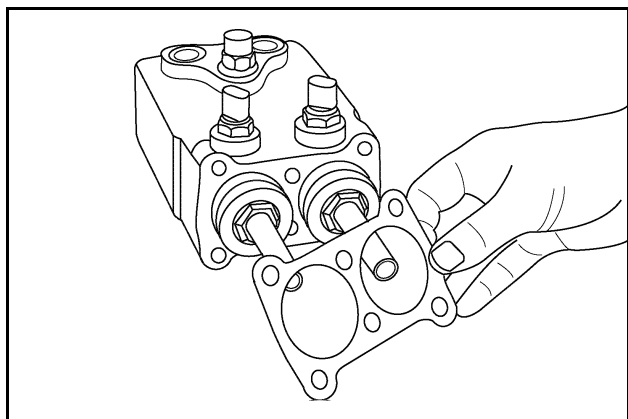
### STEP 16



RD02K108

Install the return spring (5) into the spool (4) and install the spool into the sleeve (3). Lubricate the valve bore and sleeve seal and install the sleeve into the valve body. Install the feathering spring (2) into the poppet (1) and install the poppet into the spool. repeat for the second spool.

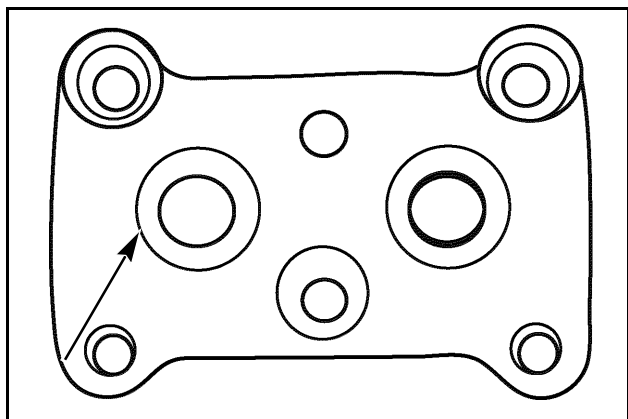
### STEP 17



RD02K112

Install a new brake valve gasket.

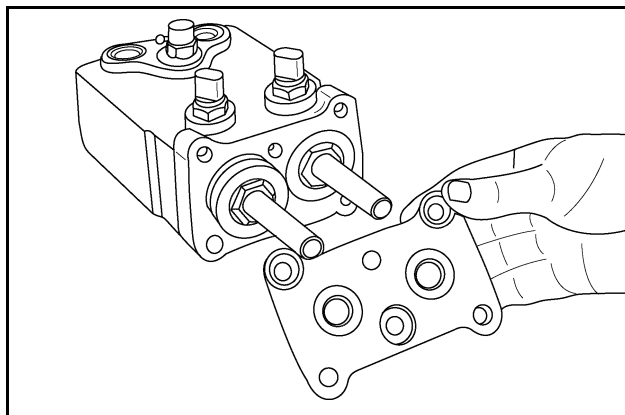
### STEP 18



RD02K111

Install new poppet shaft seals.

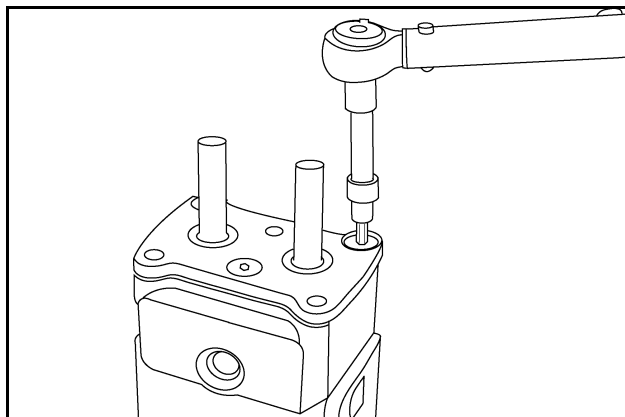
### STEP 19



RD02K107

Install the firewall brake plate onto the brake body.

### STEP 20



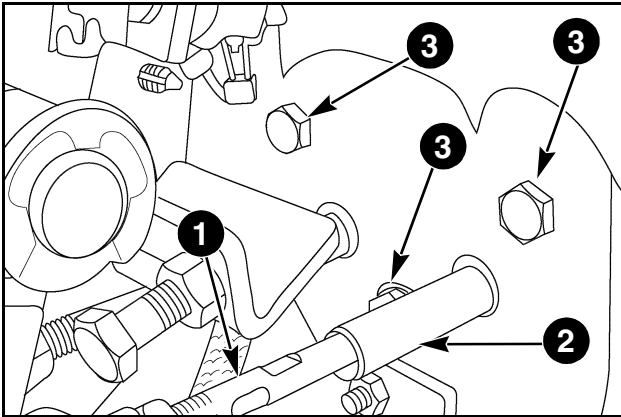
RD02K113

Install the three retaining screws and torque to 35-40 Nm (26 to 30 lb. ft.).



## Installation

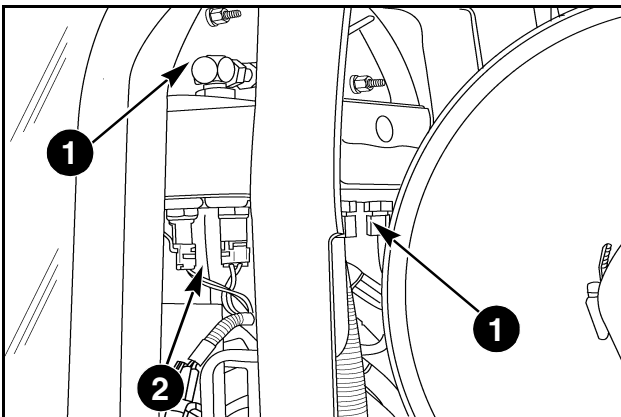
### STEP 21



Rd02K119

Install a new firewall to brake valve gasket and install the brake valve, making sure that the brake link rods (1) are installed into the poppet sleeves (2). Install and tighten the three mounting bolts (3). See the Pedal and Pedal Switch Adjustment Section of this Service Manual for the brake pedal adjustment procedure.

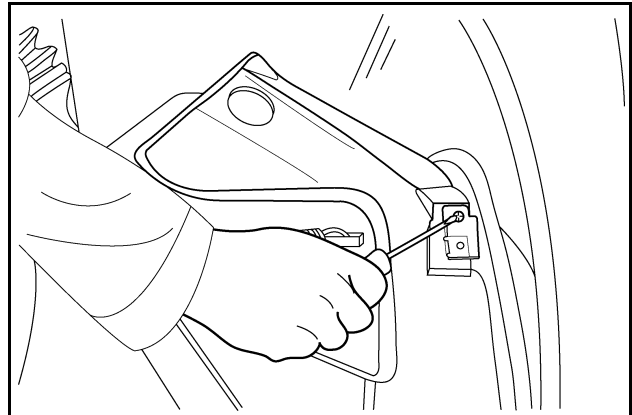
### STEP 22



RD0K118

Install new O-rings on all hose and tube connectors. Install the supply and return lines, the right and left brake lines (1) and the brake switch connectors (2). Start vehicle and check for leaks and proper brake switch operation.

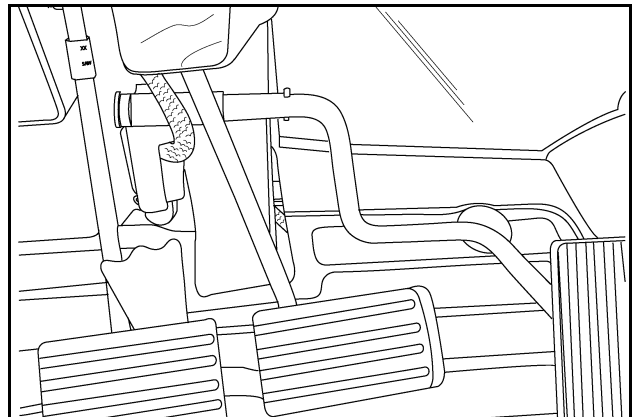
### STEP 23



101RS35A

Install the right side air duct.

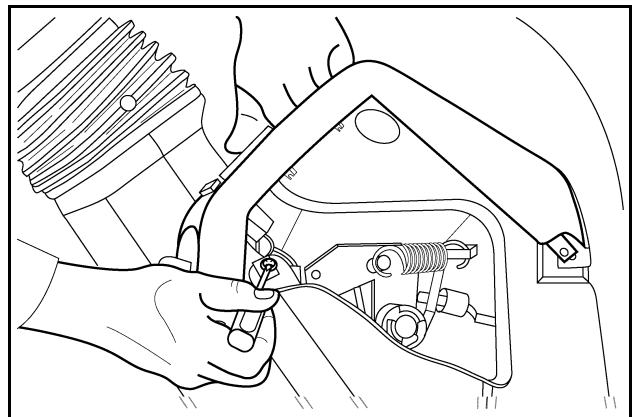
### STEP 24



RD02K120

If equipped, install the foot throttle.

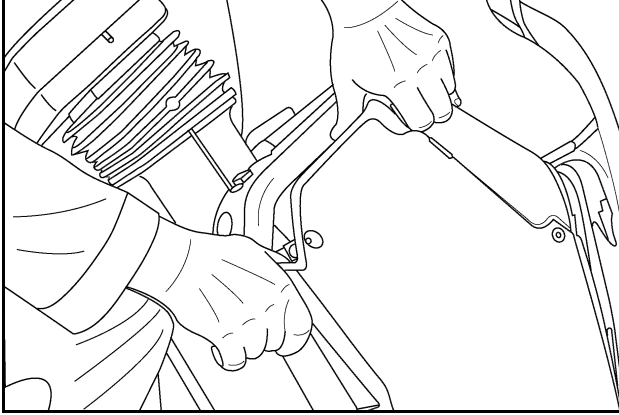
### STEP 25



102RS4

Install top steering column cover and connect all electrical connectors.

**STEP 26**



102RS5

Install the right side cover.



# **Section 33**

## **Chapter 2**

### **BRAKE CYLINDERS**

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SPECIAL TORQUES ..... 33-2-3

SPECIFICATIONS ..... 33-2-3

BRAKE CYLINDERS ..... 33-2-3

    Disassembly ..... 33-2-3

    Assembly ..... 33-2-5

## SPECIAL TORQUES

Brake Cylinder Mounting Bolts ..... 177 to 179 Nm (130 to 145 lb. ft.)

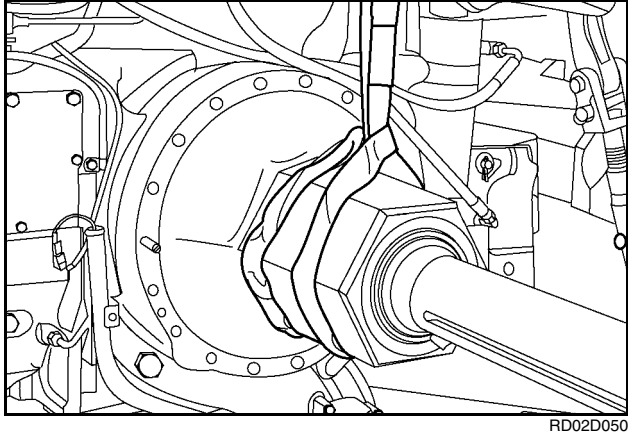
## SPECIFICATIONS

Friction Disc Minimum Thickness ..... 3.45 mm (0.136 inch)

## BRAKE CYLINDERS

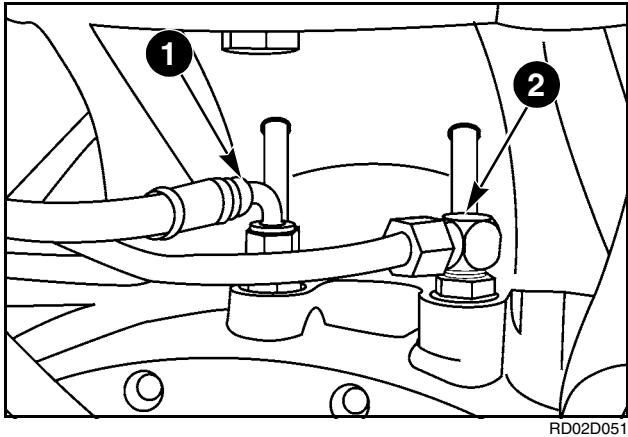
### Disassembly

#### STEP 1



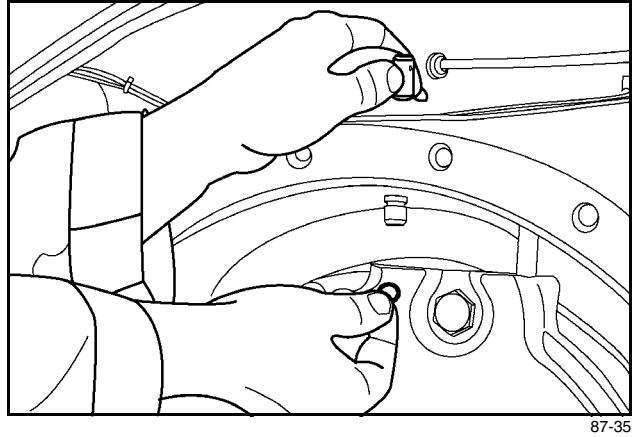
Remove the rear axles and planetarium from the rear frame. See Rear Axle and Planetaries Section in this Service Manual for axle removal.

#### STEP 2



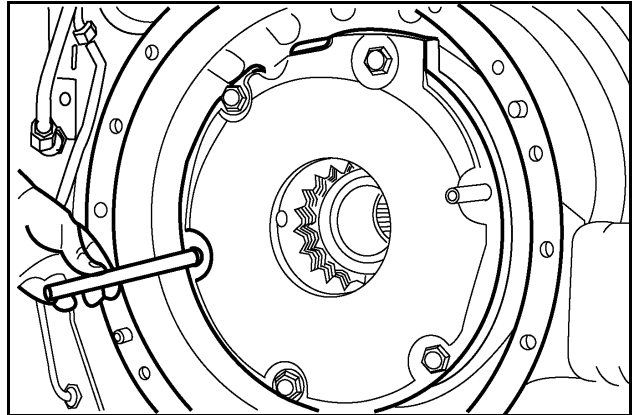
Remove the brake tube (1) and diff lock tube (2) from the rear frame housing.

#### STEP 3



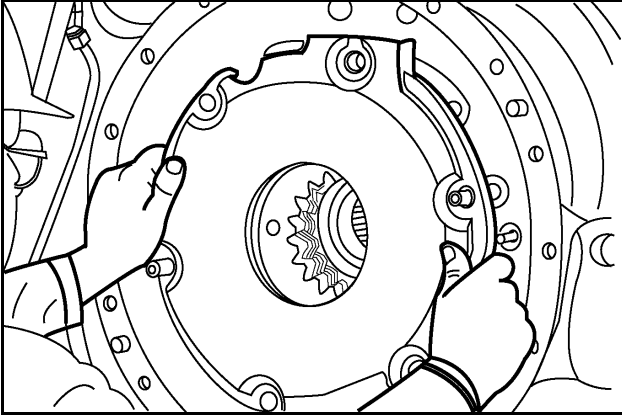
Lift the supply tubes out of the brake cover. If the supply tubes are to be removed from the rear frame, remove the lower O-rings from the tube first.

#### STEP 4



Remove two brake cover mounting bolts and install aligning dowels.

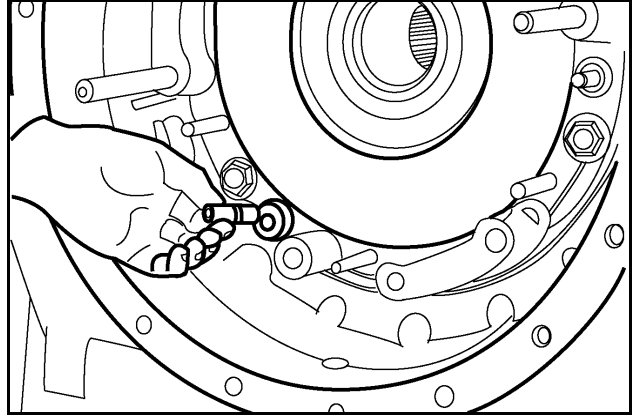
**STEP 5**



T97947

Remove the remaining bolts and the brake cover from the rear frame.

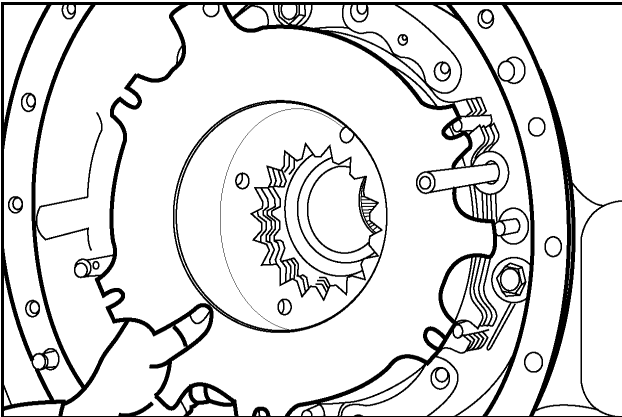
**STEP 8**



T97952

Remove the three brake adjusters from the differential retainer.

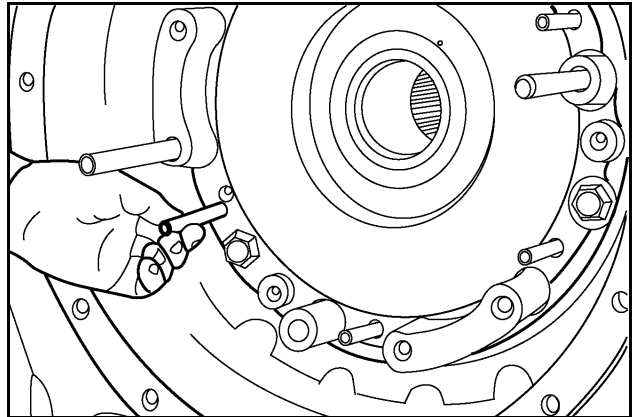
**STEP 6**



T98031

Remove the adjuster return plate from the brake discs.

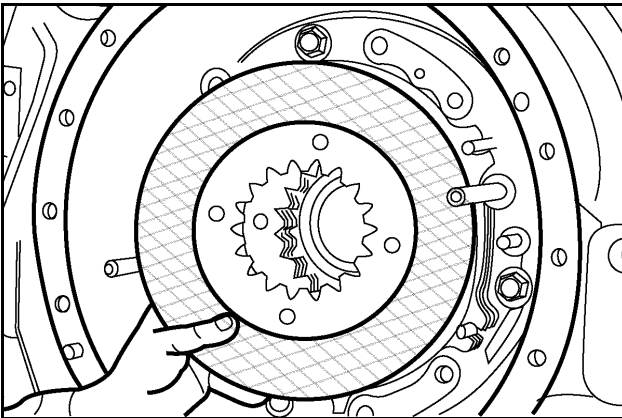
**STEP 9**



T97953

Remove the five locating pins from the differential retainer.

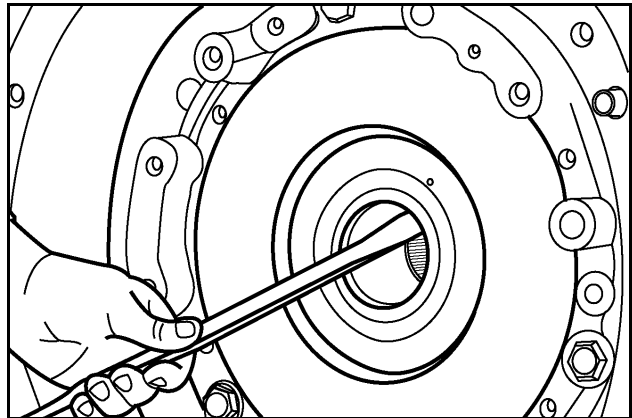
**STEP 7**



TBD

Remove the friction and separator plates from the rear frame.

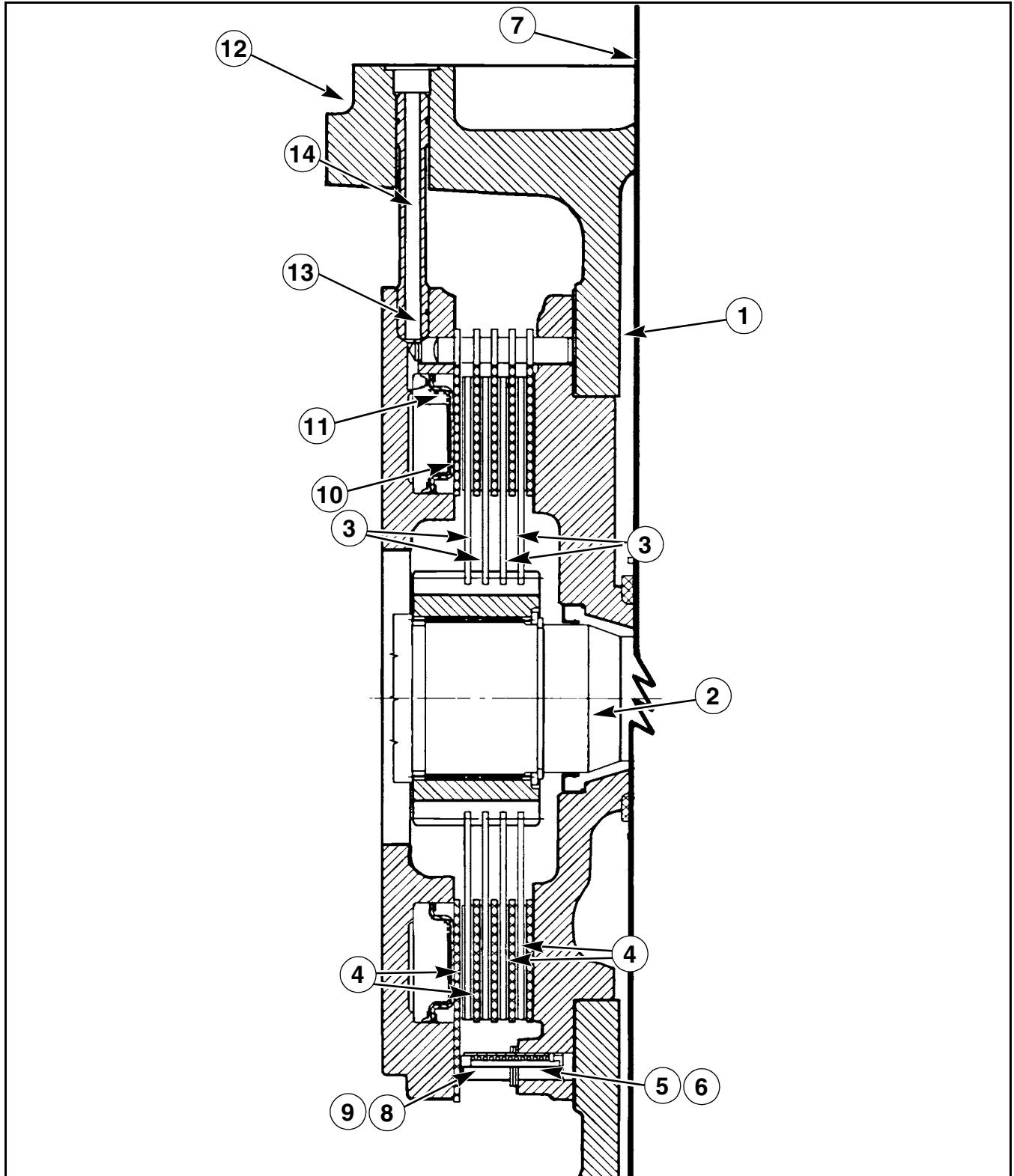
**STEP 10**



T97955

Remove the sun gear shaft seal from the differential retainer.

# Assembly

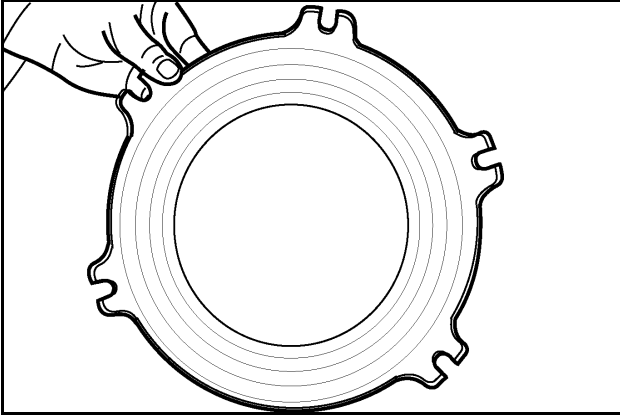


RH98B044

- |                        |                            |                 |
|------------------------|----------------------------|-----------------|
| 1. BEARING RETAINER    | 6. EXTERNAL RETAINING RING | 11. PISTON      |
| 2. OIL SEAL            | 7. AXLE ASSEMBLY HOUSING   | 12. BRAKE COVER |
| 3. SEPARATOR PLATE (4) | 8. BRAKE ADJUSTER ASSEMBLY | 13. O-RING      |
| 4. FRICTION PLATE (4)  | 9. LOCATING PIN            | 14. SUPPLY TUBE |
| 5. BELLEVILLE WASHER   | 10. ADJUSTER RETURN PLATE  |                 |

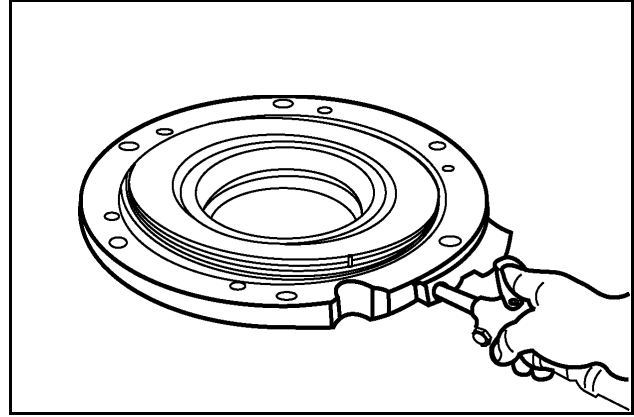


**STEP 11**



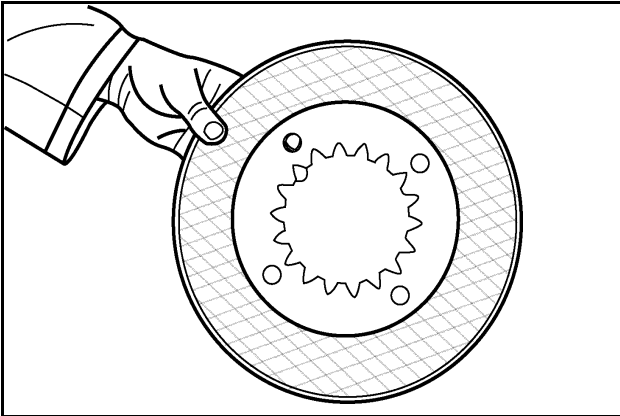
Inspect the brake separator plates. If there is damage or heavy wear, replace the plates.

**STEP 13**



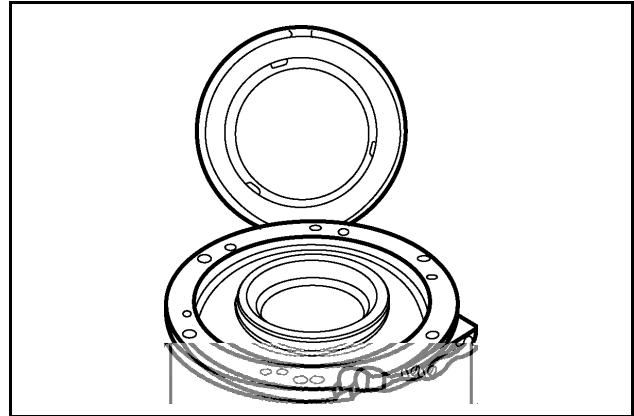
Use compressed air to push the brake piston out of the brake cover.

**STEP 12**



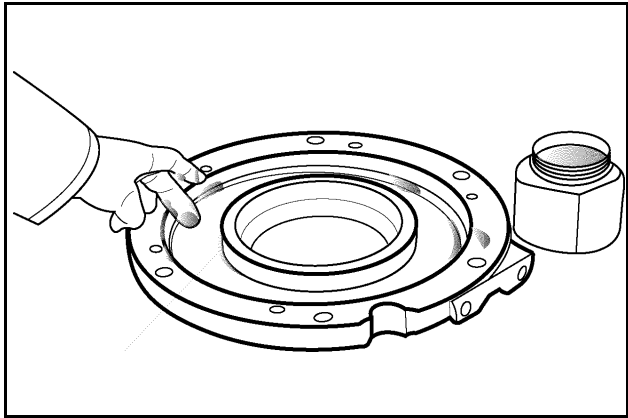
Inspect the brake friction plates. If there is damage or heavy wear (the grooves worn away), replace the friction plates. The minimum thickness for a friction plate is 3.45 mm (0.136 inch).

**STEP 14**



Carefully remove the piston from the cover. Repeat procedures for the other piston.

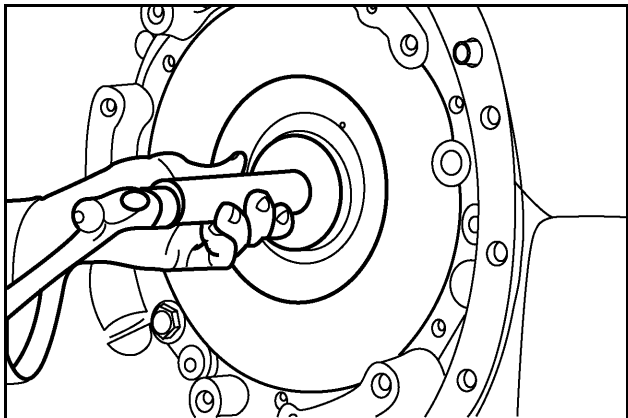
### STEP 15



A21051

Lubricate the brake cover inner and outer piston seats with petroleum jelly. Start the piston into the cover evenly by hand. Gently tap the piston with a soft face hammer until the piston is fully seated. Be careful not to damage the bonded seals.

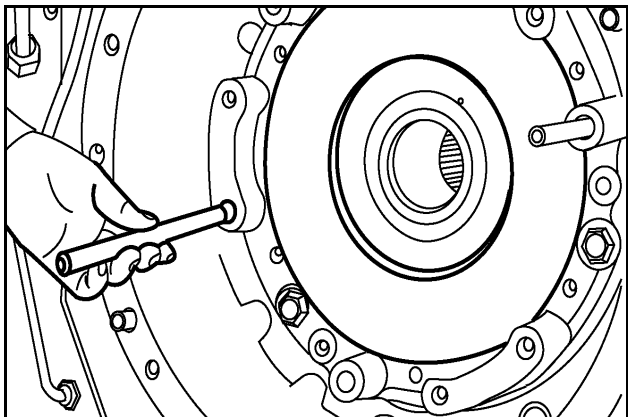
### STEP 16



T97966

Use a driver to install a new seal in the differential retainer. Lubricate the ID of the seal with Hy-Tran Plus fluid.

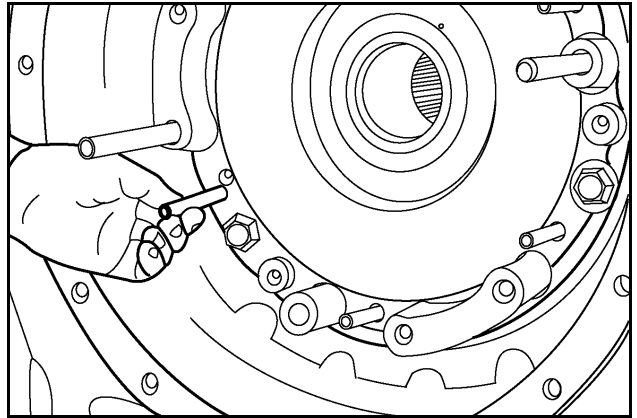
### STEP 17



T97954

Install aligning dowels in the differential carrier.

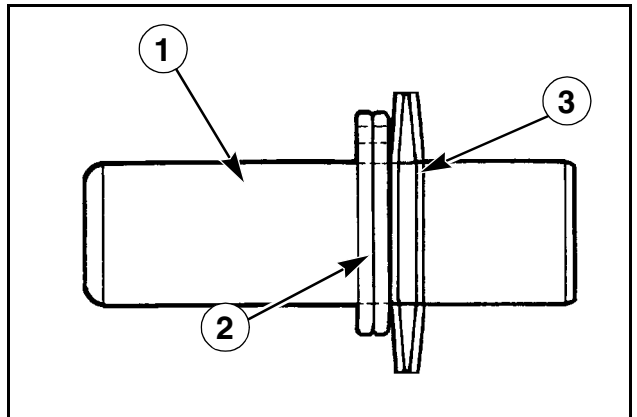
### STEP 18



T97953

Install the five locating pins in the differential carrier.

### STEP 19

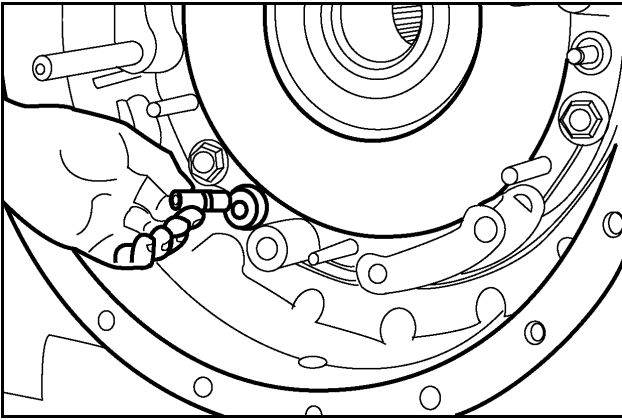


RH97K064

- 15. DOWEL
- 16. RETAINING RINGS
- 17. BELLEVILLE WASHER

If new brake plates are to be installed, the brake adjusters must be reset. Adjust the depth of the retaining rings to 25.477 mm (1 in.). If the old plates are to be reused, do not change the brake adjusters.

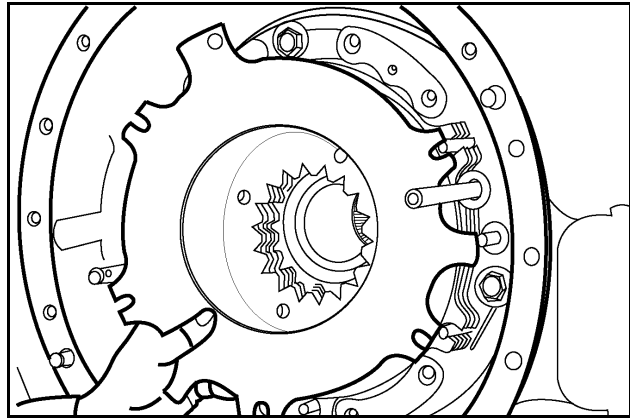
### STEP 20



T97952

Install the three brake adjuster assemblies into the differential carrier. The Belleville washer ends go into the differential carrier.

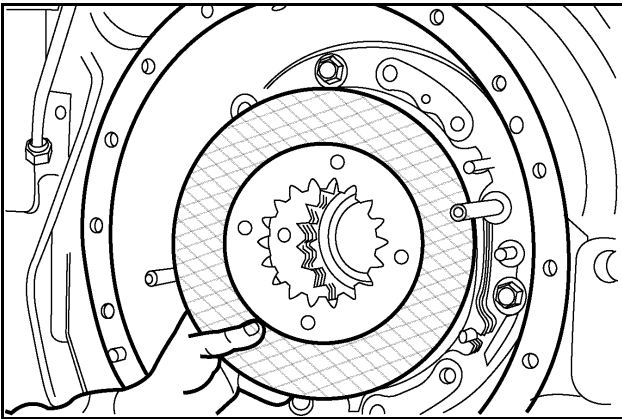
### STEP 22



T98031

Install the adjuster return plate on the locating pins. The tabs on the plate must contact the adjuster dowel assemblies.

### STEP 21

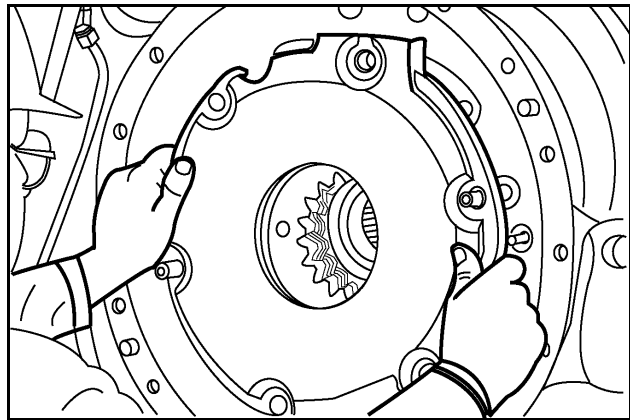


T97949

Install plates as follows:

1. Install a separator plate on to the locating pins and against the differential plate carrier.
2. Install a friction plate against the separator plate.
3. Install three more separator and friction plates. A friction plate must be the last part installed.

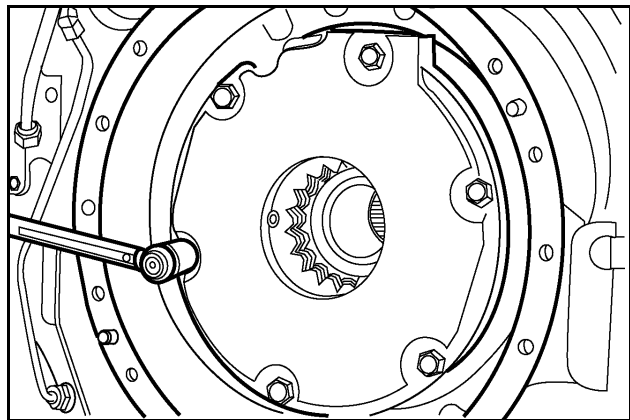
### STEP 23



T97947

Install the brake cover onto the locating dowels.

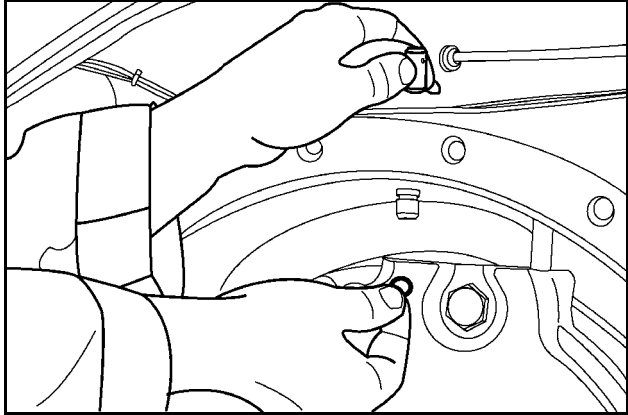
### STEP 24



T97945

Install the brake cover retaining bolts. Tighten the bolts to a torque of 177 to 197 Nm (130 to 145 lb. ft.)

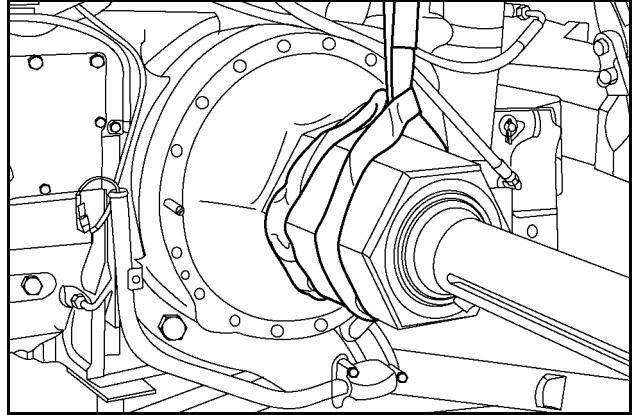
**STEP 25**



87-35

Lubricate new O-rings with petroleum jelly and install the O-rings on the supply tubes. Install the tubes into the brake cover.

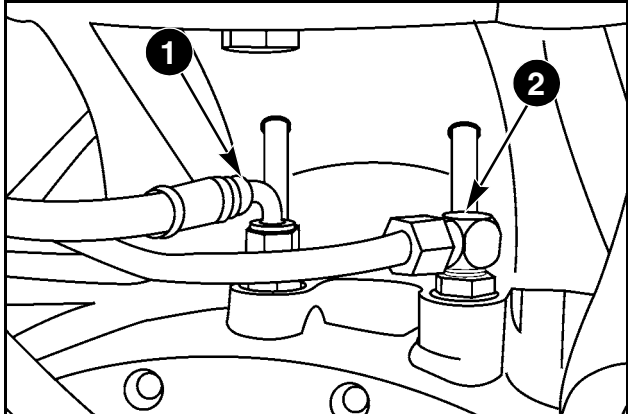
**STEP 27**



RD02D050

See Rear Axle and Planetaries Section in this Service Manual for the installation of the rear axle housing.

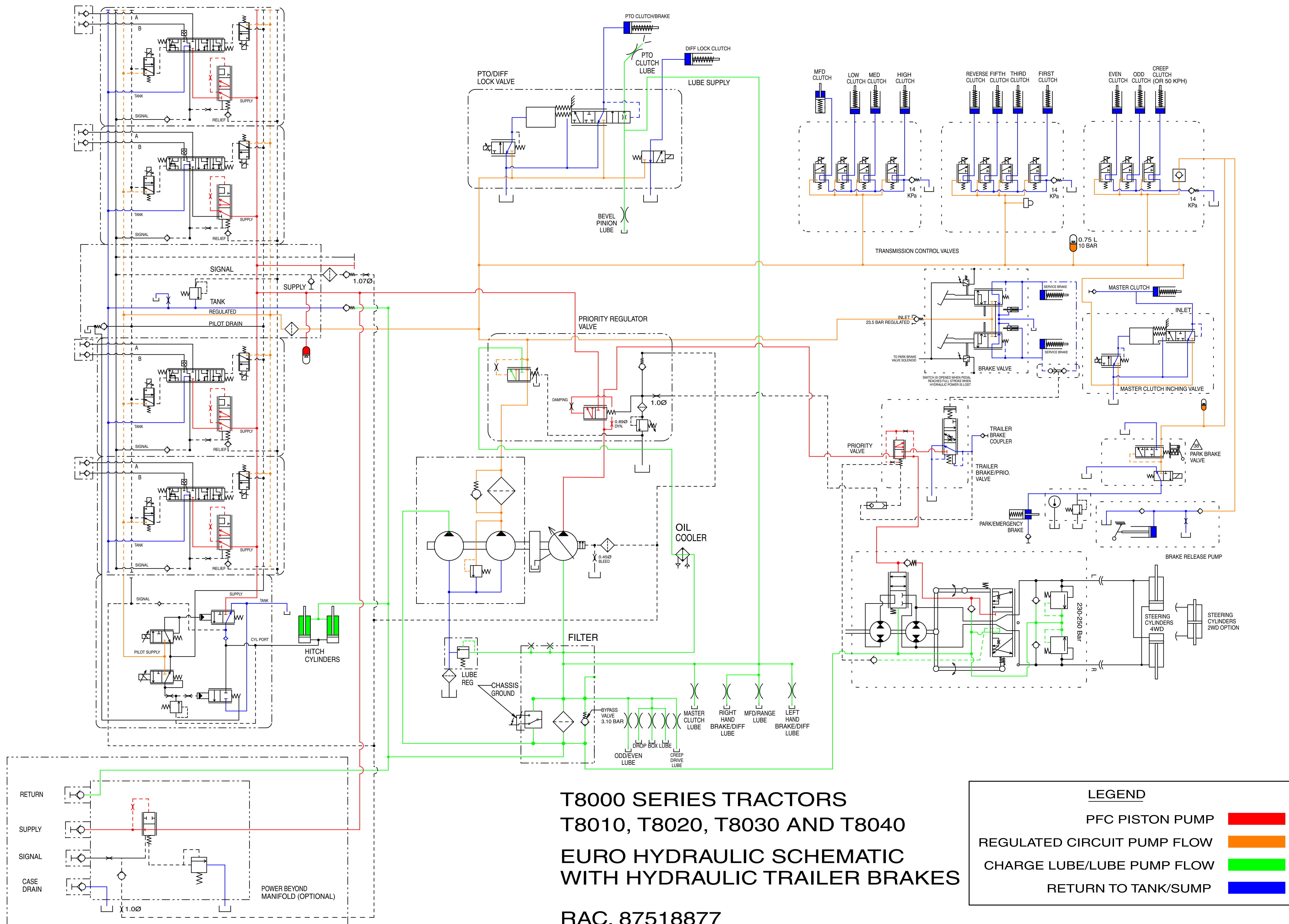
**STEP 26**



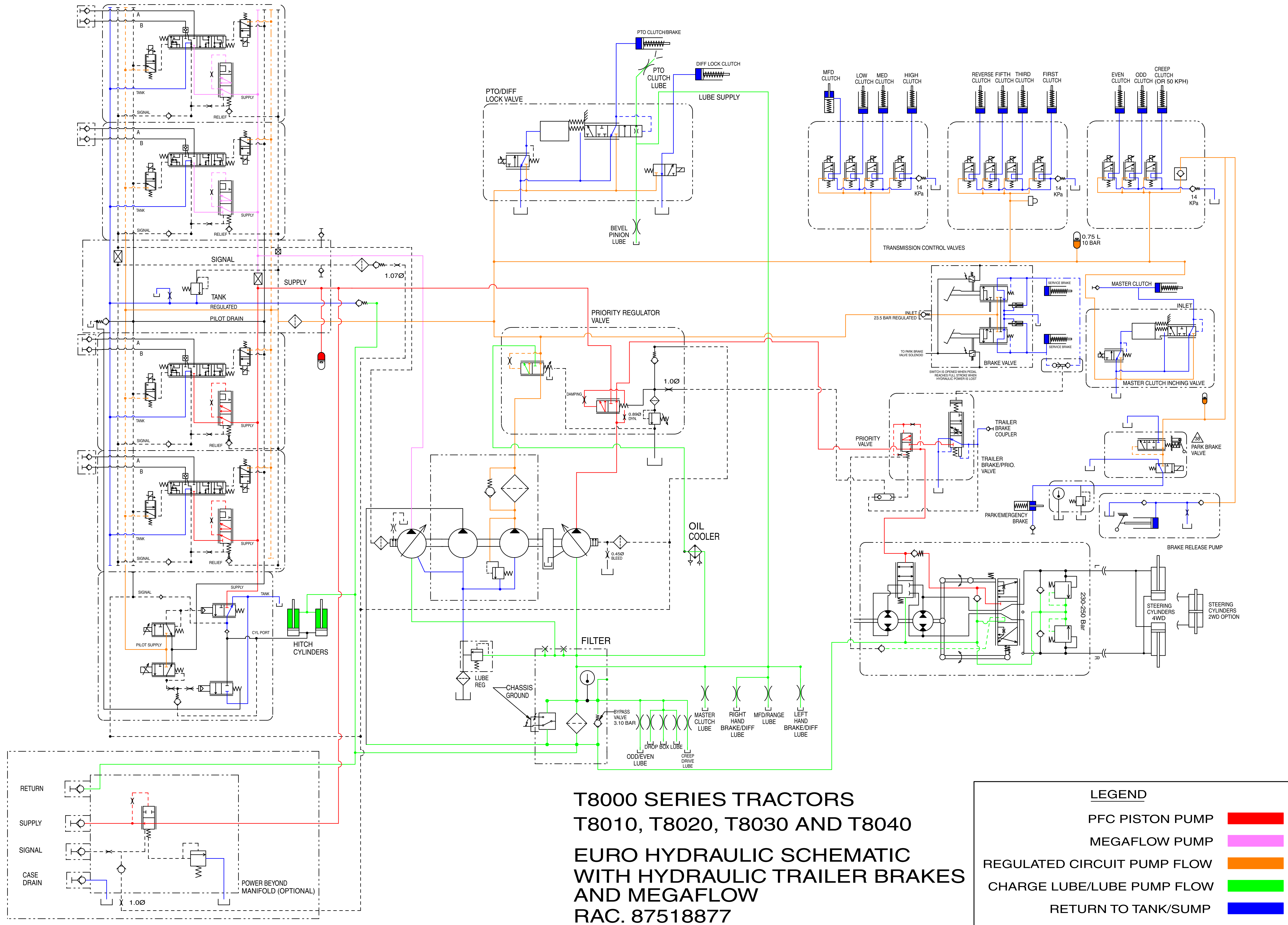
RD02D051

Install the brake supply tube (1) and connect the diff lock tube (2). Repeat installation procedures for the other brake cylinder.









# **Section 35**

## **Chapter 1**

### **HOW TO READ SYMBOLS IN A HYDRAULIC SCHEMATIC**



**TABLE OF CONTENTS**

HOW TO READ SYMBOLS IN A HYDRAULIC SCHEMATIC ..... 35-1-3

SIMPLE SCHEMATIC ..... 35-1-13

COMMON SYMBOLS ..... 35-1-15

## HOW TO READ SYMBOLS IN A HYDRAULIC SCHEMATIC

### Introduction

Accurate diagrams of hydraulic circuits are essential to the man who must repair them. The diagram shows how the components will interact. It shows the field technician how it works, what each component should be doing and where the oil should be going so that he can diagnose and repair the system.

The purpose of this section is to show you how to find your way around schematic circuit diagrams.

### Circuit Diagrams

There are two types of circuit diagrams.

1. Cutaway Circuit Diagrams show the internal construction of the components as well as the flow paths. By using colors, shades or various patterns in the lines and passages, they are able to show many different conditions of flow and pressure. Cutaway diagrams take considerably longer to produce because of their complexity.
2. Schematic Circuit Diagrams the "shorthand" system of the industry, are usually preferred for troubleshooting. A schematic diagram is made up of simple geometric symbols for the components and their controls and connections.

### Symbol Systems

There are several systems of symbols used when making schematic diagrams. They are as follows:

- I. S. O. = International Standards Organization
- A. N. S. I. = American National Standards Institute
- A. S. A. = American Standards Association
- J. I. C. = Joint Industry Conference

A combination of these symbols are shown in this section. There are differences between the symbols but there is enough similarity so that if you understand the symbols in this section you will be able to interpret other symbols as well.

### Using Schematic Symbols

#### Reservoirs



VENTED RESERVOIR

710L8B



PRESSURIZED RESERVOIR

710L8D

A rectangle with the top removed represents a vented reservoir. A rectangle with the top in place represents a pressurized reservoir.



PRESSURIZED RESERVOIR

710L8C



PRESSURIZED RESERVOIR

710L8A

There are other schematic diagrams that show a slightly different version of a pressurized reservoir, but the symbols are similar and easily recognized. An oval with a short line on top or a rectangle with curved sides represents a reservoir that is pressurized.



RETURN LINE ABOVE  
THE OIL LEVEL

710L8E

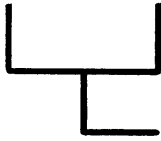
Lines connected to the reservoir usually are drawn from the top, regardless of where the actual connection is.



SUCTION LINE OR RETURN LINE  
BELOW THE OIL LEVEL

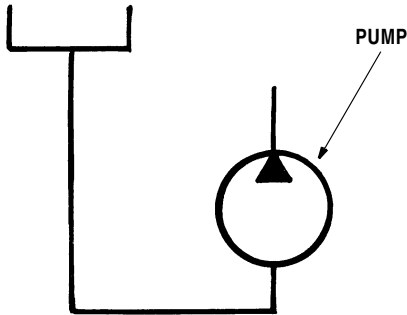
710L8F

If the hydraulic line terminates below the fluid level, it is drawn all the way to the bottom of the symbol.


**RESERVOIR WITH SUCTION LINE ATTACHED AT THE BOTTOM**

7108G

A hydraulic line connected to the bottom of the reservoir may be drawn from the bottom of the symbol if the bottom connection is essential to the systems operation.



749L8B

If the pump inlet must be charged or flooded with a positive head of oil above the inlet port, we would position the reservoir symbol above the pump symbol, and draw the suction line out of the bottom of the reservoir symbol.

Every vehicle or system reservoir has at least two hydraulic lines connected to it, and some may have many more. Often the components that are connected to the reservoir are spread all over the schematic. Rather than having a lot of confusing lines all over the schematic, it is customary to draw individual reservoir symbols close to the components. The reservoir is usually the only component symbol pictured more than once.

## Lines, Tubes and Hoses

A hydraulic line, tube, hose or any conductor that carries the fluid between components is shown as a line.



710L8H

A working line, such as an inlet pressure or return, is shown as a solid line.



OIL FLOWS ONE WAY ONLY

710L8J



OIL CAN FLOW EITHER WAY

710L8K

Working lines with arrows show direction of flow.



710L8K

Pilot or control lines are broken into long dashes.



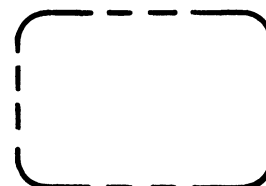
710L8B

Drain lines for leakage oil are broken into short dashes.



710L8C

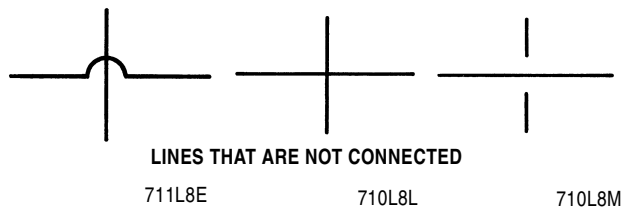
A flexible line is shown as an arc between two dots and is always represented by a solid line.



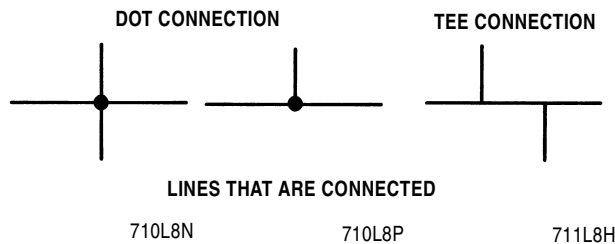
710L8D

Quite often you will see an enclosure outline that indicates that there are several symbols that make up a component assembly such as a valve or a valve stack. The enclosure outline appears like a box and is broken with dashes on all sides.

## Crossing or Joining Lines

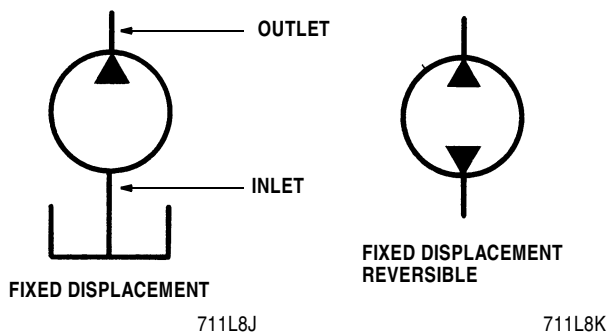


The shortest distance between two components that are not connected is a straight line. There are lines that cross other lines but are not connected. There are several ways to show crossing lines.

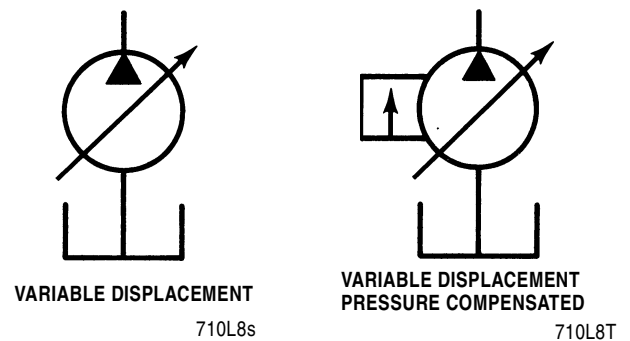


Lines that are connected are shown with a dot that represents the connection or shown as a tee connection. The dot connection is the most commonly used when drawing schematic diagrams.

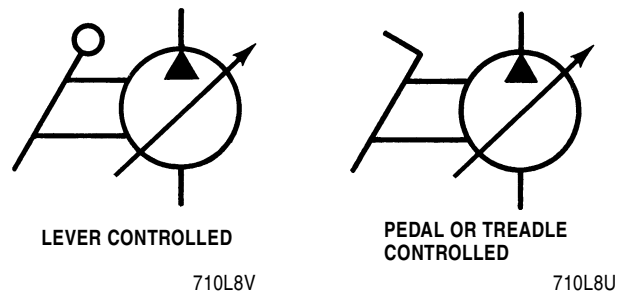
## Pump Symbols



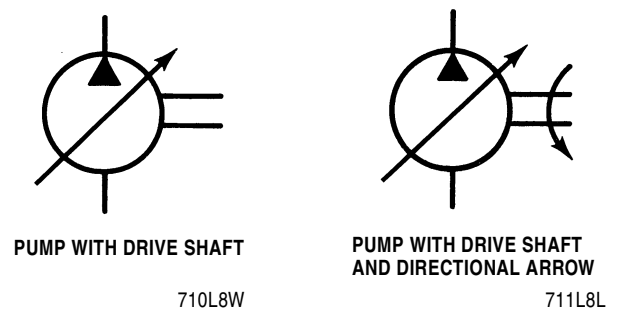
There are many basic pump designs. A simple fixed displacement pump is shown as a circle with a black triangle that is pointing outwards. The black triangle is like an arrow head and points in the direction that the oil will flow. If the pump is reversible or designed to pump in either direction, it will have two black triangles in it and they will be opposite each other.



A variable displacement pump is designated by drawing an arrow through the pump symbol at 45 degrees. To indicate a variable displacement pressure compensated pump, a small box with an arrow in it will be added to the side of the pump symbol.

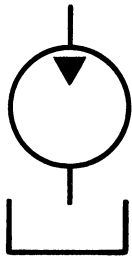


If the pump is controlled by a lever or a pedal, it will be shown on the side of the pump.



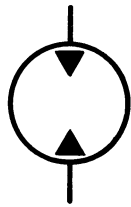
A drive shaft is shown as two short parallel lines extending from the side of the pump. If a curved arrow is shown on the drive shaft, it will indicate the direction of rotation.

## Hydraulic Motor Symbols



NONREVERSIBLE MOTOR

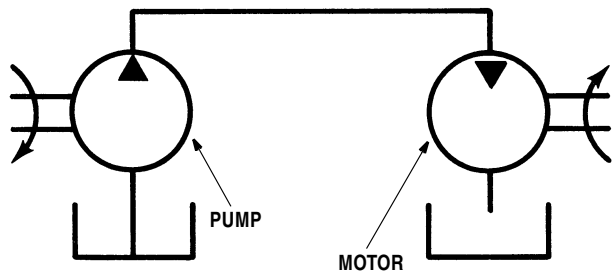
711L8M



REVERSIBLE MOTOR

711L8N

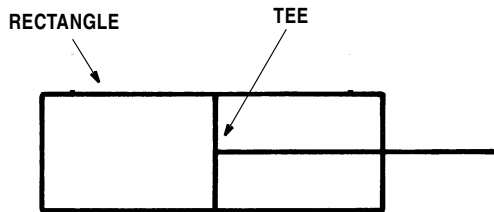
Hydraulic motor symbols are circles with black triangles, but opposite a pump the triangles point inward to show the motor is a receiver of oil. One triangle is used in a nonreversible motor and two triangles are used for a reversible motor.



711L8F

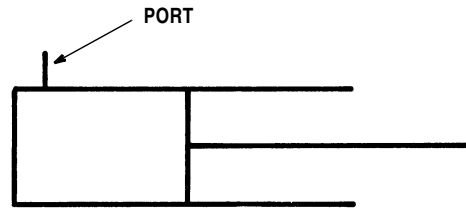
A simple schematic diagram is shown with a hydraulic motor connected to a hydraulic pump.

## Cylinder Symbols



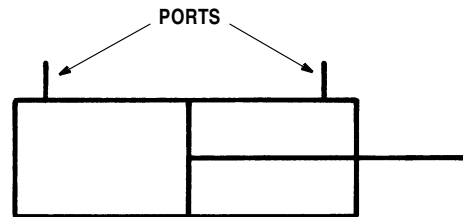
711L8Q

A cylinder symbol is a simple rectangle representing the barrel. The piston and rod are represented by a tee that is inserted into the rectangle. The symbol can be drawn in any position.



SINGLE ACTING CYLINDER

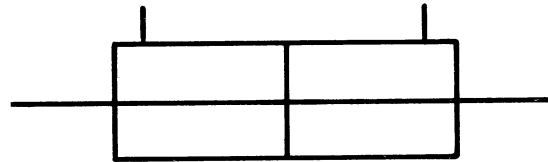
711L8P



DOUBLE ACTING CYLINDER

711L8Q

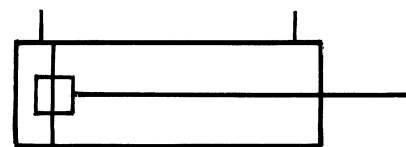
If the cylinder is single acting there is only one port shown on the symbol. The port is shown on the end of the cylinder that receives pressurized fluid and the opposite end of the cylinder is left open. A double acting cylinder symbol has both ends closed and has two ports on the symbol.



DOUBLE ROD END CYLINDER

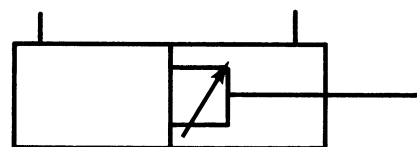
712L8A

A double rod end cylinder has a rod extending from each end of the rectangle.



SINGLE ROD END  
FIXED CUSHION BOTH ENDS

749L8E



SINGLE ROD END ADJUSTABLE  
CUSHION ROD END ONLY

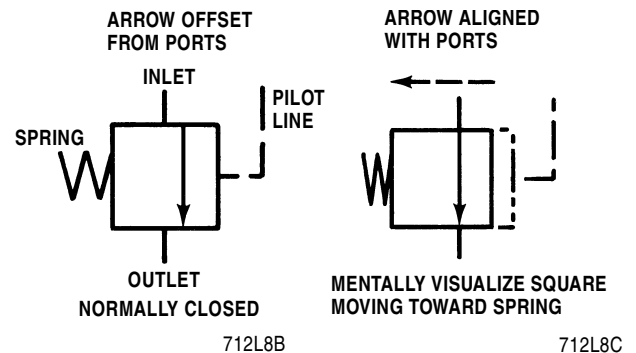
730L8E

Some cylinders have cushions built into them. The cushion slows down the movement of the piston as it nears the end of its stroke. Cylinder cushions are shown as a smaller rectangle on the piston. If the cushion has an adjustable orifice, a slanted arrow is drawn at 45 degrees across the symbol.

## Pressure Control Symbols

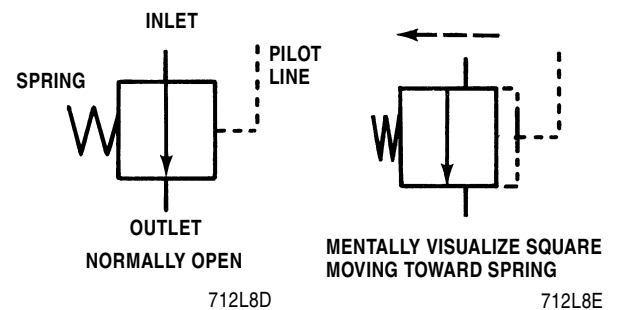
The basic symbol is a square (which is called an envelope) with external port connections and an arrow inside to show the oil passage and direction of flow. Usually this type of valve operates by balancing the oil pressure against a spring, so a spring is shown on one side of the symbol and a pilot pressure line on the other side.

### Normally Closed



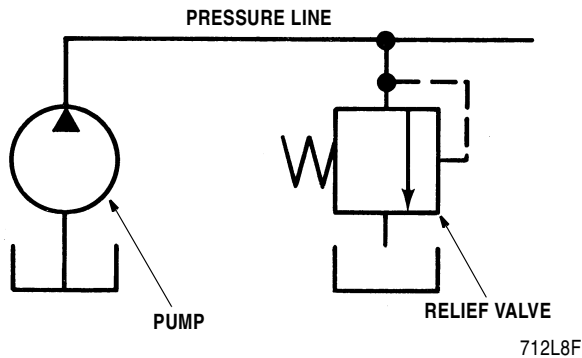
A normally closed valve, such as a relief or sequence valve, is shown with the arrow offset from the ports and toward the pilot pressure line side of the square. The spring holds the valve closed until the pilot line oil pressure is greater than the spring pressure. Mentally visualize a build up of pressure in the pilot line and the square moving over, compressing the spring. The oil can now flow through the valve.

### Normally Open



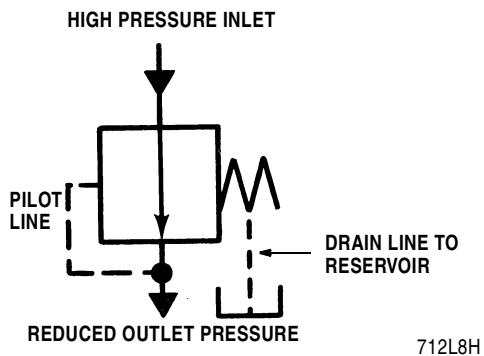
A normally open valve is shown with the arrow connecting the two ports. It closes when pressure overcomes spring force. Mentally visualize a build up of pressure in the pilot line and the square moving over, compressing the spring. The oil flow through the valve is now blocked.

## Relief Valve



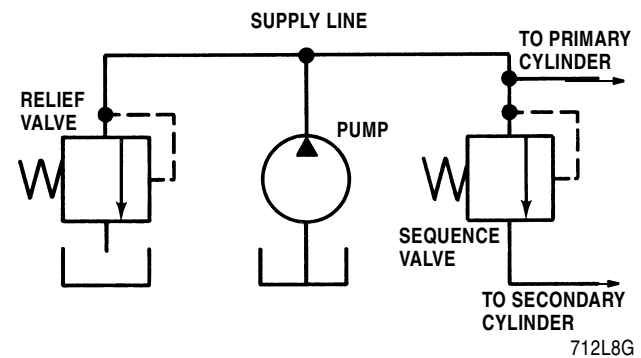
A relief valve is shown as a normally closed symbol connected between the pressure line and the reservoir. The flow direction arrow points away from the pressure line port and toward the reservoir. This shows very graphically how a relief valve operates. When pressure in the system overcomes the valve spring, flow is from the pressure line through the relief valve to the reservoir.

## Pressure Reducing Valve



A pressure reducing valve is shown as a normally open symbol in a pressure line. This valve works opposite of a relief valve, since it senses outlet pressure versus inlet pressure. As the outlet pressure builds, it works against a predetermined spring force. As the spring force is overcome, flow through the valve is modulated or shut off.

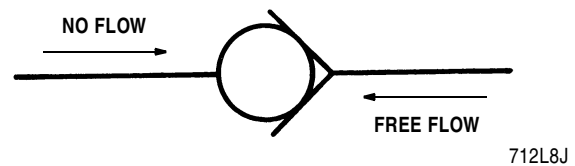
## Sequence Valve



The normally closed symbol is also used for a sequence valve. The inlet port is connected to a primary cylinder and the outlet port to the secondary cylinder line. When the piston in the primary cylinder reaches the end of its stroke, the pressure in the supply line increases. The sequence valve is also connected to the supply line and also feels the increase in pressure. As pressure increases, the square and directional flow arrow moves over, connecting the inlet and outlet ports allowing fluid to flow to the secondary cylinder.

## Directional Control Symbols

### Simplified Symbols One Way Valve



A simple ball check valve is shown. When oil pressure is exerted on the left side of the ball, the ball is forced into the V and no oil can flow past it. When oil pressure is applied to the right side of the ball, the ball moves away from the V and oil can flow past it.

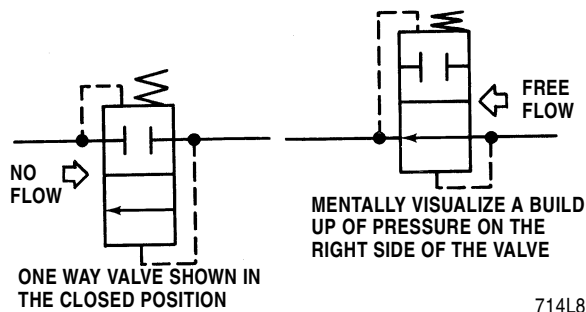
### By Pass Valve



A by pass valve is shown as a one way valve with a spring on the ball end of the symbol. This shows that a pressurized flow will be necessary to overcome the spring force and allow flow around the ball

## Composite Symbols

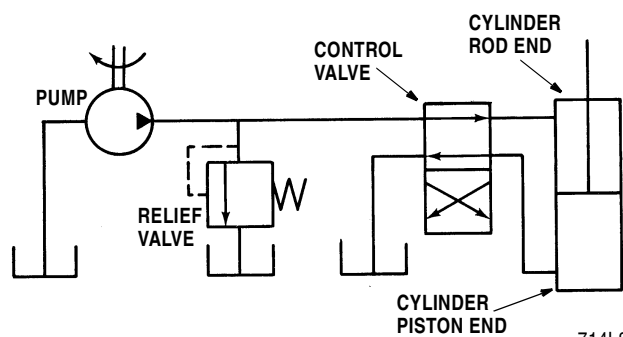
### One Way Valves



714L8A

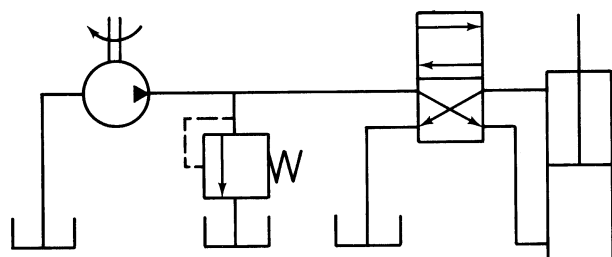
A more complex one way valve is now shown. This directional control symbol uses a multiple envelope (square) system that has a separate square for each position. Remember all of the port connections are made to the envelope that shows the neutral condition of the valve. Within each envelope are arrows showing the flow paths when the valve is shifted to that position.

### Two Position Valves



714L8

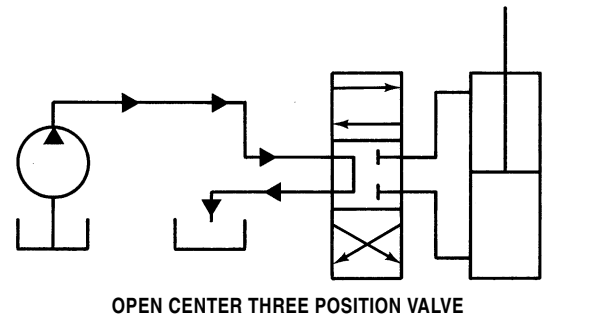
A simple control valve has two envelopes (representing the spool) if it is a two position valve. The envelopes show the flow conditions when they are in one position. The above schematic is showing that oil is being supplied to the rod end of the cylinder. If we mentally visualize the directional control valve moved to the other position, it would be as shown below.



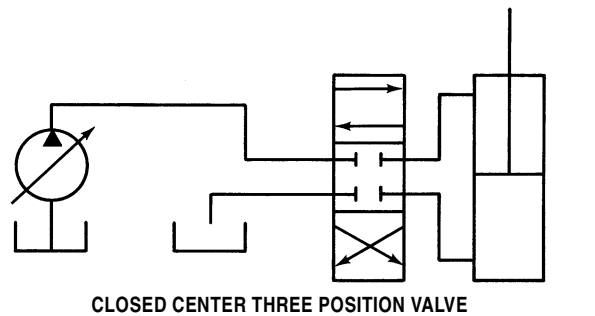
714L8C

Here, pressurized oil is being supplied to the piston end of the cylinder and oil from the rod end of the cylinder is allowed to flow to the reservoir.

### Three Position Valves



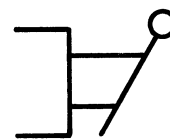
713L8A



713L8B

Three position valves will have a centered (neutral) position. The centered position can be either open or closed to flow. The open center is usually used with a fixed displacement pump and the closed center is usually used with a variable displacement pump.

### Actuating Controls



713L8G

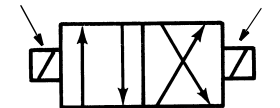


713L8F



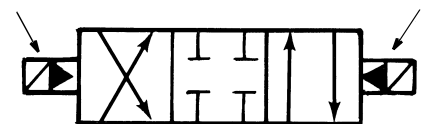
TWO POSITION, CONTROLLED BY EXTERNAL PILOT PRESSURE

713L8D



TWO POSITION, CONTROLLED BY SOLENOIDS

713L8E

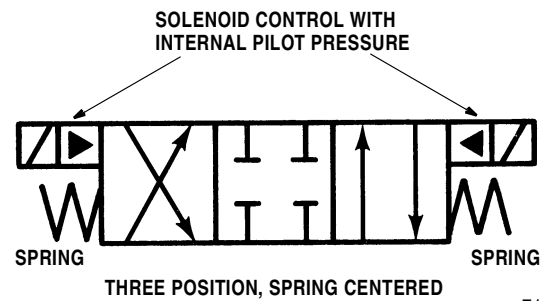


THREE POSITION, SOLENOID CONTROLLED WITH INTERNAL PILOT ASSIST PRESSURE

713L8D



Valve spools are controlled by levers, pedals, pilot oil, electric solenoids, etc., which are called actuating controls. These actuating controls are shown by symbols placed on the ends of the envelopes.

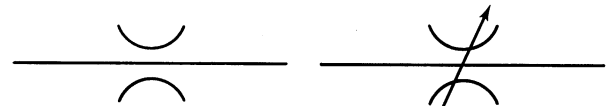


713L8C

To show that a valve is spring centered, a spring symbol is placed at each end of the envelope. The above schematic shows that an electrical solenoid and pilot pressure assist are required to overcome spring force to move the valve spool.

## Flow Control Symbols

### Restrictors



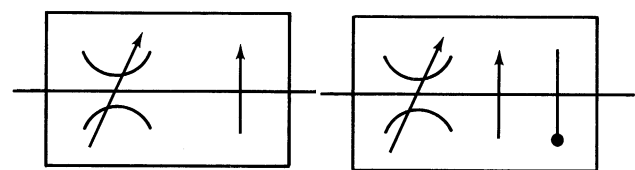
NON ADJUSTABLE RESTRICTOR

716L8A

ADJUSTABLE RESTRICTOR

716L8E

The basic flow control symbol is a representation of a restrictor. If the restrictor is adjustable, a slanted arrow is drawn across the symbol. The restrictor could be a special fitting with a small hole in it or a small drilled passageway within a valve. If it is an adjustable restriction, it could be thought of as a water faucet that can be controlled by turning the handle to regulate the flow. Restrictors can be applied to meter out, meter in and bleed off circuits.



ADJUSTABLE RESTRICTOR  
PRESSURE COMPENSATED

716L8C

ADJUSTABLE RESTRICTOR  
PRESSURE AND  
TEMPERATURE COMPENSATED

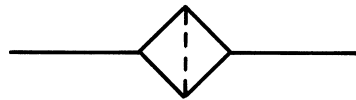
716L8D

There are adjustable restrictors that are pressure compensated. That means that the size of the opening in the restrictor will change with increases and decreases in pressure. A perpendicular arrow indicates pressure compensation. If the restrictor has both pressure and temperature compensation, the symbol for a thermometer will also be shown.

## Accessories

Filters, strainers and heat exchangers are represented as squares that are turned 45 degrees and have the port connection at the corners.

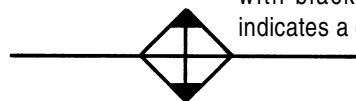
A dotted line perpendicular to the flow line indicates a filter or strainer.



**FILTER OR STRAINER**

716L8E

A solid line perpendicular to the flow with black triangles pointing out indicates a cooler.



**COOLER**

716L8F

The symbol for a heater is like the symbol for a cooler, except the black triangles point in.



**HEATER**

731L8G

Two sets of triangles pointing in and out indicates a temperature control unit



**TEMPERATURE  
CONTROL UNIT**

731L8H

As you can see, the black triangles point in the direction that the heat is dissipated. Or in the case of the control unit, they show that the heat can be regulated.

An oval with details inside indicate an accumulator. The details inside will tell you what type of accumulator it is; spring loaded, gas charged, or other features.



The divider line indicates there is a separator between the charge and the oil. A hollow triangle indicates gas.

**GAS CHARGED**

716L8G



A spring shows that the accumulator is spring loaded.

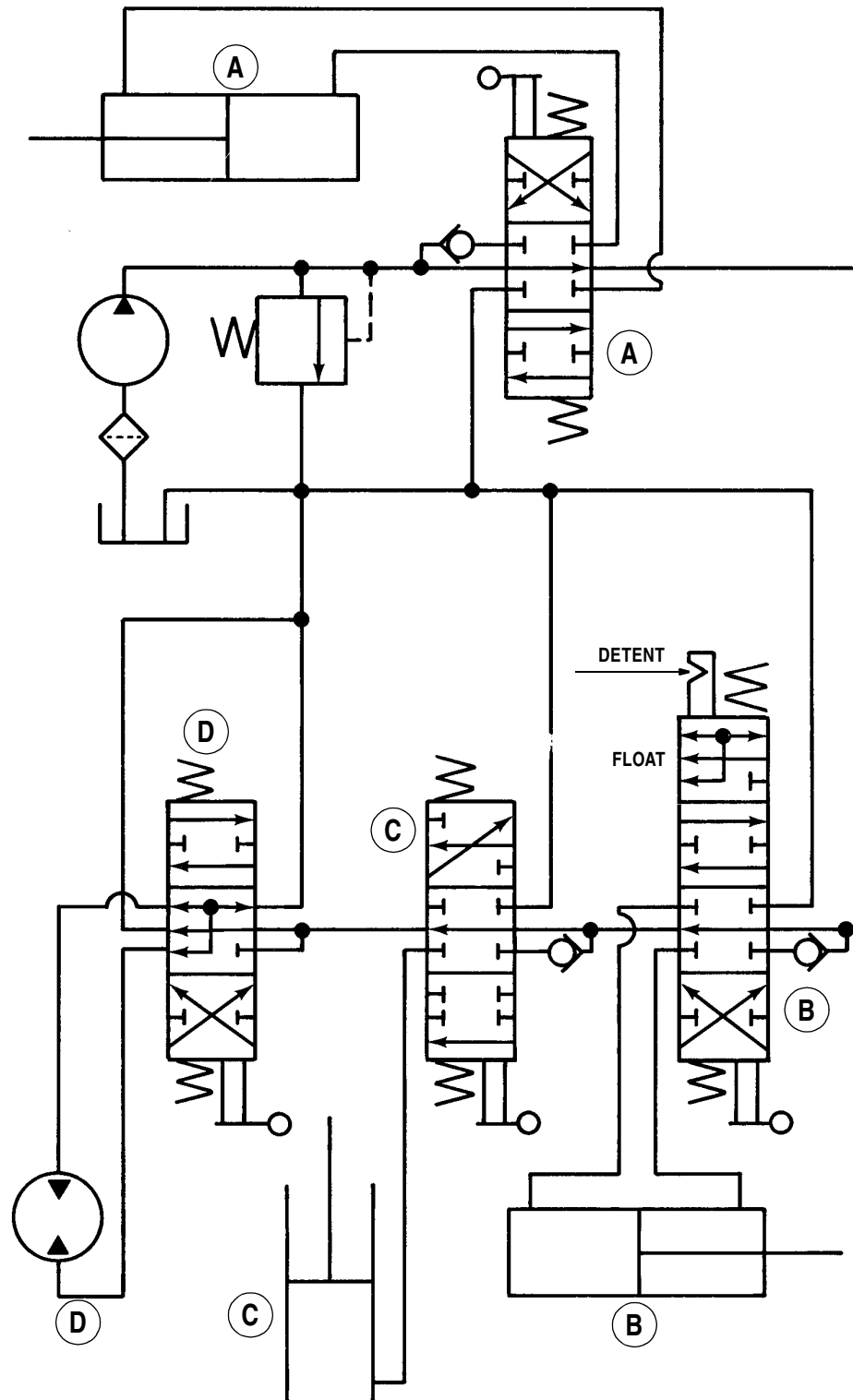
**SPRING LOADED**

716L8H

## NOTES

## SIMPLE SCHEMATIC

Now that you have completed hydraulic symbols, we have put some of the symbols together to form a simple hydraulic schematic. See if you can find your way around the schematic without reading the text for each valve. The text explains the function of each valve in the hydraulic system.



## Valve A

This valve is a three position valve. The spool is lever operated and spring centered. It is an open center valve. Visually place the envelopes into the center position and you will see that the valve will direct oil into one end or the other of cylinder A. When the spool in valve A is moved out of the centered position, the valves downstream will receive no oil.

## Valve B

Valve B is similar to valve A but it is a four position valve. The fourth position is a float position and is held into that position with a detent. With this valve the cylinder B can be extend, retracted, or placed in the float position. Visualizes the envelope for the float position in the inlet passageway.

You will see that oil can continue to flow to the next valve downstream and that the rod in cylinder B could be pushed back and forth. The oil could move from one end of the cylinder to the other via the valve. Both ends of the cylinder are also connected to the return line to the reservoir.

## Valve C

This valve is also similar to valve A but is designed to control a single acting cylinder. When you visualize placing the upper envelope in the center position you will see that oil can drain back to the reservoir from cylinder C.

At the same time, oil from the pump can flow through valve C to the next valve.

## Valve D

Valve D is a lever operated, spring centered valve and is designed to control a hydraulic motor. If a hydraulic motor was turning a flywheel and the oil supply and return were shut off abruptly, this would cause damage to the hydraulic lines, the motor, or whatever it was powering. Therefore when the valve supplying the motor is shut off, the motor should be able to slow down gradually. The center (neutral) position of valve D will allow that to happen by letting oil from the outlet of the motor return to the inlet side.

As you have seen, this brief information is all you need to read hydraulic schematics. The more you use it, the more you will be comfortable using hydraulic schematics as a troubleshooting guide.

## COMMON SYMBOLS

### Lines and Line Functions



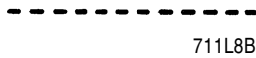
710L8H

SOLID LINE  
MAIN LINE



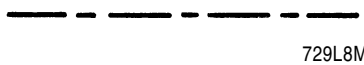
711L8A

DASHED LINE  
PILOT LINE



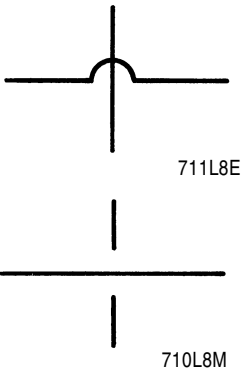
711L8B

DOTTED LINE  
EXHAUST OR DRAIN



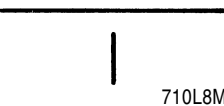
729L8M

ENCLOSURE OUTLINE



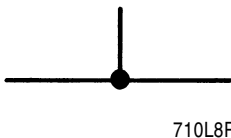
711L8E

LINES CROSSING



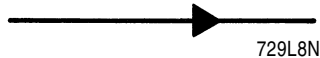
710L8M

LINES JOINING



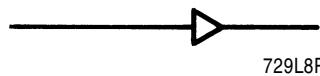
710L8P

LIQUID DIRECTION  
OF FLOW



729L8N

GASEOUS DIRECTION  
OF FLOW



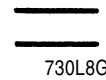
729L8P



711L8C

FLEXIBLE LINE

### Mechanical Devices



730L8G

MECHANICAL CONNECTIONS  
TWO PARALLEL LINES  
(SHAFTS, LEVERS, ECT)



730L8H

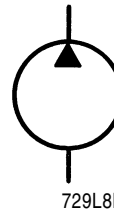
VARIABLE COMPONENT (RUN ARROW  
THROUGH SYMBOL AT 45 DEGREES)



730L8J

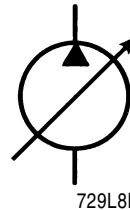
SPRING

### Pumps and Motors



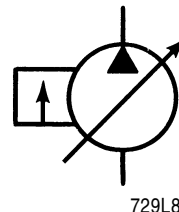
729L8D

HYDRAULIC PUMP  
FIXED DISPLACEMENT



729L8E

HYDRAULIC PUMP  
VARIABLE DISPLACEMENT



729L8F

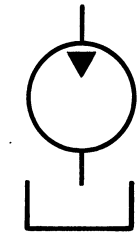
PRESSURE COMPENSATED  
VARIABLE DISPLACEMENT PUMP



711L8K

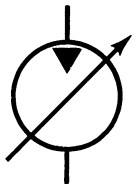
FIXED DISPLACEMENT  
HYDRAULIC PUMP  
(TWO DIRECTIONAL FLOW)

Cylinders



711L8M

HYDRAULIC MOTOR  
FIXED DISPLACEMENT



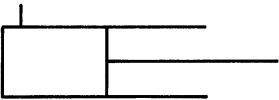
730L8B

HYDRAULIC MOTOR  
VARIABLE DISPLACEMENT



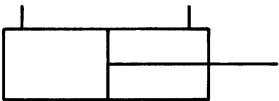
730L8C

HYDRAULIC OSCILLATOR



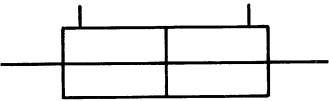
711L8P

SINGLE ACTING



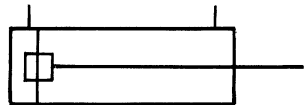
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DOUBLE ACTING  
SINGLE ROD END



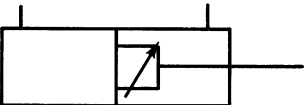
712L8A

DOUBLE ACTING  
DOUBLE ROD END



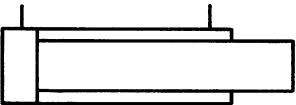
749L8EP

SINGLE ROD END  
FIXED CUSHION BOTH ENDS



730L8E

SINGLE ROD END  
ADJUSTABLE CUSHION  
ROD END ONLY



730L8F

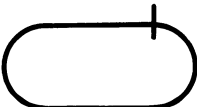
DIFFERENTIAL CYLINDER

Reservoirs



710L8B

RESERVOIR  
OPEN TO ATMOSPHERE



710L8A

PRESSURIZED RESERVOIR



710L8F

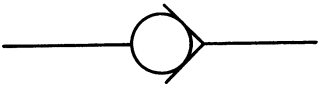
LINE TO RESERVOIR  
BELOW FLUID LEVEL



710L8E

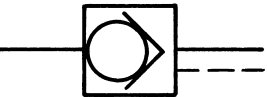
LINE TO RESERVOIR  
ABOVE FLUID LEVEL

Valves



712L8J

CHECK VALVE



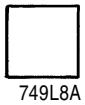
731L8A

PILOT OPERATED CHECK

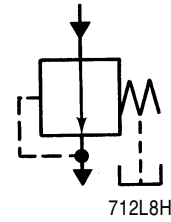


731L8B

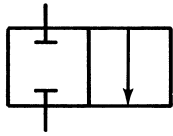
ON - OFF  
MANUAL SHUT OFF



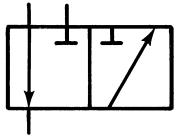
REGULATING OR  
SELECTOR VALVES



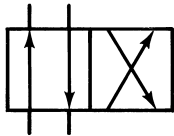
PRESSURE REDUCING VALVE



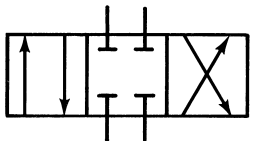
2 POSITION - 2 WAY VALVE



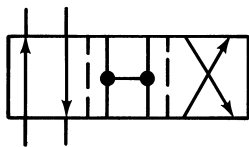
2 POSITION - 3 WAY VALVE



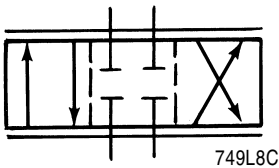
2 POSITION - 4 WAY VALVE



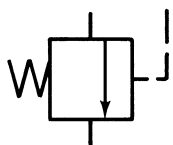
3 POSITION - 4 WAY VALVE



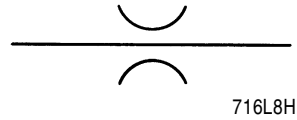
2 POSITION - 4 WAY  
OPEN CENTER CROSS OVER



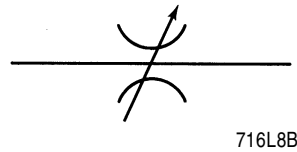
VALVE CAPABLE OF INFINITE  
POSITIONING (INDICATED BY  
HORIZONTAL LINES DRAWN  
PARALLEL TO THE ENVELOPE)



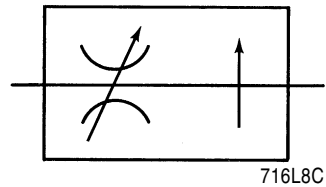
PRESSURE RELIEF VALVE



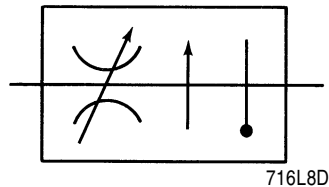
NON - ADJUSTABLE RESTRICTOR



ADJUSTABLE RESTRICTOR



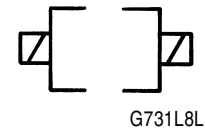
ADJUSTABLE RESTRICTOR  
PRESSURE COMPENSATED



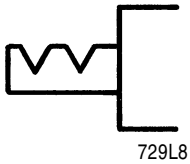
ADJUSTABLE RESTRICTOR  
(TEMPERATURE AND  
PRESSURE COMPENSATED)



Valve Actuators



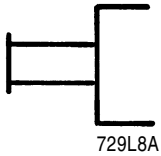
SOLENOID



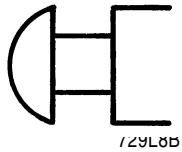
DETENT



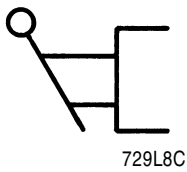
SPRING



MANUAL



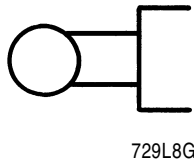
PUSH BUTTON



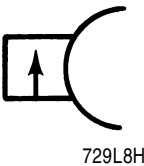
PUSH PULL LEVER



PEDAL



MECHANICAL



PRESSURE COMPENSATED

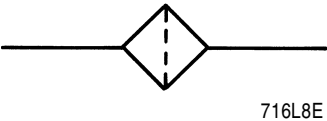


PILOT PRESSURE  
REMOTE SUPPLY

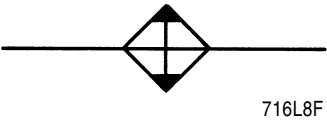


LIQUID SUPPLY

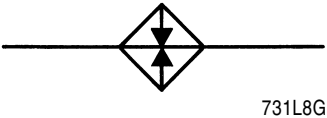
Accessories



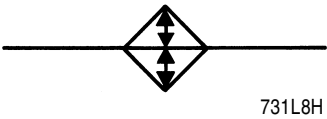
FILTER



COOLER



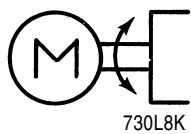
HEATER



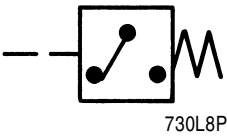
TEMPERATURE  
CONTROLLER



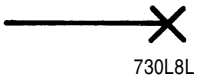
ACCUMULATOR  
HYDRO - PNEUMATIC



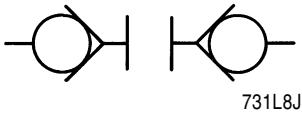
REVERSING MOTOR



PRESSURE SWITCH



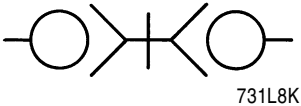
STATION OR TEST POINT



QUICK DISCONNECTS  
(DISCONNECTED)



PRESSURE INDICATOR



QUICK DISCONNECTS  
(CONNECTED)



TEMPERATURE INDICATOR



# **Section 35**

## **Chapter 2**

**HYDRAULIC SYSTEM  
HOW IT WORKS WITH TROUBLESHOOTING**

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## GENERAL INTRODUCTION

The tractor uses three hydraulic pumps which are driven through a drive housing on the right side of the range transmission. The pump drive housing gears are driven by the PTO driveline and all the pumps turn at approximately 1.33 times engine speed. A PFC piston pump is attached to the front of the pump drive housing while the tandem gear pumps are attached to the rear of the pump drive housing.

The front section of the tandem gear pump is used to supply the regulated pressure circuit: brake valve, transmission control valves, PTO and differential lock valve, auxiliary and hitch valve pilot circuits. The rear section supplies charge flow to the PFC pumps. The PFC pump supplies flow to the priority valve which directs flow to the steering system, remote auxiliary valves and, the three point hitch.

All hydraulic lines are equipped with O-ring face seals to ensure reliable, vibration resistant connections.

## Hydraulic Pumps

### Charge/Lubrication Pump

The charge/lubrication pump is the rear section of the dual gear pump and it is used to supply the main PFC pump with a charged inlet condition to prevent cavitation. The pump also supplies lubrication and cooling requirements for the transmission.

The pump draws oil from the transmission housing through a 100 mesh suction screen. The pump flow is directed across the main filter assembly to provide clean charge and lubrication oil.

The pump flow rate at rated speed 2667 RPM (2000 RPM engine speed) is 177 L/min (47 US GPM).

### Regulated Circuit Pump

The regulated circuit pump is the front section of the tandem gear pump. The pump draws oil from the system reservoir through a 100 mesh suction screen. The pump flow passes through the regulated circuit filter housing and into the priority regulator valve. The priority regulator valve maintains the regulated pressure circuit at 22.4 to 24.5 bar (325 to 355 PSI). The regulated pump flow supplies the PTO/ differential lock valve, transmission control valves and brake valve. Both the remote and hitch valves are also supplied with regulated pressure.

Once these circuits are satisfied the excess regulated pump flow is directed through the oil coolers and joins up with the charge pump flow at the downstream side of the main filter head.

The pump flow rate at rated speed 2667 RPM (2000 engine RPM) is 102 L/min (27 GPM).

### PFC Piston Pump

The axial piston pump has a variable flow output and can operate at variable pressures. The pump matches the hydraulic power output to the actual load requirements to ensure maximum efficiency and the minimum use of fuel.

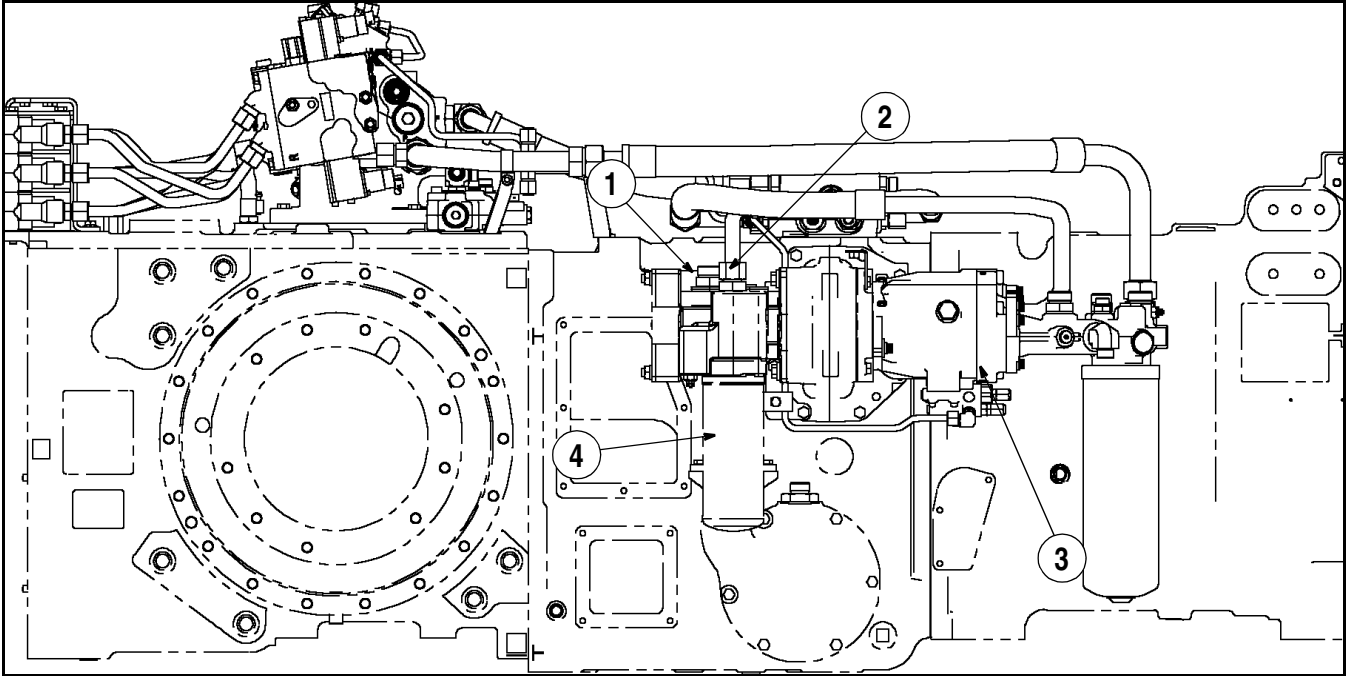
The pump inlet is charged to prevent cavitation. The pump output flow is supplied to the priority regulator valve. The priority regulator valve gives top priority to the steering system and trailer brake circuit. Once the steering system and trailer brake circuits are satisfied the priority regulator valve supplies pump flow to the remote auxiliary valves and three point hitch valve.

The maximum pump flow rate for the standard pump at rated speed 2667 RPM (2000 engine speed) is 146 L/min (38.6 GPM).

## Optional High Flow PFC Piston Pump

An optional high flow PFC piston pump is available.

The high flow rate maximum pump flow rate at rated speed 2667 RPM (2000 engine speed) is 220 L/min (58 GPM).



RI06A091

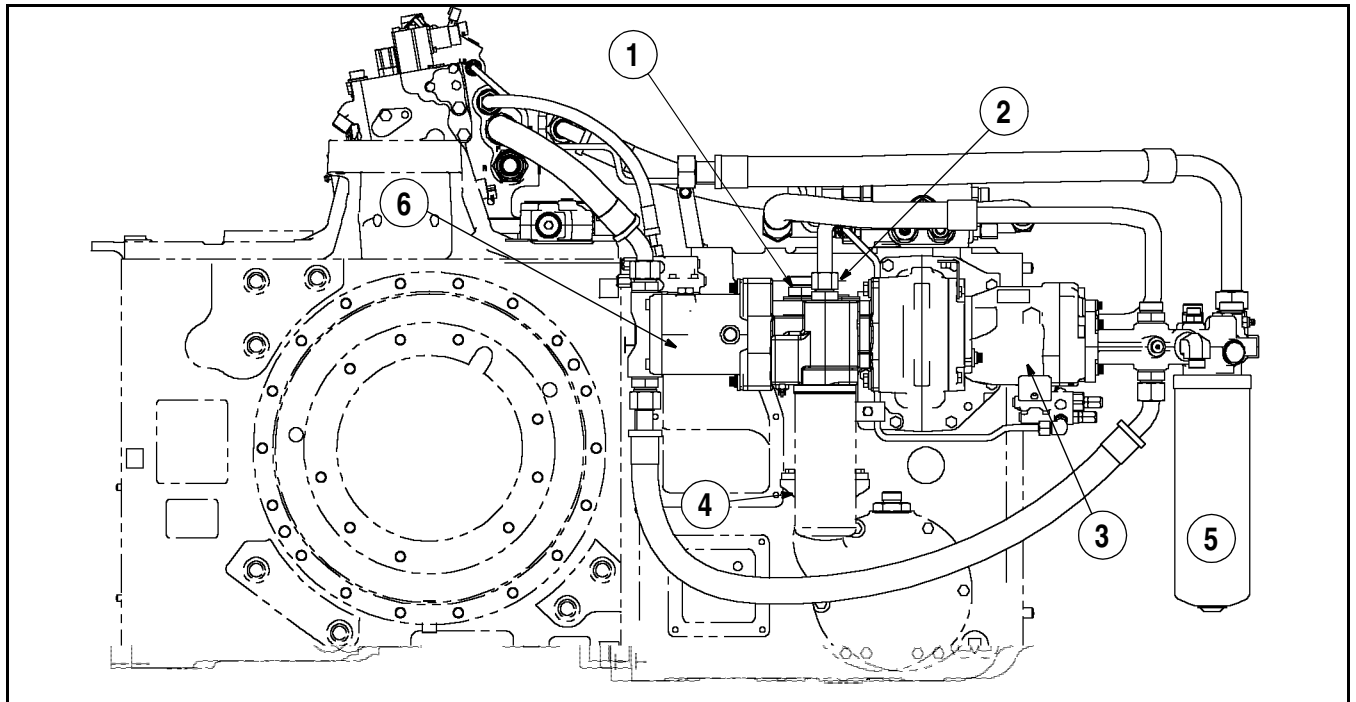
- |  |  |
|--|--|
| 1. CHARGE/LUBRICATION PUMP OUTLET (REAR SECTION) | 3. PFC PISTON PUMP                                 |
| 2. REGULATED CIRCUIT PUMP OUTLET (FRONT SECTION) | 4. DUAL GEAR PUMP/ REGULATED SYSTEM FILTER HOUSING |

## Optional MegaFlow PFC Piston Pump

The axial piston pump has a variable flow output and can operate at variable pressures. The pump matches the hydraulic power output to the actual load requirements to ensure maximum efficiency and the minimum use of fuel.

The pump inlet is charged to prevent cavitation. The pump output flow is supplied directly to the remote auxiliary manifold. The manifold is equipped with internal plugs to separate the MegaFlow supply flow, signal line pressure and signal line pilot relief from the standard PFC piston pump circuit. The MegaFlow pump supplies only the third, fourth or fifth remote sections. The two PFC pump hydraulic circuits operate independently.

The maximum pump flow rate (through one remote section) at rated speed 2667 RPM (2000 engine speed) is 117 L/min (31 GPM).

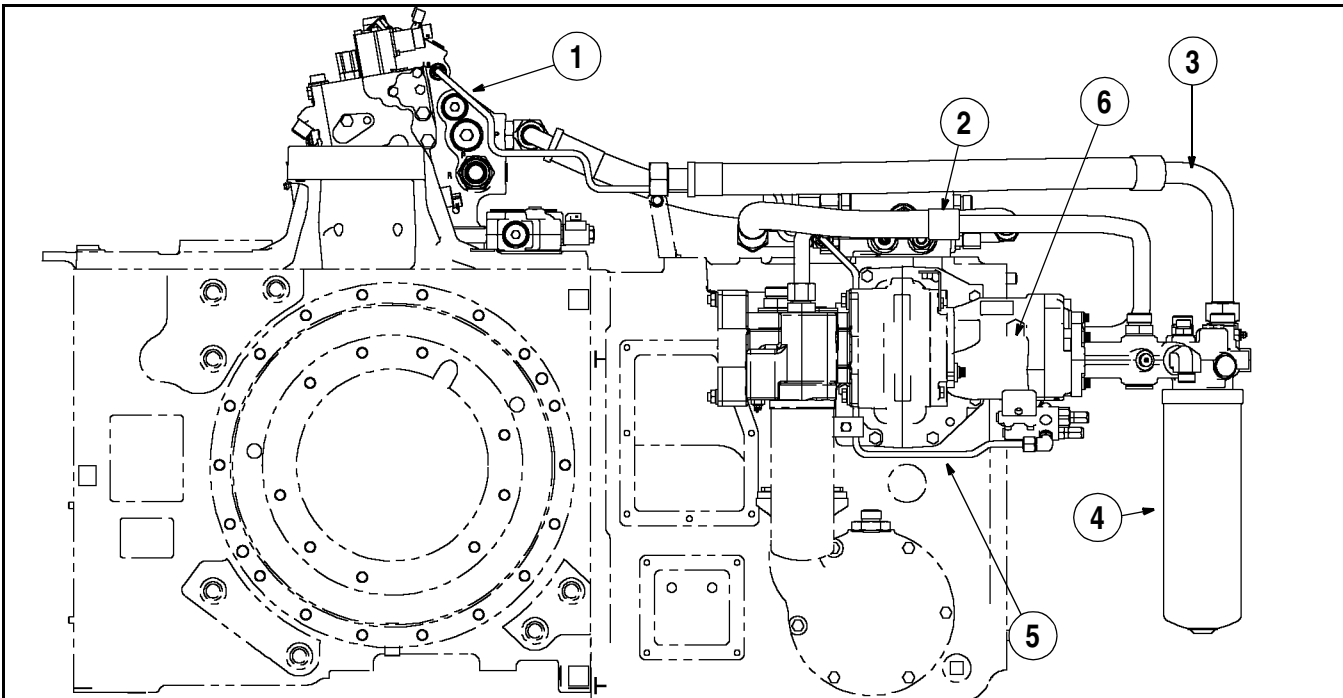


RH02K092

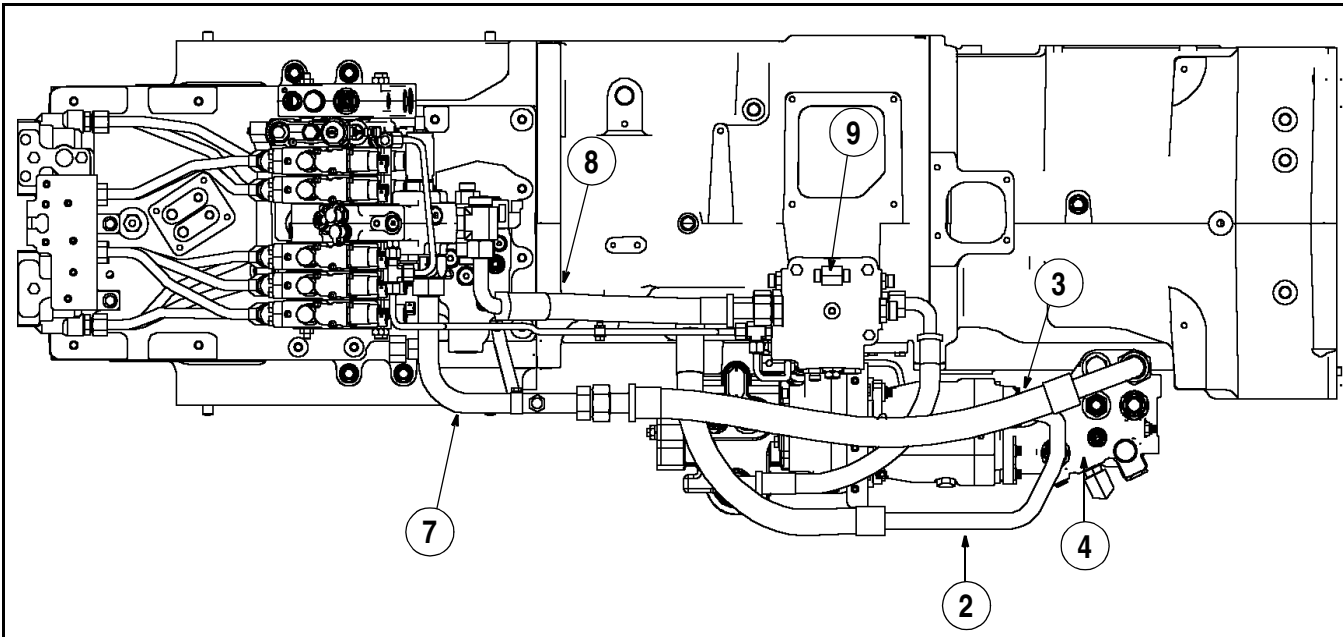
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|--|--|
| 1. CHARGE/LUBRICATION PUMP OUTLET (REAR SECTION) | 4. DUAL GEAR PUMP/ REGULATED SYSTEM FILTER HOUSING |
| 2. REGULATED CIRCUIT PUMP OUTLET (FRONT SECTION) | 5. MAIN FILTER ASSEMBLY                            |
| 3. PFC PISTON PUMP                               | 6. MEGAFLW PFC PISTON PUMP                         |



## Standard Flow PFC Pump Layout



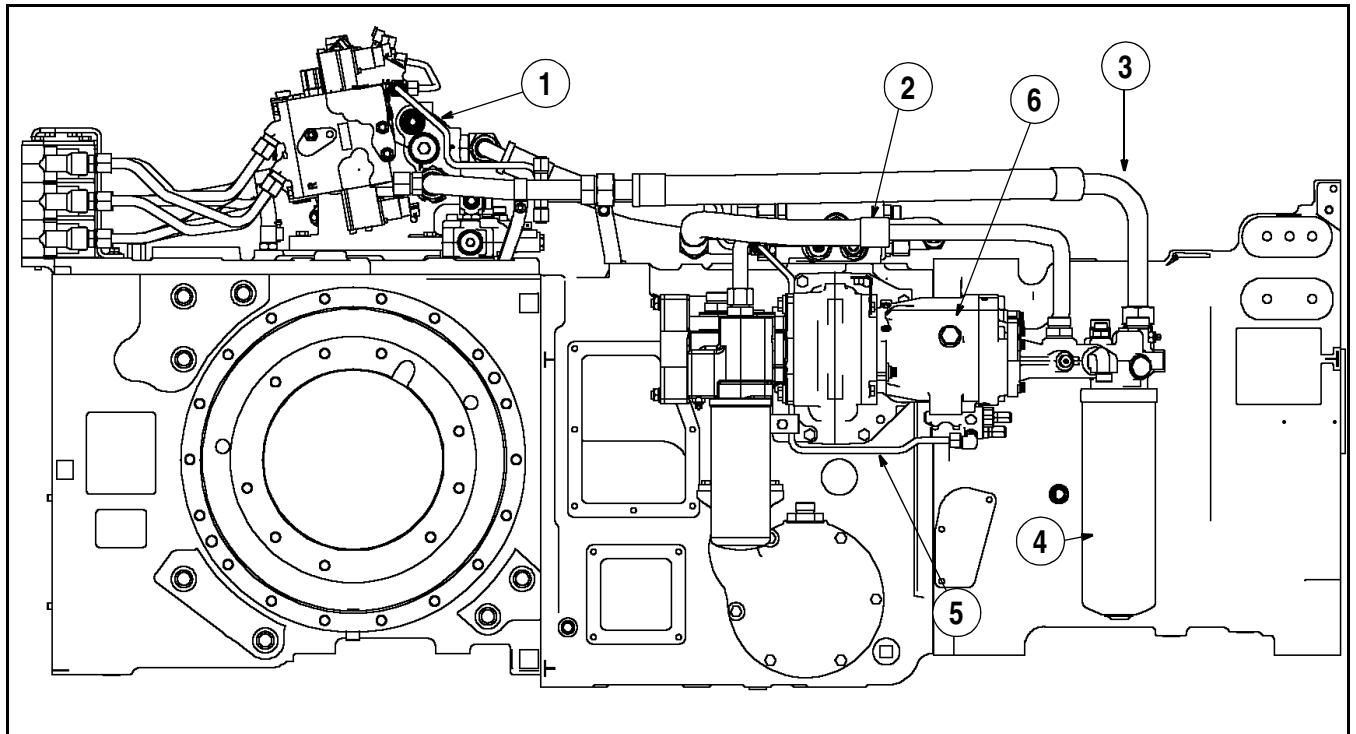
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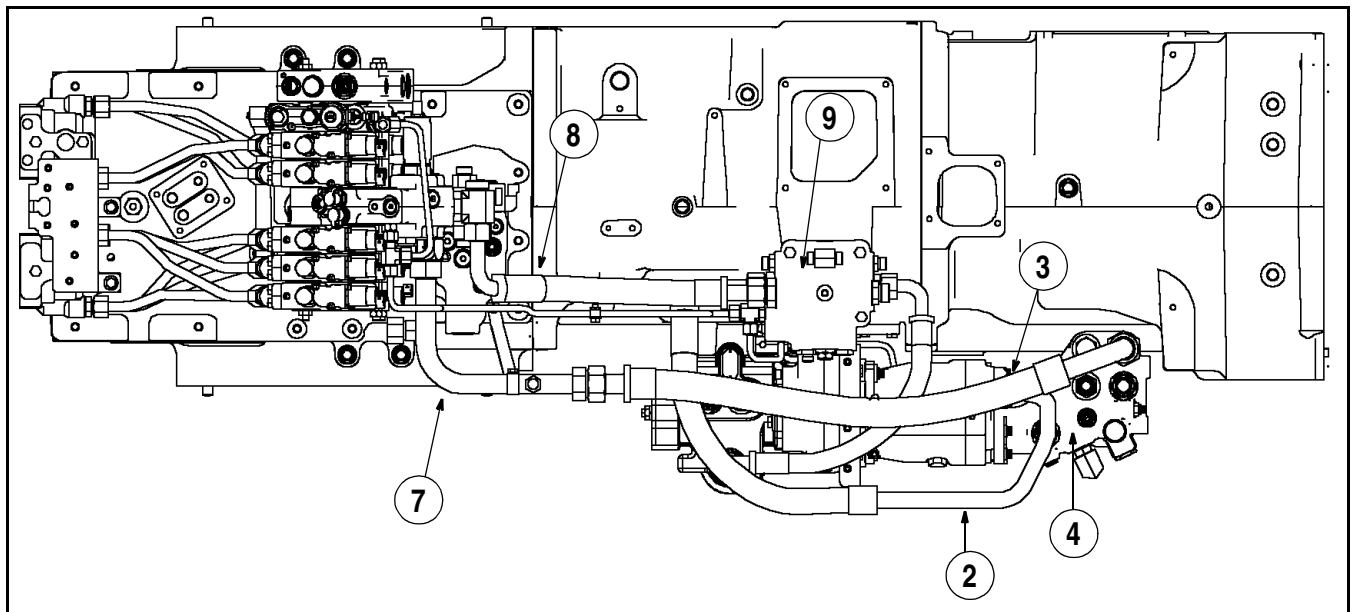
RI06A074

- |   |                                  |
|---|----------------------------------|
| 1. REMOTE MANIFOLD LOAD SENSE           | 6. PFC PISTON PUMP               |
| 2. PFC PUMP TO PRIORITY REGULATOR VALVE | 7. REMOTE MANIFOLD RETURN (TUBE) |
| 3. REMOTE MANIFOLD RETURN (HOSE)        | 8. REMOTE MANIFOLD SUPPLY        |
| 4. MAIN FILTER ASSEMBLY                 | 9. PRIORITY REGULATOR VALVE      |
| 5. PUMP LOAD SENSE                      |                                  |

## High Flow PFC Pump Layout



RI06A077

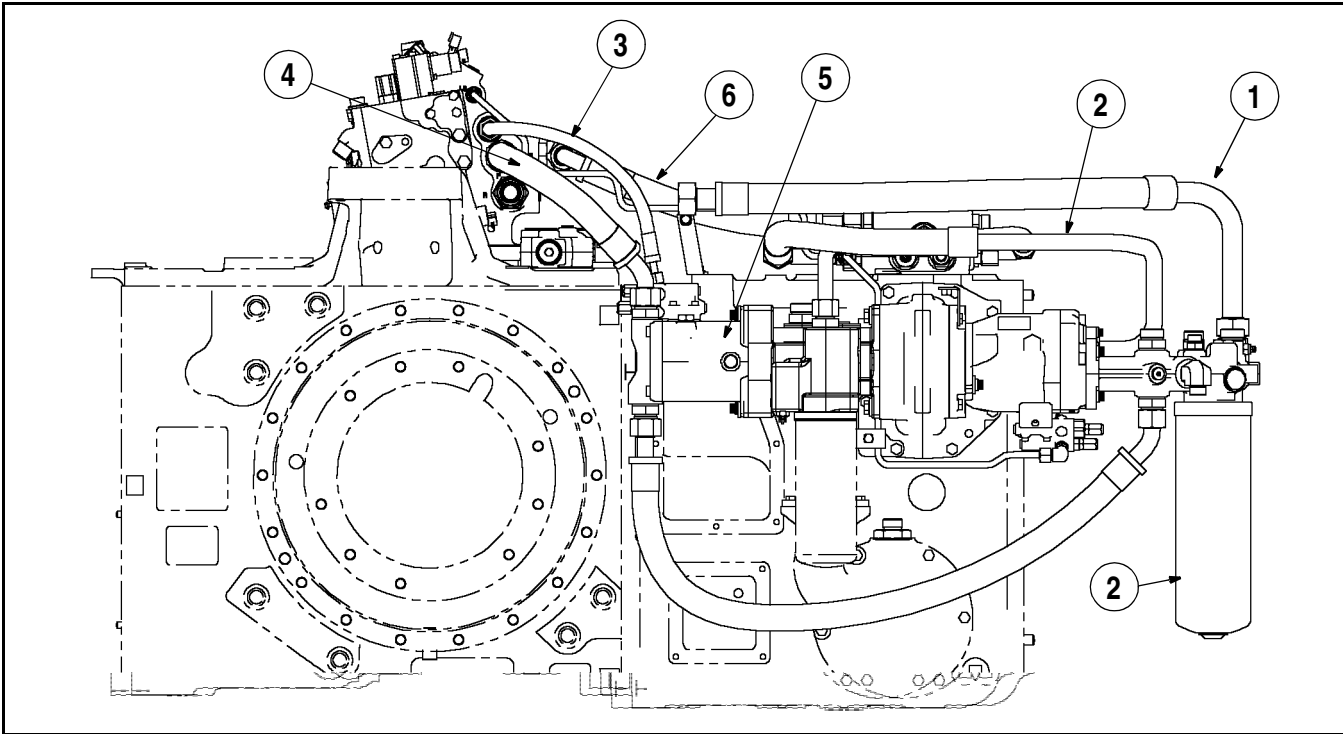


RI06A074

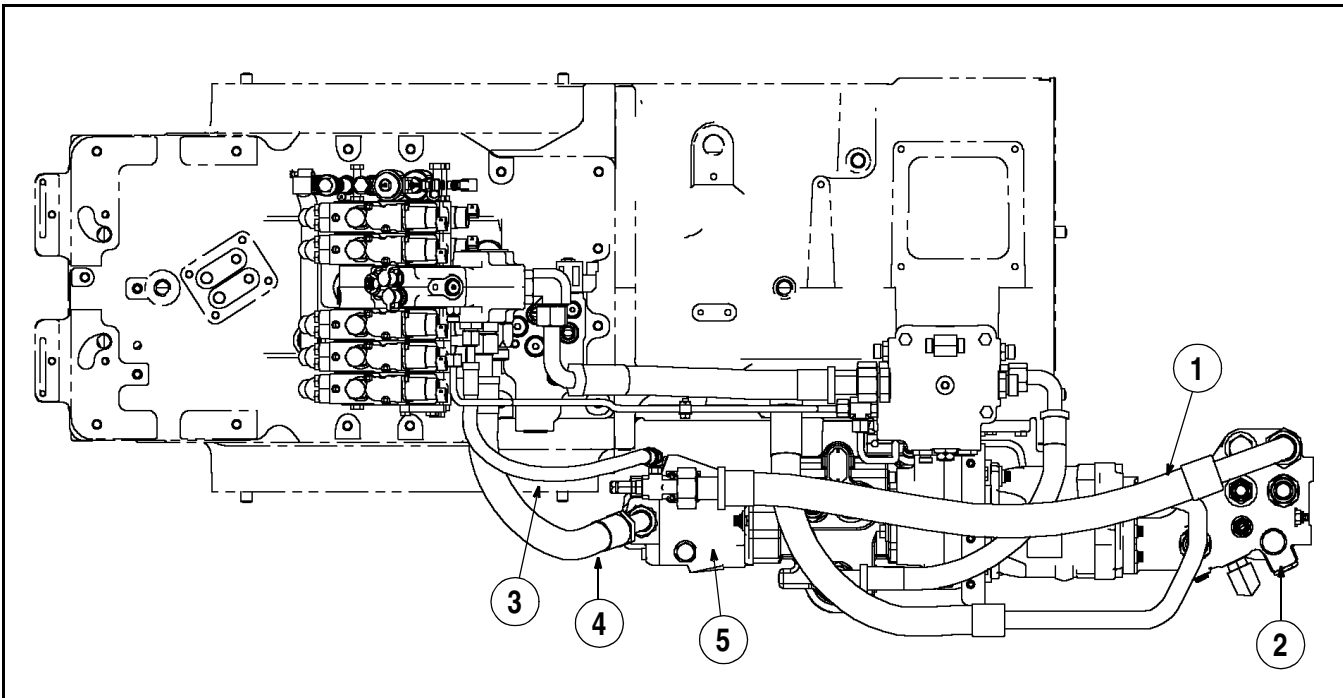
1. REMOTE MANIFOLD LOAD SENSE
2. PFC PUMP TO PRIORITY REGULATOR VALVE
3. REMOTE MANIFOLD RETURN (HOSE)
4. MAIN FILTER ASSEMBLY
5. PUMP LOAD SENSE

6. PFC PISTON PUMP
7. REMOTE MANIFOLD RETURN (TUBE)
8. REMOTE MANIFOLD SUPPLY
9. PRIORITY REGULATOR VALVE

## MegaFlow PFC Pump Layout



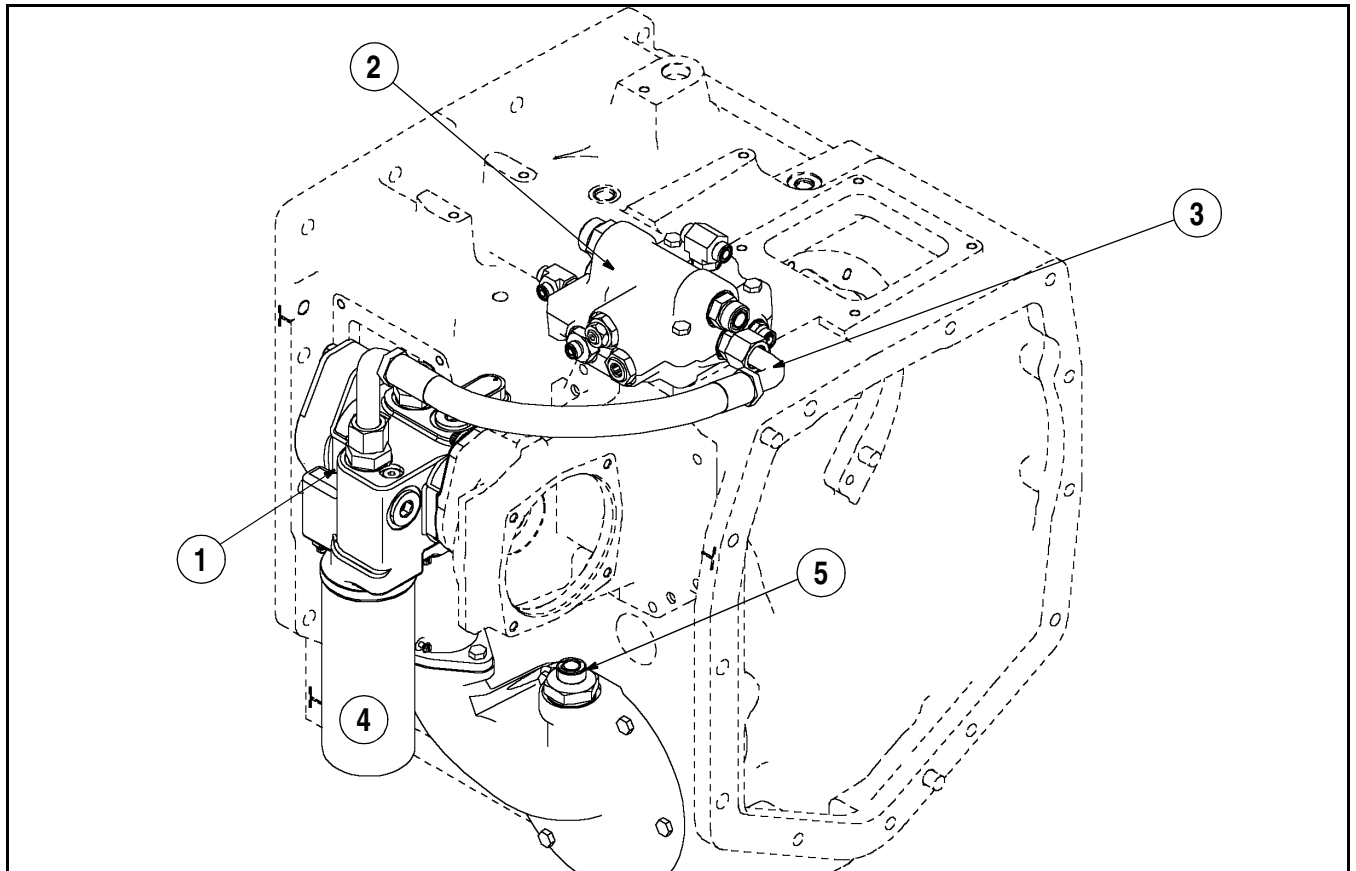
RH02K092



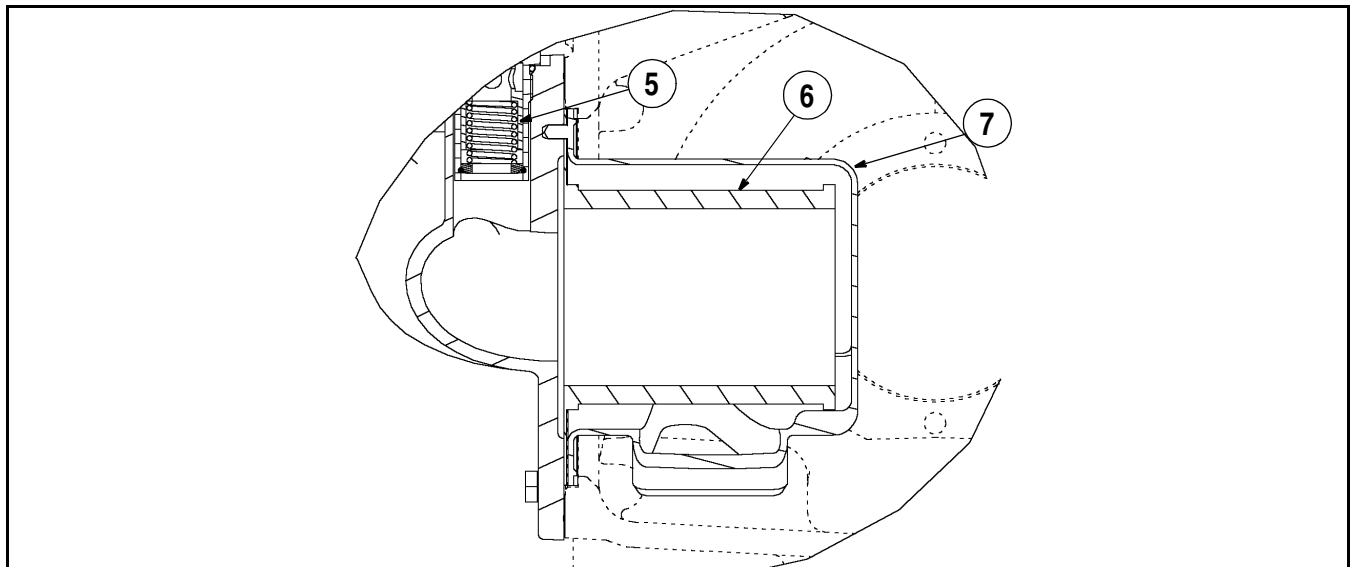
RI06A099

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| 1. REMOTE MANIFOLD RETURN (HOSE)    | 4. MEGAFLW REMOTE MANIFOLD SUPPLY |
| 2. MAIN FILTER ASSEMBLY             | 5. MEGAFLW PFC PISTON PUMP        |
| 3. MEGAFLW PFC PUMP LOAD SENSE LINE | 6. REMOTE MANIFOLD RETURN (TUBE)  |

## Charge Pump Layout



RI02D107



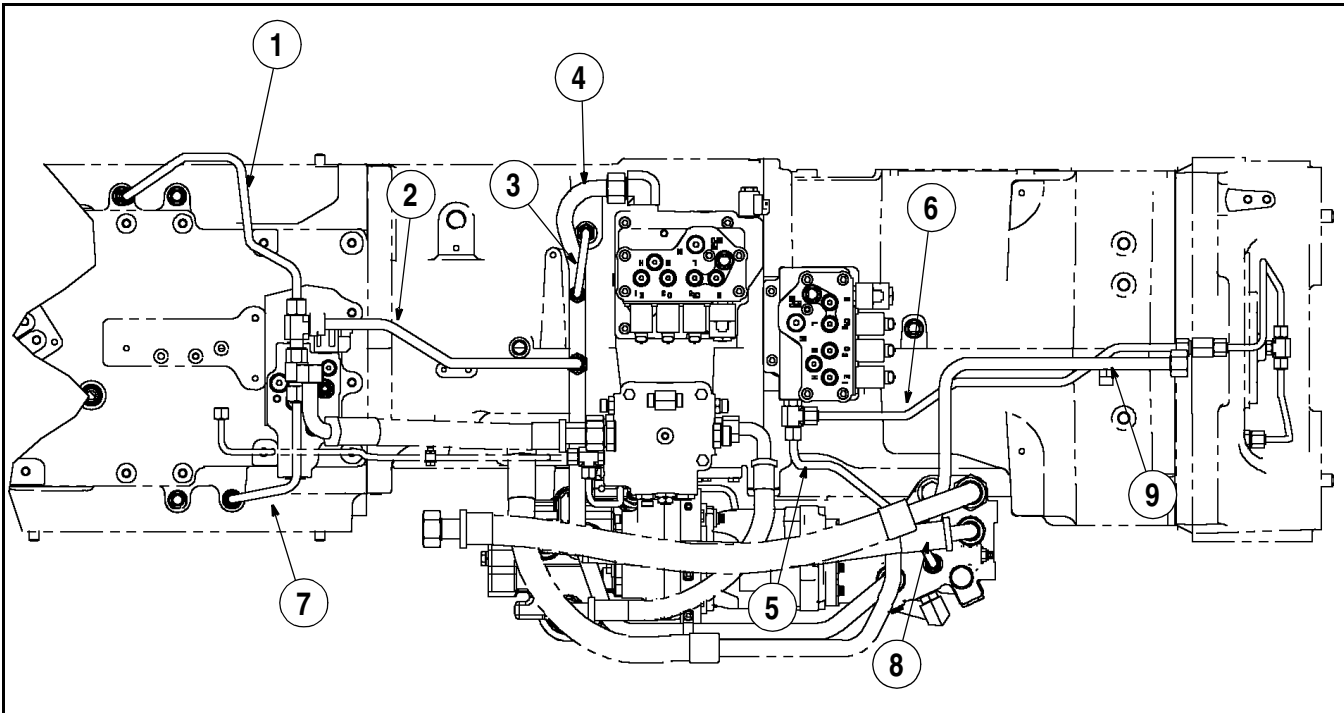
RI02D109

- |  |                               |
|--|-------------------------------|
| 1. DUAL GEAR PUMP ASSEMBLY             | 5. LUBE RELIEF VALVE ASSEMBLY |
| 2. PRIORITY REGULATOR VALVE            | 6. PUMP INLET SCREEN          |
| 3. REGULATOR SECTION INLET             | 7. SUCTION SCREEN SHROUD      |
| 4. REGULATED CIRCUIT FILTER (6 MICRON) |                               |

## Lubrication Circuit

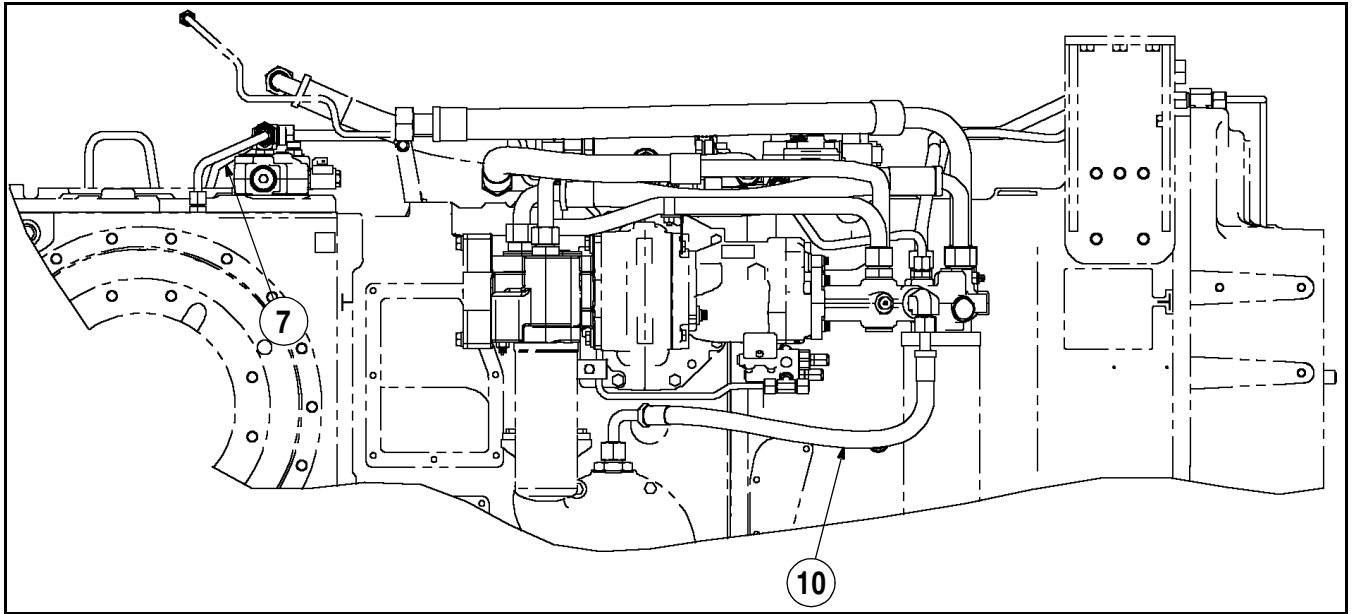
The lubrication flow is a combination of both dual gear pumps outputs. Filtered charge pump flow and filtered/cooled excess regulated circuit flow. Inlet charge pressure and lubrication are limited to 5 bar (75 PSI) by a lube relief valve.

The lubrication circuit provides a low pressure flow of oil to lubricate and cool the following transmission components: master clutch, bevel pinion gears, brakes, drop box, odd/even clutches, FWD/range, creep drive and PTO/differential lock lube.



RI06A079

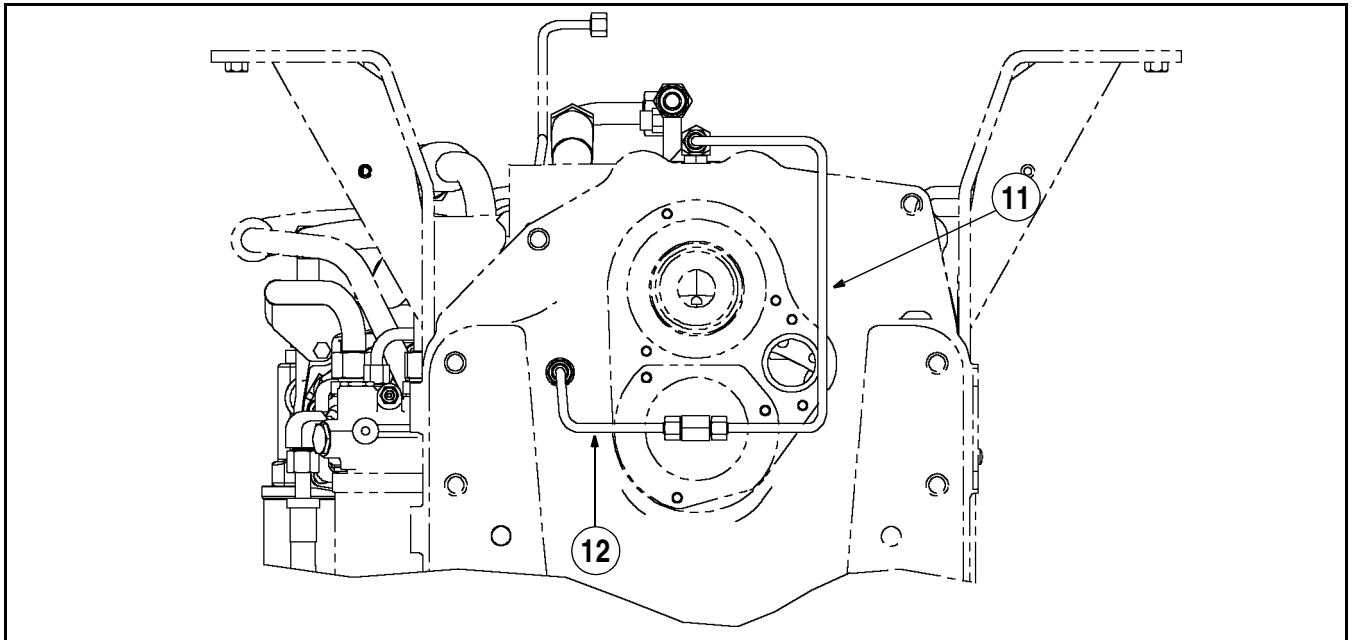
- |                       |                                |
|-----------------------|--------------------------------|
| 1. LEFT BRAKE LUBE    | 6. DROP BOX LUBE               |
| 2. PTO LUBE SUPPLY    | 7. RIGHT BRAKE LUBE            |
| 3. RANGE LUBE         | 8. CHARGE PUMP TO FILTER INLET |
| 4. MASTER CLUTCH LUBE | 9. OIL COOLER RETURN TO FILTER |
| 5. ODD/EVEN LUBE      |                                |



RI06A081

7. RIGHT BRAKE LUBE

10. LUBE RELIEF HOSE



RI06A080

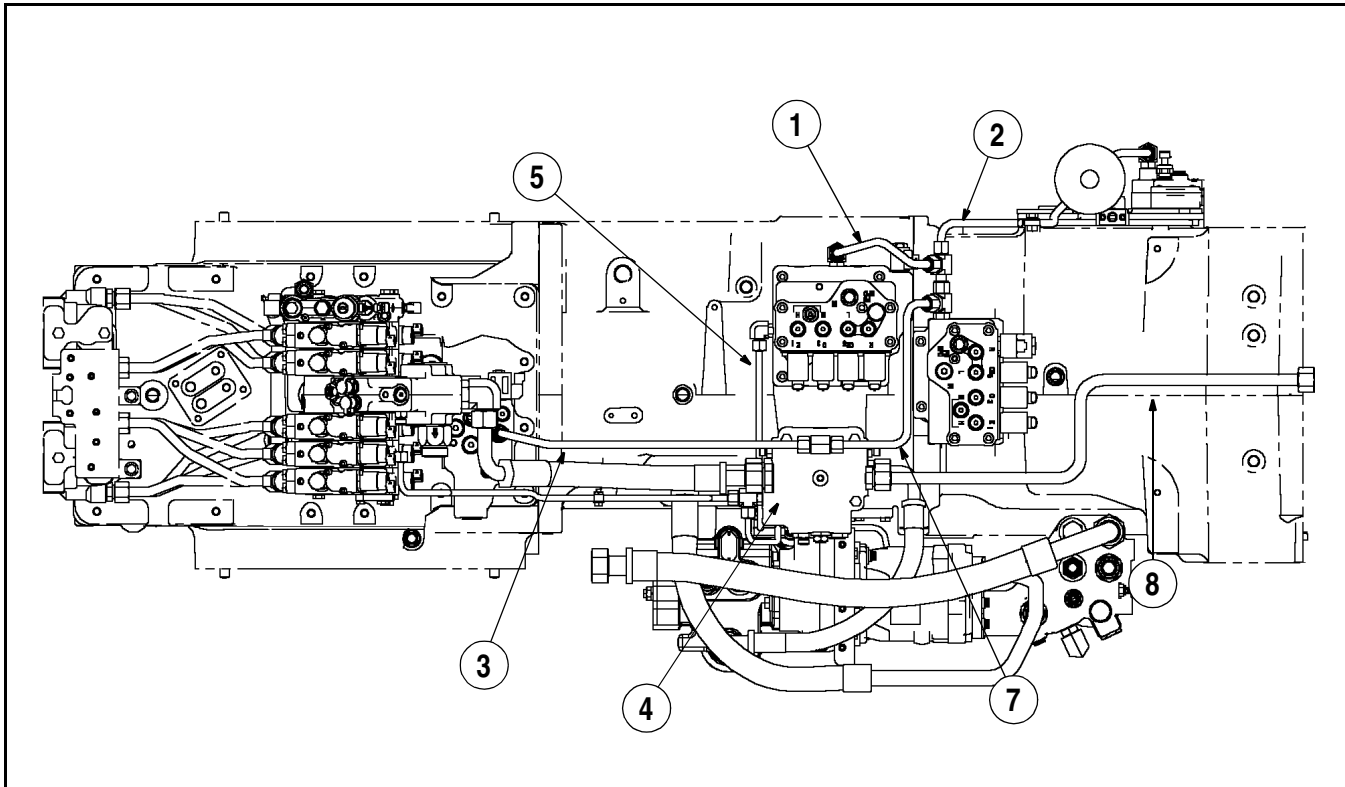
11. DROP BOX OUTPUT LUBE (WITHOUT CREEPER)

12. DROP BOX REAR BEARING LUBE

## Regulated Pressure Circuits

The regulated circuit is supplied by the front dual gear pump. The pump flow passes through the regulated circuit filter housing and onto the priority regulator valve. The pressure regulator portion of the valve maintains the regulated pressure at 22.4 to 24.5 bar (325 to 355 PSI).

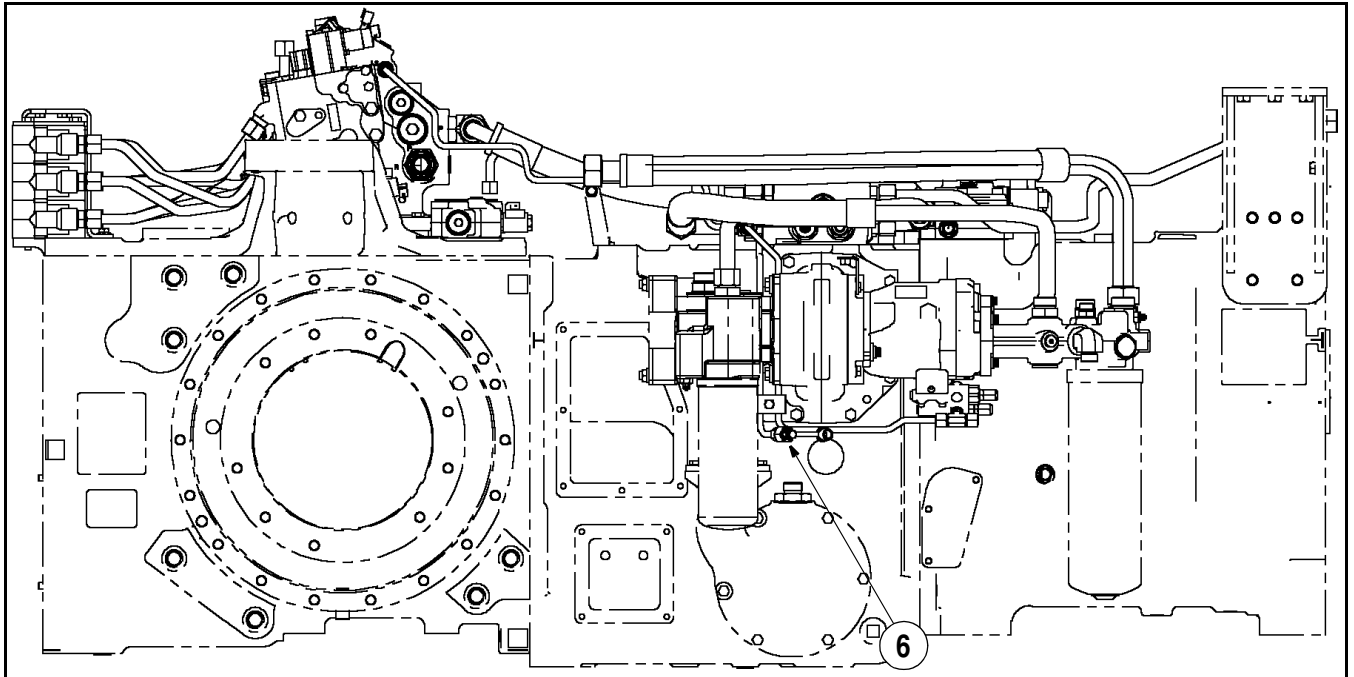
The following components are supplied by the regulated circuit: speed transmission powershift valve, odd/even transmission powershift valve (includes creep and park brake), range transmission powershift valve (includes FWD), PTO/differential lock valve, master clutch inching valve, brake valve, hitch valve pilot pressure, remote valve pilot pressure and FWD clutch supply.



RI06A086

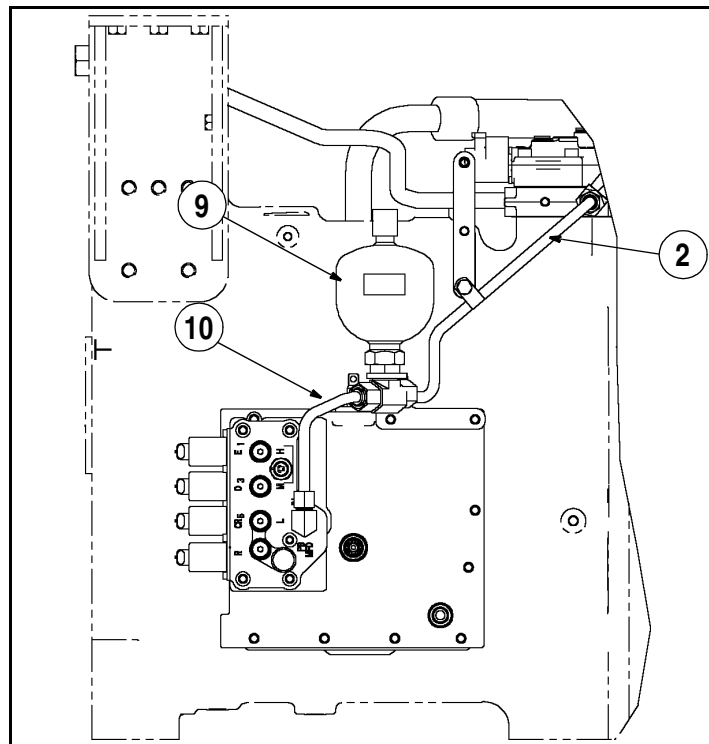
- |  |   |
|--|---|
| 1. RANGE REGULATED SUPPLY TUBE                                     | 6. MASTER CLUTCH DIAGNOSTIC COUPLER                                 |
| 2. SPEED TRANSMISSION CONTROL VALVE<br>REGULATED SUPPLY-UPPER TUBE | 7. TRANSMISSION CONTROL VALVE<br>REGULATED SUPPLY                   |
| 3. PRIORITY REGULATOR VALVE TO PTO<br>VALVE                        | 8. PRIORITY REGULATOR VALVE EXCESS TO<br>OIL COOLERS                |
| 4. PRIORITY REGULATOR VALVE  | 9. REGULATED CIRCUIT ACCUMULATOR                                    |
| 5. MASTER CLUTCH DIAGNOSTIC TUBE                                   | 10. SPEED TRANSMISSION CONTROL VALVE<br>REGULATED SUPPLY-LOWER TUBE |

**NOTE:** Brake, hitch and remote valves regulated supply tubes not shown. See brake, hitch and remote circuits in this section.



RI06A085

6. MASTER CLUTCH DIAGNOSTIC COUPLER



RI06A084

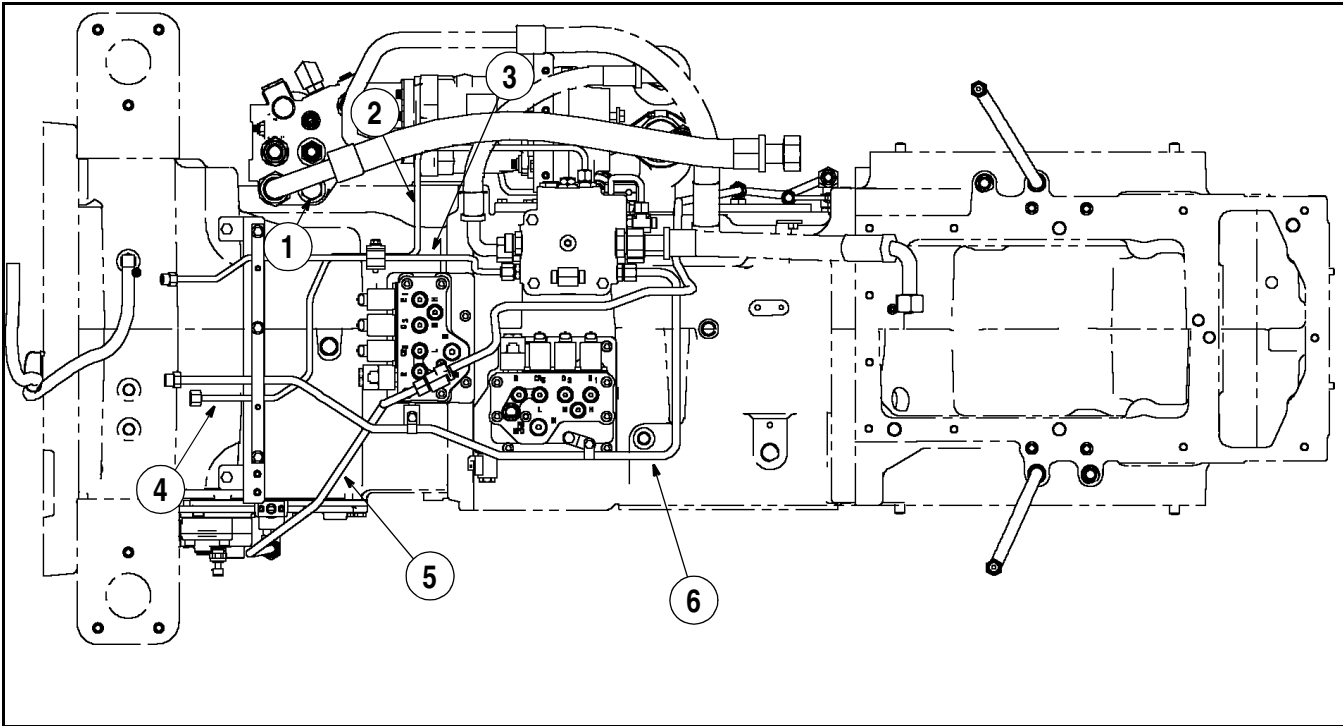
2. SPEED TRANSMISSION CONTROL VALVE  
REGULATED SUPPLY-UPPER TUBE

9. REGULATED CIRCUIT ACCUMULATOR

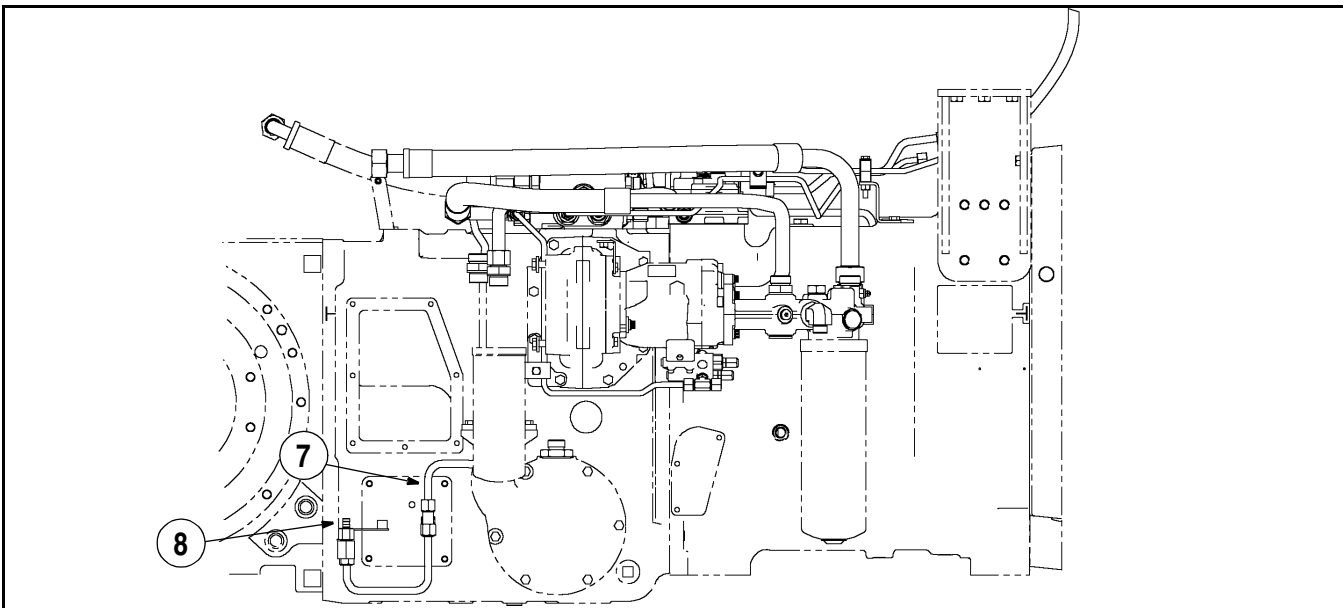
10. SPEED TRANSMISSION CONTROL VALVE  
REGULATED SUPPLY-LOWER TUBE



## Steering And Brake Tube Layout



RI06A083

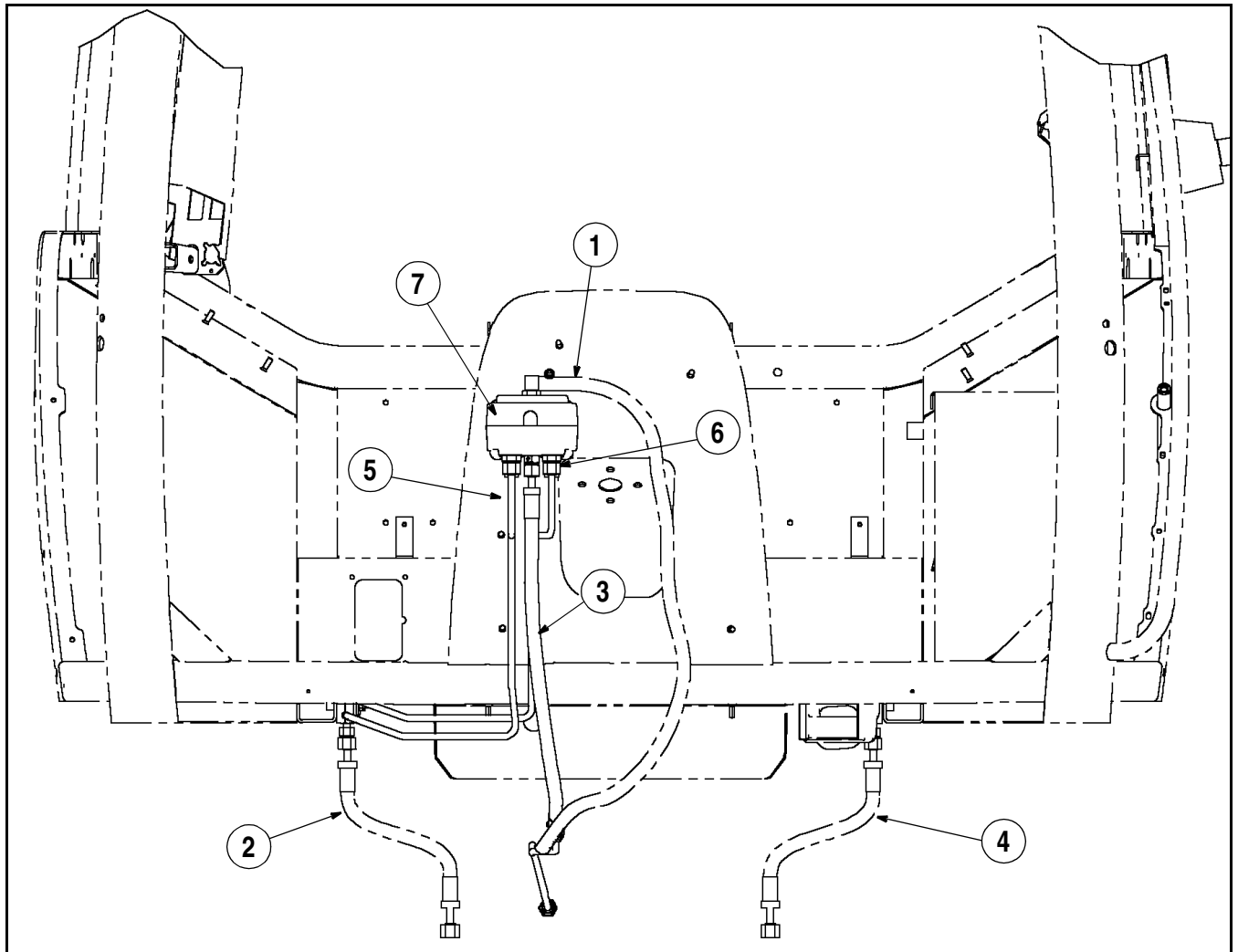


RI06A082

1. STEERING RETURN TO FILTER
2. STEERING SENSE LINE
3. BRAKE SUPPLY
4. BRAKE VALVE RETURN TO SUMP

5. PARK BRAKE (LEFT HAND)
6. STEERING SUPPLY
7. PARK BRAKE (RIGHT HAND)
8. DIAGNOSTIC COUPLER

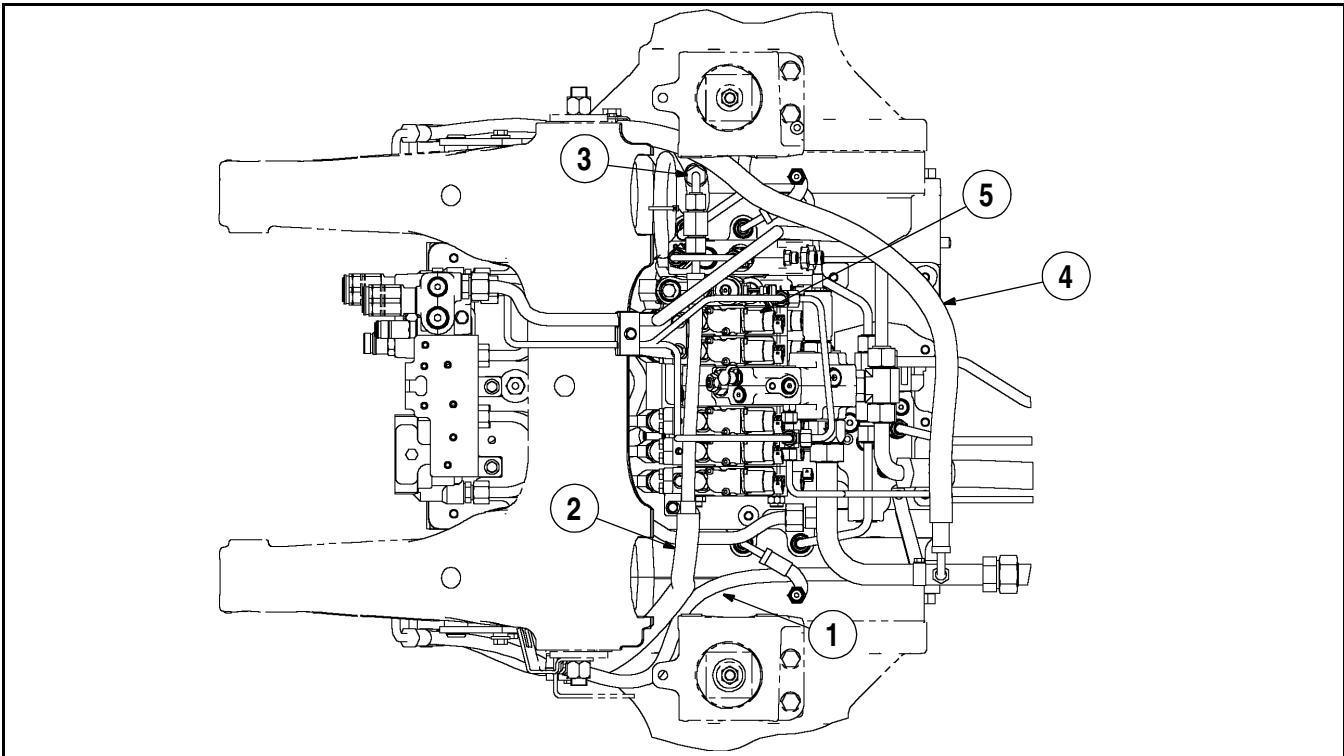
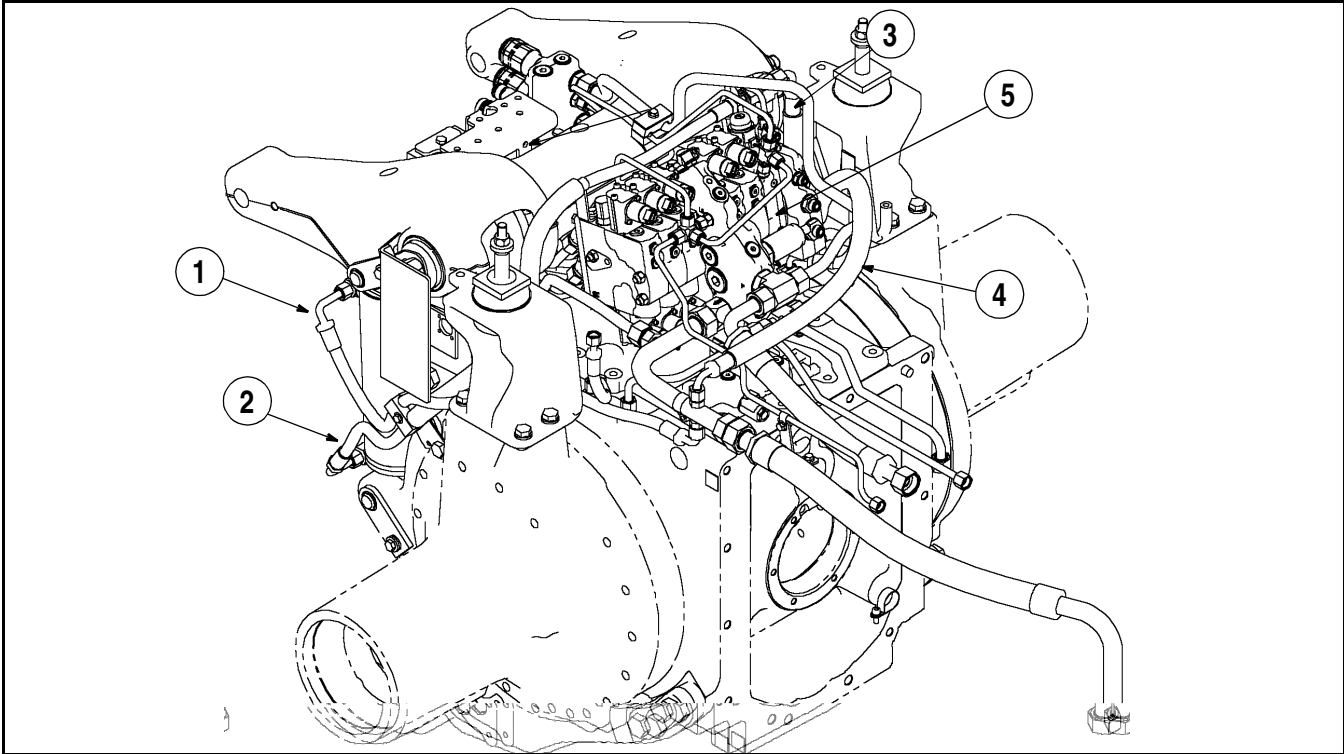
## Standard Brake Valve Plumbing Layout



R106A087

- |                               |                                   |
|-------------------------------|-----------------------------------|
| 1. BRAKE VALVE RETURN TO SUMP | 5. BRAKE SUPPLY TUBE (RIGHT SIDE) |
| 2. BRAKE HOSE (RIGHT SIDE)    | 6. BRAKE SUPPLY TUBE (LEFT SIDE)  |
| 3. BRAKE VALVE SUPPLY         | 7. BRAKE VALVE                    |
| 4. BRAKE HOSE (LEFT SIDE)     |                                   |

## Hitch System Plumbing Layout

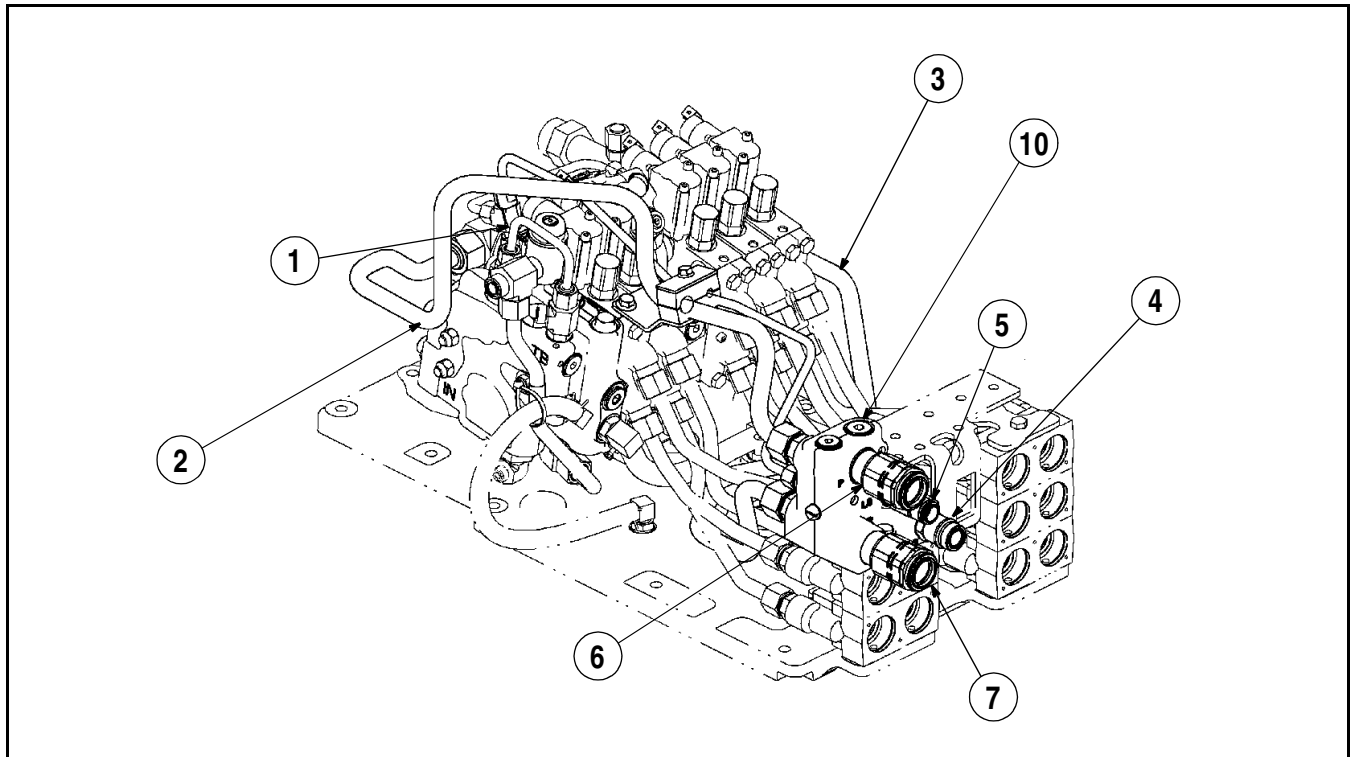


- 1. HITCH CYLINDER RIGHT HAND RETURN
- 2. HITCH CYLINDER RIGHT HAND SUPPLY
- 3. HITCH CYLINDER LEFT HAND SUPPLY

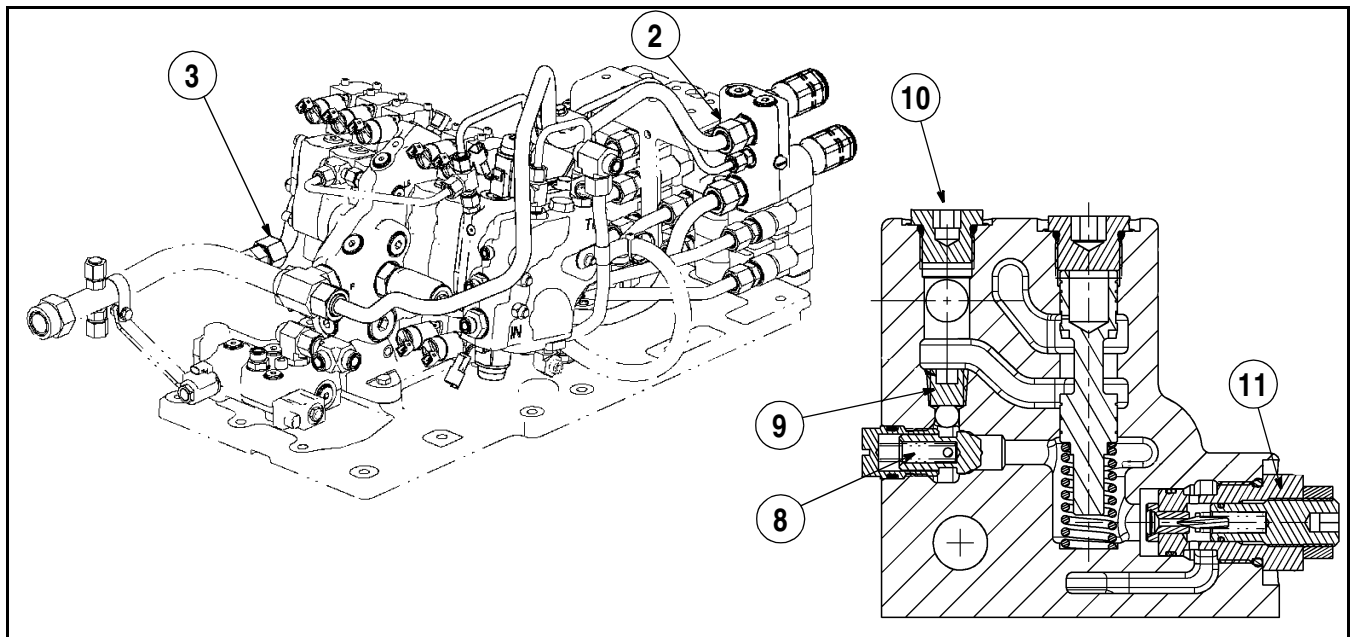
- 4. HITCH CYLINDER LEFT HAND RETURN
- 5. HITCH VALVE SECTION

R106A098

## Power Beyond Layout



RI06A064

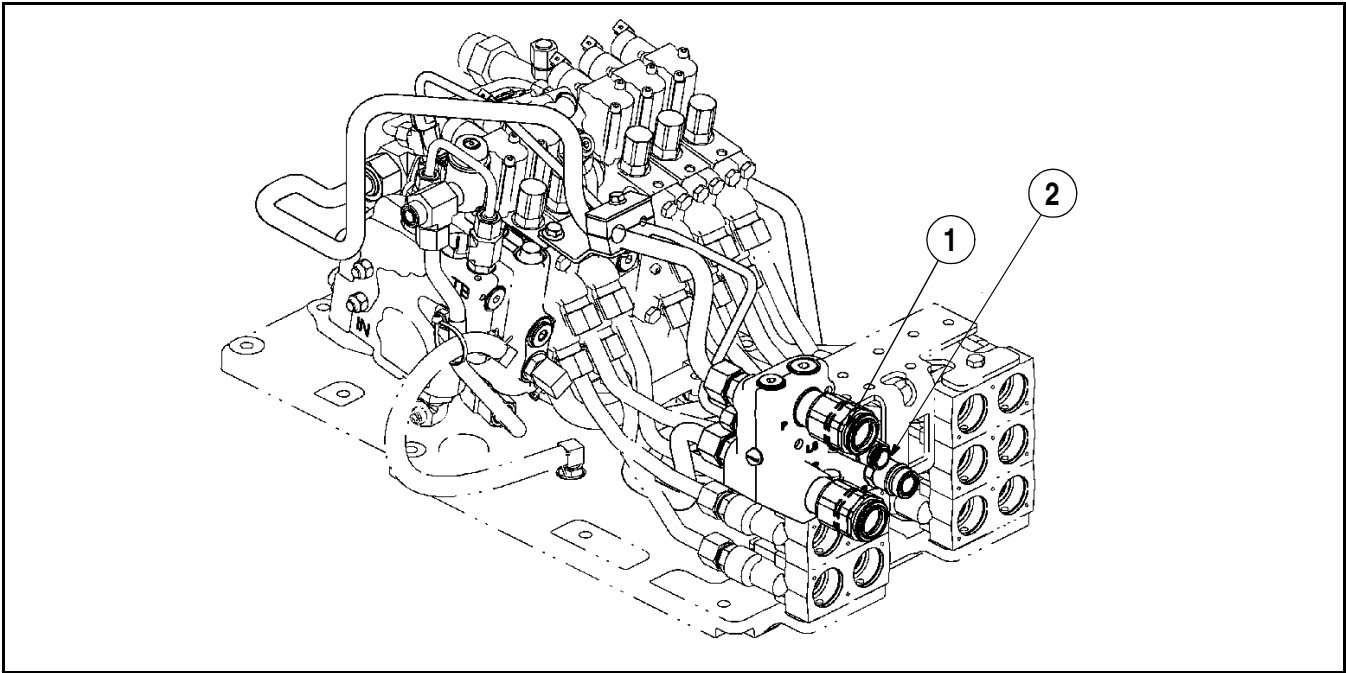


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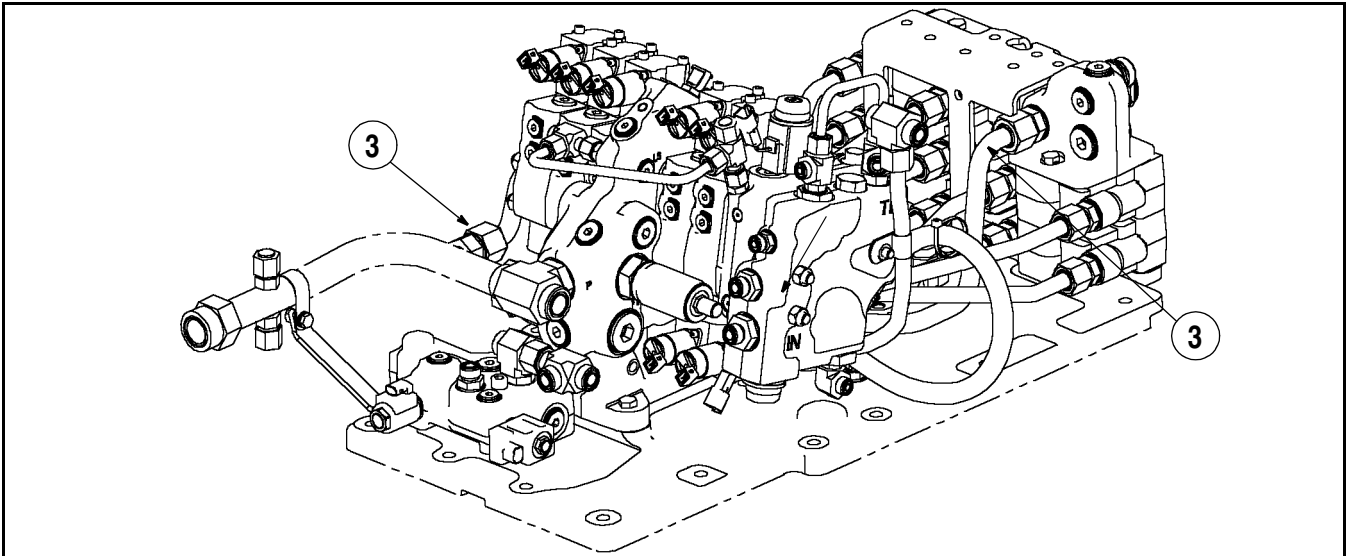
- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1. POWER BEYOND LOAD SENSE TUBE  | 7. POWER BEYOND RETURN FLOW COUPLER |
| 2. POWER BEYOND SUPPLY TUBE      | 8. CHECK VALVE                      |
| 3. POWER BEYOND RETURN TUBE      | 9. INTERNAL PLUG                    |
| 4. CASE DRAIN                    | 10. EXTERNAL PLUG                   |
| 5. LOAD SENSE COUPLER            | 11. VALVE ASSEMBLY PILOT RELIEF     |
| 6. POWER BEYOND COUPLER (SUPPLY) |                                     |

**NOTE:** Remove internal plug (9) to maintain high pressure standby condition.

## Motor Return Layout



RI06A064



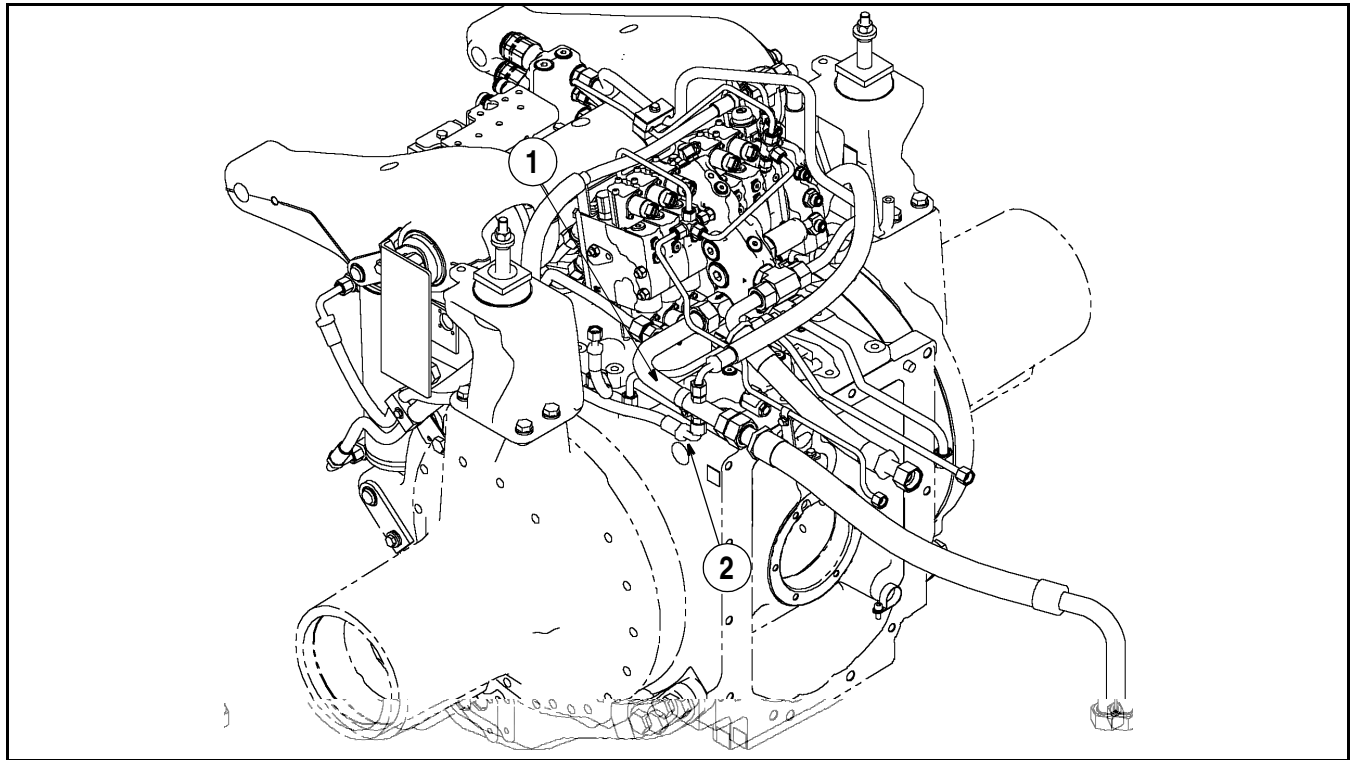
RI06A076

- 1. MOTOR CASE DRAIN COUPLER
- 2. MOTOR RETURN COUPLER
- 3. MOTOR RETURN TUBE

## REAR CHARGE/LUBE PUMP PRESSURE TEST

Perform this test when experiencing problems with all the PFC pump circuits. All remote sections and the hitch system are not operating normally. The symptoms could be low flow, aerated oil, or unusually loud pump operation possibly due to cavitation.

The rear section of the tandem gear pump supplies oil to the system filter base where it combines with the remaining pump flow from the front regulated system pump. Charge flow exits the main filter base and supplies the PFC pump inlet and is distributed to supply system lube requirements.



R106A097

1. RETURN FLOW MANIFOLD TUBE

2. CAP / HOSE ASSEMBLY

**NOTE:** Do not attempt to use the hitch during this pressure test.

Test Fitting and Tool Requirements:

- 100 PSI (7 bar) pressure gauge with extension hose long enough to reach into cab.
- Diagnostic fitting P# 322529A1.

### STEP 1- Preparation

- If necessary move the right rear tire out near end of axle.
- Locate the return flow manifold tube (1).
- Remove the lower cap, or hose assembly (2) and install diagnostic fitting P# 322529A1.
- If a hitch return hose was disconnected, plug the open fitting to keep contaminants out.
- Install hose/gauge assembly to diagnostic port.

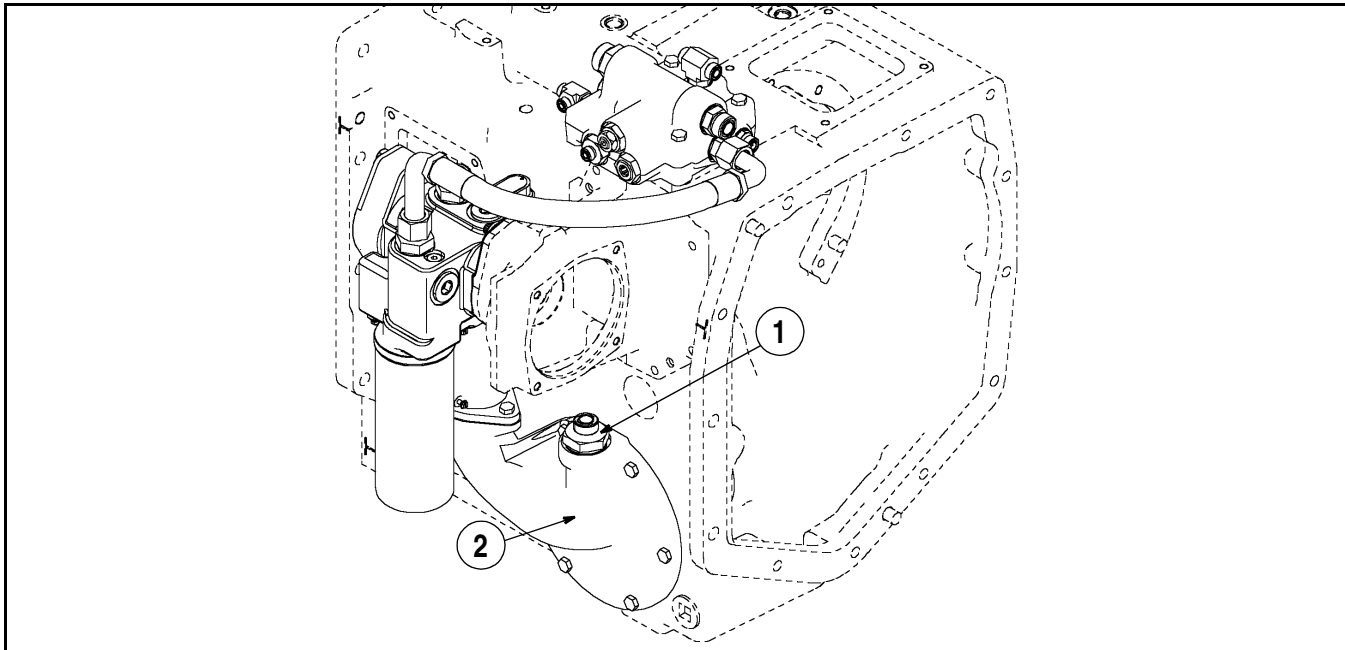
## STEP 2- Charge Pressure Measurement

- Place the transmission control lever in the "P" park position.
- Start and run the engine at low idle.
- Heat the transmission oil to a minimum of 120°F (49°C).
- Place a piece of cardboard over the oil cooler to help heat the oil.
- Increase the engine speed to 2000 RPM. Record the charge pressure \_\_\_\_\_

### Charge Pressure Specification: 50 PSI (3.4 bar) Minimum at 2000 RPM engine speed

- A. If the correct charge pressure was obtained, the charge system is functioning correctly.
- B. If the charge pressure is less than 50 PSI (3.4 bar) check for the following:
  - Low oil level in transmission.
  - Lube relief valve spring broke or poppet stuck open.
  - Inlet suction screen may be plugged. You must drain transmission.
  - Air leaks on suction side of pump. (Is hydraulic oil aerated?)
  - Low charge pump flow.
  - Low regulated pump flow. See Regulated System Pressure Test in this section.

## STEP 3- Inspecting the Lube Relief Valve



RI02D107

- 1. LUBE RELIEF VALVE
- 2. REMOVE TO ACCESS INLET SCREEN

- If the charge pressure is low, check for broken spring or damaged seat on lube relief valve cartridge.
- If the charge relief is okay, replace the pump.

## REGULATED SYSTEM PRESSURE TEST AND ADJUSTMENT PROCEDURE

Perform this test to verify the condition of the regulated system before adjusting the regulated pressure. Low regulated pressure can cause clutches to slip, hinder remote and hitch operation and decrease brake effectiveness. Even if the regulated pressure meets the specification, there could be substantial leakage in one of the regulated circuit functions that is not in use. The regulated system leakage test is designed to locate regulated circuit leakage paths. The 27 GPM front gear pump is a fixed displacement pump, therefore, as engine speed is decreased, the pump outlet flow will decrease. At lower engine speeds, leaks in the regulated circuit are more noticeable.

The front section of the tandem gear pump supplies oil flow to the steering priority/regulator valve. The pressure regulator section of the valve maintains the regulated pressure circuit at 335 to 345 PSI (23 to 24 bar). The following circuits are supplied (FWD, PTO, park brake, differential lock, transmission control valves, service brakes, and the hitch and remote valve pilot circuits). When the demand for all these regulated circuits is met, all the remaining front pump flow is directed through the oil cooler and then to the filter base.

### STEP 1- Regulated Pressure Check with the Tractor Monitor

- Start the engine.
- Cover the front grill with a large piece of paper.
- Press the INC or DECR key on the programmable instrumentation until the TRANS OIL TEMP screen is reached.

**NOTE:** Screen order is set by the operator. The TRANS OIL TEMP and TRANS SYS PRESSURE screens could or could not be together depending on setup.

- Operate the engine at 1500 RPM until the transmission temperature displayed on the instrumentation reads at least 49°C (120°F).
- Next press the PROG key until the display reads TRANS VIEW. Continue to press the PROG key until the display reads "PresS".
- Press the INCR key as required to display the TRANS SYS PRESSURE screen.
- Record pressure with the PTO and Diff Lock in the OFF position and the FWD switch in the ON position.
- With engine speed at 1500 RPM. Record the range powershift manifold pressure. Decrease engine speed.

- **Powershift System Manifold Pressure\_\_\_\_\_kPa at 1500 RPM**

- A. If the pressure reading is less than 310 PSI (20.7 bar) go to the regulated pump flow test.
- B. If the pressure reading is greater than 310 PSI (20.7 bar) go to the regulated system leakage test. (Complete the regulated system leakage test before adjusting the regulated pressure).

**NOTE:** Transducer Pressure Range: 2340 to 2450 kPa (325 to 355 PSI) at 1500 RPM and 120°F (49°C). To convert kPa to bar move the decimal place over two places to left, 2300 kPa equals 23.0 bar.



## STEP 2- Regulated System Leakage Test

A regulated system leak can be identified by a slight drop in regulated pressure at low engine RPM. As a regulated circuit is engaged and disengaged, the pressure reading on the gauge will dip slightly as each circuit is actuated.

**IMPORTANT:** *If the regulated pressure did not dip as a circuit is actuated, then that circuit is not functioning. Inspect the solenoid valve, electrical system connections and circuit fault codes for that system before proceeding.*

- Heat the transmission oil to 120°F (49°C).
- Start testing with the PTO and Diff Lock in the OFF position and the FWD switch in the ON position.
- Maintain the engine speed at 1000 RPM and record the pressure displayed on the tractor monitor.

- **Regulated Circuit Baseline Pressure \_\_\_\_\_ kPa at 1000 RPM**

Record the regulated pressure as each circuit is engaged. Once the reading is recorded, disengage the circuit.

### FWD CIRCUIT

- A. Turn the FWD OFF and back ON.

Pressure Reading with FWD OFF at 1000 RPM: \_\_\_\_\_

**NOTE:** *The FWD is spring engaged and hydraulically disengaged, so the pressure reading is taken with the FWD OFF.*

If the pressure dipped when the circuit was actuated, but does not return to the Regulated Circuit Baseline Reading the FWD clutch is leaking.

If the pressure does not dip when the circuit is actuated check the solenoid function and electrical system connections. See FWD and Diff Lock System Section and double check for fault codes on the PTO controller.

If the pressure dipped when the circuit was actuated and returns to the Regulated Circuit Baseline Reading, the FWD clutch is okay. Continue with Item B.

**NOTE:** *The FWD and Diff Lock are controlled by PTO controller.*

### DIFF LOCK CIRCUIT

- B. Turn the Diff Lock ON and back OFF.

Pressure Reading with Diff Lock ON at 1000 RPM: \_\_\_\_\_

If the pressure dipped when the circuit was actuated, but does not return to the Regulated Circuit Baseline Reading the Diff Lock clutch is leaking.

If the pressure does not dip when the circuit is actuated check the solenoid function and electrical system connections. See FWD and Diff Lock System Section and double check for fault codes on the PTO controller.

If the pressure dipped when the circuit was actuated and returns to the Regulated Circuit Baseline Reading the Diff Lock clutch is okay. Continue with Item C.

**NOTE:** *The FWD and Diff Lock are controlled by PTO controller.*

## PTO CIRCUIT

- C. Turn the PTO ON and back OFF.

Pressure Reading with PTO ON at 1000 RPM: \_\_\_\_\_

If the pressure dipped when the circuit was actuated, but does not return to the Regulated Circuit Baseline Reading the PTO clutch is leaking.

If the pressure does not dip when the circuit is actuated check the solenoid function and electrical system connections. See PTO System Section and double check for fault codes on the PTO controller.

If the pressure dipped when the circuit was actuated and returns to the Regulated Circuit Baseline Reading the PTO clutch is okay. Continue with Item D.

## PARK BRAKE CIRCUIT

- D. Shift the transmission control lever from PARK to NEUTRAL and back to PARK.

Pressure Reading with transmission control lever in NEUTRAL at 1000 RPM: \_\_\_\_\_

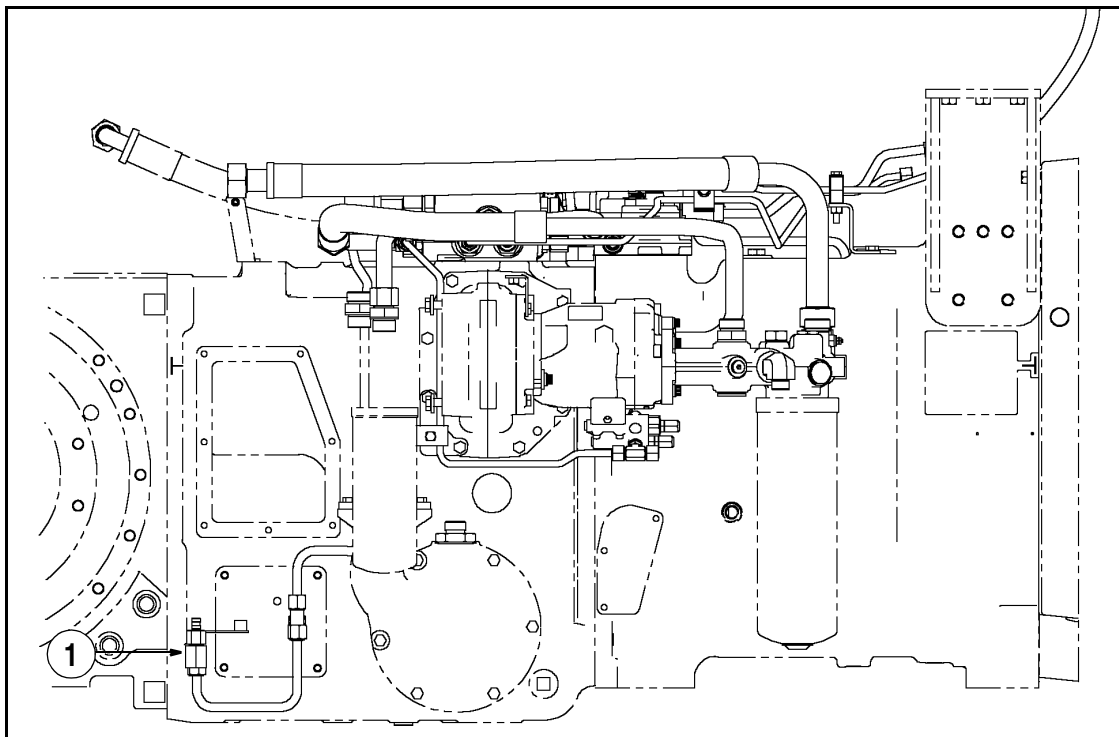
**NOTE:** The Park Brake is spring engaged and hydraulically disengaged, so the pressure reading is taken with the transmission control lever in NEUTRAL.

If the pressure dipped when the circuit was actuated, but does not return to the Regulated Circuit Baseline Reading the Park Brake clutch is leaking.

If the pressure does not dip when the circuit is actuated check the solenoid function and electrical system connections. See Park Brake System Section.

If the pressure dipped when the circuit was actuated and returns to the Regulated Circuit Baseline Reading the Park Brake clutch is okay. Continue with Step 3.

**NOTE:** Park brake pressure can also be checked at the park brake diagnostic coupler.



RI06A082

1. PARK BRAKE DIAGNOSTIC COUPLER

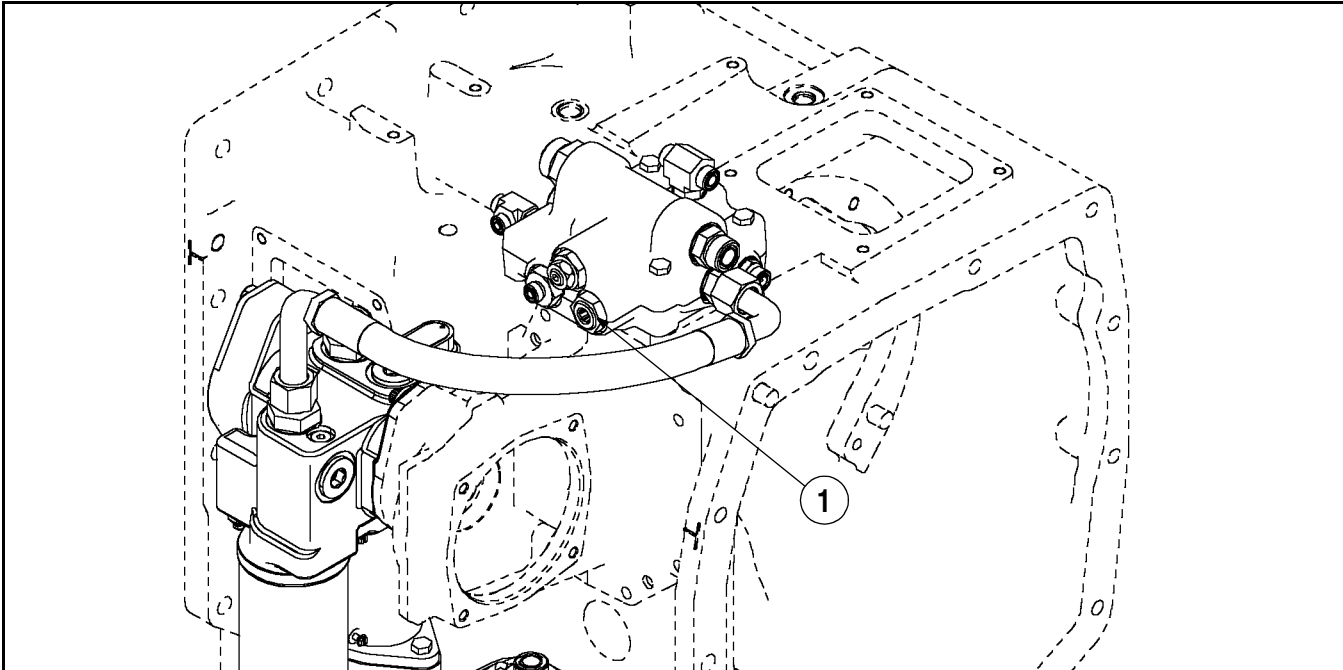
### STEP 3- Regulated Pressure Adjustment

Test Fitting and Tool Requirements:

- 1-1/4 Inch Crowfoot wrench and 7/16 Allen wrench.

If the regulated pressure measurement recorded for Step 2 was out of specification adjust the pressure as follows:

**Regulated Pressure Specification: 325 to 355 PSI (22.4 to 24.5 bar) at 1500 RPM engine speed**



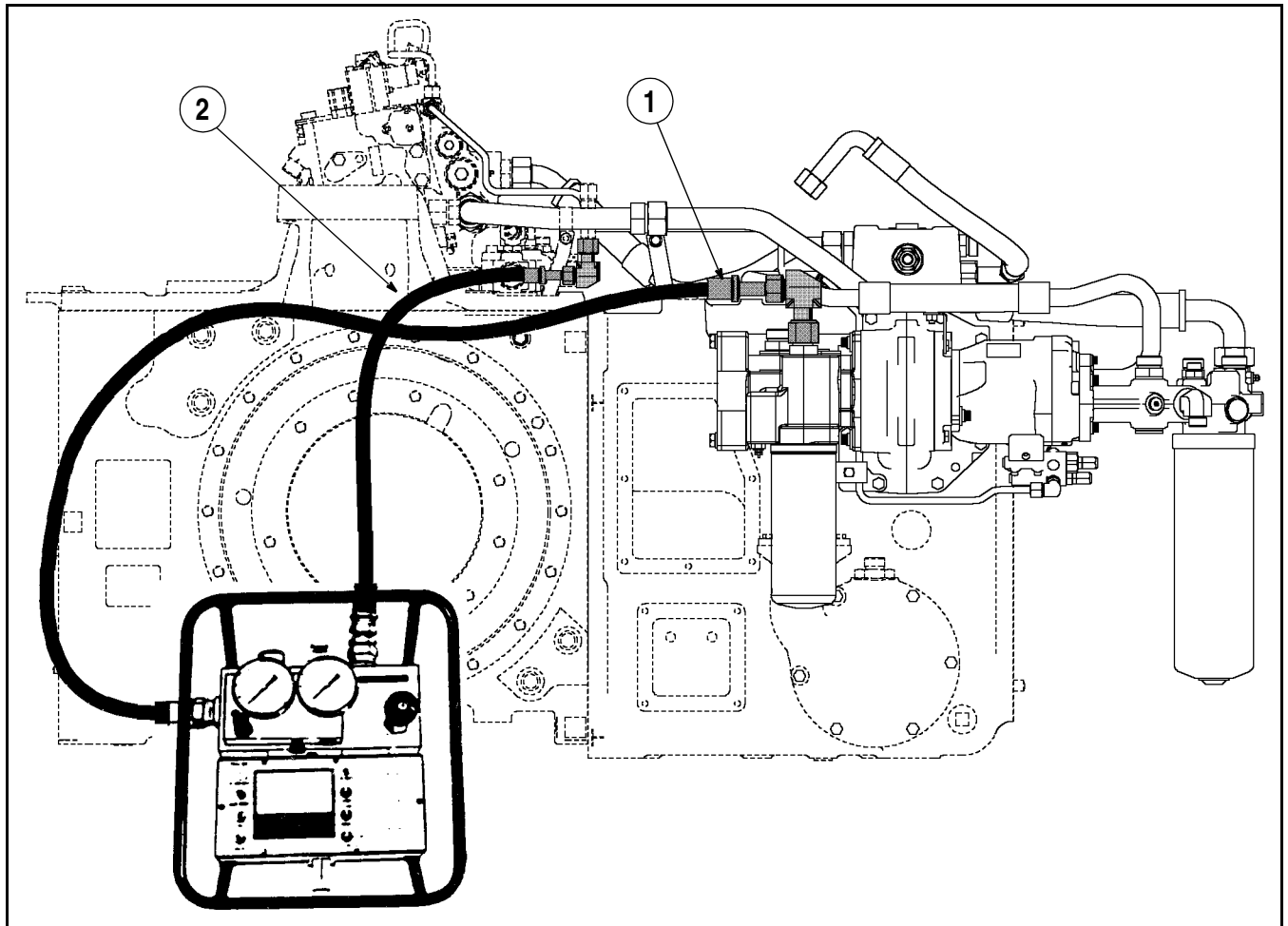
RI02D107

1. REGULATED PRESSURE ADJUSTMENT SCREW

- Start and run the engine at 1500 RPM.
- Heat the transmission oil to 120°F (49°C).
- Loosen the lock nut and turn the adjustment screw (1) in or out until the correct pressure is read on the tractor monitor.
- Tighten the lock nut to a torque of 30 to 40 lb. ft. (41 to 54 Nm). After tightening the lock nut, check the regulated pressure again.
  - A. If the correct pressure cannot be obtained, check the following:
    1. Transmission oil level.
    2. Priority/Regulator valve springs broke, or spool is sticking.
    3. Low pump flow perform "Front/Regulated System Pump Flow Test".

## FRONT/REGULATED SYSTEM PUMP FLOW TEST

Always perform the Regulated System Pressure Test and adjustment procedure before this test.



1. OUT OF FRONT PUMP SECTION TO FLOWMETER INLET

2. FROM OUTLET OF FLOWMETER TO REMOTE FLOW RETURN MANIFOLD TUBE

RI02F030

**NOTE:** Right hand side view, tire removed for clear view.

The front section of the tandem gear pump supplies oil flow to the priority/regulator valve. The regulator section of the valve maintains the regulated circuit pressure at 325 to 355 PSI (22.4 to 24.5 bar). The regulated circuits supplied are FWD, PTO, Park Brake, Diff Lock, Transmission Control Valves, Service Brakes along with the Hitch and Remote valve pilot circuits. When the demand for all these regulated circuits is met all the remaining front pump flow is directed through the oil coolers and then to the main filter base.

Test Fitting and Tool Requirements:

- CAS 10280 Flowmeter with 3/4 inch hoses.
- Test Fitting Kit 380040106.

### STEP 1- Preparation

- Connect test fittings and hoses. Pump outlet to inlet of flowmeter and the outlet of flowmeter to the remote return flow manifold tube.
- Be sure the flowmeter load valve is fully open (turned counterclockwise).

## STEP 2- Flow Measurement

**NOTE:** *It is not necessary to heat the hydraulic system for this test, but the system should be near room temperature 70°F (21°C).*

- Place the transmission control lever into “P” park position.
- Start and run the engine at 2000 RPM.
- Adjust the flowmeter load setting to approximately 300 PSI (20.7 bar).
- Record the flow reading:

Front Regulated pump flow reading at 2000 RPM\_\_\_\_\_ at 300 PSI (20.7 bar).

### **Front Regulated Pump flow specification: 27.0 GPM (102.2 L/min) minimum at 2000 RPM.**

- A. If the pump flow is 24.0 GPM (90.8 L/min) or greater, the regulated pump is functioning correctly.
- B. If the pump flow is 21.6 to 24.0 GPM (81.8 to 90.8 L/min), the pump output is adequate, but the pump efficiency is low.
- C. If the pump flow is below 21.6 GPM (81.8 L/min), replace the front regulated pump.

## STEERING RELIEF PRESSURE TEST AND ADJUSTMENT PROCEDURE

If excessive effort is required for steering, or steering is slow or sluggish the steering relief valve may be leaking or need adjustment.

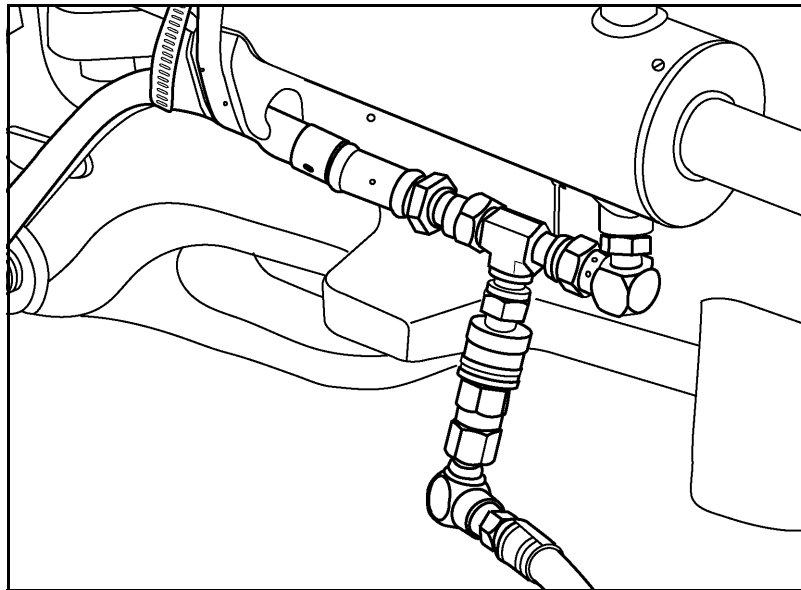
Test Fitting and Tool Requirements:

- 5000 PSI (344 bar) pressure gauge
- Run tee fitting (ORFS) and diagnostic coupler from Test Fitting Kit 380040106.

### STEP 1 - Preparation

–Place the transmission control lever in the “P” park position.

**IMPORTANT:** *Do not shift the tractor out of park.*



RD98E102

–Tee a 5000 PSI (344 bar) pressure gauge at the steering cylinder port.

### STEP 2 - Steering Relief Pressure Measurement

- Heat the transmission oil to a minimum of 120°F (50°C).

- Start and run the engine at 1000 RPM.

- Cover the oil cooler to help heat the oil.

–With the engine at 1000 RPM, turn the steering wheel and hold against the stop.

- **Steering Pressure Specification: 3000 PSI (207 bar).**

A. If the correct pressure is obtained but steering problems still exist, check for the following:

- Excessive load on front axle.
- Mechanical interference in steering column, section 5001.
- Steering priority spool is sticking or failed spring.

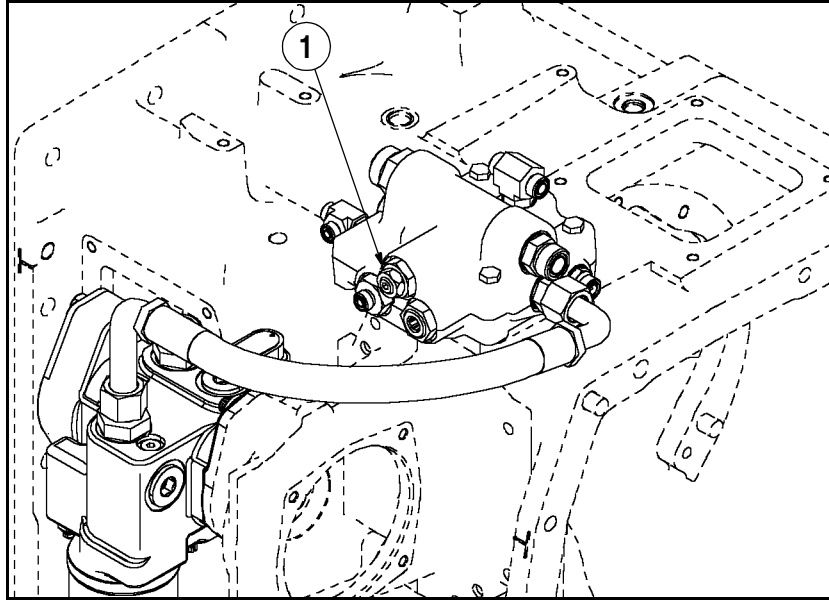
B. If the correct pressure is not obtained, go to Step 3.

### STEP 3 - Steering Relief Pressure Adjustment

Test Fitting and Tool Requirements:

- 1/4 inch Allen wrench
- 15/16 inch wrench

The steering relief valve is located in the priority/regulator valve. The priority/regulator valve is located on the top, right hand side of the range transmission.



RI02D107

1. STEERING RELIEF ADJUSTMENT

–Start and run the engine at 1000 RPM. Turn the steering against the stops.

–Loosen the lock nut and turn the adjustment screw in or out until the correct pressure is obtained.

#### - Steering Pressure Specification: 3000 PSI (207 bar).

A. If the correct pressure is obtained, torque the lock nut to 30 to 35 lb. ft. (41 to 50 Nm). After the lock nut is torqued, check the steering pressure.

B. If the correct pressure is not obtained, check for the following:

- Contamination in steering relief valve. Remove and inspect steering relief valve.
- Excessive leakage past steering cylinder piston seals. Cap lines to steering cylinder(s) and retest.
- Bad steering hand pump. Repair or replace steering hand pump.

## STEERING SYSTEM PROBLEMS

### PROBLEM: Excessive effort required for steering

POSSIBLE CAUSE	PROCEDURE
A. Excessive load on front axle.	A. Reduce load see Operator's Manual.
B. Mechanical interference in steering column.	B. Inspect and correct, see Steering Column and Hand Pump Section.
C. Misadjusted steering relief pressure.	C. Perform Steering Pressure Test and adjustment procedure in this section.
D. Steering priority spool is stuck or spring is broken.	D. Repair or replace, see Hydraulic System - How It Works and Troubleshooting Section.
E. Bad steering hand pump.	E. Repair or replace, see Steering Column and Hand Pump Section.
F. Spindle support not greased properly.	F. Grease fittings and retest. See Operator's Manual.

### PROBLEM: Slow or sluggish steering

POSSIBLE CAUSE	PROCEDURE
A. Misadjusted steering relief pressure.	A. Perform Steering Pressure Test and Adjustment procedure in this section.
B. Steering priority spool is stuck or the spring is broken.	B. Repair or replace as necessary.
C. Poor hydraulic system performance.	C. Perform General Hydraulic System Testing this section.

### PROBLEM: Excessive steering wheel rotation (slippage) at end of steering cylinder stroke

POSSIBLE CAUSE	PROCEDURE
A. Excessive steering hand pump internal leakage.	A. Cap left and right steering cylinder supply lines and retest. If the rotation stays the same, the problem is in the steering hand pump. Repair or replace. See Section 5001.
B. Steering cylinder piston leakage.	B. Repair or replace as necessary.
C. Steering cylinder side loading.	C. Repair or replace as necessary.

### PROBLEM: Excessive number of wheel turns lock to lock

POSSIBLE CAUSE	PROCEDURE
A. Bad steering hand pump.	A. Cap left and right steering cylinder supply lines and retest. If the rotation stays the same, the problem is in the steering hand pump. Repair or replace as necessary.
B. Steering cylinder piston leakage.	B. Repair or replace as necessary.
C. Steering cylinder side loading.	C. Repair or replace as necessary.
D. Wrong combination of steering hand pump and front axle.	D. Determine if correct parts were installed.

### PROBLEM: Steering hand pump rotates on its own (motors)

POSSIBLE CAUSE	PROCEDURE
A. Internal steering hand pump leakage.	A. Repair or replace as necessary.



**PROBLEM: Steering cylinder does not react when steered (freewheeling)**

POSSIBLE CAUSE	PROCEDURE
A. Internal steering hand pump leakage.	A. Cap left and right steering cylinder supply lines and retest. If the rotation stays the same, the problem is in the steering hand pump. Repair or replace as necessary.
B. Steering cylinder piston leakage.	B. Repair or replace as necessary.
C. Steering cylinder side loading.	C. Repair or replace as necessary.

## **PRIORITY AND REGULATOR VALVE**

The Priority/Regulator Valve is located on the top right side of the range transmission. The valve consists of the following components: priority spool, regulator spool, and steering relief valve.

The front section of the dual gear pump and the PFC piston pump supply oil to the Priority/Regulator Valve in the following manner:

### **Priority Spool (Supplied By PFC Piston Pump)**

Oil flows into the Priority/Regulator Valve from the left side port (2). Steering has first priority, oil flows across the priority spool (11) and out the steering supply port (3). There is a cross drilled passage near the top of the priority spool. Oil enters this orifice and starts to build pressure against the spring. As steering demand is satisfied, pressure builds on the top of the priority spool (11) and the spool moves down against its spring, opening a passage to the remote and hitch circuits (13).

When the steering circuit is placed on demand this causes a pressure drop on the top end of the priority spool (11). Signal and spring pressure work against pump outlet pressure and the priority spool (11) moves up to accommodate steering demand.

Once steering demand is satisfied, pressure builds on the top of the priority spool (11) and the spool shifts down to increase flow to the remote and hitch circuits.

When equipped with trailer brakes, oil is also supplied from the priority valve to the trailer brakes.

### **Regulator Spool (Supplied By Regulated Pump Section)**

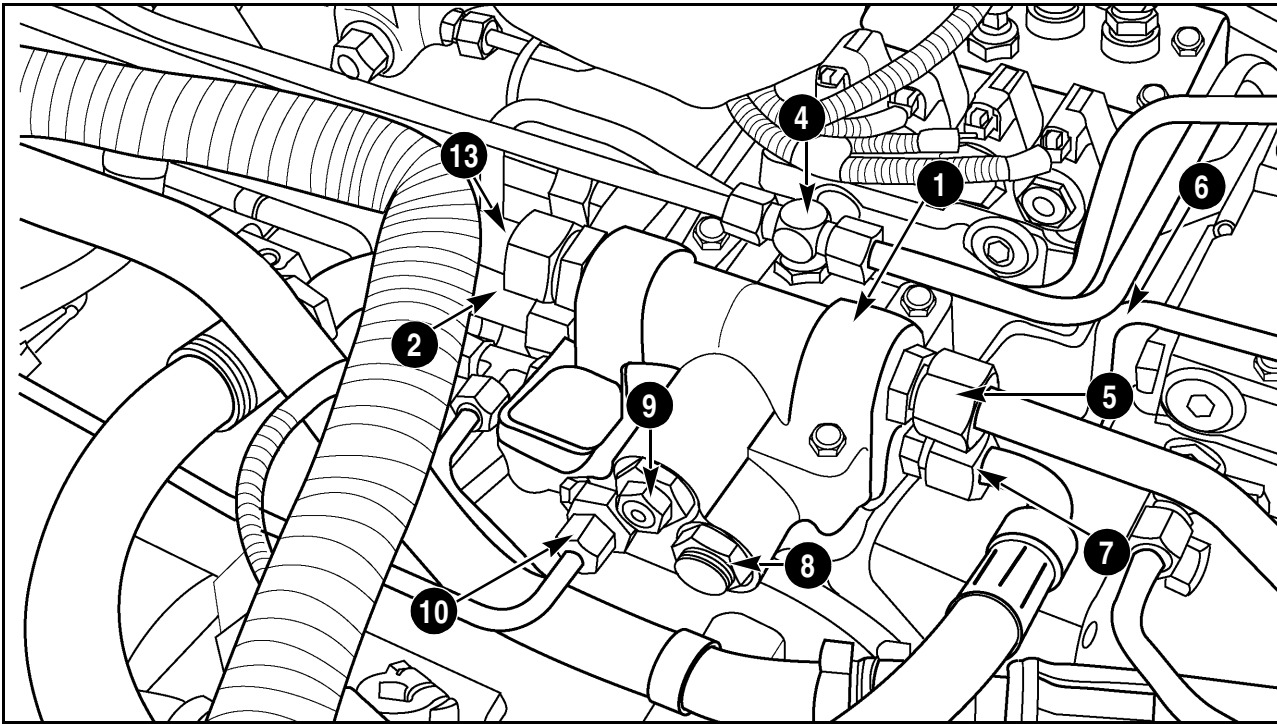
Regulated pump flow enters the Priority/Regulator valve at the right side port (7). Oil flows across the regulator spool (12) and supplies all the regulated circuits through the side port (6) and top port (4). The oil also flows through the orifice near the top of the regulator spool (12). This oil builds pressure and moves the regulator spool against the spring. This regulates pressure and maintains the 325 to 355 psi (22.4 to 24.5 bar) in the regulated circuits. These include the transmission control valves, PTO/differential lock valve, brake valve and regulated pressure for remote valve and the hitch valve pilot pressure.

When all regulated circuit demands are met the regulator spool continues to maintain the 325 to 355 psi (22.4 to 24.5 bar) pressure and allows excess pump flow out the cooler supply port (5).

When a regulated circuit is activated, the regulator spool (12) senses a momentary drop in pressure. The spring will overcome the spool and move it up to allow for an increase in flow of oil to meet the demand. As the demand is met, pressure again builds on the top side of the spool through the orifice and moves the spool down to maintain regulated pressure.

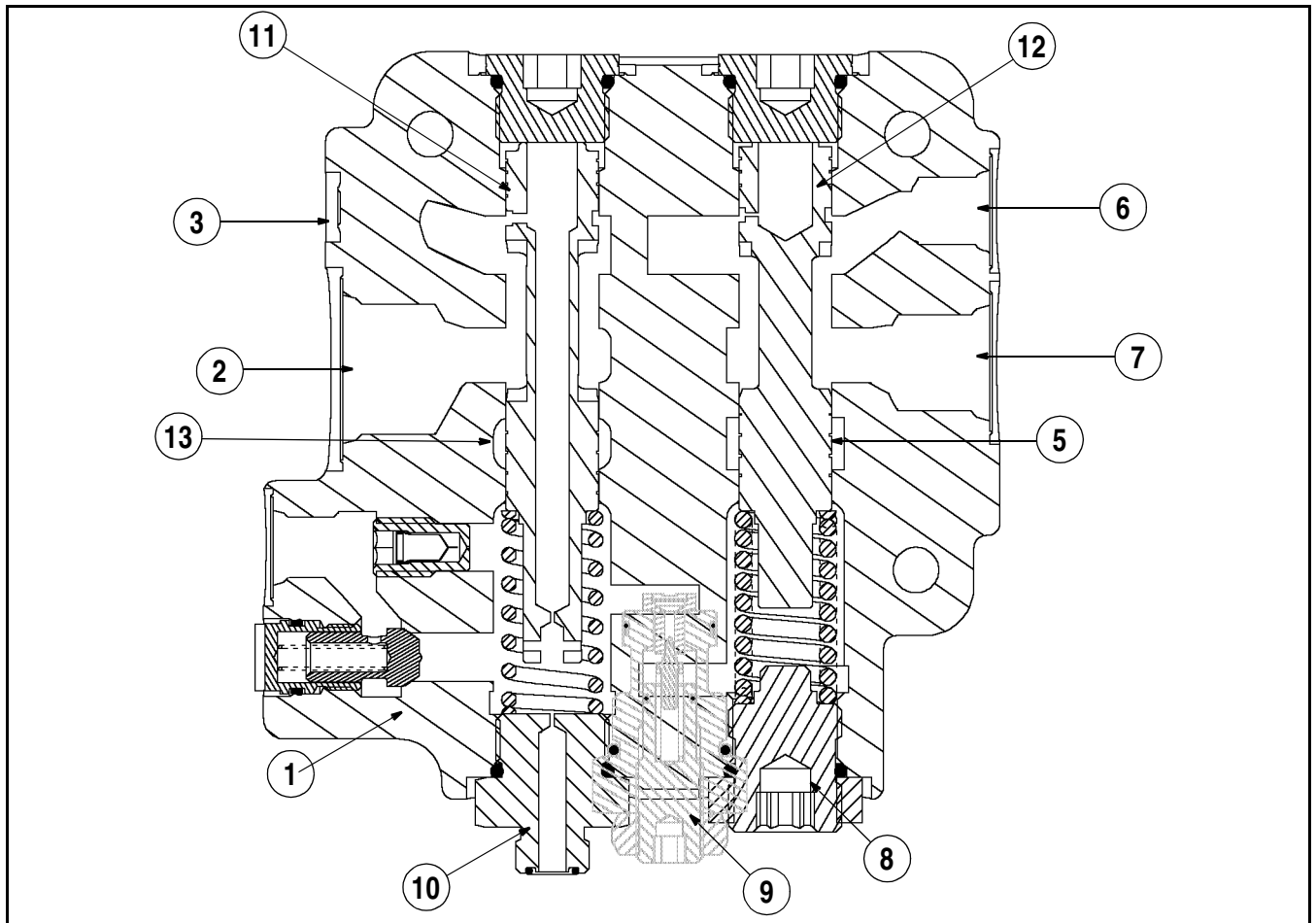
## Steering Relief Valve

The steering relief valve (9) is located in the Priority/Regulator Valve and is adjustable. The steering relief valve (9) is set to open at 2970 psi (205 bar) +/- 80 psi (5.5 bar).



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|--------------------------------|----------------------------------|
| 1. PRIORITY/REGULATOR VALVE    | 8. REGULATED PRESSURE ADJUSTMENT |
| 2. SUPPLY FROM PFC PISTON PUMP | 9. STEERING RELIEF ADJUSTMENT    |
| 3. SUPPLY TO STEERING          | 10. STEERING SIGNAL TO HAND PUMP |
| 4. REGULATED SUPPLY TO SYSTEM  | 11. PRIORITY SPOOL               |
| 5. EXCESS FLOW TO COOLERS      | 12. REGULATOR SPOOL              |
| 6. REGULATED SUPPLY TO BRAKES  | 13. SUPPLY TO REMOTE             |
| 7. REGULATED SUPPLY            |                                  |



RI02E009

- |                                |                                  |
|--------------------------------|----------------------------------|
| 1. PRIORITY/REGULATOR VALVE    | 8. REGULATED PRESSURE ADJUSTMENT |
| 2. SUPPLY FROM PFC PISTON PUMP | 9. STEERING RELIEF ADJUSTMENT    |
| 3. SUPPLY TO STEERING          | 10. STEERING SIGNAL TO HAND PUMP |
| 4. REGULATED SUPPLY TO SYSTEM  | 11. PRIORITY SPOOL               |
| 5. EXCESS FLOW TO COOLERS      | 12. REGULATOR SPOOL              |
| 6. REGULATED SUPPLY TO BRAKES  | 13. SUPPLY TO REMOTES            |
| 7. REGULATED SUPPLY            |                                  |

**NOTE:** The regulated supply to brakes, item 6 is a special fitting equipped with a check valve.

## **PFC AXIAL PISTON PUMP**

**NOTE:** *The principles of operation for the optional high flow pump are the same as the standard flow pump. The artwork supporting the PFC pump operation depicts only the standard flow pump.*

### **Principal of Control**

All remote valves, the hitch control valve and the trailer brake option each contain a signal port. If a power beyond circuit has been installed, it also contains a signal port to the pump. Each signal port directs a signal pressure, which is equal to the working pressure in that particular circuit along signal lines through check valves to the pump compensator spool. The compensator will place the pump swash plate at the correct angle to meet system demands.

A single check valve is located in each signal line connection from the control valves to the compensator spool. If several control valves are operated at the same time, the signal line at the higher pressure will cause the check valve(s) to seat against the signal at the lower pressure. This prevents signal bleed off through other control valves and ensures that the highest signal line pressure will act on the compensator spool.

### **Operating Modes**

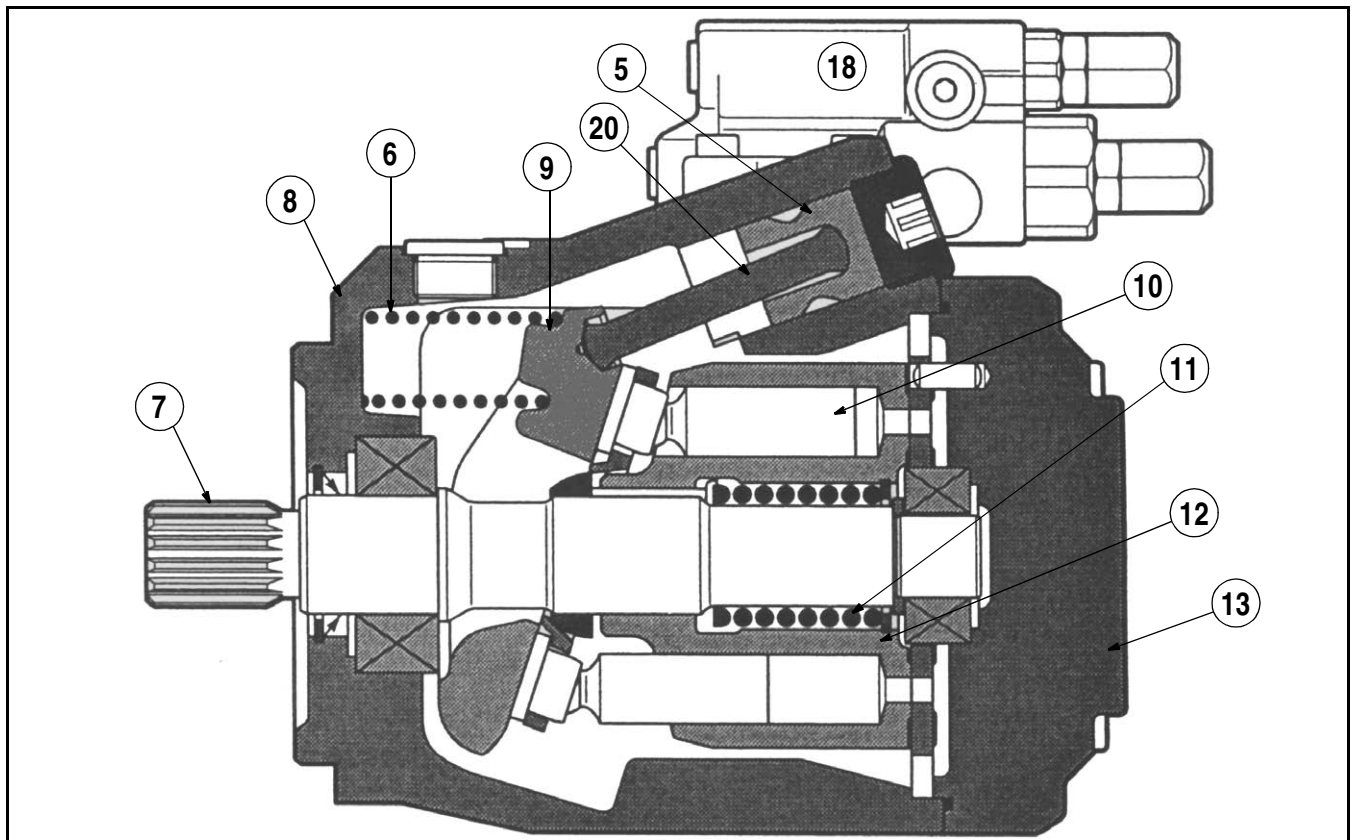
The pump is designed to operate in two different modes according to the demand for flow and pressure placed upon it. These modes are as follows:

#### **Low Pressure Standby**

When there is no demand for flow or pressure, the pump provides just enough flow to make up for internal leakage in the hydraulic system at low pressure. In this mode the pump requires very little power to drive it.

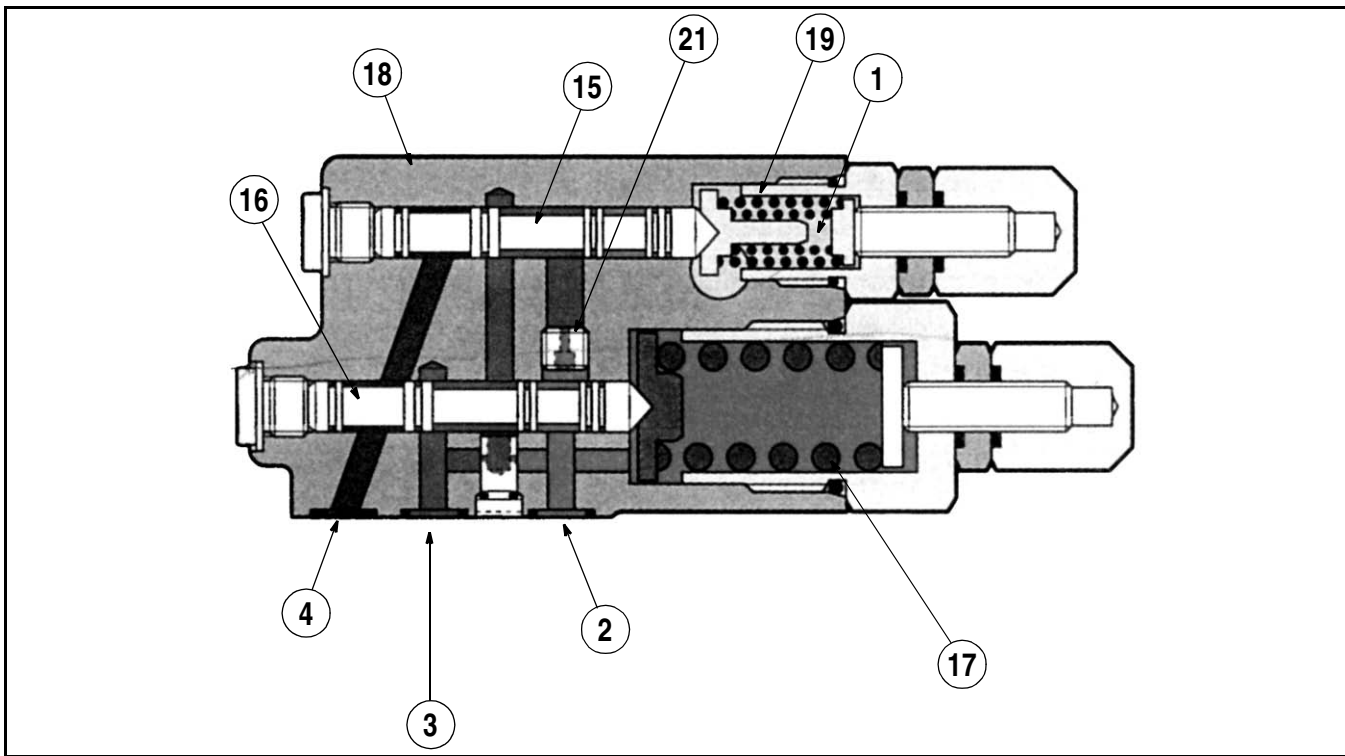
#### **Pressure and Flow Delivery and Compensation**

When there is a demand for flow and pressure from the hydraulic system, the pump responds to provide only the flow that is required. This limits the power consumption of the system.



RH02B011

- |                   |                 |                                 |                          |
|-------------------|-----------------|---------------------------------|--------------------------|
| 5. CONTROL PISTON | 8. PUMP HOUSING | 11. PISTON BLOCK LOADING SPRING | 18. COMPENSATOR ASSEMBLY |
| 6. CONTROL SPRING | 9. SWASH PLATE  | 12. PISTON BLOCK                | 20. CONTROL PISTON ROD   |
| 7. DRIVE SET      | 10. PISTON      | 13. BACK PLATE                  |                          |



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- |                                |                                     |                                     |
|--------------------------------|-------------------------------------|-------------------------------------|
| 1. SIGNAL LINE PRESSURE        | 14. OUTLET PORT (NOT SHOWN)         | 18. FLOW COMPENSATOR SPOOL          |
| 2. PUMP CASE DRAIN             | 15. FLOW COMPENSATOR SPOOL          | 19. HIGH PRESSURE COMPENSATOR SPOOL |
| 3. CONTROL PISTON PRESSURE     | 16. HIGH PRESSURE COMPENSATOR SPOOL | 21. COMPENSATOR ASSEMBLY            |
| 4. PISTON PUMP OUTLET PRESSURE | 17. HIGH PRESSURE SPRING            |                                     |

## PFC Axial Piston Pump - Operation

### Low Pressure Standby

When there is no demand for flow, there is no pressure signal feed back to the pump and the pump will go to the low pressure standby mode. As there is no place for the oil from the pump to flow, the pump will build pressure in the pump outlet passage. This pressure is directed through internal passages in the piston pump back plate to the end of the pump compensator spool opposite the spring.

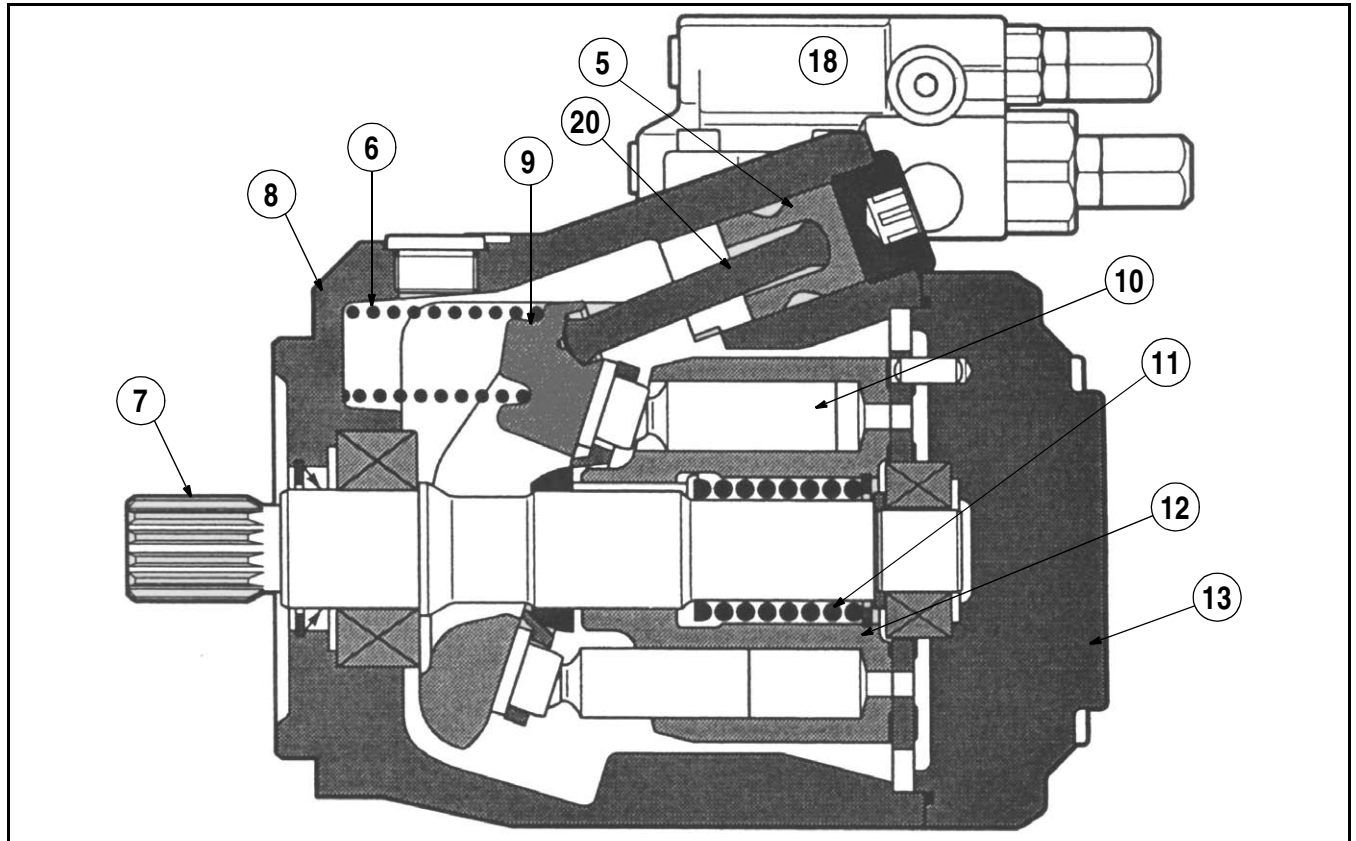
The spring acting on the flow compensator spool, is set to allow the spool to move at a 340 to 390 psi (23.5 to 27 bar) differential pressure. The flow compensator spool will then move down to allow the oil to flow into the passage leading to the pump control piston.

The pressure acting on the pump control piston tilts the pump swash plate against the swash plate control spring, to a near neutral position. In this condition, the pump will provide just enough flow to make up for internal leakage, thus maintaining a minimum system pressure of 340 to 390 psi (23.5 to 27 bar).

The pump will remain in the low pressure standby position as long as there is no pressure or flow demand from the hydraulic system. In this mode, the pump produces very little heat and absorbs very little horsepower from the engine. This is one of the outstanding features of the PFC axial piston pump.

## Engine Start Up

Before the engine is started, the pump swash plate angle will be at its maximum angle. Therefore, as soon as the engine is cranked by the starter the PFC axial piston pump will produce flow and, as explained above, pressure will build in the pump delivery passage. As soon as this pressure reaches 340 to 390 psi (23.5 to 27 bar) the pump will be put into its low pressure standby mode. This occurs almost instantly and makes engine starting much easier.



RH02B011

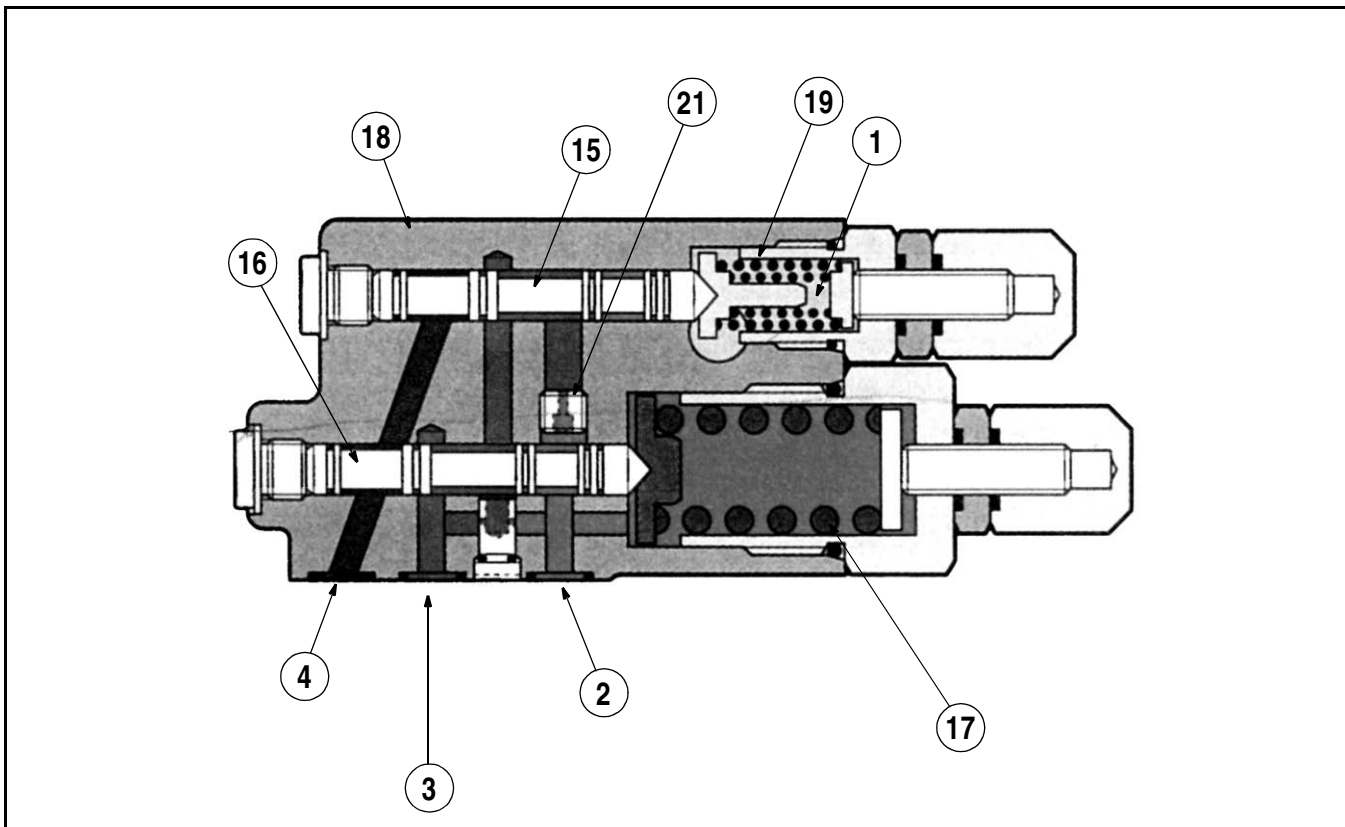
5. CONTROL PISTON  
6. CONTROL SPRING  
7. DRIVE SET

8. PUMP HOUSING  
9. SWASH PLATE  
10. PISTON

11. PISTON BLOCK LOADING SPRING  
12. PISTON BLOCK  
13. BACK PLATE

18. COMPENSATOR ASSEMBLY  
20. CONTROL PISTON ROD





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- |                                |                                     |                                     |
|--------------------------------|-------------------------------------|-------------------------------------|
| 1. SIGNAL LINE PRESSURE        | 14. OUTLET PORT (NOT SHOWN)         | 18. FLOW COMPENSATOR SPOOL          |
| 2. PUMP CASE DRAIN             | 15. FLOW COMPENSATOR SPOOL          | 19. HIGH PRESSURE COMPENSATOR SPOOL |
| 3. CONTROL PISTON PRESSURE     | 16. HIGH PRESSURE COMPENSATOR SPOOL | 21. COMPENSATOR ASSEMBLY            |
| 4. PISTON PUMP OUTLET PRESSURE | 17. HIGH PRESSURE SPRING            |                                     |

## Pressure and Flow Delivery and Compensation Principle

When oil is required in the system, the flow is controlled by the difference in pressure at opposite ends of the compensator spool.

When a control valve is operated, pressure at the outlet of the piston pump will drop slightly. This will enable the spring and signal line pressure to shift the flow compensator spool away from the spring end, allowing oil from the control piston to drain past the spool land to tank.

As the oil drains out of the control piston, the swash plate angle will increase and the pump flow will rise until the flow demand has been met. The flow from the pump is determined by the size of the orifice in the control valve which is being operated. This orifice is created by limiting the main valve spool travel within the control valve.

When a control valve is operated, the oil pressure in the circuit being supplied will increase to its operating pressure. This pressure will be transmitted through the sensing line to the spring end of the compensator spool.

## Increased Flow Demand

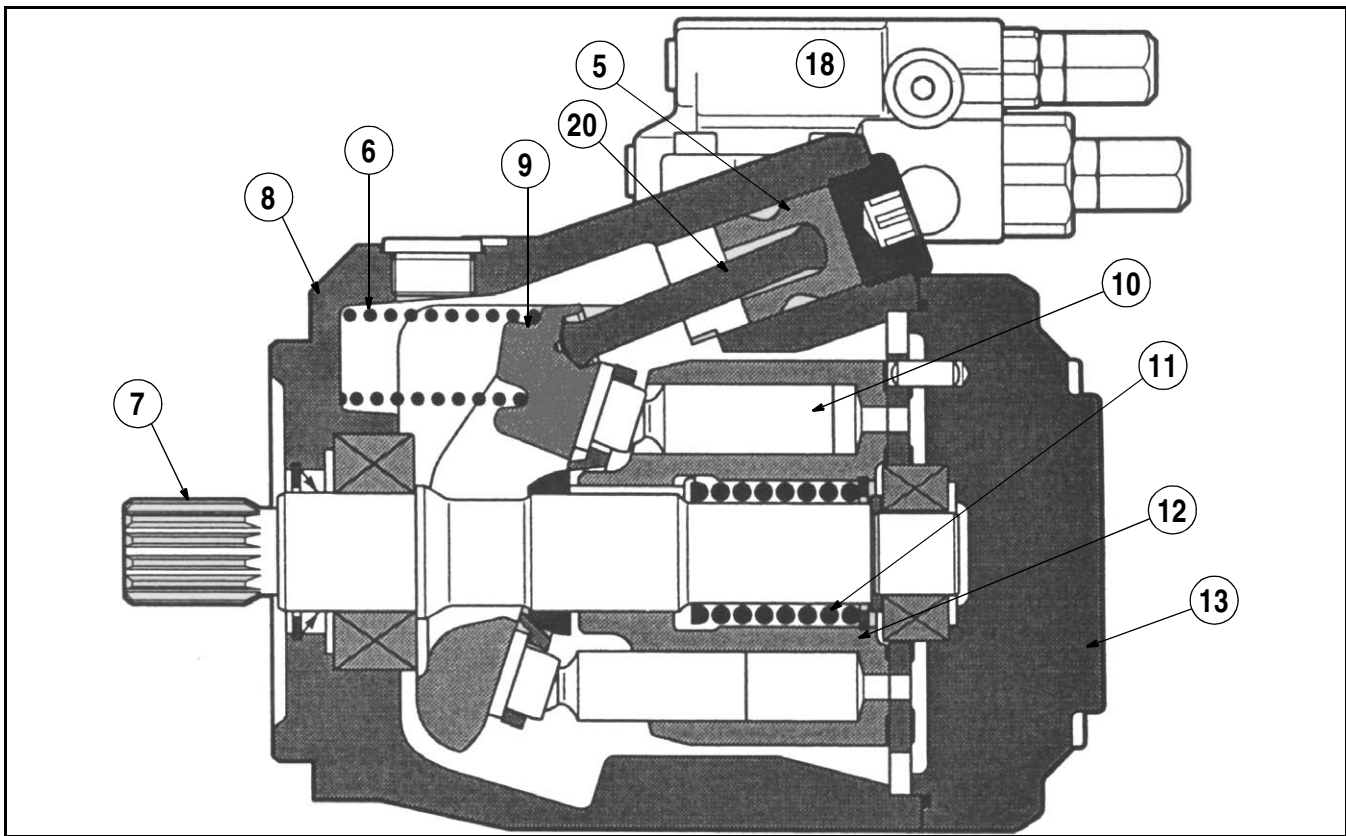
When an additional control valve is operated, it will cause a slight pressure drop at the pump pressure passage. The compensator spool will move up and allow the oil behind the control piston to drain to tank. The swash plate will move and the pump flow will be increased until the extra demand for flow has been met.

Pressure at the pump outlet will increase until it is 340 to 390 psi (23.5 to 27 bar) above the signal line pressure. This increase in pressure will move the pump compensator spool against the spring allowing sufficient flow past the spool to the control piston. This will move the swash plate to a position where the increased flow is maintained and the pressure stabilized.

## Decreased Flow Demand

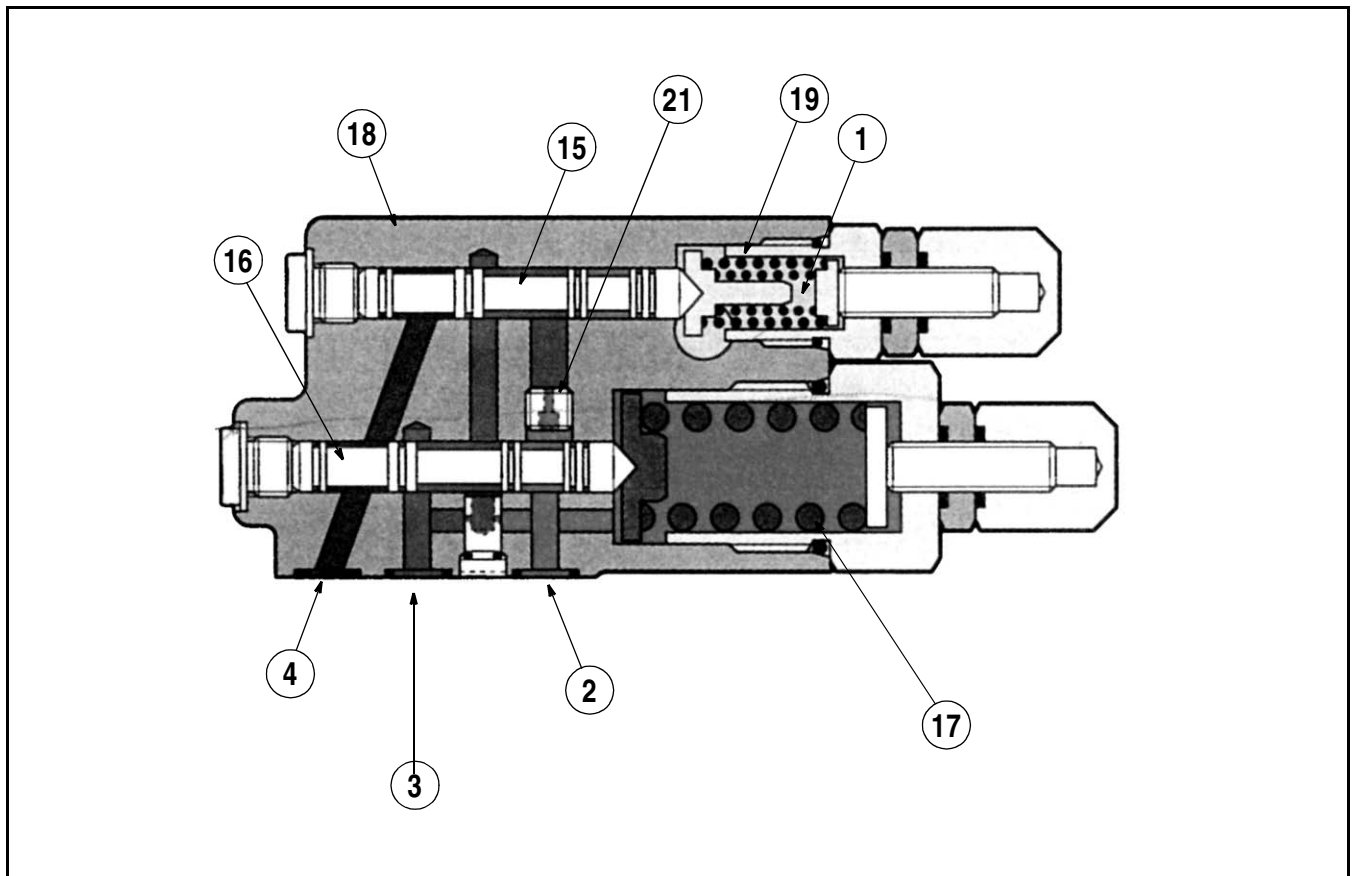
If there is a reduction in the demand for flow, pump pressure will increase until the pump outlet pressure exceeds the signal line pressure by more than 340 to 390 psi (23.5 to 27 bar). This will cause the flow compensator spool to move down to allow some oil to flow into the pump control piston. This will destroke the pump against the spring and thus reduce the pump flow.

When the pump flow has fallen to match the demand, the difference in pressure felt on the opposite ends of the pump compensator spool will return to 340 to 390 psi (23.5 to 27 bar). The pump compensator spool will then reposition itself to block off the passage to the control piston. This will lock the swash plate at that pumping angle.



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- |                   |                 |                                 |                          |
|-------------------|-----------------|---------------------------------|--------------------------|
| 5. CONTROL PISTON | 8. PUMP HOUSING | 11. PISTON BLOCK LOADING SPRING | 18. COMPENSATOR ASSEMBLY |
| 6. CONTROL SPRING | 9. SWASH PLATE  | 12. PISTON BLOCK                | 20. CONTROL PISTON ROD   |
| 7. DRIVE SET      | 10. PISTON      | 13. BACK PLATE                  |                          |



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- |                                |                                     |                                     |
|--------------------------------|-------------------------------------|-------------------------------------|
| 1. SIGNAL LINE PRESSURE        | 14. OUTLET PORT (NOT SHOWN)         | 18. FLOW COMPENSATOR SPOOL          |
| 2. PUMP CASE DRAIN             | 15. FLOW COMPENSATOR SPOOL          | 19. HIGH PRESSURE COMPENSATOR SPOOL |
| 3. CONTROL PISTON PRESSURE     | 16. HIGH PRESSURE COMPENSATOR SPOOL | 21. COMPENSATOR ASSEMBLY            |
| 4. PISTON PUMP OUTLET PRESSURE | 17. HIGH PRESSURE SPRING            |                                     |

## High Pressure Standby

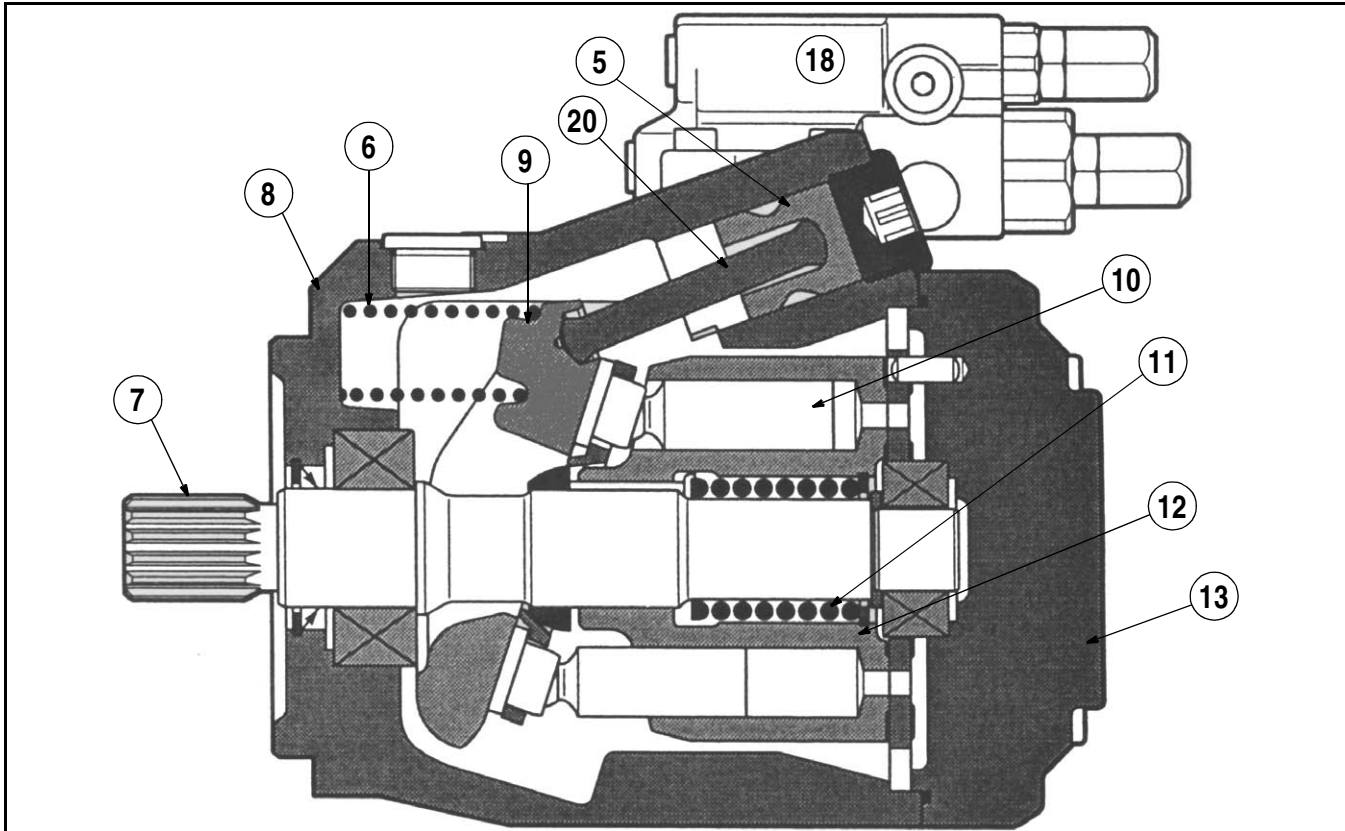
When the hydraulic cylinder reaches the end of its stroke or an unconnected remote valve is operated, the hydraulic system is protected by limiting its maximum pressure to 3250 psi (224 bar) through a signal relief valve. The hitch system pressure is not limited by a signal relief valve.

When the pressure in the system reaches the setting of the high pressure compensator spool the pump high pressure compensator spool will shift against its spring. The movement of the spool allows the full pump delivery pressure to be applied to the pump control piston to destroy the pump very rapidly from full stroke to almost zero. (Within 8 to 10 milliseconds). The swash plate will stabilize in a position to provide just sufficient flow to make up internal leakage to maintain the maximum pressure limit of 3250 psi (224 bar) in the hydraulic system.

## Return to Low Pressure Standby

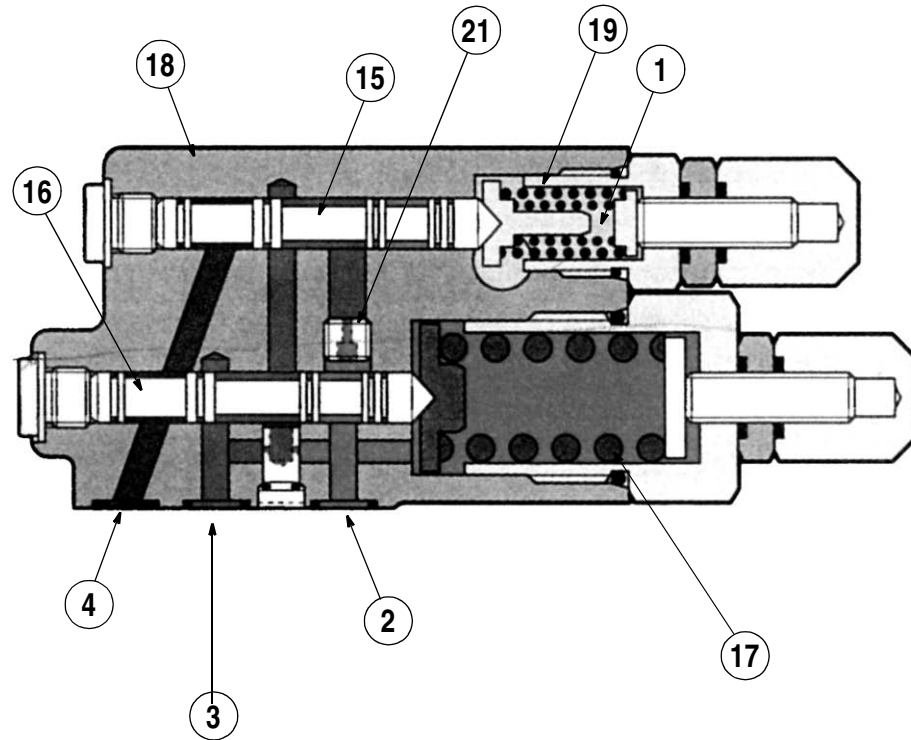
The pump will remain in the high pressure standby mode until the valve in operation is returned to neutral. When this occurs, the feed into the signal line from that valve will be cut off. The signal pressure will drop because of the drain orifice plug passage is open to the pump case drain. When there is no signal line pressure the pump immediately returns to a low pressure standby condition.

**NOTE:** The high pressure limiting spool is adjustable and can be removed for inspection.



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- |                   |                 |                                 |                          |
|-------------------|-----------------|---------------------------------|--------------------------|
| 5. CONTROL PISTON | 8. PUMP HOUSING | 11. PISTON BLOCK LOADING SPRING | 18. COMPENSATOR ASSEMBLY |
| 6. CONTROL SPRING | 9. SWASH PLATE  | 12. PISTON BLOCK                | 20. CONTROL PISTON ROD   |
| 7. DRIVE SET      | 10. PISTON      | 13. BACK PLATE                  |                          |



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- |                                |                                     |                                     |
|--------------------------------|-------------------------------------|-------------------------------------|
| 1. SIGNAL LINE PRESSURE        | 14. OUTLET PORT (NOT SHOWN)         | 18. FLOW COMPENSATOR SPOOL          |
| 2. PUMP CASE DRAIN             | 15. FLOW COMPENSATOR SPOOL          | 19. HIGH PRESSURE COMPENSATOR SPOOL |
| 3. CONTROL PISTON PRESSURE     | 16. HIGH PRESSURE COMPENSATOR SPOOL | 21. COMPENSATOR ASSEMBLY            |
| 4. PISTON PUMP OUTLET PRESSURE | 17. HIGH PRESSURE SPRING            |                                     |

## PFC PUMP HIGH PRESSURE STANDBY CHECK AND ADJUSTMENT PROCEDURE

Perform this test when all remote circuits and hitch system do not operate with full power. This would be noticeable when maximum power is needed such as when lifting heavy hitch loads, or maximum pressure is required by a remote circuit.

Test Fitting Tool Requirements:

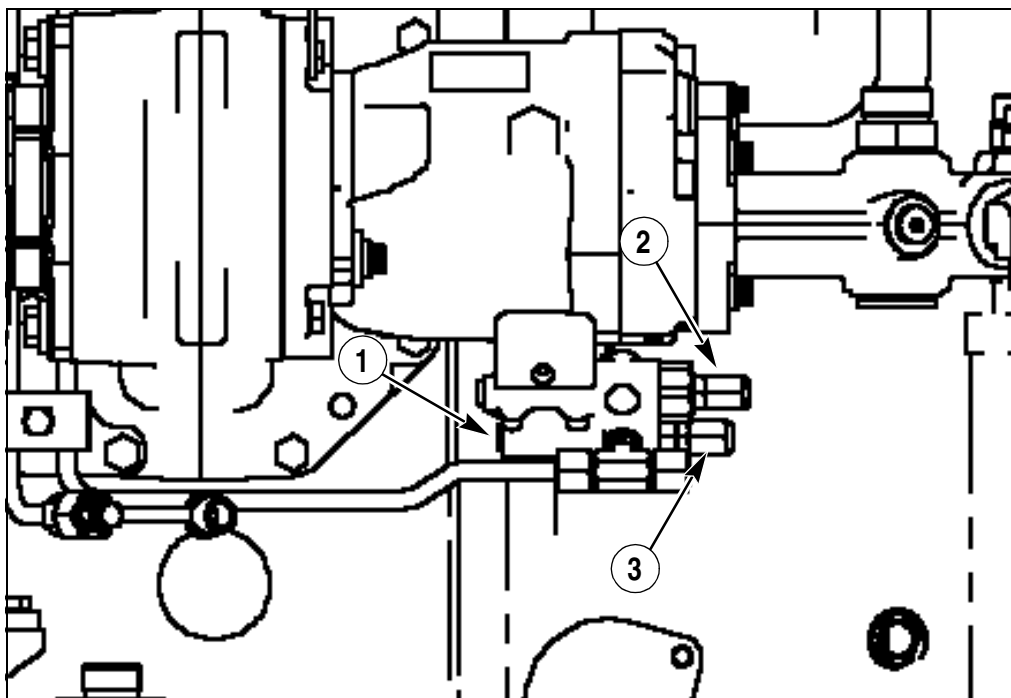
- 17 mm wrench and 3 mm Allen wrench.

### Preparation

Remove the plug at rear of high pressure compensation spool and install the diagnostic fitting (1) from Kit 380040106 into the pump compensator.

**IMPORTANT:** *Do not shift the transmission control lever out of park.*

- Install a 5000 PSI (350 bar) pressure gauge with hose onto the diagnostic fitting at the compensator.
- Start and run the engine at 1500 RPM.
- Place the number one remote valve control lever into the extend position.



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### HIGH PRESSURE STANDBY ADJUSTMENT

1. DIAGNOSTIC FITTING PORT      2. HIGH PRESSURE COMPENSATOR ADJUSTMENT      3. FLOW COMPENSATOR ADJUSTMENT

### High Pressure Standby Specification: 3250 PSI (224 bar)

Remove the cap from the high pressure adjustment. Loosen the lock nut and use the Allen wrench to adjust the pressure. Turn the adjustment screw in (clockwise) to increase the pressure, and turn the adjustment out (counterclockwise) to decrease the pressure setting.

- A. If the correct pressure could not be obtained the PFC pump may be damaged. Perform the PFC piston pump flow.

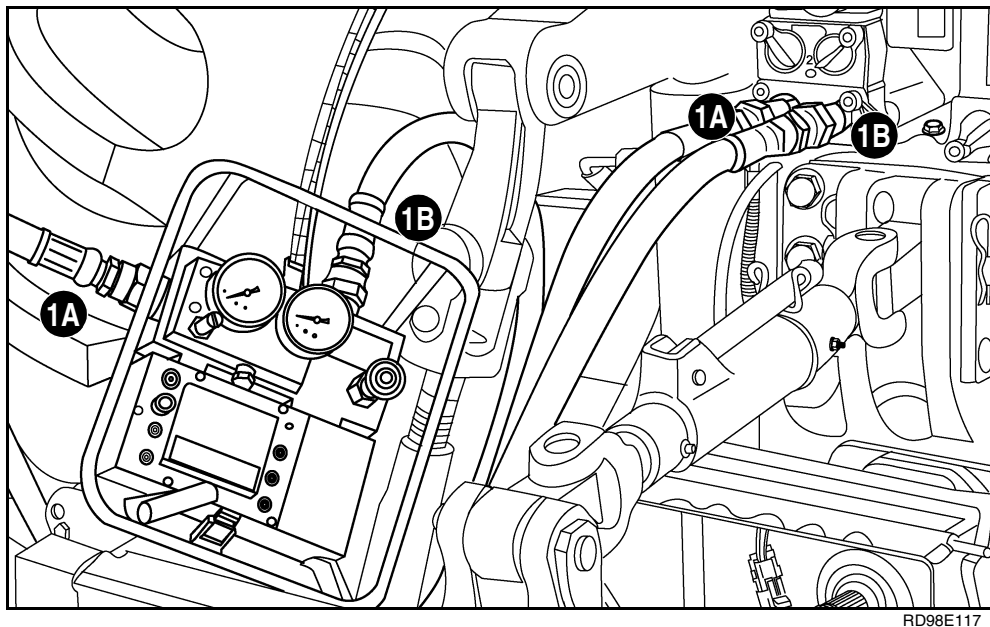
## PFC PISTON PUMP FLOW TEST

Perform this test when all remote circuits and the hitch system are not operating at full flow. This would be noticeable by slower operation of remote circuit systems along with a slower hitch raise time.

- Set all the remote valve variable flow controls to the **maximum flow** position.
- Set the remote valve timer control to the **maximum time** position.
- Cover the oil coolers on to help heat the oil.
- Start and run the engine at 1000 RPM.

**NOTE:** Use 3/4 inch hose with a minimum working pressure of 3000 PSI (206 bar) for this flow test.

- Install the CAS-10280 Flowmeter into the No. 1 remote section. Place the remote valve control lever into the detent retract position.
- Adjust the load valve on the flowmeter to 1500 PSI (103 bar) and heat the transmission oil to a minimum of 120°F (49°C).



Increase engine speed to 2000 RPM. Individually flow rate each remote valve section. Adjust the load valve on the flowmeter to 1000 PSI (69 bar).

REMOTE SECTION	FULL FLOW @ 2000 RPM
NO. 1 REMOTE SECTION	
NO. 2 REMOTE SECTION	
NO. 3 REMOTE SECTION	
NO. 4 REMOTE SECTION	
NO. 5 REMOTE SECTION	

**Full Flow Specification for Standard Flow Pump: 34.3 GPM (130 L/min)**

**Full Flow Specification for Optional High Flow Pump: 34.3 GPM (130 L/min)**

**Full Flow Specification for Optional MegaFlow Pump: 34.3 GPM (130 L/min)**

If only one remote section is delivering the correct flow and the rest record low flow. Inspect the signal check for the remote section that is delivering the correct flow. This signal check is probably leaking.

If the pump does not meet specification for standard flow pump, perform the Standard Pump Compensator and Swash Plate Inspection.



## PFC PISTON PUMP FLOW COMPENSATOR SETTING

### Preparation

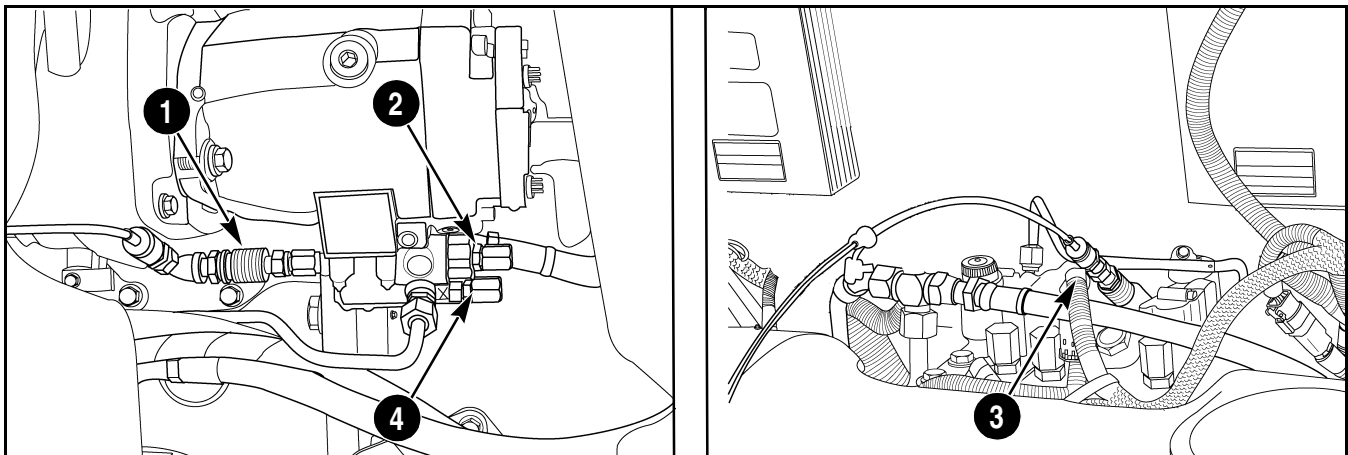
Test Fitting Tool Requirements:

- 17 mm wrench and 3 mm Allen wrench.
- Two 5000 PSI (350 bar) gauges with hose.
- CAS-10280 Flowmeter.

Remove the plug from behind the high pressure compensation spool and install the diagnostic fitting from fitting kit 380040106 into the pump compensator.

- Install a 5000 PSI (350 bar) pressure gauge with hose onto the diagnostic fitting at the compensator.
- Install a 5000 PSI (350 bar) pressure gauge with hose onto the diagnostic fitting at the remote valve manifold.

**NOTE:** Procedure shown is for standard PFC system. The MegaFlow pump system compensator setting may be checked too. Use the gauge connection (3) on the right side of manifold for MegaFlow. Use remote section No. 3 for checking MegaFlow system.



1. GAUGE CONNECTION AT COMPENSATOR  
2. HIGH PRESSURE COMPENSATOR ADJUSTMENT

3. GAUGE CONNECTION AT REMOTE MANIFOLD  
4. FLOW COMPENSATOR ADJUSTMENT

**NOTE:** Use 3/4 inch hose with a minimum working pressure of 3000 PSI (206 bar) for this test.

- Install the CAS-10280 Flowmeter into the No. 1 remote section.
- Set all the remote valve variable flow controls to the **maximum flow** position.
- Set the remote valve timer control to the **maximum time** position.
- Cover the oil cooler to help heat the oil.
- Start and run the engine at 1000 RPM.
- Place the No. 1 remote valve control lever into the detent extend position.
- Adjust the load valve on the flowmeter to 1500 PSI (103 bar) and heat the transmission oil to a minimum of 120°F (49°C).

## Flow Compensator Setting

- Increase the engine speed to 2000 RPM.
- Adjust the load valve on the flowmeter to 1000 PSI (69 bar) on the remote manifold gauge.
- Adjust the remote valve variable flow control until the remote flow is approximately one half the maximum flow rate:

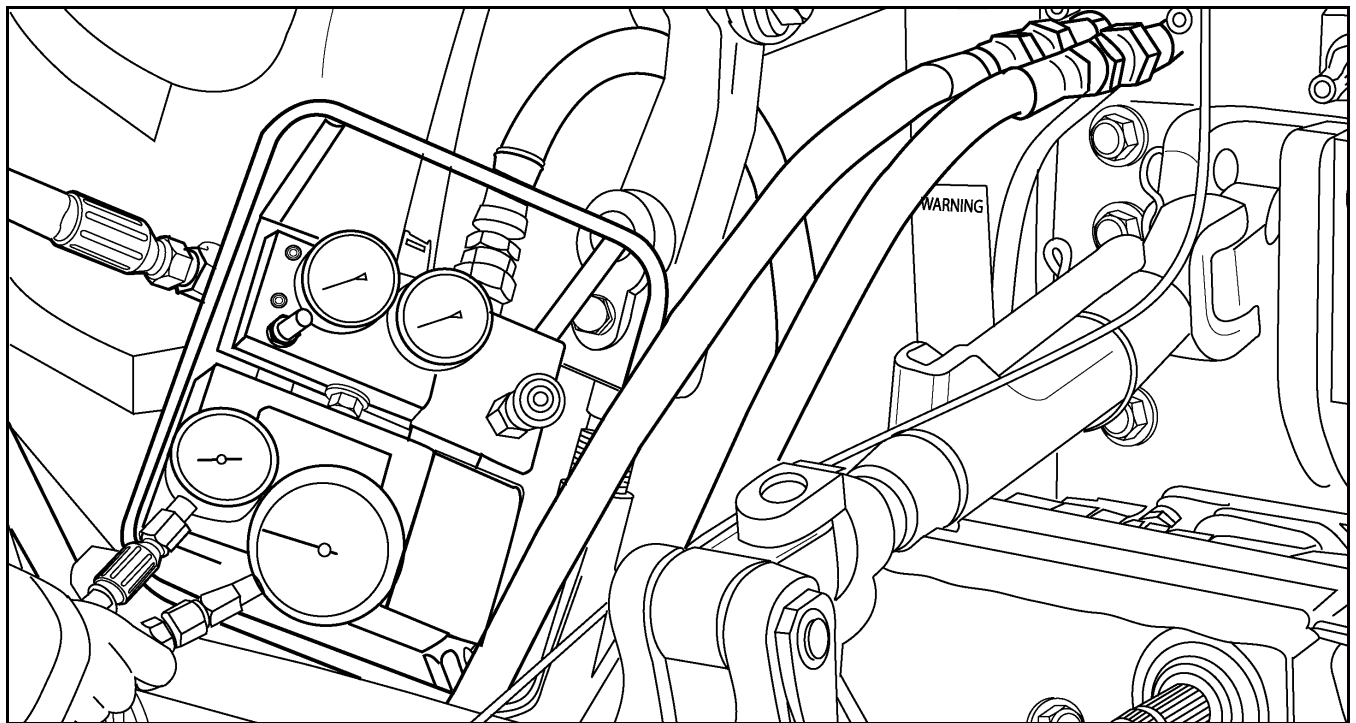
Adjust flow to approximately 18 GPM for standard flow pump.

Adjust flow to approximately 26 GPM for high flow pump.

At one half flow rate and a 1000 PSI (69 bar) pressure reading at the remote manifold, the compensator pressure gauge should read 1365 PSI (94 bar).

Adjust the load sense spool as necessary to attain the 365 PSI (25 bar) differential pressure.

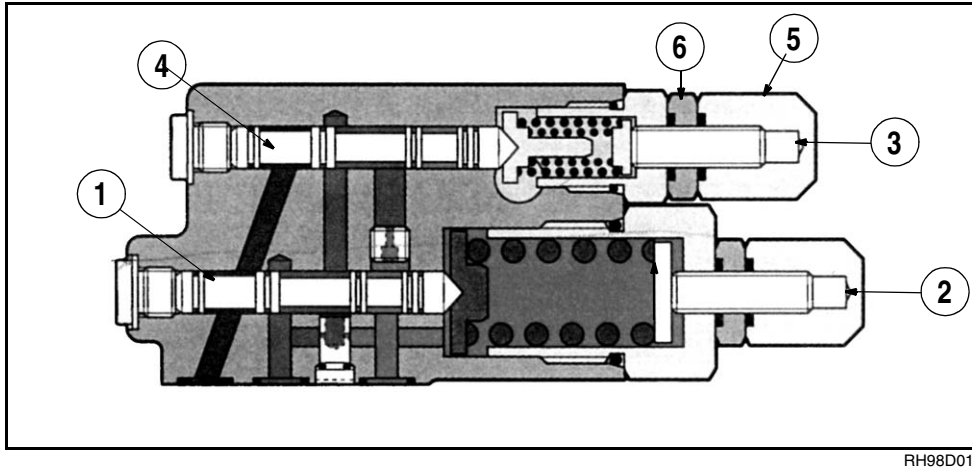
The load sense spool is the lowermost spool in the compensator. See compensator valve inspection in this section.



RD02D149

## STANDARD PUMP COMPENSATOR VALVE INSPECTION

Perform this inspection only after completing the high pressure standby check and the piston pump flow test.



- |                                   |                       |
|-----------------------------------|-----------------------|
| 1. HIGH PRESSURE SPOOL            | 4. LOW PRESSURE SPOOL |
| 2. HIGH PRESSURE ADJUSTMENT SCREW | 5. CAP                |
| 3. LOW PRESSURE ADJUSTMENT SCREW  | 6. LOCK NUT           |

### Test Fitting and Tool Requirements:

- 17 mm wrench
- 3 mm Allen wrench
- 5 mm Allen wrench

### Test Procedure:

- With two wrenches, disconnect the signal line tube at the PFC pump compensator.
- Remove the compensator valve from the PFC pump.
- Remove high pressure cap.  
Measure and record the distance from the lock nut to the end of the high pressure adjustment screw.

\_\_\_\_\_

- Remove low pressure cap.  
Measure and record the distance from the lock nut to the end of the low pressure adjustment screw.

\_\_\_\_\_

- Check for broken springs
- Remove high pressure spool. Make sure it moves freely within the bore.
- Remove low pressure spool. Make sure it moves freely within the bore.
- Clean cored passages in the compensator valve.
- Assemble compensator valve. Set high and low pressure adjustment screws to their original positions.
- Reinstall compensator. Perform PFC Piston Pump Flow Test.
- If the pump is still not able to meet specifications, remove PFC pump for repair or replacement.

## **PFC PUMP OPERATIONAL PROBLEMS**

### **POOR OVERALL HYDRAULIC PERFORMANCE - LOW FLOW TO HITCH AND ALL REMOTE VALVE CIRCUITS**

- A. Low hydraulic oil level in transmission.
- B. Low charge/lube pressure. Perform rear charge/lube pump pressure test in this section. Complete the entire test procedure
- C. Perform the PFC pump high pressure standby test.
- D. Perform the PFC piston pump flow test.
- E. After completing items A,B,C and D from above:
  - If the pump performance is now okay troubleshooting is completed.
  - If poor overall hydraulic performance continues, remove PFC pump for repair or replacement. See PFC Pump section of this manual.

### **POOR HYDRAULIC PERFORMANCE - LOW FLOW TO HITCH AND ALL BUT ONE REMOTE VALVE CIRCUIT**

- A. Bad signal check in the one working remote section.

### **POOR HYDRAULIC PERFORMANCE - HITCH OPERATING OKAY, BUT LOW FLOW FROM ALL REMOTE CIRCUITS**

- A. Check for remote system fault codes
  - If there are fault codes continue with fault code troubleshooting.
  - If there no fault codes check hitch valve signal check for leakage.

### **POOR HYDRAULIC PERFORMANCE - LOW FLOW OR ERRATIC HITCH OPERATION, BUT ALL REMOTE VALVE CIRCUITS ARE OPERATING OKAY**

- A. Check for hitch system fault codes
  - If there are fault codes continue with fault code troubleshooting.
  - If there no fault codes, go to the Hitch System How It Works section of this manual.

### **PFC SYSTEM REMAINS ON HIGH PRESSURE STANDBY, OR IS SLOW TO COME OFF HIGH PRESSURE STANDBY**

- A. Pump compensator bleed down orifice is blocked, or partially blocked.

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# **Section 35**

## **Chapter 3**

### **PTO AND DIFFERENTIAL LOCK VALVE**

**TABLE OF CONTENTS**

SPECIAL TORQUES ..... 35-3-2

SPECIFICATIONS ..... 35-3-2

PTO AND DIFFERENTIAL LOCK VALVE ..... 35-3-3

**SPECIAL TORQUES**

Solenoid Valve Nut ..... 5 to 8 Nm (4 to 6 lb. ft.)

Plug ..... 34 to 54 Nm (25 to 40 lb. ft.)

Solenoid Cartridge..... 12 to 18 Nm (9 to 13 lb. ft).

Valve Mounting Bolts ..... 41 to 46 Nm (30 to 34 lb. ft.)

**SPECIFICATIONS**

Modulation Spring (smaller)

    Free Length.....39.17 mm (1.542 inch)

    Compress to 2.70 mm (1.063 inch)..... 122.9 to 159.2 N (27.6 to 33.8 lb.)

Preload Spring (larger)

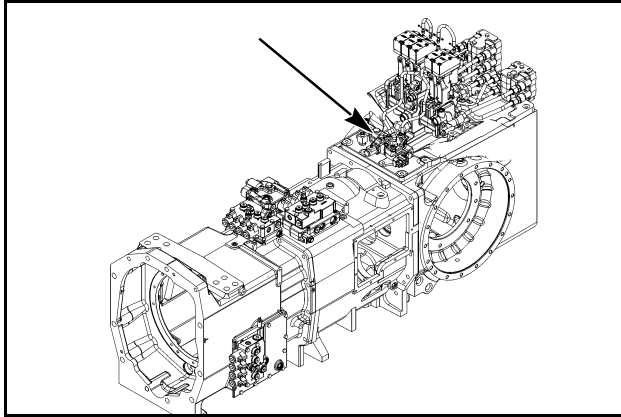
    Free Length.....39.17 mm (1.542 inch)

    Compress to 47.52 mm (1.871 inch)..... 96.07 to 117.43 N (21.6 to 26.4 lb.)

## PTO AND DIFFERENTIAL LOCK VALVE

### Troubleshooting

#### STEP 1



RH98F160

The PTO and diff lock valve can be serviced after the cab is either raised or removed. See the Cab Raise/Removal and Installation Section in this Service Manual for procedure.

Before removing the valve, check the PTO controller for fault codes. See the PTO Sections in this Service Manual for procedure and corrective action if a fault exists. Depending on which system is not functioning correctly, see Power Take Off Control System How It Works, or Differential Lock Control System How It Works.

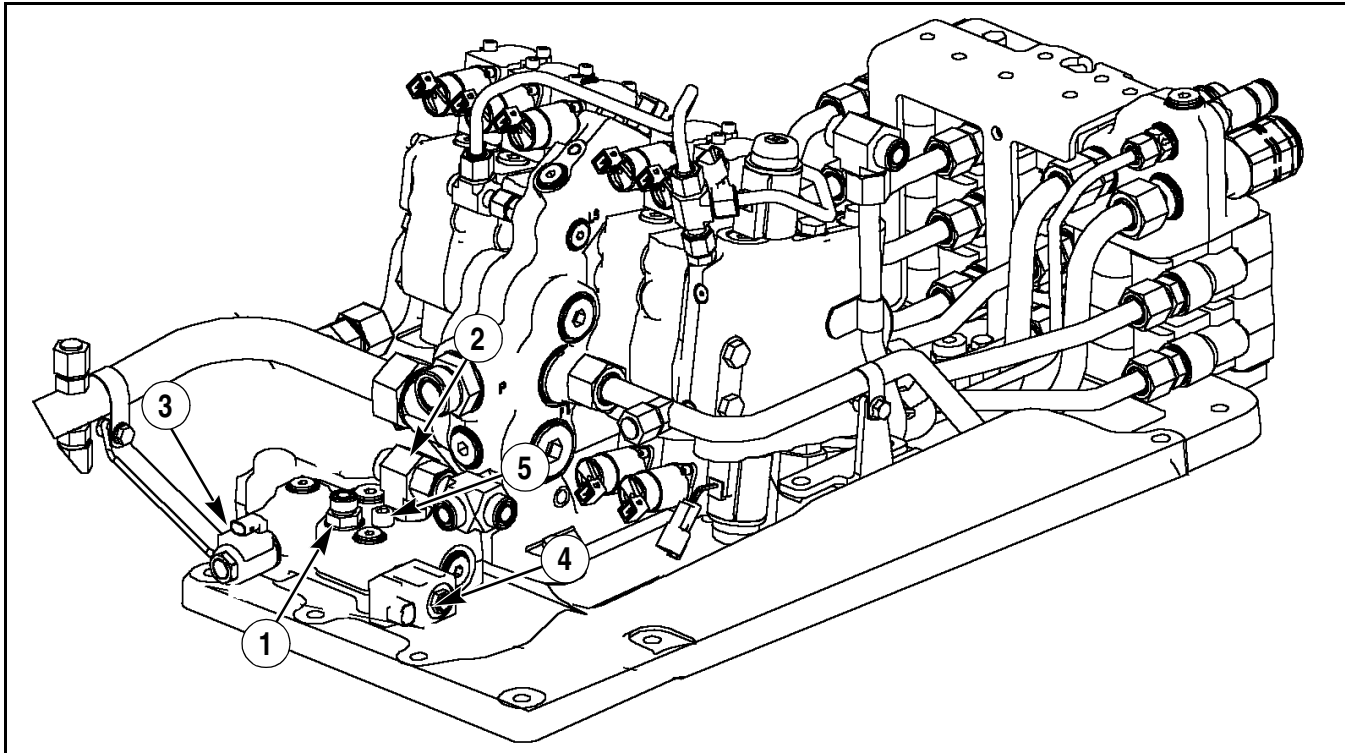
#### STEP 2

If other regulated pressure functions such as braking or transmission control are not operating properly, Check the regulated pressure. See the Hydraulic Systems How It Works With Troubleshooting Section of this Service Manual.



## Removal

### STEP 3



R102D105

- |                     |                       |
|---------------------|-----------------------|
| 1. INLET            | 4. DIFF LOCK SOLENOID |
| 2. LUB INLET        | 5. MOUNTING BOLT      |
| 3. PTO PWM SOLENOID |                       |

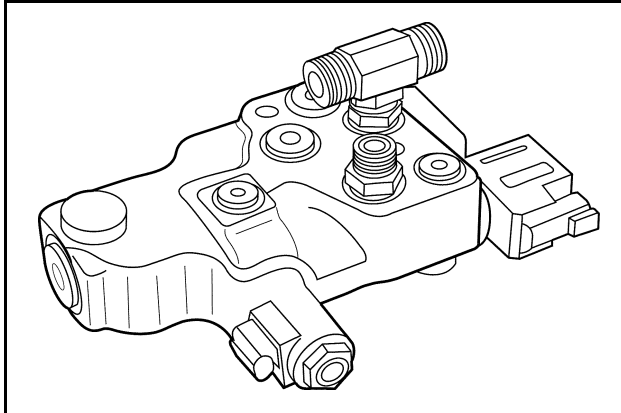
**NOTE:** Clean the surface of the PTO valve and all tube connections before doing any service work. Tag tube and electrical connections. Cap or plug all open hydraulic connections.

**NOTE:** Depending on how your tractor is equipped, it may be necessary to remove hydraulic tubes that run across the top of the valve in order to remove the valve.

1. Disconnect the tube from the valve inlet (1).
2. Disconnect the tubes from the lube inlet (2).
3. Disconnect the wire harness from the PTO PWM solenoid (3).
4. Disconnect the wire harness from the diff lock solenoid (4).
5. Remove the two mounting bolts (5) and remove the valve from the mounting plate.

## Disassembly

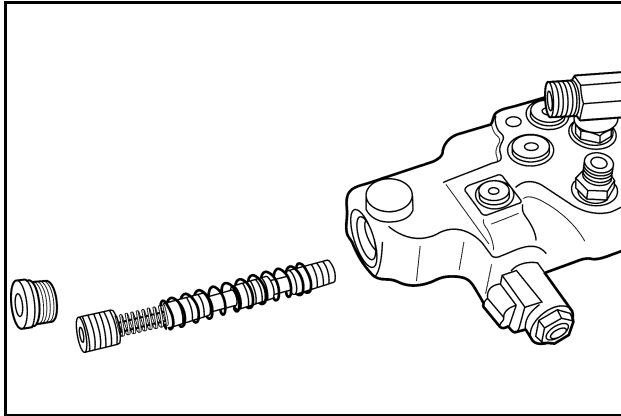
### STEP 4



RD02E110

Place the PTO valve on a clean workbench.

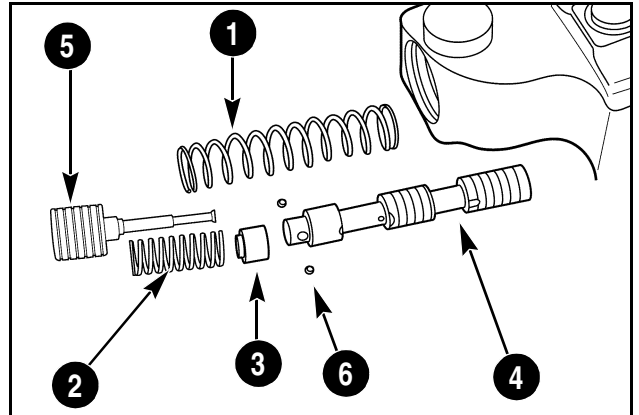
### STEP 5



RD02E111

Remove the plug and PTO modulation spool.

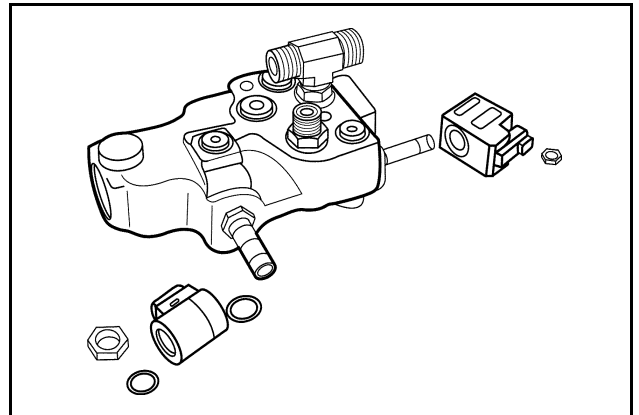
### STEP 6



RD02E112

Remove the preload spring (1) from the spool assembly. Compress the modulation spring (2) by pushing on the retaining sleeve (3) and separate the modulator spool (4) from the modulator piston (5). Be careful not to lose the two steel balls (6) when the assembly comes apart.

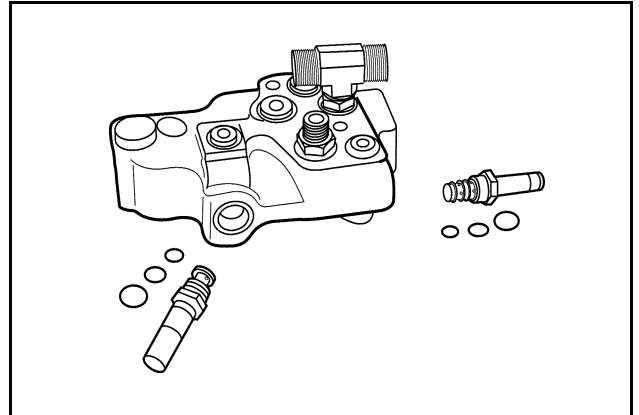
### STEP 7



RD02E114

Remove the PTO solenoid coil and two O-rings and the diff lock solenoid from the valve.

### STEP 8

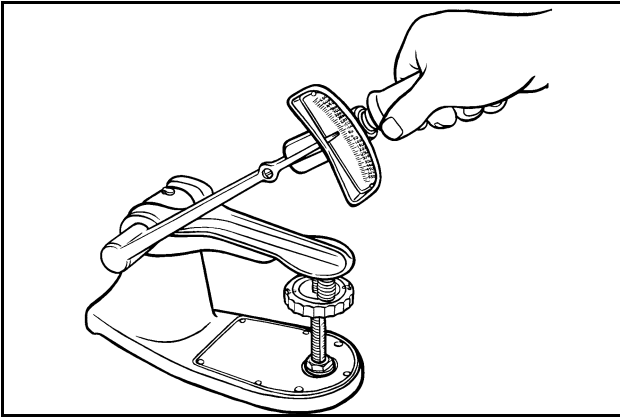


RD02E115

Remove the solenoid cartridges from the valve and discard the O-rings.

## Inspection

### STEP 9

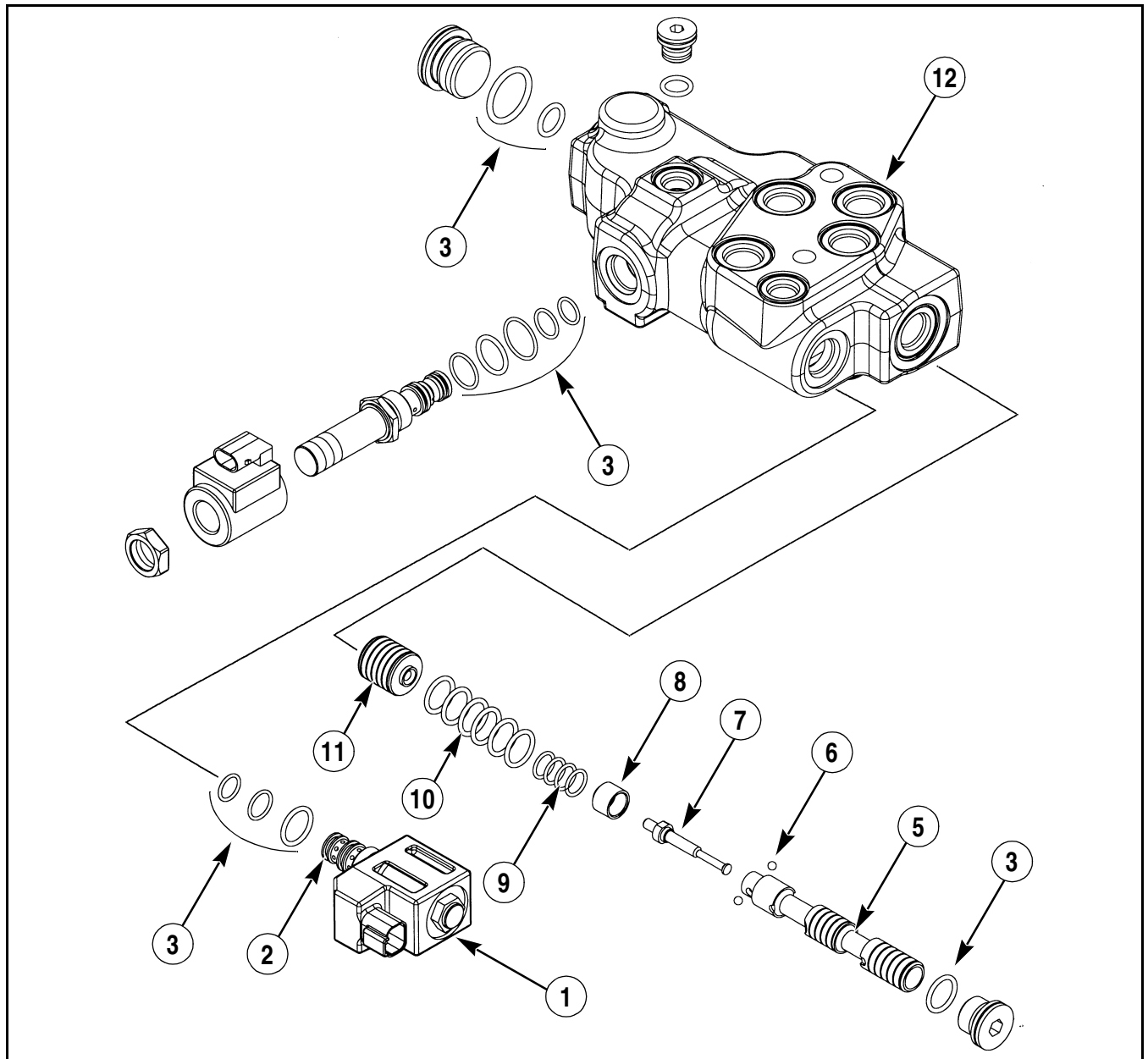


66L7

1. Check the two PTO modulation spool springs with a compression tester. Check each spring for free length and for compressed load force per specifications in this section.
2. Inspect the valve spool and piston for heavy wear or damage. If present, the complete assembly must be replaced.
3. Replace all O-rings.
4. Clean the valve body with suitable cleaning fluid.

## Assembly

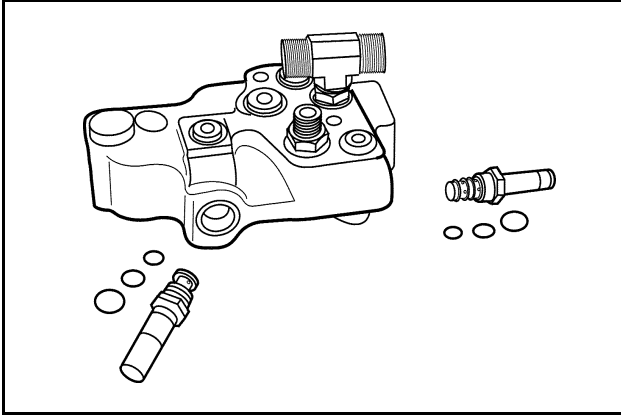
**NOTE:** Lubricate spools and cartridges with clean hydraulic fluid during assembly.



RI98G167

- |                       |                         |                       |
|-----------------------|-------------------------|-----------------------|
| 1. DIFF LOCK SOLENOID | 5. MODULATOR SPOOL      | 9. MODULATION SPRING  |
| 2. CARTRIDGE          | 6. STEEL BALL           | 10. PRELOAD SPRING    |
| 3. O-RING             | 7. MODULATOR PISTON PIN | 11. MODULATION PISTON |
| 4. PTO SOLENOID       | 8. RETAINER SLEEVE      | 12. BODY              |

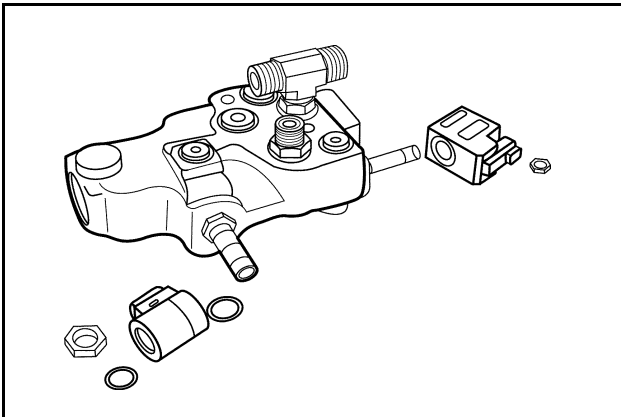
## STEP 10



RD02E115

Install new O-rings on the solenoid cartridges. Install the cartridges and tighten to a torque of 12 to 18 Nm (9 to 13 lb. ft.)

## STEP 11

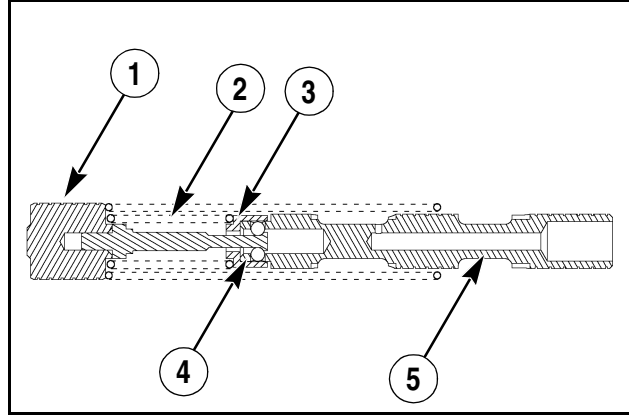


RD02E114

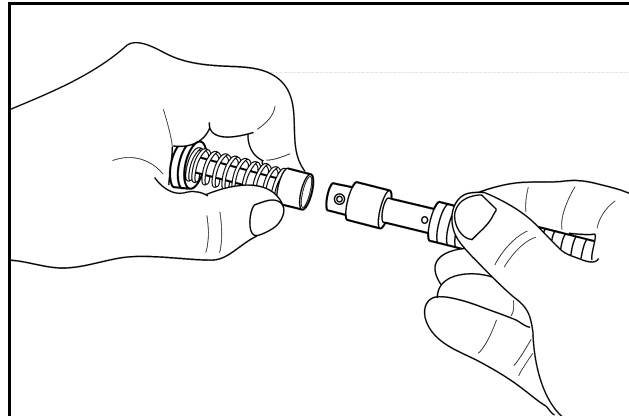
Install two new O-rings on the PTO solenoid coil and install on the cartridge. Install the diff lock solenoid on to the cartridge. Install the retaining nuts and tighten to a torque of 5 to 8 Nm (4 to 6 lb. ft.).

**NOTE:** There are no O-rings on the diff lock solenoid.

## STEP 12



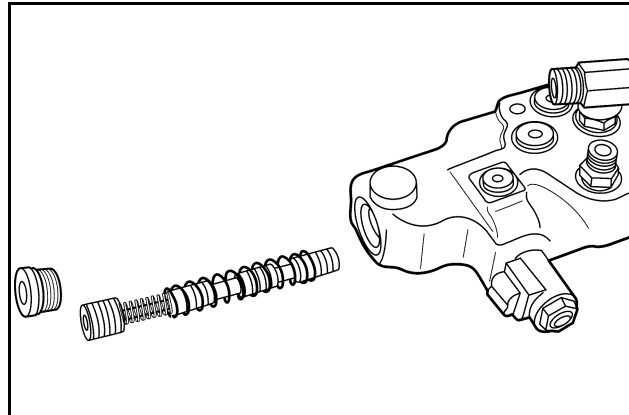
RI02E060



RD02E113

Assemble the modulator piston (1), modulation spring (2) and retaining sleeve (3). Apply petroleum jelly to the steel balls (4) and insert them into the bore at the end of the modulator spool (5). Push on the retaining sleeve (3) and compress the modulation spring (2) a small amount. Install the end of the modulator piston pin into the modulator spool (5) and release the retaining sleeve (3). Install the preload spring (6) onto the assembly.

## STEP 13

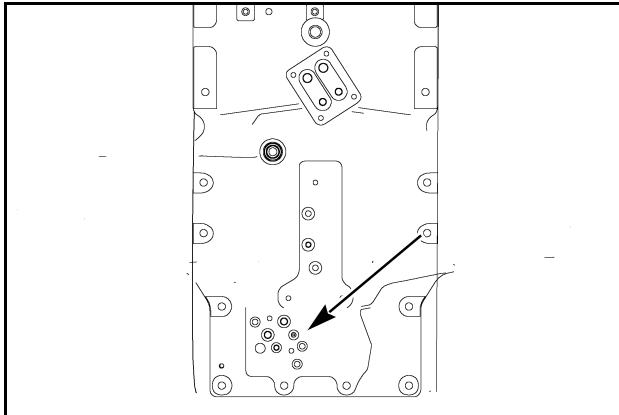


RD02E111

Install the PTO modulation spool into the valve. Install the plug and tighten to a torque of 34 to 54 Nm (25 to 40 lb. ft.).

## Installation

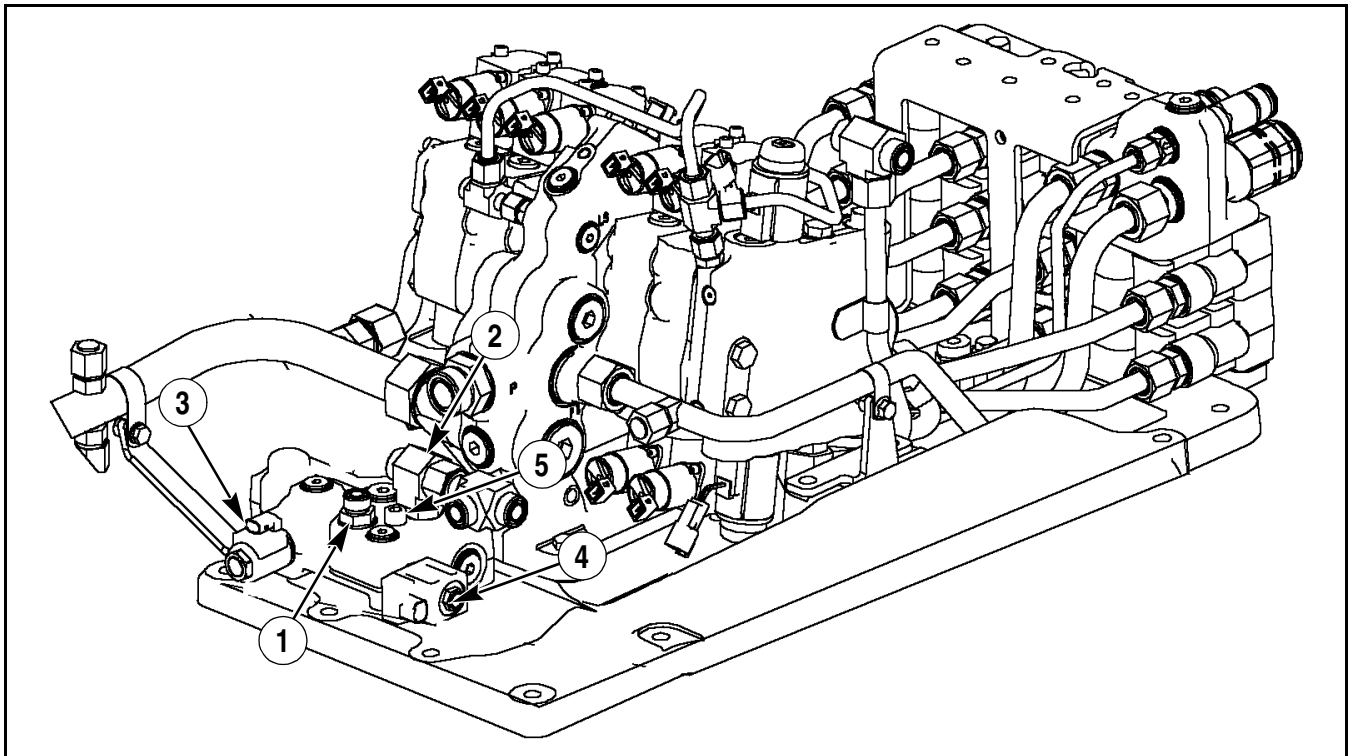
### STEP 14



RI02E059

Apply petroleum jelly to new O-rings and install the O-rings onto the valve mounting plate.

### STEP 15



RI02D105

1. INLET

2. LUB INLET

3. PTO PWM SOLENOID

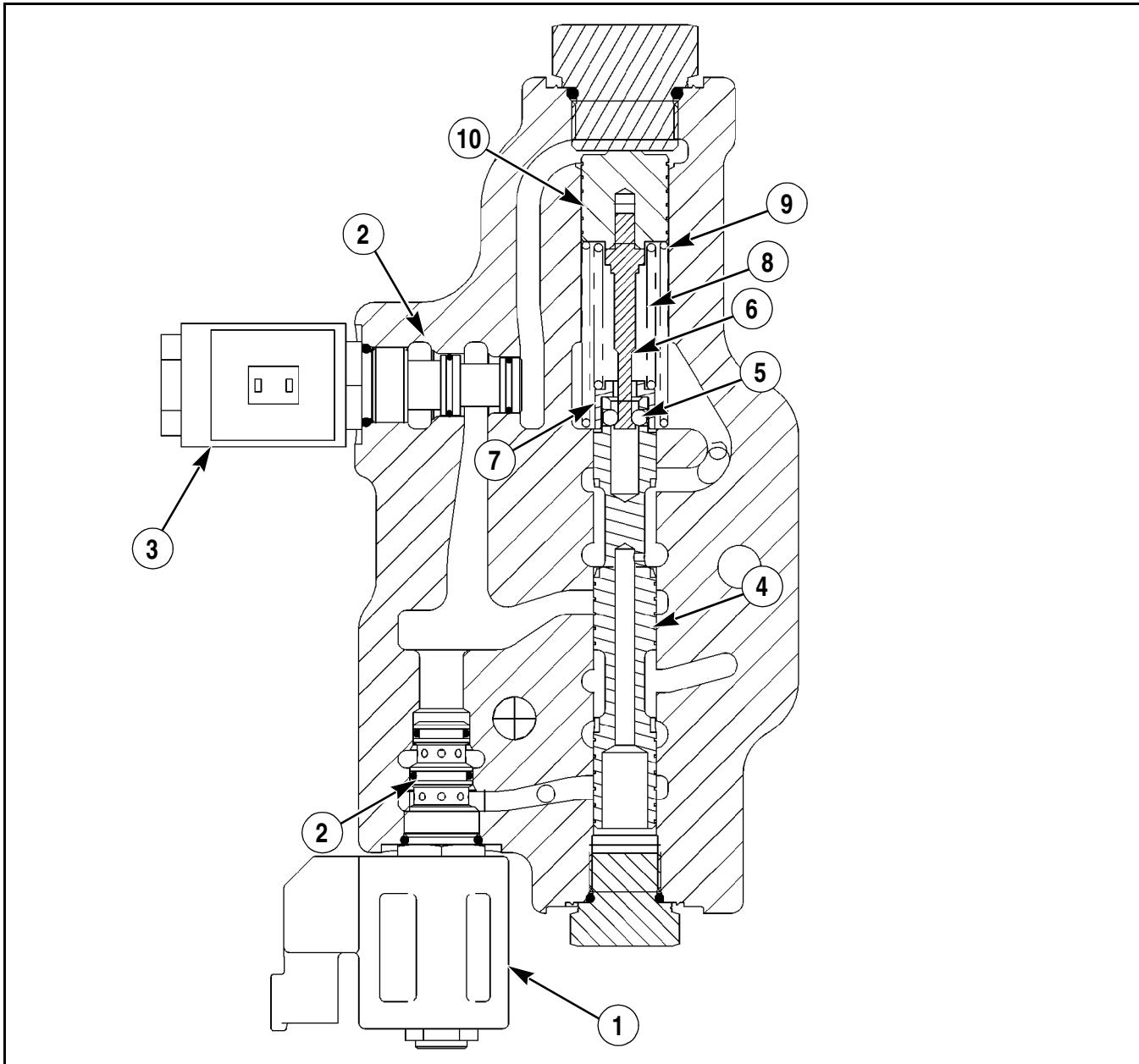
4. DIFF LOCK SOLENOID

5. MOUNTING BOLT

1. Position the valve onto the mounting plate. Install the mounting bolts (5) and tighten to a torque of 41 to 46 Nm (30 to 34 lb. ft.).
2. Connect the wire harness connectors to the diff lock solenoid (4) and PTO solenoid (3).

3. Connect and tighten the tube to the lube inlet fitting (2).
4. Connect and tighten the tube to the valve inlet fitting (1).

## PTO And Diff Lock Valve Cross Section



RT98A024

- |                       |                         |
|-----------------------|-------------------------|
| 1. DIFF LOCK SOLENOID | 6. MODULATOR PISTON PIN |
| 2. CARTRIDGE          | 7. RETAINER SLEEVE      |
| 3. PTO SOLENOID       | 8. MODULATION SPRING    |
| 4. MODULATOR SPOOL    | 9. PRELOAD SPRING       |
| 5. STEEL BALL         | 10. MODULATION PISTON   |

# **Section 35**

## **Chapter 4**

### **REMOTE VALVE AND COUPLER SERVICE**



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REMOTE COUPLERS ..... 35-4-13

**SPECIAL TORQUES**

Valve Section Mounting Bolts

    M12 x 100mm ..... 40 to 45 Nm (30 to 33 lb. ft.)

    M10 x 110mm ..... 25 to 30 Nm (18 to 22 lb. ft.)

Solenoid Block Retaining Screws ..... 10 to 13 Nm (7 to 10 lb. ft.)

Load Check Valve Cap ..... 30 to 41 Nm (22 to 30 lb. ft.)

Main Valve Spool Plug ..... 14 to 16 Nm (10 to 12 lb. ft.)

Pressure Compensating Spool Plug (5/8) ..... 50 to 58 Nm (37 to 43 lb. ft.)

Pressure Compensating Spool Plug (3/8) ..... 33 to 35 Nm (24 to 26 lb. ft.)

## REMOTE VALVE AND COUPLER SERVICE

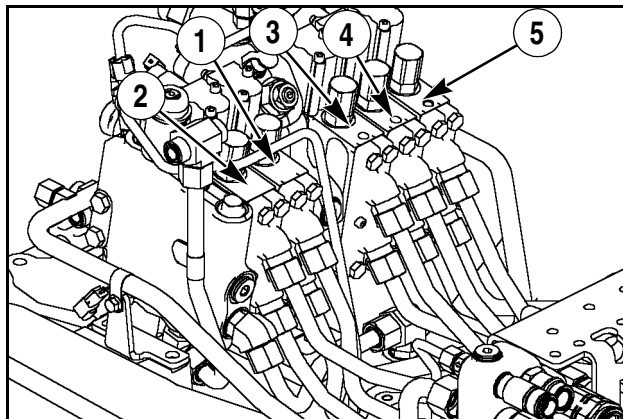
### Load Check Inspection On The Tractor

**IMPORTANT:** Always fully lower and disconnect any implements from the remote hydraulic couplers before doing service work on the remote valve sections.

#### STEP 1

See the Remote Hydraulic System How it Works and Troubleshooting Section in this Service Manual before starting remote valve service. Once it is determined that repair or replacement is necessary, follow the procedures in this section.

#### STEP 2



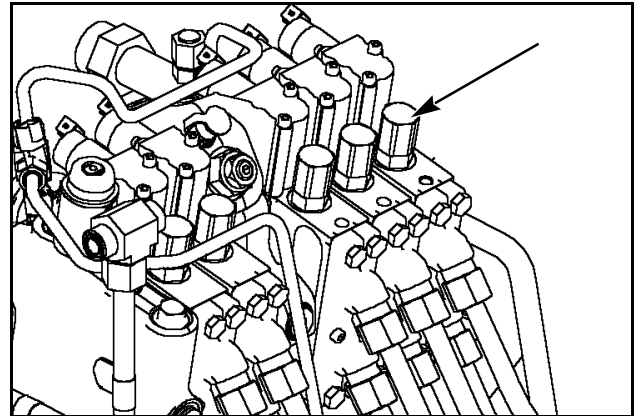
1. VALVE SECTION NO. 1
2. VALVE SECTION NO. 2
3. VALVE SECTION NO. 3

4. VALVE SECTION NO. 4
5. VALVE SECTION NO. 5

The remote valves are located at the rear of the tractor. Remove the rear cover to access the valves.

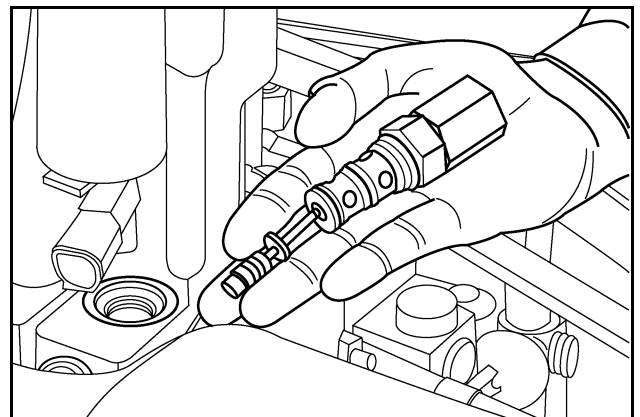
Thoroughly clean the remote valves and surrounding area before performing any service work.

#### STEP 3



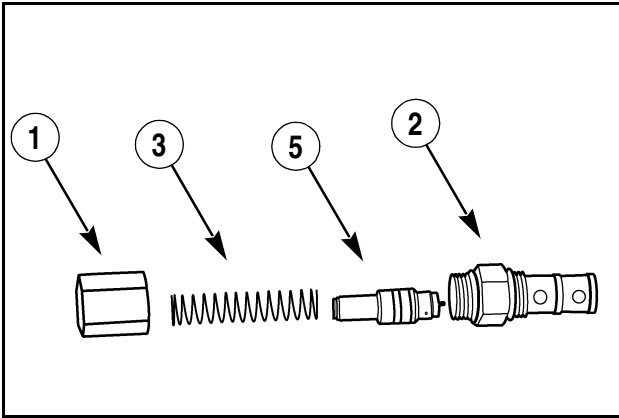
Use a 1-inch wrench to slowly loosen the load check cap to relieve any trapped pressure.

#### STEP 4

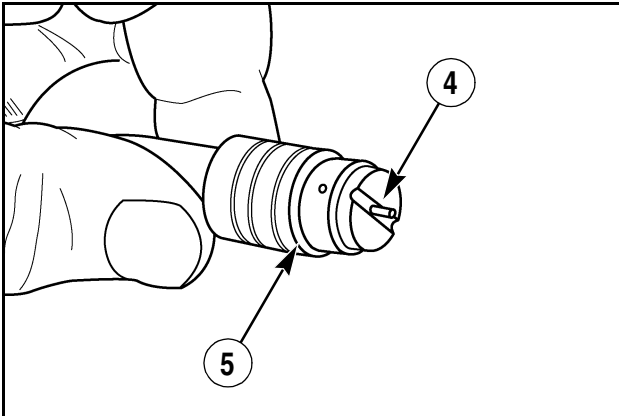


Remove the load check valve. Remove the plunger from the bore. Check for wear or damage. The plunger must move freely within the bore.

## STEP 5



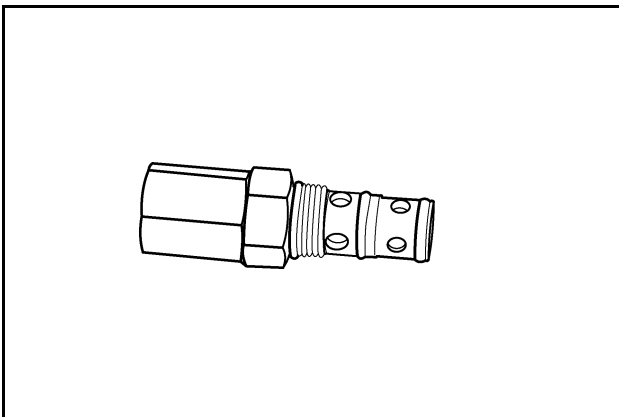
RD98K201



RD98K202

Remove the cap (1) from the load check body (2). There will be a light load from the spring (3). Make sure the stem (4) on the main poppet (5) is in place. Inspect the poppet and poppet seat for wear or damage.

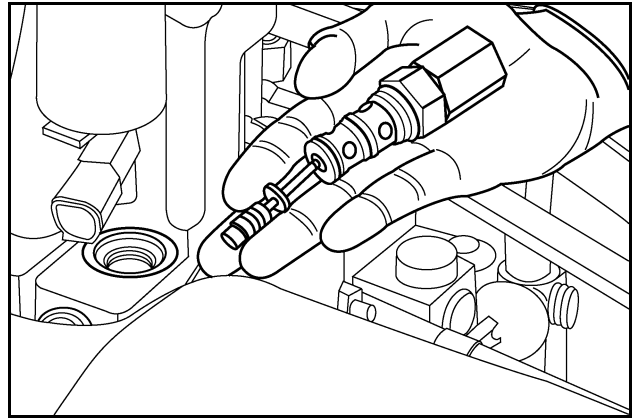
## STEP 6



RD98K200

Replace all backup rings and O-rings. Assemble the load check.

## STEP 7



RD98E128

Install the load check assembly and plunger into the valve section. Tighten the cap to a torque of 30 to 41 Nm (22 to 30 lb. ft.).

## REMOTE VALVE REMOVAL AND SERVICE

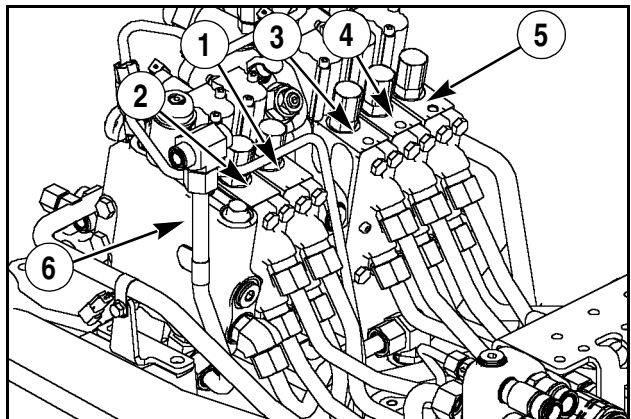
### Removal

**IMPORTANT:** Always fully lower and disconnect any implements from the remote hydraulic couplers before doing service work on the remote valve sections.

#### STEP 8

See the Remote Hydraulic System How it Works and Troubleshooting Section of this Service Manual before starting remote valve service. Once it is determined that repair or replacement is necessary, follow the procedures in this section.

#### STEP 9



RI02D103

- |                        |                        |
|------------------------|------------------------|
| 1. VALVE SECTION NO. 1 | 4. VALVE SECTION NO. 4 |
| 2. VALVE SECTION NO. 2 | 5. VALVE SECTION NO. 5 |
| 3. VALVE SECTION NO. # | 6. HITCH VALVE         |

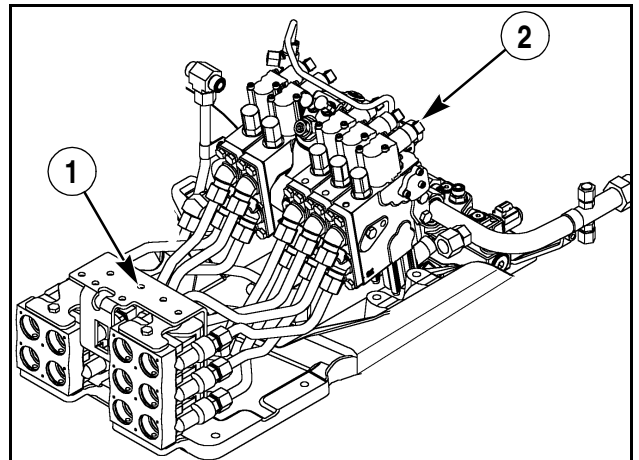
The remote valves are located at the rear of the tractor. Remove the rear cover to access the valves.

Thoroughly clean the remote valves and surrounding area before performing any service work.

If remote valve sections 1 or 2 are to be serviced, the hitch valve (6) must be removed first. See the Hitch Valve Section in this Service Manual for hitch valve removal procedure.

**NOTE:** For better valve access, the rear wheels can be moved out on the axles.

#### STEP 10

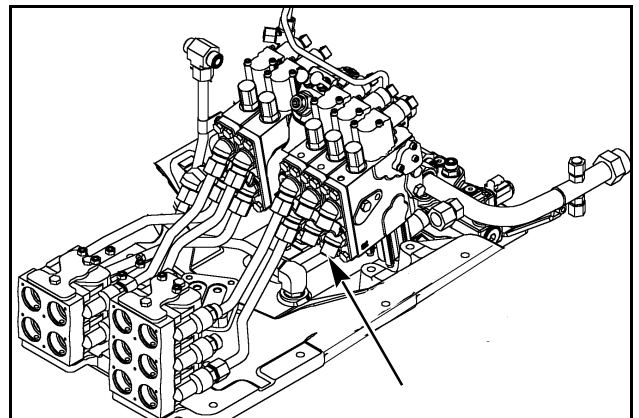


RI02E042

**NOTE:** This procedure will depict the removal of valve sections 4 and 5.

Remove the seven pin connector mounting bracket (1). Tag and disconnect the wiring harness from the solenoids (2).

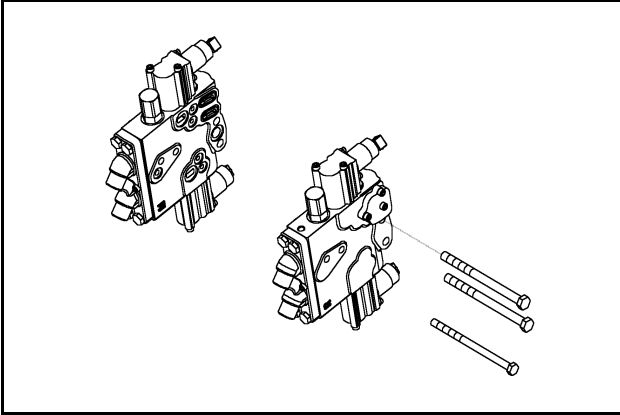
#### STEP 11



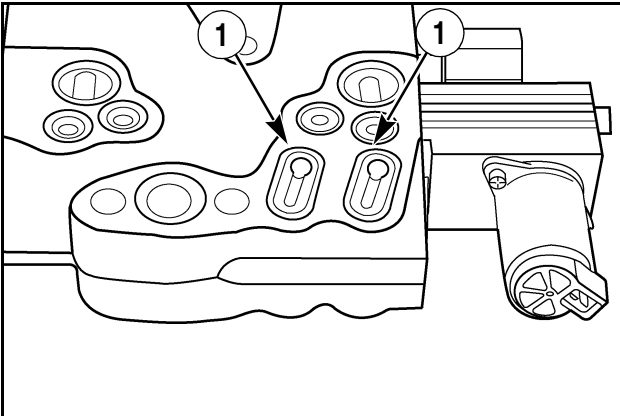
RI02E043

Tag and remove the raise and lower hydraulic tubes for the 4th and 5th remote sections.

## STEP 12



RI02E044



RD02D053

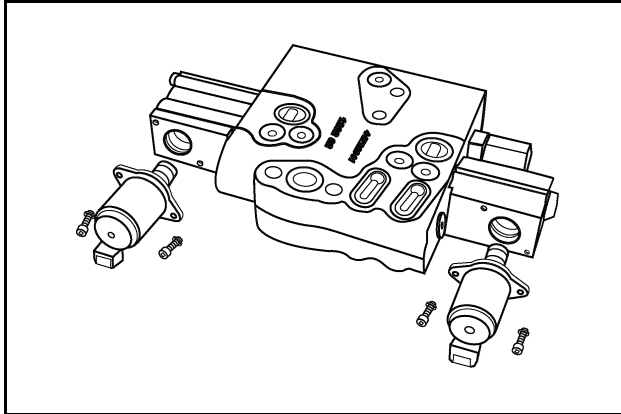
Remove the three mounting bolts and the 4th and 5th remote sections.

**NOTE:** *There are two signal check springs (1) on the mating side of each valve. Be sure that the springs are not lost during disassembly.*

## Disassembly

**NOTE:** If there is heavy wear or damage in a valve bore, the valve section must be replaced.

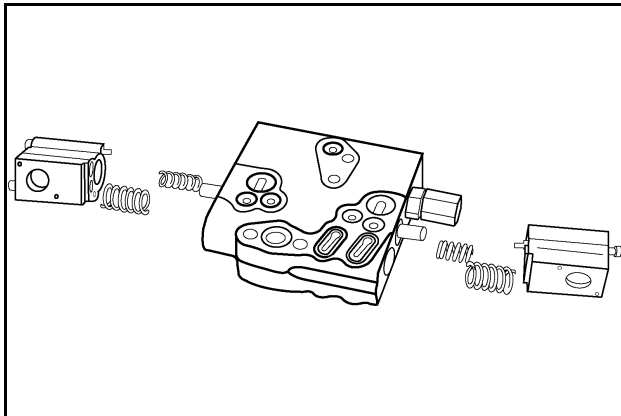
### STEP 13



RD02D054

Thoroughly clean the valve section and place on a clean work surface. Remove the solenoids from the solenoid bodies. Note the position of the solenoids on the body for assembly.

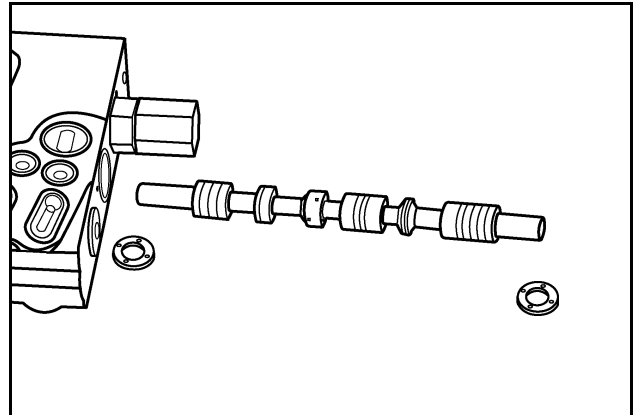
### STEP 14



RD02D055

Remove the solenoid blocks and springs from each end of the valve section. Note which side of the valve that the springs are from. Inspect for damage.

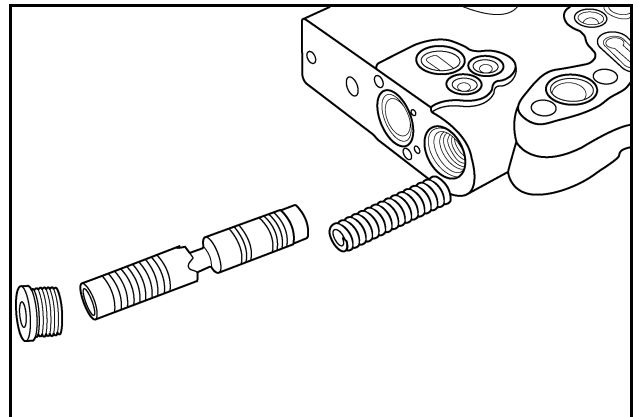
### STEP 15



RD02D056

Remove the main valve spool and washers. Note the end of the spool that is toward the load check cap end of the valve. Inspect the spool and bore for heavy wear or damage. The spool must move freely in the bore.

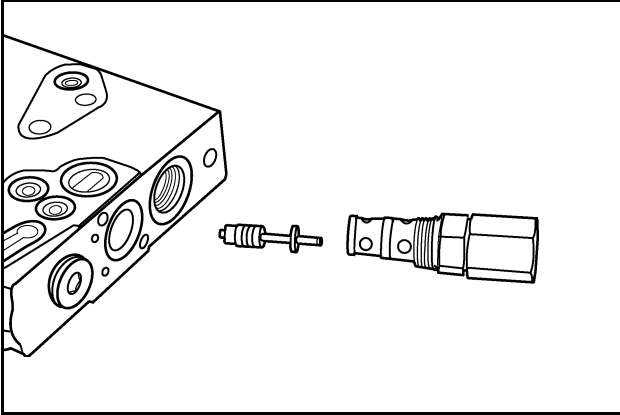
### STEP 16



RD02D057

Remove the pressure compensating flow control spool and spring from the valve from the end without the load check cap. Inspect the parts for and bore for heavy wear or damage. The spool must move freely in the bore.

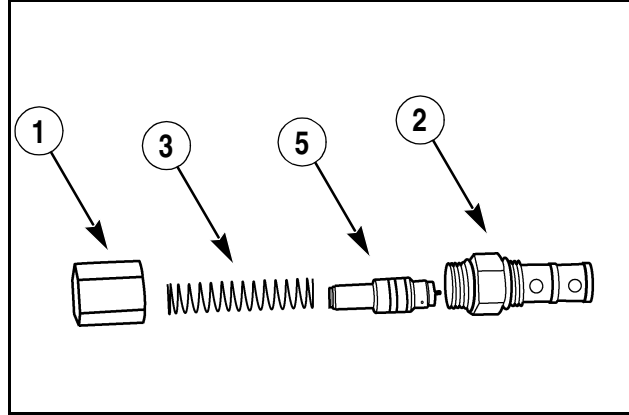
## STEP 17



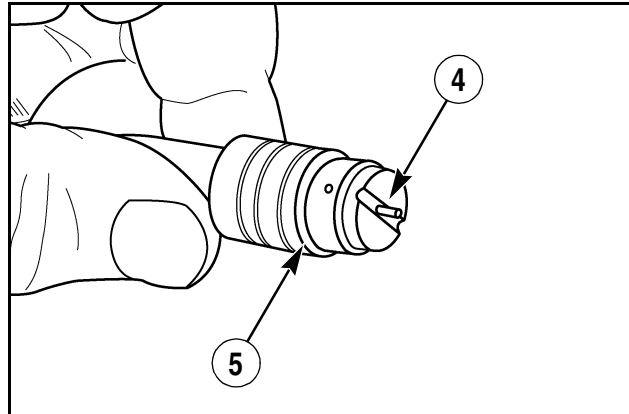
RD02E057

Remove the load check valve. Remove the plunger from the bore. Check for wear or damage. The plunger must move freely within the bore.

## STEP 18



RD98K201



RD98K202

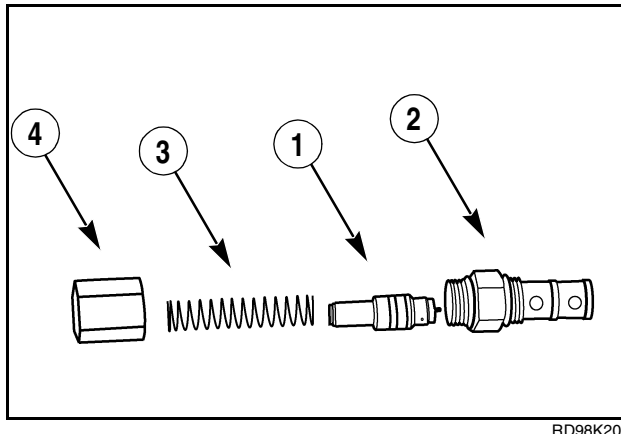
Remove the cap (1) from the load check body (2). There will be a light load from the spring (3). Make sure the stem (4) on the main poppet (5) is in place. Inspect the poppet and poppet seat for wear or damage.

## Assembly

**NOTE:** Always replace damaged or heavily worn parts. If the parts are not serviceable, the entire valve section must be replaced.

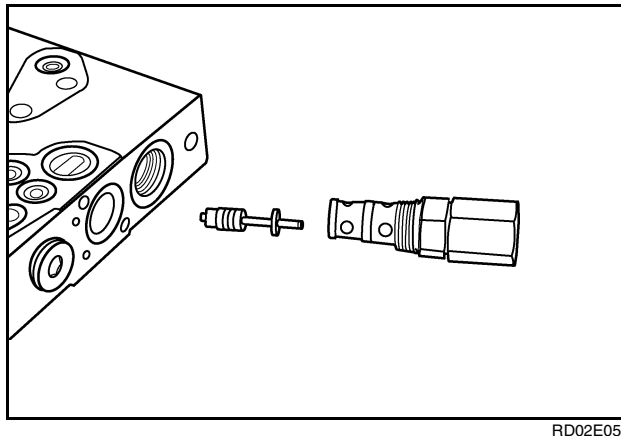
**NOTE:** Always install new O-rings, backup rings and seals during assembly.

### STEP 19



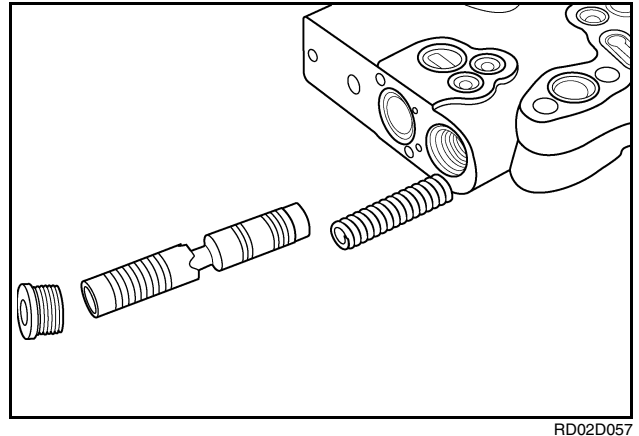
Install new backup rings and O-rings on the on the main poppet (1) and load check body (2). Install the main poppet and spring (3) into the load check body and install the cap (4).

### STEP 20



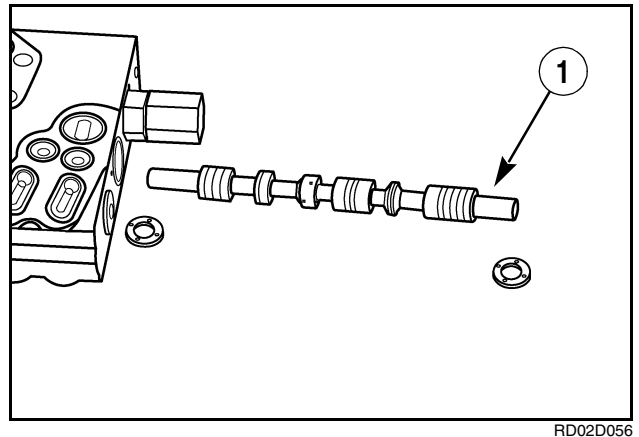
Install the plunger in the load check. Install the load check assembly into the valve body and tighten the cap to a torque of 30 to 41 Nm (22 to 30 lb. ft.).

### STEP 21



Install the spring and pressure compensated flow control spool into the valve body. Install the plug and tighten to a torque of 50 to 58 Nm (37 to 43 lb. ft.).

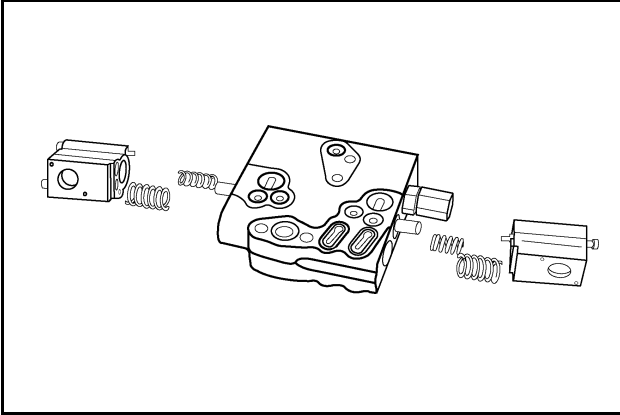
### STEP 22



Install a washer on each end of the main spool. Be sure that the end of the spool with the brass plug (1) is toward the top of the valve body (the end with the load check cap). Install the plug and tighten to a torque of 14 to 16 Nm (10 to 12 lb. ft.).



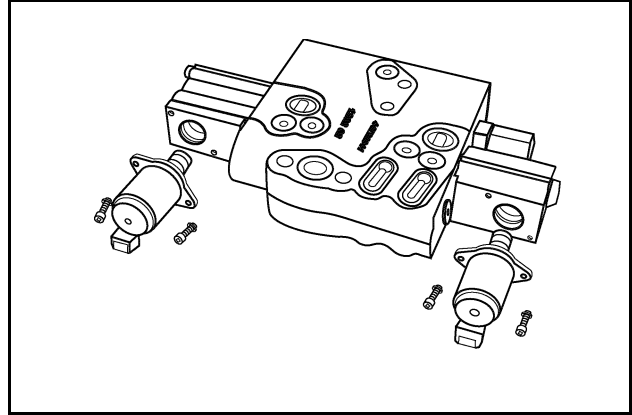
### STEP 23



RD02D055

Install new O-rings onto the solenoid bodies. Install the two springs and a solenoid block onto each side of the valve body. Be sure that the 27.16 mm (1.069 inch) inner spring is on the return side.

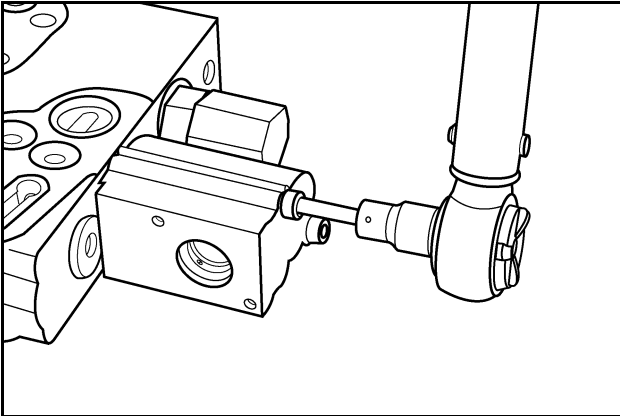
### STEP 25



RD02D054

Install new O-rings on the solenoids. Install the solenoids and tighten the mounting screws. Be sure the solenoids are positioned on the bodies as noted during disassembly.

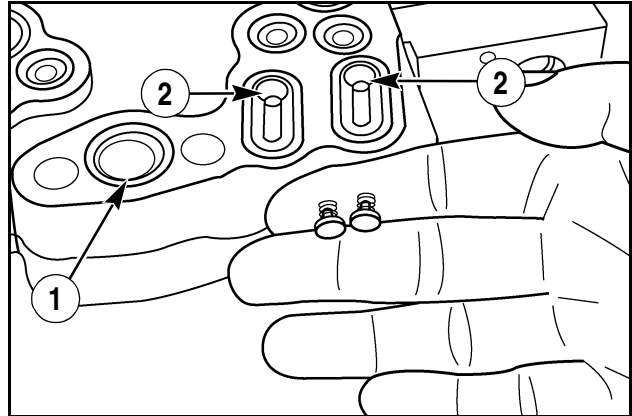
### STEP 24



RD02E093

Tighten the retaining screws to a torque of 10 to 13 Nm (7 to 10 lb. in.).

### STEP 26

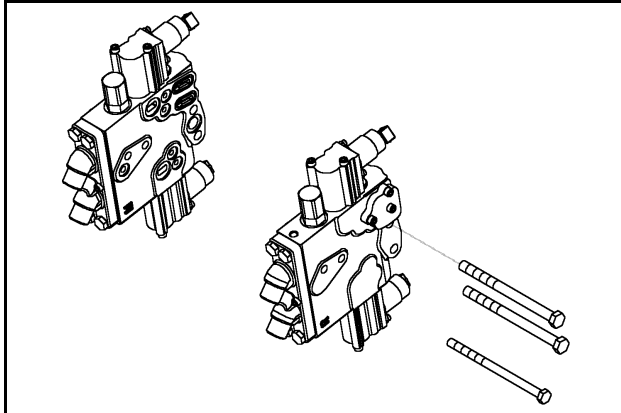


RD02E058

Apply petroleum jelly to new O-rings (1) and install them onto the valve ports. Apply petroleum jelly to the two signal check springs and install them into the ports (2) in the valve.

## Installation

### STEP 27

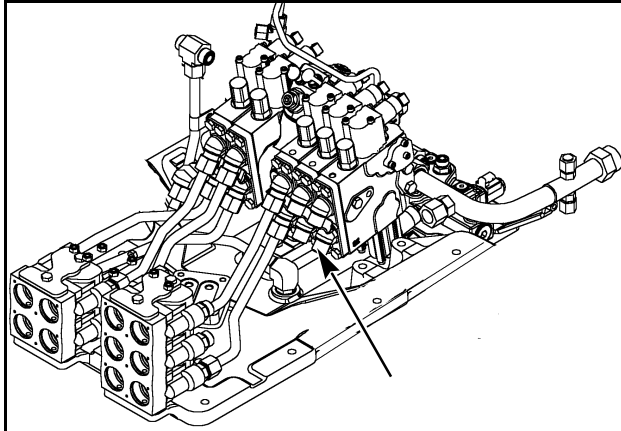


RI02E044

Position the valve sections on the valve stack and install the three retaining bolts. Tighten the M10 bolt to a torque of 25 to 30 Nm (18 to 22 lb. ft.). Tighten the M12 bolts to a torque of 40 to 45 Nm (30 to 33 lb. ft.).

**NOTE:** Be sure that the two signal check springs do not fall from the ports when assembling the valve sections.

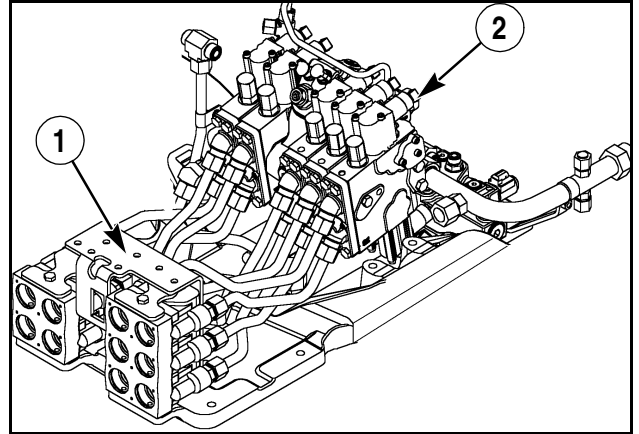
### STEP 28



RI02E043

Install the raise and lower hydraulic tubes for the 4th and 5th remote valve sections.

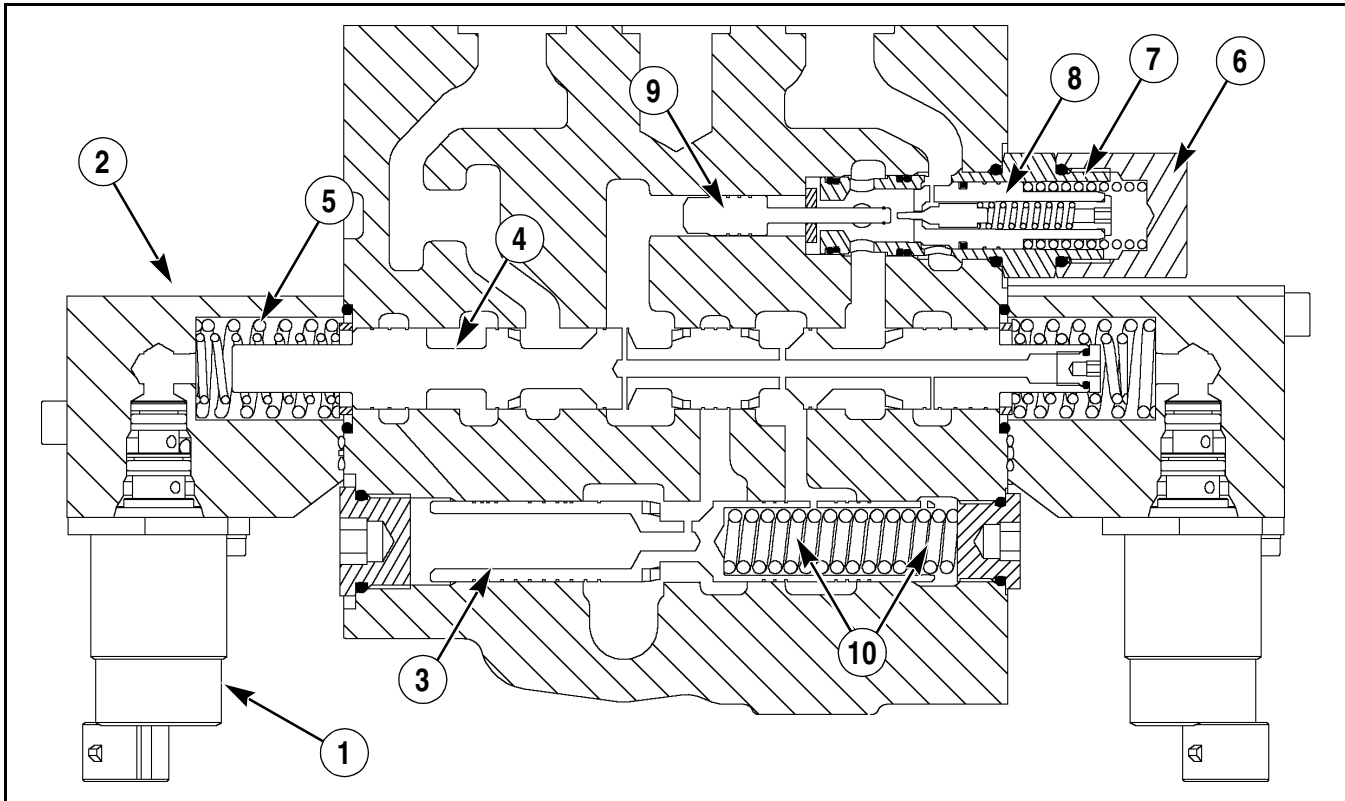
### STEP 29



RI02E042

Connect the wiring harness to the solenoids (1). Install the seven pin connector mounting plate (2).

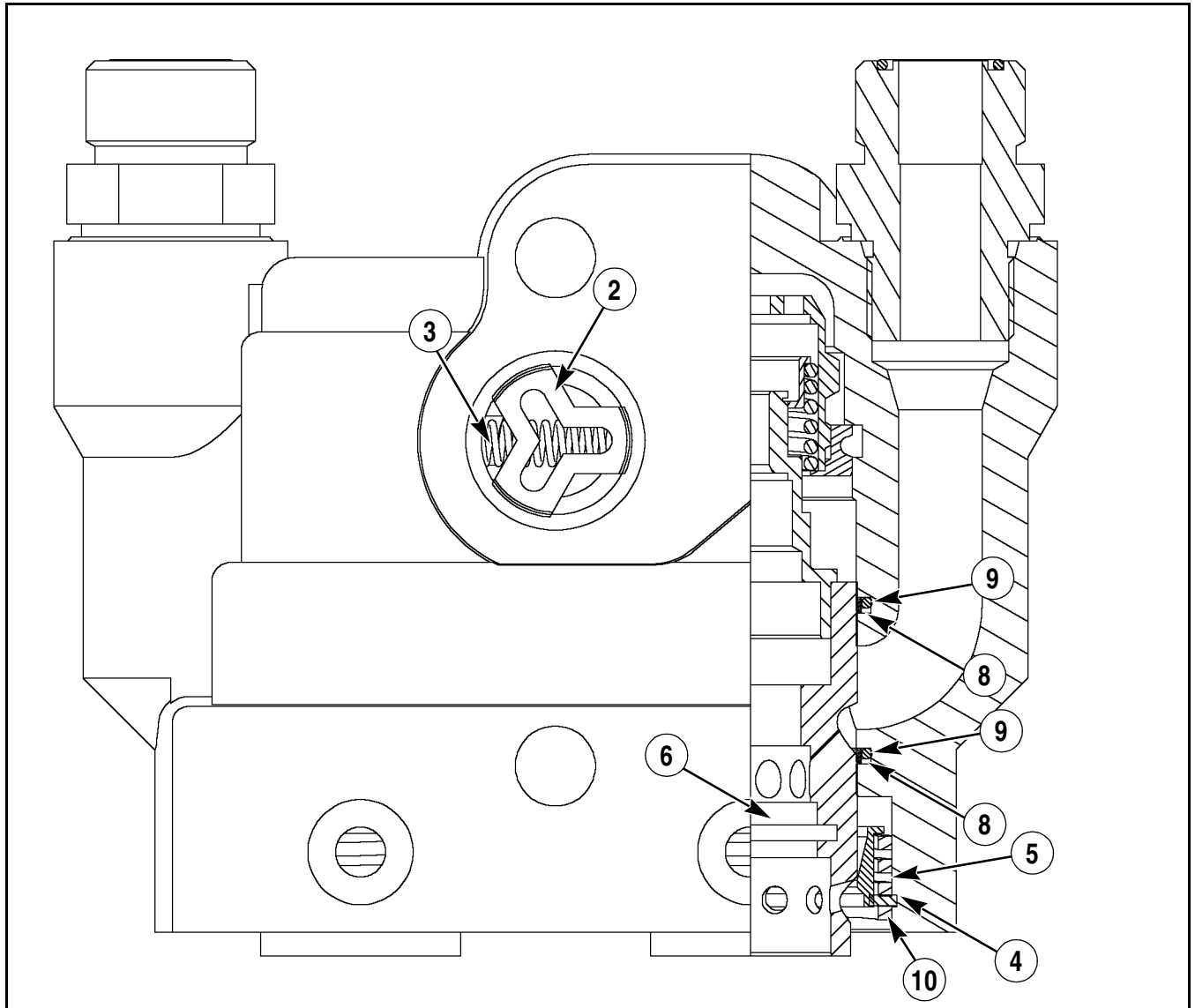
## Remote Valve Cross Section



RI02B027

- |   |   |
|---|---|
| 1. SOLENOID                                 | 6. LOAD CHECK CAP                             |
| 2. SOLENOID BLOCK                           | 7. LOAD CHECK BODY                            |
| 3. PRESSURE COMPENSATING FLOW CONTROL SPOOL | 8. MAIN POPPET                                |
| 4. MAIN SPOOL                               | 9. LOAD CHECK PLUNGER                         |
| 5. MAIN SPOOL SPRINGS                       | 10. SIGNAL CHECK SPRINGS (BACK SIDE OF VALVE) |

## REMOTE COUPLERS

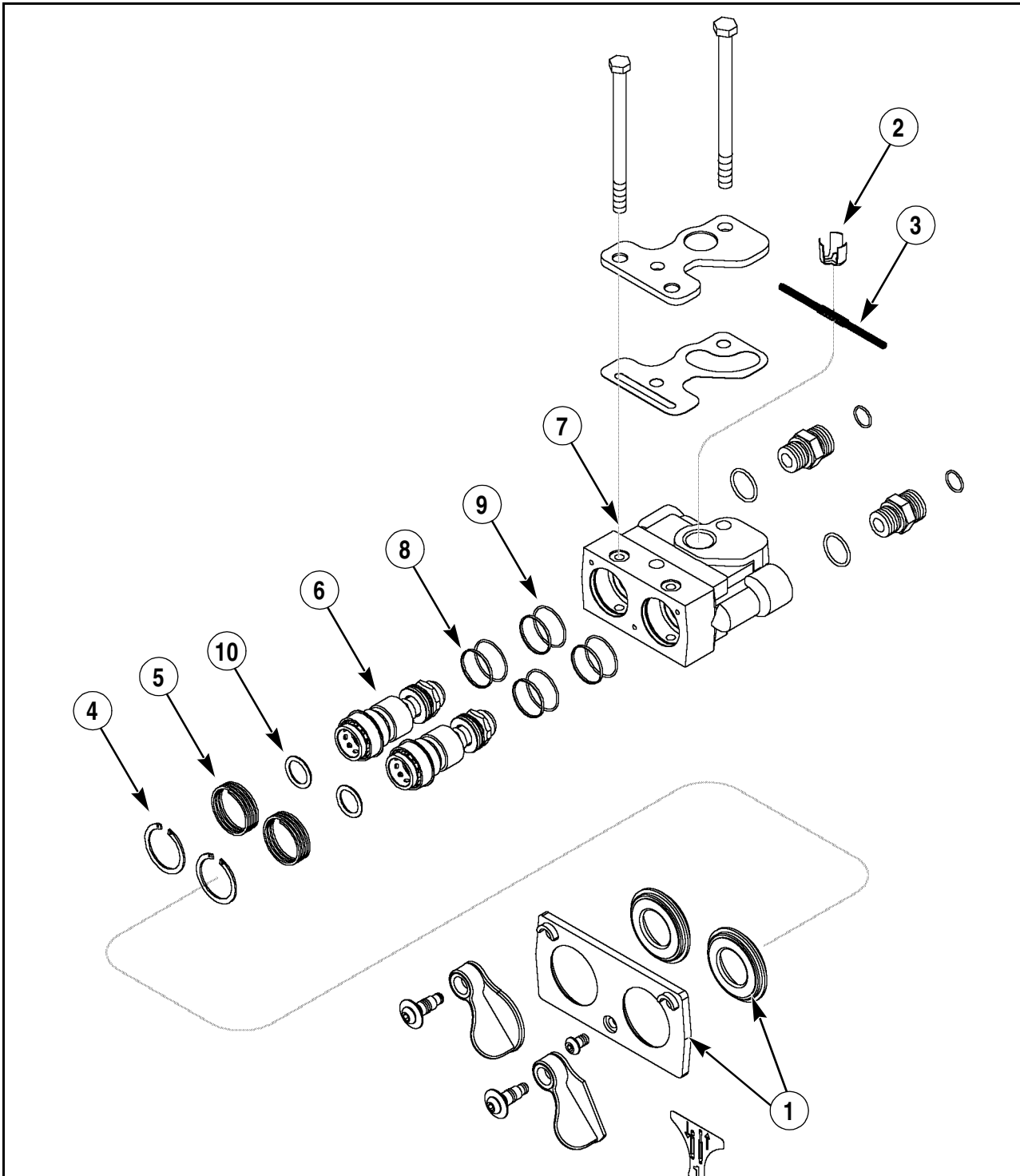


RI02E027

- |  |                 |
|--|-----------------|
| 1. COVER AND GASKET (ON EXPLODED VIEW) | 6. CARTRIDGE    |
| 2. SPRING RETAINER                     | 7. BODY         |
| 3. COIL SPRING                         | 8. SLIPPER SEAL |
| 4. SNAP RING                           | 9. O-RING       |
| 5. SPRING                              | 10. O-RING      |

1. Remove the cover plate and gaskets (1). Remove the spring retainer (2) and coil spring (3).
2. Remove the snap ring (4) and spring (5).
3. Remove the coupler cartridge (6) from the coupler body (7).
4. Remove the slipper seals (8) and O-rings seals (9). Install new O-rings and slipper seals. Be sure the slipper seal is in front of the O-ring.
5. Remove the O-ring (10) from the end of the coupler cartridge. Install a new O-ring.
6. Assemble the coupler in reverse order.

## Exploded View



RI02E028

1. COVER AND GASKET
2. SPRING RETAINER
3. COIL SPRING
4. SNAP RING
5. SPRING

6. CARTRIDGE
7. BODY
8. SLIPPER SEAL
9. O-RING
10. O-RING

# **Section 35**

## **Chapter 5**

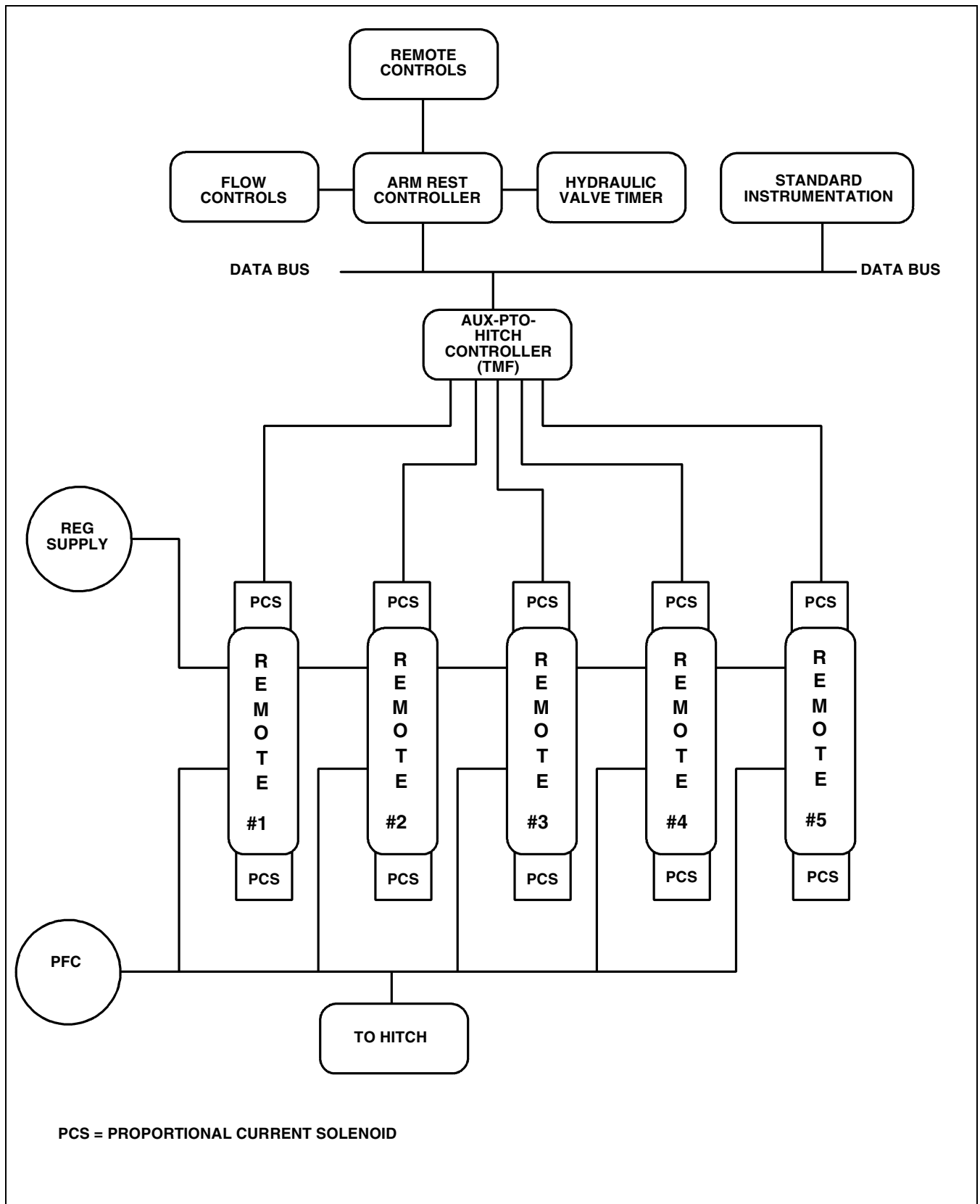
### **REMOTE HYDRAULIC SYSTEM**

#### **How It Works and Troubleshooting**

## TABLE OF CONTENTS

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## REMOTE HYDRAULIC SYSTEM INTRODUCTION



RI99F043



All remote hydraulic controls are located in the right-hand Armrest Control Console. These controls include the:

Remote Hydraulic Control Levers

Remote Function Control Levers

Variable Flow Controls

Hydraulic Valve Timer Control

Fifth Remote Switch (If Equipped)





Extend/Retract Limiter Switch

All these remote hydraulic controls are hard wired directly into the armrest controller. Each remote control lever actuates a potentiometer within the armrest control console. As a remote control lever is actuated the armrest controller reads the potentiometer setting and sends a signal through the Data Bus to the remote controller. The remote controller sends the signal onto a proportional solenoid which shifts the main valve spool allowing flow through to the respective remote coupler.

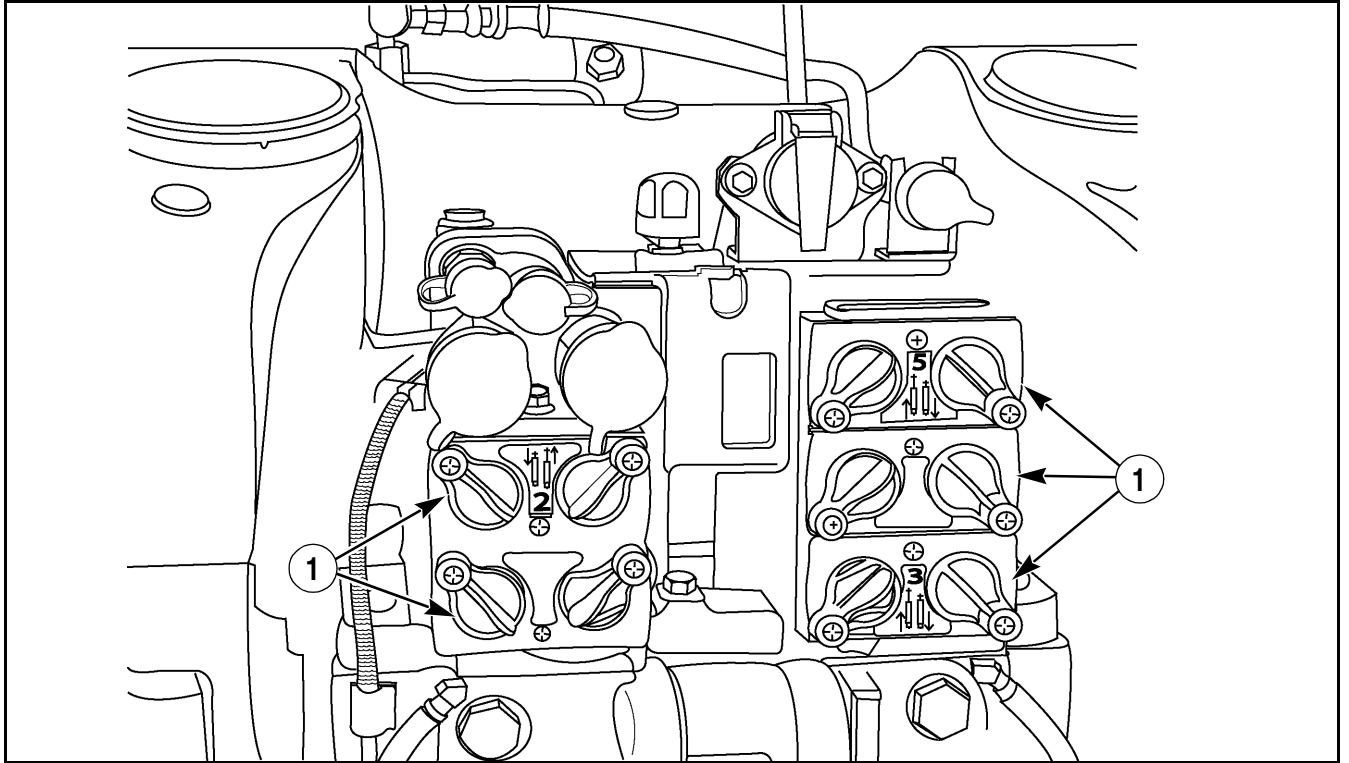
The remote controller will report any problems directly to the instrument controller. The instrument controller will display any system faults or fault code information through the standard instrumentation display.

When a fault occurs, a 3 second continuous audible alarm will sound. The audible alarm will stop after 3 seconds. Once the fault has been corrected the fault codes should be erased. To erase the fault codes from a controller, press and hold both the INCR and DECR keys for 10 seconds.

The following faults will not cause immediate damage to the tractor or shut the tractor down, but may make other systems inoperative. Pushing the "Reset" button on the standard instrumentation display will clear the fault, however the fault will reappear after ten minutes if not corrected.

Display	Description	Corrective Action
 <b>AUX OFF LINE</b>	Aux Bus Off fault.	If condition persists, contact your dealer.
 <b>AUX FAULT</b>	Armrest Bus Off fault.	If condition persists, contact your dealer.
 <b>AUX CONF/CAL</b>	Aux - Config/Cal required (bit in system status).	If condition persists, contact your dealer.
 <b>AUX</b>	Aux re-enable required.	If condition persists, contact your dealer.

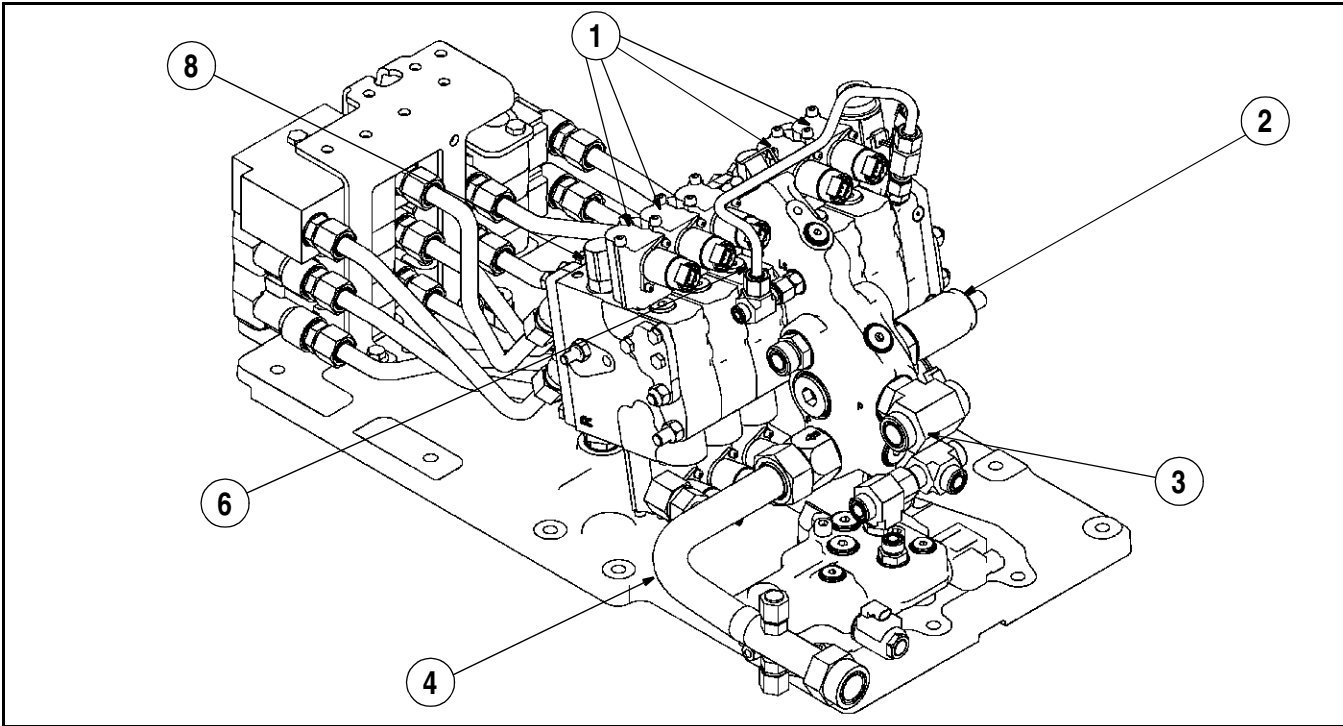
## REMOTE VALVE SYSTEM COMPONENTS



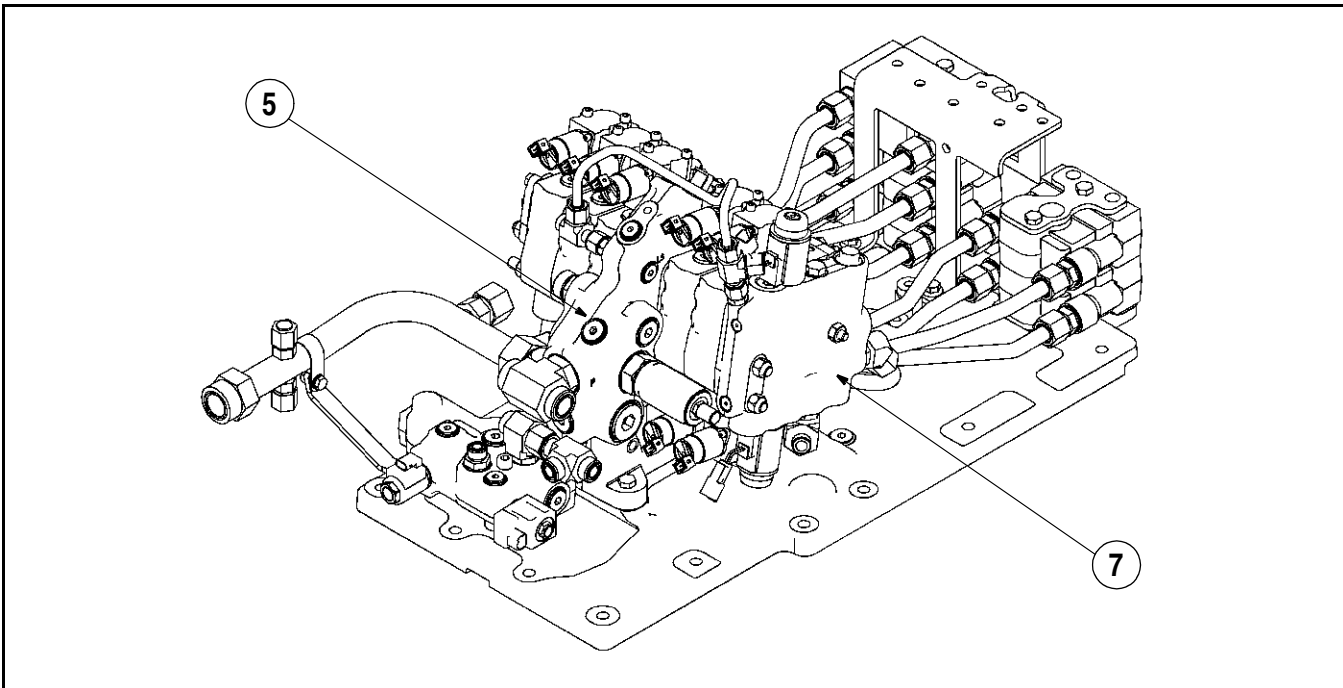
RD02D042

1. REMOTE COUPLERS

The remote valve assembly is located at the rear of the tractor. Remove the Controller cover to access the valve assembly by removing two bolts from each side of the cover (the bolts do not go through the fender assemblies).

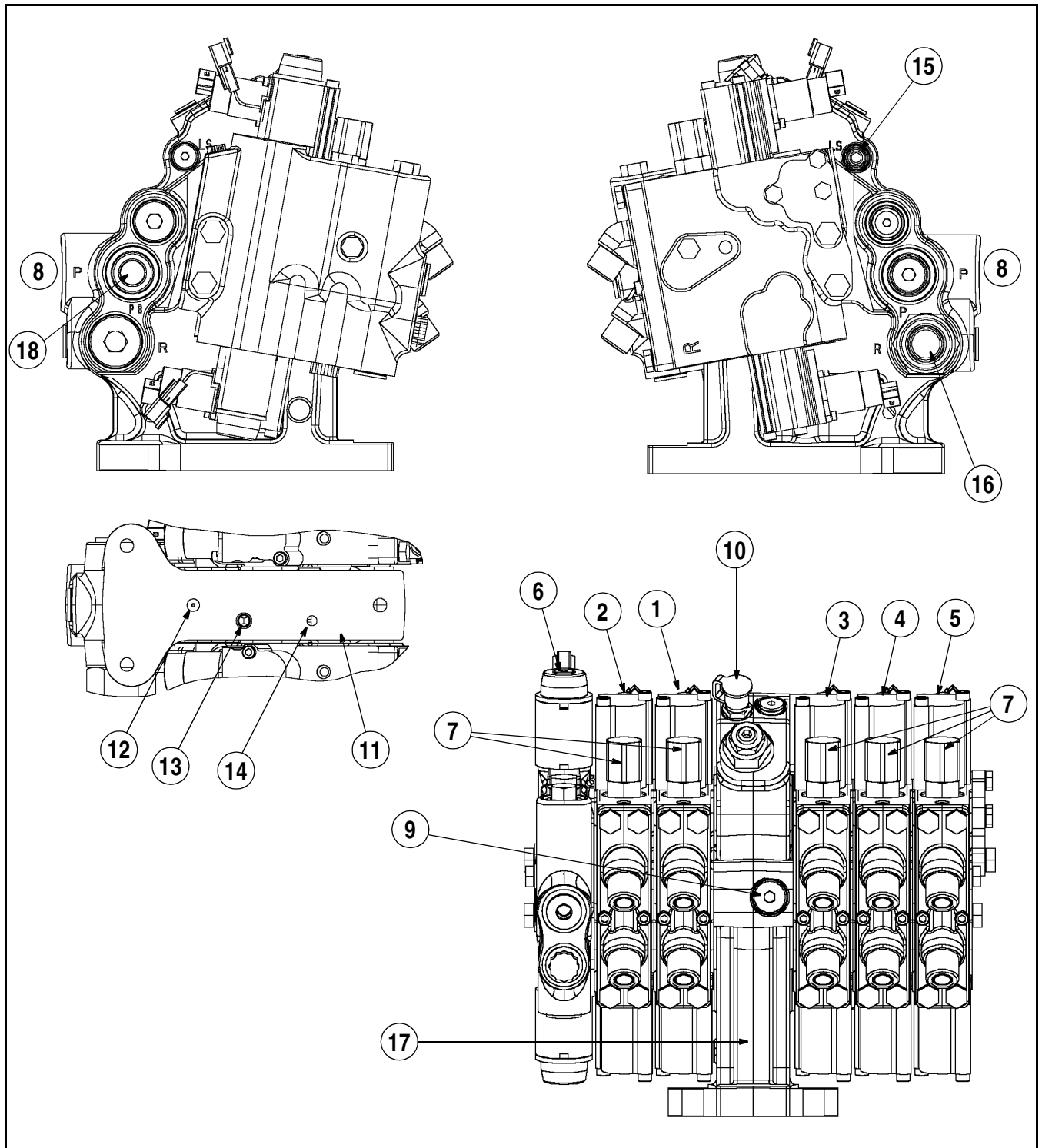


RI06A062



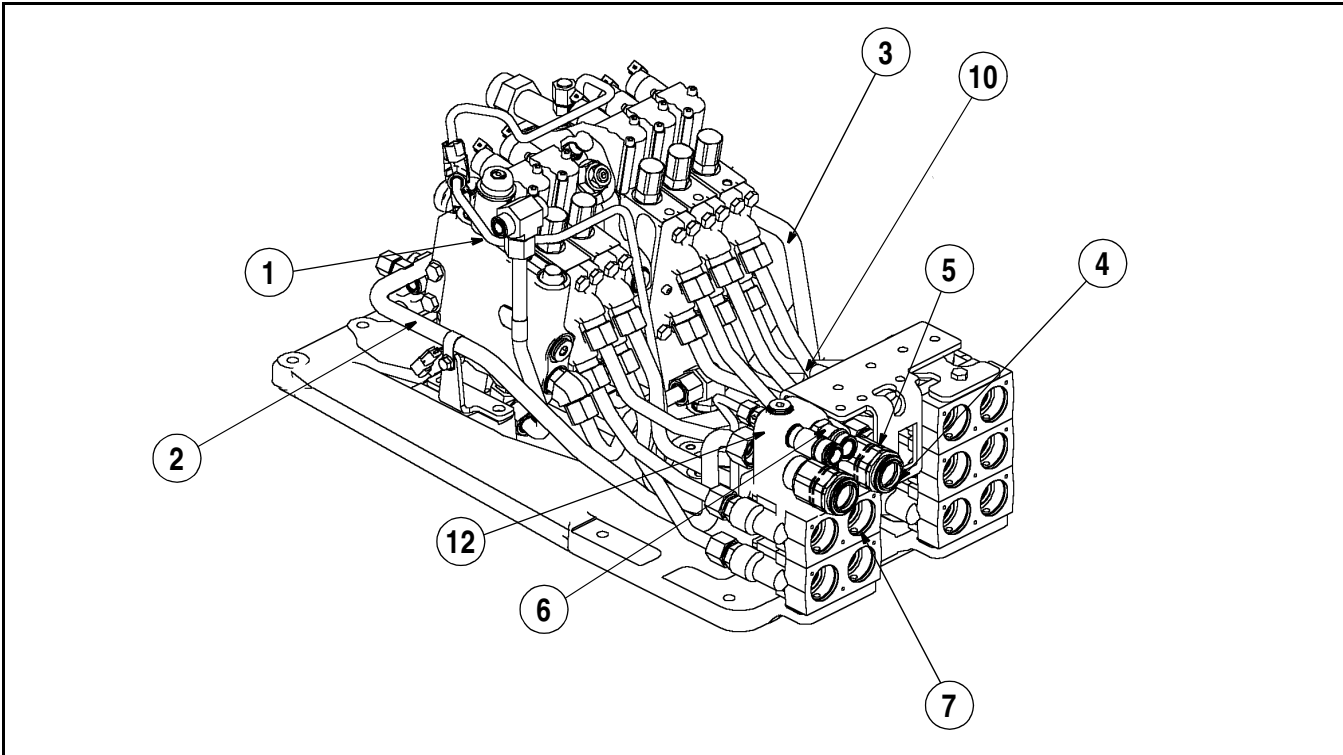
RI02J006

- |   |                             |
|---|-----------------------------|
| 1. PROPORTIONAL CURRENT CONTROL SOLENOIDS | 5. REMOTE MANIFOLD ASSEMBLY |
| 2. HIGH PRESSURE ACCUMULATOR              | 6. SIGNAL LINE              |
| 3. MANIFOLD SUPPLY (INLET)                | 7. HITCH VALVE              |
| 4. MANIFOLD RETURN TUBE                   | 8. LOAD CHECKS              |

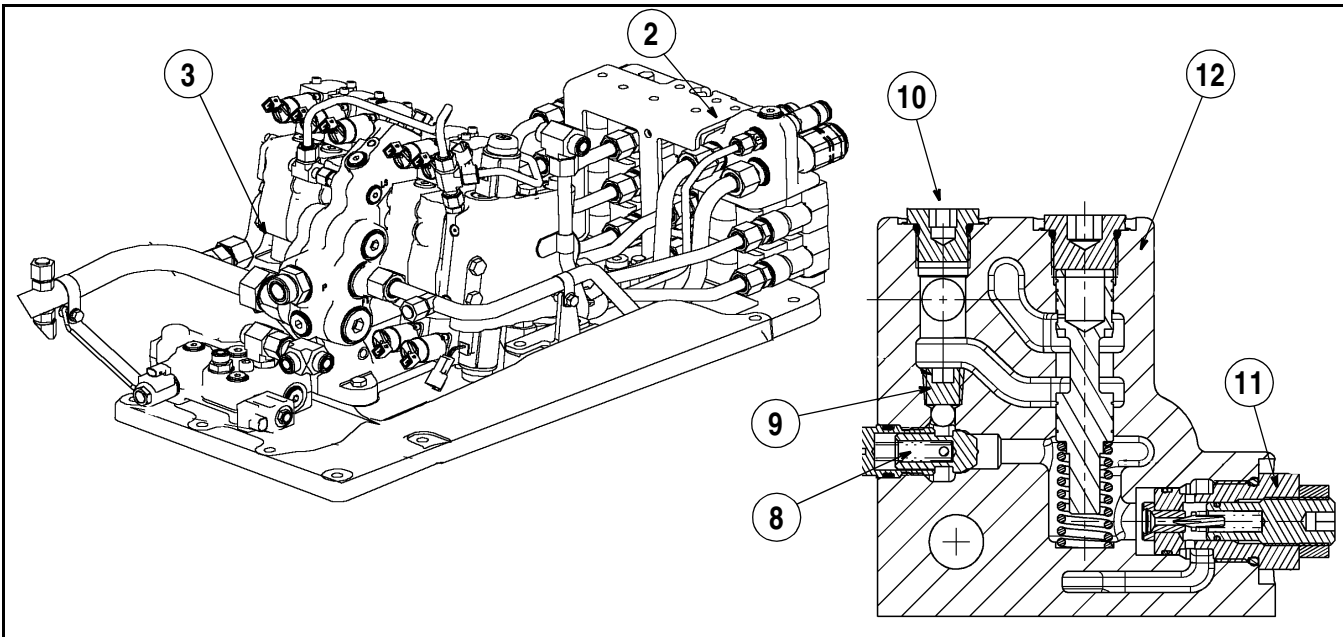


RI02J007 THRU J010 AND RH02J047

- |  |   |
|--|---|
| 1. REMOTE SECTION NO. 1                  | 10. FLOW CALIBRATION DIAGNOSTIC PORT          |
| 2. REMOTE SECTION NO. 2                  | 11. REMOTE MANIFOLD BASE (BOTTOM VIEW)        |
| 3. REMOTE SECTION NO. 3                  | 12. MARKER DRAIN                              |
| 4. REMOTE SECTION NO. 4                  | 13. REGULATED SUPPLY (PRESSED IN SCREEN PLUG) |
| 5. REMOTE SECTION NO. 5                  | 14. PILOT DRAIN                               |
| 6. HITCH VALVE                           | 15. LOAD SENSE PORT                           |
| 7. LOAD CHECKS                           | 16. RETURN PORT                               |
| 8. INLET                                 | 17. REMOTE MANIFOLD                           |
| 9. INTERNAL CHECK VALVE 36 PSI (2.5 BAR) | 18. POWER BEYOND PORT                         |



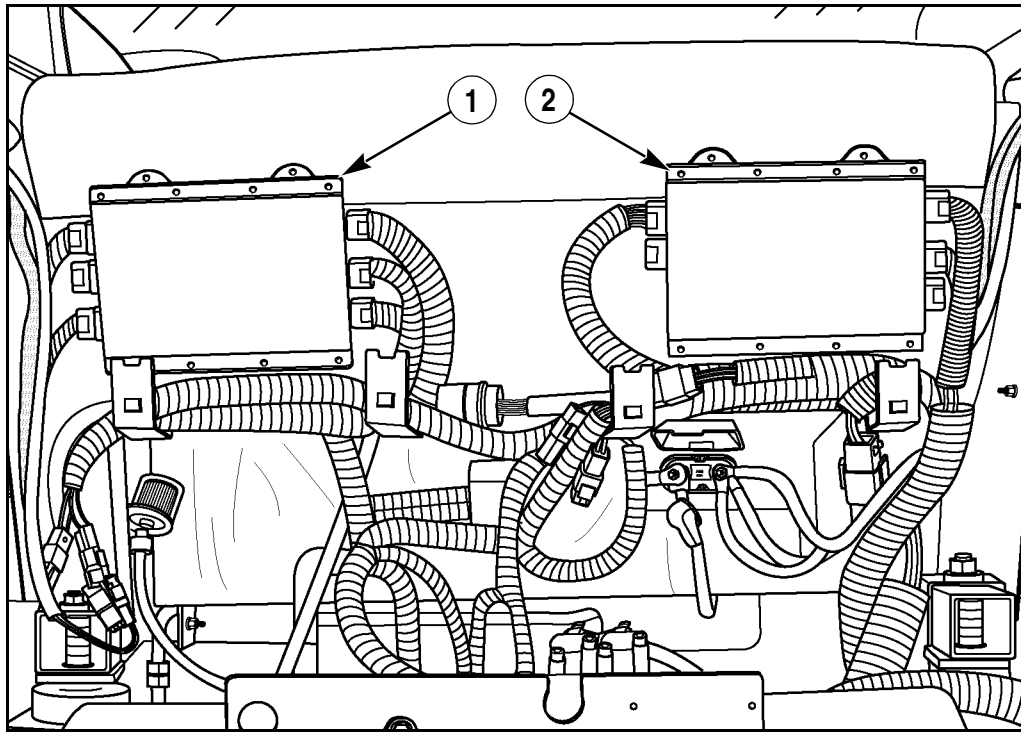
RI02D103



RI02D105 AND RH02J002

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1. POWER BEYOND LOAD SENSE TUBE  | 7. POWER BEYOND RETURN FLOW COUPLER |
| 2. POWER BEYOND SUPPLY TUBE      | 8. CHECK VALVE                      |
| 3. POWER BEYOND RETURN TUBE      | 9. INTERNAL PLUG                    |
| 4. CASE DRAIN                    | 10. EXTERNAL PLUG                   |
| 5. LOAD SENSE COUPLER            | 11. VALVE ASSEMBLY PILOT RELIEF     |
| 6. POWER BEYOND COUPLER (SUPPLY) | 12. POWER BEYOND ASSEMBLY MANIFOLD  |

**NOTE:** Remove internal plug (9) to maintain high pressure standby condition.



RD05M054

1. AUX - PTO - HITCH (TMF)
2. TRANSMISSION - FRONT AXLE

**REAR VIEW (CONTROLLERS)**

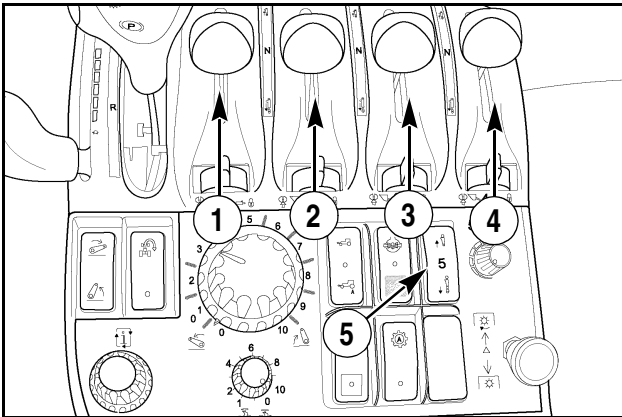
## REMOTE VALVE SYSTEM CONTROLS

### Remote Hydraulic Control Levers

There are three or four remote hydraulic control levers (and a switch to control a 5th remote if equipped) on the arm rest control console depending on the number of remote circuits on your tractor. The No. 1 remote hydraulic control lever will operate the lower left rear hydraulic coupler.

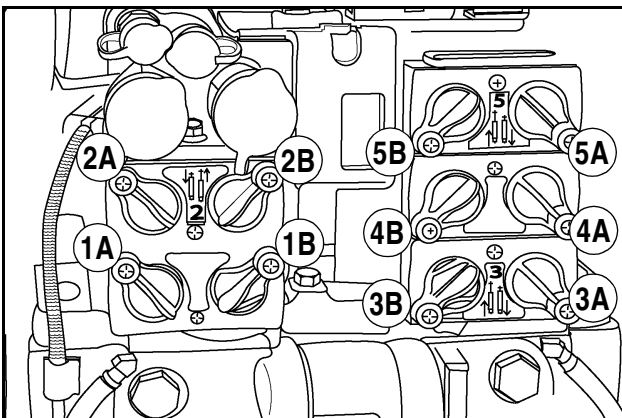
Each remote coupler has an identification plate. The couplers are identified as Number 1, Number 2, Number 3, Number 4 and Number 5 (if equipped) corresponding to the remote control levers on the arm rest control console.

Pushing the No. 1 remote lever forward will direct remote flow to the retract port of the hydraulic coupler (1A). Pulling the remote lever rearward will direct remote flow to the extend port of the hydraulic coupler (1B).



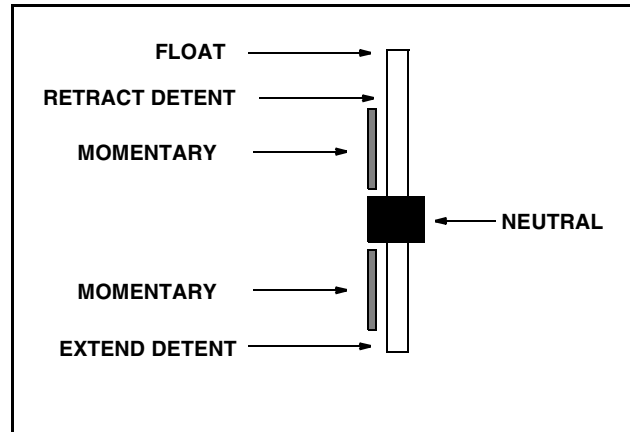
RD05J060

Item 5 is the optional 5th remote switch.



RD02D042

All the retract "A" ports are on the outside. All the extend "B" ports are to the inside.

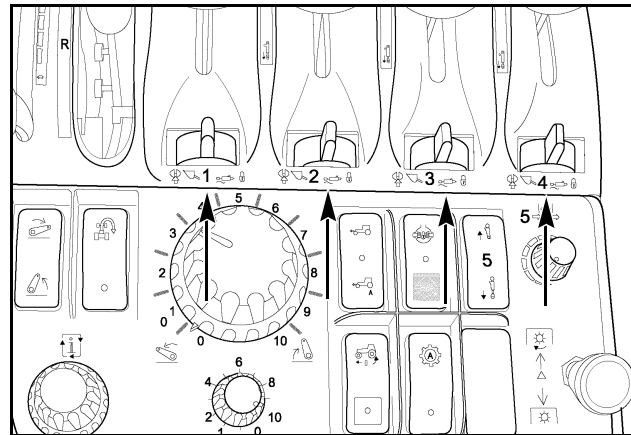


Remote Valve Control Lever Positions

### Remote Valve Function Control

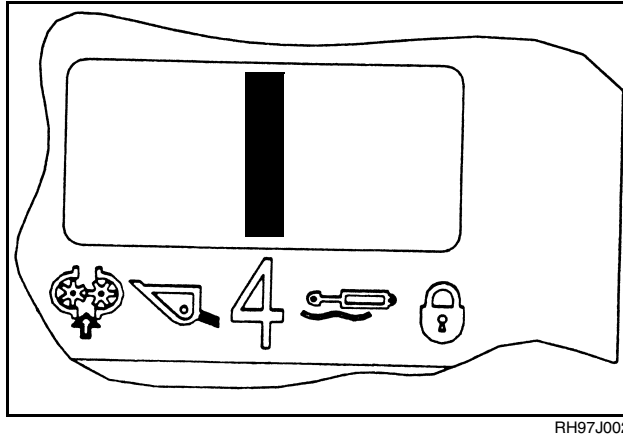
There are three or four remote function controls on the armrest control console depending on the number of remote circuits on your tractor. There is no remote function control for the optional 5th remote section.

There are five remote function control positions for special remote system conditions.



RD05J059

## Full Function Position



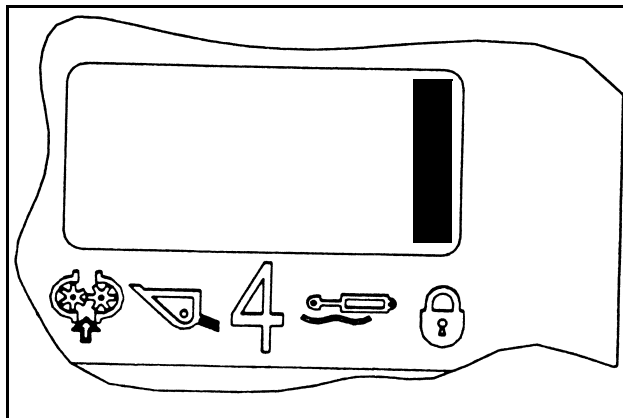
RH97J002

**Remote Valve Function Control - Full Function Position**

In the full function position the remote control lever will have full function including the float position.

To operate the remote hydraulics in a float condition, make sure the remote function control is in the full function position and push the remote control lever fully forward.

## Neutral Lock Position



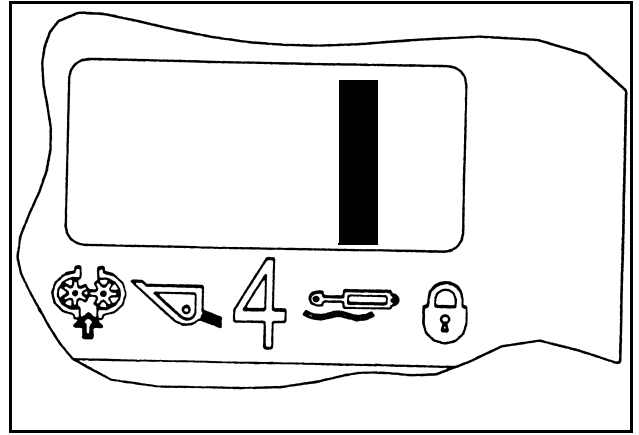
RH97J002

**Remote Valve Function Control - Neutral Lock Position**

The remote hydraulic control levers can be locked in the neutral position. This prevents a remote lever from being accidentally operated during transport. This can be done by moving the remote control lever to the neutral position and rotating the remote function control to the right lock position.

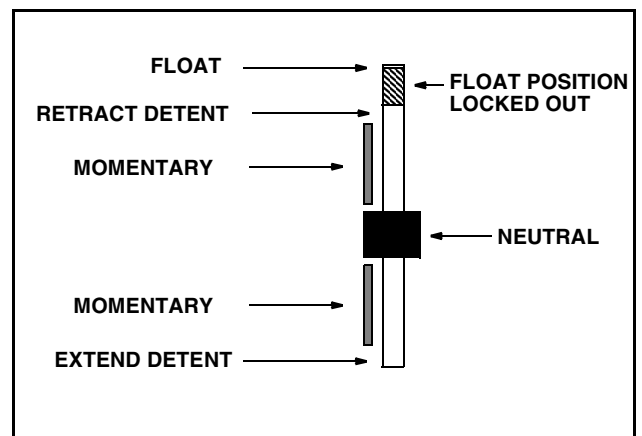
**NOTE:** This must be done for each remote control lever that you intend to be locked out.

## No Float Position



RH97J002

**Remote Valve Function Control**

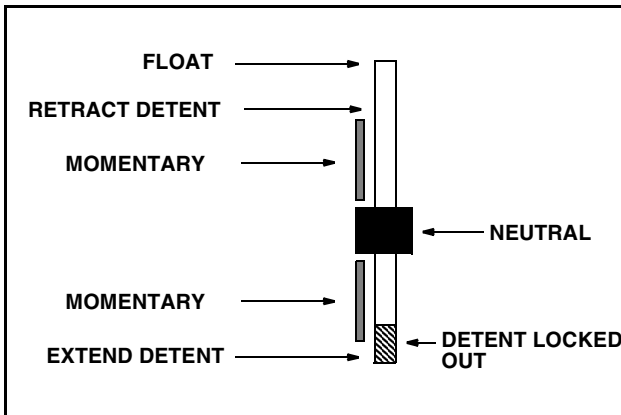
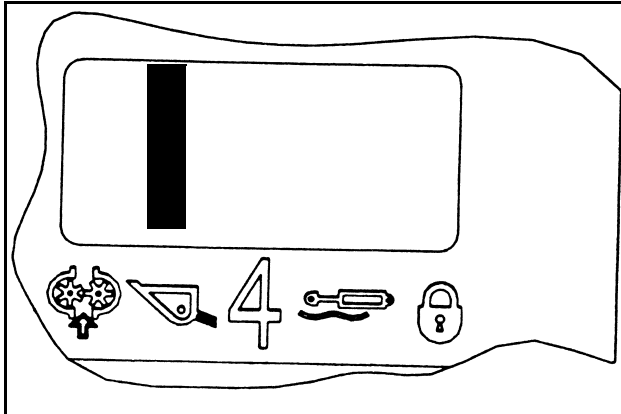


**Remote Control Lever Positions - No Float Position**

To operate in a no float position, rotate the remote function control to the float lockout position as shown. Now the remote control lever cannot be moved into the float position.



## Loader Position



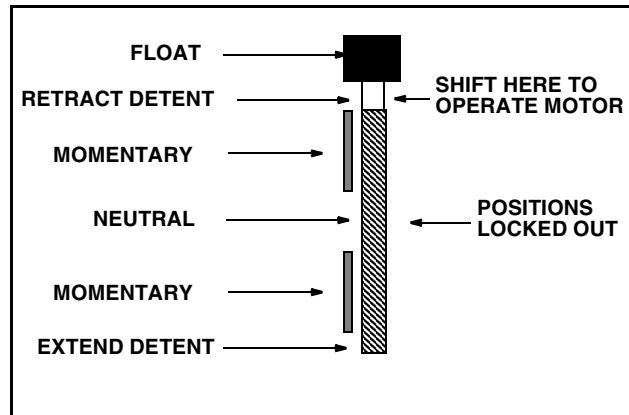
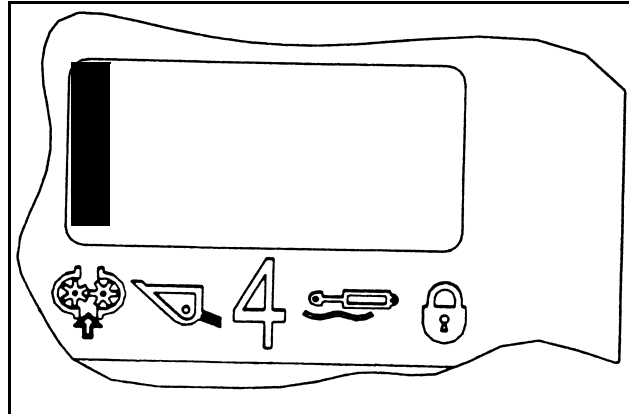
### Remote Control Lever Positions - Loader Position

When operating a front end loader the remote function control **MUST** be rotated to the loader position. This prevents the remote control lever from moving into the detent positions.



**WARNING:** When doing a loader operation, the remote function control **MUST** be in the loader position. This will prevent the remote control lever from going into a timed raise detent. A timed detent during loader operation can cause uncontrolled loader operation which may cause load dumping. Uncontrolled loader operation in a full height raising of the loader can cause load dumping which may result in injury or death. M586

## Hydraulic Motor Position



### Remote Control Lever Positions - Hydraulic Motor Position

Shut off the engine. Move the remote control lever that the hydraulic motor circuit is connected to forward to the float position. Rotate the remote function control to the left over the hydraulic motor symbol. This will limit the remote control lever to two operating positions for hydraulic motor applications only. Retract detent position is to operate the motor and the float position to stop.

To engage the hydraulic motor, start the engine and move the remote control lever rearward from the float position to the retract detent position. The hydraulic motor will now operate. Use the variable flow control to regulate the hydraulic motor speed.

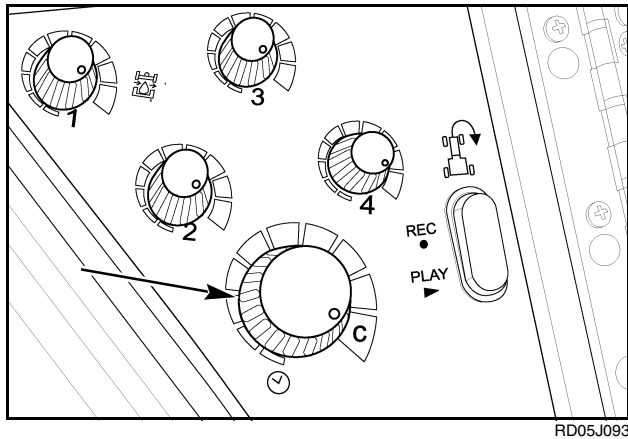
To stop driving the hydraulic motor, move the remote control lever back up to the float position. This will allow the hydraulic motor to slowly come to a stop.

**IMPORTANT:** Do not rotate the remote function control from the hydraulic motor position during motor applications as it can cause the hydraulic motor to stop immediately. This will cause damage to the hydraulic motor, hoses and equipment.

Switch the remote hose coupler positions at the rear of the tractor to change the direction of rotation of the motor.

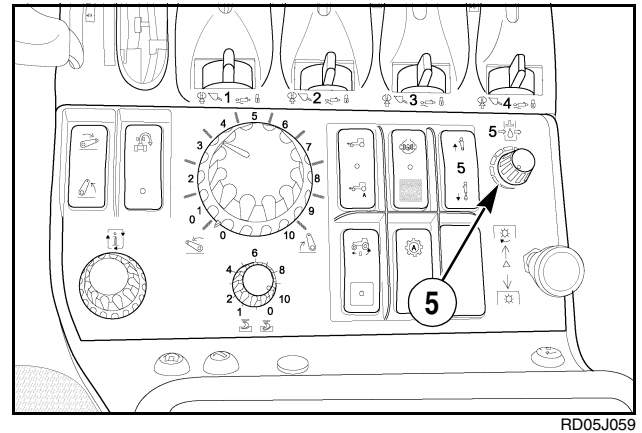
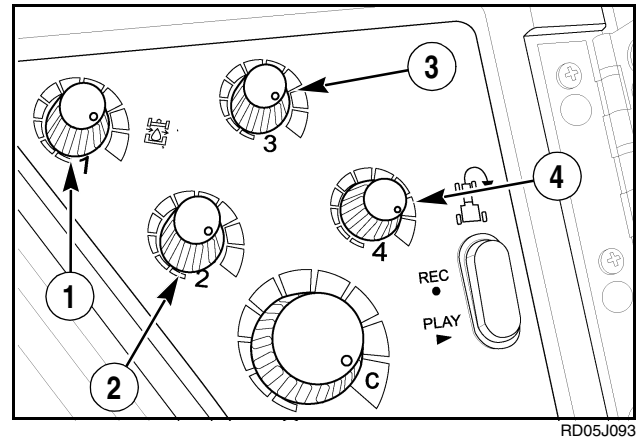
## Hydraulic Valve Timer Control

The timer control located under the arm rest cover determines the amount of time a remote circuit has hydraulic flow after the control lever is moved to the detent position. Turning the knob clockwise increases the amount of time and turning the knob counterclockwise decreases the amount of time. The timer can be set from the minimum of 1 second up to a maximum of 30 seconds. The 30 second timer control range is through the first 9 timer bars around the timer control. When the timer control is turned fully clockwise to the 10th bar the detents will not time out and will remain in detent.



## Variable Flow Control

Each circuit of the five remote hydraulic system has a variable flow control. Use the variable flow control to increase or decrease the rate of flow of hydraulic fluid to the remote hydraulic couplers. The flow can be adjusted from a minimum of 2 GPM (8 L/min) up to the maximum flow available from the PFC piston pump. To increase the flow turn the flow control knob clockwise or turn the flow control knob counterclockwise to decrease the rate of flow.



**Variable Flow Controls  
On Arm Rest Control Console**

## REMOTE VALVE OPERATION

### General

**MAIN VALVE SPOOL** - The main valve spool is spring centered in neutral and is positioned by the proportional current control solenoids. The spool position determines the flow rate and the flow path of the supply flow.

**PRESSURE-COMPENSATED FLOW CONTROL SPOOL** - Each valve section contains a pressure compensated flow control spool which functions to maintain a constant pressure drop across the main valve spool. This constant pressure drop results in a constant flow rate across the main valve spool.

**LOAD CHECK AND PLUNGER** - The load check is installed in the "B" extend port to prevent the settling of a load (in neutral) because of control spool leakage. It also serves as a check valve to prevent a drop in a partially raised cylinder when the remote valve is operated.

When lowering, oil is fed to the left hand side of the plunger. The plunger will be forced up against the load check pilot poppet to relief trapped pressure. The plunger then contacts the main poppet moving it to the left allowing flow back to tank.

**SIGNAL CHECK TO COMPENSATOR** - The signal check isolates each remote valve's operating pressure from the other valves in the system. When more than one remote valve section is in operation, the valve operating at the higher pressure will signal the compensator on the PFC pump.

**SIGNAL CHECK PILOT RELIEF**- Each remote section is equipped with a second relief signal check that limits each remote sections maximum pressure.

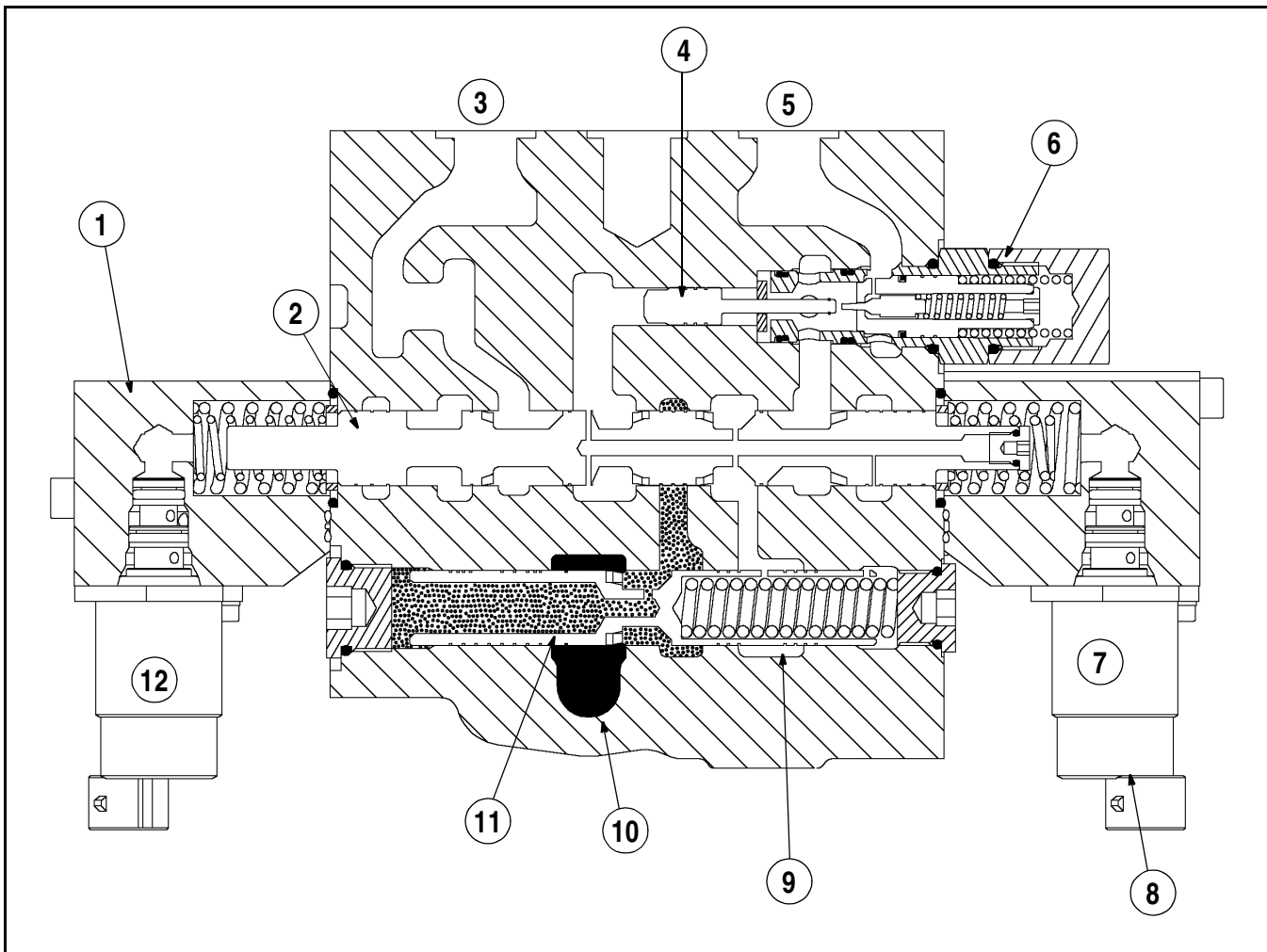
## Neutral

All the remote valve sections function in the same way. In neutral the position of the main valve spool is spring centered. Pump supply is available to the inlet ports of all the remote valve sections.

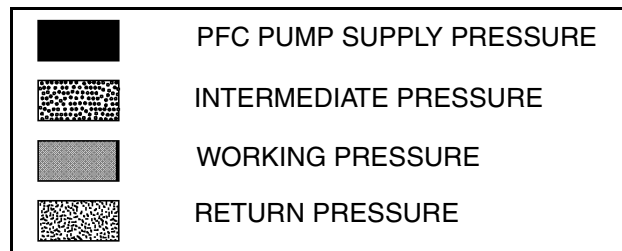
Pump pressure from the inlet is available to the left end of the pressure compensated flow control spool by way of an orifice in the center of the hollow pressure compensated flow control spool. This will force the spool against the spring. The flow control spool spring force tries to open up supply flow to the main valve spool and the intermediate pressure on the left hand side of the flow control spool tries to close flow down. Once the intermediate pressure is high enough to overcome the flow control spring force the flow control spool blocks the flow path to the main valve spool. In neutral the intermediate pressure is blocked from the work ports by the main valve spool lands.

A load check valve is installed into the extend port, which will prevent the settling of a load (in neutral) due to main valve spool land leakage. It also serves as a check valve to prevent a drop in a partially raised cylinder when that valve is operated.

A signal check valve is installed into the signal port, which will isolate the highest system signal pressure from each individual remote valve's operating pressure. Each remote section is equipped with a second relief signal check that limits each remote sections maximum pressure.



RI02C044



RI02E014

- |   |   |
|---|---|
| 1. PROPORTIONAL SOLENOID VALVE ASSEMBLY | 7. EXTEND                                   |
| 2. MAIN VALVE SPOOL                     | 8. PROPORTIONAL SOLENOID VALVE ASSEMBLY     |
| 3. RETRACT PORT                         | 9. FLOW CONTROL SPRING                      |
| 4. LOAD CHECK PLUNGER                   | 10. PFC PUMP SUPPLY                         |
| 5. EXTEND PORT                          | 11. PRESSURE COMPENSATED FLOW CONTROL SPOOL |
| 6. LOAD CHECK                           | 12. RETRACT                                 |

### REMOTE VALVE SECTION IN NEUTRAL

## Extend

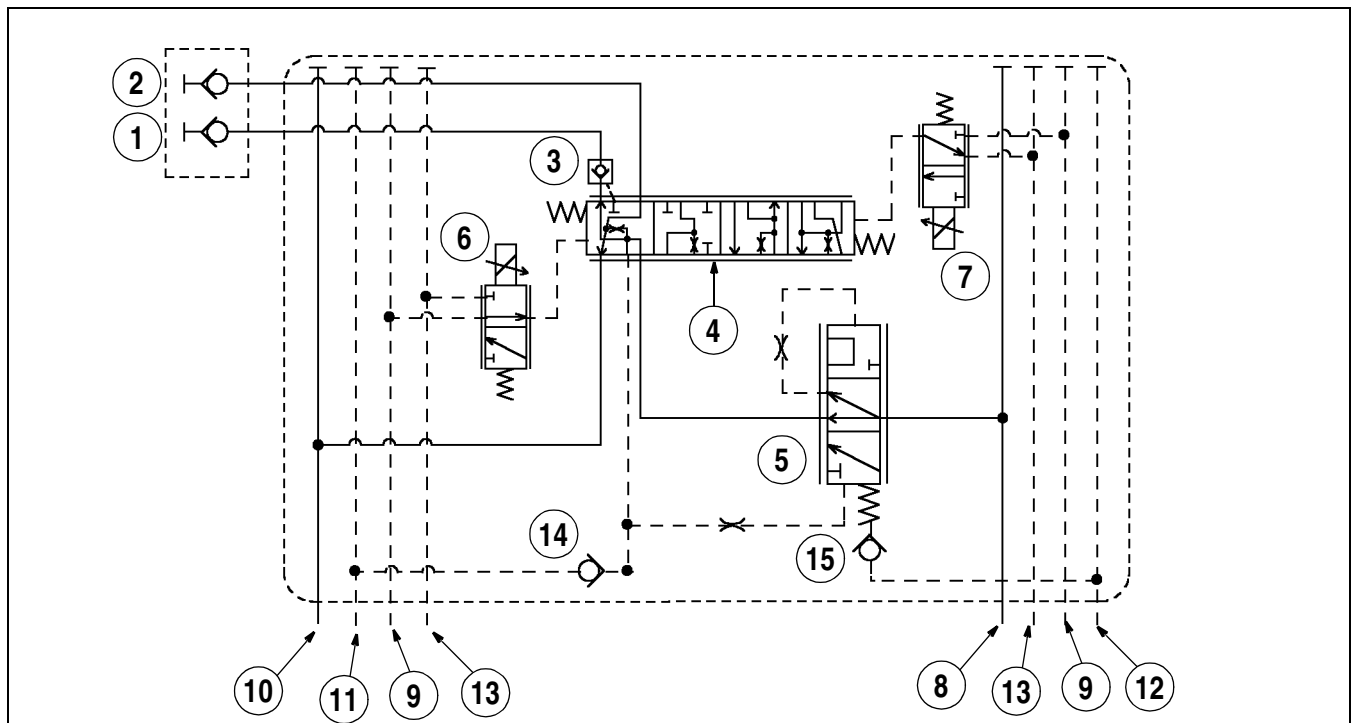
When the remote hydraulic control lever is moved to the extend position, the main valve spool is shifted to the left a fixed distance by the proportional solenoid pressure supply. The position of the main valve spool determines the flow rate to the extend port.

As PFC pump supply oil flows past the pressure compensated flow control spool, there is a pressure drop, to an intermediate pressure. The intermediate pressure is always equal to the pressure required by the load, plus 100 PSI. The added 100 PSI is needed to balance the spring force on the right hand side of the pressure compensated flow control spool.

The main valve spool can now direct flow from the intermediate pressure area to the work pressure area and on to the remote valve coupler. As oil flows across the main valve spool there is always a 100 PSI pressure drop. This constant pressure drop results in a constant flow across the main spool out to the remote coupler. The constant pressure drop is maintained through a balance of intermediate pressure on the left hand side of the pressure compensated flow control spool and work pressure plus the spring force on the right hand side of the spool.

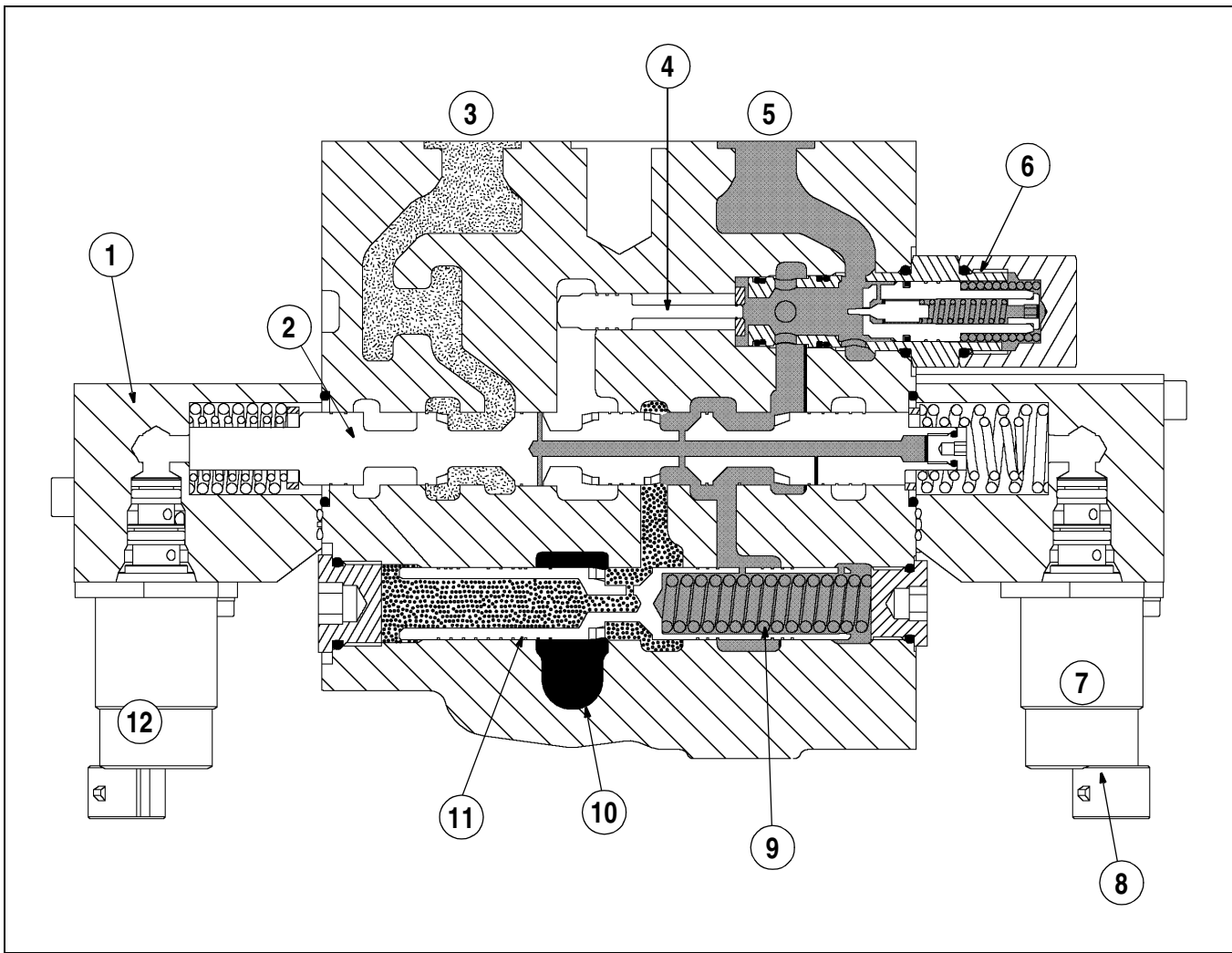
At the same time the main valve spool first shifts, work pressure is also directed to the signal checks. The work port pressure can open the signal check valve and signal the pump compensator to increase PFC pump flow. The work pressure is also directed to the relief signal check to limit the remote sections maximum pressure.

The flow exiting the extend port is in a free flow condition, the load check only works in the opposite direction. Return oil from the lower coupler is directed into the retract port, past the spool and on to the inlet side of the filter base.

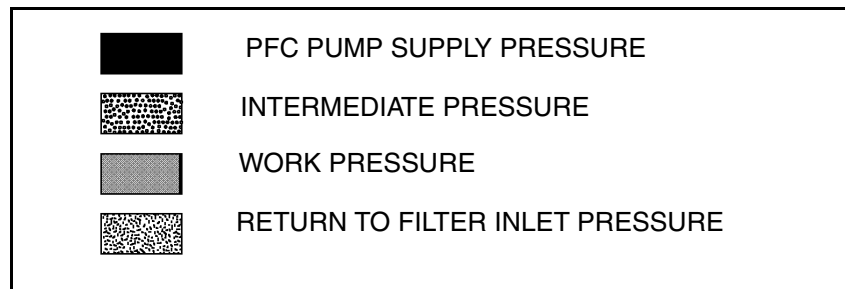


RI02F017

- |   |                                      |
|---|--------------------------------------|
| 13. EXTEND PORT                             | 21. REGULATED PRESSURE SUPPLY        |
| 14. RETRACT PORT                            | 22. BACK TO TANK                     |
| 15. LOAD CHECK PLUNGER                      | 23. SIGNAL LINE TO COMPENSATOR       |
| 16. MAIN VALVE SPOOL                        | 24. TO REMOTE SIGNAL RELIEF VALVE    |
| 17. PRESSURE COMPENSATED FLOW CONTROL SPOOL | 25. PILOT DRAIN                      |
| 18. PROPORTIONAL SOLENOID (EXTEND)          | 26. SIGNAL CHECK TO PUMP COMPENSATOR |
| 19. PROPORTIONAL SOLENOID (RETRACT)         | 27. SIGNAL CHECK PILOT RELIEF        |
| 20. PFC PUMP SUPPLY                         |                                      |



RI02C046



RI02E014

- |   |   |
|---|---|
| 1. PROPORTIONAL SOLENOID VALVE ASSEMBLY | 7. EXTEND                                   |
| 2. MAIN VALVE SPOOL                     | 8. PROPORTIONAL SOLENOID VALVE ASSEMBLY     |
| 3. RETRACT PORT                         | 9. FLOW CONTROL SPRING                      |
| 4. LOAD CHECK PLUNGER                   | 10. PFC PUMP SUPPLY                         |
| 5. EXTEND PORT                          | 11. PRESSURE COMPENSATED FLOW CONTROL SPOOL |
| 6. LOAD CHECK                           | 12. RETRACT                                 |

**REMOTE VALVE PRESSURE TO "B" PORT (EXTEND)**

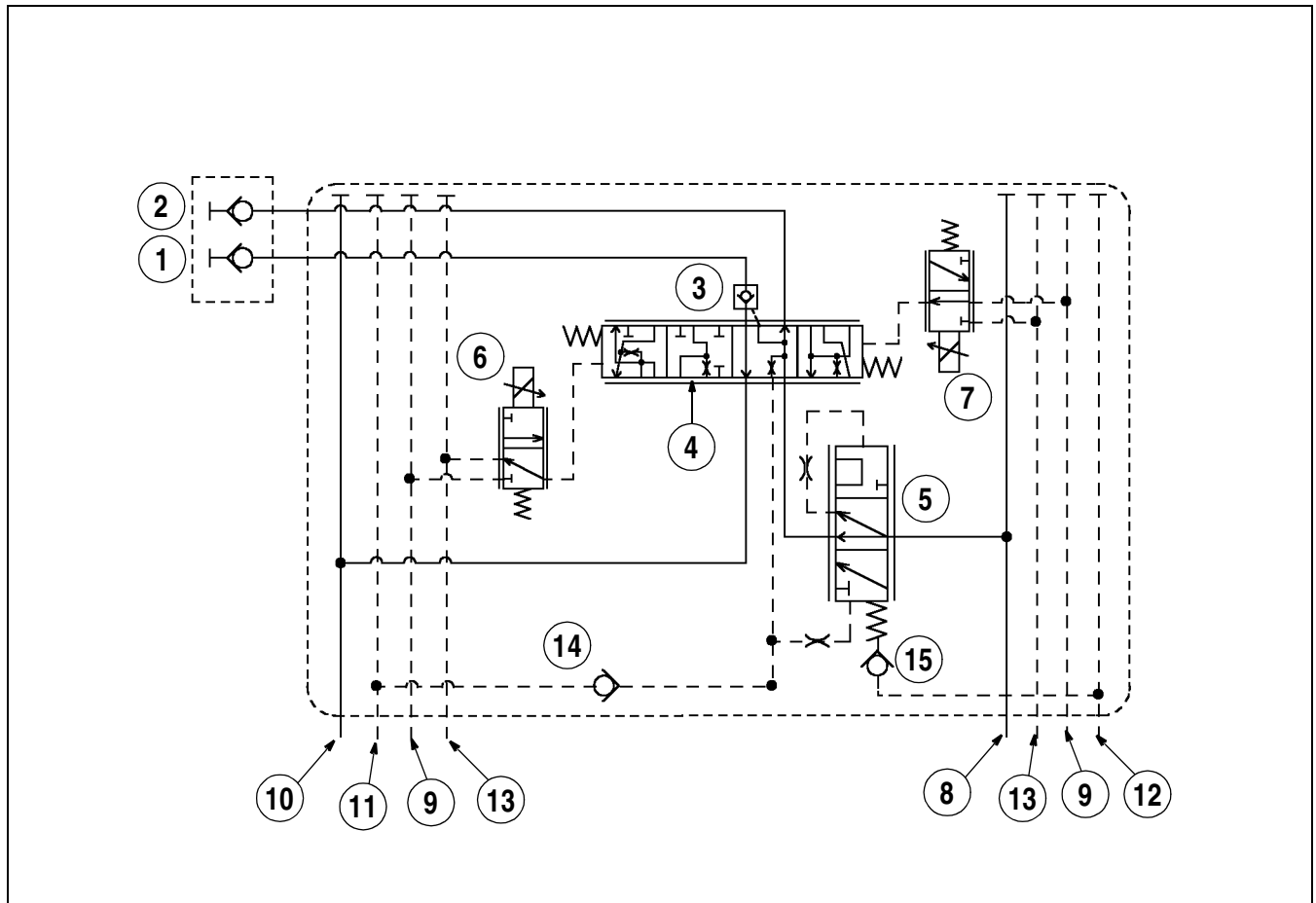
## Retract

When the remote hydraulic control lever is moved to the retract position, the main valve spool is shifted to the right a fixed distance by the proportional solenoid pressure supply. The position of the main valve spool determines the flow rate to the retract port.

As the main valve spool is shifted, flow from the intermediate pressure area is directed to the lower port and to the left hand side of the load check plunger. The plunger is forced to move right unseating the load check pilot poppet. This relieves the pressure on the spring side of the main poppet back to tank. The plunger contacts and unseats the main

poppet which allows the return oil to flow back to the inlet side of the filter base. (Differential pressure between the raise port and the spring side of the main poppet also contribute to unseating the main poppet).

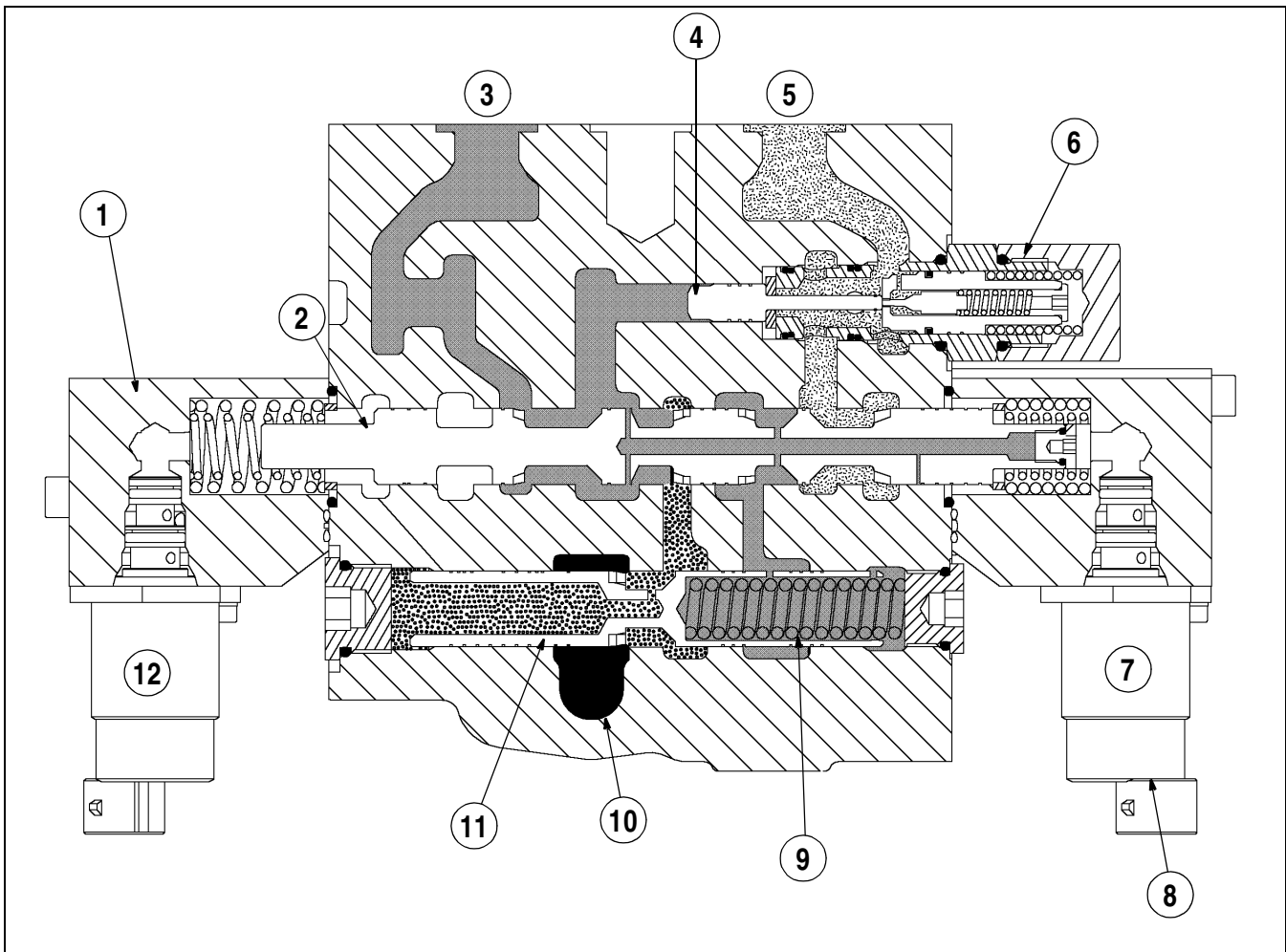
At the same time work pressure is communicated to the signal checks through the center drilled passage in the main valve spool. The signal check is forced off the seat and the signal pressure is then directed to the pump compensator to increase PFC pump flow. The work pressure is also directed to the relief signal check to limit the remote sections maximum pressure.



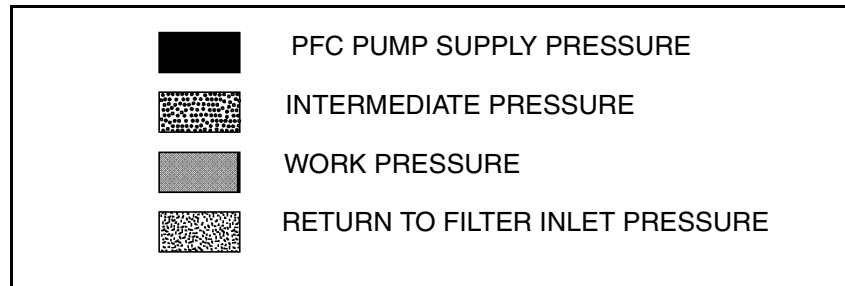
RI02F019

- |  |                                      |
|--|--------------------------------------|
| 1. EXTEND PORT                             | 9. REGULATED PRESSURE SUPPLY         |
| 2. RETRACT PORT                            | 10. BACK TO TANK                     |
| 3. LOAD CHECK PLUNGER                      | 11. SIGNAL LINE TO COMPENSATOR       |
| 4. MAIN VALVE SPOOL                        | 12. TO REMOTE SIGNAL RELIEF VALVE    |
| 5. PRESSURE COMPENSATED FLOW CONTROL SPOOL | 13. PILOT DRAIN                      |
| 6. PROPORTIONAL SOLENOID (EXTEND)          | 14. SIGNAL CHECK TO PUMP COMPENSATOR |
| 7. PROPORTIONAL SOLENOID (RETRACT)         | 15. SIGNAL CHECK PILOT RELIEF        |
| 8. PFC PUMP SUPPLY                         |                                      |





RI02C048



RI02E014

- |   |   |
|---|---|
| 1. PROPORTIONAL SOLENOID VALVE ASSEMBLY | 7. EXTEND                                   |
| 2. MAIN VALVE SPOOL                     | 8. PROPORTIONAL SOLENOID VALVE ASSEMBLY     |
| 3. RETRACT PORT                         | 9. FLOW CONTROL SPRING                      |
| 4. LOAD CHECK PLUNGER                   | 10. PFC PUMP SUPPLY                         |
| 5. EXTEND PORT                          | 11. PRESSURE COMPENSATED FLOW CONTROL SPOOL |
| 6. LOAD CHECK                           | 12. RETRACT                                 |

### REMOTE VALVE PRESSURE TO "A" PORT (RETRACT)

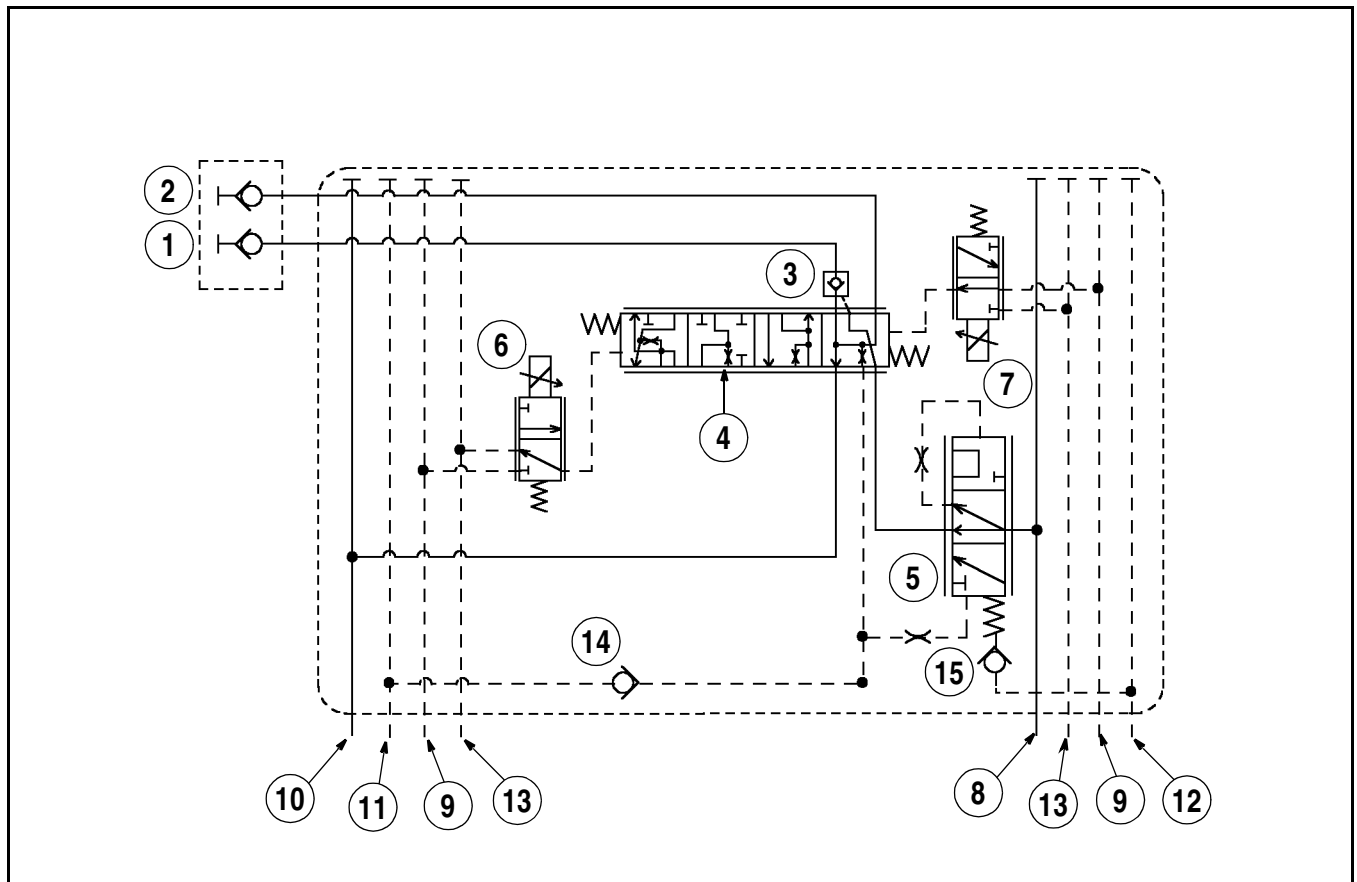
## Float

When the remote hydraulic control lever is moved to the float position, the main valve spool is moved to the far right position by the proportional solenoid pressure supply.

The main valve spool lands block flow to the extend and retract ports. At the same time the main valve spool opens the work ports to the return to filter inlet. To unseat the load check on the raise port low

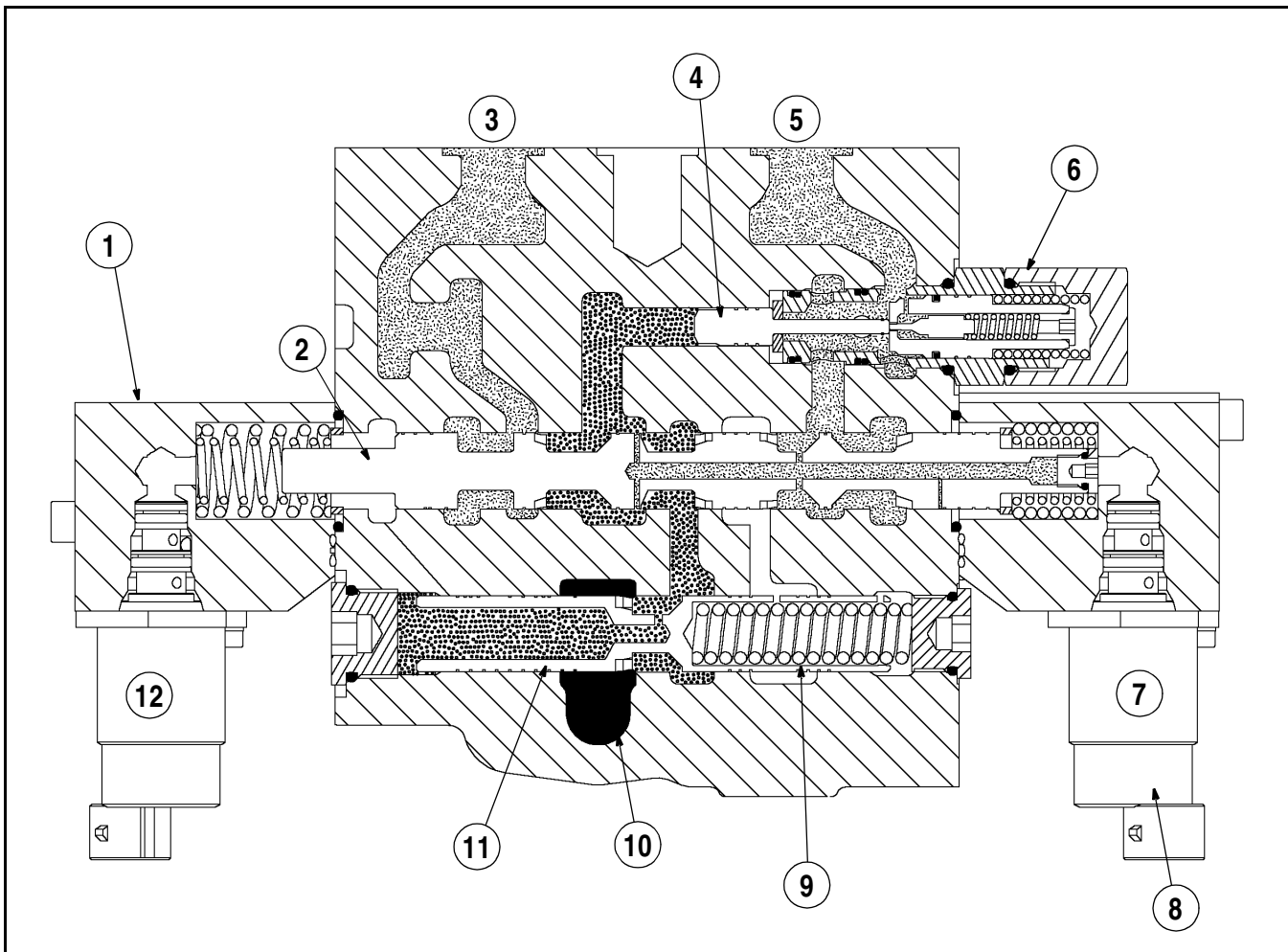
pressure standby pressure is directed to the backside of the load check plunger. The plunger moves to the right, unseating the load check main poppet.

When the extend and retract work ports are connected to the return to filter inlet it allows the implement to float and follow the contour of the ground. The valve will now float a double acting or single acting cylinder.

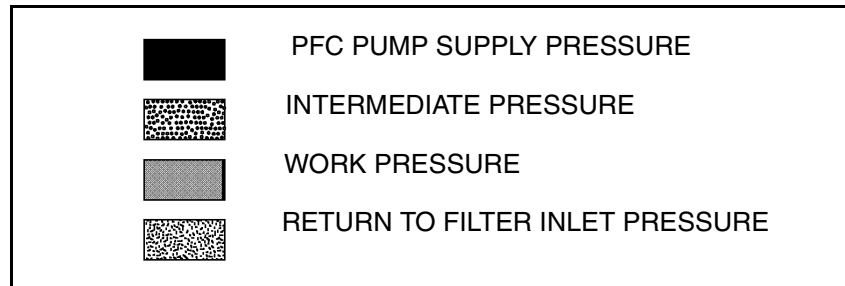


RI02F018

- |  |                                      |
|--|--------------------------------------|
| 1. EXTEND PORT                             | 9. REGULATED PRESSURE SUPPLY         |
| 2. RETRACT PORT                            | 10. BACK TO TANK                     |
| 3. LOAD CHECK PLUNGER                      | 11. SIGNAL LINE TO COMPENSATOR       |
| 4. MAIN VALVE SPOOL                        | 12. TO REMOTE SIGNAL RELIEF VALVE    |
| 5. PRESSURE COMPENSATED FLOW CONTROL SPOOL | 13. PILOT DRAIN                      |
| 6. PROPORTIONAL SOLENOID (EXTEND)          | 14. SIGNAL CHECK TO PUMP COMPENSATOR |
| 7. PROPORTIONAL SOLENOID (RETRACT)         | 15. SIGNAL CHECK PILOT RELIEF        |
| 8. PFC PUMP SUPPLY                         |                                      |



RI02D003

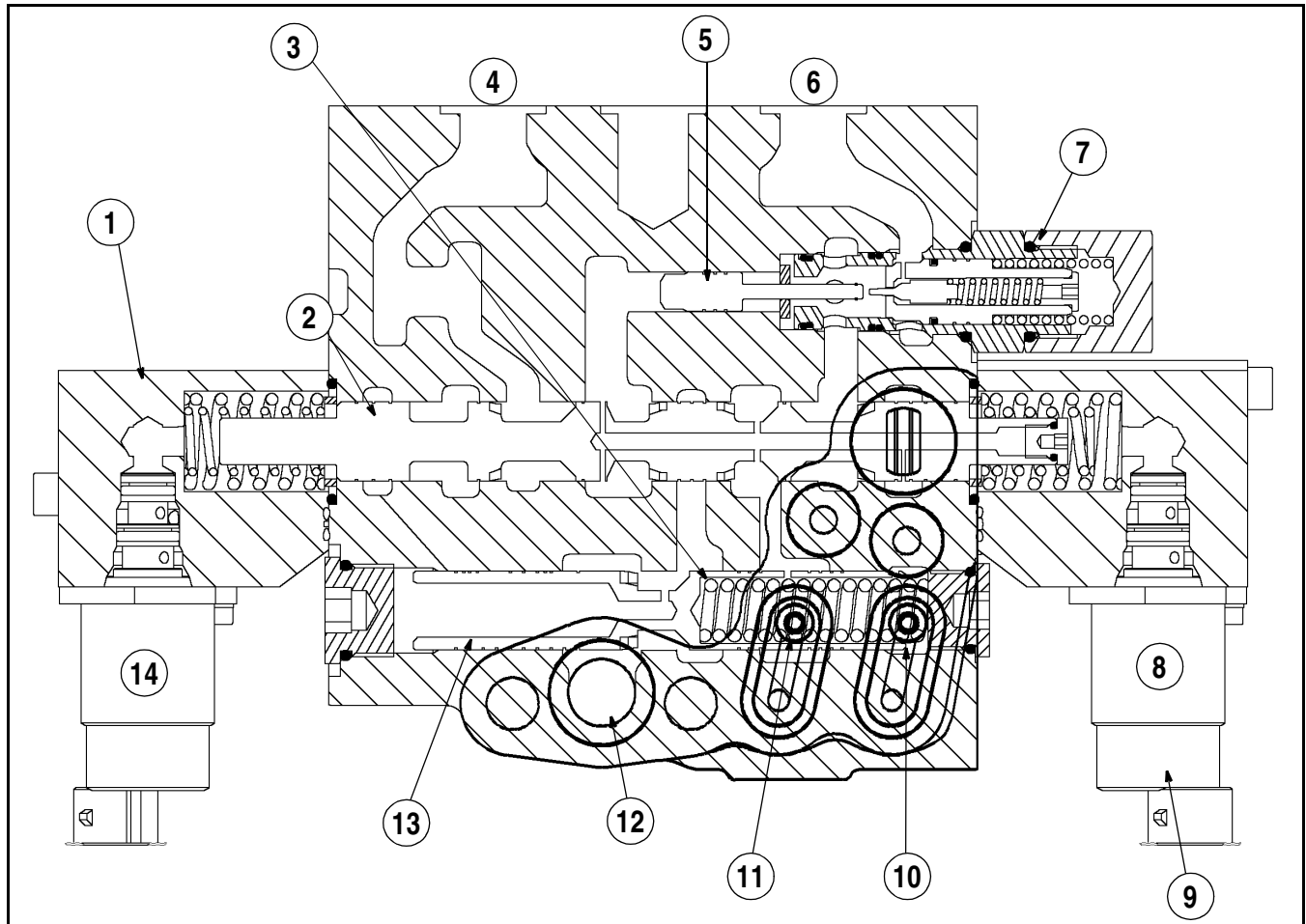


RI02E014

- |   |   |
|---|---|
| 1. PROPORTIONAL SOLENOID VALVE ASSEMBLY | 7. EXTEND                                   |
| 2. MAIN VALVE SPOOL                     | 8. PROPORTIONAL SOLENOID VALVE ASSEMBLY     |
| 3. RETRACT PORT                         | 9. FLOW CONTROL SPRING                      |
| 4. LOAD CHECK PLUNGER                   | 10. PFC PUMP SUPPLY                         |
| 5. EXTEND PORT                          | 11. PRESSURE COMPENSATED FLOW CONTROL SPOOL |
| 6. LOAD CHECK                           | 12. RETRACT                                 |

### REMOTE VALVE IN FLOAT

## REMOTE VALVE PROBLEMS AND WHERE TO LOOK



RI02B027

1. PROPORTIONAL SOLENOID VALVE ASSEMBLY
2. MAIN VALVE SPOOL
3. FLOW CONTROL SPRING
4. RETRACT PORT
5. LOAD CHECK PLUNGER
6. EXTEND PORT
7. LOAD CHECK

8. EXTEND
9. PROPORTIONAL SOLENOID VALVE ASSEMBLY
10. SIGNAL CHECK TO PILOT RELIEF
11. SIGNAL CHECK TO PUMP COMPENSATOR
12. PFC PUMP SUPPLY
13. PRESSURE COMPENSATED FLOW CONTROL SPOOL
14. RETRACT

**NOTE:** *Signal checks added to cross-section for location purposes.*

### Pressure Compensated Flow Control Spool

- Should the spool be stuck in a position that still allows it to direct oil to the main spool, but cannot balance, the flow rates will vary with changing load pressures.

### Flow Control Spring

If the flow control spring is broken, the flow rate range (normally 2 to 33 GPM) will be greatly reduced and erratic. Set the flow control pot to the maximum setting at 2000 engine RPM and a 500 PSI load. If approximately 33 GPM (125 L/min) is not reached the flow control spring could be broken. (Note this assumes that the maximum 33 GPM (125 L/min) can be achieved on another remote section).

## **Load Check**

Implements leak down. See load check inspection in this section.

## **Signal Check To Pump Compensator**

If a single signal check is leaking. The leaky signal check remote section will function normally. The remaining remote sections will show reduced flow.

## **Signal Check To Pilot Relief**

A leaky pilot relief valve (located in remote manifold) can decrease system flow and pressure for both remote and hitch circuits.

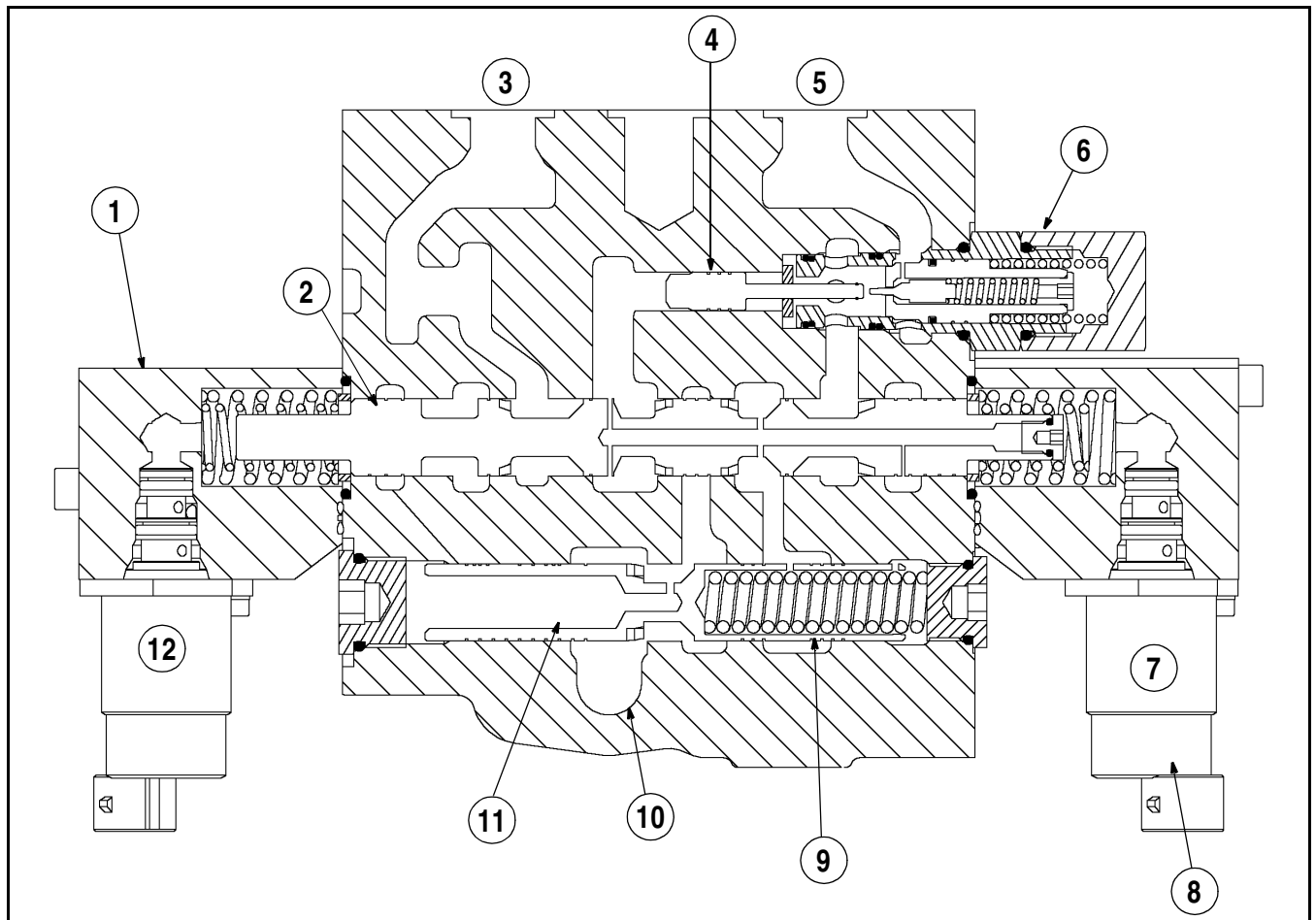
## REMOTE VALVE PROPORTIONAL CURRENT CONTROL (PCC) SOLENOID OPERATION

There is a proportional solenoid mounted on each end of a remote valve section. Each proportional solenoid is supplied with 335 to 345 PSI (23 to 24 bar) pilot pressure from the regulated pressure circuit. When the remote valve control lever is in the neutral position the proportional solenoid valve blocks the regulated pressure supply and drains the spool end cavities to tank.

When the remote control lever is moved down to the extend/raise position, the remote controller sends a current supply to the extend/raise proportional solenoid. The proportional solenoid valve does not just turn ON and OFF, but sets and maintains a pressure in the spool end cavity. The spool will shift to the left compressing the opposite side return springs. When the spring force equals the hydraulic force the spool stops and maintains that position.

The distance that the spool will shift is determined by the flow control setting for that remote section. Increasing the flow control setting will increase the current supply to the proportional solenoid, which in turn increases the hydraulic pressure in the spool end cavity. The increased pressure moves the spool further to the left, until the spring force once again equals the hydraulic force. The spool will maintain the new position (flow setting) until the flow control setting is changed again, or the remote control lever is moved to neutral.

When the remote control lever is moved to neutral the current supply is cut off, the proportional solenoid valve shifts opening the spool end cavity to tank. The return springs center the valve spool in the neutral position.



R102B027

1. PROPORTIONAL SOLENOID VALVE ASSEMBLY
2. MAIN VALVE SPOOL
3. RETRACT PORT
4. LOAD CHECK PLUNGER
5. EXTEND PORT
6. LOAD CHECK

7. EXTEND
8. PROPORTIONAL SOLENOID VALVE ASSEMBLY
9. FLOW CONTROL SPRING
10. PFC PUMP SUPPLY
11. PRESSURE COMPENSATED FLOW CONTROL SPOOL
12. RETRACT

## REMOTE VALVE SYSTEM TESTING

Each of the remote hydraulic system circuits is made up of four different systems. A problem with any one of these systems will effect remote valve performance.

**ELECTRICAL SYSTEM** - A fault code will be recorded and stored when there is a problem in the remote electrical system.

**REGULATED PRESSURE CIRCUIT** - Regulated pressure is needed to move the remote valve control spool.

**PFC PISTON PUMP CIRCUIT** - Provides oil flow to the remote couplers.

**MECHANICAL CONNECTIONS** - Couplers (male and female) and control spools.

Talk to the owner/operator about the problem. Gather as much information about what should be happening versus what is happening. Note as many symptoms as possible.

Next operate the system and attempt to duplicate the problem. If the problem is not repeatable it could be user error, or an intermittent problem. If the problem cannot be repeated you will have to wait until the problem reoccurs. However, you should refer to the Electronic Controller Configuration and Fault Code Retrieval Section in this Manual to determine if any fault codes exist.

Once the problem is identified use the following procedure to determine the problems solution.

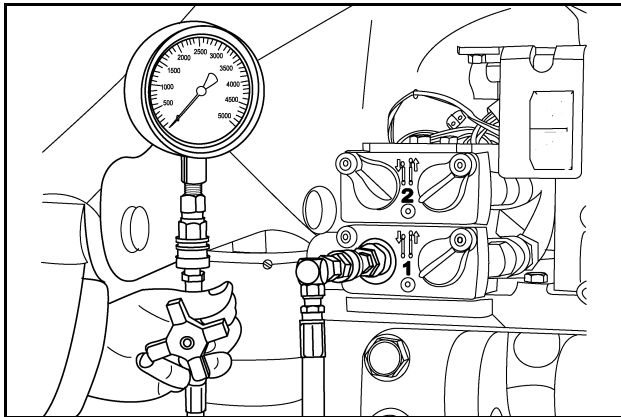
## REMOTE VALVE HIGH PRESSURE TEST

### Test Fitting Tool Requirements:

- 5000 PSI (350 bar) gauge with male remote valve coupler tip.

### Test Procedure:

1. Start and run the engine at 1500 RPM.
2. Fully lower the hitch if possible.
3. Set all the remote valve variable flow controls to the **maximum flow** position.
4. Set the remote valve timer control to the **maximum time** position.
5. Individually pressure check each remote valve section with a 5000 PSI (350 bar) gauge.



RD98E116

6. Record the pressures read on the gauge for each remote section.

#### Reading at 1500RPM:

- 1st Remote valve pressure: \_\_\_\_\_
- 2nd Remote valve pressure: \_\_\_\_\_
- 3rd Remote valve pressure: \_\_\_\_\_
- 4th Remote valve pressure: \_\_\_\_\_
- 5th Remote valve pressure: \_\_\_\_\_

### High Pressure Standby Specification: 2930 PSI (202 bar)

If no remote valve pressure is recorded and the hitch will not raise or lower. Perform the following

- Charge pump pressure check.
- Perform an inspection of the PFC pump compensator and pump swash plate.

If all remote valve pressures measured are the same, but low, check the following:

- PFC pump high pressure standby is set low.
- Problem with PFC pump compensator valve.
- Hitch signal line has excessive leakage.

If only one remote valve section fails to engage, or build correct pressure, check the following:

- Female coupler problem. Test the other valve port to eliminate the coupler as a cause.
- Perform Remote Valve Flow Test.

If the tractor PFC pump goes to high pressure standby (based on engine sound) when the tractor is started and the remote control levers are in neutral, check the following:

- Hitch is fully raised and not turning off, see TMF Controller calibration and Fault codes.
- Remote valve is partially engaged, a main valve spool is sticking.

-- Move a 5000 PSI (350 bar) gauge to each remote coupler to isolate the problem valve.

If the remote pressure does not return to zero after a remote control lever is placed in neutral, check the following:

- Calibrate remote valve control lever see Armrest Controller Calibration and Fault Codes.
- Check for broken centering springs on main valve spool.
- Remote valve main spool sticking in bore.

Pressure on test gauge returns to zero, but PFC pump remains at high pressure (based on engine sound) after a remote valve control lever is placed in neutral (pump won't destroke), check the following:

- Sticking high pressure compensator spool in pump compensator. Inspect the PFC pump compensator valve and swash plate.
- Check for blocked bleed down orifice in pump compensator.



## PFC PUMP HIGH PRESSURE STANDBY CHECK AND ADJUSTMENT PROCEDURE

Perform this test when all remote circuits and hitch system do not operate with full power. This would be noticeable when maximum power is needed such as when lifting heavy hitch loads, or maximum pressure is required by a remote circuit.

### Test Fitting Tool Requirements:

- 17 mm wrench and 3 mm Allen wrench.

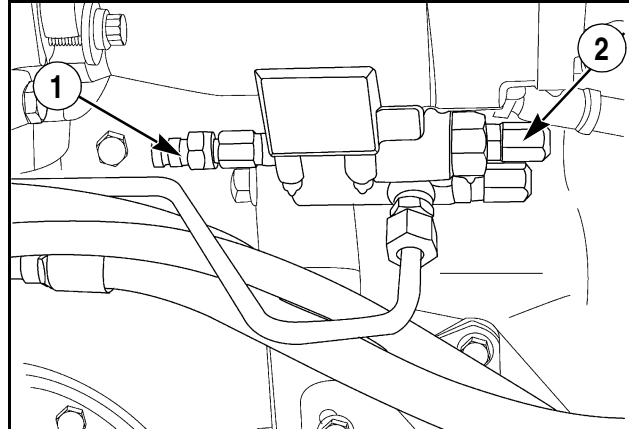
### Preparation:

Remove the plug and install the diagnostic fitting from Fitting Kit 380040106 into the pump compensator.

**IMPORTANT:** *Do not shift the transmission control lever out of park.*

### Test Procedure:

- Install a 5000 PSI (350 bar) pressure gauge with hose onto the diagnostic fitting at the compensator.
- Start and run the engine at 1500 RPM.
- Place the number one remote valve control lever into the extend position.



1. DIAGNOSTIC FITTING      2. HIGH PRESSURE  
COMPENSATOR  
ADJUSTMENT

### High Pressure Standby Specification: 3250 PSI (224 bar)

Remove the cap from the high pressure adjustment. Loosen the lock nut and use the Allen wrench to adjust the pressure. Turn the adjustment screw in (clockwise) to increase the pressure, and turn the adjustment out (counterclockwise) to decrease the pressure setting.

- A. If the correct pressure could not be obtained the PFC pump may be damaged. Perform the PFC piston pump flow.

## PFC PISTON PUMP FLOW TEST

Perform this test when all remote circuits and the hitch system are not operating at full flow. This would be noticeable by slower operation of remote circuit systems along with a slower hitch raise time.

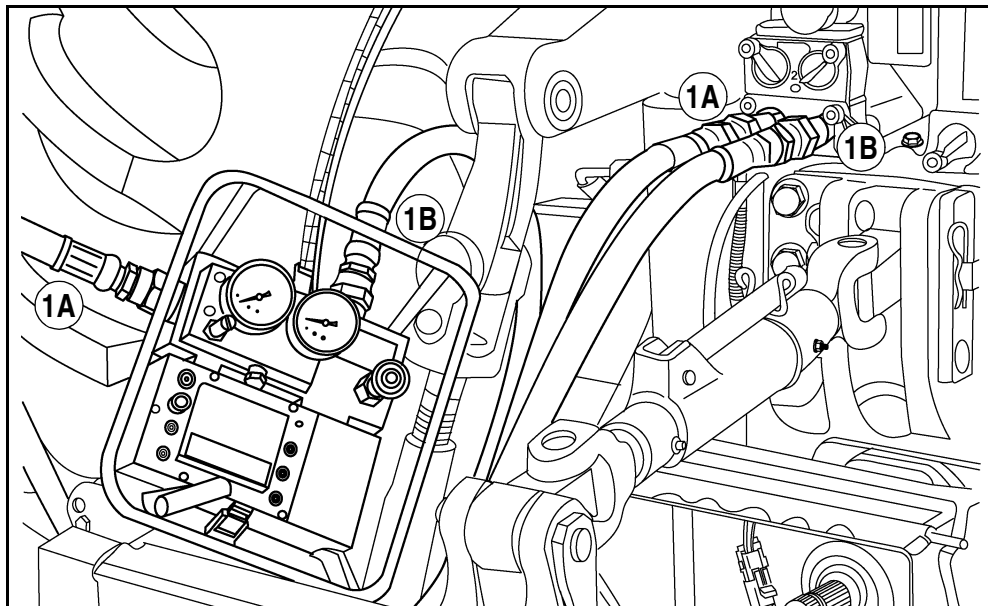
- Set all the remote valve variable flow controls to the **maximum flow** position.
- Set the remote valve timer control to the **maximum time** position.
- Place a 25 x 4 inch (63 x 10 cm) piece of cardboard over each of the two oil coolers on each side of the engine radiator to heat the oil.

- Start and run the engine at 1000 RPM.

**NOTE:** Use 3/4 inch hose with a minimum working pressure of 3000 PSI (206 bar) for this flow test.

- Install the CAS-10280 Flowmeter into the No. 1 remote section. Place the remote valve control lever into the detent retract position.
- Adjust the load valve on the flowmeter to 1500 PSI (103 bar) and heat the transmission oil to a minimum of 120 degrees F (49 degrees C).

Increase engine speed to 2000 RPM. Individually flow rate each remote valve section. Adjust the load valve on the flowmeter to 1000 PSI (69 bar).



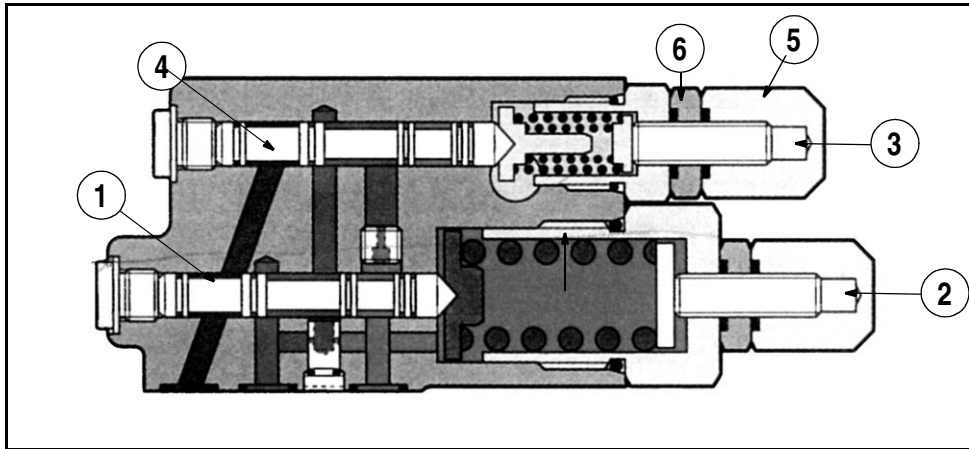
REMOTE SECTION	FULL FLOW @ 2000 RPM
NO. 1 REMOTE SECTION	
NO. 2 REMOTE SECTION	
NO. 3 REMOTE SECTION	
NO. 4 REMOTE SECTION	
NO. 5 REMOTE SECTION	

**Full Flow Specification for Standard Flow Pump: 38.6 GPM (146 L/min)**  
**Full Flow Specification for Optional MegaFlow Pump: 68.0 GPM (257 L/min)**

If the pump does not meet specification for standard flow pump, perform the Standard Pump Compensator and Swash Plate Inspection.

## STANDARD PUMP COMPENSATOR VALVE INSPECTION

Perform this inspection only after completing the high pressure standby check and the piston pump flow test.



1. HIGH PRESSURE SPOOL
2. HIGH PRESSURE ADJUSTMENT SCREW
3. LOW PRESSURE ADJUSTMENT SCREW

4. LOW PRESSURE SPOOL
5. CAP
6. LOCK NUT

### Test Fitting and Tool Requirements:

- 17 mm wrench
- 3 mm Allen wrench
- 5 mm Allen wrench

### Test Procedure:

- With two wrenches, disconnect the signal line tube at the PFC pump compensator.

- Remove the compensator valve from the PFC pump.

- Remove high pressure cap. Measure and record the distance from the lock nut to the end of the high pressure adjustment screw.

- Remove low pressure cap. Measure and record the distance from the lock nut to the end of the low pressure adjustment screw.

- Check for broken springs

- Remove high pressure spool. Make sure it moves freely within the bore.

- Remove low pressure spool. Make sure it moves freely within the bore.

- Clean cored passages in the compensator valve.

- Assemble compensator valve. Set high and low pressure adjustment screws to their original positions.

- Reinstall compensator. Perform PFC Piston Pump Flow Test.

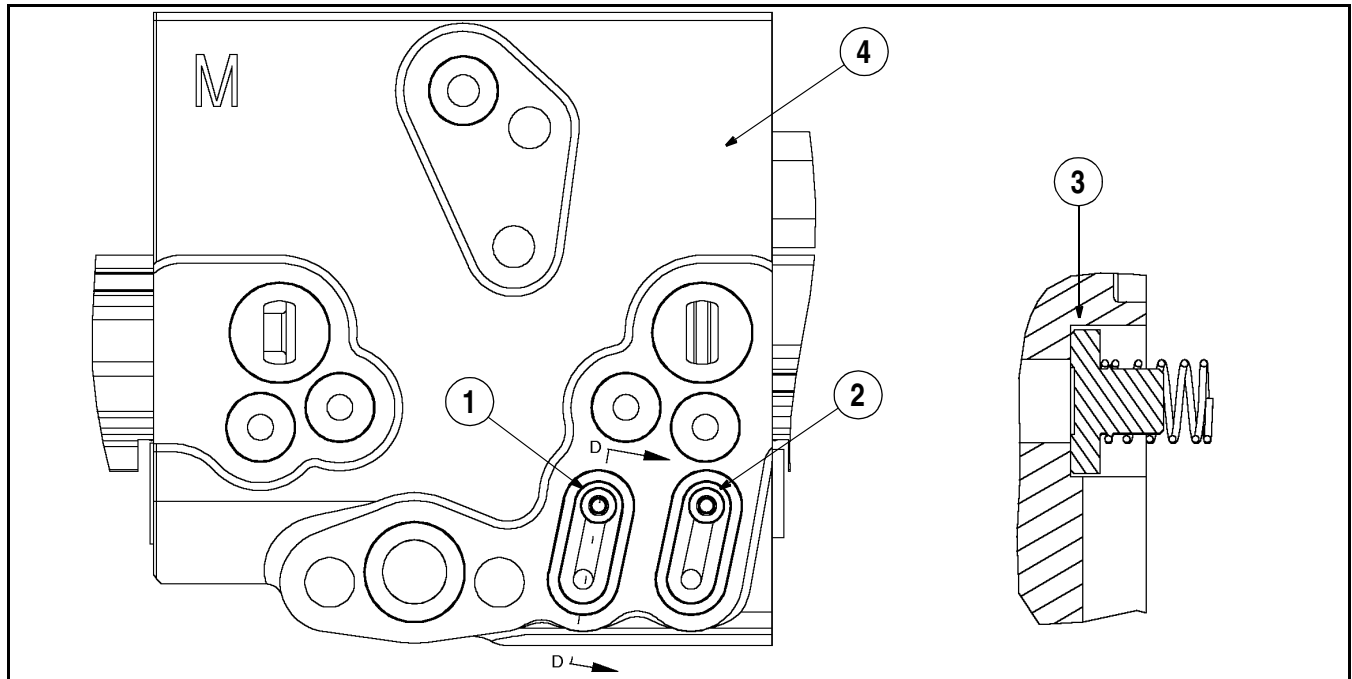
- If the pump is still not able to meet specifications remove PFC pump for repair or replacement. See PFC Pump Section in this Service Manual.

## REMOTE VALVE SIGNAL CHECK AND HITCH SIGNAL CHECK

Each remote section and the hitch circuit are equipped with a signal check. If any one signal check is leaking it will effect the performance of all the other circuits.

**REMOTE SIGNAL CHECK LEAKING:** All remaining remote circuits and hitch are operating at reduced flow. The leaking remote section operates normally.

**HITCH SIGNAL CHECK LEAKING:** All remotes operating at reduced flow. Hitch operates normally.

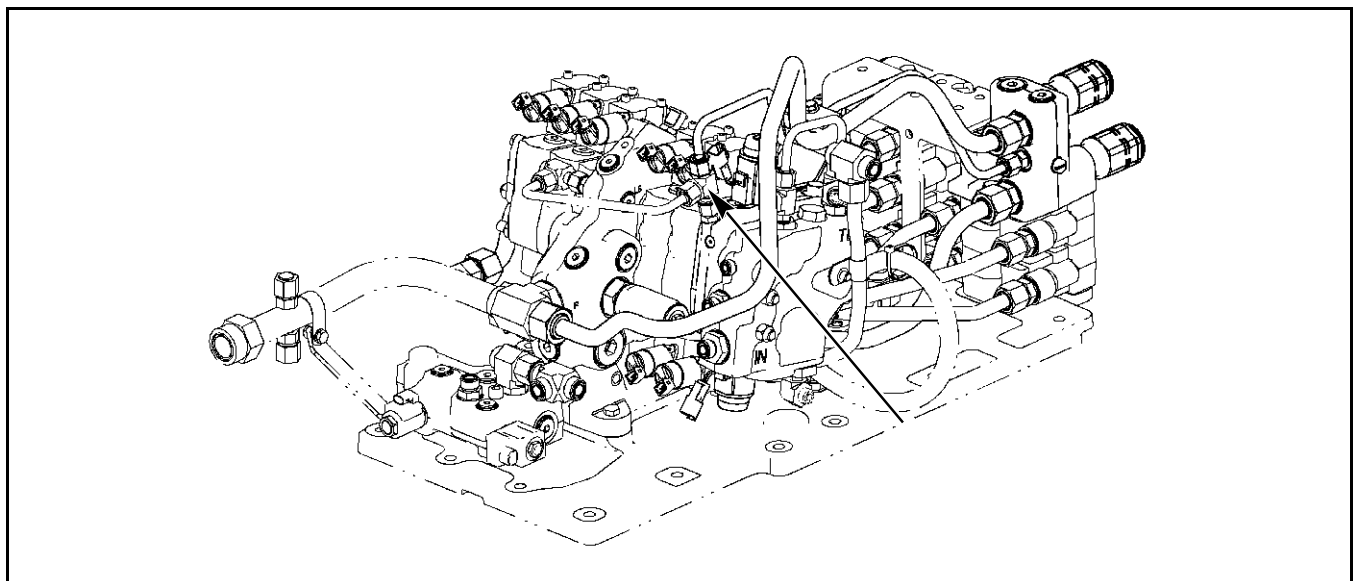


RI02F021

1. SIGNAL CHECK TO PUMP COMPENSATOR
2. SIGNAL CHECK TO PILOT RELIEF

3. SIGNAL CHECK POPPET AND SPRING
4. REMOTE VALVE SECTION

### REMOTE VALVE SIGNAL CHECKS



RD06A065

### HITCH VALVE SIGNAL CHECK (INTERNAL)

## REMOTE VALVE COUPLER TEST

Remote valve couplers seal leaks will cause the following problem.

- Male coupler tip spit out when remote valve lever is engaged.
- Implement settles when attached to tractor.
- Low remote flow through the coupler.

### Inspection

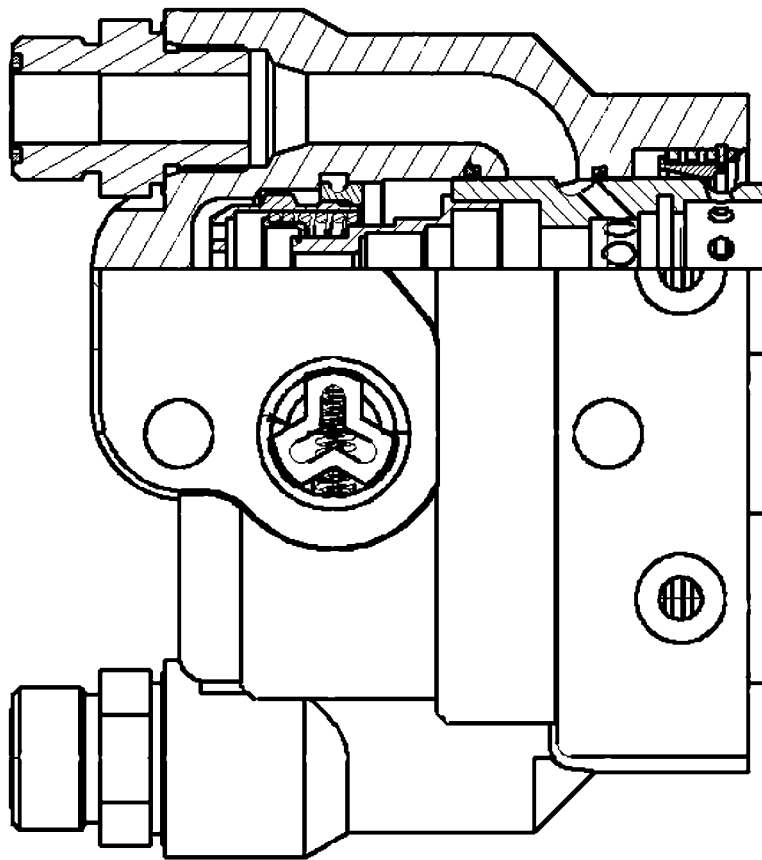
—Talk to the owner/operator about the problem.

—Find out what type of male coupler tip is being used.

—Check the male tip and make sure it is compatible with the tractor (the male tip must have ball on the end or it will damage the female cartridge tip).

—Check to make sure the implement supply and return hoses are properly supported to prevent unnecessary loading of the female coupler cartridge.

—Clean the coupler. Remove all dirt from inside the detent mechanism. This is a mechanical connection, coupler balls must be free to move.



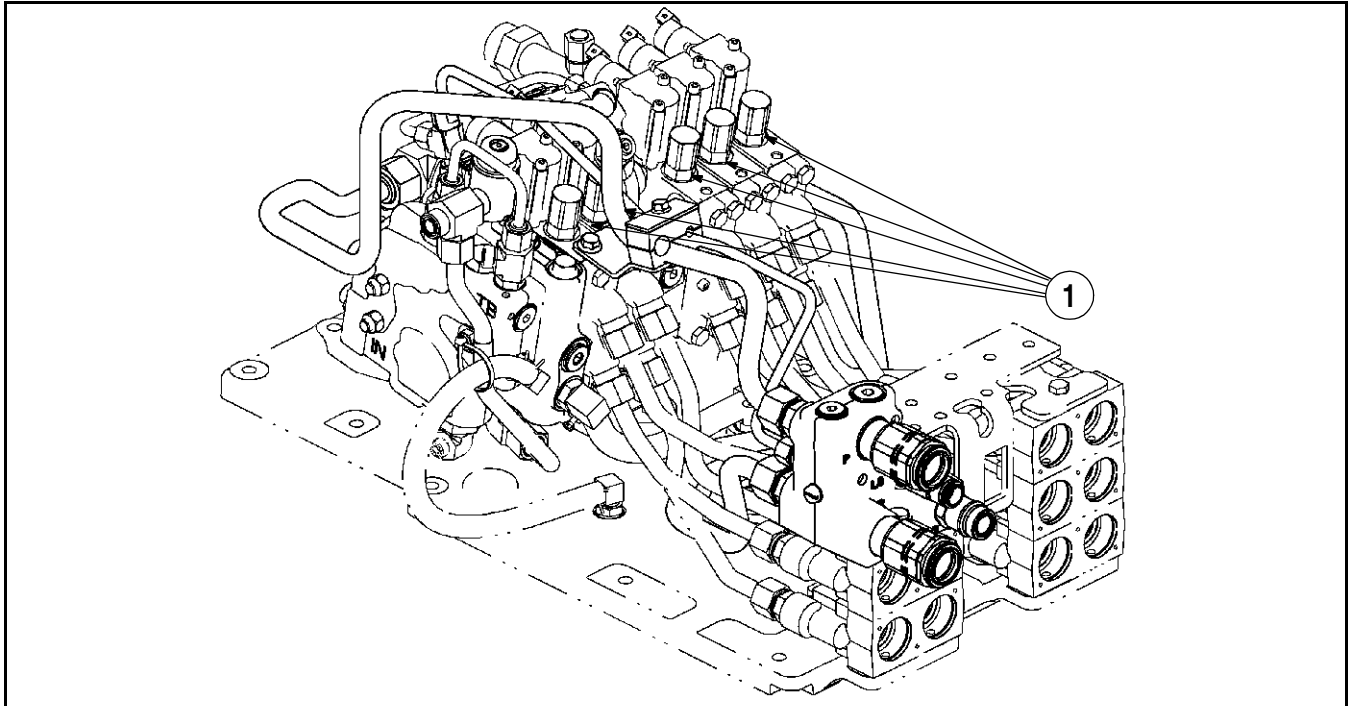
RH02J046

REMOTE COUPLER ASSEMBLY

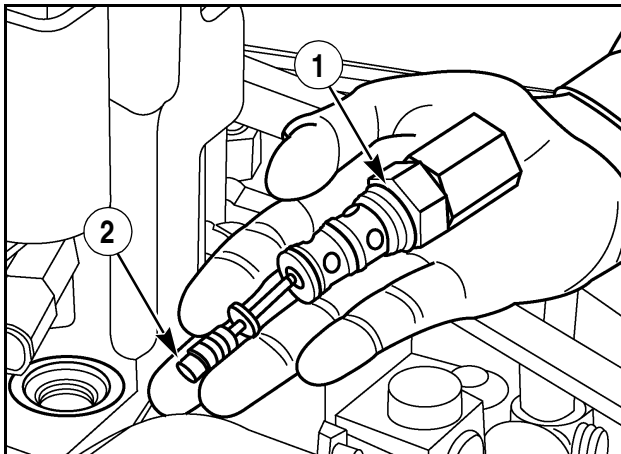
## LOAD CHECK INSPECTION

### Remote Valve Load Check Valves

The remote hydraulic valve is equipped with a single load check on all five remote sections on the “B” (extend) port. The load check is used in applications where a remote hydraulic cylinder must be hydraulically locked in position with a minimal amount of leak down.



RI06A064



- 1. LOAD CHECK
- 2. LOAD CHECK PLUNGER

- Lower suspended/ raised implements.
- Clean the load check area.
- Slowly loosen the load check and relieve any trapped pressure.
- Use a needle nose pliers to retrieve the plunger.
- Inspect seals and check for damage. (See Remote Valve Service Manual Section).

## OPERATIONAL PROBLEMS

### IMPLEMENT SETTLES OR LEAKS DOWN

- A. Problem with implement cylinder. Raise implement and disconnect hoses to isolate cylinder.
- B. Internal coupler leak. Perform remote valve coupler test.
- C. Load check in remote valve leaking. See remote valve general information.

### IMPLEMENT CHATTERS OR JERKS WHEN LOWERED

- A. Increase the remote valve flow control setting to prevent the load check in remote valve from closing.
- B. Remove load check from the remote valve and install a load check plug assembly. Eliminating the load check will allow the implement to settle.
- C. Install a floating orifice in the lowering side of the implement hydraulic line. The orifice should restrict the return flow and cause the supply line to build back pressure when lowering the implement. This will prevent the load check from seating and will eliminate the chatter.

### THE MALE AND FEMALE COUPLERS WILL NOT CONNECT OR COUPLE TOGETHER CORRECTLY.

- A. Perform coupler inspection outlined in Step 1.
- B. Coupler defective or damaged from improper usage.
- C. There is extreme pressure within the cylinder hose, bleed hose to reduce pressure.

### LOW REMOTE VALVE FLOW THROUGH THE COUPLER

- A. Find out what type of male coupler tip is being used.
- B. Check the male tip make sure it is compatible with the tractor. (The male tip must have ball on the end or it will damage the female cartridge tip).
- C. Perform remote valve coupler test to check for internal leakage.
- D. The coupler seals are worn or damaged.
- E. Remote valve flow control not fully open.

- F. Bypass coupler to determine if the problem is with the remote valve/hydraulic system or coupler. Connect the flowmeter directly to the lower and raise tubes.

### COUPLER SPITS OUT IN EXTREMELY COLD WEATHER

- A. Turn the flow control down. Turn the implement hose as it is being installed. Once the hose is installed slightly pull on the hose.
  - If the hose pops out the mechanical connection was not completed.
  - If the hose stays in place, start the engine and engage the remote valve. If the hose stays in, increase the flow control to the desired setting.
- B. Clean the coupler, if the hose pops out, remove all dirt from inside the detent mechanism. This is a mechanical connection, coupler balls must be free to move.
- C. Perform remote valve coupler testing to check for internal leakage.

# **Section 35**

## **Chapter 6**

### **PRIORITY AND REGULATOR VALVE**



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PRIORITY VALVE AND REGULATOR ..... 35-6-4

    Removal ..... 35-6-4

    Disassembly ..... 35-6-6

    Assembly ..... 35-6-9

    Installation ..... 35-6-12

CROSS SECTION OF PRIORITY AND REGULATOR VALVE ..... 35-6-14

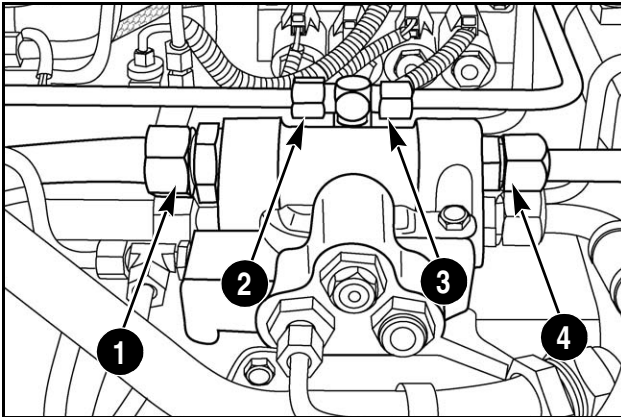
**SPECIAL TORQUES**

Socket Head Plug .....	16 to 24 Nm (12 to 18 lb. ft.)
PFC Pump Signal Orifice and Screen Plug .....	14 to 21 Nm (10 to 15 lb. ft.)
Logic Check Valve Plug .....	16 to 19 Nm (12 to 14 lb. ft.)
Regulator Spool Lock Nut.....	41 to 48 Nm (30 to 35 lb. ft.)
Pilot Relief Valve Assembly .....	75 to 108 Nm (55 to 80 lb. ft.)

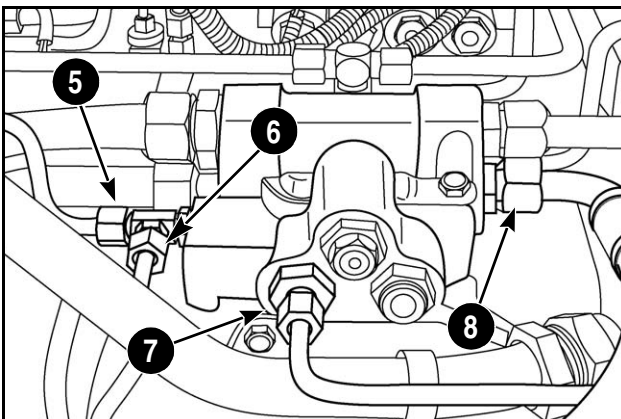
## PRIORITY VALVE AND REGULATOR

### Removal

#### STEP 1



RD02E055



RD02E056

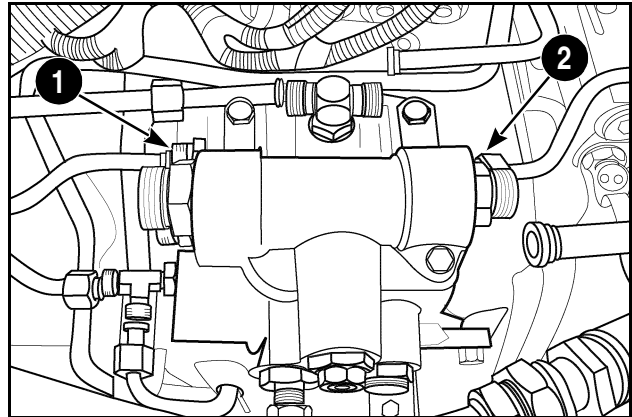
- |   |  |
|---|--|
| 1. REMOTE HYDRAULIC<br>MANIFOLD SUPPLY LINE | 5. SIGNAL LINE TO<br>REMOTE VALVE        |
| 2. PTO SUPPLY LINE                          | 6. PFC COMPENSATOR<br>SIGNAL LINE        |
| 3. REGULATED SUPPLY<br>LINE                 | 7. STEERING SENSING<br>LINE              |
| 4. OIL COOLER SUPPLY<br>LINE                | 8. CHARGE PUMP TO<br>PRIORITY VALVE HOSE |

Remove these lines from the priority and regulator valve.

**NOTE:** The cab will have to be raised to gain access to the priority and regulator valve. The cab has been removed in this section for photographic purposes. Refer to the Cab Raise/Removal and Installation Section in this Repair Manual for the cab raising procedure.

**NOTE:** The steering sensing line (7) runs toward the rear of the tractor, if equipped with trailer brakes.

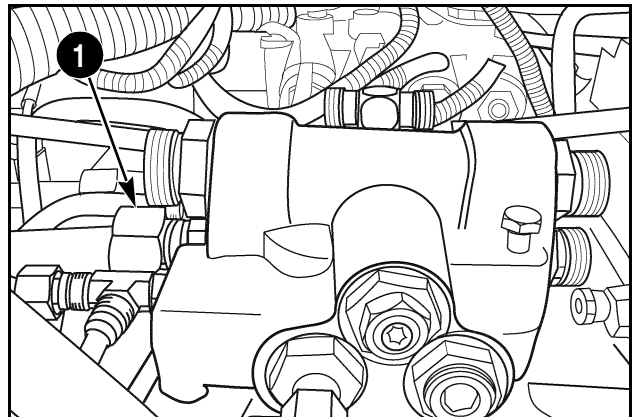
#### STEP 2



RD02D088

Remove the steering supply line (1). Remove the brake valve supply line (2).

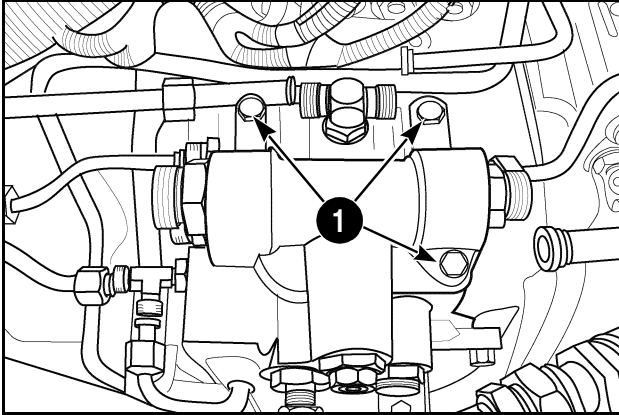
#### STEP 3



RD02D104

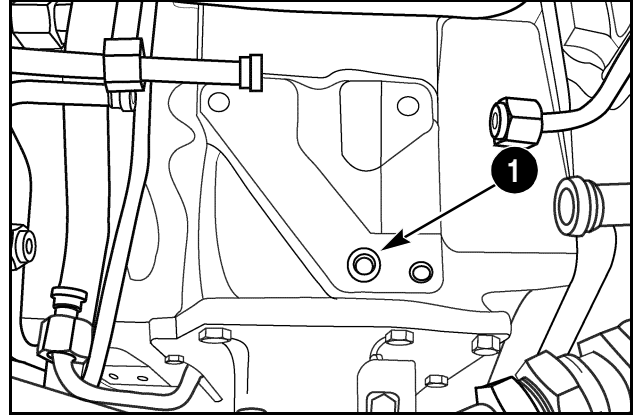
Remove the PFC pump supply hose to the priority valve (1).

**STEP 4**



Remove the three priority valve mounting bolts (1).

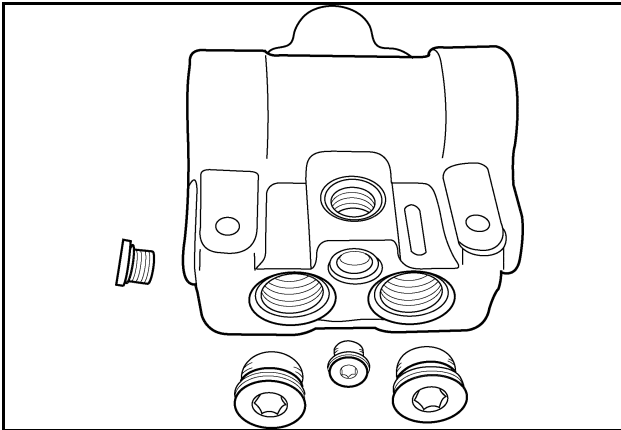
**STEP 5**



Remove the priority valve from the top of the transmission. Remove the O-ring (1) in the top of the transmission housing and discard.

## Disassembly

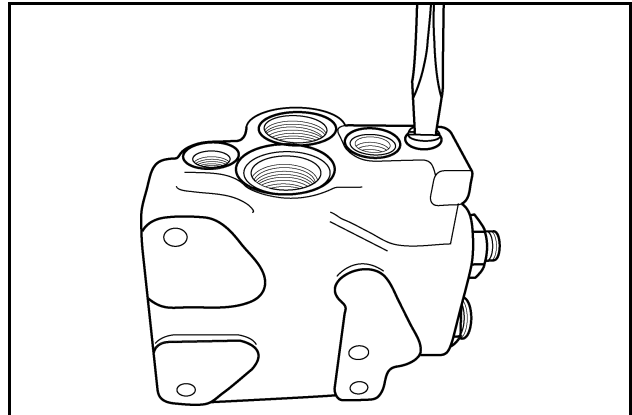
### STEP 6



RD02D106

Remove the four plugs from the priority and regulator valve and discard the O-rings.

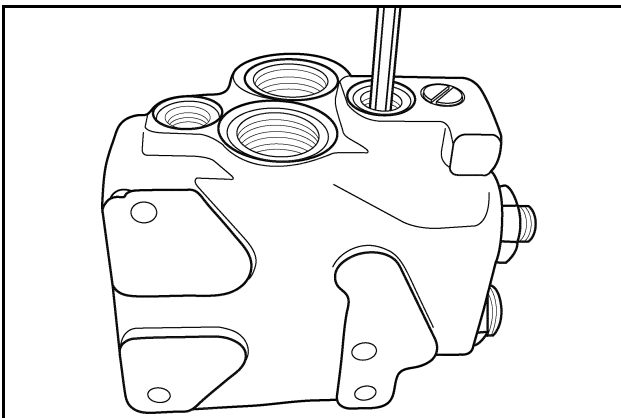
### STEP 9



RD02D112

Unscrew the logic check valve plug.

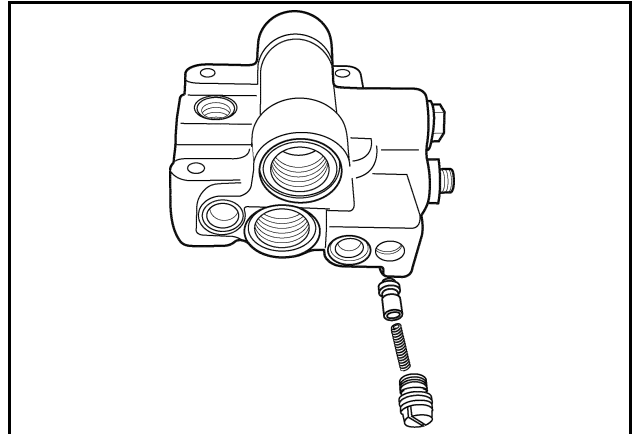
### STEP 7



RD02D108

Unscrew the PFC pump signal orifice and screen plug.

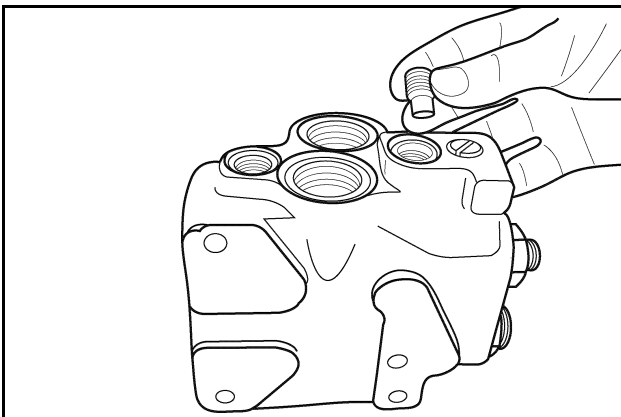
### STEP 10



RD02D114

Remove the logic check valve plug and discard the O-ring and backup ring. Inspect the spring and valve for damage or wear.

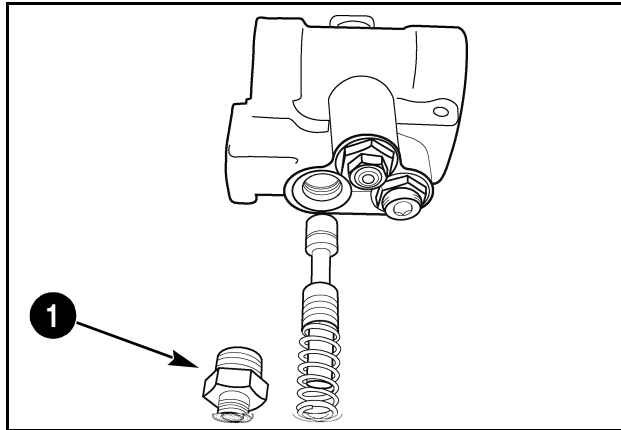
### STEP 8



RD02D110

Remove the plug. Inspect the screen and clean as needed.

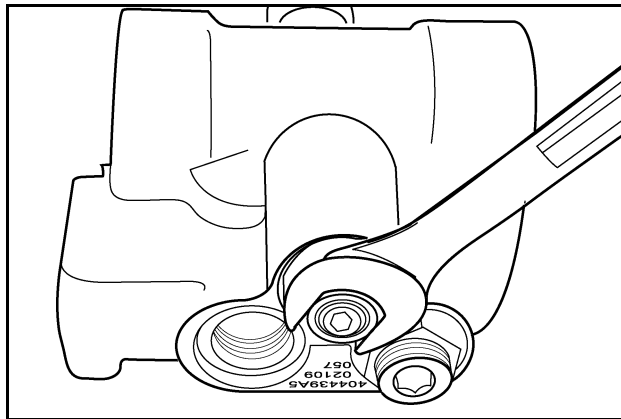
## STEP 11



RD02D117

Remove the steering line orifice fitting and discard the O-ring (1). Remove the priority valve spring and spool. Inspect the spring and spool for damage or wear.

## STEP 12

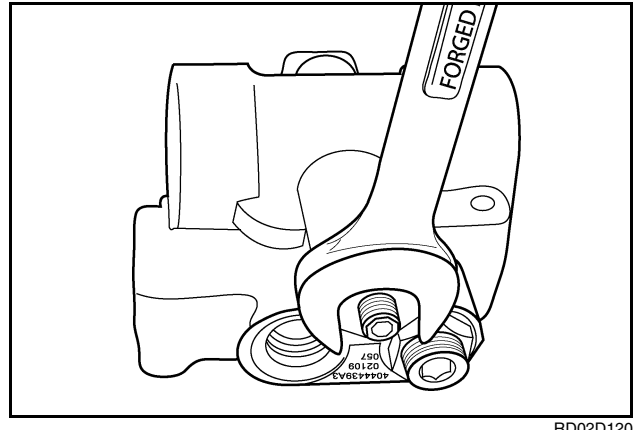


RD02D119

**NOTE:** Measure the distance from the adjustment end of the pilot relief valve assembly to the body of the valve before removing the lock nut.

Remove the pilot relief valve lock nut.

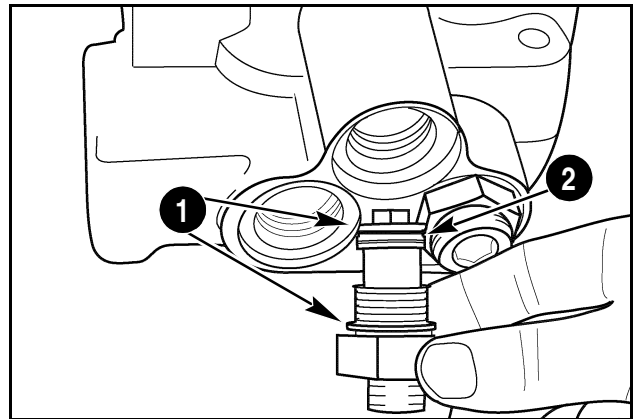
## STEP 13



RD02D120

Remove the pilot relief valve assembly.

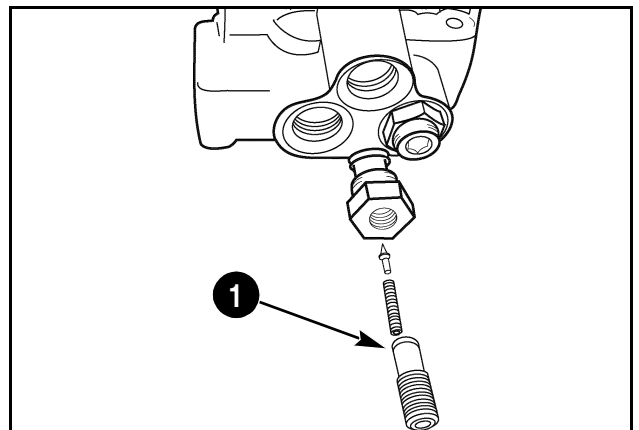
## STEP 14



RD02D124

Remove and discard the O-rings (1) and the backup ring (2) from the pilot relief valve orifice fitting.

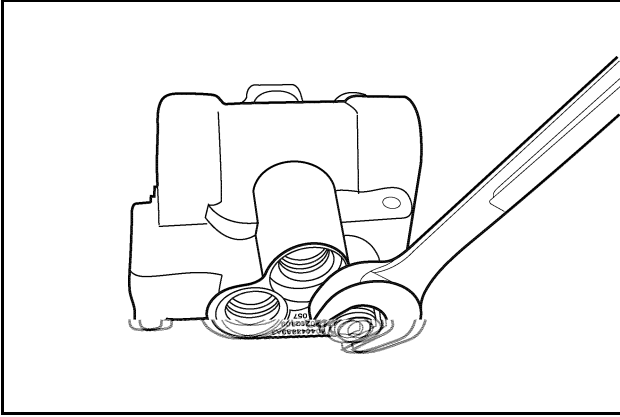
## STEP 15



RD02D126

Unscrew the pilot relief valve adjuster from the orifice fitting and discard the O-ring (1). Remove the spring and the needle valve from the orifice fitting. Inspect for damage or wear.

## STEP 16

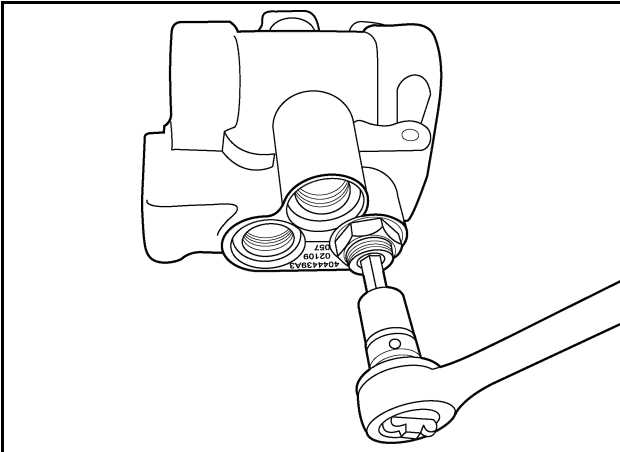


RD02D128

**NOTE:** Measure the distance from the adjustment end of the regulator spool to the body of the valve before removing the lock nut.

Remove the lock nut from the regulator spool adjusting plug.

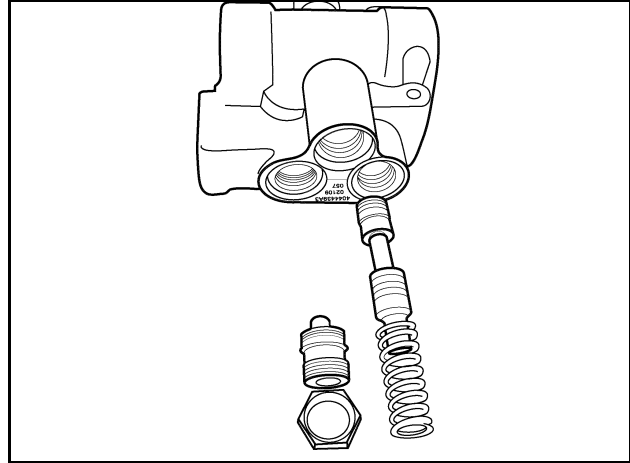
## STEP 17



RD02D130

Unscrew the regulator spool adjusting plug.

## STEP 18

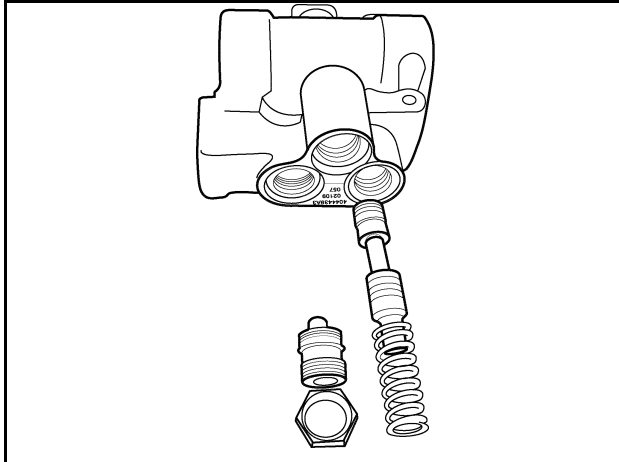


RD02D134

Remove and discard the O-ring from the adjusting plug. Remove the spring and the regulator spool. Inspect for damage or wear.

## Assembly

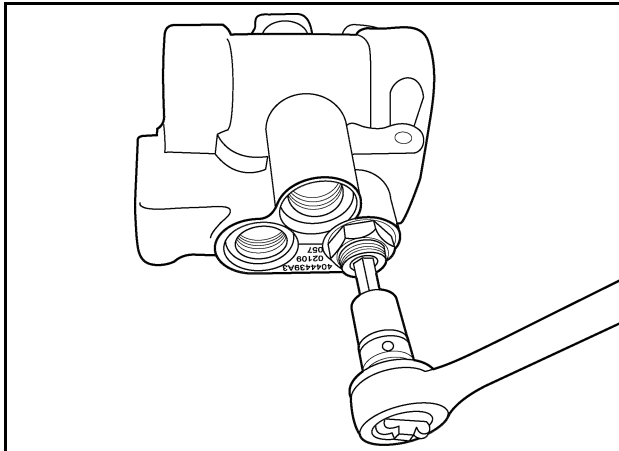
### STEP 19



RD02D134

Lubricate the adjusting plug O-ring with hydraulic fluid and install on the plug. Lubricate the regulator spool and the spring. Install the spool and spring in the priority valve.

### STEP 20

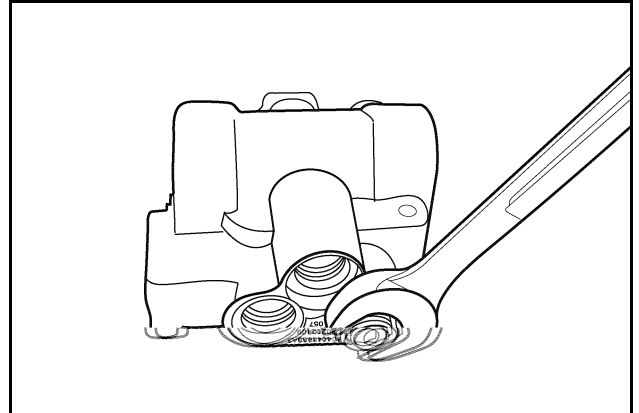


RD02D130

**NOTE:** Use the measurements made during the disassembly procedure to install the regulator spool adjusting plug.

Install the regulator spool adjusting plug.

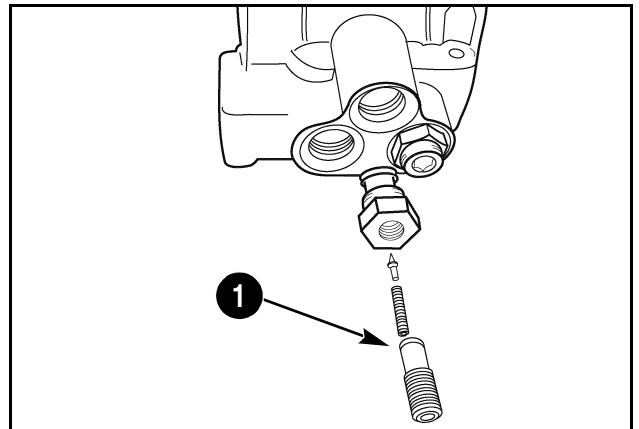
### STEP 21



RD02D128

Install the regulator spool lock nut. Tighten the nut to a torque of 41 to 48 Nm (30 to 35 lb. ft.).

### STEP 22

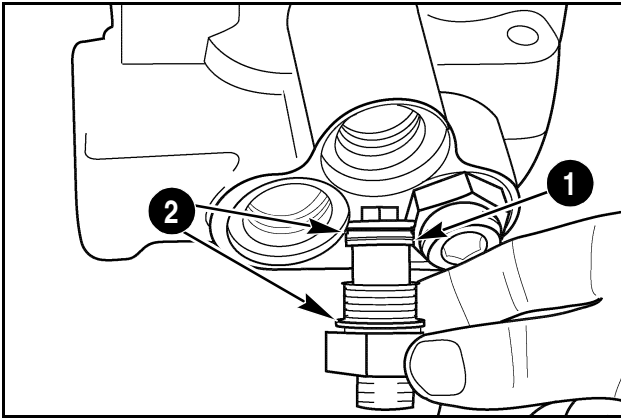


RD02D126

Lubricate and install a new O-ring (1) on the pilot relief valve adjuster. Lubricate the needle valve and the spring. Install the needle valve, spring, and the pilot relief valve adjuster into the pilot relief valve orifice fitting.



### STEP 23

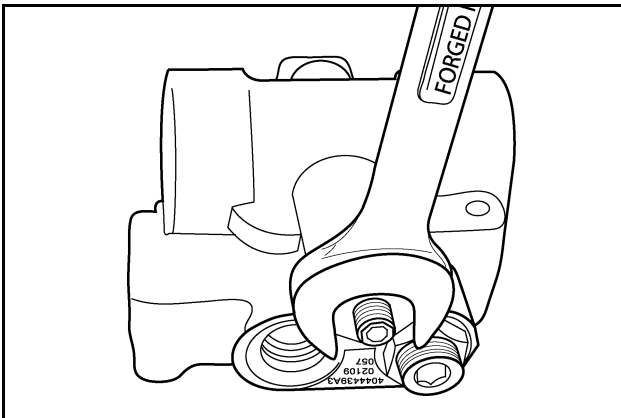


RD02D124

Lubricate and install a new backup ring (1) and new O-rings (2) on the pilot relief valve assembly.

**NOTE:** Install the backup ring (1) before the O-ring, as shown.

### STEP 24

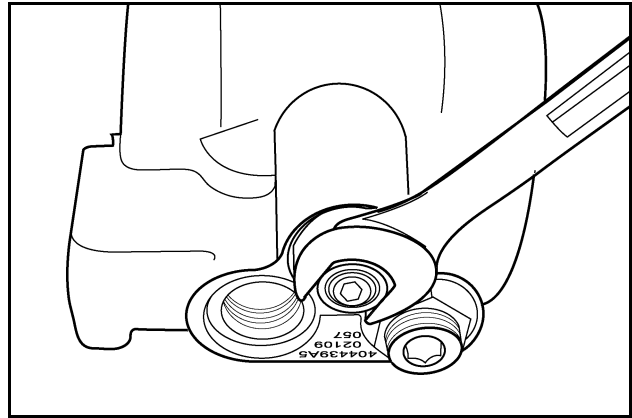


RD02D120

Install the pilot relief valve assembly. Make sure the pilot relief needle valve is properly seated in the priority valve. Tighten the pilot relief valve assembly to a torque of 75 to 108 Nm (55 to 80 lb. ft.).

**NOTE:** Use the measurements made during the disassembly procedure to install the pilot relief valve assembly.

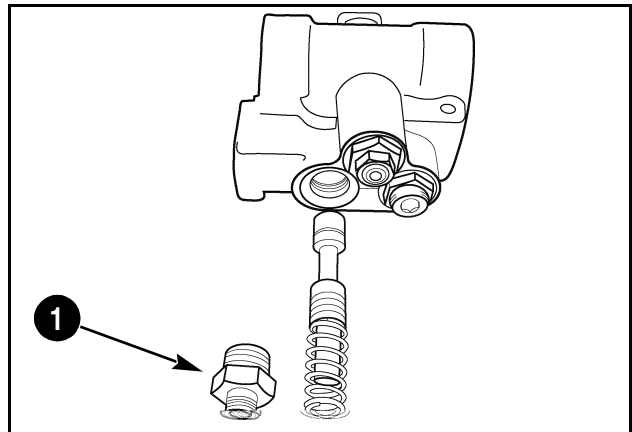
### STEP 25



RD02D119

Install the pilot relief valve lock nut.

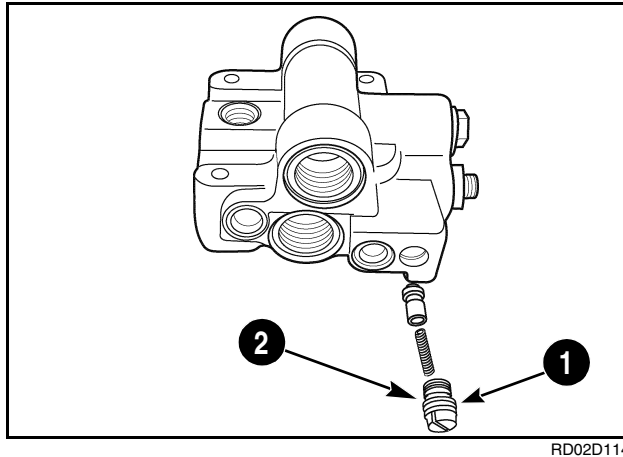
### STEP 26



RD02D117

Lubricate the priority valve spool and the spring. Install the spool and the spring into the valve assembly. Lubricate a new O-ring (1) and install on the steering line orifice fitting. Install the orifice fitting into the priority valve.

## STEP 27

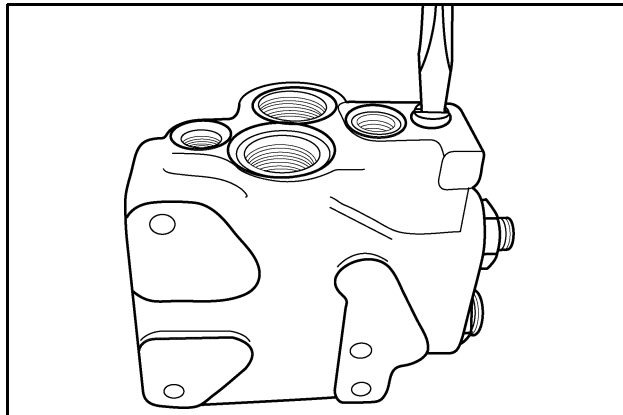


RD02D114

Lubricate the logic check valve and the spring. Install the check valve and the spring in the priority valve. Lubricate and install a new backup ring (1) and O-ring (2) on the logic check valve plug.

**NOTE:** Install the backup ring (1) before the O-ring.

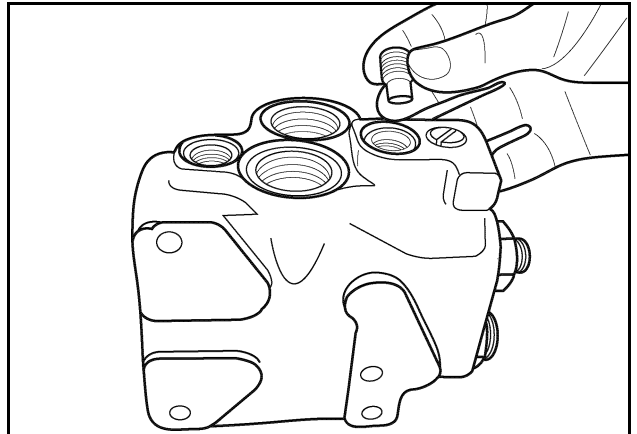
## STEP 28



RD02D112

Install the logic check valve plug. Tighten the plug to a torque of 16 to 19 Nm (12 to 14 lb. ft.).

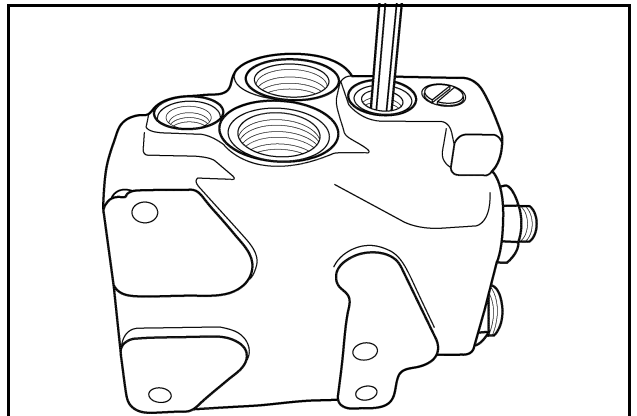
## STEP 29



RD02D110

Apply a fine strip of Loctite® 242 adhesive on the internal land of the priority valve casting. Install the PFC pump signal orifice and screen plug.

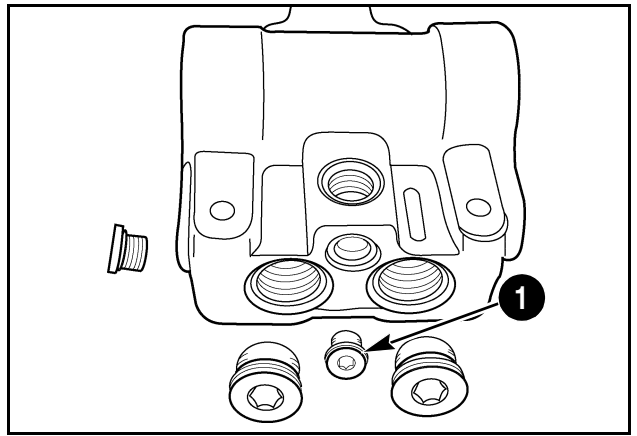
## STEP 30



RD02D108

Tighten the plug to a torque of 14 to 21 Nm (10 to 15 lb. ft.).

## STEP 31

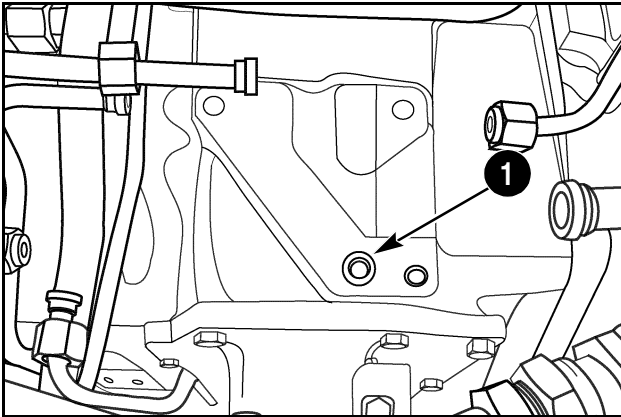


RD02D106

Lubricate and install new O-rings on the valve plugs. Tighten plug (1) to a torque of 16 to 24 Nm (12 to 18 lb. ft.).

## Installation

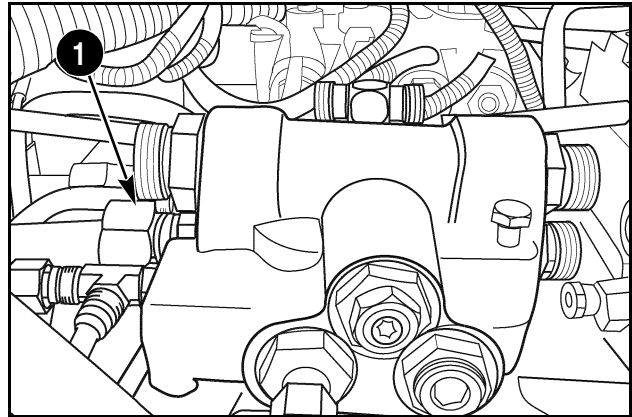
### STEP 32



RD02D093

Install a new O-ring (1) in the top of the transmission housing. Place the priority valve on the top of the transmission.

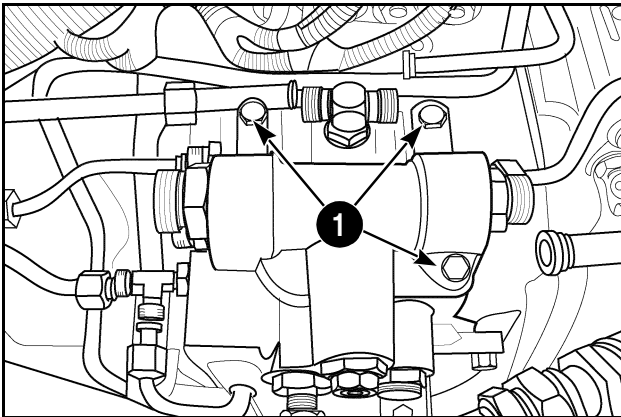
### STEP 34



RD02D104

Install the PFC pump supply hose to the priority valve (1).

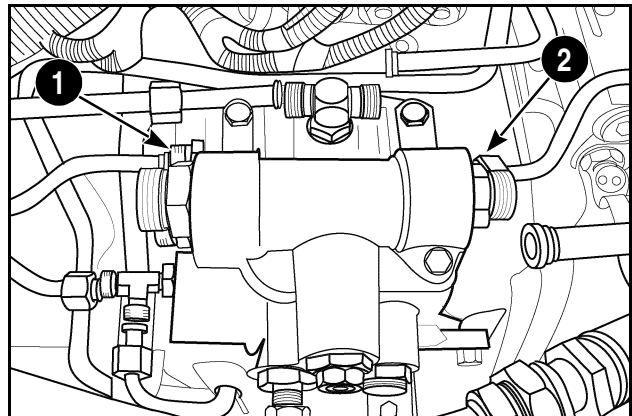
### STEP 33



RD02D089

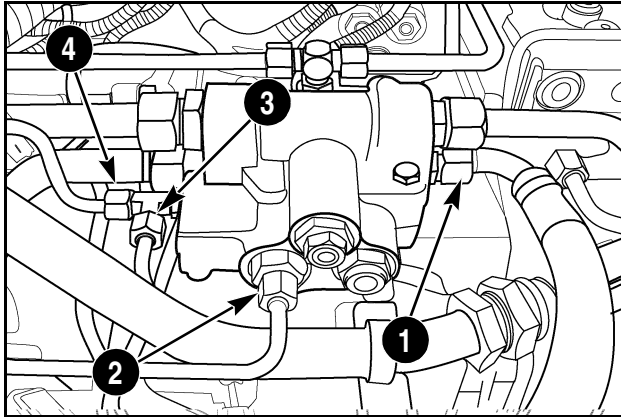
Install the three priority valve mounting bolts (1).

### STEP 35

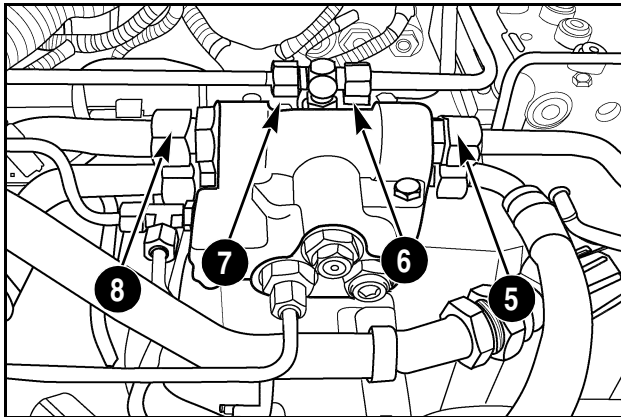


RD02D088

Install the steering supply line (1). Install the brake valve supply line (2).

**STEP 36**

RD02D081



RD02D084

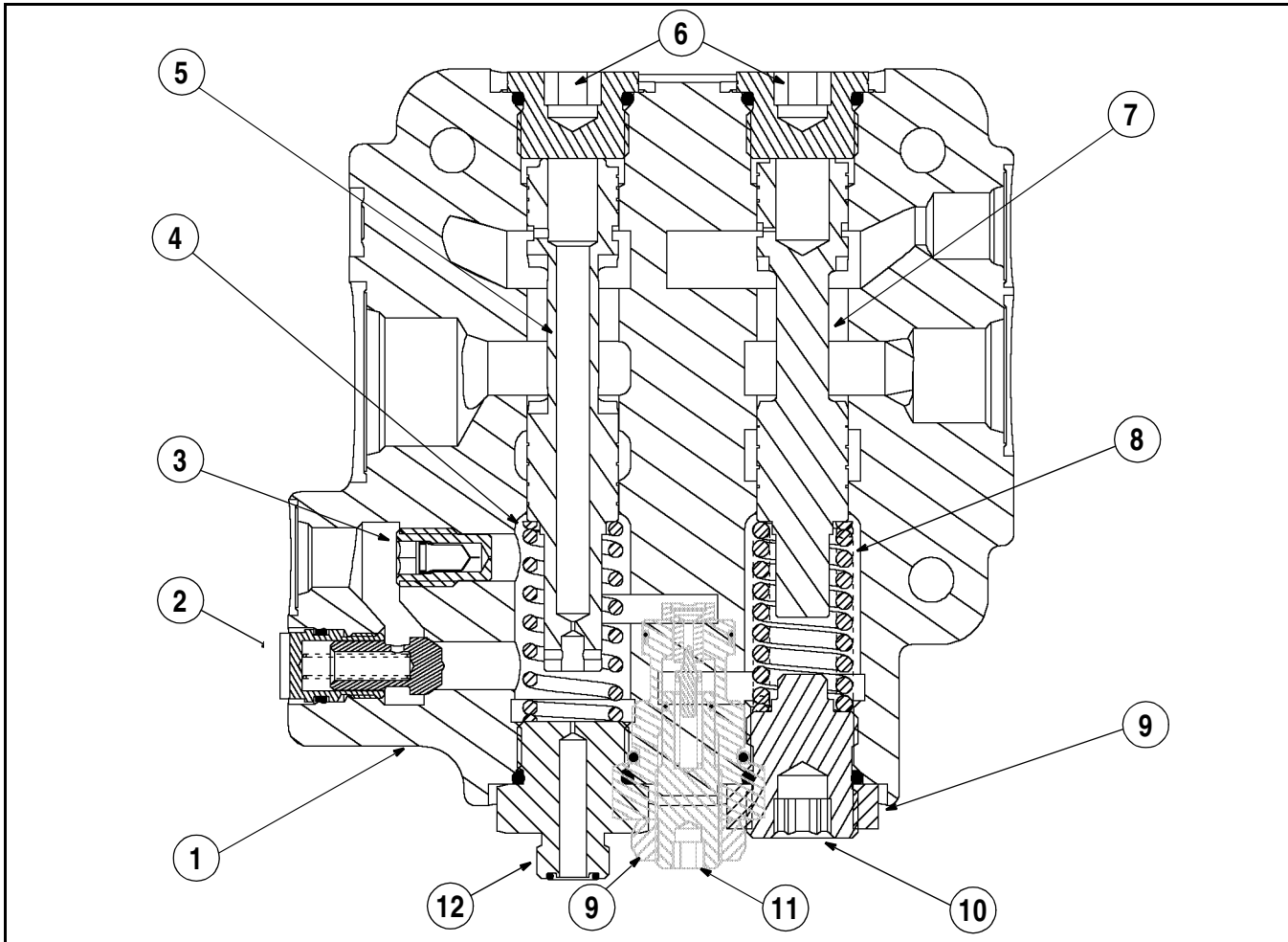
- |                                       |  |
|---------------------------------------|--|
| 1. CHARGE PUMP TO PRIORITY VALVE HOSE | 5. OIL COOLER SUPPLY LINE                |
| 2. STEERING SENSING LINE              | 6. REGULATED SUPPLY LINE                 |
| 3. PFC COMPENSATOR SIGNAL LINE        | 7. PTO SUPPLY LINE                       |
| 4. SIGNAL LINE TO REMOTE VALVE        | 8. REMOTE HYDRAULIC MANIFOLD SUPPLY LINE |

Install these lines on the priority and regulator valve.

**STEP 37**

Lower the cab. Refer to the information in this service manual for the cab lowering procedure. Check the tractor hydraulic fluid level and add fluid as necessary. The steering priority valve and regulator must be adjusted after disassembly. Refer to the Hydraulic System - How It Works and Troubleshooting Section of this Repair Manual for the adjustment procedure.

## CROSS SECTION OF PRIORITY AND REGULATOR VALVE



RI02E009

- |                                 |                         |                                  |
|---------------------------------|-------------------------|----------------------------------|
| 1. PRIORITY AND REGULATOR VALVE | 5. PRIORITY VALVE SPOOL | 9. LOCKING NUT                   |
| 2. LOGIC CHECK VALVE ASSEMBLY   | 6. PLUG                 | 10. ADJUSTING PLUG               |
| 3. ORFICE AND SCREEN PLUG       | 7. REGULATOR SPOOL      | 11. PILOT RELIEF VALVE ASSEMBLY  |
| 4. REGULATOR SPRING             | 8. STEERING SPRING      | 12. ORFICE FITTING BODY ASSEMBLY |

# **Section 35**

## **Chapter 7**

### **CHARGE PUMP**

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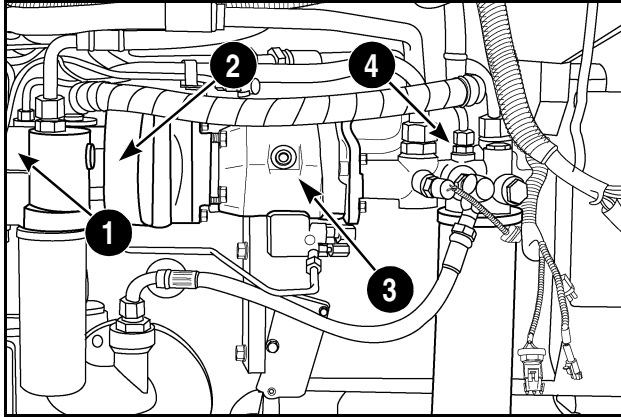
    Removal ..... 35-7-3

    Installation ..... 35-7-4

## CHARGE PUMP

### Removal

#### STEP 1

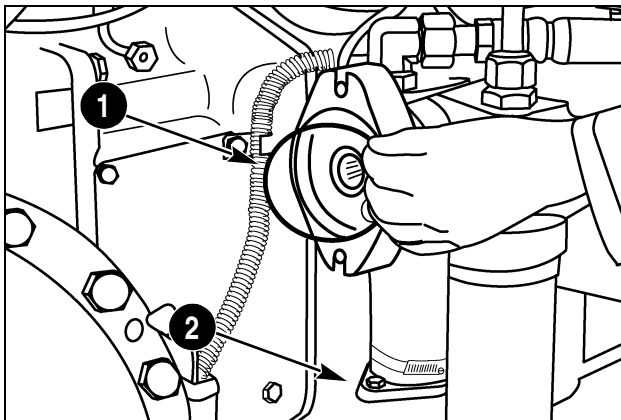


RD02D002

The charge pump (1), is mounted to the hydraulic pump drive (2), on the right-hand side of the transmission. The hydraulic pump drive (2), the hydraulic piston pump (3), and the filter head (4), do not need to be removed to remove the charge pump.

**NOTE:** Provide open access to the charge pump by blocking the front wheels and properly supporting the rear axle. Loosen the six rear wheel bushing bolts and move the wheel outward on the axle.

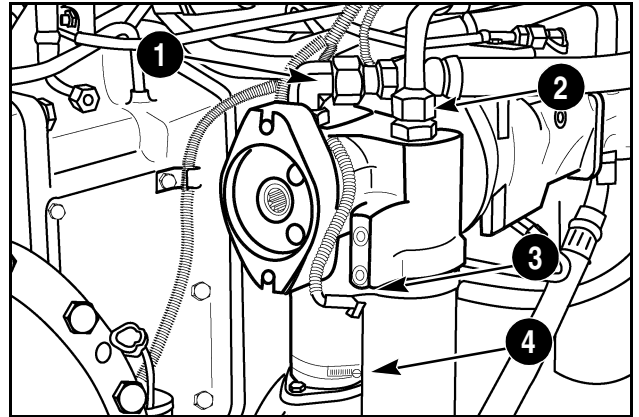
#### STEP 2



RD02D006

Remove the cover plate and two bolts from the charge pump flange. Remove the O-ring (1) from the flange. Remove the two suction hose flange bolts (2) from the suction screen housing on the transmission.

#### STEP 3



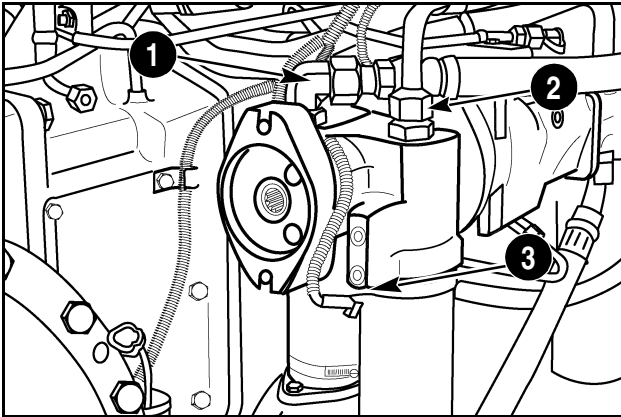
RD02D009

Remove the charge pump outlet hose (1) to the filter head. Remove the outlet line to the priority valve (2). Remove the connector from the hydraulic filter pressure sender (3). Remove the two charge pump to hydraulic pump drive mounting bolts and remove the charge pump. Remove the O-ring from the suction hose flange (4).



## Installation

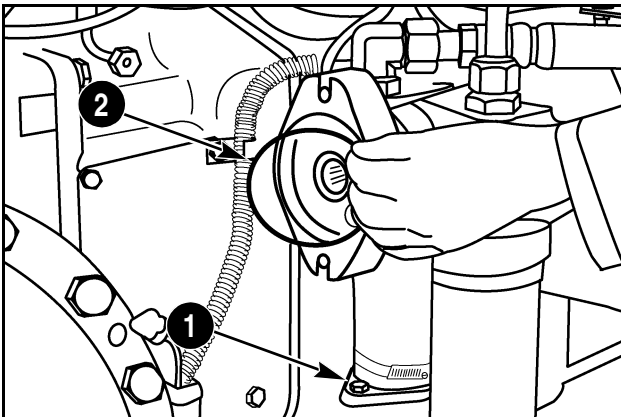
### STEP 4



RD02D009

Install the two charge pump to hydraulic pump drive mounting bolts. Install the charge pump outlet hose (1) to the filter head. Install the outlet line to the priority valve (2). Install the connector to the hydraulic filter pressure sender (3).

### STEP 5



RD02D006

Install a new O-ring on the suction hose flange. When installing the charge pump, it will be necessary to loosen the hose clamps on the rubber charge pump suction hose and pry up on the hose to provide needed clearance for the suction flange O-ring. Install the two suction hose flange bolts (1) and tighten the hose clamps. Install a new O-ring (2) on the charge pump flange. Install the cover plate and bolts.

### STEP 6

Move the rear wheel inward on the axle. Apply antiseize to the bushing bolts. Tighten the bushing bolts to a torque of 300 to 350 Nm (220 to 260 lb. ft.). Remove the axle support equipment and the front wheel blocks. Check the hydraulic fluid level in the tractor and add fluid as needed.

# **Section 35**

## **Chapter 8**

**PFC PISTON PUMP**

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PFC PISTON PUMP ..... 35-8-3

    Removal ..... 35-8-3

    Installation ..... 35-8-4

## SPECIAL TORQUES

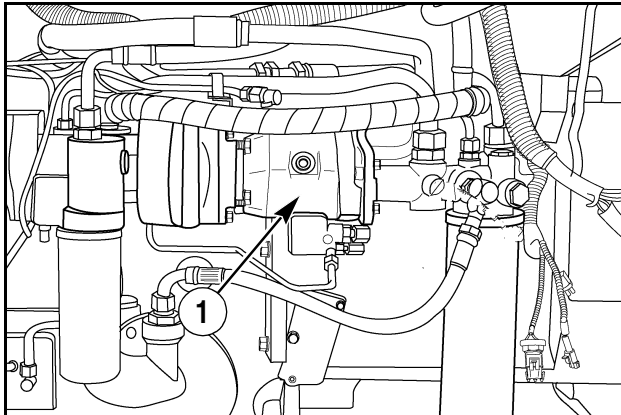
Compensator Valve Orifice .....	1.7 to 2.3 Nm (15 to 20 lb. in.)
Compensator Valve Inlet Port Plug .....	1.7 to 2.3 Nm (15 to 20 lb. in.)
Filter Head Retaining Bolts .....	62 to 80 Nm (46 to 59 lb. ft.)
Hydraulic Piston Pump Split Flange Retaining Bolts .....	40 to 60 Nm (30 to 44 lb. ft.)

## PFC PISTON PUMP

### Removal

Park the tractor on a hard, level surface. Place the transmission in PARK and remove the key. Place blocks in front of and behind the front wheels.

#### STEP 1

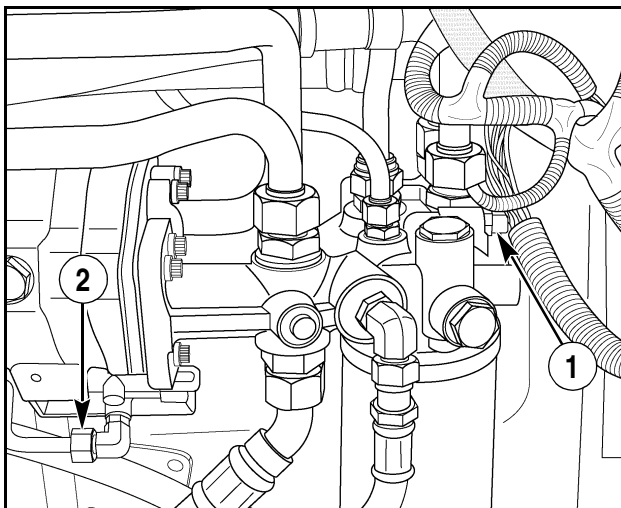


RD02D002

If needed, slide the right rear tire out to gain access to the piston pump.

**NOTE:** Right hand fuel tank removed for photographic purposes.

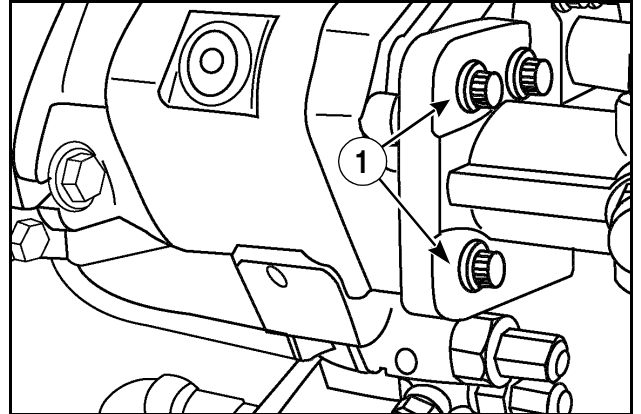
#### STEP 2



RD06A136

Disconnect the connector from the lube oil pressure sensor (1). Tag and remove ALL hydraulic lines from the filter head. Remove the PFC pump compensator signal line (2).

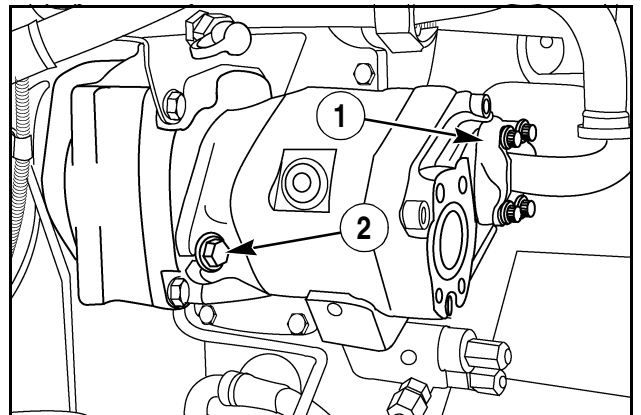
#### STEP 3



RD02D018

Remove the four bolts (1) that attach the filter head to the piston pump. Remove and discard the filter head to piston pump O-ring.

#### STEP 4

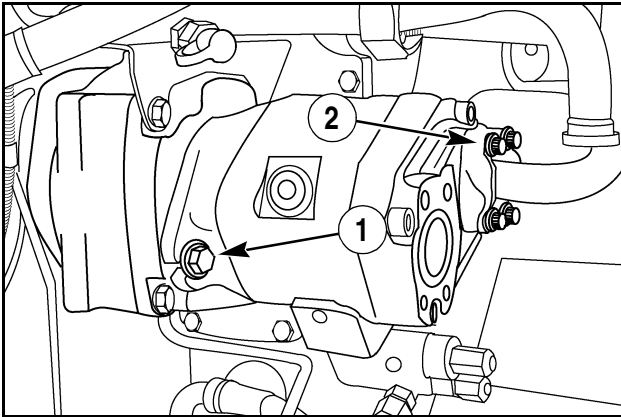


RD02D019

Remove the four mounting bolts (1) from the piston pump split flange on the priority valve supply tube. Remove the O-ring and discard. Remove the two piston pump mounting bolts (2) from the hydraulic pump drive cage. Remove the O-ring from the piston pump and discard. Remove the piston pump and compensator from the tractor.

## Installation

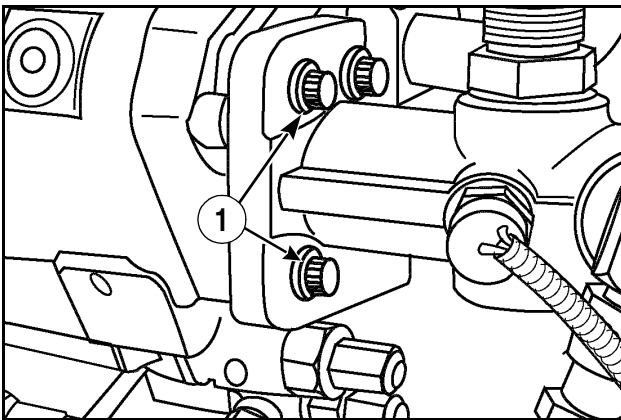
### STEP 5



RD02D019

Install a new O-ring on the piston pump and install the two piston pump mounting bolts (1) to the hydraulic pump drive cage. Install a new O-ring on the priority valve supply tube split flange and install the four mounting bolts (2) to the piston pump. Tighten the bolts to a torque of 40 to 60 Nm (30 to 44 lb. ft.).

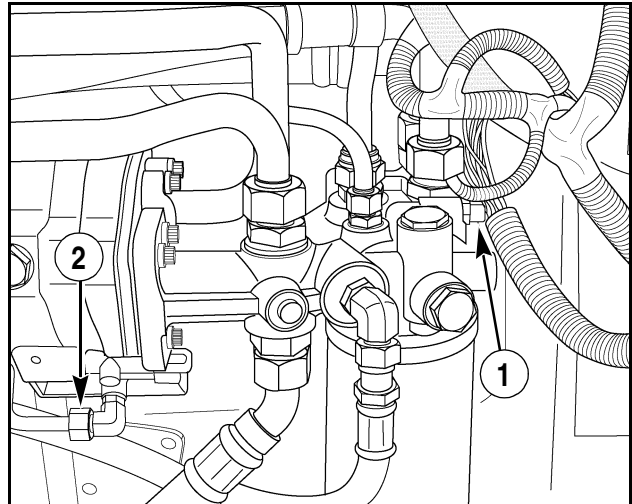
### STEP 6



RD02D018

Install a new O-ring on the filter head flange to the piston pump. Install the four flange bolts (1). Tighten the bolts to a torque of 62 to 80 Nm (46 to 59 lb. ft.).

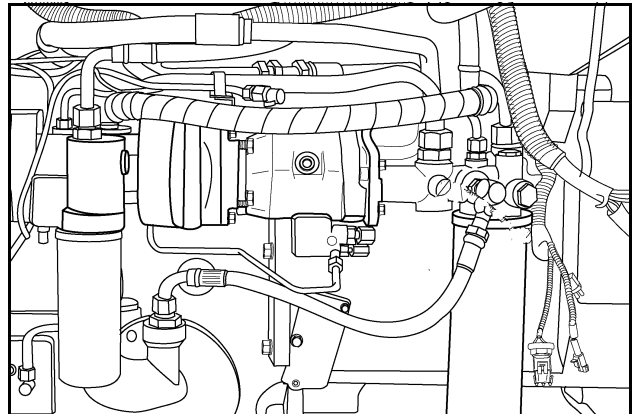
### STEP 7



RD06A136

Install new O-rings on all hydraulic lines. Install and tighten all filter head hydraulic lines. Install the pressure sensor connector and nut (1), do not over tighten the nut. Install the compensator signal line (2).

### STEP 8



RD02D002

Prior to start up, ensure the piston pump is filled with oil by removing the plug from the side of the pump housing (pump drain port) and filling the pump with 2 Liters (2.1 U.S. Quarts) of hydraulic fluid. Check the tractor hydraulic fluid level and add fluid as necessary. Start the tractor and check for leaks. Repair as necessary. Shut off the tractor and remove the key. Move the rear wheel inward on the axle. Apply antiseize to the bushing bolts prior to installation. Tighten the six bushing bolts to a torque of 300 to 350 Nm (220 to 260 lb. ft.). Remove the axle support equipment and wheel blocks.

# **Section 35**

## **Chapter 9**

### **HITCH SYSTEM**

#### **How it Works**

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SETUP / ADJUSTMENT SEQUENCE ..... 35-9-22

## THREE POINT HITCH

**GENERAL DESCRIPTION** - The Three Point Hitch consists of the rockshaft supports, rockshaft, upper link, lift links, draft arms and the external lift cylinders.

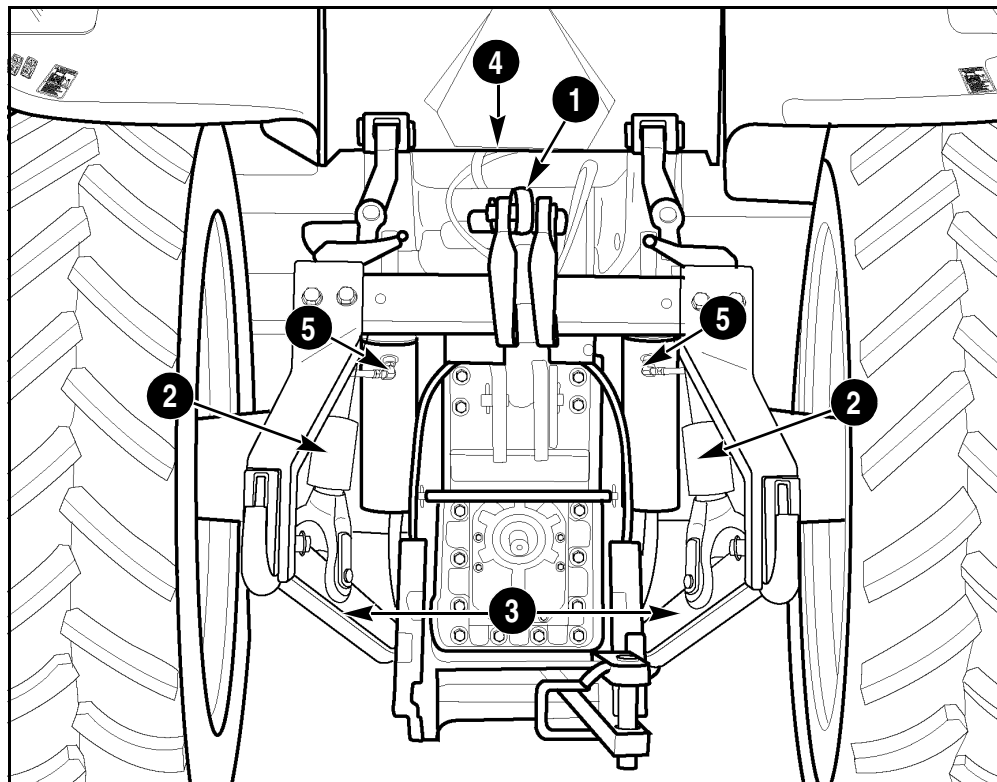
The hitch conforms to ASAE standard dimensions for a Category III/IIIN hitch. The hitch is controlled with an electronic hitch system which provides position control of soil engaging implements. The hitch will accept all mounted implements conforming to SAE, ASAE standard dimensions for Category III/IIIN.

A hitch coupler can be used with the three point hitch to quickly connect and disconnect implements. See the operator's manual for proper hitch preparation.

The single acting hydraulic cylinders are mounted externally and are supplied from the hitch control valve. The hitch control valve is mounted on the left hand side of remote valve stack (rear/top of the transmission).

The electro-hydraulic control valve is supplied from the Pressure Flow Compensating (PFC) hydraulic system and the regulated system. The regulated supply is used to operate the valve and the PFC supply provides the high pressure flow to extend the cylinders and raise the hitch. To lower the hitch regulated pressure is used to operate the valve to lower the hitch without activating the PFC system. Two electrical solenoids control the regulated oil supply to the valve, one to control the raise and one to control hitch lower.

The Electronic Hitch Controller supplies current to the raise or lower solenoids based on commands from the operator and measurement signals from the hitch and other tractor systems.



RD05J140

- |               |                            |
|---------------|----------------------------|
| 1. UPPER LINK | 4. ROCKSHAFT ASSEMBLY      |
| 2. LIFT LINKS | 5. EXTERNAL LIFT CYLINDERS |
| 3. DRAFT ARMS |                            |



## ELECTRONIC HITCH CONTROL

**GENERAL DESCRIPTION** - The Electronic Hitch Control (EHC) system consists of the operator controls, electronic hitch controller, hitch position sensor, hitch control valve and the wiring harness.

All operator commands except Remote Up/Down commands are sent to the Arm Rest Control Unit then relayed to the Hitch Controller by way of the Data Bus. The Remote Up/Down commands are sent to the EHC controller direct as well as the Rockshaft Position Sensor signals. Wheel speed and optional True Ground speed signals are sent to the Instrument Cluster Unit (ICU) then relayed to the Hitch Controller. Diagnostic and programming information are communicated between the EHC controller and the Instrument Cluster Unit (ICU) by way of the Data Bus.

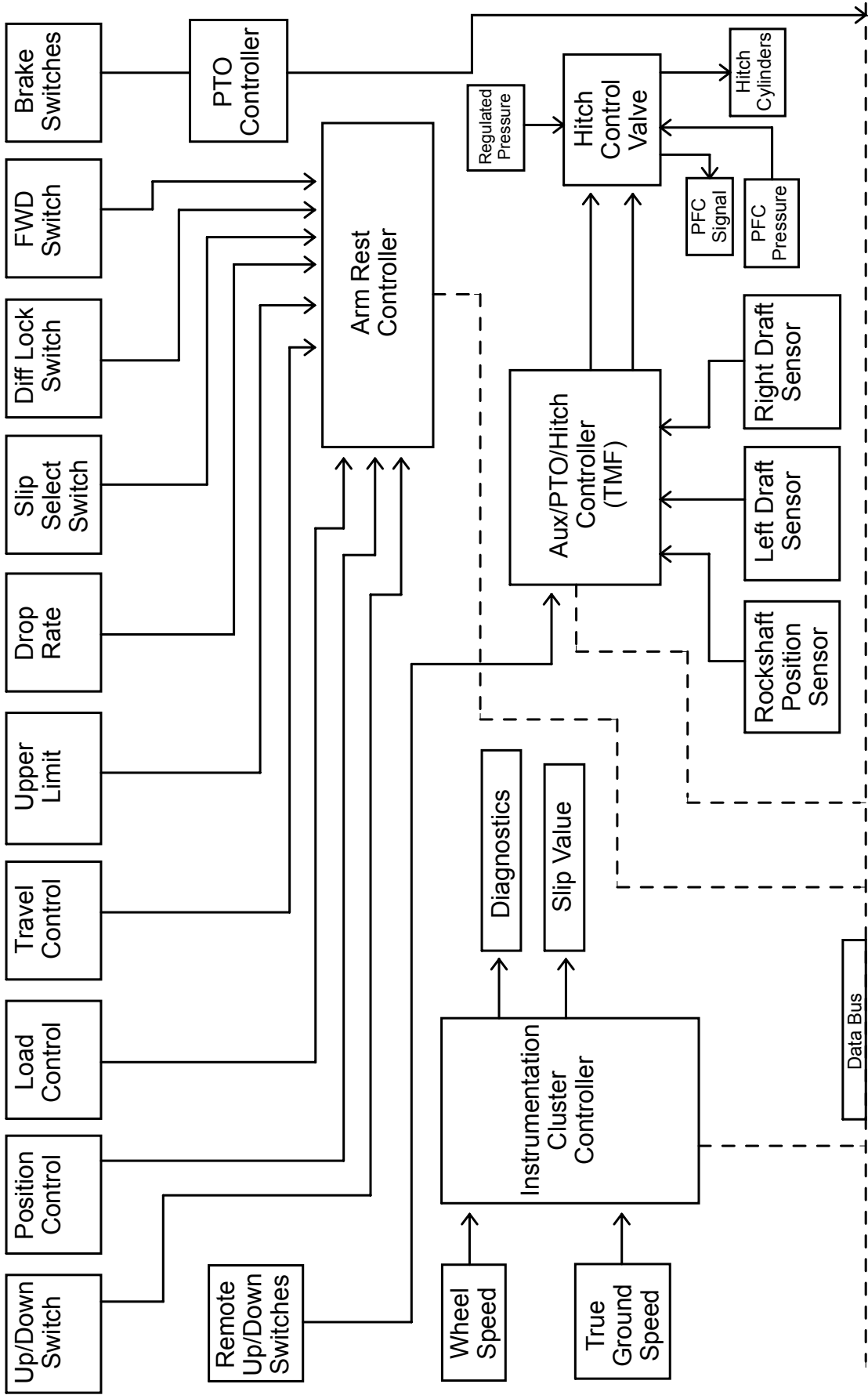
**OPERATING MODES** - The EHC system operates in three modes based on operator commands and measurement signals from the hitch and other systems.

1. Position Control
2. Load Control
3. Slip Control (Optional with True Ground Speed)

**END-OF-ROW FEATURE** - The EHC will also engage and disengage the differential lock and the Front Wheel Drive (FWD) when the hitch is raised at the end of the row to facilitate turning and re-engage when the hitch is lowered.

ELECTRONIC HITCH CONTROL

Operator Controls and Settings



## ELECTRONIC HITCH CONTROL

**POSITION CONTROL** - In the Position Control Mode, the hitch position and movement is directly related to the position of the control lever. The Electronic Hitch Control (EHC) monitors the position of the hitch by signals received from a hitch position sensor on the hitch rockshaft and raises or lowers the hitch to match the signal from the hitch position control lever sensor. The hitch will always raise at maximum speed to a height set by the operator with the upper limit control. During lowering, the hitch moves at the speed selected by the Drop Speed Control to a position set by the operator with the Position Control. The operator can override the Drop Rate setting when lowering the hitch by activating the Up/Down switch to the down momentary position 2 times within 2 seconds and holding it in the momentary position. The hitch will lower at maximum rate. In this case the hitch will lower to the lowest possible position, even if this is below the position command.

**LOAD CONTROL** - In the Load Control Mode, the EHC maintains a constant draft load on the tractor's three point hitch in changing soil conditions. When an increase in load is sensed by the lower link draft pins, the EHC will raise the hitch until the load matches the load set by the operator with the Load Control. With a decrease in load, the EHC will lower the hitch to a depth the operator has set with the Position Control.

**SLIP LIMIT CONTROL** - The Slip Limit Control Mode is available when the tractor is equipped with a True Ground Speed (Radar) attachment. The Instrument Cluster Unit receives measurement signals from the True Ground Speed Unit and the Wheel Speed Sensor to determine the actual slip percentage. The percent of slippage is relayed to the EHC by way of the Data Bus. The operator can set a desired slip limit range between 5 and 40% which the EHC compares to the actual slippage signal from the Instrument Cluster Unit and raises the hitch when the slip limit is exceeded. When the actual slip no longer exceeds the slip limit, the hitch will lower to the position command setting. The tractor must be travelling above 2 mph before the EHC will enter slip limit.

## ELECTRONIC HITCH CONTROL SYSTEM FEATURES

**HITCH POSITION CONTROL KNOB** - The Position Control knob (1) is used to raise and lower implements, and select the maximum working depth of the implement. To lift an implement with the three point hitch, the Position Control Knob is rotated clockwise.

To lower an implement, rotate the Knob counterclockwise. The Lower Limit Stop Ring (2) can be adjusted to provide a detent which will enable the Position Control Knob to return to the same set position and set the maximum implement depth.

**UP/DOWN SWITCH** - The Up/Down Switch (3) is a three position switch used to raise and lower the hitch without changing any of the hitch adjustments. The three positions of the switch are: UP; DOWN (Middle) and MOMENTARY (Full forward).

When the switch is put in the UP position, the hitch will raise at maximum speed to the position set by the Upper Limit Control.

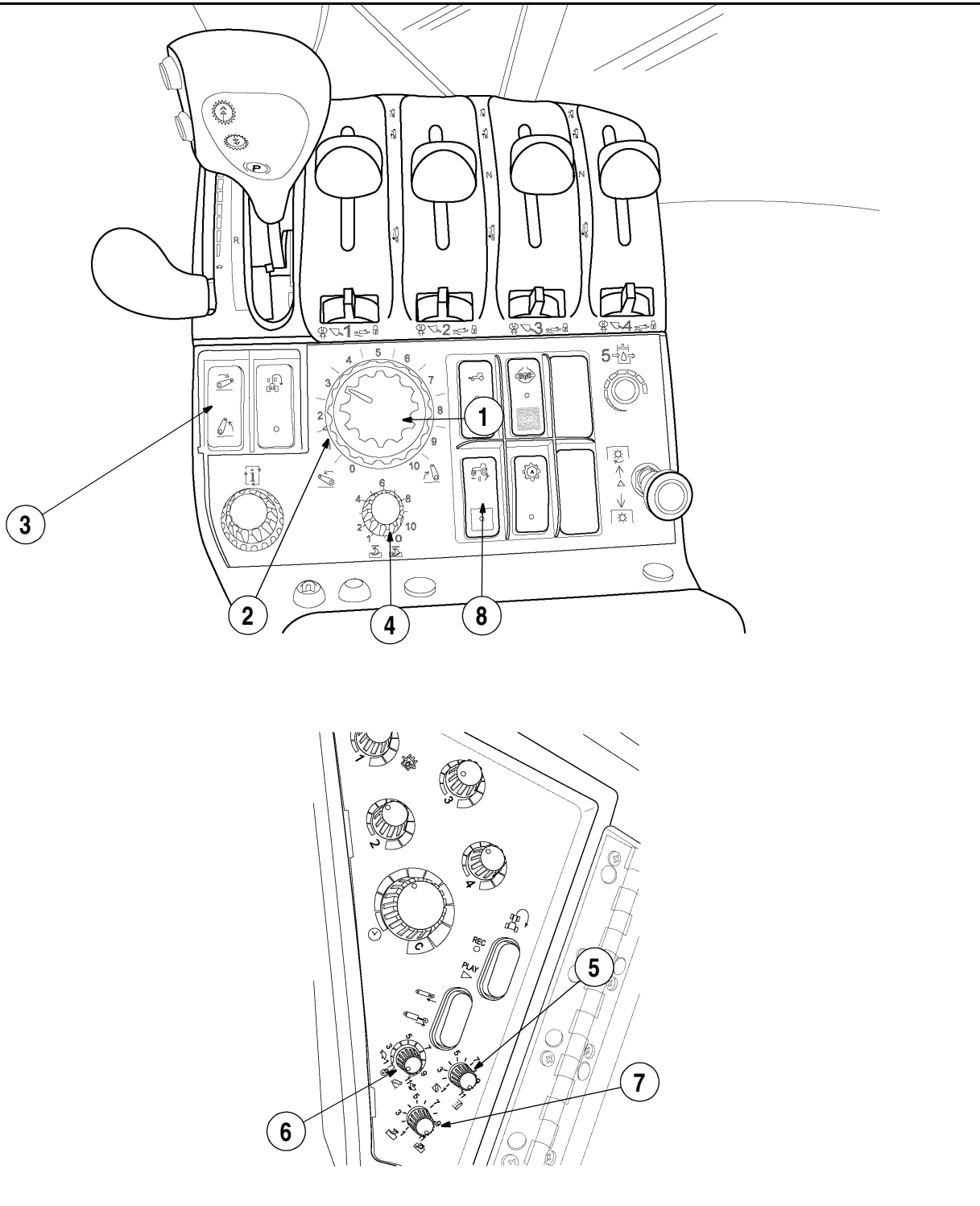
When the switch is put in the DOWN position the hitch will lower to the limit set by the Position Control Lever at the speed set by the Drop Speed Control.

When the switch is pushed into the MOMENTARY position and released, pushed again and held (within 2 seconds), the hitch will lower to the lowest possible position at maximum speed (bypassing the Drop Rate Speed setting and position control lever).

The switch can also be used to raise and lower the hitch at a timed momentary rate in case a system malfunction creates a "Limp Mode" condition (electronic system not functioning). The MOMENTARY position will allow a timed (1.5 seconds) lowering of the hitch when in the "Limp Mode". When the hitch is in the "Limp Mode" toggling the switch between the UP and DOWN positions will allow a timed raise (1.5 seconds) of the hitch.

**HITCH LOAD CONTROL** - The hitch load control knob (4) sets the depth of the implement to control the load on the tractor. Turn the knob clockwise to increase the load on the tractor by lowering the implement. Turn the knob counterclockwise to decrease the load on the tractor by raising the implement.

## ELECTRONIC HITCH CONTROL



RD05J154 / RD05J116

- |                                |                              |
|--------------------------------|------------------------------|
| 1. HITCH POSITION CONTROL KNOB | 5. UPPER LIMIT CONTROL       |
| 2. LOWER LIMIT STOP RING       | 6. DROP SPEED TRANSPORT LOCK |
| 3. UP DOWN SWITCH              | 7. TRAVEL CONTROL KNOB       |
| 4. HITCH LOAD CONTROL          | 8. SLIP LIMIT CONTROL SWITCH |

## ELECTRONIC HITCH CONTROL SYSTEM FEATURES

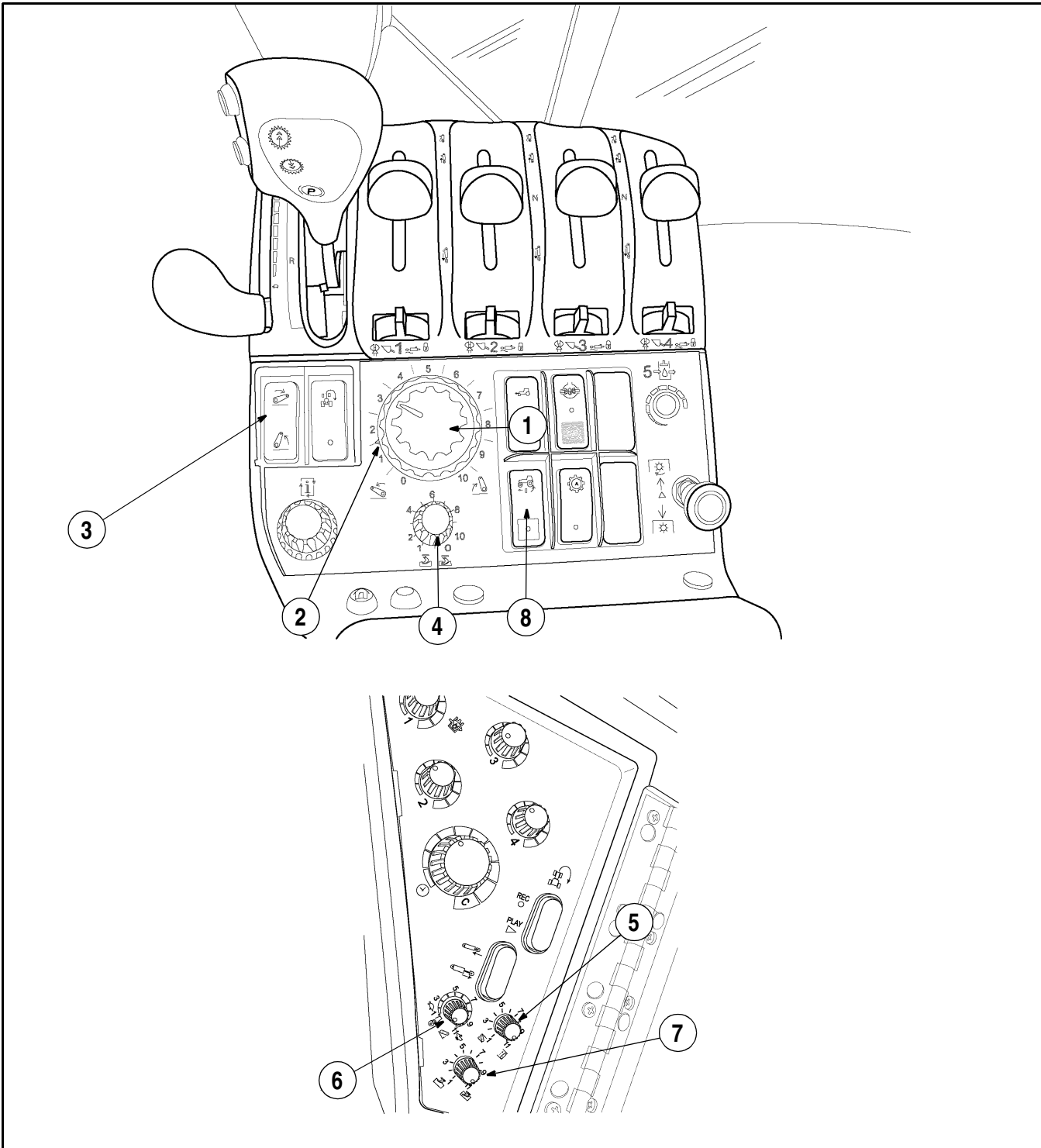
**UPPER LIMIT CONTROL** - The Upper Limit Control (5) limits the amount of upward travel when the hitch is raised. The control knob is mounted under the armrest cover on the armrest control console and has number settings from “1” to “11”. Turning the knob counterclockwise limits the upward travel of the hitch and turning clockwise allows the hitch to raise further. A setting of “11” will allow the hitch to raise to the “Full Up” position. A setting of “1” will allow the hitch to raise to approximately 50% of full travel. The UPPER LIMIT CONTROL allows the operator to tailor the upward hitch travel to specific implements or mounted PTO implements.

**DROP SPEED/TRANSPORT LOCK CONTROL** - The Drop Speed Control (6) limits the hitch lowering speed. The control is located under the arm rest control cover on the arm rest control console. Turning the knob counterclockwise causes the hitch to lower slower. The Drop Speed should be adjusted slower for specific implements such as planters, to prevent seed tube plugging. A faster speed would be used for plows and rippers. Turning the knob fully counterclockwise to the detent will prevent the hitch from lowering during roading.

**REMOTE UP/DOWN SWITCHES** - The REMOTE UP/DOWN SWITCHES are located on the tractor rear fenders. The switches are used to operate the hitch momentarily from outside the cab to make small slow movements to the hitch to aid in attaching implements to the hitch. The switches will only be active if the tractor is not moving. The hitch cannot be raised above the upper limit. After the hitch is moved with the remote switches it may be necessary the recapture the hitch with the Position Control Knob when the operator returns to normal operation.

**LOAD CONTROL** - The LOAD CONTROL KNOB (4) is located on the arm rest control console and is used to set draft load on the three point hitch. The EHC receives a load signal from the lower link draft pins and adjusts the depth of implement to match the draft load signal set by the operator with the LOAD CONTROL KNOB. The tractor must be moving 0.5 mph or faster before the Load Control Mode will activate. Turning the LOAD CONTROL KNOB clockwise will increase the load and counterclockwise will decrease the load. Load Control Mode will be shut off when the LOAD CONTROL KNOB is turned to position “11”.

## ELECTRONIC HITCH CONTROL SYSTEM FEATURES



RD05J154 / RD05J116

- |                                |                               |
|--------------------------------|-------------------------------|
| 1. HITCH POSITION CONTROL KNOB | 5. UPPER LIMIT CONTROL        |
| 2. LOWER LIMIT STOP RING       | 6. DROP SPEED /TRANSPORT LOCK |
| 3. UP DOWN SWITCH              | 7. TRAVEL CONTROL KNOB        |
| 4. HITCH LOAD CONTROL          | 8. SLIP LIMIT CONTROL SWITCH  |

## ELECTRONIC HITCH CONTROL SYSTEM FEATURES

**TRAVEL CONTROL KNOB** - The TRAVEL CONTROL KNOB (7) is located under the arm rest control console cover. Travel Control varies the range of hitch corrections in response to load variations when operating in the LOAD CONTROL MODE. Turning the TRAVEL CONTROL clockwise to a higher setting will result in larger amounts of hitch movement in response to a load change and a closer control of the load when operating on uneven terrain. Turning the TRAVEL CONTROL counterclockwise will result in less hitch movement in response to a load change and increase the variations in load which would be used in level ground conditions.

**SLIP LIMIT CONTROL SWITCH** - The SLIP LIMIT CONTROL SWITCH (8) (If equipped) is located on the arm rest control console and is used to engage or disengage slip control and set the desired slip limit. The slip control rocker switch has three positions:

1. OFF - Symbol (O) this position is used to turn SLIP CONTROL OFF and it is also used to decrease the slip limit setting.
2. ON - Symbol (I) in this position, the system will operate in the Slip Limit Control Mode. If no limit has been set the system will default to 30%.
3. SET (Momentary) This position is used to set the slip limit.

To set the SLIP LIMIT the tractor must be properly ballasted for the load being pulled and moving over 2 MPH with the hitch set for the desired implement load or position. Move the Slip Limit Control Switch to the "ON" (middle) position, then press the "SET" (momentary) and release. The performance monitor screen on the Instrument Cluster will display. The triangle indicator under the bar graph will indicate slip limit value, which will be the current slip + 5%. The system will not set below 5% or above 40%. The EHC will raise the hitch if wheel slip exceeds the limit value.

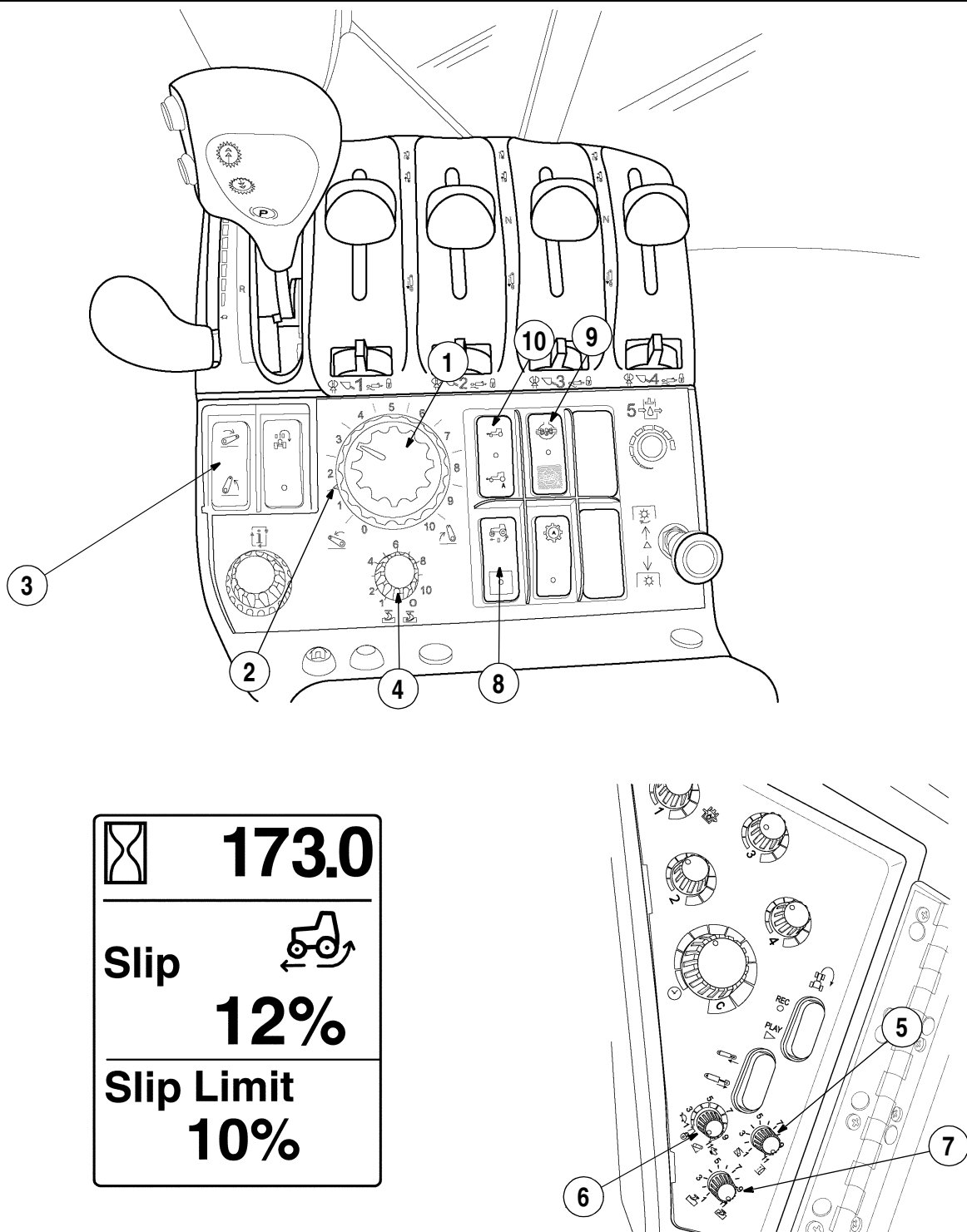
The SLIP LIMIT can be changed three ways to match field conditions:

1. Reset system - Move the switch to the OFF position for at least two seconds then reset by moving the switch to ON then to SET and release.
2. Manually Increase Set Point - Press the switch to the SET position and release. Each time the switch is pressed the Slip Limit Setting will increase 1%.
3. Manually Decrease Set Point - Move the switch to the OFF position then back to the ON position quickly (one second or less) the Slip Limit Setting will be decreased 1% each time the switch is cycled.

**NOTE:** *The slip limit control switch is not functional unless the tractor is moving faster than 2 mph.*



## ELECTRONIC HITCH CONTROL SYSTEM FEATURES



1. HITCH POSITION CONTROL KNOB
2. LOWER LIMIT STOP RING
3. UP DOWN SWITCH
4. HITCH LOAD CONTROL
5. UPPER LIMIT CONTROL

6. DROP SPEED /TRANSPORT LOCK
7. TRAVEL CONTROL KNOB
8. SLIP LIMIT CONTROL SWITCH
9. DIFFERENTIAL LOCK SWITCH
10. FWD SWITCH

RD05J154 / MT04M013 / RD05J116

## EHC SYSTEM FEATURES

**END OF ROW FUNCTION** - The END OF ROW feature involves the Differential Lock and the Front Wheel Drive (FWD) (if equipped) and the Brake Switches. The FWD and Diff Lock control systems are equipped with an automatic function that disengages both Diff Lock and FWD when the hitch is raised for a turn around and re-engages them when the hitch is lowered after the turn.

**DIFFERENTIAL LOCK SWITCH** - The Differential Lock Switch (9) has three positions;

1. SET (differential symbol) - Push full forward (Momentary) to engage Differential Lock in the manual mode.
2. Center Position - Latch position for manual mode and Reset position for Automatic mode.
3. Automatic (A) - Provides automatic operation.

**FWD SWITCH** - The FWD Switch (10) has three positions;

1. ON - (FWD symbol)
2. AUTOMATIC - (A)
3. OFF - (O) ISO Symbol

**AUTOMATIC MODE FUNCTION** - When the FWD and Diff Lock are in the automatic mode and the hitch is raised to the upper third of travel they will disengage and reengage when the hitch is lowered below the upper third of travel.

The automatic mode of operation of the FWD also provides these additional features:

The FWD will disengage when:

- A. Travel speed exceeds 10 MPH.
- B. One brake is applied.

The FWD will engage or reengage when:

- A. One brake is released.
- B. Both brakes are applied.
- C. Wheel Slip exceeds 10% (if equipped with Radar).
- D. Travel speed drops below 8 MPH after travel above 10 MPH.
- E. Differential Lock is applied.

The automatic mode of operation of the Diff Lock also provides these additional features:

The Diff Lock will disengage when:

- A. Travel speed exceeds 10 MPH.
- B. One or both brakes are applied and held on.

The Diff Lock will engage or reengage:

- A. One or Both brakes are released.
- B. Wheel Slip exceeds 10% (if equipped with Radar).

## **HITCH CONTROL VALVE**

### **General**

The hitch control valve is a closed center valve that receives oil from the PFC hydraulic system. To control the pump during hitch operations, signal pressure is sent from the valve to the PFC pump. The raise and lower functions of the valve are operated by regulated pressure received from the regulated hydraulic system. The valve is mounted in the remote valve stack and consists of the following components:

### **Raise and Lower Solenoids**

The raise and lower solenoids, (1) and (2), when energized by the Electronic Hitch Controller, will move the raise and lower pilot spools (3) and (4) inward through contact with the control pins (14).

### **Raise and Lower Pilot Spools**

The raise and lower pilot spools (3) and (4) control the amount of regulated oil pressure allowed to pass the spool lands to operate the raise spool (5) and lower control piston (7).

### **Raise Spool**

The raise spool (5) is held in position by a spring which blocks the flow of oil from the PFC pump. Regulated pressure from the raise pilot spool (3) will move the spool against spring force, which will open the PFC pump port and expose PFC pump pressure to the load check ball (10) and the signal port.

### **Lower Poppet**

The lower poppet (9), lower pilot poppet (8) and spring (15) trap oil in the hitch cylinder circuit. The lower pilot poppet (8) is held on its seat by a spring (15) and cylinder circuit pressure, which is allowed to get to the back side of the spool through an orifice (16) in the poppet.

### **Load Check Ball**

The load check ball (10) traps oil in the hitch cylinder circuit to hold the hitch in a raised position. The ball is unseated when PFC pump pressure exposed to the ball by the raise spool over comes the pressure in the hitch cylinder circuit.

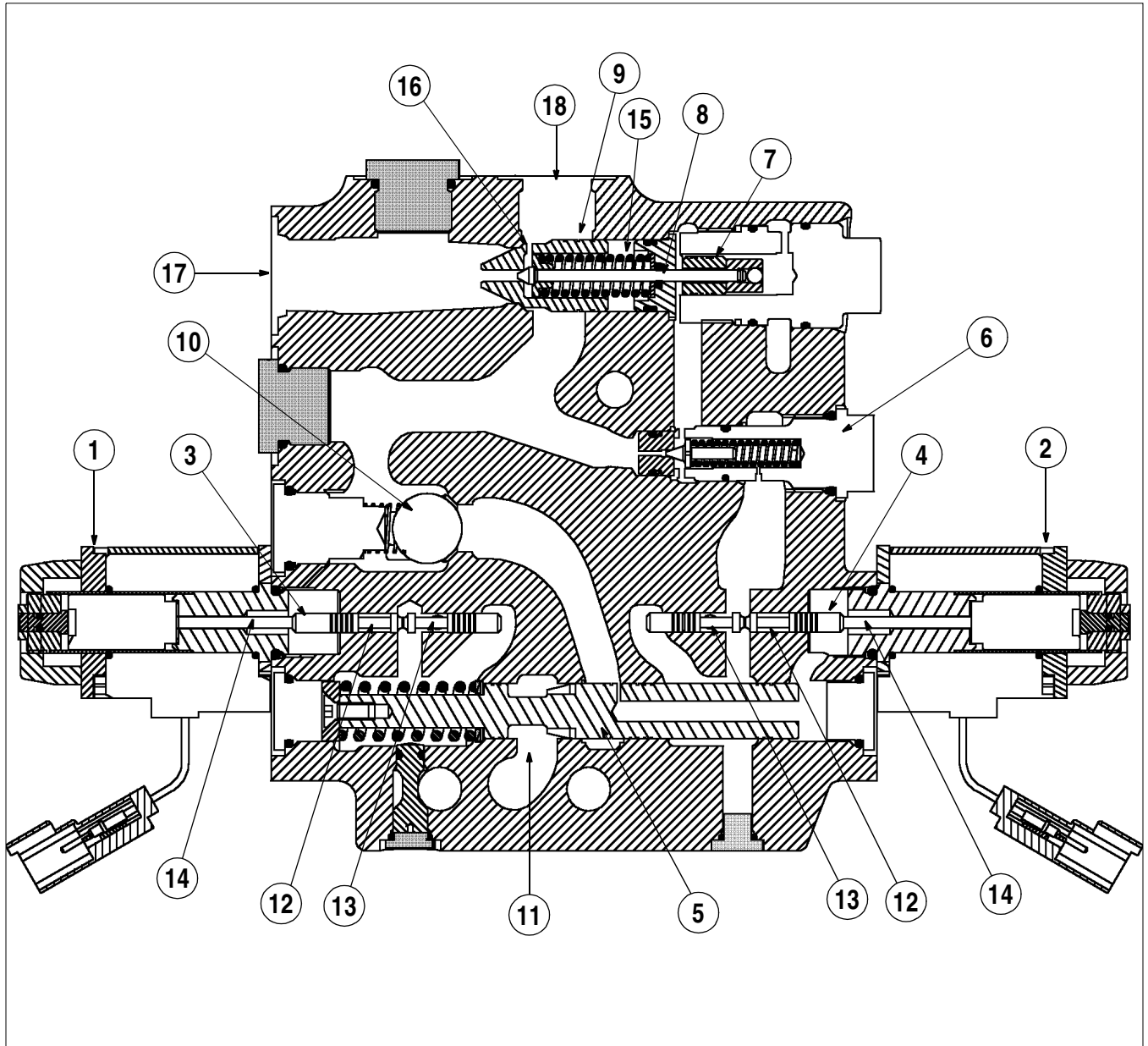
### **Manual Raise or Lower Control Pins**

The raise and lower solenoid each contain a pin (14) in the center of the outer end that can be used to manually activate the raise spool and lower control piston.

### **Overload Relief Valve**

The overload relief valve (6) will allow oil from the raise/lower port to flow into the pilot chamber of the lower control piston (7). The piston moves to the right and pulls the lower pilot poppet (8) off its seat when the hitch sees an overload.

## HITCH CONTROL VALVE



RI02B003

- |                         |                               |
|-------------------------|-------------------------------|
| 1. RAISE SOLENOID       | 10. LOAD CHECK BALL           |
| 2. LOWER SOLENOID       | 11. PFC PUMP SUPPLY           |
| 3. RAISE PILOT SPOOL    | 12. REGULATED PRESSURE SUPPLY |
| 4. LOWER PILOT SPOOL    | 13. RETURN PORT               |
| 5. RAISE SPOOL          | 14. CONTROL PIN               |
| 6. OVERLOAD RELIEF      | 15. SPRING                    |
| 7. LOWER CONTROL PISTON | 16. ORIFICE                   |
| 8. LOWER PILOT POPPET   | 17. TANK PORT                 |
| 9. LOWER POPPET         | 18. RAISE/LOWER PORT          |

## HITCH CONTROL VALVE

### Neutral Function and Troubleshooting

#### FUNCTION

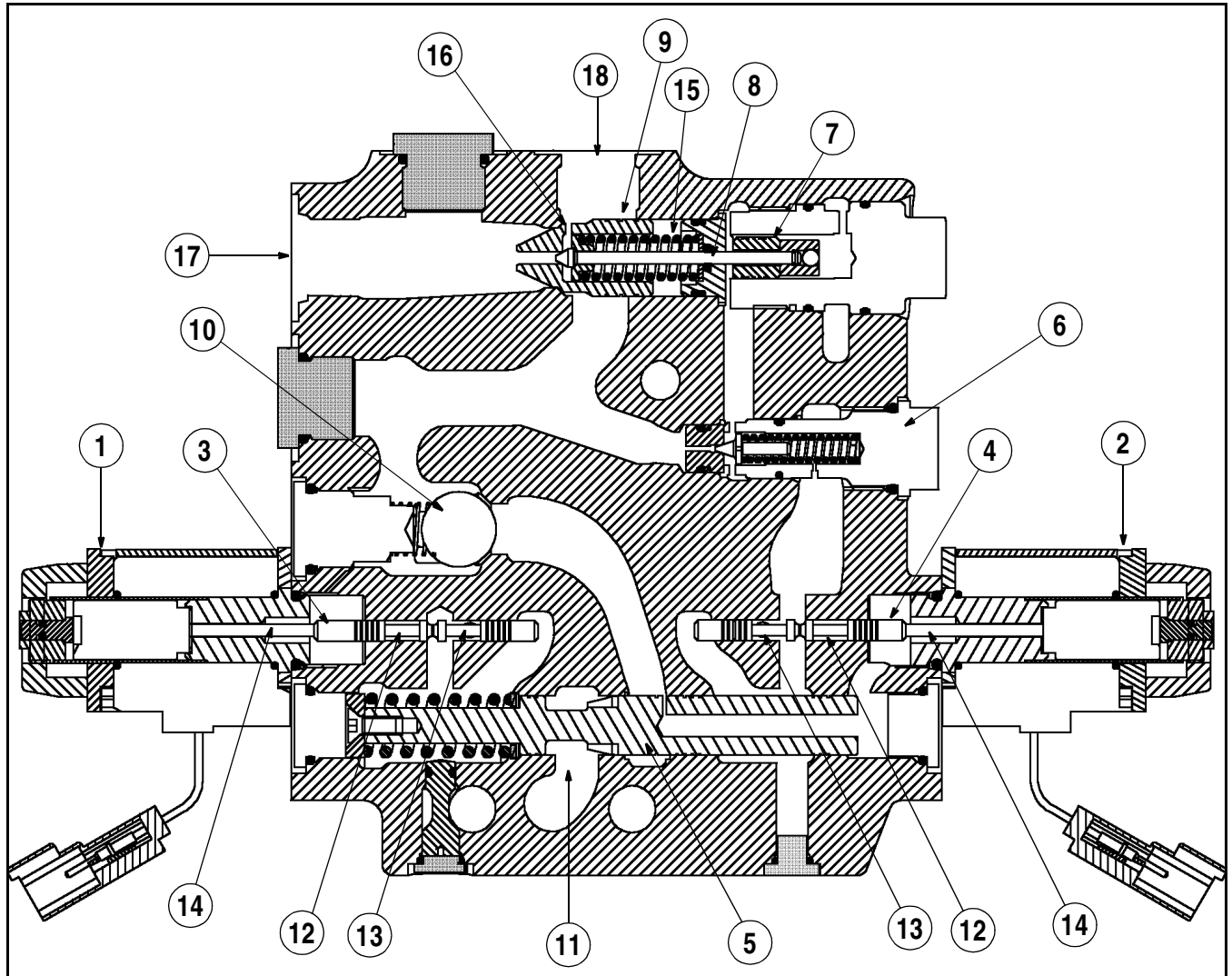
**Hitch Control Valve in Neutral** - The hitch control valve is a closed-center valve. In neutral there will be no electric current supplied to the raise or lower solenoids (1) and (2) and no oil flow through the valve. The pilot spools (3) and (4) are blocking the supply of oil from the regulated circuit. The raise spool (5) is blocking the supply of oil from the PFC system and is held in place by a spring. The lower poppet (9), lower pilot poppet (8) and the load check ball (10) are blocking the return of oil from the hitch cylinder circuit. The overload relief (6) also blocks the return of oil from the hitch cylinder circuit. The lower poppet (9) is held on the seat by a spring (15) and the oil trapped behind the poppet by the lower pilot poppet (8). Pressure from the hitch cylinder circuit gets behind the lower poppet through an orifice (16) in the side of the poppet.

#### TROUBLESHOOTING

**Problem - Hitch will not hold position or leaks down.**

1. Check the function of other systems (Transmission, Remote Valves, etc.).
  - A. If the other systems do not function properly, refer to troubleshooting of the non-functioning system.
  - B. If other systems function properly, go to Step 2.
2. Check for HITCH fault codes.
  - A. If fault codes are found, follow procedures outlined in HITCH fault code troubleshooting in this section.
  - B. If no fault codes are found, go to Step 3.
3. With a load on the hitch, raise the hitch to maximum height and disconnect the hitch cylinder drain line from the rear frame housing.
  - A. If oil flows from the drain line as the hitch settles the cylinder(s) is/are leaking internally. Repair cylinders as needed.
  - B. If no oil flows from the drain line go to Step 4.
4. Check and repair the hitch valve as needed.
  - A. Check load check ball (10) and seat if seat is damaged replace the hitch valve.
  - B. Check the lower poppet (9) and seat, lower pilot poppet (8) and seat. If any components are damaged repair or replace as necessary.
  - C. Check overload relief assembly (6) and seat. If any components are damaged repair or replace as necessary.

## HITCH CONTROL VALVE - NEUTRAL



RI02B003

- |                         |                               |
|-------------------------|-------------------------------|
| 1. RAISE SOLENOID       | 10. LOAD CHECK BALL           |
| 2. LOWER SOLENOID       | 11. PFC PUMP SUPPLY           |
| 3. RAISE PILOT SPOOL    | 12. REGULATED PRESSURE SUPPLY |
| 4. LOWER PILOT SPOOL    | 13. RETURN PORT               |
| 5. RAISE SPOOL          | 14. CONTROL PIN               |
| 6. OVERLOAD RELIEF      | 15. SPRING                    |
| 7. LOWER CONTROL PISTON | 16. ORIFICE                   |
| 8. LOWER PILOT POPPET   | 17. TANK PORT                 |
| 9. LOWER POPPET         | 18. RAISE/LOWER PORT          |

## HITCH CONTROL VALVE

### Raise Function and Troubleshooting

#### FUNCTION

**Hitch Control Valve in Raise** - To raise the hitch, the hitch raise solenoid (1) must be energized by the Electronic Hitch Controller. When the solenoid is energized, the armature in the solenoid moves toward the valve contacting a control pin (14) which moves the raise pilot spool (3) inward. The amount of movement of the spool depends on the amount of current applied to the solenoid by the controller. The amount of current the controller applies to the solenoid depends on the command information the operator has sent to the controller. As the raise pilot spool (3) is shifted inward, it meters regulated pressure from the regulated circuit (12) to the left hand side of raise spool (5).

The metered regulated pressure shifts the raise spool against the spring, allowing oil from the PFC pump circuit (11) to flow past the spool land to the hitch load check ball (10) which is seated by pressure from the hitch cylinders created by the load on the cylinders. At the same time PFC standby pressure is sent through the signal port and signal check valve to the PFC pump compensator, which will activate the pump to increase flow output. As pressure increases, the load check ball is lifted off the seat, allowing flow to the hitch cylinders.

The hitch will stop raising when the controller shuts off current to the raise solenoid (1). Regulated pressure acting on the right hand end of the raise pilot spool will shift the pilot spool outward shutting off regulated pressure supply (12) and opening the return port (13) to release the pressure on the raise spool. The spring will shift the raise spool (5) shutting off the PFC inlet port. The pressure in the hitch cylinders will seat the hitch load check ball (10) trapping the oil. The signal pressure will bleed off through the orifice in the raise spool (5) and allow the pump to return to low pressure standby.

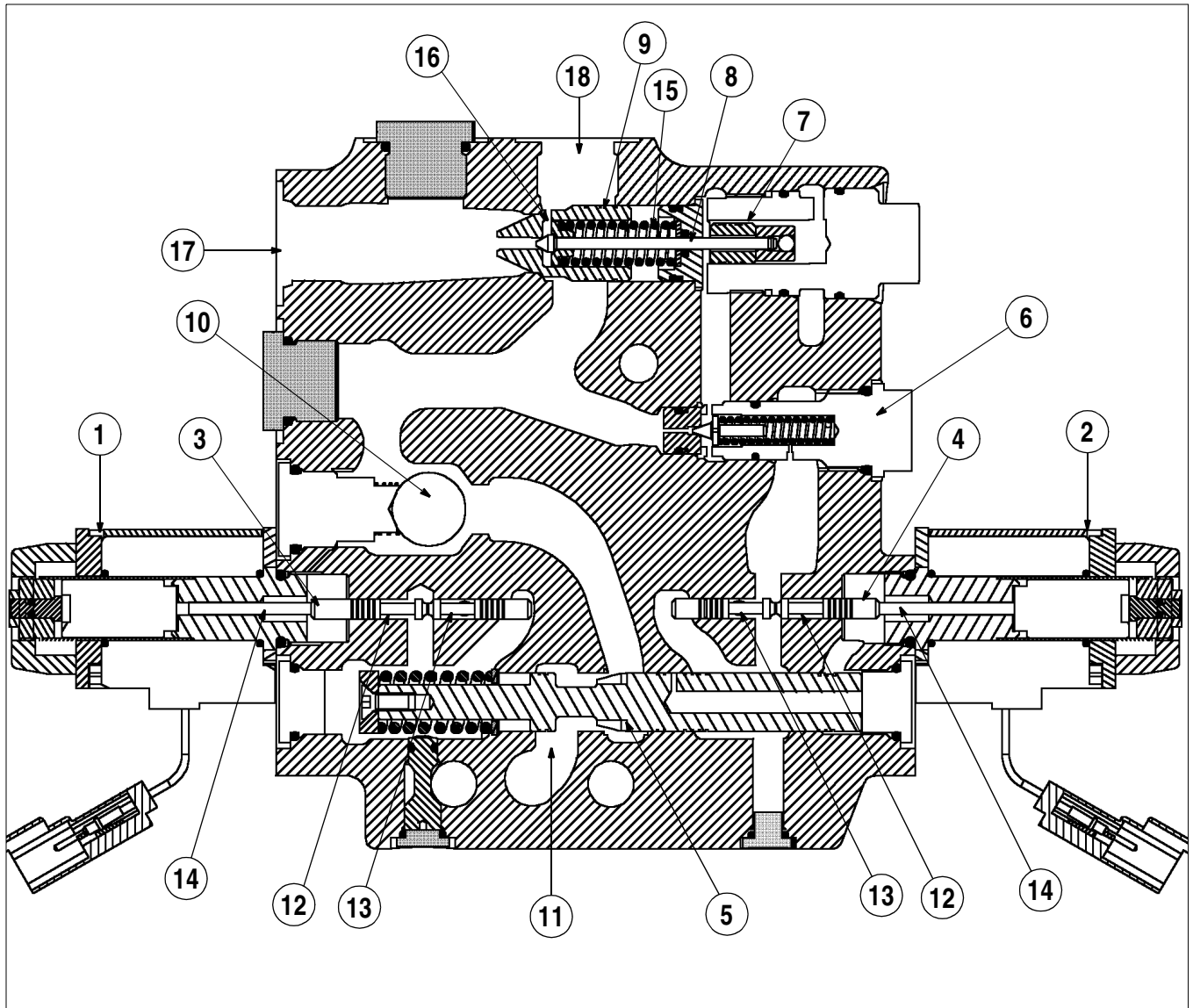
#### TROUBLESHOOTING

##### Problem - Hitch will not raise

1. Check the function of other systems (Transmission, Remote Valves).
  - A. If other systems do not function properly, refer to the troubleshooting section on the non-functioning system.
  - B. If other systems function properly, go to Step 2.
2. Check for HITCH fault codes
  - A. If fault codes are present, refer to fault code troubleshooting in this section.
  - B. If no fault codes are present, go to Step 3.
3. Check for manual operation of the control valve by pushing in on the manual control pin (14) in the center of the outer end of the raise solenoid with a small punch or 1/8 inch rod.
  - A. If the hitch raises, test hitch raise solenoid for proper electrical function and recheck HITCH fault codes.
  - B. If the hitch does not raise, refer to the Hydraulic Troubleshooting the PFC System and the regulated pressure system. If the hydraulic system functions properly, go to Step C.
  - C. Check for free movement of the raise pilot spool (3) and raise spool (5). Repair or replace as necessary.

## HITCH CONTROL VALVE

### Raise Function and Troubleshooting



RI02B006

- |                         |                               |
|-------------------------|-------------------------------|
| 1. RAISE SOLENOID       | 10. LOAD CHECK BALL           |
| 2. LOWER SOLENOID       | 11. PFC PUMP SUPPLY           |
| 3. RAISE PILOT SPOOL    | 12. REGULATED PRESSURE SUPPLY |
| 4. LOWER PILOT SPOOL    | 13. RETURN PORT               |
| 5. RAISE SPOOL          | 14. CONTROL PIN               |
| 6. OVERLOAD RELIEF      | 15. SPRING                    |
| 7. LOWER CONTROL PISTON | 16. ORIFICE                   |
| 8. LOWER PILOT POPPET   | 17. TANK PORT                 |
| 9. LOWER POPPET         | 18. RAISE/LOWER PORT          |



## HITCH CONTROL VALVE

### Lower Function and Troubleshooting

#### FUNCTION

Hitch Valve in Lower - To lower the hitch, the lower solenoid (2) must be energized by the Electronic Hitch Controller based on the commands entered by the operator. Activation of the PFC system is not required to lower the hitch. When the lower solenoid (2) is energized, the armature will move toward the valve, contacting the control pin (14), which pushes the lower pilot spool (4) inward. The amount of movement depends on the amount of current that is sent to the solenoid by the Electronic Hitch Controller based on the commands to the controller by the operator. As the lower pilot spool (4) shifts, it meters regulated pressure from the regulated pressure supply (12), through the overload relief, to the lower control piston (7). The piston moves to the right and pulls the lower pilot poppet (8) off its seat against spring (15) tension. Pressure escapes to tank creating a drop in pressure behind the lower poppet (9). The pressure in the raise/lower port now moves the lower poppet off the seat. The hitch can now lower as oil flows through to the tank port.

The hitch will stop lowering when the solenoid (2) is de-energized. Oil pressure acting on the left end of the lower pilot spool (4) moves the spool outward closing the regulated pressure supply (12) to the lower control piston (7). As the pressure drops on the piston the pilot poppet (8) returns to its seat by spring force. With the pilot poppet port closed pressure from the hitch cylinders builds behind the lower poppet (9) through the orifice (16) forcing the poppet onto its seat trapping oil in the hitch cylinders.

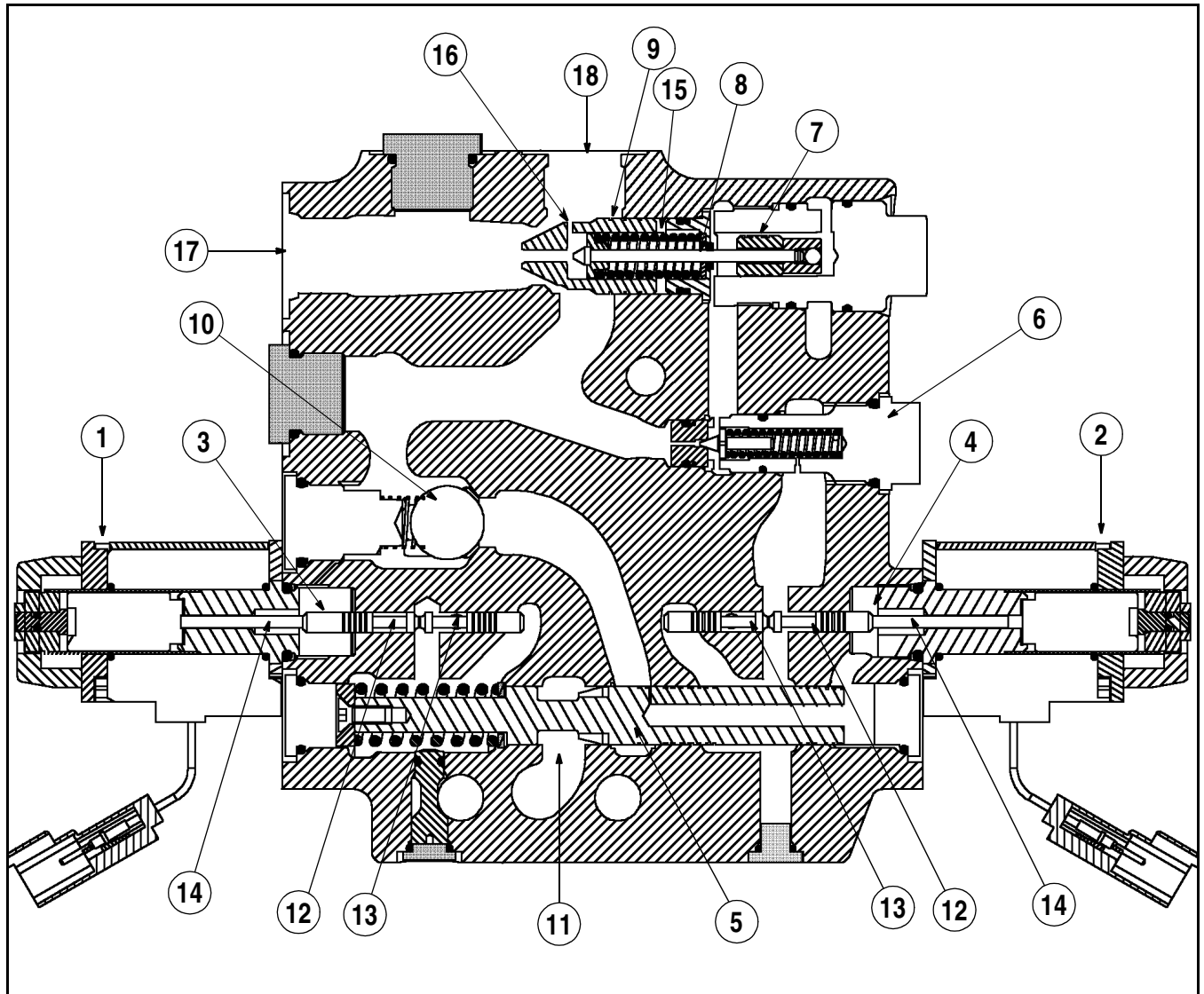
#### TROUBLESHOOTING

##### Problem - Hitch will not lower

1. Check the function of other systems (Transmission, Remote valves).
  - A. If other regulated pressure systems do not operate properly, refer to troubleshooting of non-operating system.
  - B. If other systems operate properly, go to Step 2.
2. Check for HITCH fault codes.
  - A. If fault codes are found, refer to troubleshooting of any fault found.
  - B. If no fault codes are found, refer to Step 3.
3. Check for manual operation lower function by pushing in on the lower manual operating pin (14) in the center of the outer end of the lower solenoid with a small punch or 1/8 inch rod.
  - A. If the hitch lowers, test hitch lower solenoid (2) for proper electrical function and recheck HITCH error codes.
  - B. If hitch does not lower, refer to Hydraulic Troubleshooting of the Regulated Pressure System. If the hydraulic system functions properly, go to Step C.
  - C. Check the hitch control valve for free movement of the lower pilot spool (4), the lower poppet (9) and the lower control piston (7). Check condition of all O-ring seals and replace as necessary.

## HITCH CONTROL VALVE

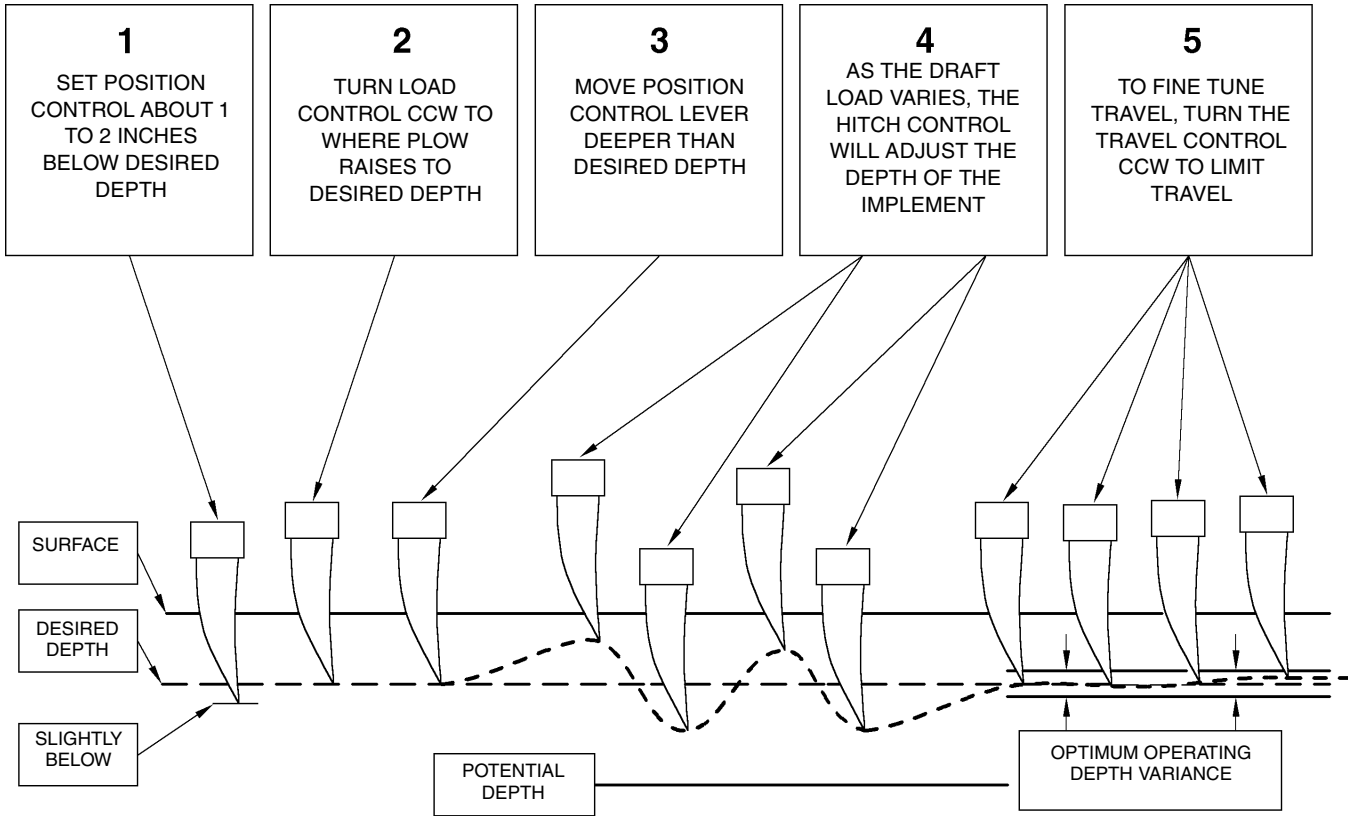
### Lower Function and Troubleshooting



R102B007

- |                         |                               |
|-------------------------|-------------------------------|
| 1. RAISE SOLENOID       | 10. LOAD CHECK BALL           |
| 2. LOWER SOLENOID       | 11. PFC PUMP SUPPLY           |
| 3. RAISE PILOT SPOOL    | 12. REGULATED PRESSURE SUPPLY |
| 4. LOWER PILOT SPOOL    | 13. RETURN PORT               |
| 5. RAISE SPOOL          | 14. CONTROL PIN               |
| 6. OVERLOAD RELIEF      | 15. SPRING                    |
| 7. LOWER CONTROL PISTON | 16. ORIFICE                   |
| 8. LOWER PILOT POPPET   | 17. TANK PORT                 |
| 9. LOWER POPPET         | 18. RAISE/LOWER PORT          |

## SETUP / ADJUSTMENT SEQUENCE



# **Section 35**

## **Chapter 10**

### **HITCH CONTROL VALVE**

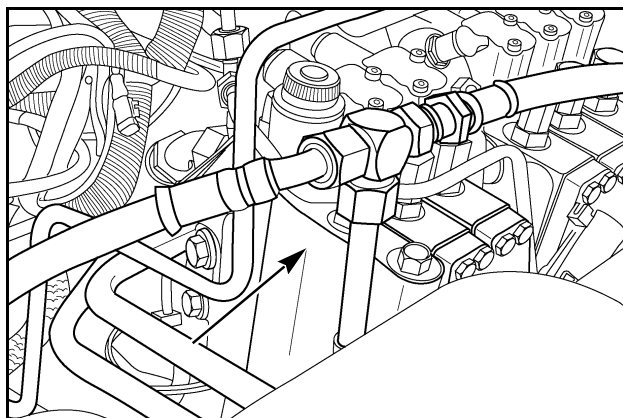
## TABLE OF CONTENTS

HITCH CONTROL VALVE .....	35-10-3
Removal .....	35-10-3
Disassembly .....	35-10-5
Assembly .....	35-10-7
Installation .....	35-10-9
HITCH CONTROL VALVE CROSS SECTION .....	35-10-11

## HITCH CONTROL VALVE

### Removal

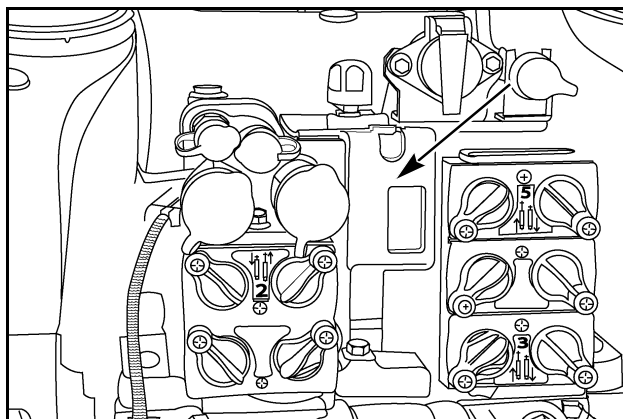
#### STEP 1



RD02D041

The hitch control valve is located on the left hand side of the remote valve stack (viewed from rear). Gaining access to the return line fittings at the bottom of the valve will depend on what hydraulic accessories your tractor is equipped with, i.e. how many remote sections, power beyond, motor return etc.

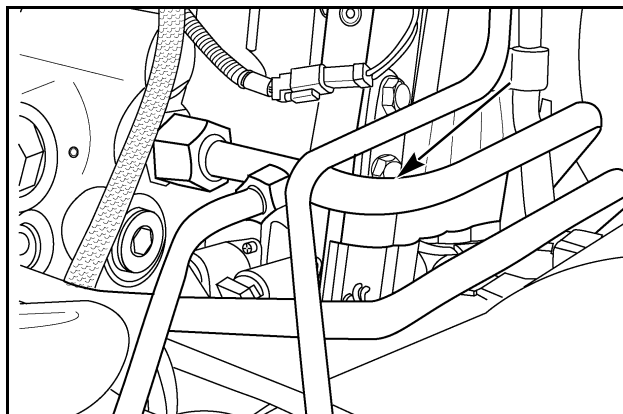
#### STEP 2



RD02D042

Remove the seven pin connector mounting bracket if equipped with four or more remote.

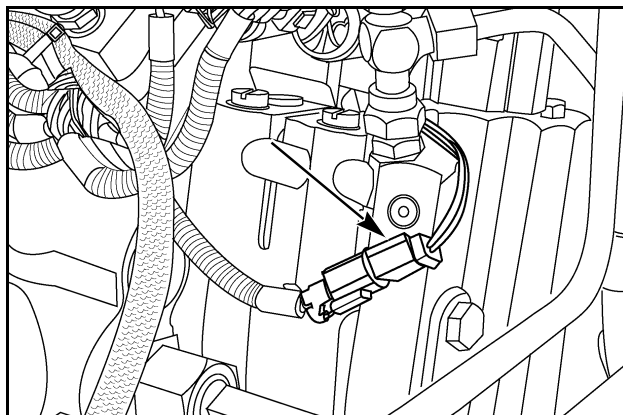
#### STEP 3



RD02D043

If equipped, remove the power beyond supply line to help obtain access to the hitch valve to case return line.

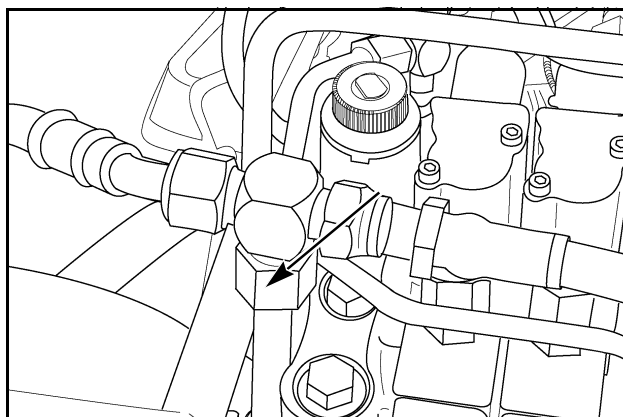
#### STEP 4



RD02D044

Disconnect the hitch valve solenoids from the wire harness.

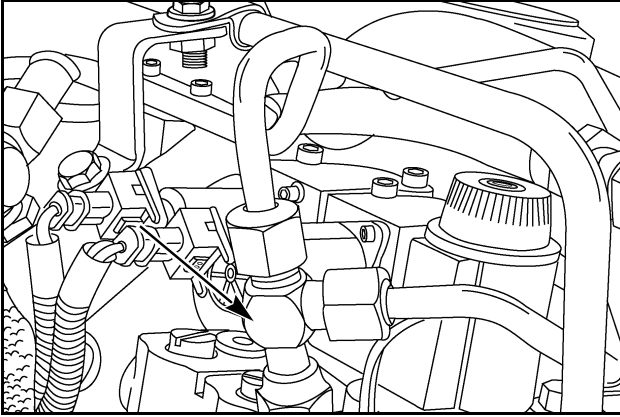
#### STEP 5



RD02D047

Disconnect the valve supply line at the tee.

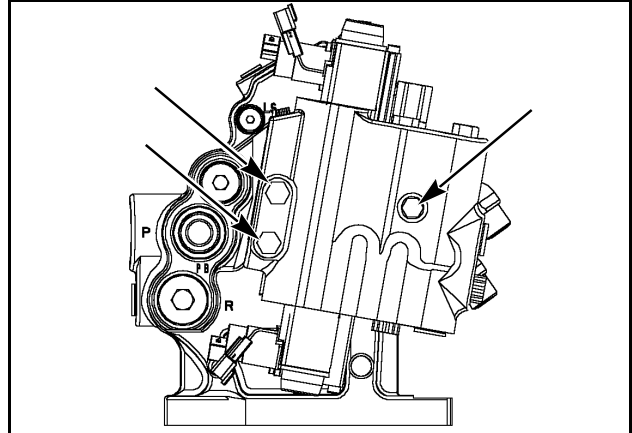
**STEP 6**



RD02D045

Disconnect the hitch valve load sensing signal lines.

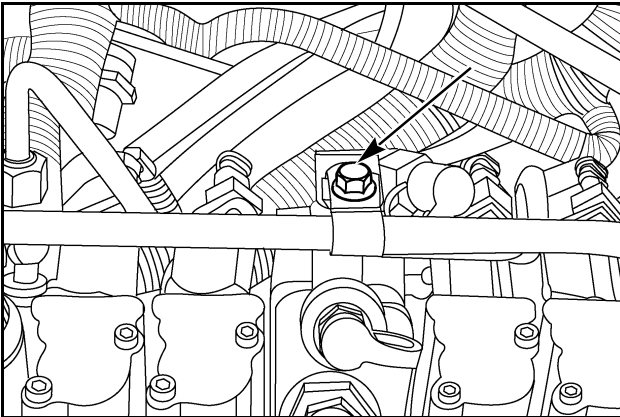
**STEP 9**



RI02D045

Remove the three hitch valve mounting bolts and remove the hitch valve.

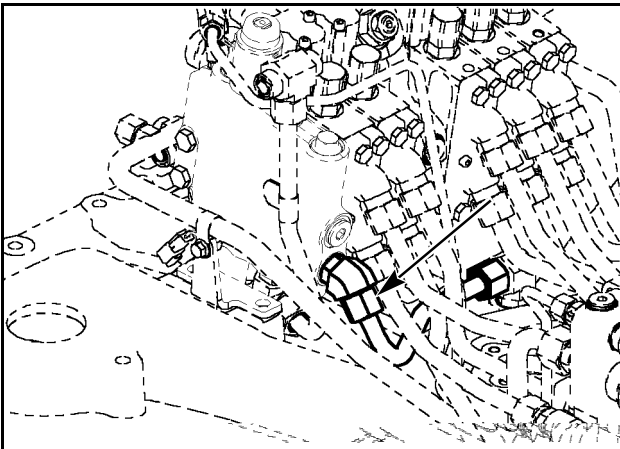
**STEP 7**



RD02D046

If equipped, remove the hydraulic trailer brake line mounting clamp.

**STEP 8**

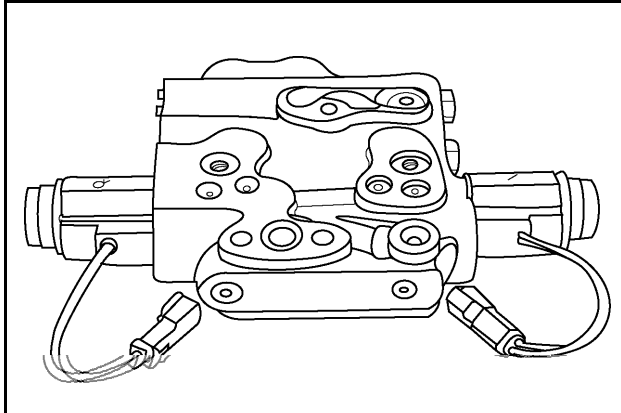


RI02D067

Remove the case drain line.

## Disassembly

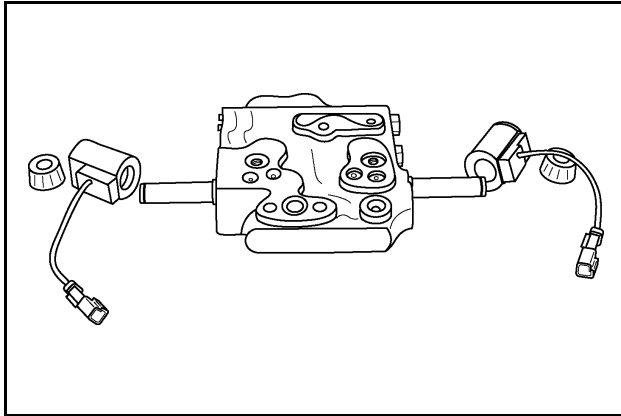
### STEP 10



RD02C198

Place the hitch valve on a clean work surface.

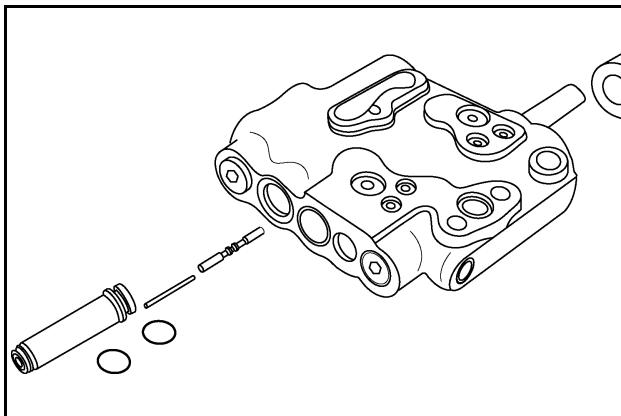
### STEP 11



RD02C199

Remove the solenoid coils from the valve.

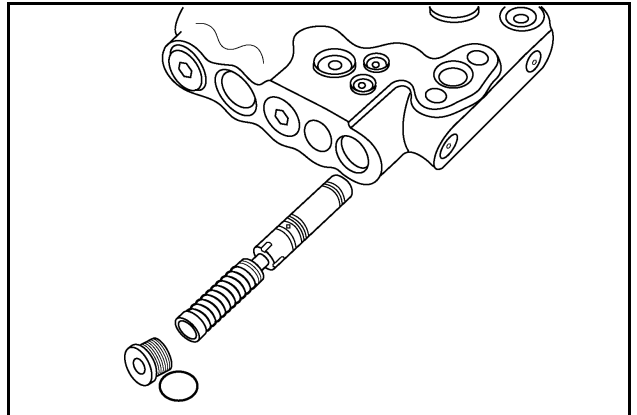
### STEP 12



RD02C200

Remove the raise solenoid core, control pin and pilot spool. Discard both O-rings. Inspect for heavy wear or damage. Replace the valve assembly if necessary. Repeat for the lower solenoid core.

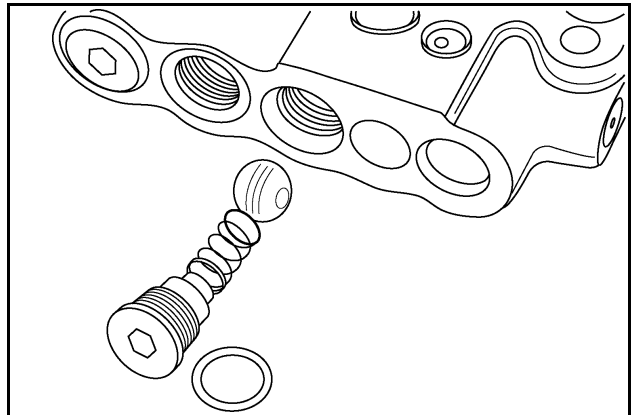
### STEP 13



RD02D037

Remove the raise spool. Discard the O-ring. Inspect for heavy wear or damage. Replace the valve assembly if necessary.

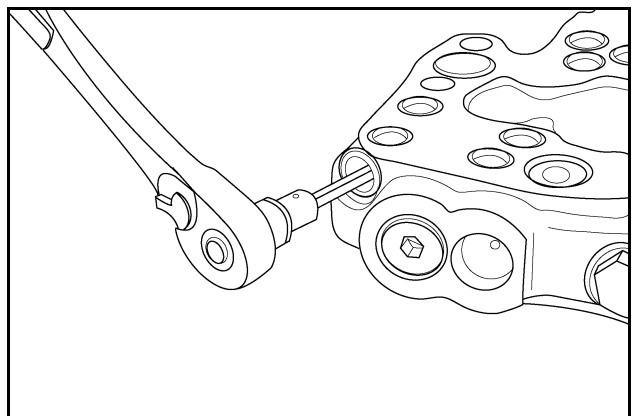
### STEP 14



RD02D038

Remove the load check spring and ball. Discard the O-ring.

### STEP 15

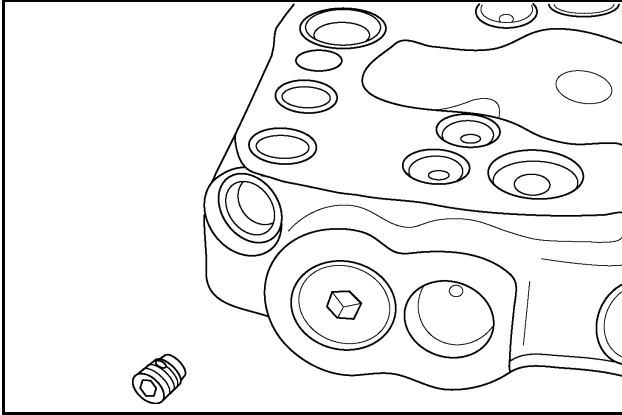


RD02F147

If not removed, remove the tee fitting from the load sense check port. Use a 3/16 Allen wrench and remove the load sense check.



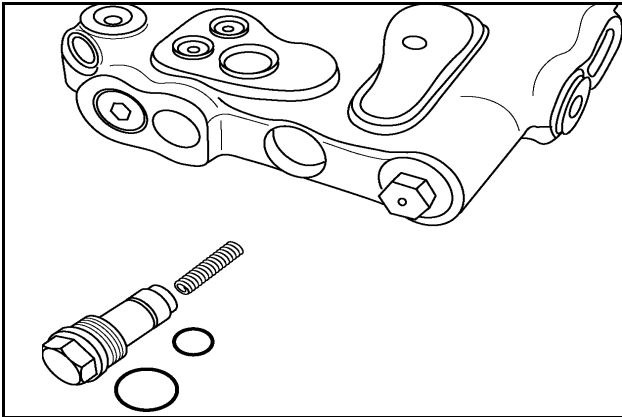
## STEP 16



RD02F148

Inspect the check for debris and that the check ball moves freely.

## STEP 17

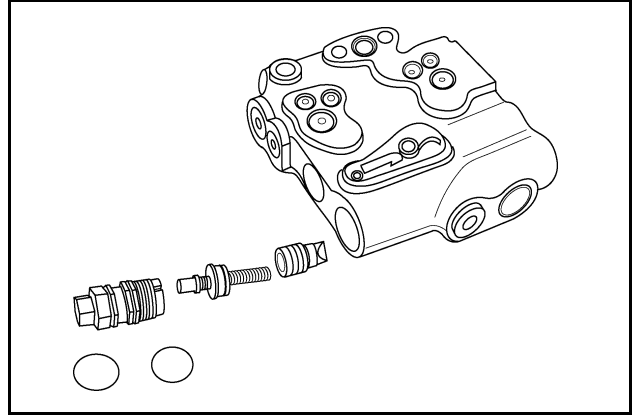


RD02D039

Remove the overload relief body, spring and poppet. Discard the O-rings. Inspect for heavy wear or damage. Replace the valve assembly if necessary.

**NOTE:** *There are shims on the poppet that must be kept for assembly.*

## STEP 18

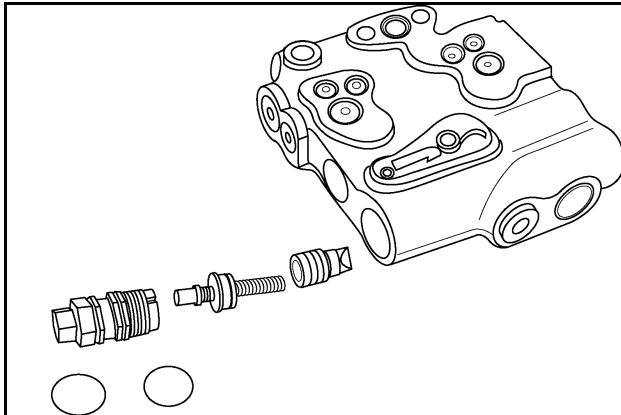


RD02D040

Remove the poppet body, lower pilot and spring assembly and lower poppet. Discard the three O-rings and backup ring. Inspect for heavy wear or damage. Replace the valve assembly if necessary.

## Assembly

### STEP 19

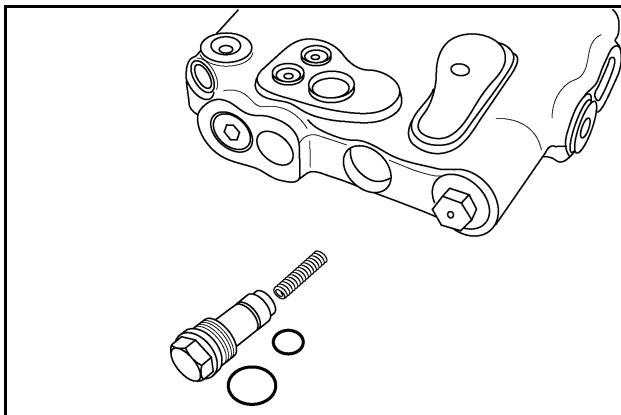


RD02D040

Lubricate the new O-rings and backup ring with petroleum jelly. Install two new O-rings on the poppet body. Install a new backup ring and a new O-ring on the lower pilot and spring assembly. The backup ring will be on top of the O-ring. Lubricate all parts with clean hydraulic fluid.

Install the lower poppet, lower pilot and spring assembly and the popper body into the valve. Tighten the poppet body to a torque of 21 to 27 Nm (15 to 20 lb. ft.).

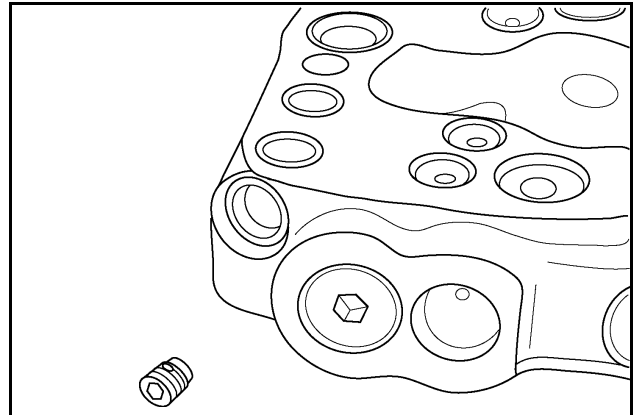
### STEP 20



RD02D039

Lubricate the new O-rings with petroleum jelly. Install two new O-rings on the overload relief body. Install the spring and poppet with shims into the body. Install the assembly into the valve. Tighten the body to a torque of 14 to 28 Nm (10 to 21 lb. ft.).

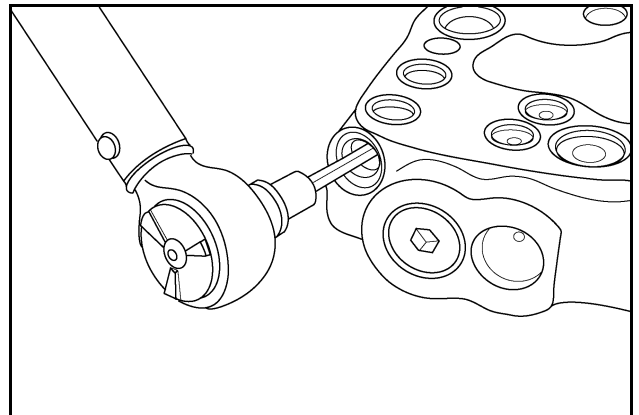
### STEP 21



RD02F148

Install the load sense check into the valve.

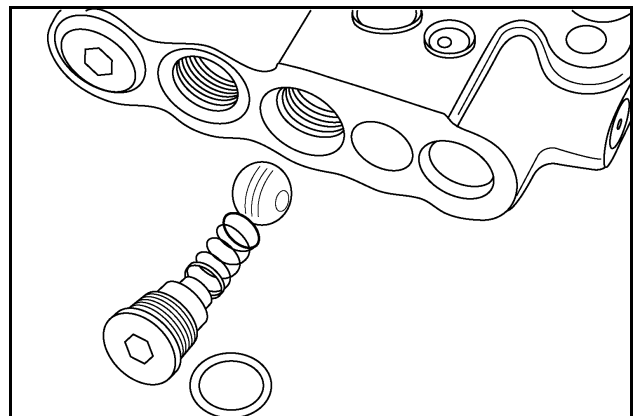
### STEP 22



RD02F149

Use a 3/16 inch allen wrench and tighten the check to a torque of 8 to 13 Nm (6 to 10 lb. ft.). Install the tee fitting.

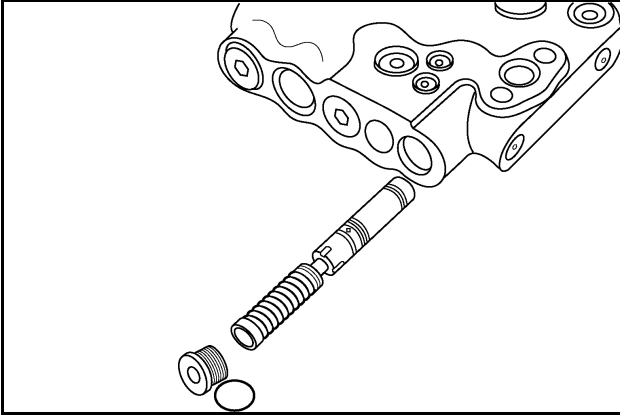
### STEP 23



RD02D038

Lubricate the new O-ring with petroleum jelly. Install the O-ring onto the plug. Install the ball, spring and plug. Tighten the plug to a torque of 14 to 28 Nm (10 to 21 lb. ft.).

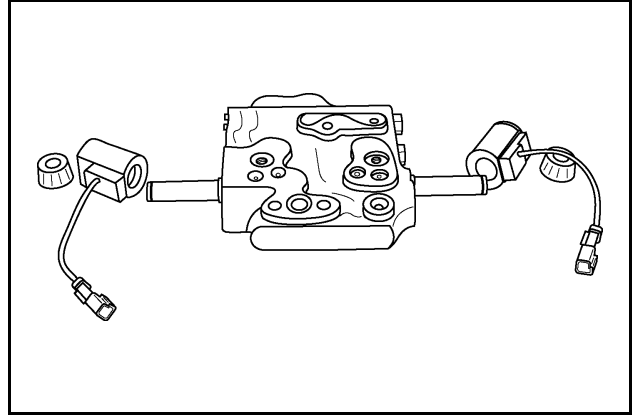
## STEP 24



RD02D037

Lubricate the new O-ring with petroleum jelly. Install the O-ring onto the plug. Lubricate the raise spool with clean hydraulic fluid and install the spool into the valve. Install and tighten the plug to a torque of 14 to 28 Nm (10 to 21 lb. ft.).

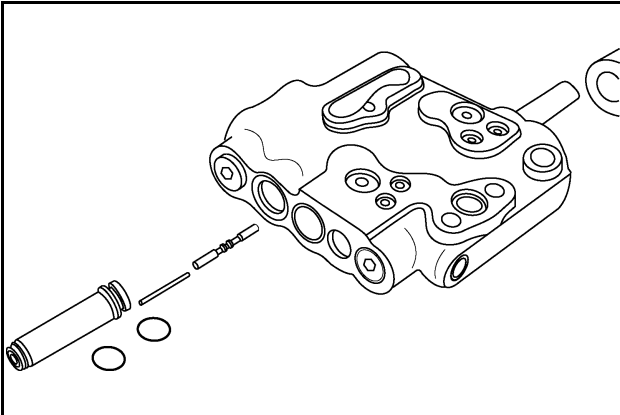
## STEP 26



RD02C199

Install the coils and coil nuts. Tighten the coil nuts to a torque of 2 to 4 Nm (17 to 35 lb. in.).

## STEP 25



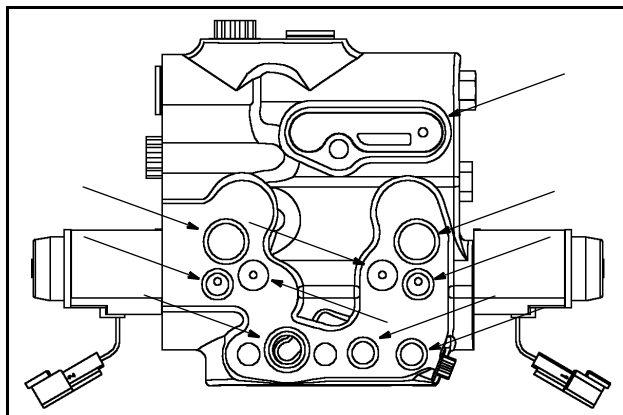
RD02C200

Lubricate the new O-rings with petroleum jelly. Install two new O-rings onto the raise solenoid core. Lubricate the pilot spool, control pin and solenoid core with clean hydraulic fluid and install into the valve. Tighten the core to a torque of 14 to 28 Nm (10 to 21 lb. ft.).

Repeat the procedure for the lower solenoid core.

## Installation

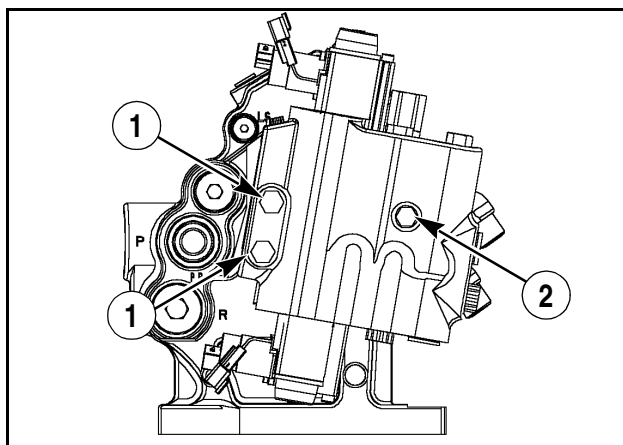
### STEP 27



RI02D046

Apply petroleum jelly to the new O-rings and install them to the back of the hitch valve.

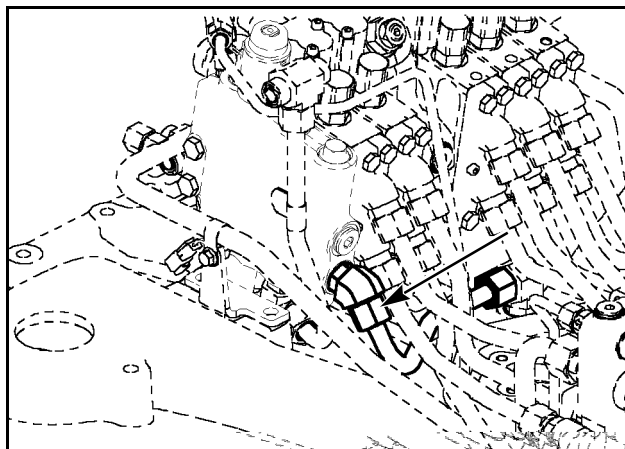
### STEP 28



RI02D045

Position the hitch valve on the remote valve stack and install the three mounting bolts. Tighten the two M12 bolts (1) to a torque of 40 to 45 Nm (30 to 33 lb. ft.) and the one M10 bolt (2) from 25 to 30 Nm (18 to 22 lb. ft.).

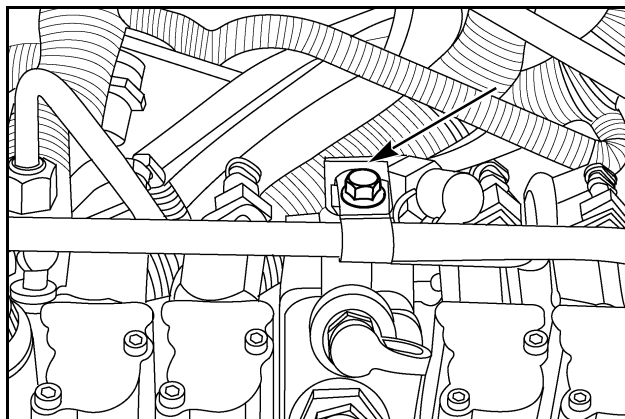
### STEP 29



RI02D067

Install and tighten the case drain line.

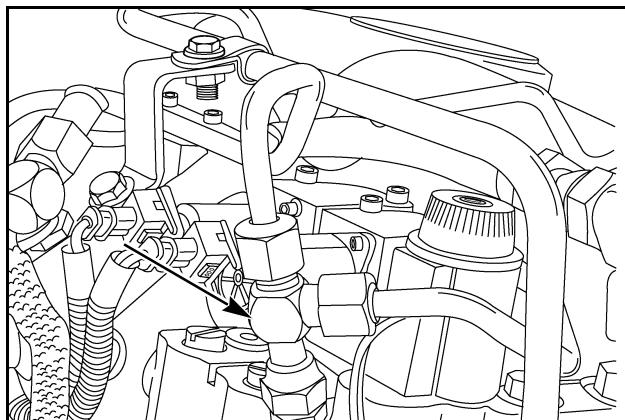
### STEP 30



RD02D046

If equipped, install the hydraulic trailer brake line mounting clamp.

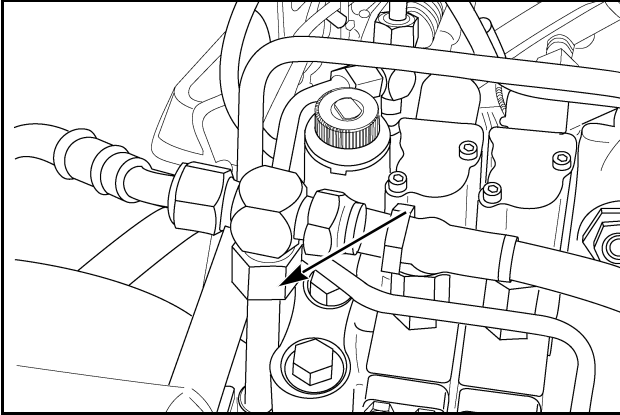
### STEP 31



RD02D045

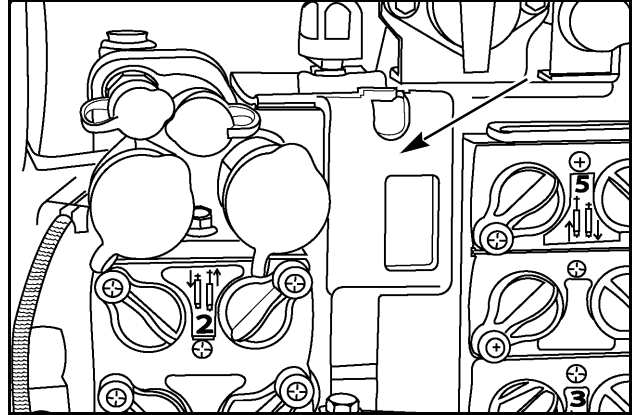
Connect the hitch valve load sensing signal lines.

**STEP 32**



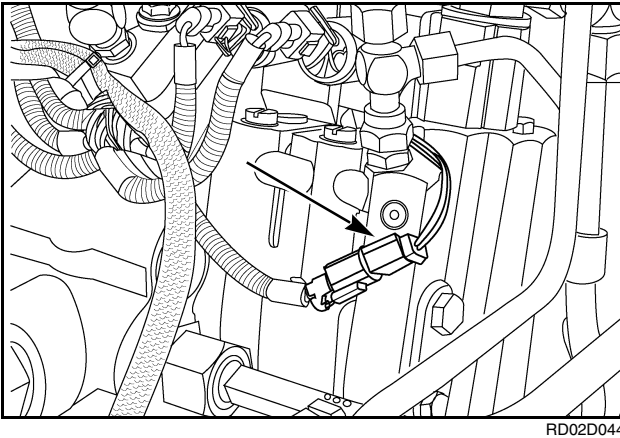
Connect the valve supply line.

**STEP 35**



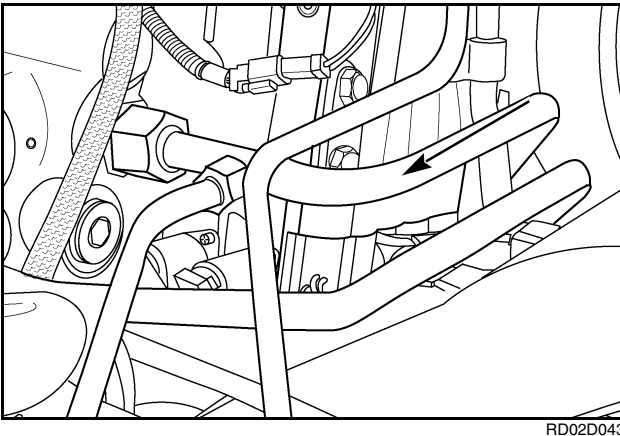
If removed, install the seven pin connector mounting bracket.

**STEP 33**



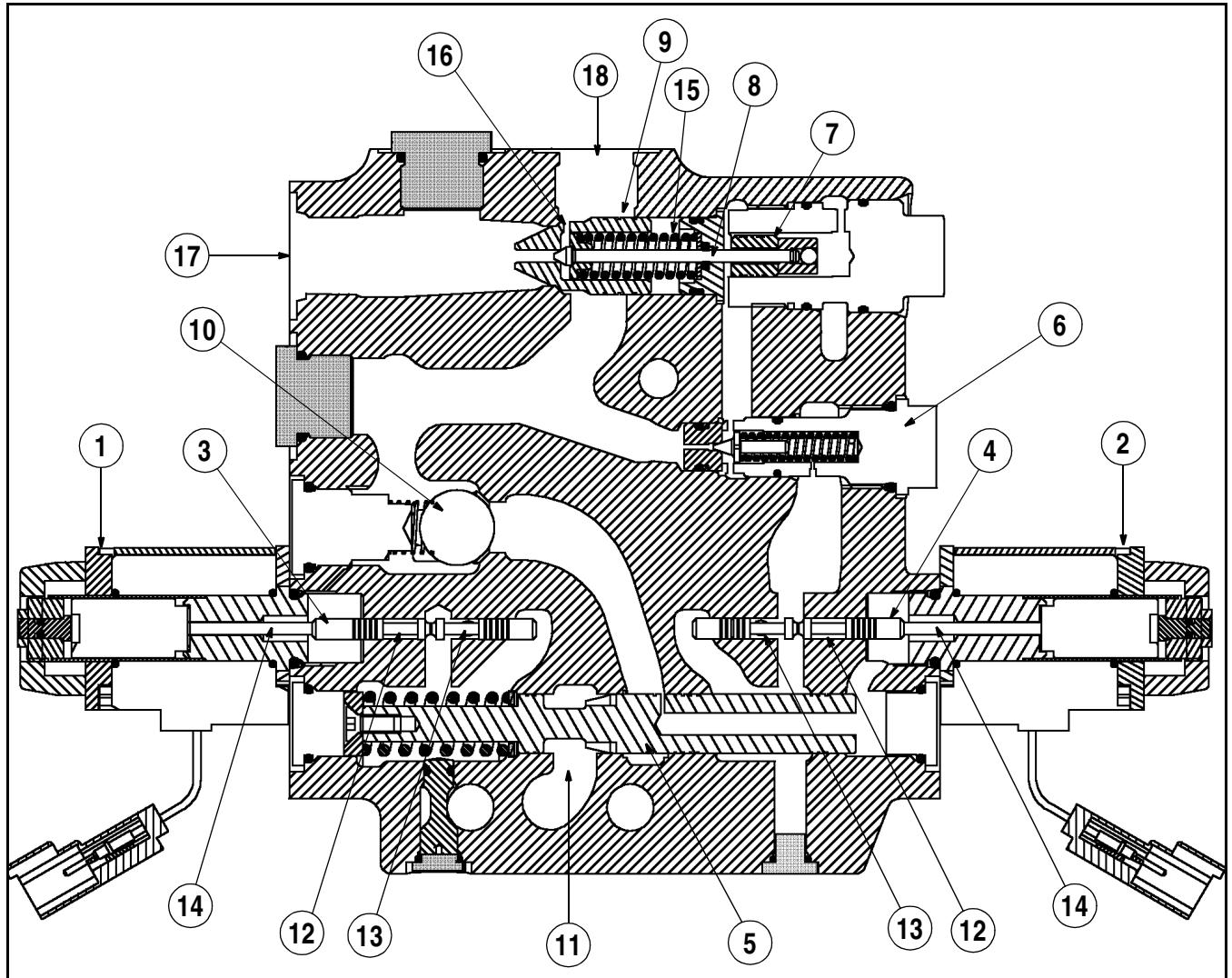
Connect the hitch valve solenoids to the wire harness.

**STEP 34**



If equipped, connect the power beyond supply line.

## HITCH CONTROL VALVE CROSS SECTION



RI02B003

- |                         |                               |
|-------------------------|-------------------------------|
| 1. RAISE SOLENOID       | 10. LOAD CHECK BALL           |
| 2. LOWER SOLENOID       | 11. PFC PUMP SUPPLY           |
| 3. RAISE PILOT SPOOL    | 12. REGULATED PRESSURE SUPPLY |
| 4. LOWER PILOT SPOOL    | 13. RETURN PORT               |
| 5. RAISE SPOOL          | 14. CONTROL PIN               |
| 6. OVERLOAD RELIEF      | 15. SPRING                    |
| 7. LOWER CONTROL PISTON | 16. ORIFICE                   |
| 8. LOWER PILOT POPPET   | 17. TANK PORT                 |
| 9. LOWER POPPET         | 18. RAISE/LOWER PORT          |



# **Section 35**

# **Chapter 11**

**TRACTOR HITCH**



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## SPECIAL TORQUES

Nut for Position Locator Bracket .....	490 to 555 Nm (362 to 410 lb. ft.)
Bolts for Hitch Support C-Bracket.....	845 to 950 Nm (624 to 700 lb. ft.)
Nuts for Hitch Potentiometer Bushing.....	3.5 to 6.3 Nm (2.6 to 4.6 lb. ft.)
Bolts for Linkage Shield.....	62 to 80 Nm (46 to 59 lb. ft.)
Nut for Link Assembly .....	18 to 23 Nm (14 to 17 lb. ft.)
Bolt for Hitch Cylinder Locking Flag Plate .....	83 to 106 Nm (60 to 78 lb. ft.)
Bolt for Vertical Lift Link Locking Flag Plate (top) .....	82 to 106 Nm (60 to 78 lb. ft.)
Bolt for Vertical Lift Link Locking Flag Plate (bottom) .....	82 to 106 Nm (60 to 78 lb. ft.)
Bolts for EDC Cover .....	62 to 80 Nm (46 to 59 lb. ft.)
Locking Bolt for Cam Bumper.....	385 to 495 Nm (285 to 365 lb. ft.)
Bolt for Drawbar Support (bracket) .....	610 to 730 Nm (450 to 540 lb. ft.)

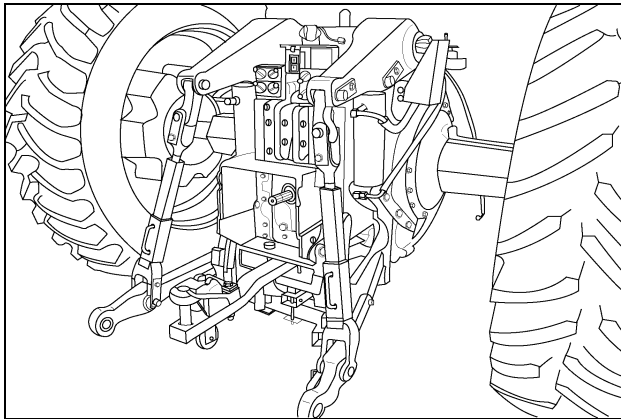
## TRACTOR HITCH

### Removal of 3-Point Hitch

**NOTE:** If the Quick Coupler is attached, remove it.

**IMPORTANT:** Move the tires out to gain access to the hitch, orient the chain holes with the hitch tie rod before starting so the tie rod can be removed later in Step 21.

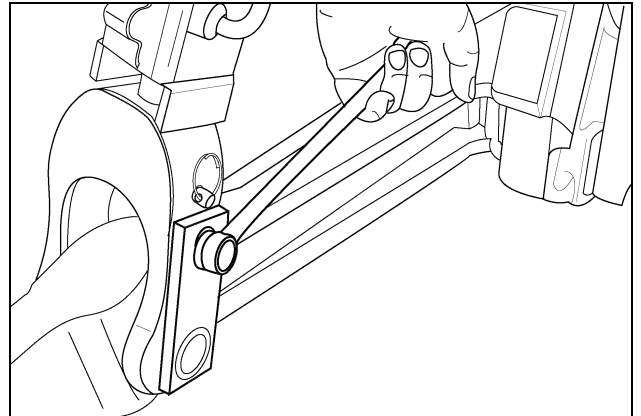
#### STEP 1



26-16

Lower the rockshaft assembly until the hydraulic hitch lift cylinders reach the bottom of their stroke. Place the transmission in PARK, shut off the engine and remove the key.

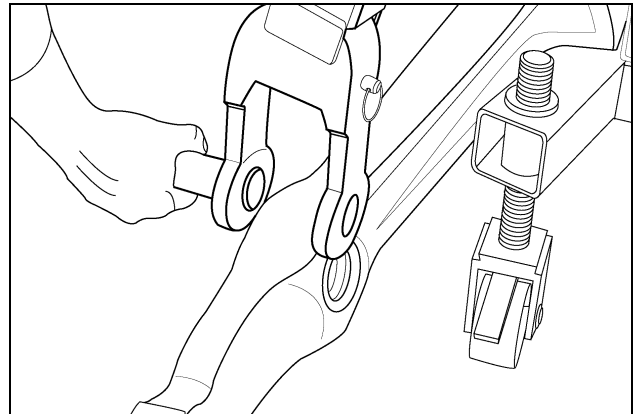
#### STEP 2



76-5

Remove the bolt, nut, and locking plate from the lower end of the vertical lifting link.

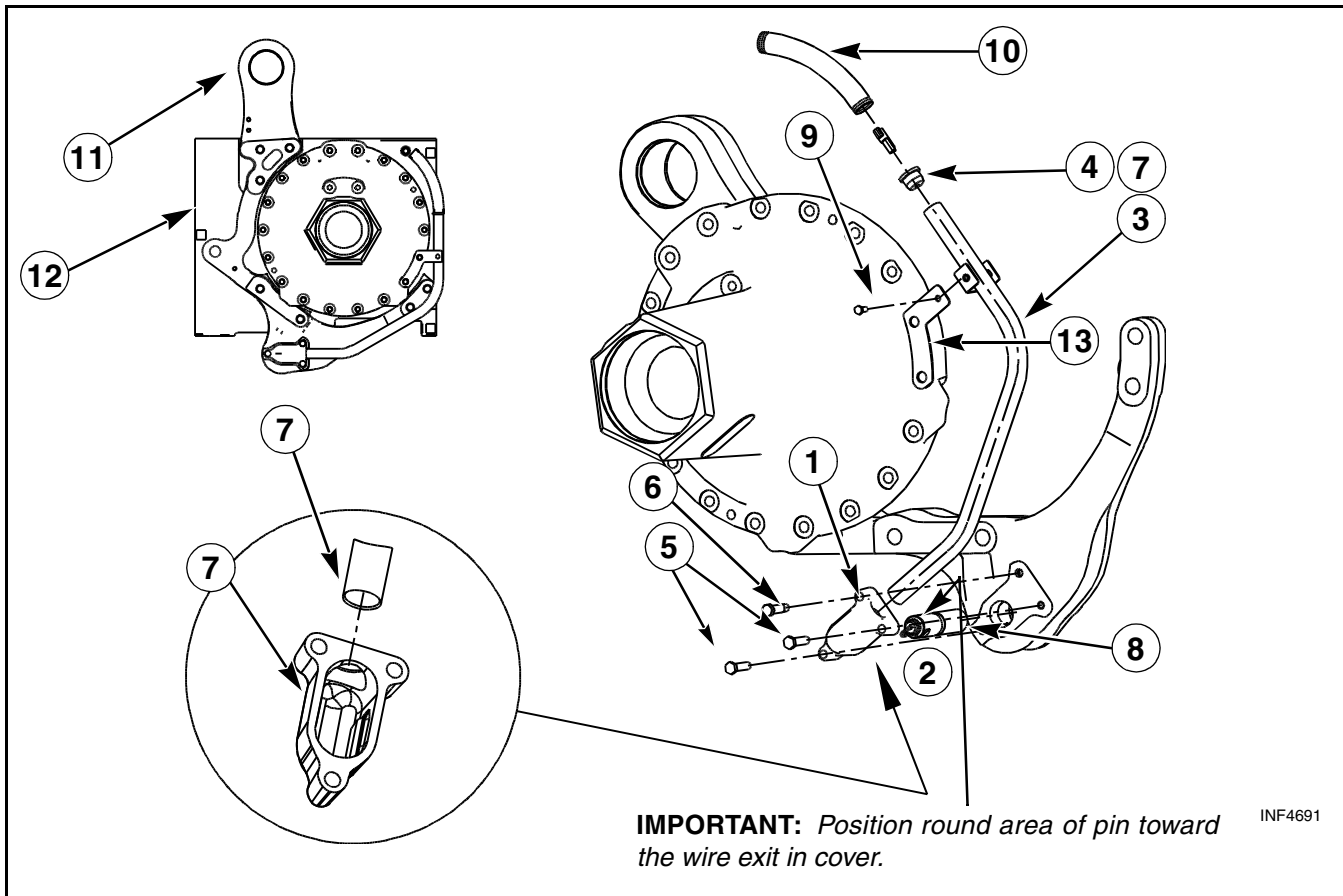
#### STEP 3



26-33

Support the draft arm and remove the lower hitch swivel pin to release the vertical lifting link from the draft arm.

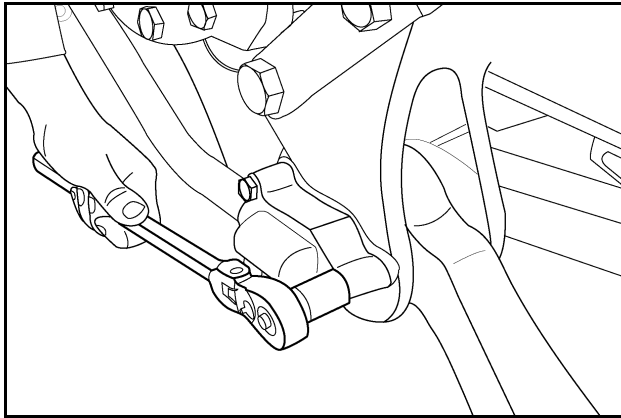
## Rear Hitch Disassembly



1. COVER
2. EDC PIN
3. TUBE
4. GROMMET
5. HEX HEAD BOLT (2)
6. SHOULDER BOLT

7. SILICONE SEALANT (3 PLACES)
8. ANTI-SEIZE COMPOUND
9. BOLT
10. CONDUIT (RH SIDE ONLY)
11. HITCH SUPPORT ARM
12. REAR FRAME HOUSING
13. TUBE BRACKET

## STEP 4



26-35

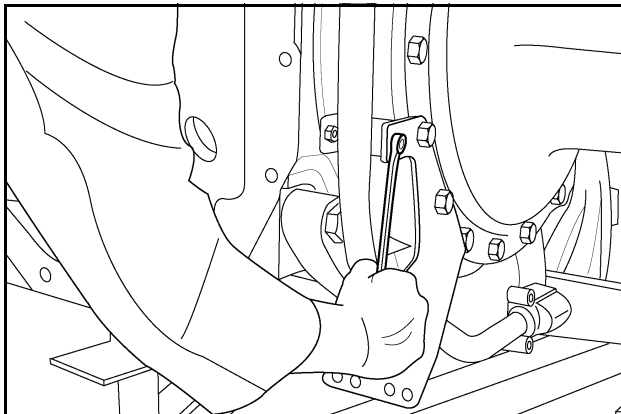
Remove the electronic draft control (EDC) components as follows:

1. Disconnect the EDC pin electrical connector from the top of the EDC tube (3).
2. Remove the hex head bolt (9) through the bracket at the top of the EDC tube.
3. Remove the three bolts from the cover over the electronic draft control (EDC) pin and the EDC tube in the rear of the draft arm.
4. Carefully remove the EDC pin, cover, and tube as a complete subassembly.

**IMPORTANT:** Be prepared for the sudden drop of the draft arm as the pin is removed.

**NOTE:** Removal of the tube bracket (13) from the axle carrier is not required.

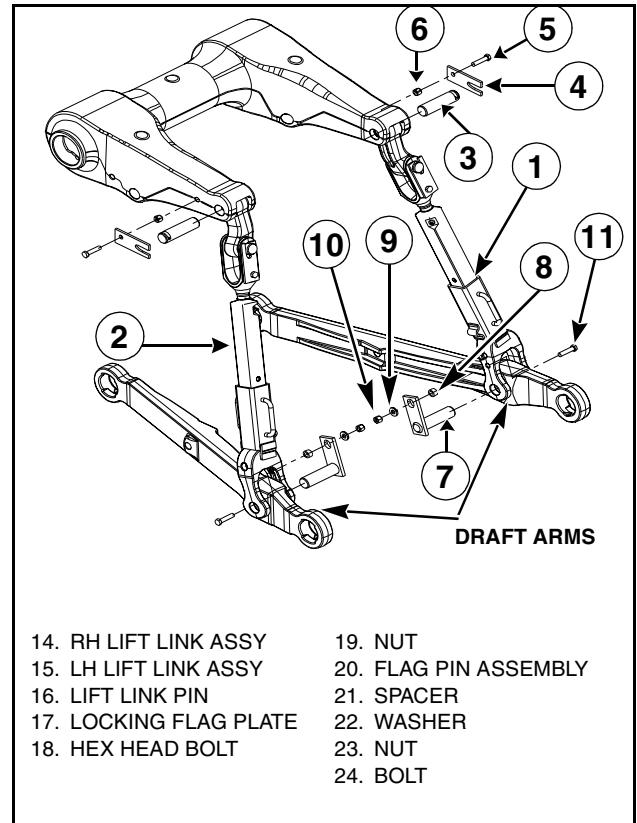
## STEP 5



27-7

Remove the EDC pin from the other side of the rear frame housing also.

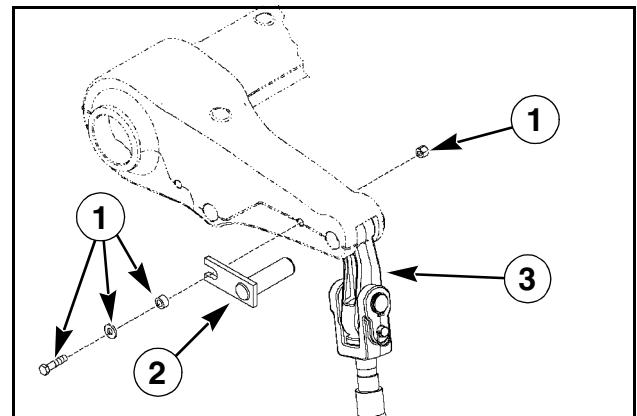
## STEP 6



INF5299L

Once the EDC pins have been removed, pull and remove the draft arms.

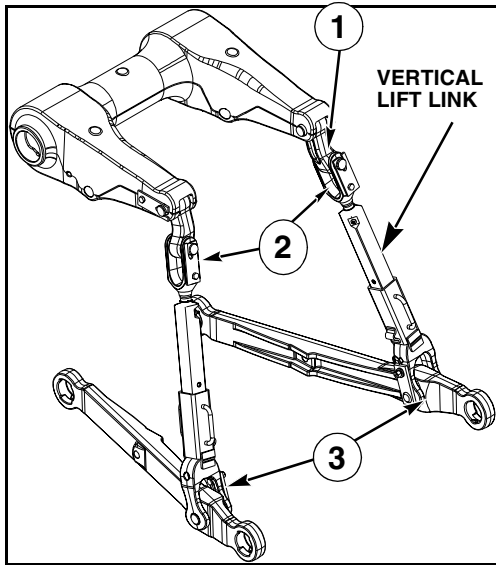
## STEP 7



RI03G003

Remove the hex head bolt, washer, spacer and nut (1) from the locking plate (2) where the vertical lifting link (3) is attached to the rock shaft. Properly support the lift link (3) and remove the flag/pin assembly (2).

## STEP 8



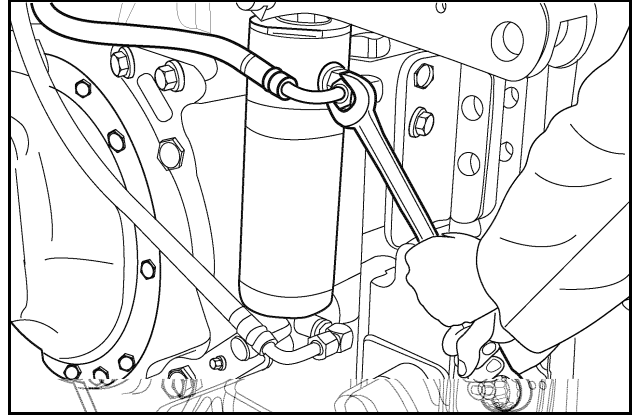
1. SWIVEL MUST BE POSITIONED OUTWARD.
2. FLAGS MUST FACE REARWARD ON BOTH SIDES.
3. FLAGS FOR FLAG PIN ASSY MUST FACE INWARD.

INF5299R

Before disassembly observe the position of parts as explained in the notes above. Disassemble the vertical lift link as follows:

1. Observe the position of the vertical lift link and all the components on the lift link as shown in the isometric view above.
2. Disassemble the components of the vertical lift link, such as the turnbuckle, only if needed.

## STEP 9

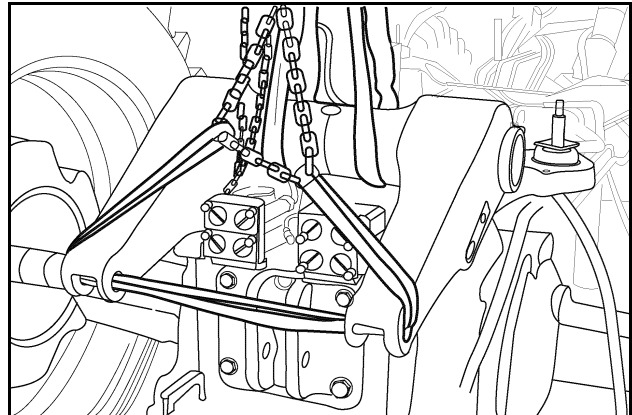


27-12

Remove the hydraulic lines to the hitch lift cylinder as follows:

1. Be prepared to catch hydraulic fluid as the hydraulic system is opened.
2. Remove the hydraulic line from the top of the hitch lift cylinder and then from the bottom of the hitch lift cylinder (both sides).

## STEP 10

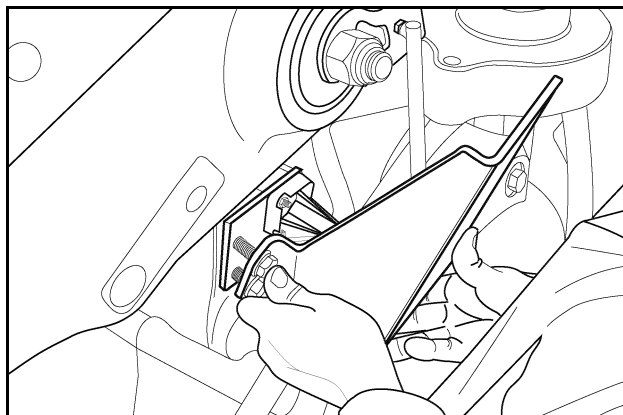


35-24

Secure the rockshaft assembly as follows:

1. Attach a chain hoist to the top of the rockshaft assembly.
2. Place enough tension on the chains to support the assembly without adding a lifting force.

## STEP 11

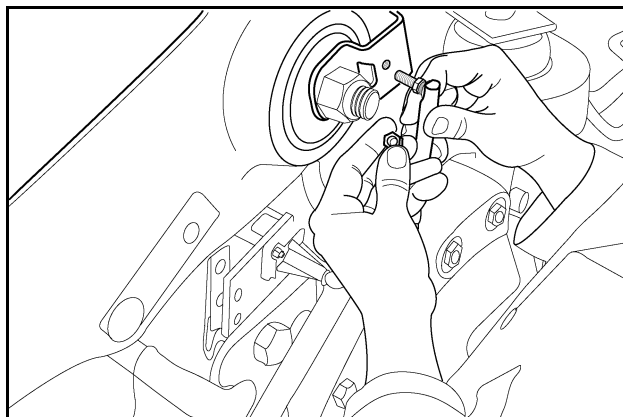


36S21

Remove the two bolts that attach the linkage shield to the hitch support C-bracket.

**IMPORTANT:** *Be sure to remove hitch position sensor (potentiometer) prior to removing the hitch lift cylinders. If the cylinders are removed first, there may be excessive travel of the rockshaft, which would damage the sensor.*

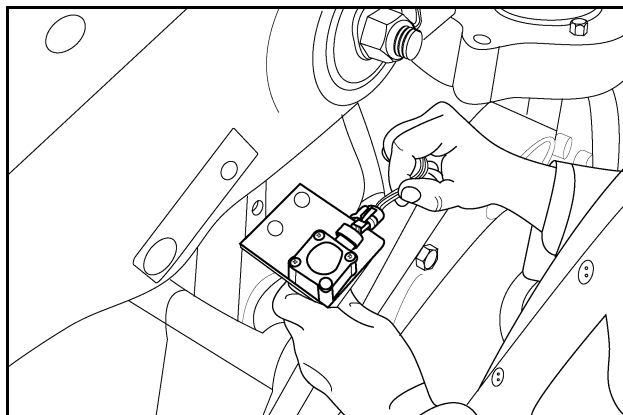
## STEP 12



36S17

Remove the nut from the link assembly.

## STEP 13

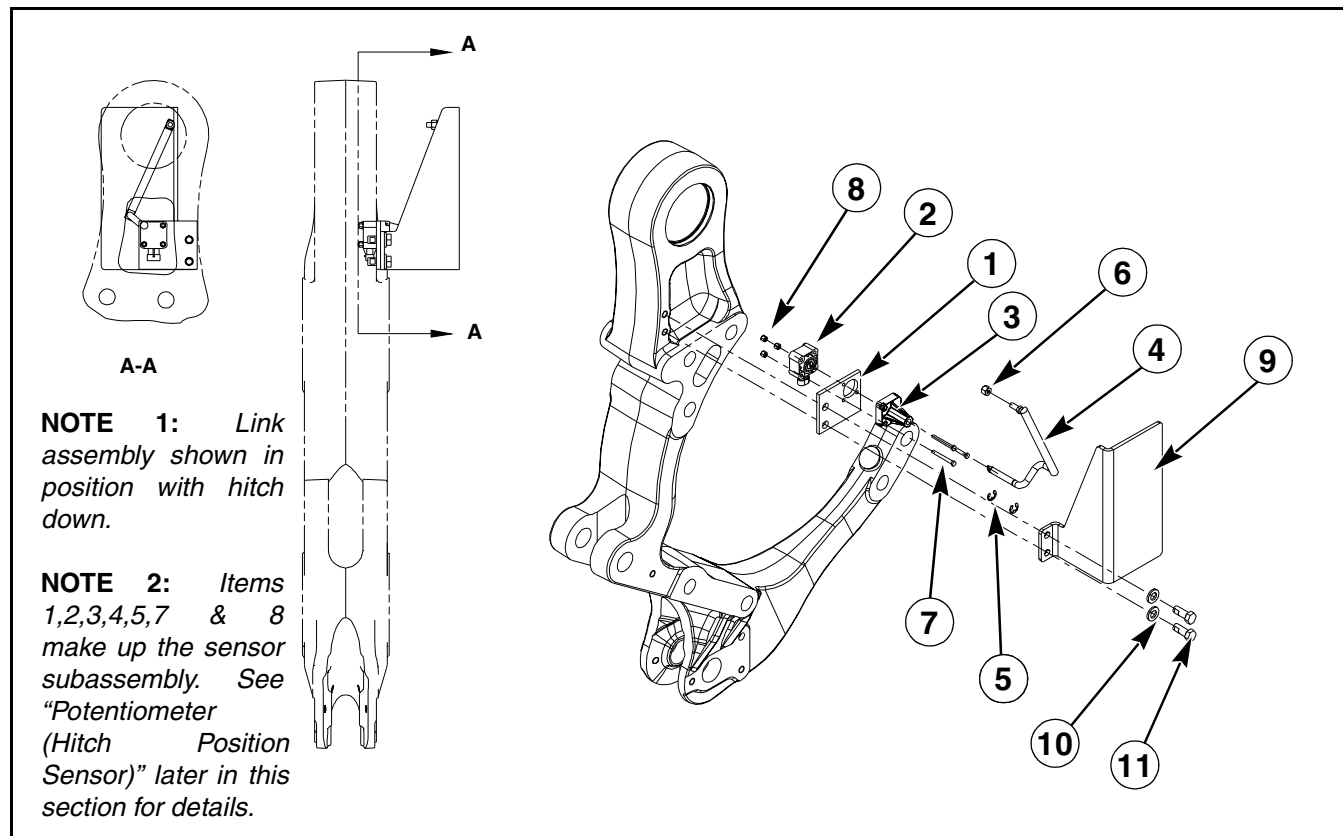


36S15

If necessary remove the three nuts from the bolts that attach the hitch potentiometer bushing to the sensor bracket and sensor.

**NOTE:** *This is a subassembly and does not need to be disassembled. See Note 2 in exploded view.*

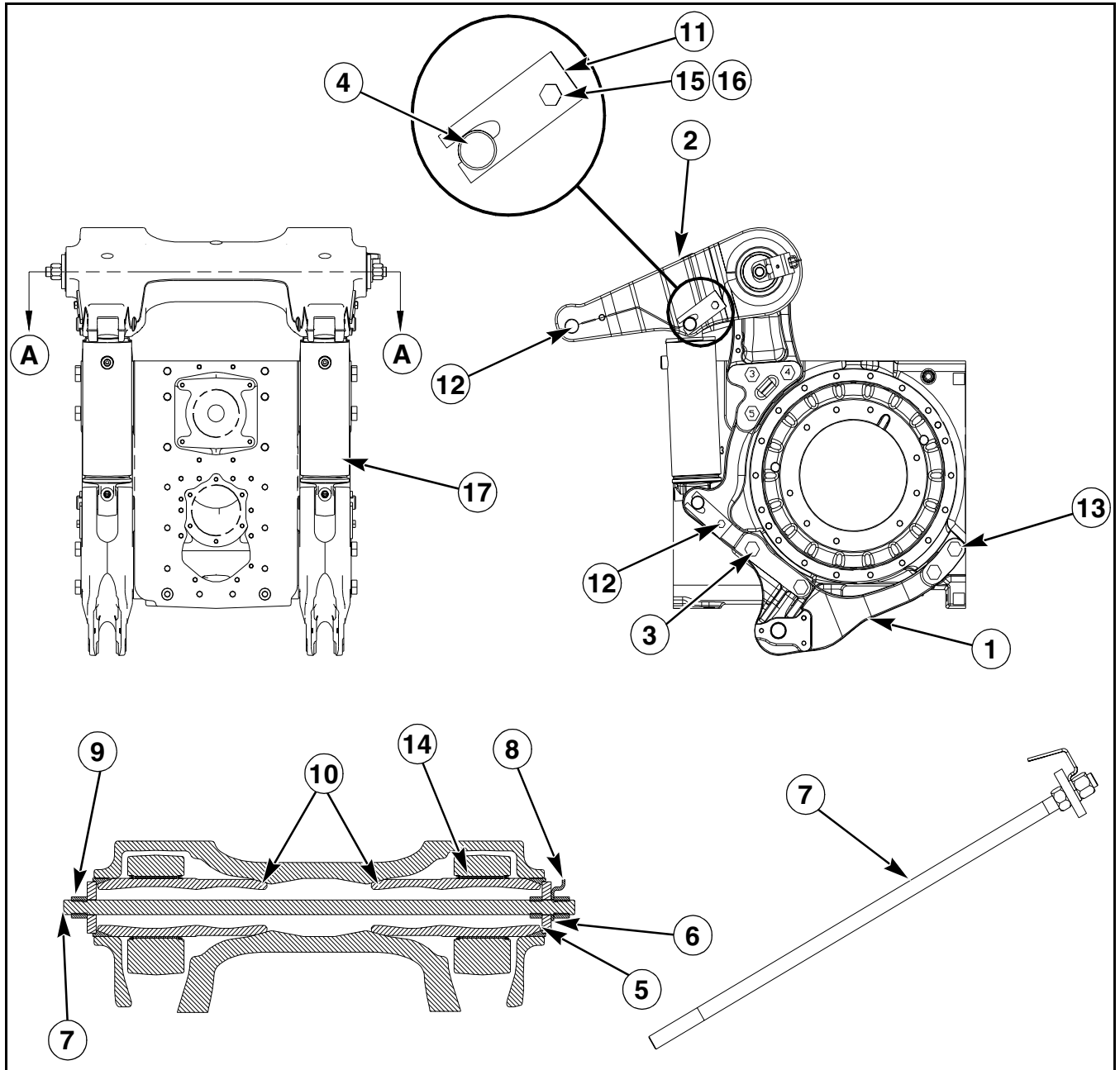
## Hitch Position Sensor



INF6913

- |                  |            |
|------------------|------------|
| 1. BRACKET       | 7. BOLT    |
| 2. SENSOR        | 8. NUT     |
| 3. BUSHING       | 9. SHIELD  |
| 4. LINK ASSEMBLY | 10. WASHER |
| 5. SNAP RING     | 11. BOLT   |
| 6. NUT           |            |

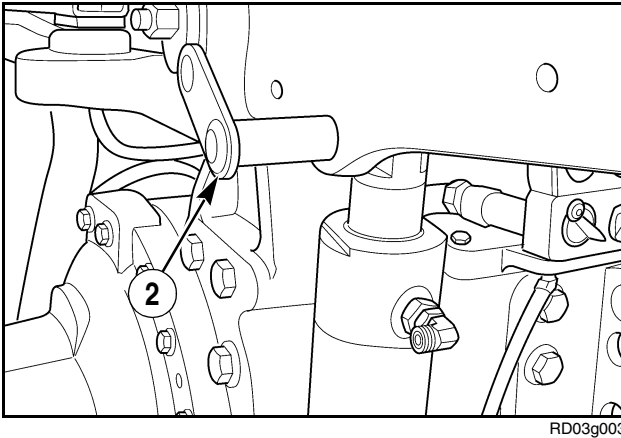
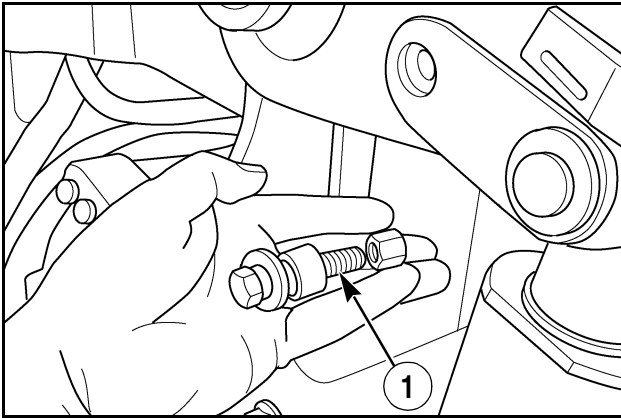
## Basic Hitch Assembly



- |                              |                         |
|------------------------------|-------------------------|
| 12. HITCH SUPPORT C-BRACKET  | 21. ROCKER PIN          |
| 13. ROCKSHAFT                | 22. FLAG PLATE          |
| 14. BOLT                     | 23. BOLT                |
| 15. PIN                      | 24. BOLT                |
| 16. RETAINER                 | 25. SEAL                |
| 17. WASHER                   | 26. BOLT                |
| 18. TIE ROD                  | 27. NUT                 |
| 19. POSITION LOCATOR BRACKET | 28. HITCH LIFT CYLINDER |
| 20. NUT                      |                         |

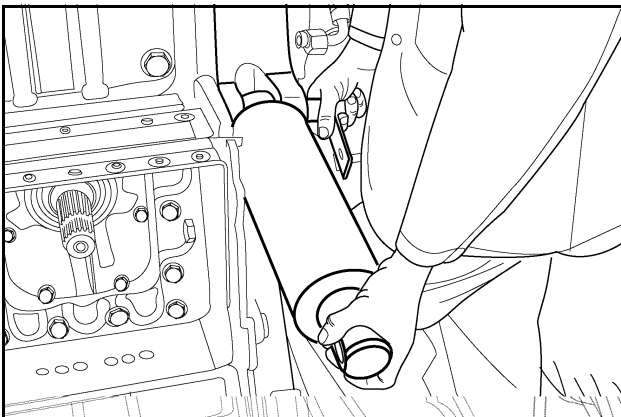


## STEP 14



Remove the bolt, washer, spacer and nut (1). Remove pin (2) of the hitch lift cylinder (both sides).

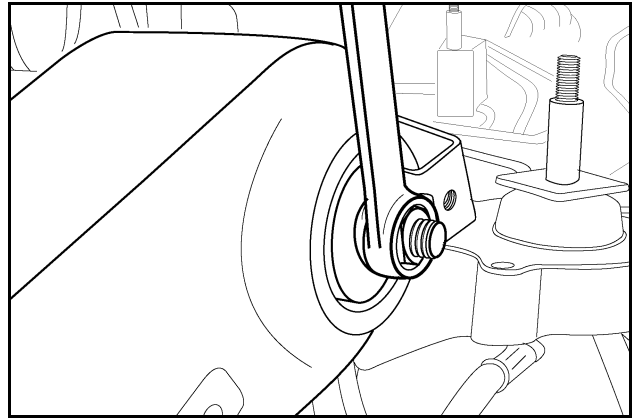
## STEP 15



Remove the bolt, locking flag plate, and holding pin and free the lower end of the hitch lift cylinder. Remove the cylinder. Repeat Steps 17 and 18 for opposite side.

**IMPORTANT:** Note the position of the plate to the slot for correct assembly.

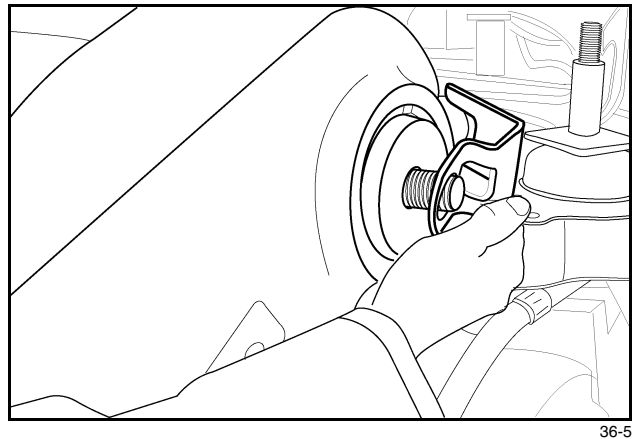
## STEP 16



Support the nut that attaches the position locator bracket to the tie rod.

**NOTE:** Right side nut (shown) should be held in place while nut on left side is removed.

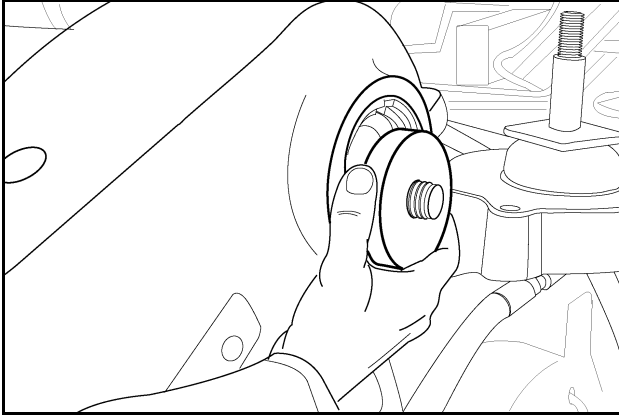
## STEP 17



Remove the position sensor bracket.

**NOTE:** This step only needs to be performed if the tires prevent removal of the tie rod assembly (shown in the lower right corner of the previous drawing).

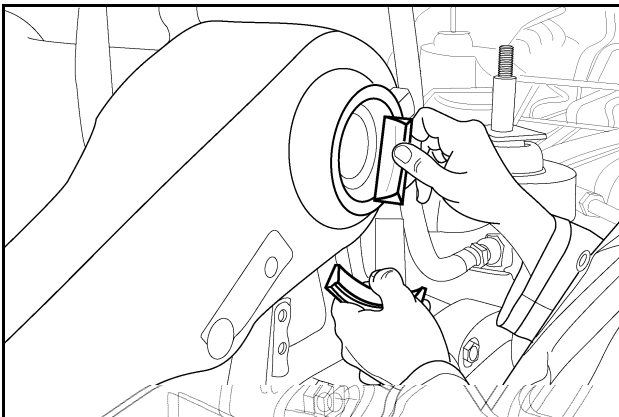
## STEP 18



36-2

Remove the split ring washer that holds the pin-to-rockshaft retainer in place. Remove the tie rod through the opposite end from which the washer and retainer were removed. If tires are on tractor, the tie rod may be disassembled by sliding tie rod through chain support hole on tire. Orient tire(s) as necessary.

## STEP 19

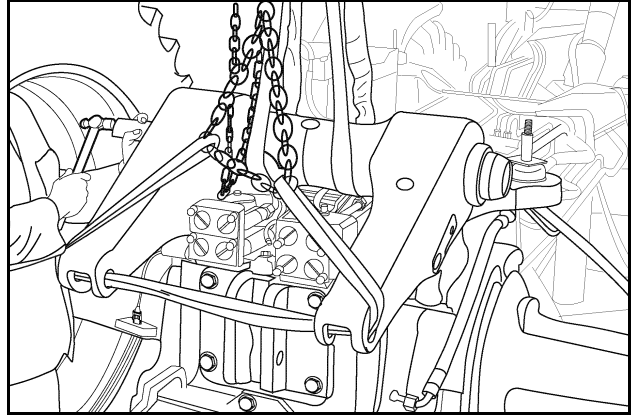


35-30

Remove the pin-to-rockshaft retainers from both ends of the rockshaft.

**NOTE:** If necessary, tap the rockshaft casting near the retainer to loosen the retainer.

## STEP 20

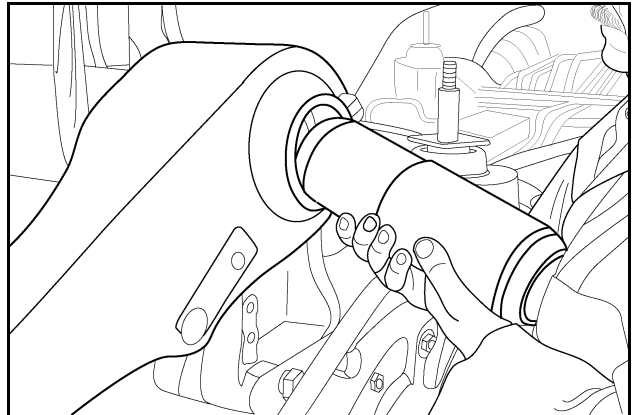


35-21

Use a long piece of wood to reach through the rockshaft and contact the rocker pin. Tap the piece of wood to dislodge the rockshaft pin. Use care not to damage the seal or bushing.

**IMPORTANT:** Use the hoist to hold the weight of the rockshaft. The pin will slide easily if there is no weight on the pin.

## STEP 21



35-18

Remove the rockshaft pin.

**IMPORTANT:** Note position of pin for correct assembly.

## STEP 22

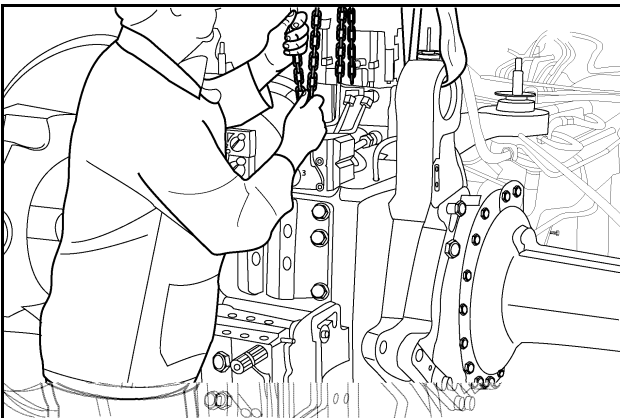


35-14

When both rockshaft pins are removed, lift and set aside the rockshaft casting.

**NOTE:** Keep bearings and seals free of foreign material.

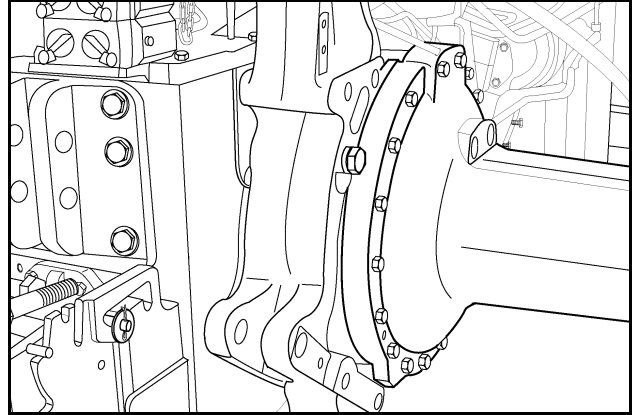
## STEP 23



35-10

While both hitch support C-brackets are still firmly held in place, attach a sling and hoist to the large pin bearing hole in one of the hitch support arms. Take the slack out of the sling, but do not lift up on the bracket. If bushings and seals are not going to be replaced, use care not to damage seal or bushing nor contaminate them with dirt, grease or oil.

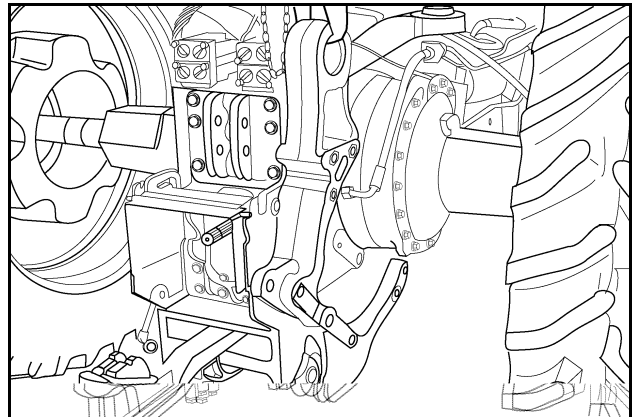
## STEP 24



35-8

Remove the seven attaching bolts that pass through the hitch support C-brackets into the rear frame housing.

## STEP 25



35-5

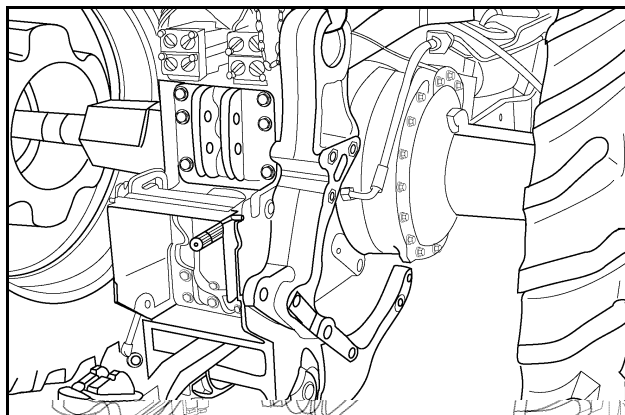
Lift off and set aside the hitch support C-bracket.

## STEP 26

Repeat Steps 26 through 28 for the other hitch support arm.

## Installation of the 3-Point Hitch

### STEP 27

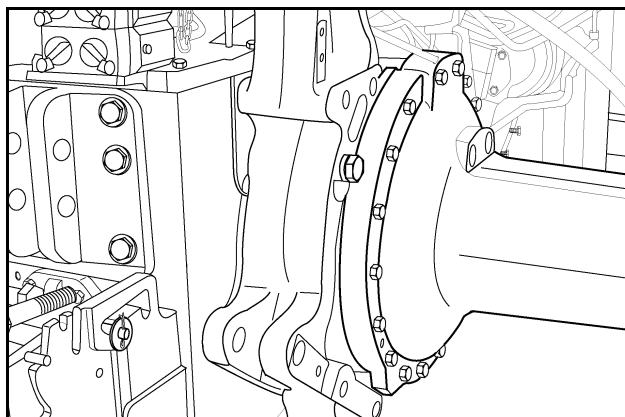


35-5

All six mating surfaces of the hitch support C-bracket and rear frame must be clean and free of paint, oil, grease, anti-seize, etc. Move a hitch support C-bracket into place with a hoist and sling. These components should be replaced with new components during installation:

1. Bushing and seals
2. M24 bolts and nuts
3. Retainers

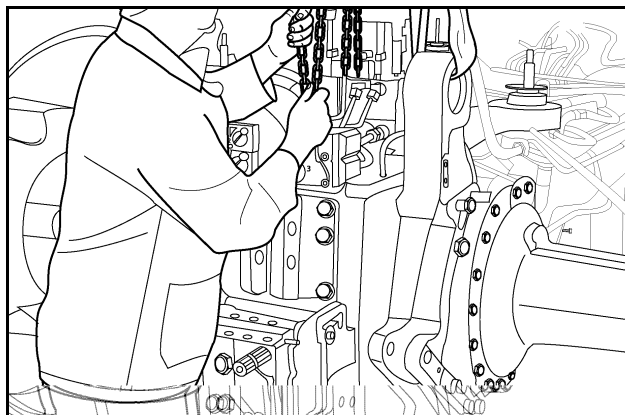
### STEP 28



35-8

Attach both hitch support C-brackets to the rear frame housing. Install new M24 bolts, but do not tighten. Keep a gap of 5mm between M24 bolt and bracket. The C-brackets must be free to move easily.

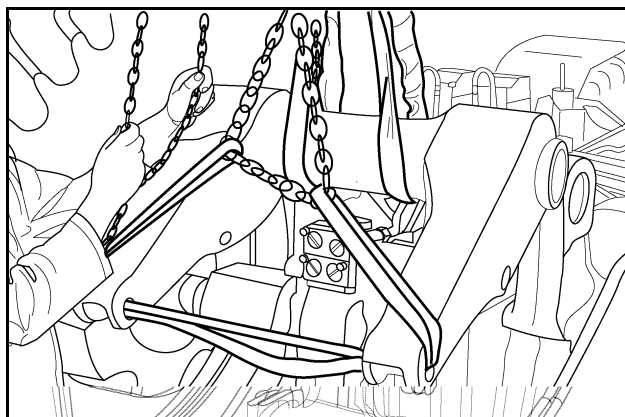
### STEP 29



35-10

Remove the sling and hoist.

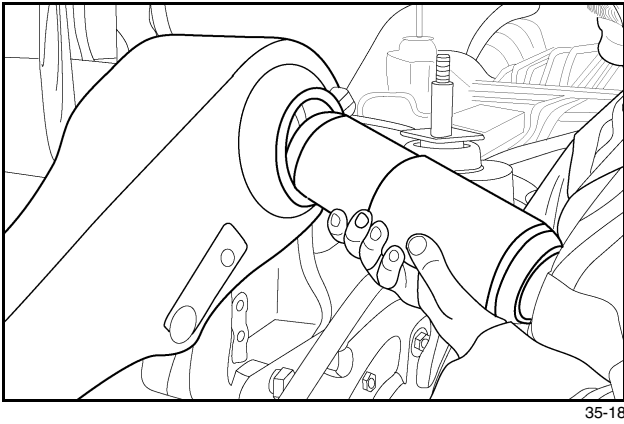
### STEP 30



35-14

With a sling and hoist, lift the rockshaft casting into place.

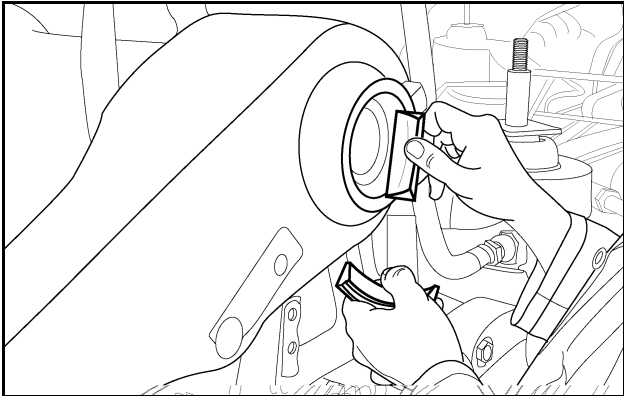
### STEP 31



35-18

Pins must be clean and free of oil, grease, antiseize, compound, etc. Orient pin with bearing surface outboard. Insert a rockshaft pin. Use a wooden block to tap the pin until it is seated in place. Replace the other rocker pin. Adjust the hoist to allow the pins to slide easily.

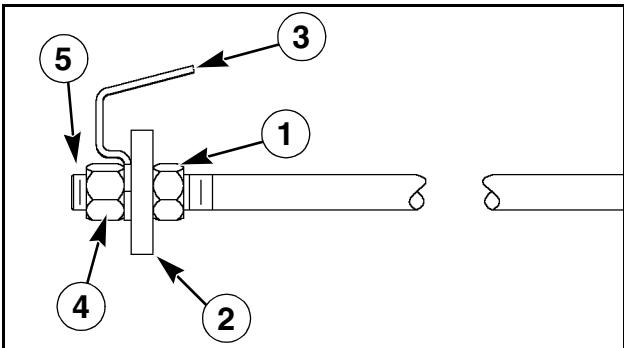
### STEP 32



35-30

Insert new pin-to-rockshaft retainers at the ends of both rockshafts.

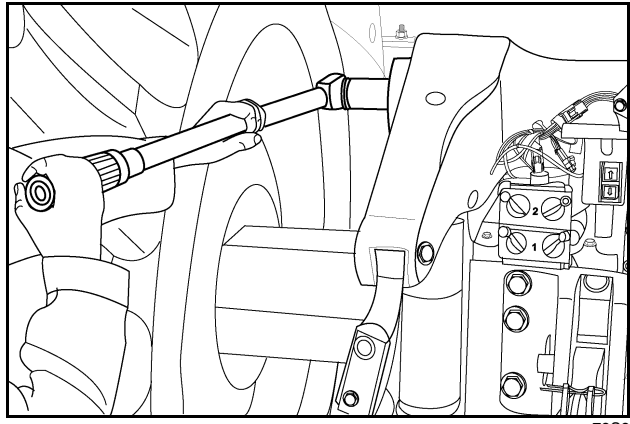
### STEP 33



RDE03G005

If tie rod was disassembled, install a nut (1), washer (2) hitch retaining bracket (3) and prevent torque nut (4). With a minimum of three threads (5) showing, torque the nut to 490 to 550 Nm (362 to 410 lb. ft.).

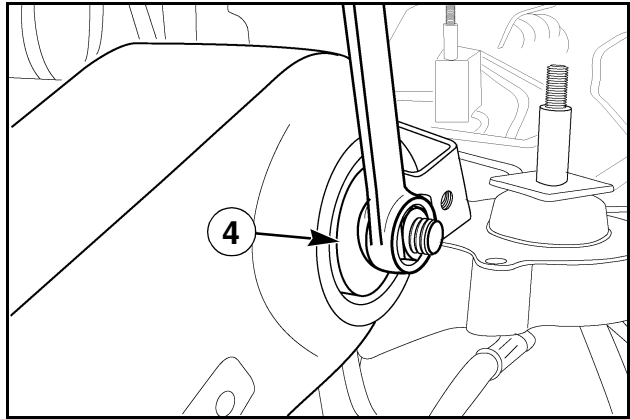
### STEP 34



79S9

Install the tie bolt. Install the washer and M24 nut on the opposite (left hand) side.

### STEP 35



36-9

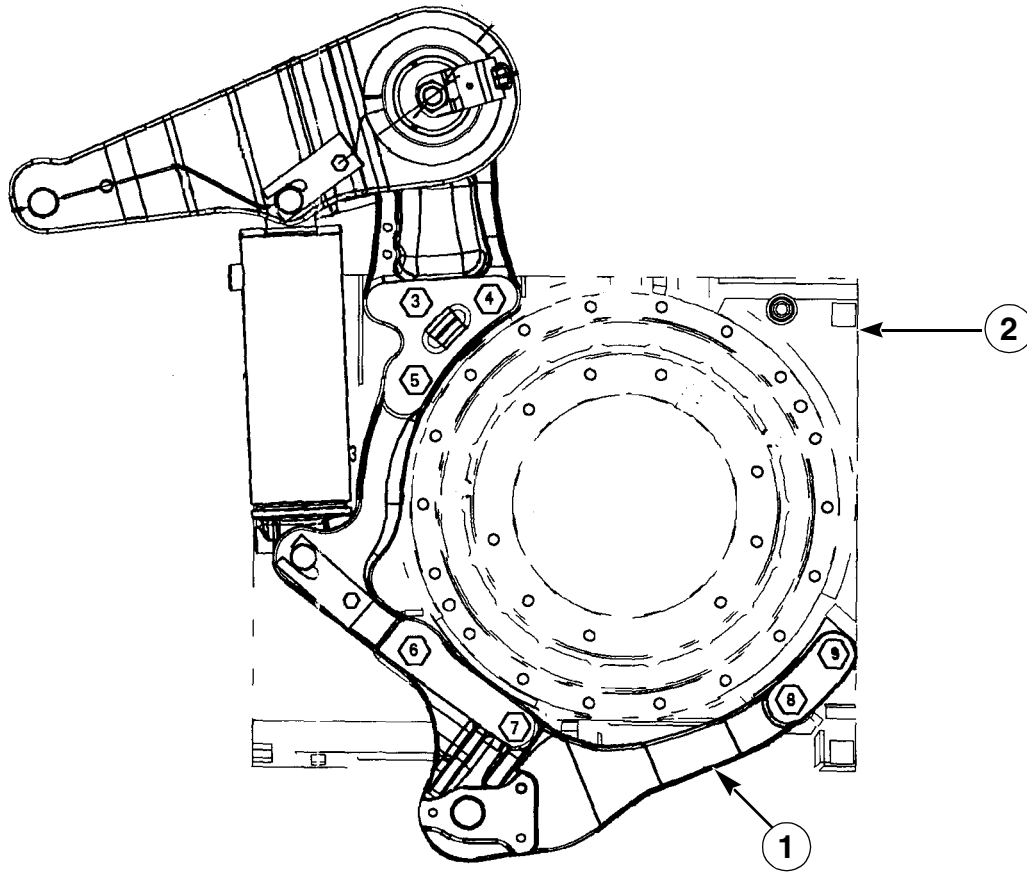
While preventing the M24 nut on the right-hand side from rotating (shown above), tighten the left-hand M24 nut to 490 to 555 Nm (362 to 410 lb. ft.).

**NOTE:** Make sure the retaining washer (1) stays in the split ring counter bores when tightening the tie bolt nuts.

### STEP 36

Tighten all 14 bolts for the hitch support C-brackets to a torque of 845 to 950 Nm (624 to 700 lb. ft.). The bolts must be tightened in the sequence shown in the view below.

## Bolt Tightening Sequence



**Note 1:** Numbers 3-9 on bolt heads denote bolt torque sequence.

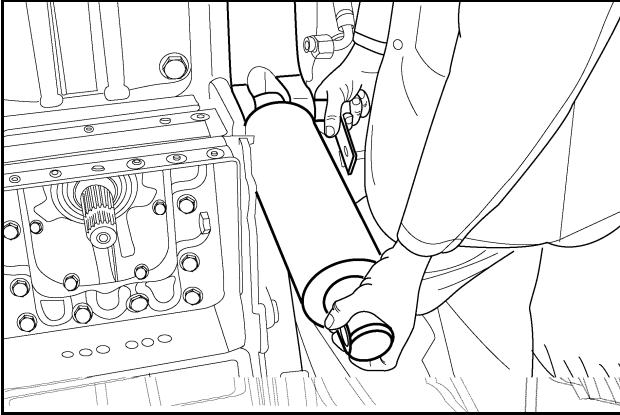
**Note 2:** Use same sequence on both sides.

**Note 3:** Bolts tightening sequence numbers 1 and 2 are for nuts on both ends of the tie rod (not shown here) (performed in Step 38).

INF4919

29. HITCH SUPPORT C-BRACKET  
30. REAR FRAME HOUSING

### STEP 37

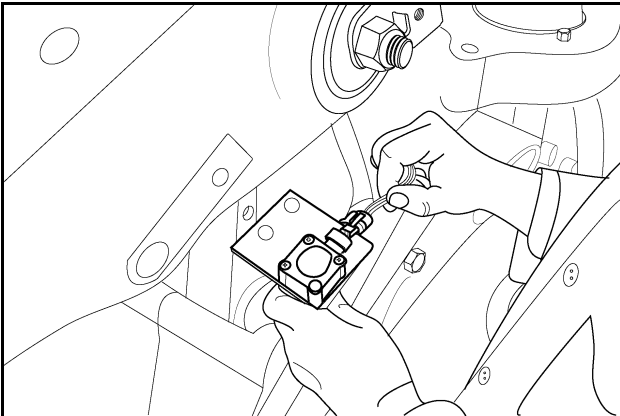


36-28

Attach the hitch lift cylinder as follows:

1. Pin must be clean and free of dirt, grease, oil and anti-seize compound, etc.
2. Move a hitch lift cylinder into place. Insert the holding pin through the hole in the lower end of the cylinder shaft and the shaft support.
3. Install the bolt, washer and spacer. Tighten bolt to a torque of 82 to 106 Nm (60 to 78 lb. ft.).

### STEP 38

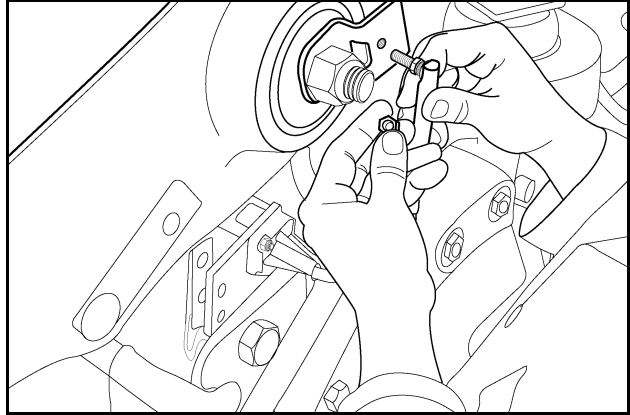


36-15

Install the three nuts that attach the hitch potentiometer bushing to the sensor bracket and sensor. Tighten to a torque of 3.5 to 6.3 Nm (2.6 to 4.6 lb. ft.).

**NOTE:** This step may not be required. If required, refer to potentiometer assembly drawing, shown on page 21).

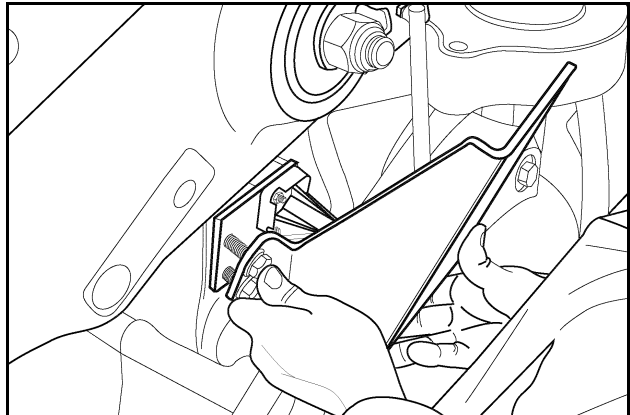
### STEP 39



36-18

Install the nut for the link assembly. Tighten to a torque of 18 to 23 Nm (14 to 17 lb. ft.).

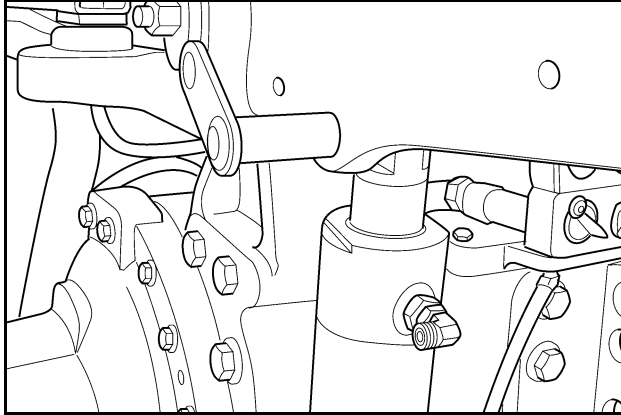
### STEP 40



36-21

Install the two bolts that attach the linkage shield to the hitch support arm. Tighten to a torque of 62 to 80 Nm (46 to 59 lb. ft.).

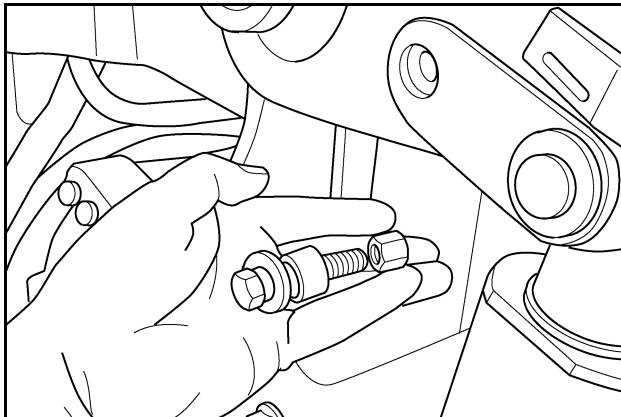
### STEP 41



Insert a holding pin as follows:

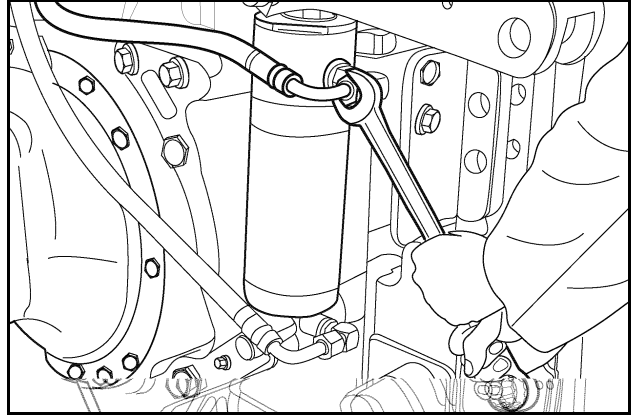
1. Pin must be clean and free of oil, grease, anti-seize.
2. Adjust the vertical position of the rockshaft, if necessary.
3. Move the upper end of the shaft into place so that the hole in the shaft of the hitch lift cylinder is aligned with its mating holes. Position both sides before proceeding to the next task in this step.
4. Insert the holding pin through the holes.

### STEP 42



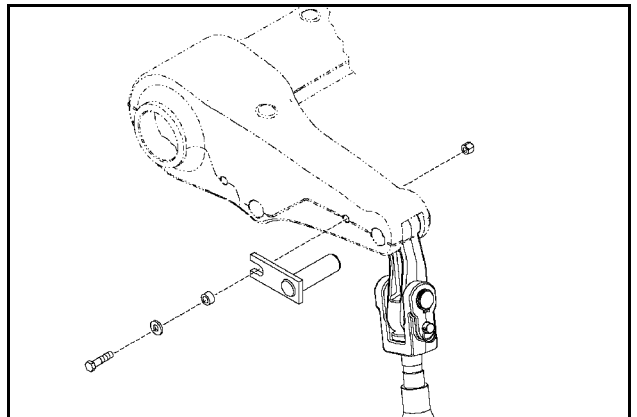
Install the bolt, washer, spacer and nut. Tighten to a torque of 82 to 106 Nm (60 to 70 lb. ft.). Be sure the locking plate and slot are positioned correctly to prevent damage to plate. Repeat for opposite side.

### STEP 43



Attach the hydraulic line to the top of the hitch. Repeat for the other hitch lift cylinders.

### STEP 44

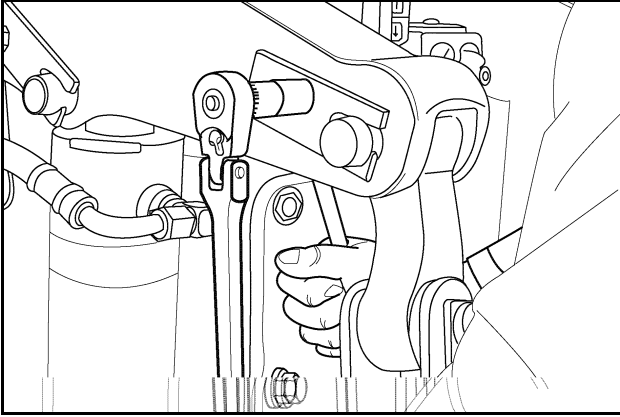


Attach a vertical lift link as follows:

1. Pin must be clean and free of oil, grease, anti-seize.
2. Place a hitch swivel pin part-way through the outside hole in the upper end of a vertical lift link.
3. Lift the link into position.
4. Insert the hitch swivel pin into the mating holes.



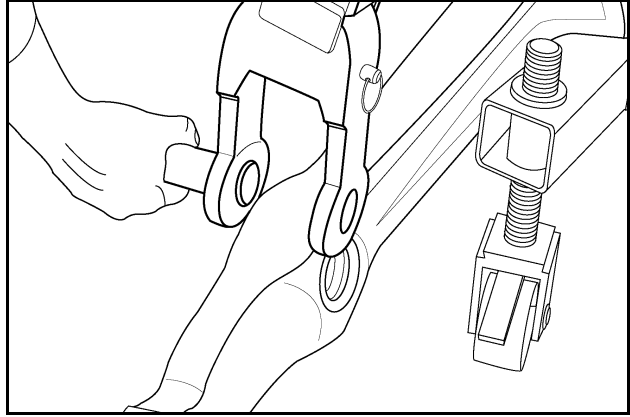
## STEP 45



26-21

Install the hex-head bolt, washer, spacer and nut. Tighten it to a torque of 82 to 106 Nm (60 to 78 lb. ft.). Repeat for the other vertical lifting link.

## STEP 46



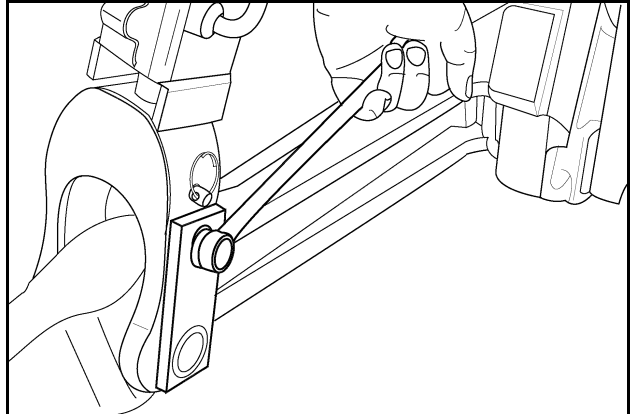
26-33

Insert a hitch swivel pin through the inside hole at the bottom of the vertical lifting link. Lift up the draft arm and insert pin. Pin must be clean and free of oil, grease, anti-seize compound, etc.

**NOTE:** Be sure the lift link is properly timed.

**NOTE:** Be sure there is alignment of parts. Refer to Steps 6 and 10.

## STEP 47

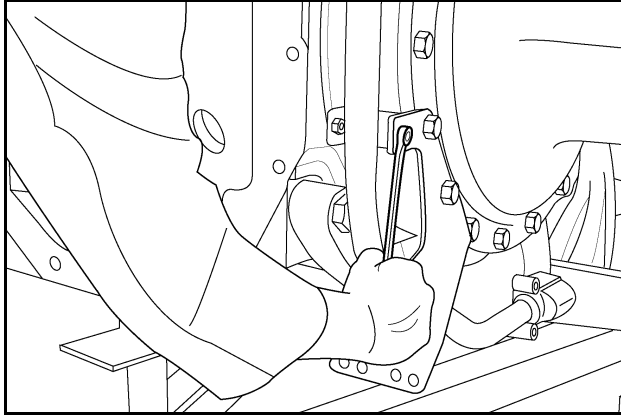


76-5

Install the locking flag plate as follows:

1. Insert the locking flag plate.
2. Install the bolt and nut. Tighten to a torque of 82 to 106 Nm (60 to 78 lb. ft.).

## STEP 48



27-5

Install the EDC components (refer to exploded view for Step 4) as follows:

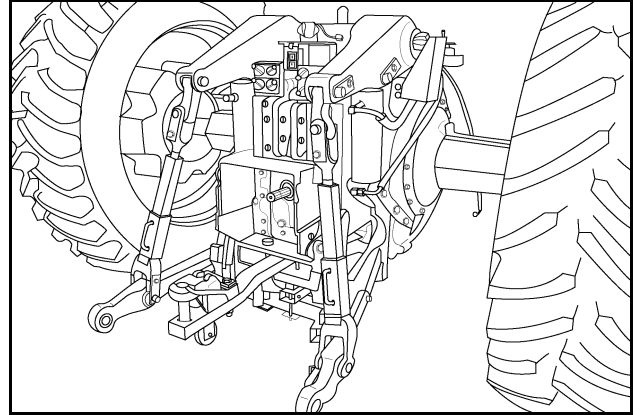
1. Move a lower draft arm into position for installation. If necessary, refer to the view in Step 10.
2. Install the cover, EDC pin, and tube subassembly in place to secure the draft arm

**NOTE:** Refer to EDC Pin Assembly for application of antisieze and silicon. Remove all original silicon before applying new silicon.

3. Install the three bolts to hold the cover in place.
4. Install the shoulder bolt in the upper forward hole.
5. Install the bolt to secure the tube. Tighten to a torque of 17 to 31 Nm (13 to 23 lb. ft.).
6. Tighten to a torque of 62 to 80 Nm (57 to 73 lb. ft.).

**NOTE:** For details on assembly of the EDC pin, refer to EDC Pin Assembly in this section.

## STEP 49



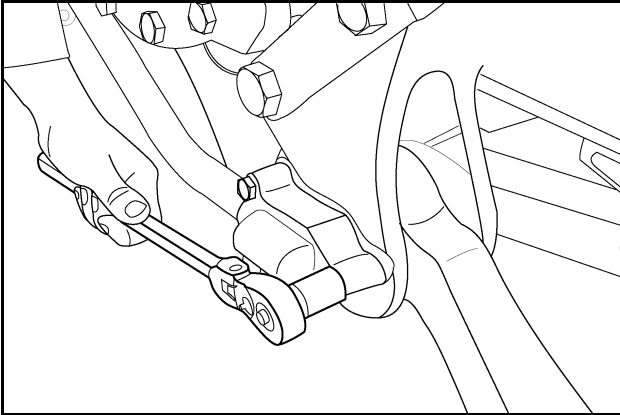
26-16

Check hitch operation as follows:

1. Turn on the ignition key.
2. Operate the hitch slowly for one cycle.
3. If there are not visible problems, operate the hitch for several cycles and check for binding or malfunction.
4. Attach top link.
5. Install quick coupler
6. Calibrate hitch. (refer to Hitch Controller Section in this Service Manual.)

## EDC PIN ASSEMBLY

### STEP 50



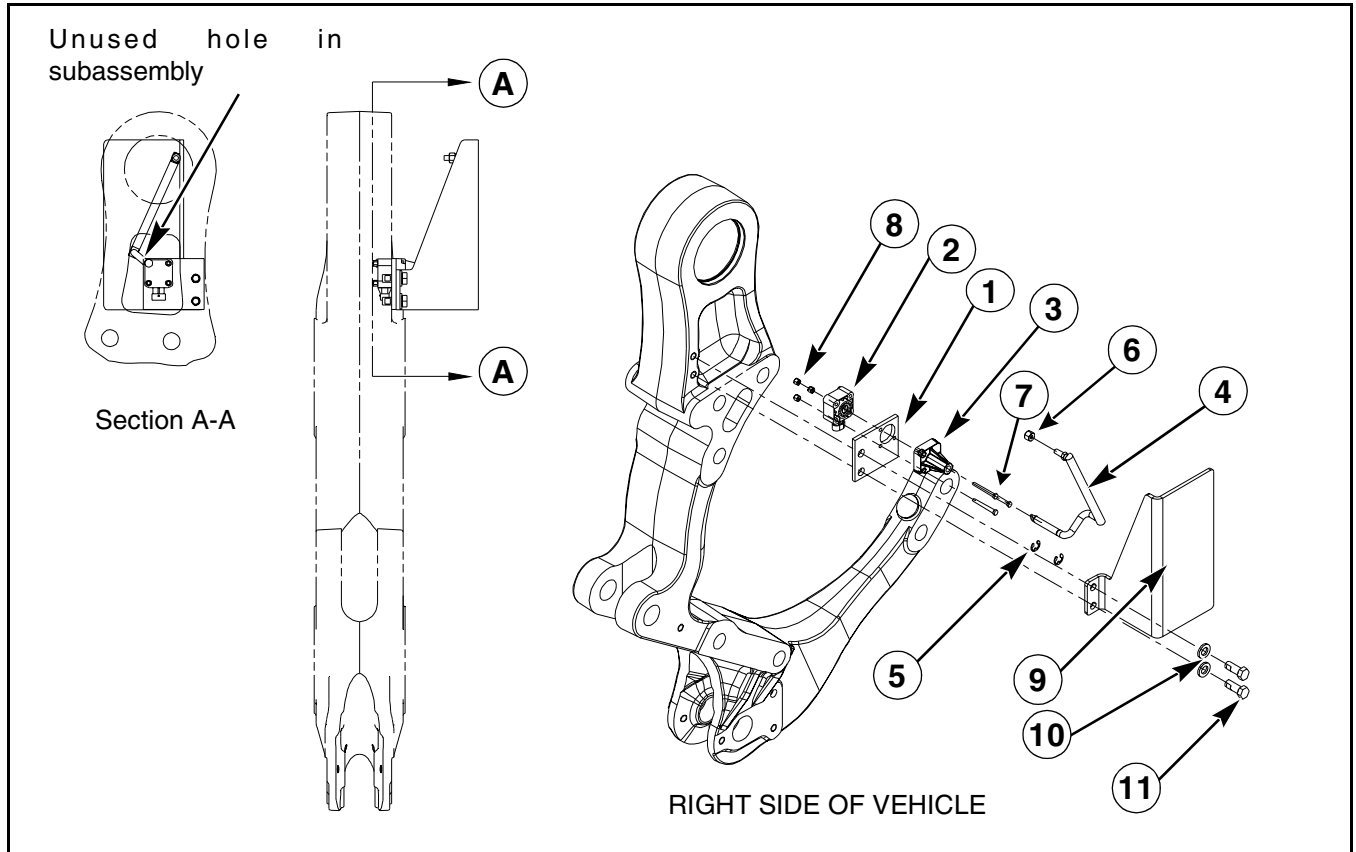
26-36

Install electronic draft control (EDC) pin and pin wire tube as shown in the exploded view for Step 4. Continue installation as follows:

1. Apply RTV sealant on the inner surface of the cover, lower end of tube, and grommet. On the tube and cover, the bead of sealant should surround the entire 360 degrees of the component. On the grommet, the bead should be applied where wire exits at the top and between the grommet and tube. Apply a 5 MM. bead all around.
2. Place anti-seize compound on the EDC pin and install pin.
3. Install the cover. Check the finished installation. All voids in sealant must be closed. If necessary, reapply RTV sealant to fill voids.
4. Slide EDC conduit past EDC connector on wire harness. Assemble the EDC connector. Slide conduit back over the EDC connector and flush with the top of the grommet.

**NOTE:** *There is no conduit on the left side EDC assembly. Otherwise the left and right assemblies are identical.*

## POTENTIOMETER (HITCH POSITION SENSOR)



INF6913

31. BRACKET  
32. SENSOR  
33. BUSHING  
34. LINK ASSEMBLY

35. RING  
36. NUT  
37. BOLT  
38. NUT

39. SHIELD  
40. WASHER  
41. BOLT

## Disassembly

**NOTE:** *Be sure to remove the M8 nut that attaches the link to the position locator bracket located on the rockshaft.*

### STEP 51

After the linkage shield for the potentiometer (hitch position sensor) is removed. The potentiometer subassembly can be removed as a unit.

### STEP 52

Remove the three nuts holding the sensor, bracket and bushing together. Separate these three components.

**STEP 53** Remove the E-ring from each side of the bushing.

**STEP 54** Remove the link from the bushing.

## Assembly

### STEP 55

Lubricate the link and slide it into the bushing as far as possible. Install an E-ring on the backside of the bushing.

### STEP 56

Pull the link back until the E-ring bottoms out. Install the second E-ring.

### STEP 57

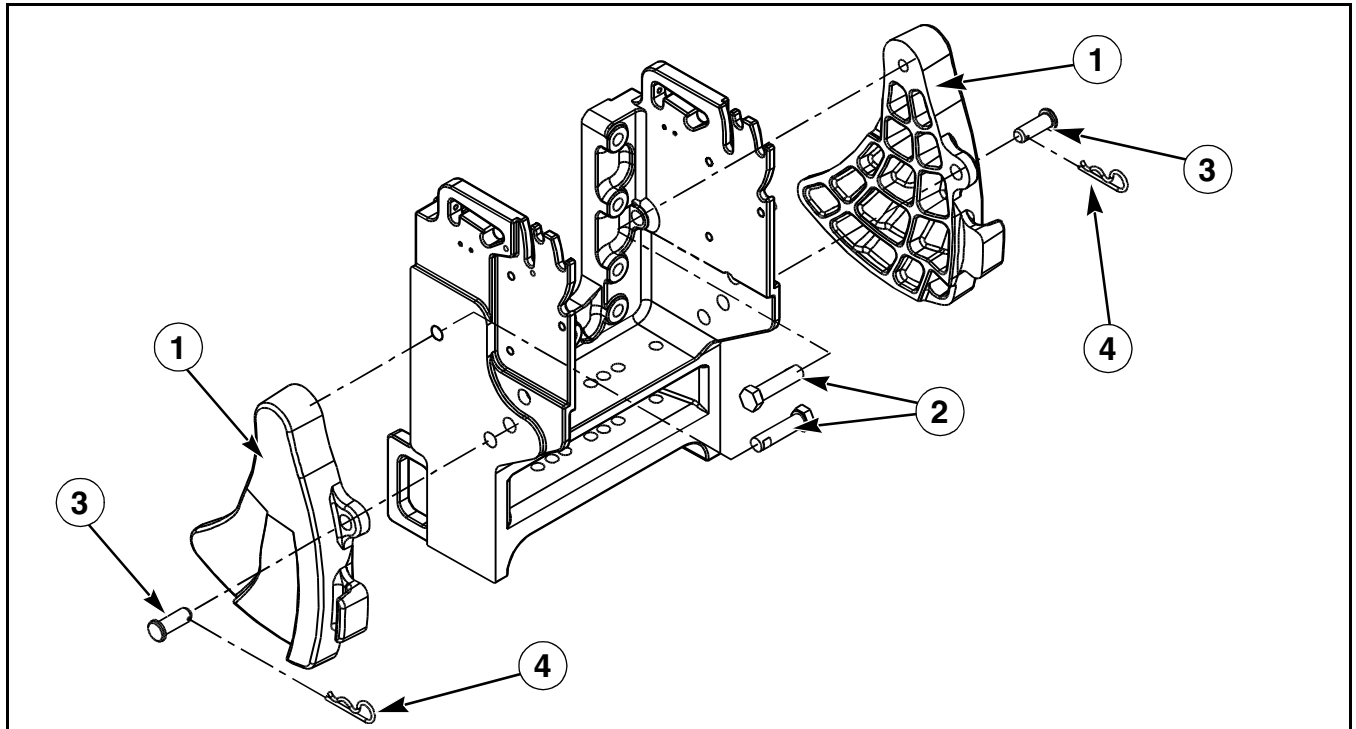
Hold the bushing and link subassembly. Position the bend in the link over the corner that does not have a bolt. Insert the three bolts into the bushing. Slide the bracket over the three bolts. Slide the potentiometer over the bolts. Position the tip of the link into the slot as the potentiometer slides into position. The link should be positioned as the parts are assembled (as shown in Section A-A).

### STEP 58

Install the three nuts and tighten to a torque of 3.5 to 6.3 Nm (2.6 to 4.6 lb. ft.).

## CAM SWAY LIMITER

### Removal



INF5577A

42. CAM  
43. PIVOT BOLT

44. CLEVIS PIN  
45. LOCKING PIN

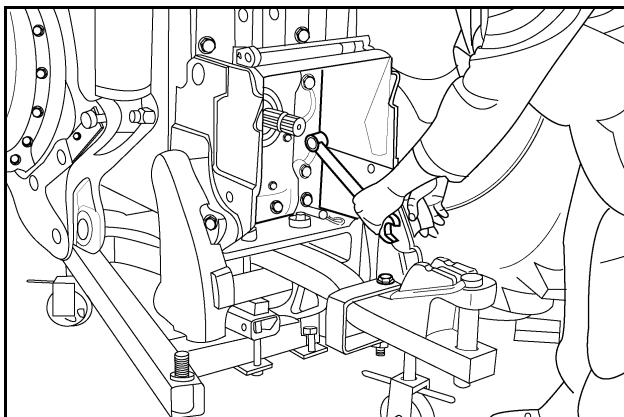
### STEP 59

Remove the sway limiter cam as follows:

1. Place a suitable support under the sway limiter cam to stop the cam from dropping when the bolt is removed.
2. Remove the locking pin from the clevis pin.
3. Remove the clevis pin.
4. Remove pivot bolt.
5. Remove cam.

## Installation

### STEP 60

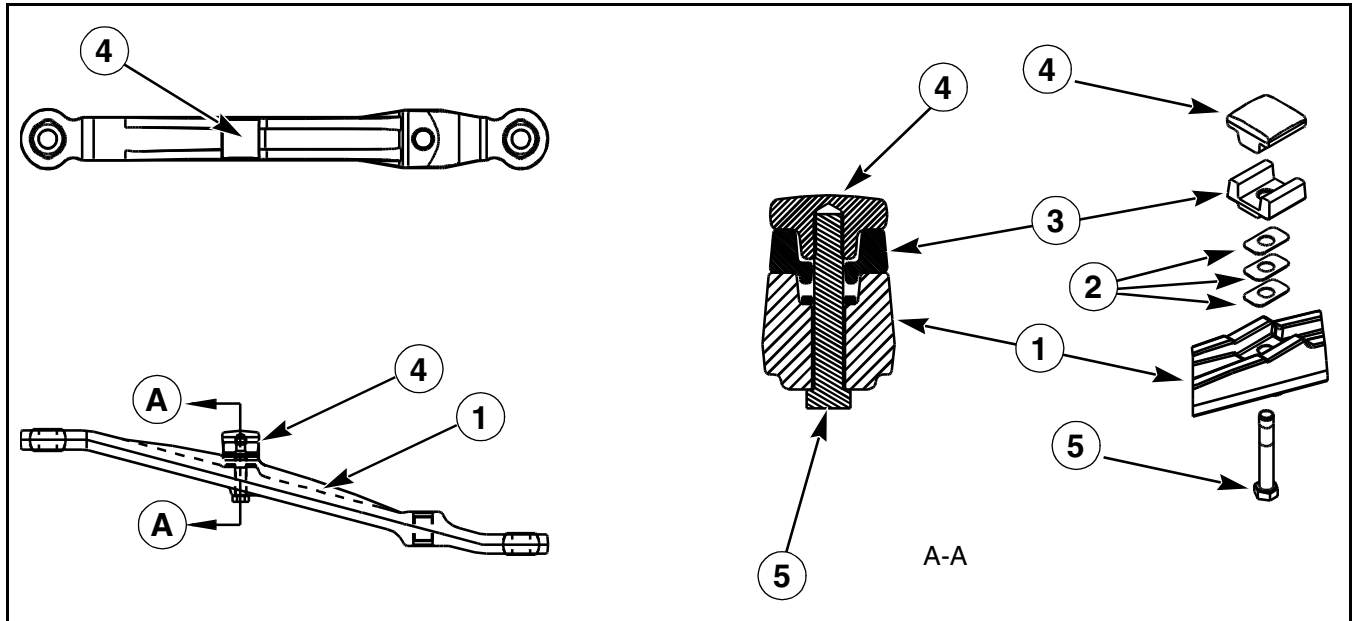


27-27

Install the sway limiter cam as follows:

1. Move cam into position.
2. Install the pivot bolt. Turn the bolt until bolt head contacts the drawbar support bracket. Back out the pivot bolt by 1/8th turn.
3. Install clevis pin.
4. Install locking pin.
5. Remove support.

## CAM BUMPERS FOR DRAFT ARM



6166H2

- 1. DRAFT ARM (LOWER LINK) ASSEMBLY
- 2. SHIM
- 3. SPACER

- 4. BUMPER
- 5. LOCKING BOLT

### Removal

**NOTE:** Each cam bumper is located on a lower draft arm of the hitch.

#### STEP 61

Remove a draft arm cam bumper as follows:

1. Loosen and remove locking bolt.
2. Carefully remove the draft arm bumper and other parts.
3. Keep shims separate from other parts in new order.

### Installation

#### STEP 62

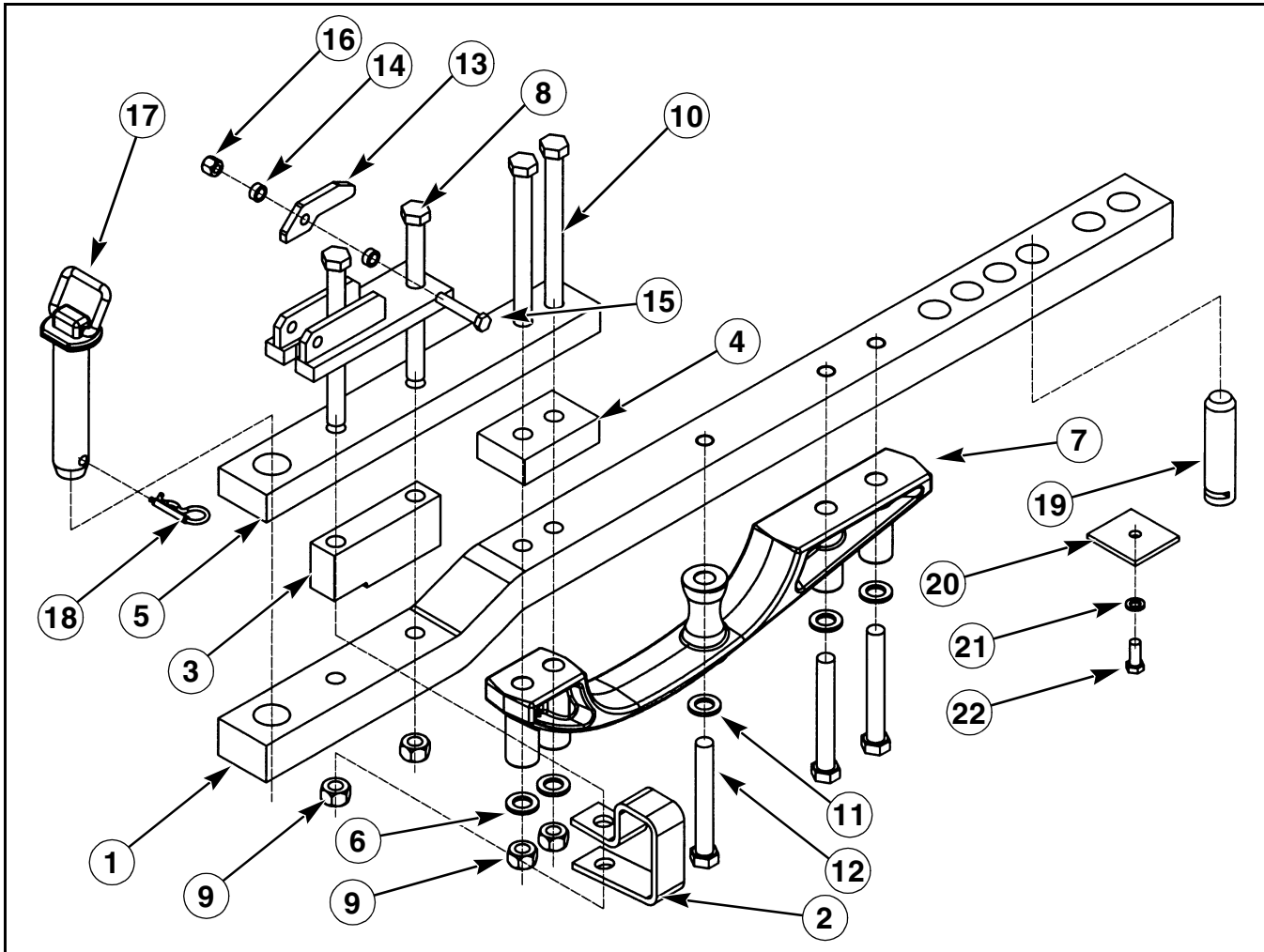
Install a cam bumper as follows:

1. Place a bolt through the draft arm from the back side.
2. Stack shims over the bolt shank on front side.
3. Place the cam bumper spacer over the bolt shaft with the high risers facing away from the draft arm.
4. Start the draft arm bumper onto the locking bolt.

Turn locking bolt into bumper and tighten bolt to 385 to 495 Nm (285 to 365 lb. ft.).



## DRAWBAR, HIGH VERTICAL CAPACITY



RH98H044

- |                         |                              |
|-------------------------|------------------------------|
| 6. HEAVY-DUTY DRAWBAR   | 17. M20X150 BOLT             |
| 7. SAFETY CHAIN SUPPORT | 18. HAMMERSTRAP LATCH        |
| 8. DRAWBAR STRAP SPACER | 19. HAMMERSTRAP LATCH SPACER |
| 9. HAMMERSTAP SPACER    | 20. BOLT                     |
| 10. HAMMERSTRAP         | 21. NUT                      |
| 11. WASHER              | 22. HAMMERSTRAP PIN          |
| 12. DRAWBAR SUPPORT     | 23. COTTER PIN               |
| 13. M20X220 BOLT        | 24. PIVOT PIN                |
| 14. NUT                 | 25. PIN RETAINER             |
| 15. M20X260 BOLT        | 26. WASHER                   |
| 16. WASHER              | 27. BOLT                     |

### Removal

#### STEP 63

Remove the hammerstrap pin (17) and cotter pin. Remove two M20x220 bolts (8). Remove two M20x260 bolts (10). Remove hammerstap (5) and spacers.

#### STEP 64

Remove the three M20 x150 bolts (12) bolts attaching the drawbar support (assist casting) to the high vertical capacity drawbar. Remove the support. Remove the bolt and washer for the pin retainer (20). Remove the retainer.

## Installation

### STEP 65

Install the pin retainer and washer; tighten the bolt to a torque of 134 to 151 Nm (99 to 111 lb. ft.). Install the drawbar support (assist casting) under the drawbar as shown.

### STEP 66

Tighten the three M20 x 150 bolts to a torque of 485 to 620 Nm (358 to 458 lb. ft.). Install the spacers and hammerstrap. Install the two M20 x 260 bolts and tighten to a torque of 486 to 620 Nm (358 to 458 lb. ft.). Install two M20 x 220 bolts to and tighten to a torque of 485 to 620 Nm (358 to 458 lb. ft.). Install the hammerstrap pin and cotter pin. If hammerstrap latch was removed, tighten the bolt to a torque of 71 to 128 Nm (52 to 94 lb. ft.).

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# **Section 41**

## **Chapter 1**

**STEERING COLUMN AND STEERING HAND PUMP**

**REMOVAL AND INSTALLATION**

**TABLE OF CONTENTS**

SPECIAL TOOLS ..... 41-1-2

SPECIAL TORQUES ..... 41-1-3

STEERING COLUMN REMOVAL ..... 41-1-3

STEERING HAND PUMP SERVICE ..... 41-1-6

STEERING COLUMN ASSEMBLY ..... 41-1-8

**SPECIAL TOOLS**

380000795 - Steering Line Quick Disconnect Tool

## SPECIAL TORQUES

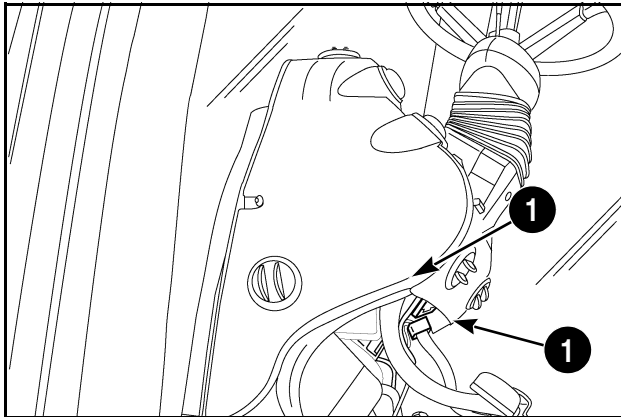
Bolt for Steering Hand Pump Bracket and Isolator .....	32 to 36 Nm (24 to 27 lb. ft.)
Lock Nut for Steering Column Base .....	29 to 32 Nm (22 to 24 lb. ft.)
Nut for Steering Wheel .....	45 to 54 Nm (33 to 40 lb. ft.)

## STEERING COLUMN REMOVAL

### STEP 1

Park the tractor on a hard level surface. Put the transmission shift lever in PARK. Turn off the engine and remove the key. Place blocks in front of and behind the rear wheels.

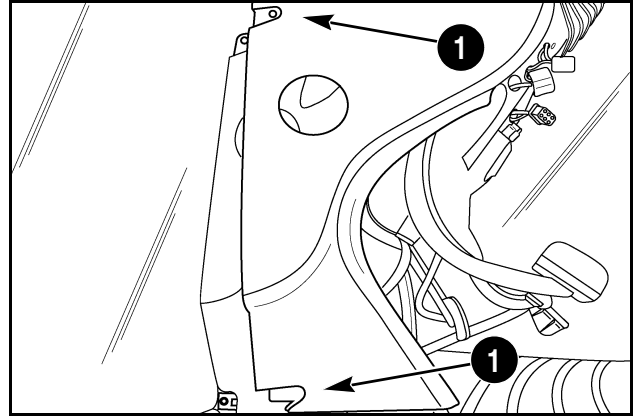
### STEP 2



RD02C075

Remove the two screws (1) from the lower console panel. Leave the circular heater duct outlets in the panel. Disconnect the electrical plugs from the ignition and light switch and remove the panel.

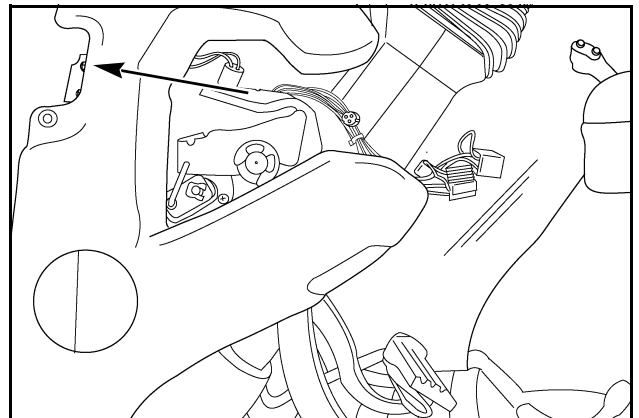
### STEP 3



RD02C083

Remove all circular heater duct outlets from the upper console panel. Remove the two retaining screws (1) on each side of the panel. Disconnect the electrical plugs from the switches and upper indicator lights. Pull up on the cab floor mat on both sides of the upper console panel and remove the panel.

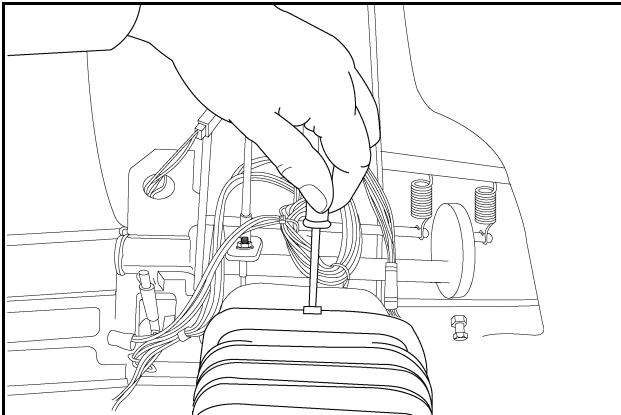
### STEP 4



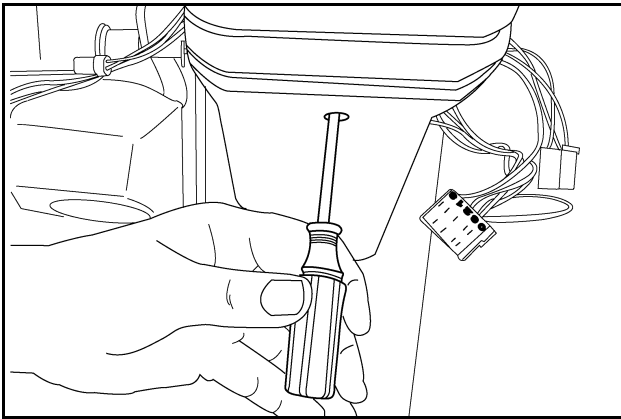
RD02C085

Remove the heat duct retaining screw on the left and right heat ducts. Pull up on the cab floor mat and remove the left console heat duct. Move the right heat duct to the right. Removal is not necessary.

## STEP 5



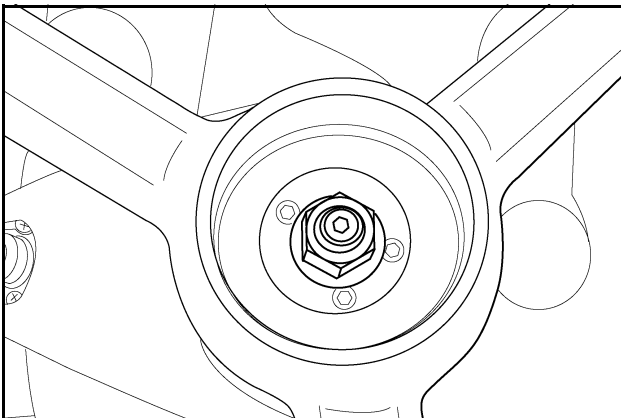
RD02C095



RD02C093

Use a Torx screwdriver to remove the upper and lower steering column covers.

## STEP 6

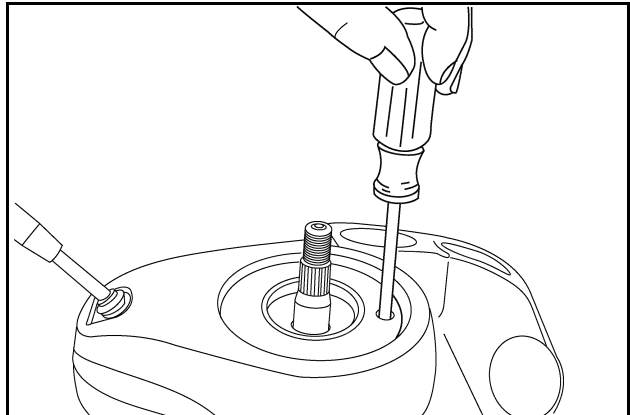


RD02C090

Remove the horn button. Remove the steering wheel retaining nut and flat washer. Mark the position of the steering wheel on the column for reassembly. Remove the steering wheel with a swift, upward pull.

**NOTE:** If the steering wheel cannot be removed by the method above, use a steering wheel puller.

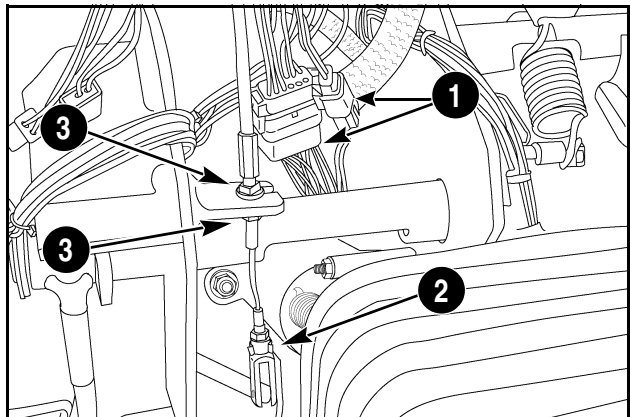
## STEP 7



RD02C098

Remove the retaining screw from the steering column upper control housing.

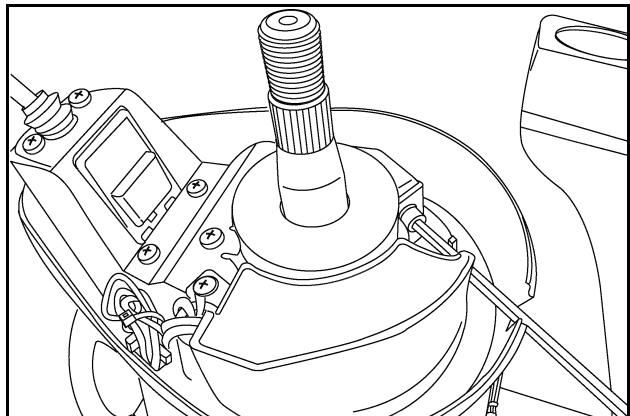
## STEP 8



RD02C096

Remove the two steering column electrical connectors (1). Remove the cable clip with pin (2) from the steering column tilt mechanism cable. Loosen the cable lock nuts (3) from the anchor bracket, and move the cable aside.

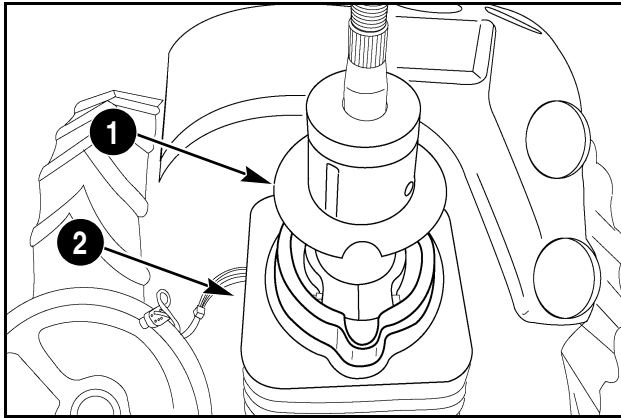
## STEP 9



RD02C105

Loosen the socket head cap screw for the turn signal switch clamp and remove the lower control housing.

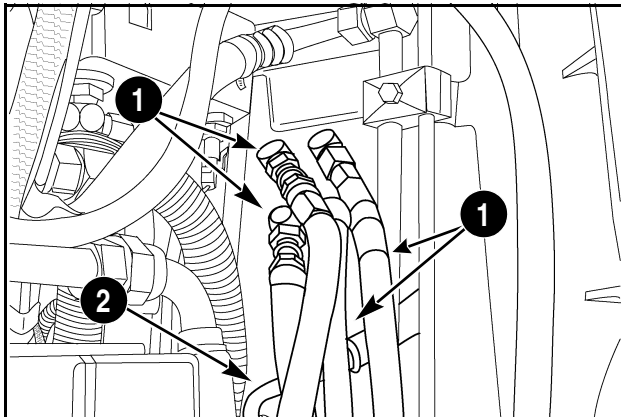
### STEP 10



RD02C109

Remove the boot support washer (1). Remove the steering column boot (2) along with the boot support plate and wire stiffener.

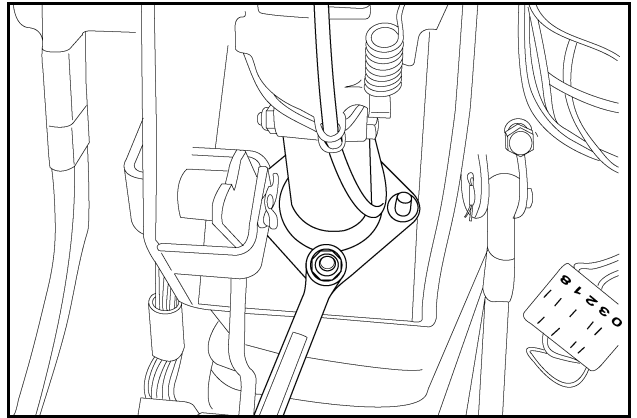
### STEP 11



RD02C074

Tag and remove the four hydraulic hoses (1) and the steering sensing line (2) from the steering hand pump. Cap the lines and open fittings. If your tractor is equipped with quick disconnect fittings, use special tool 380000795 to disconnect the lines.

### STEP 12



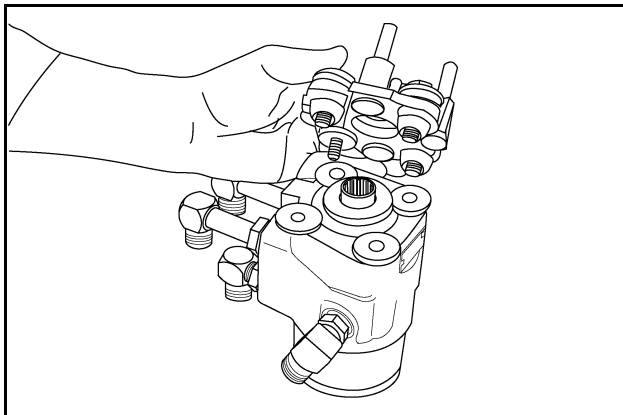
RD02C111

Remove the four steering column lock nuts and washers at the column base. Support the steering column in the cab while an assistant removes the steering hand pump from the cab firewall. Remove the steering column.



## STEERING HAND PUMP SERVICE

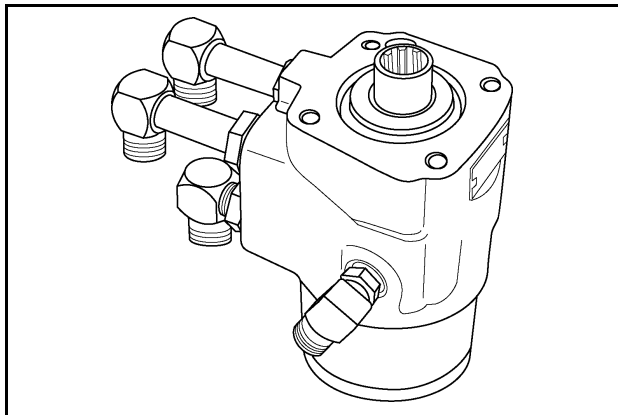
### STEP 13



114S26

Mark the position of the pump bracket and isolator on the steering hand pump. Loosen the bolts and remove as a unit.

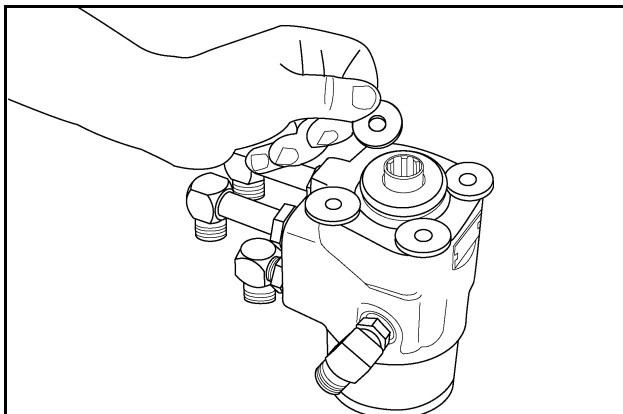
### STEP 16



114S9

Remove and replace the outer seal of the steering hand pump, if necessary.

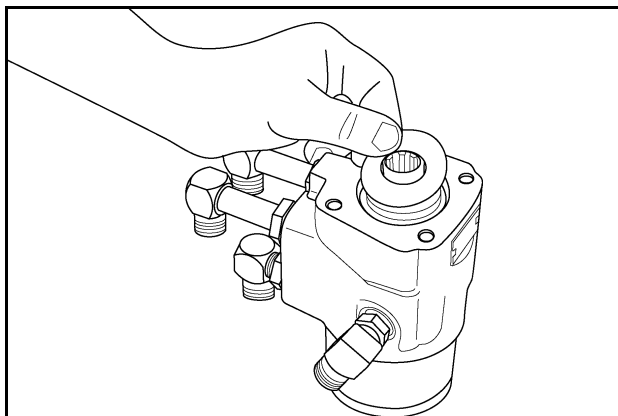
### STEP 14



114S15

Remove the four washers.

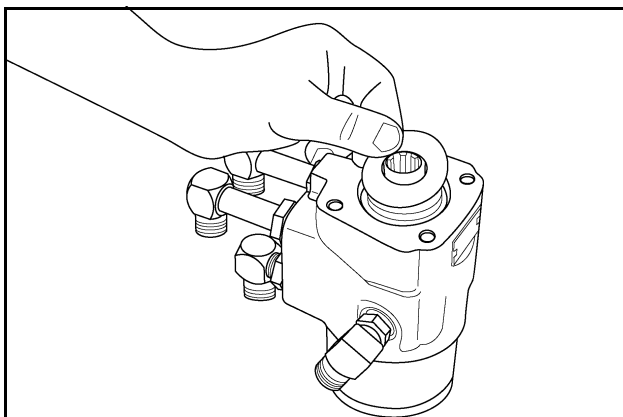
### STEP 17



114S12

Install a new shaft noise seal.

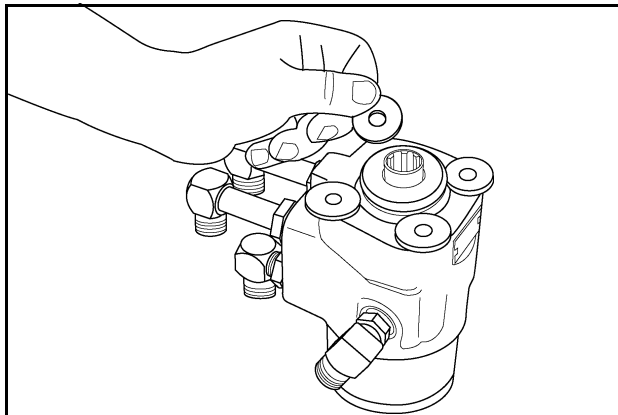
### STEP 15



114S12

Remove the shaft noise seal.

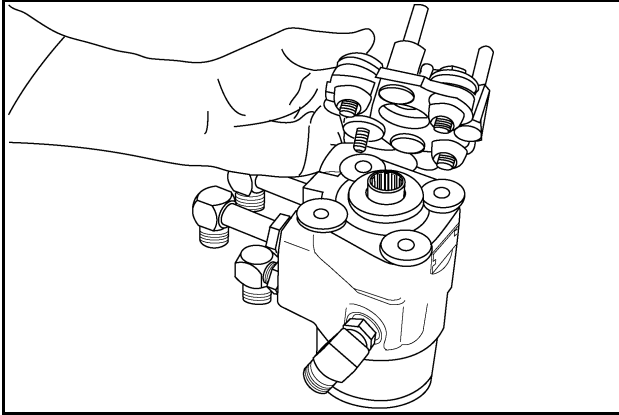
### STEP 18



114S15

Install the four washers.

## STEP 19

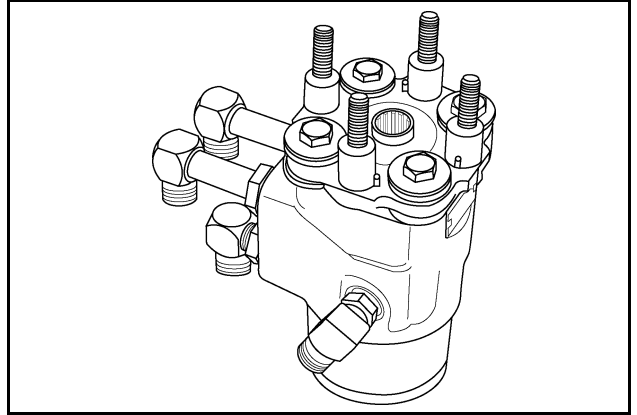


114S26

Check the pump bracket to make sure it is not warped or bent. Using the marks made during disassembly, install the pump bracket and isolator on the steering hand pump.

**NOTE:** *The pump bracket must be squarely aligned with the housing of the pump. Otherwise, the steering column may bind and not properly center. If this happens, the steering wheel will move constantly back and forth, trying to center.*

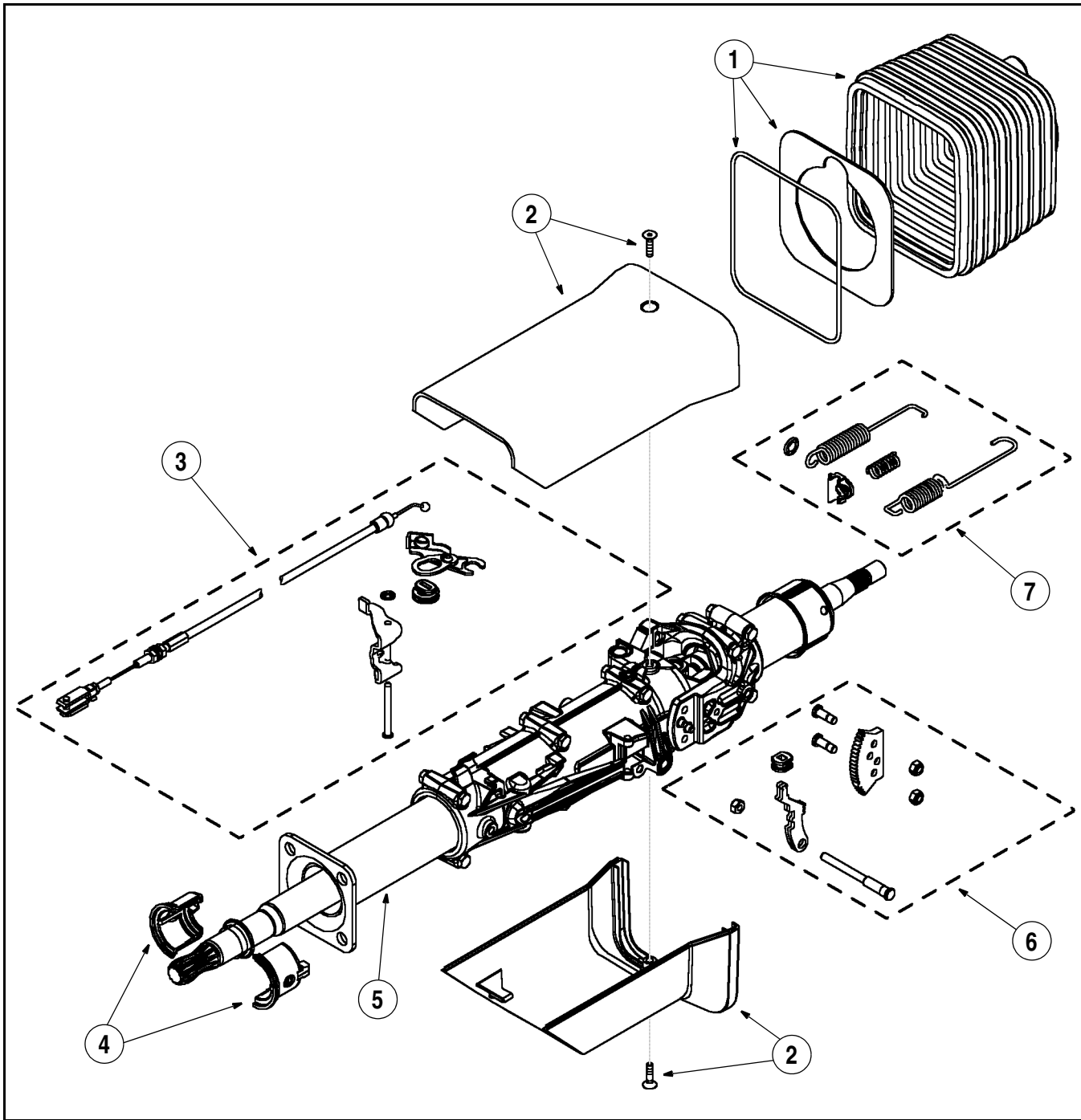
## STEP 20



114S29

Tighten the pump bracket bolts evenly in a crossing pattern to a torque of 32 to 36 Nm (24 to 27 lb. ft.). Lubricate the internal splines of the steering hand pump with grease.

## STEERING COLUMN ASSEMBLY

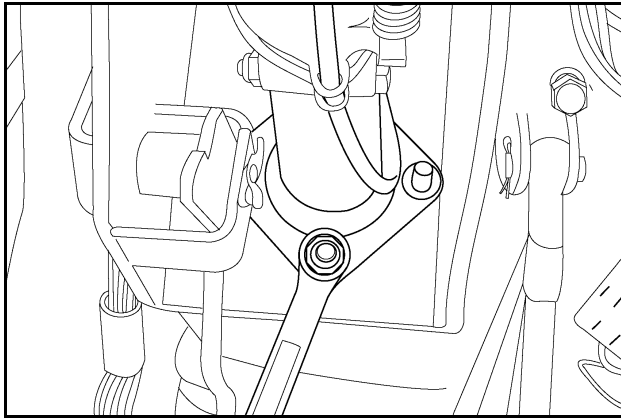


RI02G035

1. BELLOW SET
2. COVER SET
3. RELEASE DEVICE SET
4. BEARING SET

5. STEERING COLUMN
6. SEGMENT SET
7. SPRING SET

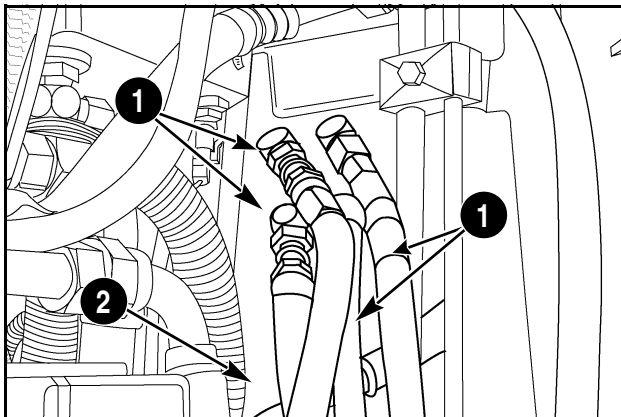
## STEP 21



RD02C111

Support the steering column in the cab while an assistant installs the steering hand pump. Install the steering column over the four studs and into the steering hand pump. Install the four washers and hand tighten the four new lock nuts at the column base. Install the steering wheel on the column just far enough to engage the steering mechanism.

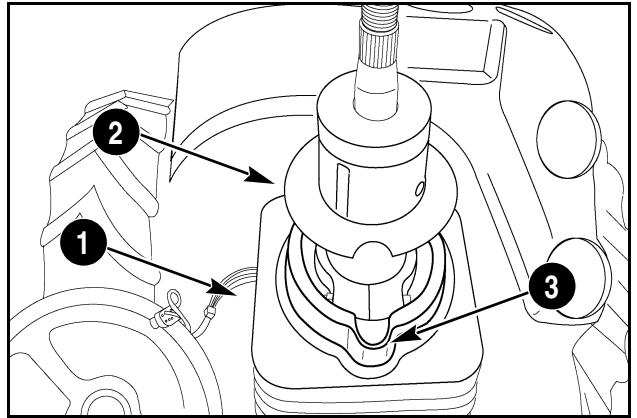
## STEP 22



RD02C074

Install the four hydraulic hoses (1) and the steering sensing line (2) on the steering hand pump. Check the hydraulic oil level. Temporarily install the ignition switch. Start the tractor. Turn the steering wheel to one stop, then the other. Re-center the steering wheel. Turn the engine off and unplug the ignition switch. Mark the top of the steering column shaft to identify the centered position. Tighten the steering column lock nuts to a torque of 29 to 32 Nm (22 to 24 lb. ft.). Remove the steering wheel.

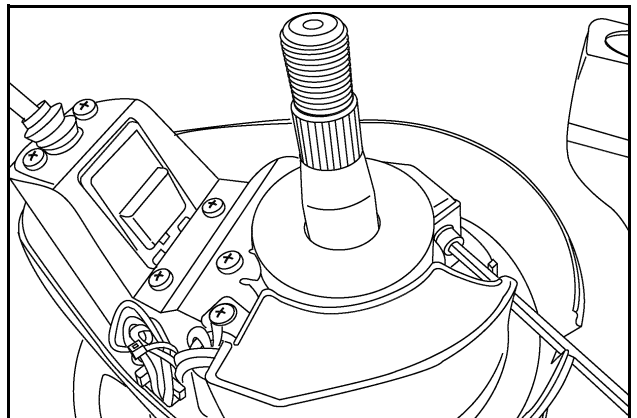
## STEP 23



RD02C109

Place the boot (1) with wire stiffener and boot plate installed, over the steering column. Partially install the boot support washer (2). Install the turn signal switch wiring harness through the protruding opening in the boot (3).

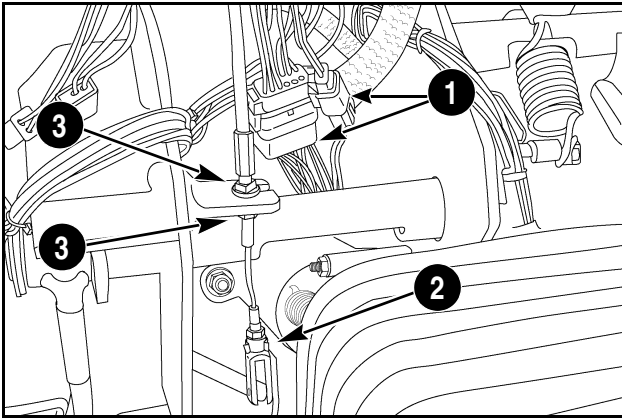
## STEP 24



RD02C105

Install the lower control housing assembly. Make sure the alignment tab on the turn signal switch clamp is located in the hole on the steering column collar. Tighten the socket head cap screw for the turn signal switch clamp.

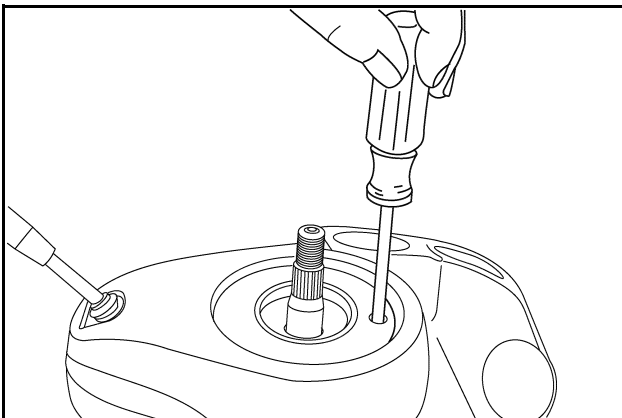
## STEP 25



RD02C096

Connect the two steering column electrical connectors (1). Install the cable clip with pin (2) for the steering column tilt mechanism cable. Install the cable into the anchor bracket and tighten the lock nuts (3).

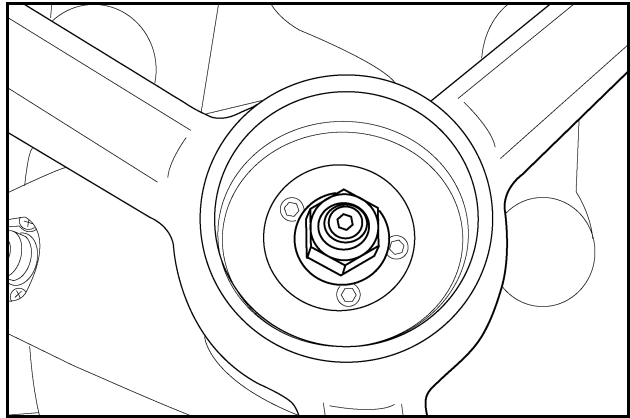
## STEP 26



RD02C098

Install the upper control housing and tighten the retaining screw.

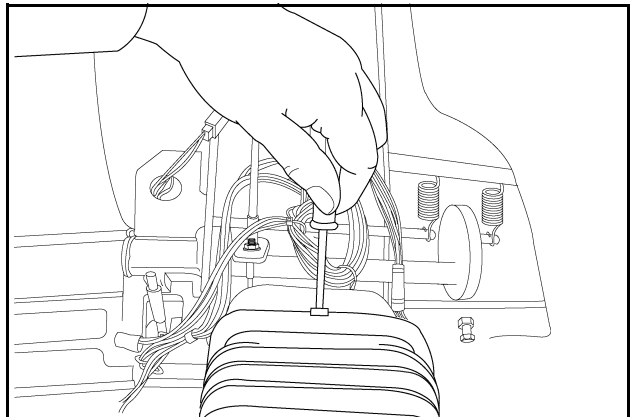
## STEP 27



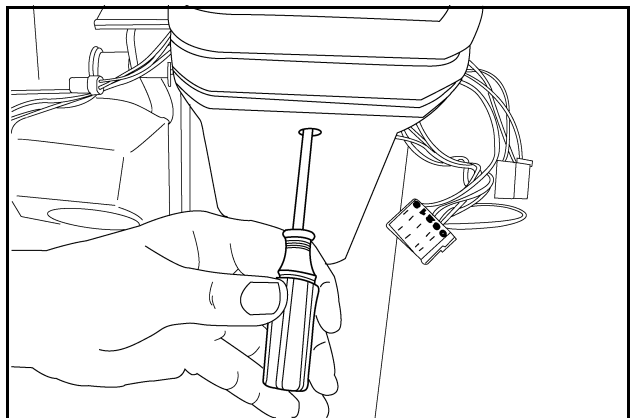
RD02C090

Use the steering wheel position mark made during disassembly, and the steering column shaft centering mark made during assembly, install the steering wheel. Install the steering wheel retaining nut and flat washer. Tighten the nut to a torque of 45 to 54 Nm (33 to 40 lb. ft.). Install the horn button.

## STEP 28



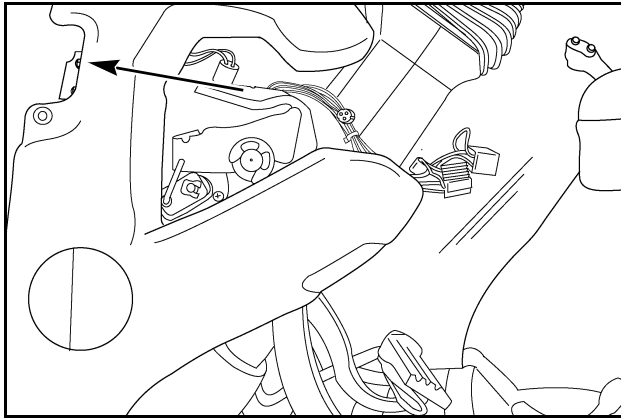
RD02C095



RD02C093

Use a Torx screwdriver to install the upper and lower steering column covers.

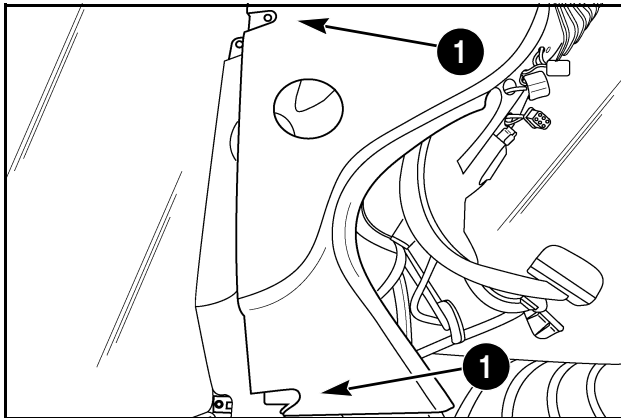
### STEP 29



RD02C085

Pull up on the cab floor mat and install the left console heat duct into the cab floor duct. Install the retaining screw. Position the right console heat duct and install the retaining screw.

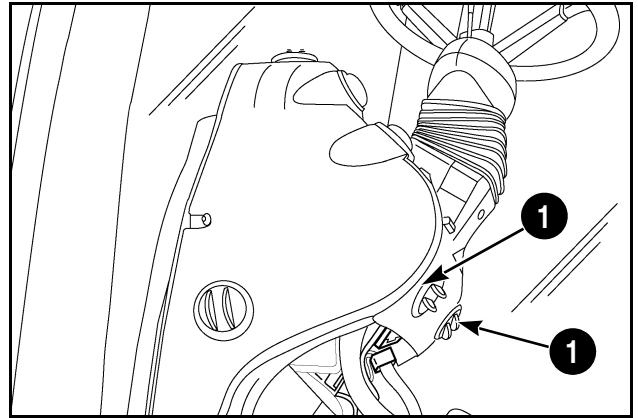
### STEP 30



RD02C083

Pull up on the cab floor mat and install the two screws (1) in the left side of the upper console panel. Repeat this procedure for the right side. Connect the electrical plugs to the switches and upper indicator lights. Install the circular heater duct outlets into the upper console panel.

### STEP 31



RD02C075

Connect the electrical plugs to the ignition switch and the light switch. Install the two screws (1) for the lower console panel.

### STEP 32

Make sure the transmission shift lever is in PARK. Start the engine and check the operation of the steering hand pump. Check the hydraulic fluid level. Add fluid as needed. Turn the engine off and remove the key. Remove the blocks in front of and behind the rear wheels.

**NOTE:** Do not hold the steering wheel during startup.



# **Section 41**

## **Chapter 2**

### **WHEEL TOE IN SETTING**

#### **SuperSteer FWD Axle**



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WHEEL TOE IN SETTING DIAGRAM ..... 41-2-9

SPECIAL TOOL LAYOUT DRAWINGS ..... 41-2-10

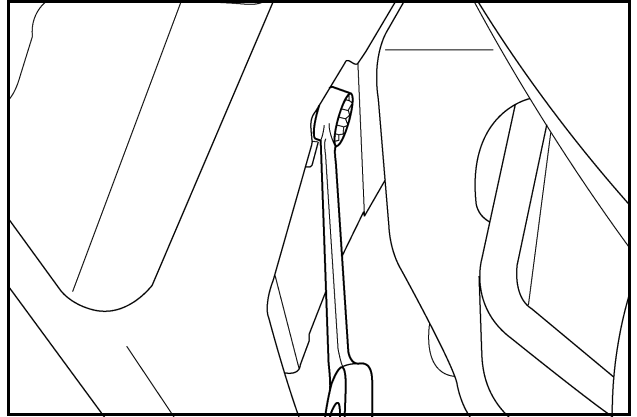
## WHEEL TOE IN SETTING

**NOTE:** The toe in setting must be done on a clean, level surface.

**NOTE:** See the special tool layout drawings at the end of this section to fabricate the required spacer tubes and straightedge before starting wheel setting procedure.

### STEP 1

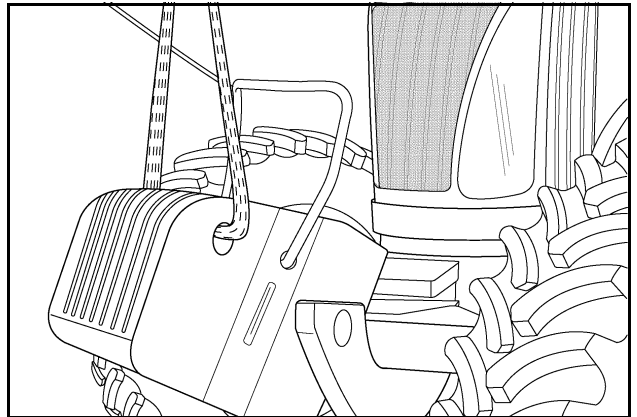
Install appropriate lift straps in the weight package (if equipped). Remove the weight package retaining bolts.



RD05E076

### STEP 2

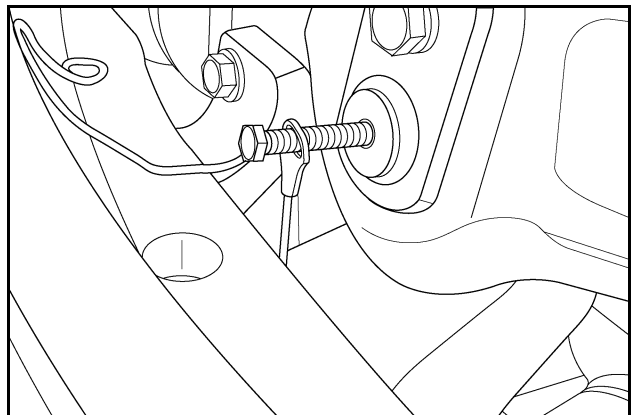
Carefully remove the weight package. Adjust the air pressure in both front tires so that they are equal.



RD05E077

### STEP 3

Remove the grease fitting from the upper linkage pin. Place a circular ring or other suitable device over an M10 x 60 - 1.0 bolt. (If metric bolt is not available, a 3/8 in. - 24 x 2.5 in. bolt may be substituted.) Attach a length of string and a plum bob to the ring. Allow the plum bob to swing freely in front of the drag link.



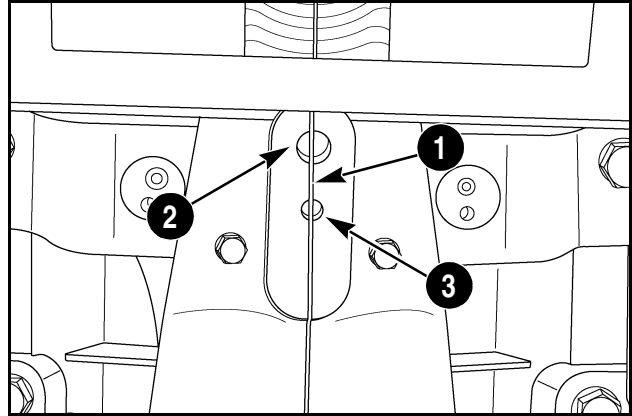
RD05E078

## STEP 4

Steer the axle until the string (1) hangs vertically and bisects the dowel hole (2) and threaded hole (3) in the drag link. The axle will then be "Dead Centered".

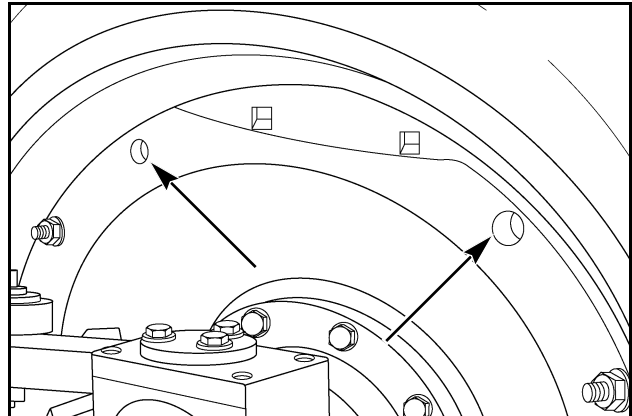
**NOTE:** The string must hang freely between the drag link and weight support bracket.

**NOTE:** If this step is not performed correctly, all other measurements and adjustments will be incorrect.



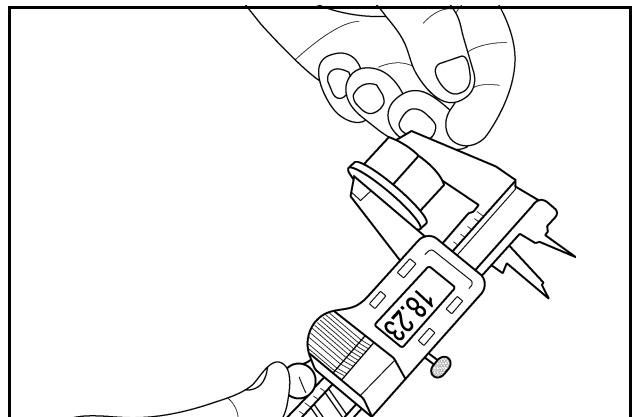
## STEP 5

Remove two nuts and washers from the rim mounting bolts from the location shown. Use an appropriate solvent to clean the nuts and washers.



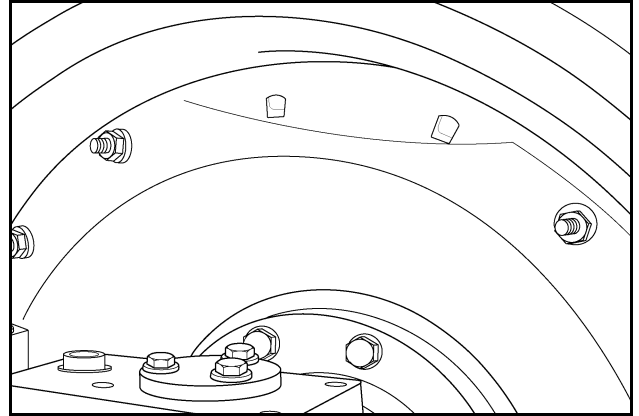
## STEP 6

Measure the combined thickness of the nut and washer. The stack height must be within 0.05 mm (0.002 in.) of each other. If they are not within specification, obtain new hardware and verify combined thickness.



## STEP 7

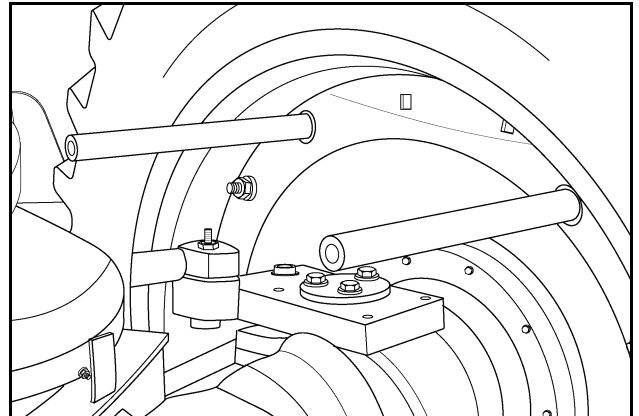
Be sure the rim surface in the nut area is free of dirt rust or debris as this will affect the accuracy of future measurements. Install and tighten the measured washers and nuts.



RD05E083

## STEP 8

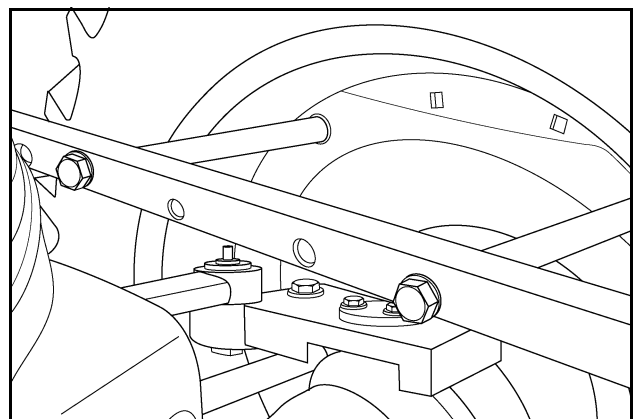
Install the two fabricated threaded spacer tubes onto the rim bolts. Hand tighten firmly against the rim.



RD05E084

## STEP 9

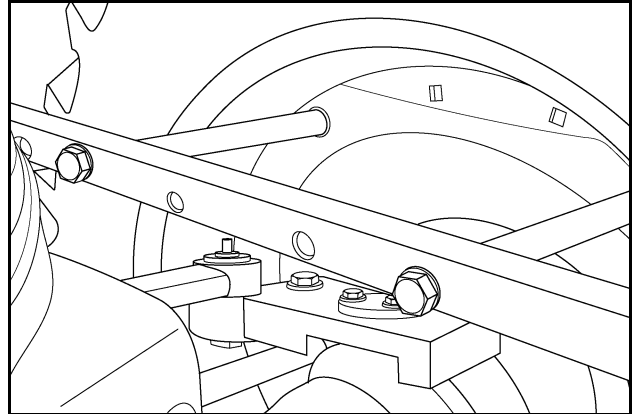
Install the fabricated straightedge onto the two spacer tubes using two M16 bolts.



RD05E085

## STEP 10

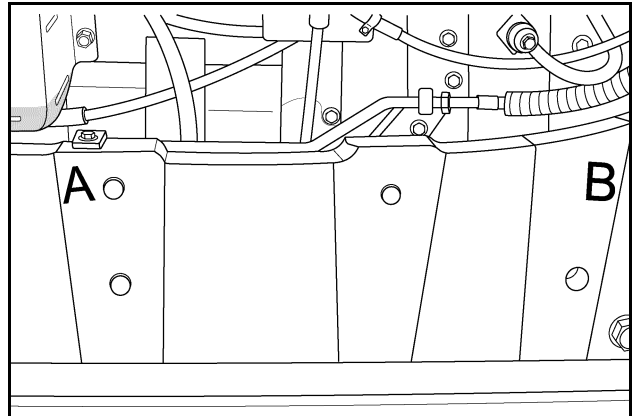
Make sure that the wheel/rim is positioned so that the straightedge is parallel to the floor when mounted on the spacer tubes.



RD05E086

## STEP 11

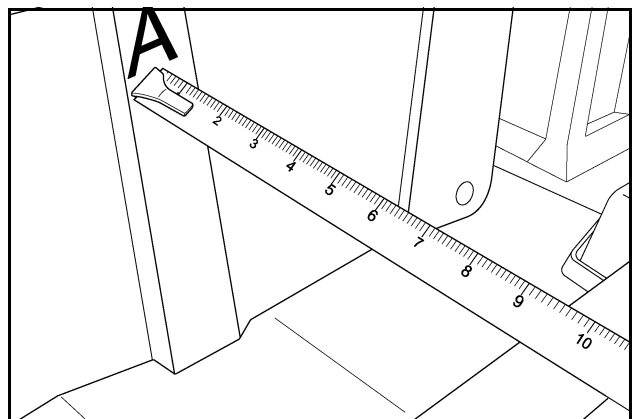
Locate two points about 500 mm (20 in.) apart on the machine frame milled surface. Mark these points "A" and "B".



RD05E087

## STEP 12

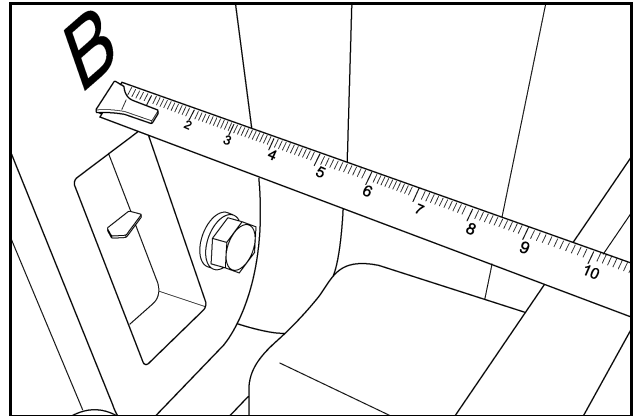
Measure and record the distance from the straightedge to point "A".



RD05E088

### STEP 13

Measure and record the distance from the straightedge to point "B". The difference between measurements "A" and "B" must not exceed 1mm. Measurement "A" should not be larger than measurement "B".



RD05E089

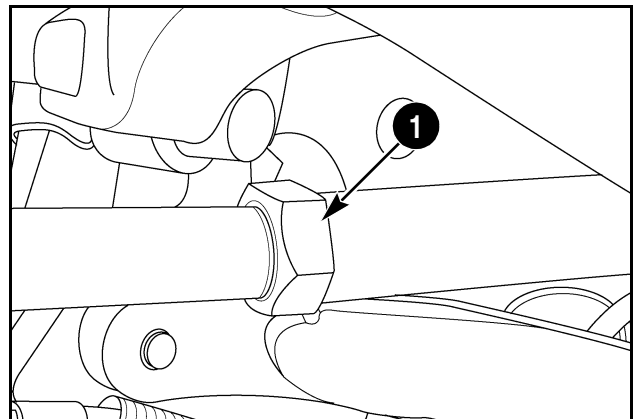
### STEP 14

If adjustment is necessary, loosen the tie rod tube locking nut (1). Disconnect the steering lines from the outboard ends of both steering cylinders to avoid repositioning of the axle.

Turn the tube (when viewed from the wheel) clockwise to shorten the tie rod. Turn the tube counterclockwise to lengthen the tie rod.

**NOTE:** Check to be sure that the axle is still "Dead Centered" after the tie rod had been adjusted. If the axle has moved from the dead center position, the steering cylinder lines will have to be connected and the axle must be steered back to dead center.

Check measurements "A" and "B" again with the axle dead centered. If the measurements are within specification, repeat the procedure on the other side of the tractor.



RD05E093

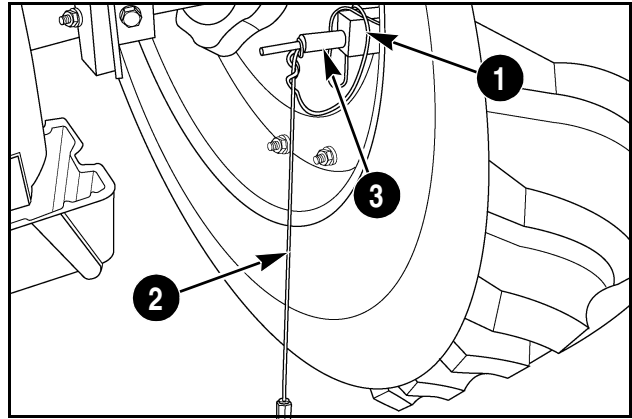
## Setting Verification

Verification of the toe in setting is done by taking plumb bob measurements from the rims. Be sure the axle is still dead centered before starting the checking procedure.

### STEP 15

Install a magnetic base (1) for a dial indicator on the front inside of the rim. Locate the base on the rim at the center line of the axle (so that it is on the most forward part of the rim).

Hang a plumb bob (2) on the base. Install a spacer of other suitable device (3) so that the distance from the string to base remains constant.

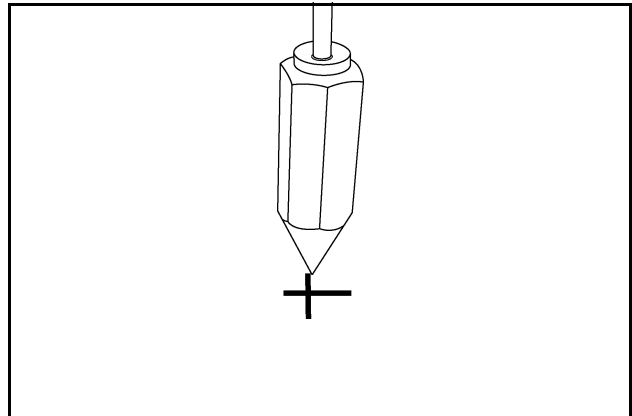


RD05E090

### STEP 16

Accurately mark the point where the plumb bob intersects the floor. Repeat the procedure at the rear inside of the rim.

A total of four marks will be made, two from each tire.

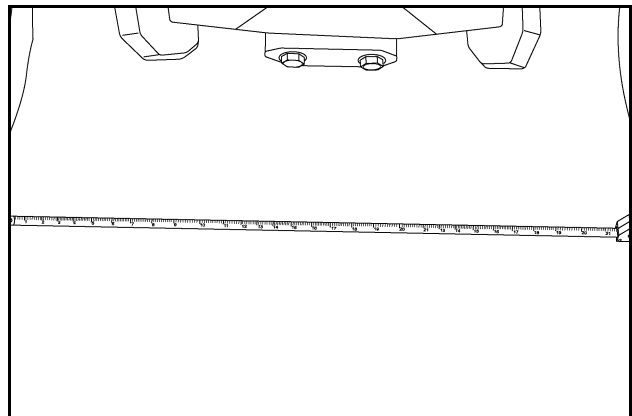


RD05E091

### STEP 17

Accurately measure and record the distance across the two rear marks. Repeat the measurement across the front two marks. Compare the two measurements. The distance across the front marks should be within 3 mm of the rear measurement. The front distance should never be larger than the rear distance.

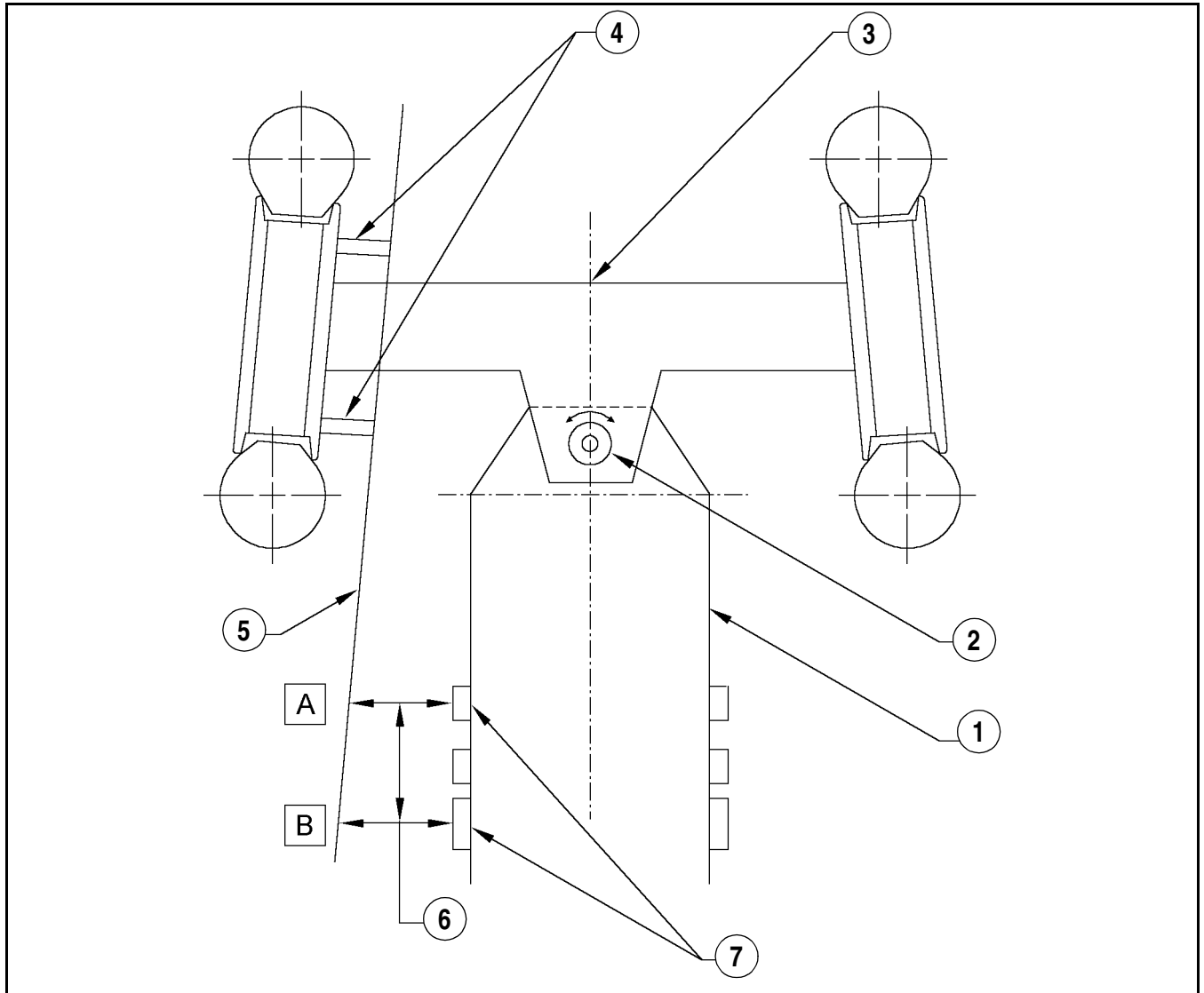
If not within specifications, adjust the tie rod tubes equally to correct the toe in setting. Rotate the adjustment tube 1/4 turn at a time and check the toe setting by marking four new points using the plumb bob and string. Be sure the axle remains dead centered after each adjustment is made to the tie rods.



RD05E092

## WHEEL TOE IN SETTING DIAGRAM

Top View Of Front Axle

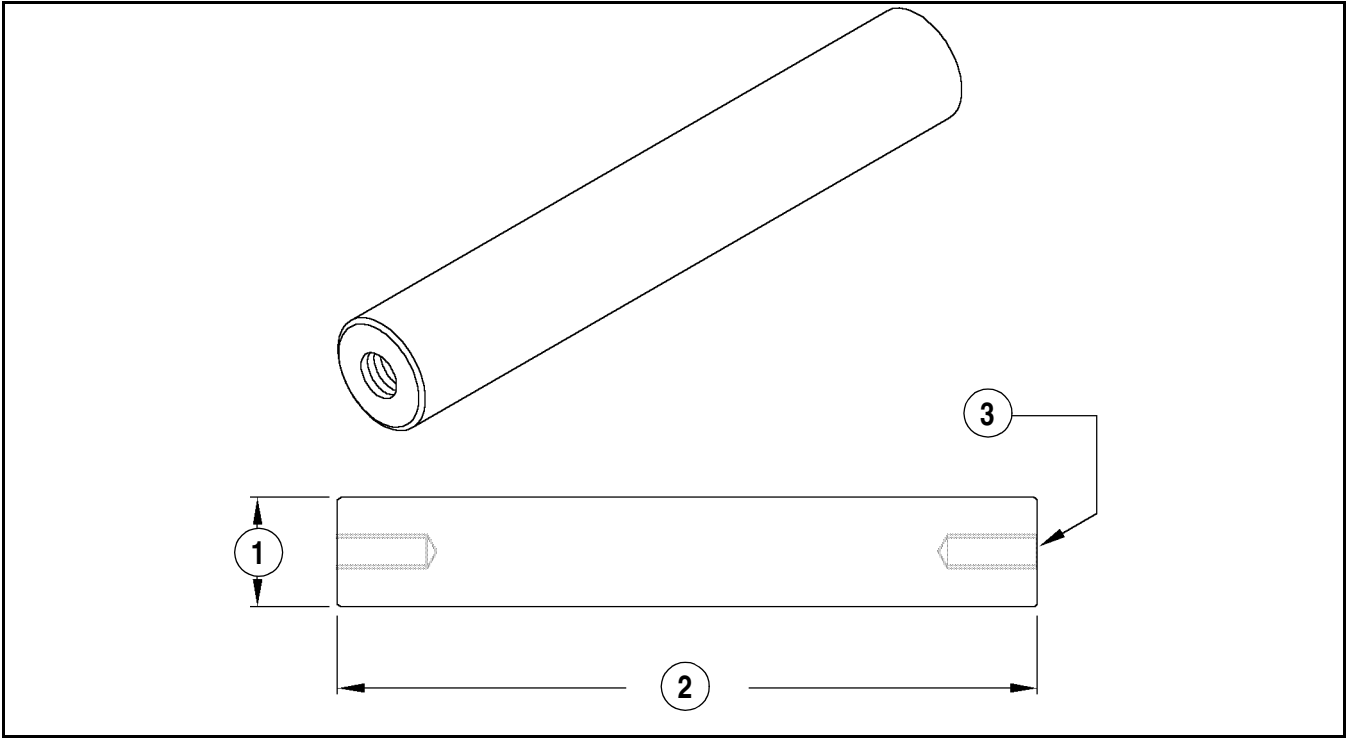


RI05E015

- |                       |                        |
|-----------------------|------------------------|
| 1. MAIN CHASSIS FRAME | 5. STRAIGHTEDGE        |
| 2. AXLE               | 6. 500 MM (20 IN.)     |
| 3. AXLE DEAD CENTER   | 7. MACHINED FRAME PADS |
| 4. SPACER TUBES       |                        |

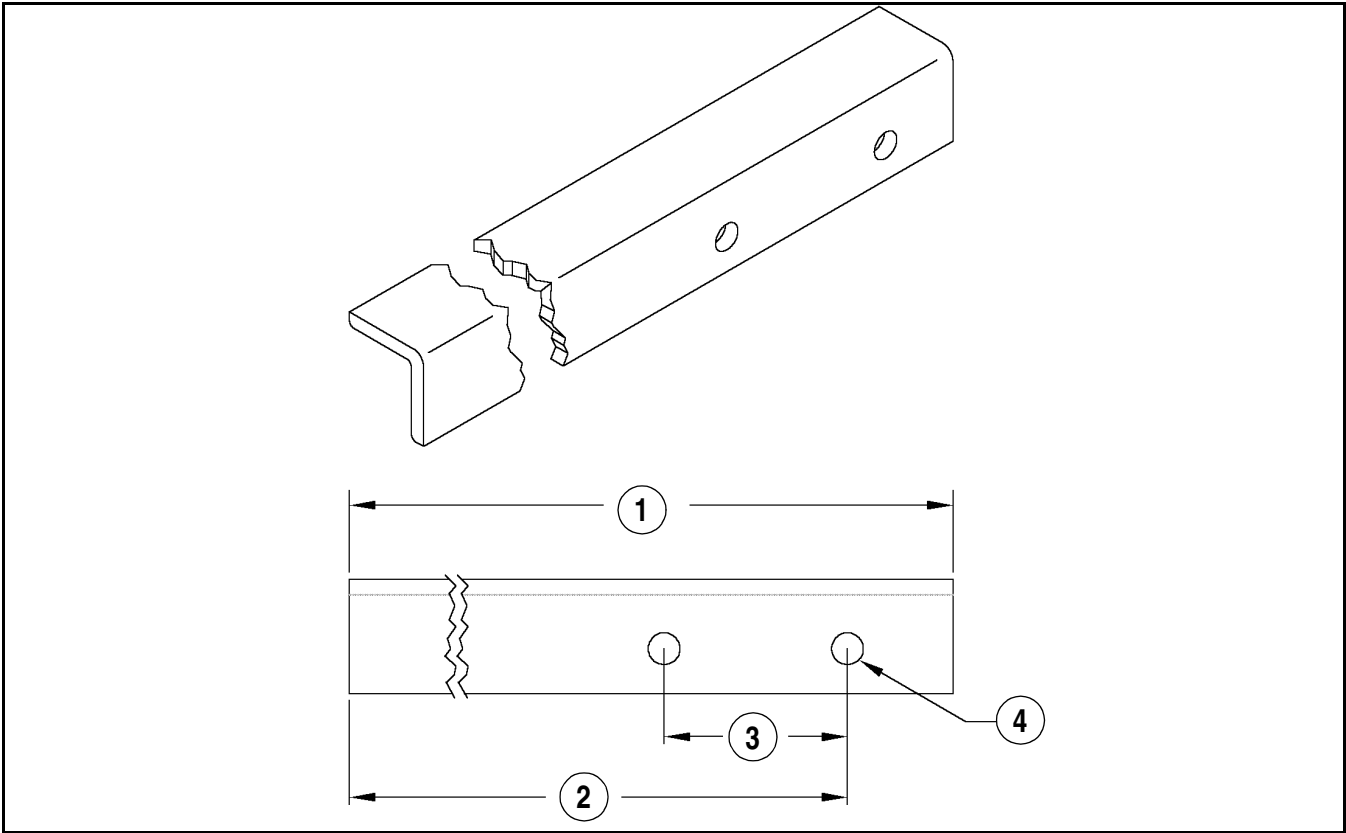


SPECIAL TOOL LAYOUT DRAWINGS



RI05F002

1. 30 TO 38 MM (1-1/4 TO 1-1/2 INCH) BARSTOCK (TUBES MUST BE WITHIN 0.05 MM)      2. 300 MM (12 INCHES)      3. M16 X 2.0 X 30 MM DEEP INTERNAL THREAD



RI05F001

1. 1.5 X 1/8 INCH X 72 INCH      2. 62 INCHES      3. 16 INCHES      4. 11/16 INCHES

# **Section 50**

## **Chapter 1**

### **AIR CONDITIONING SYSTEM**

#### **Troubleshooting and Fault Codes**

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## SAFETY PROCEDURES



THIS SAFETY ALERT SYMBOL INDICATES IMPORTANT SAFETY MESSAGES IN THIS MANUAL. WHEN YOU SEE THIS SYMBOL, CAREFULLY READ THE MESSAGE THAT FOLLOWS AND BE ALERT TO THE POSSIBILITY OF PERSONAL INJURY OR DEATH.

M171B

**ATTENTION:** Only authorized technicians certified by an approved training and certification organization may service or repair motor vehicle or mobile air conditioning systems.

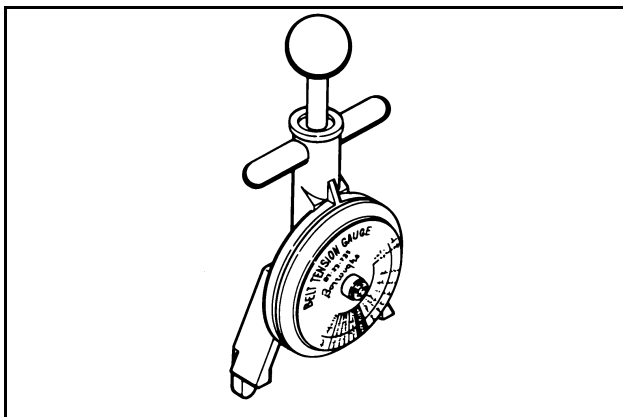
Refrigerant HFC-134a is the most stable and easiest to work with of the refrigerants now used in air conditioning systems. Refrigerant R-134a does not contain chlorofluorocarbons (CFC's) which are harmful to the earth's ozone layer.

Safety procedures must be followed when working with refrigerant HFC-134a to prevent possible personal injury.

1. Always wear combination impact and chemical splash safety goggles when doing any service work near an air conditioner system. Liquid refrigerant in the eyes can cause serious injury. Do the following if you get refrigerant near or in your eyes:
  - A. Flush your eyes with water for 15 minutes.
  - B. See a physician immediately. M779
2. Always reclaim all refrigerant prior to opening an A/C system. (See A/C System Service Section) A drop of liquid refrigerant on your skin may cause frostbite burns. Open fittings carefully and slowly when servicing the air conditioning system. Your skin must be treated for frostbite or a physician must be seen if you get refrigerant on your skin. M799

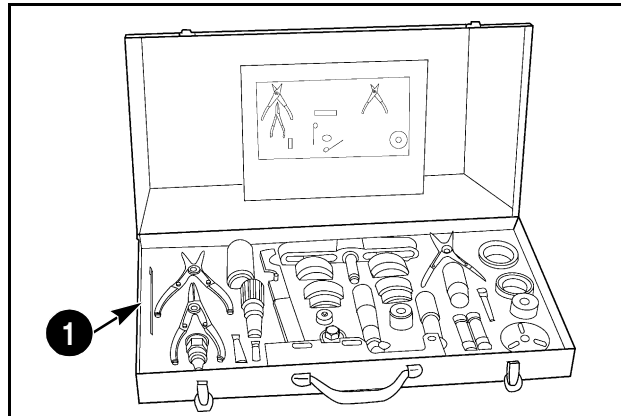
3. Keep refrigerant containers in correct upright position. Always keep refrigerant containers away from heat and sunlight. The pressure in a container will increase with heat. M743
4. Always check refrigerant purity with the OEM4450 Refrigerant Identifier before recovering refrigerant and before testing the system. M777
5. Use the air-powered OEM1691 ONLY to recover contaminated refrigerant. Do NOT use OEM1415 or OEM1418 recycling stations to recover contaminated refrigerant. If contaminated refrigerant contains more than 2% hydrocarbon (propane, butane or isobutane), the mixture must be considered flammable; if more than 4% hydrocarbon, the mixture must be treated as explosive; in both cases an electric-powered recovery station may NOT be used. Avoid heat, sparks and flame when working with this contaminated refrigerant. M800
6. Dangerous gas can form when refrigerant comes in contact with an open flame. Never inhale fumes. M745
7. Never leak test with compressed air or flame tester. Tests have indicated that compressed mixtures of HFC-134a and air can form a combustible gas. M746

## SPECIAL TOOLS



299L7C

**Belt Tension Tool CAS10808**

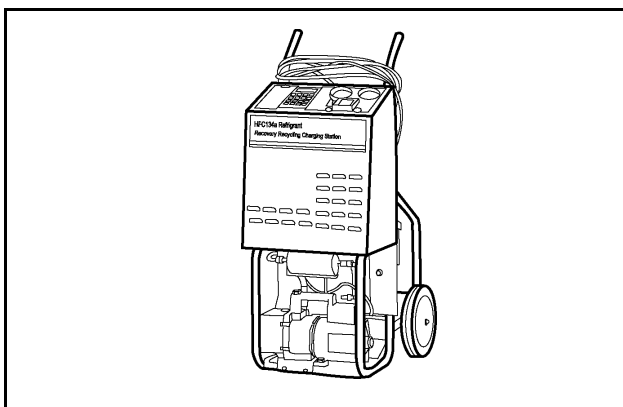


RD99K079

**1. COMPRESSOR DIPSTICK**

### **Compressor Tool Set, CAS10747A**

The compressor dipstick can be found in the Compressor Tool Set or purchased separately - CAS10747-19.

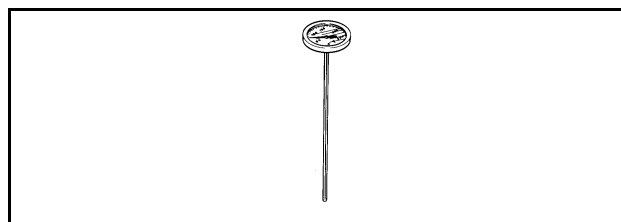


A22094

**OEM1415 Refrigerant Recovery Station**

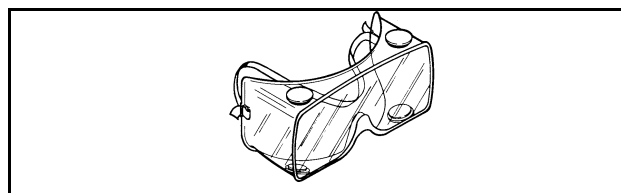
6 Foot Length, Quick Disconnect Refrigerant Charging Hoses: OEM1438 (Yellow), OEM1439 (Blue), OEM1440 (Red)

20 Foot Length, Quick Disconnect Refrigerant Hoses - OEM1442 (Set includes Yellow, Blue and Red hoses)



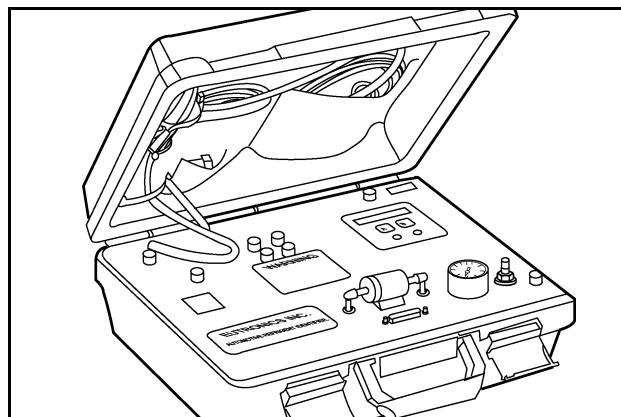
299L7B

**9 Inch Stem Type Thermometer  
0° TO 250° F CAS10248**



299L7B

**Combination Impact and Chemical Splash  
Safety Goggles**



RR99M070

**Refrigerant Identifier OEM4450**

## A/C THERMAL OPERATION

The refrigerant circuit of the air conditioning system contains five major components: compressor, condenser, receiver-drier, expansion valve and evaporator.

These components are connected by tubes and hoses and operate as a closed system. The air conditioner system is charged with HFC-134a refrigerant.

(See diagram on next page to follow refrigerant flow.)

The compressor receives the refrigerant as a low pressure gas. The compressor then compresses the refrigerant and sends it in the form of a high pressure gas to the condenser. Air flow through the condenser removes the heat from the refrigerant. As the heat is removed the refrigerant is “condensed” to a high pressure liquid.

The high pressure refrigerant liquid flows from the condenser to the receiver-drier. The receiver-drier is a container filled with moisture removing material, which removes any moisture that may have entered the air conditioner system in order to prevent corrosion of the internal components.

**NOTE:** *Not all refrigerant leaves the condenser as a liquid. Some leaves as a gas without affecting system performance. Liquid refrigerant pools at the bottom of the receiver-drier, while the lighter gas collects at the top. Since the pick-up tube draws refrigerant from the bottom of the receiver-drier, only liquid refrigerant flows to the thermal expansion valve.*

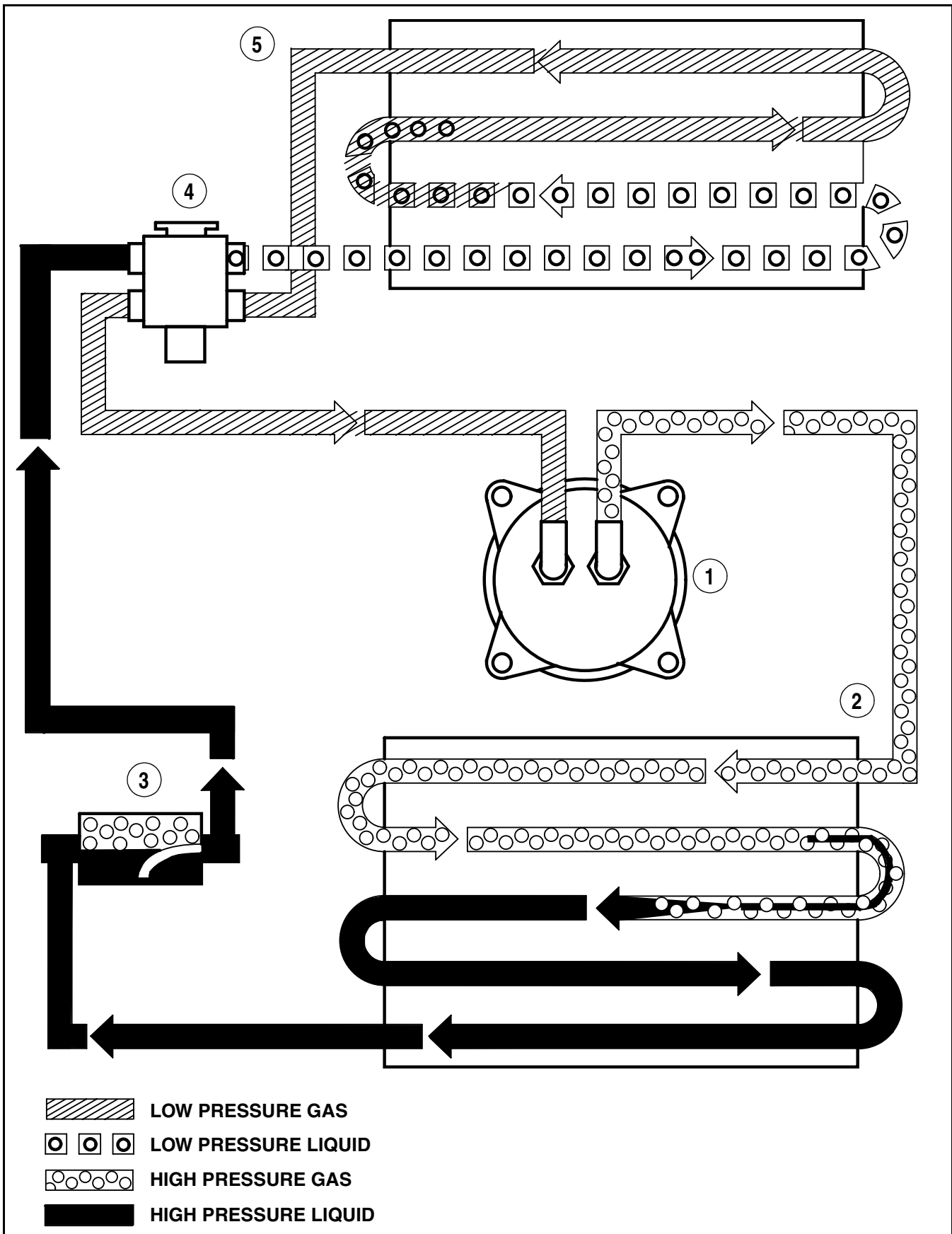
The refrigerant, still in high pressure liquid form, flows from the receiver-drier to the expansion valve. The expansion valve provides a restriction to refrigerant flow to cause a pressure drop which allows the liquid refrigerant to expand, decreasing its temperature and pressure.

**NOTE:** *The thermal expansion is internally equalized: the need for refrigerant to handle the heat load is balanced with the ability to fully vaporize the refrigerant within the one valve.*

This low temperature, low pressure liquid or mist flows through the evaporator. The hot cab air passes through the evaporator fins cooling the air and evaporating the liquid refrigerant.

The low pressure gas returns to the compressor and the cycle starts all over again.





209L95

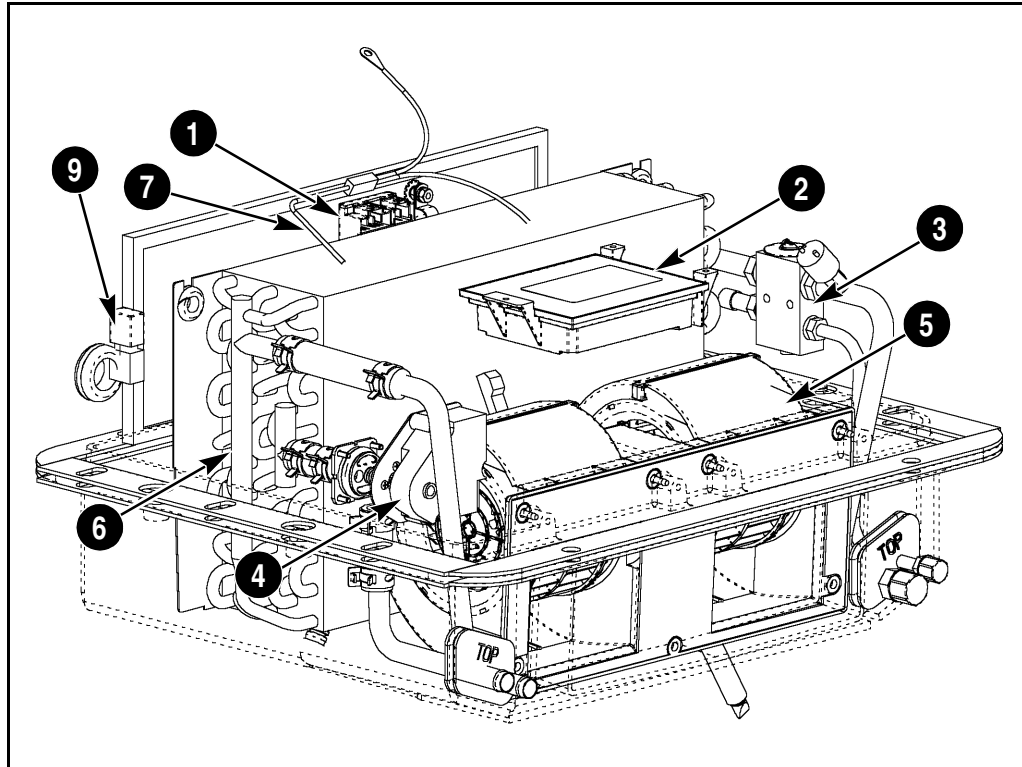
1. COMPRESSOR  
2. CONDENSOR

3. RECEIVER-DRIER  
4. THERMAL EXPANSION VALVE

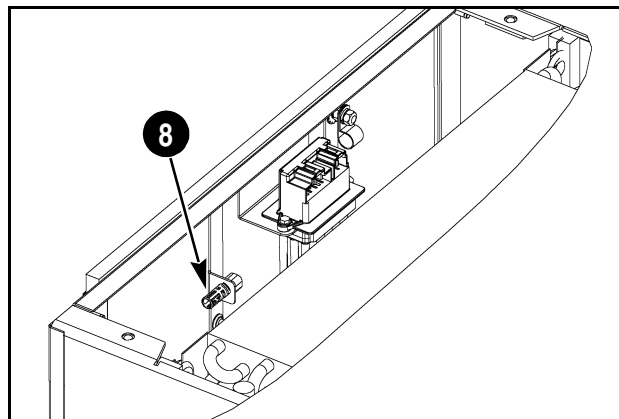
5. EVAPORATOR

## A/C SYSTEM COMPONENTS

### Cab HVAC Box Components - Automatic Temperature Control



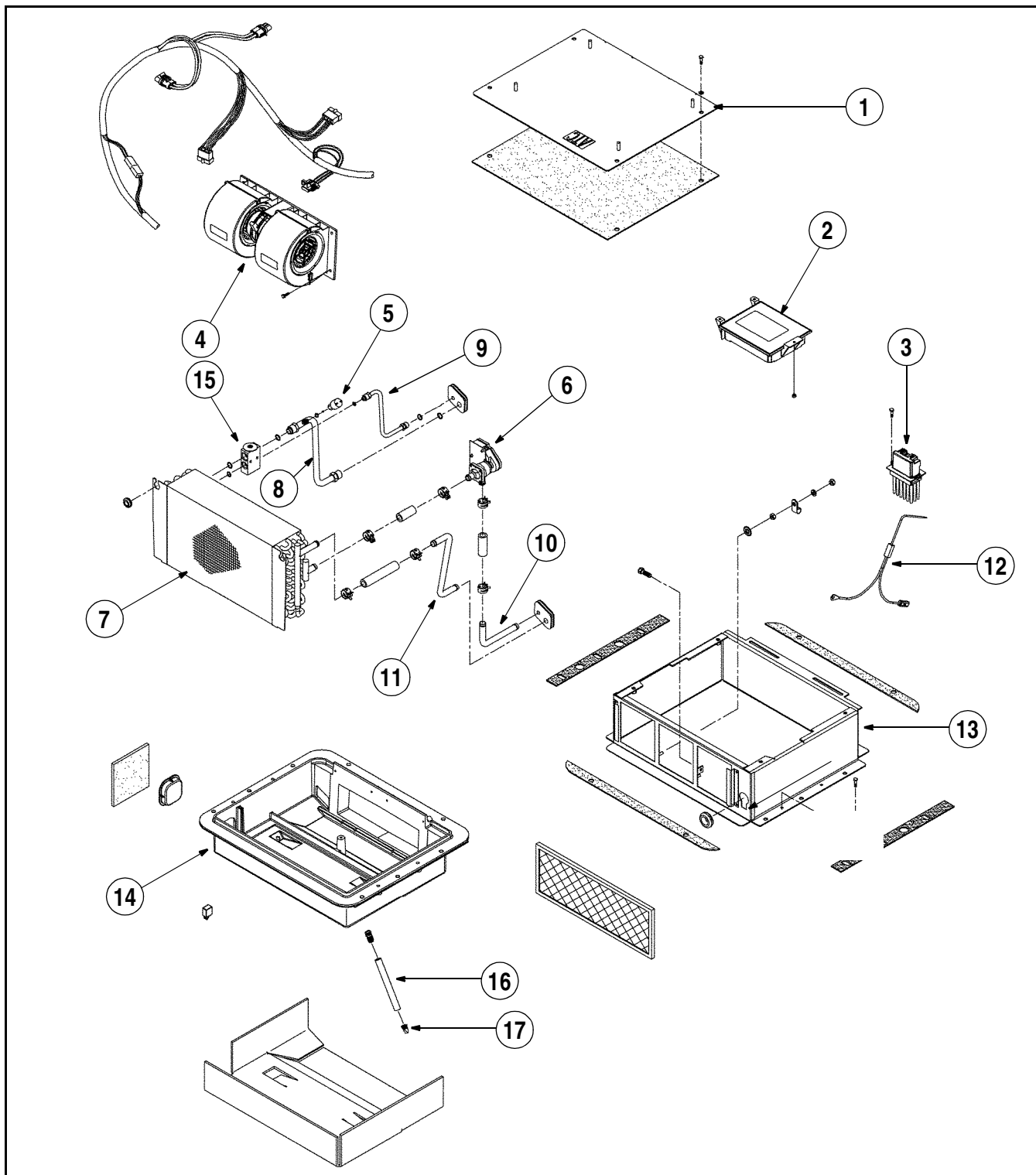
RI05H007



RI05H008

- |                            |                          |                                  |
|----------------------------|--------------------------|----------------------------------|
| 1. BLOWER SPEED DRIVER     | 4. HEATER CONTROL VALVE  | 7. EVAPORATOR TEMPERATURE SENSOR |
| 2. ATC CONTROLLER          | 5. BLOWER MOTOR ASSEMBLY | 8. CAB TEMPERATURE SENSOR        |
| 3. THERMAL EXPANSION VALVE | 6. EVAPORATOR CORE       | 9. COMPRESSOR CLUTCH RELAY       |

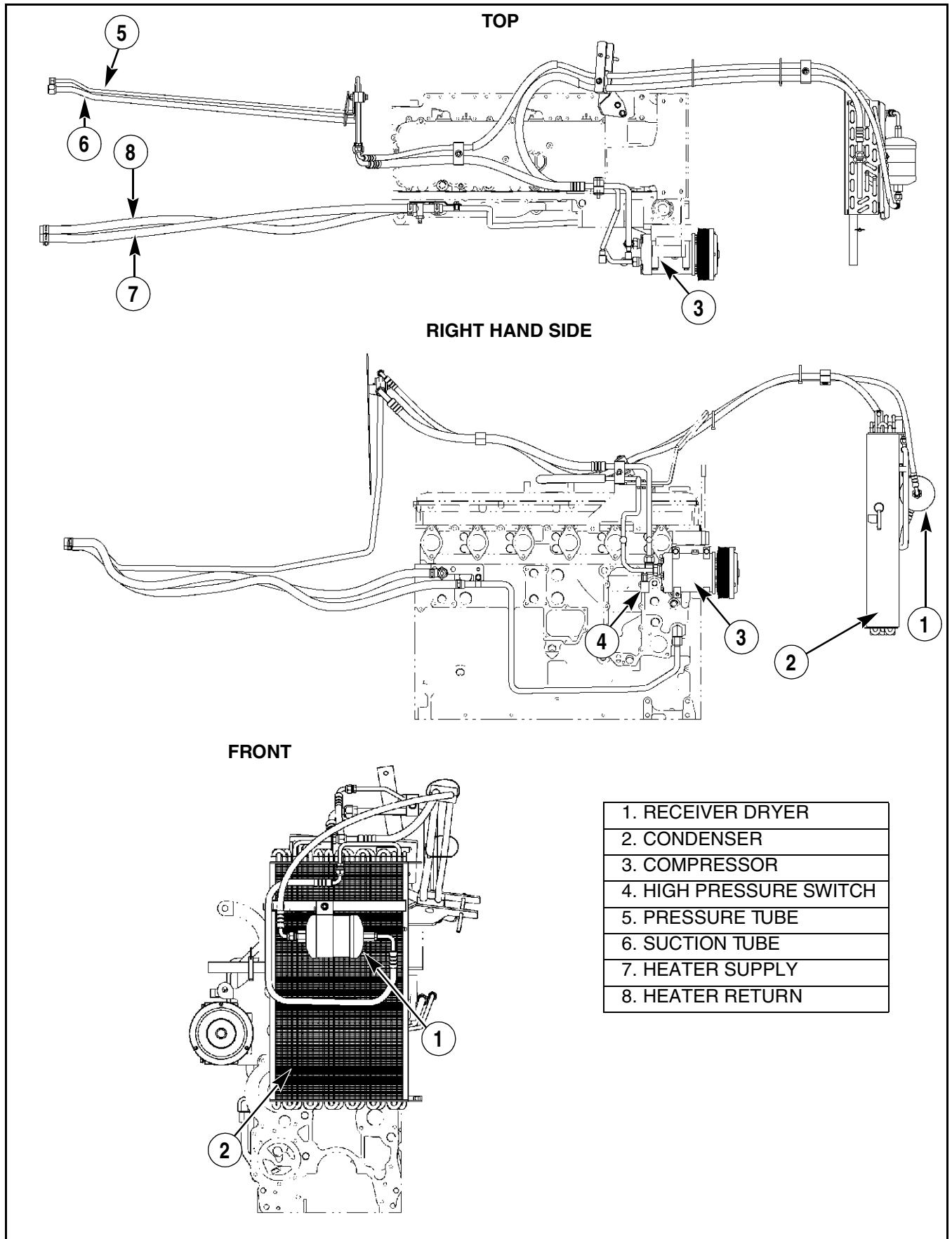
## Cab HVAC Box Components - Automatic Temperature Control



RI00A009

- |                               |                                   |                             |
|-------------------------------|-----------------------------------|-----------------------------|
| 1. LID ASSEMBLY               | 8. A/C SUCTION LINE TUBE          | 15. THERMAL EXPANSION VALVE |
| 2. ATC CONTROLLER             | 9. A/C LIQUID LINE TUBE           | 16. DRAIN HOSE              |
| 3. BLOWER SPEED DRIVER        | 10. HEATER SUPPLY HOSE            | 17. CHECK VALVE             |
| 4. BLOWER ASSEMBLY            | 11. HEATER RETURN HOSE            |                             |
| 5. A/C LOW PRESSURE SWITCH    | 12. EVAPORATOR TEMPERATURE SENSOR |                             |
| 6. HEATER CONTROL VALVE ASSY  | 13. BASE WELDMENT                 |                             |
| 7. HEATER/EVAPORATOR ASSEMBLY | 14. EVAPORATOR BOX ASSEMBLY       |                             |

## Chassis Components



RR106A027/RI06028/RI06029

## AUTOMATIC TEMPERATURE CONTROL (ATC) OPERATION

The ATC controller is a closed loop control device which takes the data from a variety of inputs and executes output instructions to the devices it controls. The controlling parameter for the system is **cab inside temperature**.

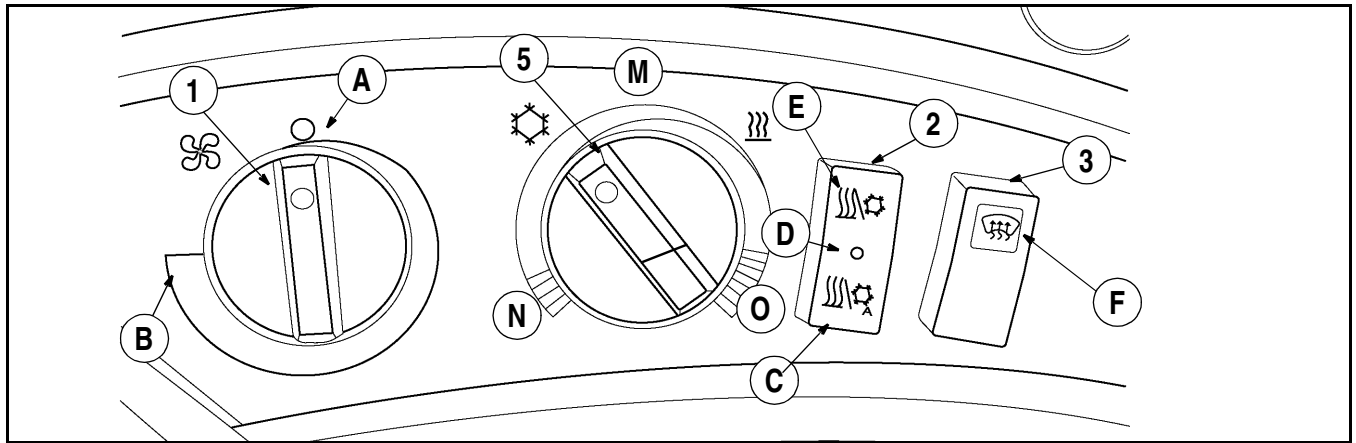
The operator selects a desired cab temperature with the temperature control. The controller uses the compressor, heater control valve and blower speed to drive to and maintain the desired setpoint. It also uses the mode door to effectively distribute the cooled or warmed air in the cab.

The controller receives input from the following controls and sensors:

ATC Switch	on the desired operational mode for the system: Off, Automatic or Defog/Defrost,
Cab Temperature Sensor	located at the recirculated air return, on current cab temperature,
Setpoint Temperature	selected by the operator with temperature control, on desired cab temperature,
Evaporator Temperature Sensor	inserted in the evaporator/heater assembly, on current cooling or heating temperatures,
Low Pressure Switch	on the status of abnormal system pressures on the low side,
High Pressure Switch	on the status of abnormal system pressures on the high side,
Blower Speed Control	when the operator chooses to override the blower speed selected by the controller,
and °F/°C Display Selector	which changes temperature display from Fahrenheit to Celsius.

To accomplish its heating and cooling functions, the controller uses the following output devices:

Compressor Clutch via Clutch Relay	to engage or disengage the compressor to achieve the desired cab cooling setpoint,
Heater Control Valve	by varying the valve opening, to achieve the desired cab heating setpoint,
Blower Speed via Blower Speed Driver	to deliver the conditioned air from the evaporator/heater assembly at a speed proportional to the gap between the current cab temperature and the desired setpoint,
and Instrument Cluster Display (in Instrument Cluster)	to display the desired cab temperature setpoint, operational modes, system status and fault codes.



RD05J039

<b>1. Blower Speed Control</b>	Manual selection of blower speed which overrides controller selection	A. Blower OFF
		B. Maximum Blower Speed
<b>2. ATC Switch</b>	Selects operational mode	C. Automatic Mode
		D. OFF
		E. Manual Mode
<b>3. Defog/Defrost Switch</b>		F. Defog/Defrost Mode

<p><b>4. Instrument Cluster Display</b></p>	<p>Displays temperature setpoint and system status</p>	<div> <p>RD05J048</p> </div> <p>G. Digital Temperature Display: Displays current setpoint selected by the operator for desired cab temperature.</p> <p>On start-up flashes "88" for short time to indicate that the controller is initializing.</p> <p>When system fault occurs, display toggles between temperature display and fault code number.</p> <p>H. Displays °F or °C for Fahrenheit or Celsius. To change the display to °F or °C, press and hold the key pad AUTO key for three seconds after the screen has been turned on.</p> <p>I. Icon displays when system is operating in Defog/Defrost mode.</p> <p>J. Auto/Manual Switch Status</p> <p>K. Blower Control Status</p> <p>L. Blower Control Level</p>
<p><b>5. Temperature Control</b></p>	<p>Selects temperature setpoint, the controlling parameter for the system</p>	<p>M. ATC Temperature Range: 60° F to 90° F (15.5° C to 32° C)</p> <p>N. Maximum Cooling Zone: 60° F (15.5° C)</p> <p>O. Maximum Heating Zone: 90° F (32° C)</p>

## Operation Modes

### Automatic Mode

Automatic mode is selected by placing the three position mode switch in Auto mode (down position). The AUTO icon will display on the bottom right corner of the programmable display screen. In this mode the system attempts to maintain cab set point temperature selected by the operator with the Temperature Control Knob (displayed on the programmable display screen) by modulating temperature and fan speed.

**Manual Override of the Blower Fan While in Automatic Mode** - If the blower fan knob is adjusted while in the Automatic mode, the blower speed is changed to a manually selected setting and remains constant. The system will attempt to maintain cab set point temperature only by modulating air flow temperature at the blower speed selected by the operator. To return to automatic control mode, toggle the three position mode switch from AUTO to OFF and back to the AUTO mode.

**Maximum Cooling in Automatic Mode** - Maximum cooling is selected by moving the Temperature Control Knob fully counter clockwise. In this mode, the blower fan is automatically set to full speed, pressurizer blower is disengaged (unless defog mode has been previously selected) and A/C system delivers maximum cooling capacity. Pressurizer blower is re-engaged in two ways:

1. If defog function is selected by pressing momentary defog switch to provide additional fresh air required for defog operation.
2. Blower speed setting is manually reduced to a lower setting.

### Defog Mode

The purpose of Defog mode is removal of moisture from the cab which is fogging or frosting the windows.

Defog mode is selected by pressing the momentary DEFOG switch when in either Auto mode or Manual mode. The switch lamp will illuminate and the defog icon will display in the lower left corner on the programmable display screen.

**Maximum Heating in Automatic Mode** - Maximum heating is selected by moving the Temperature Control Knob fully clockwise. In that mode, the blower fan is automatically set to full speed and the heating system delivers maximum heating capacity. Blower speed can be manually changed to a lower speed.

**NOTE:** *In any heating operation blower speed remains at 25% until the circulated air flow warms to 12.8°C (55°F).*

**OFF Mode** - OFF mode is selected by placing the three position mode switch in OFF mode. (center position) In OFF mode the blower fan is disengaged and the HVAC system provides no means of cooling or heating the cab. The pressurizer blower continues to operate to provide fresh air and to pressurize the cab.

**Manual Override of the Blower Fan While in OFF Mode** - If the blower fan knob is adjusted while in OFF mode, the blower speed is changed to the manually selected setting and remains constant. To turn blower back OFF, either turn the blower speed control knob fully counterclockwise or toggle the three position mode switch from OFF to AUTO or Manual mode and back to OFF.

**Manual Mode** - Manual mode is selected by placing the three position mode switch in the manual mode (up position). In manual mode all control variables such as blower speed, level of cooling or heating are set by the operator. The system does not maintain cab temperature but rather maintains blower speed and cooling or heating level requested by the operator. If tractor cab heating or cooling load changes the operator may need to adjust the controls to maintain adequate comfort level in the cab.

The HVAC system enables the A/C compressor to run at all times, but otherwise functions according to the mode selected by the three position ATC selection switch. Defog function is stopped if the momentary defog switch is pressed again or the OFF mode is selected by the three position ATC switch. Once selected, Defog operation is retained if the three position mode switch is toggled quickly between Auto and Manual modes. Defog function is not retained if the mode switch is toggled slowly or the ignition key switch is cycled.



<b>Automatic Operation Summary</b> (ATC switch set to “Auto,” and “Auto” displays on the Instrument Cluster Display. No fault codes active.)		
<b>Temperature Argument</b>	Controller needs a 2°F (1°C) difference between the setpoint and temperature sensed at cab sensor before responding - engaging the compressor or opening the heater valve. Selecting a setpoint one degree cooler or warmer than the temperature desired may increase operator comfort.	
<b>Blower Speed</b>	<b>If difference between cab temperature and the setpoint is ...</b>	<b>Then the blower speed used by the controller is ...</b>
	less than or equal to 2°F (1°C)	25%
	greater than 2°F (1°C) but less than or equal to 4°F (2°C)	35%*
	greater than 4°F (2°C) but less than or equal to 6°F (3°C)	45%*
	greater than 6°F (3°C) but less than or equal to 8°F (4°C)	55%*
	greater than 8°F (4°C) but less than or equal to 10°F (5°C)	65%*
	greater than 10°F (5°C) but less than or equal to 12°F (6°C)	75%*
	greater than 12°F (6°C)	100%*
<b>Compressor Clutch Cycling</b>	Compressor clutch is cycled ON or OFF by the controller as needed to drive to or maintain the desired cab temperature setpoint.	
<b>Heater Control Valve</b>	Heater control valve is opened or closed as needed to drive to or maintain the desired cab temperature setpoint.	
<b>Manual Override of Blower Control</b>	<ul style="list-style-type: none"> <li>● Blower speed remains in position selected by operator. ● Instrument Cluster Display no longer displays “Auto” for automatic. ● Temperature and mode door control remain automatic, but controller cannot use any speed beyond that selected to achieve the desired setpoint.</li> <li>● Turning ATC switch OFF and then to “A” returns system to automatic operation.</li> </ul>	
<b>Maximum Cool Setting Selected</b>	<ul style="list-style-type: none"> <li>● Blower speed at 100%. ● Mode door to mid-cab vents ● Compressor runs continuously. The clutch is only cycled OFF when the freeze setting - 32° F (0° C) - is reached at the evaporator temperature sensor, and then ON again when temperature sensed warms to 37° F (3° C). ● Instrument Cluster Display no longer displays “Auto” for automatic. ● Moving the temperature control outside the maximum range returns the system to automatic control of compressor, blower and mode door.</li> </ul>	
<b>Maximum Heat Setting Selected</b>	<ul style="list-style-type: none"> <li>● Blower speed at 100%.* ● Mode door to floor vents. ● Heater control valve at full open position ● Instrument Cluster Display no longer displays “Auto” for automatic. ● Moving the temperature control outside the maximum range returns the system to automatic control of valve, blower and mode door.</li> </ul>	
<b>Exception</b>	* When heating is selected, blower speed remains at 25% until temperature sensed at evaporator exceeds 55° F (12.8° C).	

<b>Defog/Dehumidify Operation Summary</b> (Defog/Dehumidify switch “ON”, Defog light ON. No fault codes active.)		
<b>Temperature Argument</b>	Controller needs a 2°F (1°C) difference between the setpoint and temperature sensed at cab sensor before responding - engaging the compressor or opening the heater valve. Selecting a setpoint one degree cooler or warmer than the temperature desired may increase operator comfort.	
<b>Blower Speed</b>	<b>If difference between cab temperature and the setpoint is ...</b>	<b>Then the blower speed used by the controller is ...</b>
	less than or equal to 2°F (1°C)	25%
	greater than 2 °F (1°C) but less than or equal to 4°F (2°C)	35%*
	greater than 4°F (2°C) but less than or equal to 6°F (3°C)	45%*
	greater than 6°F (3°C) but less than or equal to 8°F (4°C)	55%*
	greater than 8°F (4°C) but less than or equal to 10°F (5°C)	65%*
	greater than 10 °F (5°C) but less than or equal to 12°F (6°C)	75%*
	greater than 12°F (6°C)	100%*
<b>Compressor Clutch Cycling</b>	**Compressor runs continuously to remove moisture from cab. The clutch is only cycled OFF when the freeze setting - 32° F (0° C) - is reached at the evaporator temperature sensor, and then ON again when temperature sensed warms to 37° F (3° C).	
<b>Heater Control Valve</b>	Heater control valve is opened or closed as needed to drive to or maintain the desired cab temperature setpoint.	
<b>Manual Override of Blower Control</b>	<ul style="list-style-type: none"> <li>● Blower speed remains in position selected by operator.</li> <li>● Instrument Cluster Display continues to display “defog” icon.</li> <li>● Temperature and mode door control remain automatic, but controller cannot use any speed beyond that selected to achieve the desired setpoint.</li> <li>● Turning ATC switch OFF and then to the “snowflake” icon returns the blower to standard defog operation.</li> </ul>	
<b>Maximum Cool Setting Selected</b>	Improper use of the system; compressor is running continuously in defog mode. Temperature control must be in heating range to defog or defrost the cab.	
<b>Maximum Heat Setting Selected</b>	<ul style="list-style-type: none"> <li>● Blower speed at 100%.*</li> <li>● Heater control valve at full open position</li> <li>● Instrument Cluster Display continues to display “defog” icon.</li> <li>● Moving the temperature control outside the maximum range returns the system to standard defog control of valve, blower and mode door.</li> </ul>	
<b>Exceptions</b>	<p>* When heating is selected, blower speed remains at 25% until temperature sensed at evaporator exceeds 55° F (12.8° C).</p> <p>** On very cold days, compressor does not engage until temperature at the evaporator sensor exceeds 32° F (0° F).</p>	

## ATC Fault Codes

ATC fault codes display on the Instrument Cluster display. The display toggles between the current cab temperature setpoint and the fault code.

ATC fault codes are not recorded or stored.

If more than one fault code is active, the codes display sequentially on the Instrument Cluster Display and alternate with the temperature setpoint. The service required icon also flashes on the Instrument Cluster Display whenever a fault code is active.

Except for codes **129** and **134**, all fault codes display immediately when the fault is detected and disappear if the fault condition clears.

With the smart pressure switch counting feature, code **129** for high pressure does not display until two occurrences within a 60 second interval; code **134** for low pressure does not display until four occurrences within a 60 second interval. The interval starts with the first occurrence, but may be as short as 10 seconds if the pressure problem is constant.

Only fault codes **129** and **134** “latch” the compressor clutch OFF. The keyswitch must be toggled OFF and ON, or the ATC switch must be toggled OFF and then to the “A” or “snowflake” position before the clutch is reenabled.

### **ATC Fault Code 111 Cab temp sensor open or shorted to power**

#### **Cause:**

Wire harness/connector failure  
Temperature sensor failure  
ATC module failure

#### **Possible failure modes:**

ATC module defaults to manual mode.

#### **Solution:**

- 1)** Disconnect cab temp sensor and check its resistance. It should measure around 10K Ohms at room temperature. Replace if faulty.
- 2)** Inspect harness and connectors for possible shorting between cab temp sensor wire and other wires or possible open condition. If a short or open exists, then replace harness.
- 3)** If no fault found with cab temp sensor, wire harness, or connectors, then replace ATC module.

## **ATC Fault Code 112**

### **Cab temp sensor shorted to ground**

#### **Cause:**

Wire harness/connector failure  
Temperature sensor failure  
ATC module failure

#### **Possible failure modes:**

ATC module defaults to manual mode.

#### **Solution:**

- 1) Disconnect cab temp sensor and check its resistance. It should measure around 10K Ohms at room temperature. Replace if faulty.
- 2) Inspect harnesses and connectors for possible shorting between cab temp sensor wire and other wires or ground. If a short exists then replace harness.
- 3) If no fault found with cab temp sensor, wire harnesses, or connectors, then replace ATC module.

## **ATC Fault Code 115**

### **Evap temp sensor open or shorted to power**

#### **Cause:**

Wire harness/connector failure  
Temperature sensor failure  
ATC module failure

#### **Possible failure modes:**

Compressor clutch disabled.

#### **Solution:**

- 1) Disconnect evap temp sensor and check its resistance. It should measure around 10K Ohms at room temperature. Replace if faulty.
- 2) Inspect harness and connectors for possible shorting between evap temp sensor wire and other wires or possible open condition. If a short or open exists, then replace harness.
- 3) If no fault found with evap temp sensor, wire harness, or connectors, then replace ATC module.

**ATC Fault Code 116**  
**Evap temp sensor shorted to ground**

**Cause:**

Wire harness/connector failure  
Temperature sensor failure  
ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

- 1) Disconnect evap temp sensor and check its resistance. It should measure around 10K Ohms at room temperature. Replace if faulty.
- 2) Inspect harness and connectors for possible shorting between evap temp sensor wire and other wires or ground. If a short exists then replace harness.
- 3) If no fault found with evap temp sensor, wire harness, or connectors, then replace ATC module.

**ATC Fault Code 120**  
**Blower speed selector open or shorted to power**

**Cause:**

Wire harness/connector failure  
Blower speed selector failure  
ATC module failure

**Possible failure modes:**

If in auto mode, then the ATC module automatically adjusts the blower speed.

If in manual mode, then the ATC module defaults the blower speed to 75%.

**Solution:**

- 1) Disconnect blower speed selector and verify its operation. Replace if faulty.
- 2) Inspect harness and connectors for possible shorting between blower speed selector wires and other wires or possible open condition. If a short or open exists then replace harness.
- 3) If no fault found with blower speed selector, wire harness, or connectors, then replace ATC module.

**ATC Fault Code 121**  
**Temperature select pot open or shorted to power**

**Cause:**

Wire harness/connector failure  
Temperature pot failure  
ATC module failure

**Possible failure modes:**

ATC module defaults to 72 °F (22 °C) setpoint.

**Solution:**

- 1) Disconnect temperature pot and verify its operation. Its resistance should vary when rotated. Replace if faulty.
- 2) Inspect harness and connectors for possible shorting between temperature pot wires and other wires or possible open condition. If a short or open exists then replace harness.
- 3) If no fault found with temperature pot, wire harness, or connectors, then replace ATC module.

**ATC Fault Code 122**  
**Mode select pot open or shorted to power**

**Cause:**

Wire harness/connector failure  
Mode pot failure  
ATC module failure

**Possible failure modes:**

ATC module (Manual Mode) - defaults to Defrost mode.

ATC module (Automatic Mode) - defaults to Automatic mode.

**Solution:**

- 1) Disconnect mode pot and verify its operation. Its resistance should vary when rotated. Replace if faulty.
- 2) Inspect harness and connectors for possible shorting between mode pot wires and other wires or possible open condition. If a short or open exists then replace harness.
- 3) If no fault found with mode pot, wire harness, or connectors, then replace ATC module.

**ATC Fault Code 125**  
**High pressure switch (+) shorted to power**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the high pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

**1)** Inspect harness and connectors for possible shorting between high pressure switch wires (both leads) and other wires. If a short exists then replace harness.

**2)** If no fault found with wire harness, or connectors, then replace ATC module.

**ATC Fault Code 126**  
**High pressure switch (+) shorted to ground**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the high pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

**1)** Inspect harness and connectors for possible shorting between high pressure switch wires (both leads) and other wires. If a short exists then replace harness.

**2)** If no fault found with wire harness, or connectors, then replace ATC module.

**ATC Fault Code 127**  
**High pressure switch (-) shorted to power**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the high pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

**1)** Inspect harness and connectors for possible shorting between high pressure switch wires (both leads) and other wires. If a short exists then replace harness.

**2)** If no fault found with wire harness or connectors, then replace ATC module.

**ATC Fault Code 128**  
**High pressure switch (-) shorted to ground**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the high pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

**1)** Inspect harness and connectors for possible shorting between high pressure switch wires (both leads) and other wires. If a short exists, then replace harness.

**2)** If no fault found with wire harness or connectors, then replace ATC module.



**ATC Fault Code 129**  
**High pressure switch cycling error (2 times in 1 minute)**

**Cause:**

Incorrect charge in system  
Wire harness/connector failure

**NOTE:** *If system is properly charged, then the high pressure switch will be closed and the failure could be on either leg of the switch.*

High pressure switch failure  
ATC module failure

**Possible failure modes:**

Compressor clutch locked out until unit is cycled off then back on.

**Solution:**

- 1) Verify that system charge is within specification.
- 2) Inspect harness and connectors for possible shorting between high pressure switch wires (both leads) and other wires or possible open condition. If a short or open exists then replace harness.
- 3) Disconnect high pressure switch from harness and check its resistance. It should be closed (measure around 0 Ohms) if system charged correctly. Replace if faulty.
- 4) If no fault found with system charge, wire harness, connectors, or high pressure switch then replace ATC module.

**ATC Fault Code 130**  
**Low pressure switch (+) shorted to power**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the low pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

- 1) Inspect harness and connectors for possible shorting between low pressure switch wires (both leads) and other wires. If a short exists then replace harness.
- 2) If no fault found with wire harness, or connectors, then replace ATC module.

**ATC Fault Code 131**  
**Low pressure switch (+) shorted to ground**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the low pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

- 1) Inspect harness and connectors for possible shorting between low pressure switch wires (both leads) and other wires. If a short exists, then replace harness.
- 2) If no fault found with wire harness or connectors, then replace ATC module.

**ATC Fault Code 132**  
**Low pressure switch (-) shorted to power**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the low pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

- 1) Inspect harness and connectors for possible shorting between low pressure switch wires (both leads) and other wires. If a short exists then replace harness.
- 2) If no fault found with wire harness or connectors, then replace ATC module.

**ATC Fault Code 133**  
**Low pressure switch (-) shorted to ground**

**Cause:**

Wire harness/connector failure

**NOTE:** *If system is properly charged, then the low pressure switch will be closed and the short could be on either leg of the switch.*

ATC module failure

**Possible failure modes:**

Compressor clutch disabled.

**Solution:**

**1)** Inspect harness and connectors for possible shorting between low pressure switch wires (both leads) and other wires. If a short exists, then replace harness.

**2)** If no fault found with wire harness or connectors, then replace ATC module.

**ATC Fault Code 134**  
**Low pressure switch open for more than 1 minute**

**Cause:**

Incorrect charge in system  
Wire harness/connector failure

**NOTE:** *If system is properly charged, then the low pressure switch will be closed and the failure could be on either leg of the switch.*

Low pressure switch failure  
ATC module failure

**Possible failure modes:**

Compressor clutch locked out until unit is cycled off then back on.

**Solution:**

**1)** Verify that system charge is within specification.

**2)** Disconnect low pressure switch from harness and check its resistance. It should be closed (measure around 0 Ohms) if system charged correctly. Replace if faulty.

**3)** Inspect harness and connectors for possible shorting between low pressure switch wires (both leads) and other wires or possible open condition. If a short or open exists, then replace harness.

**4)** If no fault found with system charge, wire harness, connectors, or low pressure switch, then replace ATC module.

## Locating System Problems Without Fault Codes

### Controller-Based Resistance Tests

Pin ID		Description	Wire/ Color	Fault Code	Expected Result/Reference
36-Pin Conn					
1	-->	Can Low	CAN LO		
2	-->	Can High	CAN HIGH		
3	-->	Heat Signal Output	9C-Or		If open line, see <b>Heater Control Valve</b> .
4	-->	Heat Actuator Power	6D-Or		
5	-->	Blower Speed Output	SBC-Or		If open line, see <b>Blower Speed Driver</b> .
6	-->	Blower Actuator Power	252-Or		
7	-->	Mode 1 Output	102-Or		If open line, see <b>Mode Door Control</b> .
8	-->	Mode 1 Act Power	MD-Or		
9	-->	Mode 2 Output	OPEN		
10	-->	Mode 2 Act Power	OPEN		
11	-->	Recirc Output	OPEN		
12	-->	Recirc Act Power	OPEN		
13	-->	Pressurizer Output	OPEN		
14	-->	Pressure Act Power	OPEN		
15	-->	Clutch Relay Coil	AC-ATC		
16	-->	Condenser Fan Relay Coil	DEFLT-Or		
17	-->	Switch Batt B+	252-Or		
18	-->	Ground	309-N		Less than 10 ohms. If open line, see <b>Controller Power and Ground</b> .
19		RCV From Keypad	OPEN		
20		TK To Keypad	262-Or		
21		Cab Temp	SEN-Or		If open line, see <b>Sensors</b> . Perform initial temperature versus resistance test to check if sensor is failing. See same reference. Retest at sensor location/temperature for most accurate result.
22		Outlet Temp	OPEN		
23		Evap Temp	PB-S		If open line, see <b>Sensors</b> . Perform initial temperature versus resistance test to check if sensor is failing. See same reference. Retest at sensor location/temperature for most accurate result.
24		Outside Temp	OPEN		
25		Manual Switch	266-Or		Less than 10 ohms. If open line, see <b>Controller Power and Ground</b> .
26		Auto Switch	136-Or		Less than 10 ohms. If open line, see <b>Controller Power and Ground</b> .

27	C/F Ground Selection	143-N		
28	Blower Input	326-Or		
29	Set Point Input	103-Or		
30	Air Direction Input	154-Or		
31	Defog Switch	DEFSW- Or		
32	Cab Pressure Input	OPEN		
33	High Pressure + Input	80-Or		
34	High Pressure - Input	HP-Bk		
35	Low Pressure + Input	LP-Or		
36	Low Pressure - Input	LP-N		

To perform the above resistance tests at the controller, with the keyswitch OFF:

1. Disconnect the harness to the 36-pin connector at the ATC controller.
2. At the harness connector, test the resistance between the pins indicated and the battery negative post.

**NOTE:** Use an appropriately sized probe when testing to avoid damaging the pins.

## ATC Controller Test (Connector J8 Test Points)

The following tests determine whether the ATC controller requires replacement, since it tests primary input and output circuits. Some test steps isolate system problems to specific circuits which can simplify general troubleshooting.

In general, the service technician should resist the temptation to replace the controller as the solution to all A/C system problems. Double check your test results to avoid a return service call. The absence of key control voltages or switched ground does require controller replacement.

*\* The ATC controller and many components are grounded to "HVAC ground." HVAC ground is both a grounding bolt at the rear of the HVAC box and chassis ground at ring terminal 173B through C139-J on wire 443-Bk.*

CONNECTOR J8 TEST POINTS	
Test	Instructions and Actions
①	<b>Test ground continuity to controller: Pin 18 to HVAC ground</b>
	Condition(s): ATC Switch OFF Expected Result: Less than 1 ohm <b>Action:</b> Restore clean ground and retry the unit.
②	<b>Confirm switched B+ is present at controller: Pin 17 to Battery GND</b>
	Condition(s): Keyswitch ON Expected Result: 12V <b>Action:</b> Restore 12V and retry the unit. See Controller Power Supply and Ground Test in this Section.
③	<b>Confirm power output to heater valve/mode door motor: Pin 8 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch to "AUTO" Expected Result: 12V <b>Action:</b> If no voltage, replace the controller.
④	<b>Confirm control signal to heater control valve: Pin 3 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch to "AUTO" Expected Result: 11.5 to 1.5V while turning temperature control from max cool to max heat setting <b>Actions:</b> If no voltage, replace the controller. If no voltage change or drop out, test the pot circuit. See Temperature Control Pot testing.
⑤	<b>Confirm control signal to blower speed driver: Pin 5 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch to "AUTO" Expected Result: 11.5 to 1.5V while turning blower speed control from full CCW to full CW <b>Actions:</b> If no voltage, replace the controller. If no voltage change, test the pot circuit. See Blower Speed Pot testing.
⑥	<b>Confirm control signal to mode door motor: Pin 7 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch to "AUTO" Expected Result: 0.0 to 5.0V while turning mode door control from full CCW to full CW <b>Actions:</b> If no voltage, replace the controller. If no voltage change, test the pot circuit. See Mode Door Pot testing.
⑦	<b>Test high pressure switch circuit: Pin 33 to Battery GND</b>
	Condition(s): Keyswitch ON and Defog/Defrost Switch to ON; disconnect harness to high pressure switch Expected Result: 5V <b>Action:</b> If no voltage, replace the controller. (Reconnect harness if continuing testing.)
⑧	<b>Test low pressure switch circuit: Pin 35 to Battery GND</b>
	Condition(s): Keyswitch ON and Defog/Defrost Switch to ON, disconnect harness to low pressure switch Expected Result: 5V <b>Action:</b> If no voltage, replace the controller. (Reconnect harness if continuing testing.)
⑨	<b>Test evaporator temperature sensor: Pin 23 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch to "AUTO" Expected Result: 0.5V at 70°F (21°C) at the sensor. Voltage decreases as temperature increases. <b>Actions:</b> If no voltage, replace the controller. If voltage out of range for temperature, test sensor. See sensor test.

CONNECTOR J8 TEST POINTS	
Test	Instructions and Actions
⑩	<b>Test cab temperature sensor: Pin 21 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch to "AUTO" Expected Result: 0.5V at 70°F (21°C) at the sensor. Voltage decreases as temperature increases. <b>Actions:</b> If no voltage, replace the controller. If voltage out of range for temperature, test sensor. See sensor test.
⑫	<b>Test temperature control pot output: Pin 29 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC switch to "AUTO" Expected Result: 0.0 to 3.0V while turning temperature control from full CCW to full CW <b>Actions:</b> If no voltage, replace the controller.
⑬	<b>Test blower speed control pot output: Pin 28 to Battery GND</b>
	Condition(s): Keyswitch and A/C switch ON Expected Result: 0.0 to 3.0V while turning blower speed pot from full CCW to full CW <b>Actions:</b> If no voltage, replace the controller.
⑭	<b>Test mode door control pot output: Pin 30 to Battery GND</b>
	Condition(s): Keyswitch and A/C switch ON Expected Result: 0.0 to 3.0V while turning mode door control from full CCW to full CW <b>Actions:</b> If no voltage, replace the controller.
⑮	<b>Test Defog/Defrost switch control function - : Pin 25 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch OFF Expected Result: 5V <b>Actions:</b> If no voltage, replace the controller.
⑯	<b>Test ATC switch control function - Automatic mode: Pin 26 to Battery GND</b>
	Condition(s): Keyswitch ON and ATC Switch OFF Expected Result: 5V <b>Actions:</b> If no voltage, replace the controller.



## ATC Field Reported Symptoms/Causes

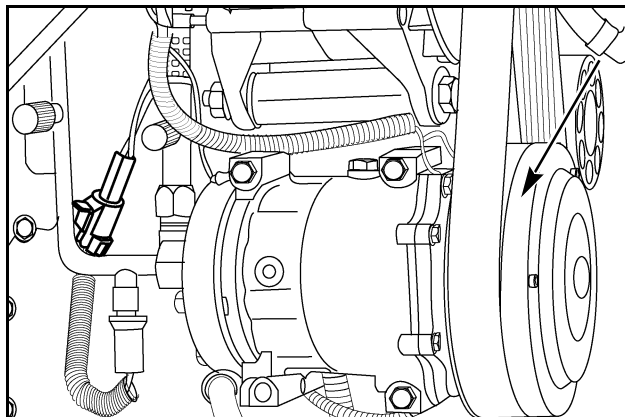
Symptom	Correction/Test Point	
Hot air discharge out of vents - above 100°F (38°C) - without adjusting the temperature control with cooling request. No fault codes displayed.	<ol style="list-style-type: none"> <li>1. Test cab temperature and evaporator temperature sensors and circuits. See <b>Sensors</b>.</li> <li>2. Test heater control valve for leakage. See valve "leak through".</li> </ol>	
System fails to heat or cool correctly, but otherwise appears to function normally. No fault codes.	<ol style="list-style-type: none"> <li>1. Check cab recirculation filter for obstruction.</li> <li>2. Check recirculation filter for cleanness.</li> <li>3. Test cab temperature and evaporator temperature sensors. See <b>Sensors</b>.</li> </ol>	
Blower operates. "AUTO" does not display on Instrument Cluster Display. System does not cool.	Test blower speed potentiometer for short to ground.	
In Automatic mode, when switching from maximum cool range to warmer setpoint, if temperature sensed at cab temperature sensor is less than the setpoint selected, controller opens heater valve and warm air blows out the vents. Heat output continues until the cab temperature sensor reaches the setpoint.	System anomaly.	
Instrument Cluster Display is blank.	No compressor/heater valve operation. Blower speed at 100% only.	Check Fuse 37 Test power and ground to controller.
	System cools and heats normally.	Test Instrument Cluster Display.
Instrument Cluster displays "88," and icons and "88" flash on and off.	At startup for less than one minute	Normal.
	Continuous with blower cutting in and out	Test power and ground to controller.
	Continuous without blower cutting in and out	Test Instrument Cluster display.
60°F (16°C) displays continuously on Instrument Cluster Display. Cannot be changed with temperature control.	Fault Code 121 displays.	Test temperature control potentiometer and circuit for a short.
	Fault Code 121 does not display	

## Compressor And Clutch

### Operational Check

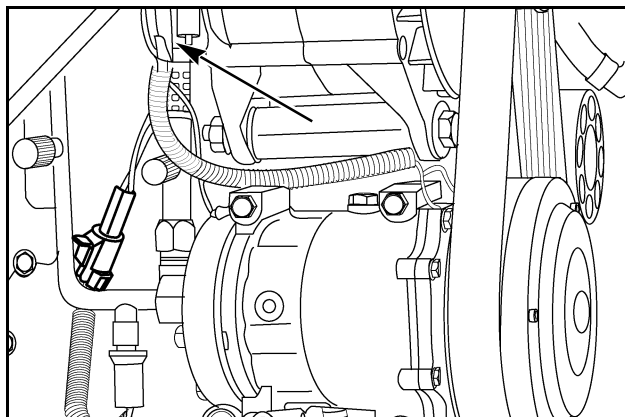
1. When functioning normally, the compressor clutch is always grounded to the chassis, and switched 12V is supplied by a controller-activated relay to energize the clutch coil and engage the compressor.

With keyswitch ON, ATC switch to "A," temperature control on maximum cool, check that clutch is engaged and the compressor is operating.



RD02H026

2. Disconnect the clutch at the harness. The clutch should disengage smoothly with little noise from the pulley or the bearings. Reconnect the harness to the clutch. The clutch should engage rapidly, and operation should be smooth and quiet.



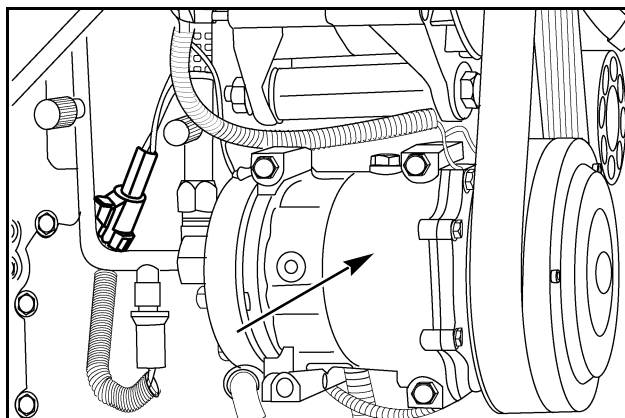
RD02H026

3. If operation is noisy, feel the compressor next to the clutch for vibration. If the compressor is vibrating next to the clutch and the noise changes when the clutch disengages, the clutch has failed. If the compressor is vibrating, the compressor has failed. The vibrating component is usually the source of the problem.



**WARNING:** Do NOT attempt to test the clutch directly with your hand. Rotating parts can cause severe personal injury.

M842



RD02H026

4. With the clutch still engaged, momentarily touch the suction and discharge hoses at the compressor for temperature difference. The suction line should be cool to cold, and the discharge line should be hot to very hot.



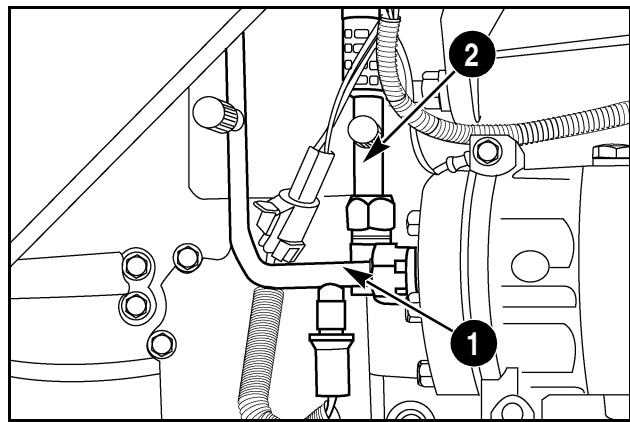
**WARNING:** *This is only a momentary contact with the hose.*

M636

Little or no temperature difference between the hoses is another indication of compressor failure: internal leakage between discharge and suction sides.

**NOTE:** *The compressor end plate is stamped with a "D" and "S" to indicate the discharge and suction ports.*

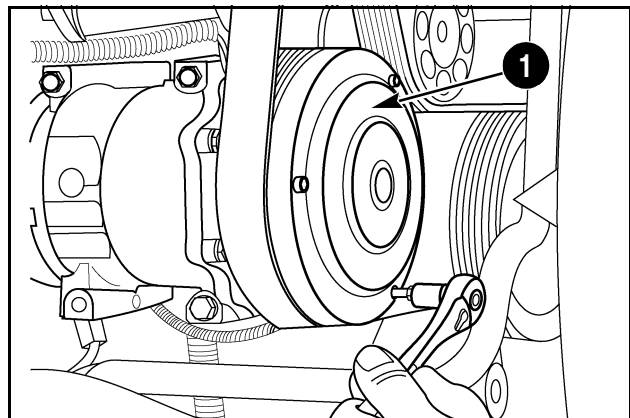
5. Verify an internal problem when compressor failure is suspected. Turn the A/C system and tractor OFF. Remove the three Torx® screws to remove dust cover (1) from clutch. Use a wrench to slowly rotate the compressor clockwise. Compressor rotation should be smooth and not require much effort. If severe rough spots or catches are felt when turning the shaft, the compressor has been damaged internally and must be replaced.



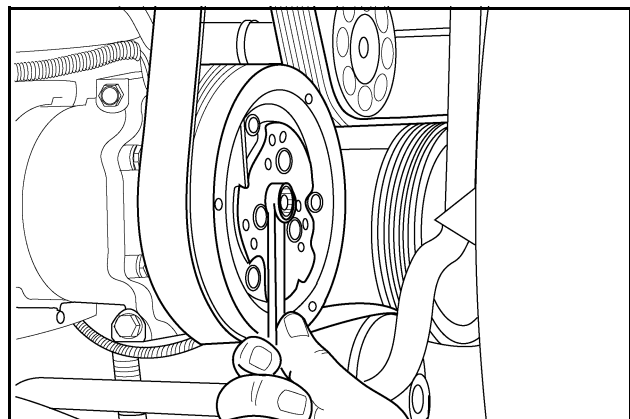
RD02H031

1. DISCHARGE/HIGH  
PRESSURE LINE

2. SUCTION/LOW  
PRESSURE LINE



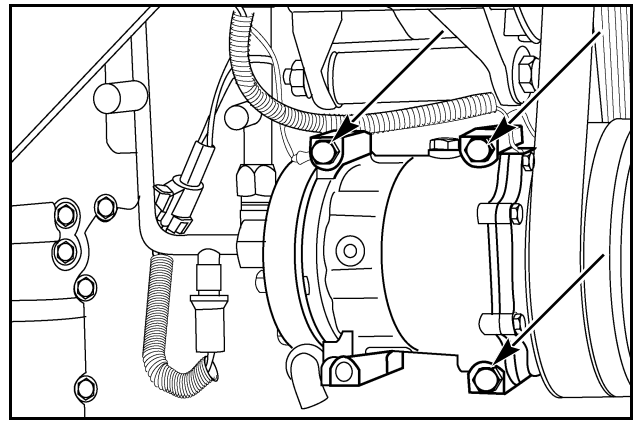
RD02H023



RD02H024

6. Check for loose mounting bolts for the compressor. Tighten the bolts to the correct torque.

**NOTE:** Loose mounting can cause a “knocking” sound at the compressor. A refrigerant overcharge also causes a knocking sound at the compressor.

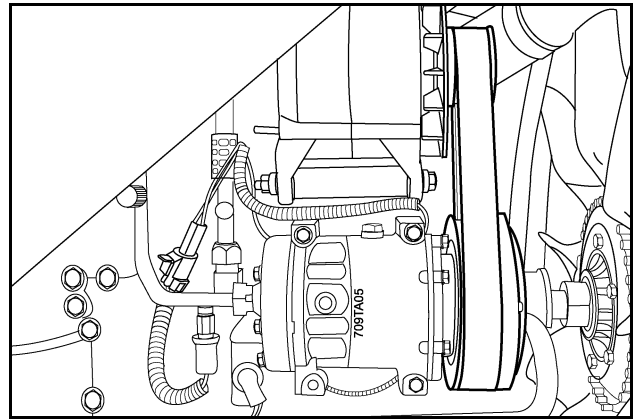


RD02H025

7. Clutch drive belt should be running smooth and straight. Clutch pulley and the drive pulley must be aligned within 1/16 inch (1.6 mm) of each other. Use a straight edge to check pulley alignment. Adjust the compressor on the mounting bracket if required.

The drive belt should be firmly seated in the clutch grooves.

Check for too much belt wear: cracking, cord wear, piling, chunking, glazing or separated layers. Replace a worn or deteriorated belt.



RD02H027

## Electrical Test

See Electrical Schematic sections 60, 61, 6 at the end of this section.

### Background

The compressor clutch is cycled On or Off by the controller based on the difference between the selected cab temperature setpoint and the temperature sensed at the cab temperature sensor.

When functioning normally, the clutch is always grounded to the engine through the compressor mounting bracket. The controller grounds the compressor clutch relay to provide 12V from fuse 36 to energize the clutch coil and engage the compressor.

### Power and Ground Circuit

Switched 12V is fed to the compressor clutch relay on pin 3 through pin 17 switched power at ATC Controller.

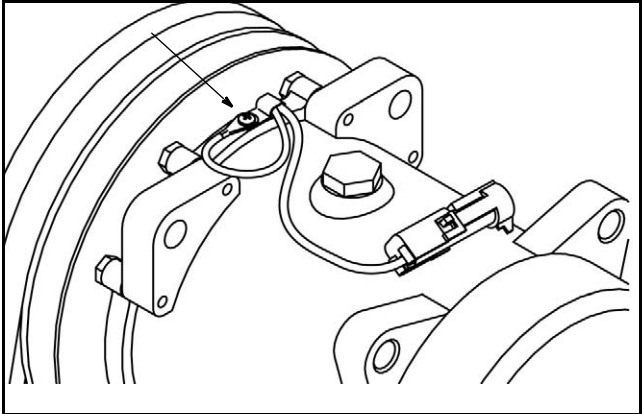
The controller energizes the relay by supplying power through pin 15 to pin 2 on the clutch relay.

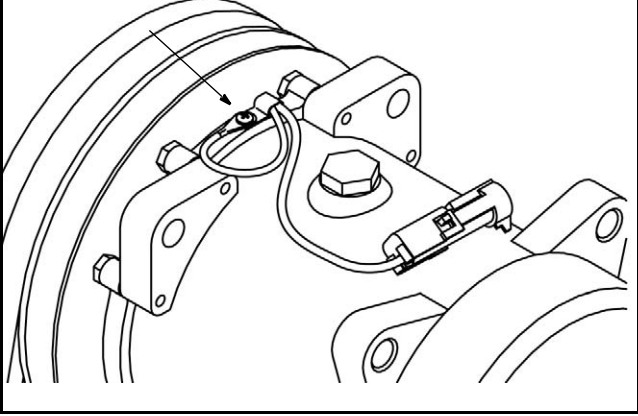
12V is fed from pin 5 on the relay - through C139-C, C333-26, and C60-P - to energize the clutch coil at C72-1.

### Possible Failure Modes:

1. Short circuit or open circuit in clutch coil.
2. Open circuit in power or ground between controller and relay.
3. Open circuit in power and ground between clutch and relay.
4. Controller fault.

## Compressor Clutch Control Circuit Test Procedure

Steps and Test Point	Corrective Actions
<p><b>NOTE:</b> This procedure assumes that the clutch has NOT been latched OFF by the controller due to high or low pressure switch activation and that no fault codes are displayed on the Instrument Cluster Display.</p>	
 <p>RI01H035</p> <p>1. Keyswitch and ATC switch OFF. Test continuity between clutch screw and ground screw on compressor mounting bracket. Less than 1 ohm?</p>	<p>YES - Go to next Step.</p> <p>NO - Repair open circuit or replace wire. Retry the unit.</p> <p>NOT OK - Go to next Step.</p>

Steps and Test Point	Corrective Actions
 <p>2. Measure resistance from C72-1 through clutch screw to ground screw on bracket. Is resistance between 3.6-4.2K ohms?</p> <p style="text-align: right;">RI01H035</p>	<p>YES - Go to next Step.</p> <p>NO - If open line or resistance is severely out of range, replace the clutch.</p> <p><b>NOTE:</b> If clutch is shorted, also check condition of fuse 36 (5 amp). The clutch draws enough amperage to cause fuse 36 to blow.</p>
<p>3. Keyswitch ON and DEFOG/DEFROST switch ON. Is 12V present at male harness connector to clutch?</p>	<p>YES - Clutch tests okay. Check for fault codes on Display.</p> <p>NO - Go to next Step.</p>
<p>4. Turn key switch ON. Check connector J8, pin 17. Is there 12 volts present?</p> <p><b>NOTE:</b> Refer to Accessing the HVAC Box at the end of this Section if required.</p>	<p>YES - Go to next Step.</p> <p>NO - Check condition of fuse 36 (5 amp).</p>
<p>5. Check clutch relay, pin 5. Is 12 volts present?</p>	<p>YES - Go to Next Step.</p> <p>NO - Go to Step 9.</p>
<p>6. Check continuity from clutch relay, pin 5 to connector 139, pin C</p>	<p>OKAY - Go to next Step.</p> <p>NOT OKAY - Locate and repair the open condition between the clutch relay, pin 5 to connector 139, pin C.</p>
<p>7. Check continuity from connector 139, pin C to connector 333, pin26</p>	<p>OKAY - Go to next Step.</p> <p>NOT OKAY - Locate and repair the open condition between the connector 139, pin C to connector 333, pin 26.</p>
<p>8. Check continuity from connector 333, pin 26 to connector 60, pin P.</p>	<p>OKAY - Go to next Step.</p> <p>NOT OKAY - Locate and repair the open condition between the connector 333, pin 26 to connector 60, pin P</p>
<p>9. Check continuity from connector 60, pin P to connector 72.</p>	<p>OKAY - Go to Step 12.</p> <p>NOT OKAY - Locate and repair the open condition between the connector 60, pin P to connector 72.</p>
<p>10. Check continuity from connector 333, pin 26 to connector 72.</p>	<p>OKAY - Go to next Step.</p> <p>NOT OKAY - Locate and repair the open condition between the connector 333, pin 26 to connector 72.</p>
<p>11. Check connector J8, pin 15 to ground. Is 12 volts present?</p>	<p>YES - Go to next Step.</p> <p>NO - See ATC Controller Test.</p>

Steps and Test Point	Corrective Actions
12. Check continuity from clutch relay, pin 1 to pin 2.	OKAY - Go to next Step NOT OKAY - Replace the clutch relay.
13. Check continuity from clutch relay, pin 1 to ground.	OKAY - Go to next Step NOT OKAY - Locate and repair the open condition between clutch relay pin 1 to ground.
14. Trouble may be intermittent.	Double check all test points.

### Service Note: Adjusting Clutch Air Gap

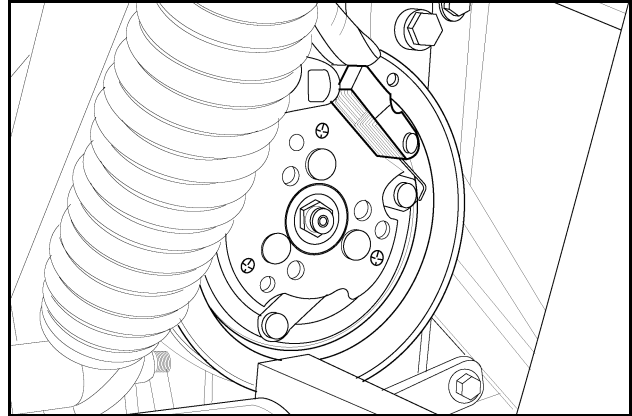
When replacing a clutch in the field, pay special attention to the air gap between the clutch plate and pulley. Too little gap will increase voltage draw at the the clutch, resulting in premature failure. Too much gap will introduce too much foreign material into the clutch.

A spark plug gauge with 90° wire feelers may be used to check the gap. Slip the wires between the clutch plate and the pulley, and check the gap at the three rivets. The gap must be 0.016 to 0.031 inch (0.41 to 0.79 mm). The gap must be even all the way around the plate. If necessary, lightly lift or push down on the plate to make the gap even.

**NOTE:** *If the gap does not meet the above specifications, remove the front plate and add or subtract clutch shims as required.*

#### Reference:

See A/C System Service in this manual for clutch disassembly and adjusting the air gap during clutch replacement.

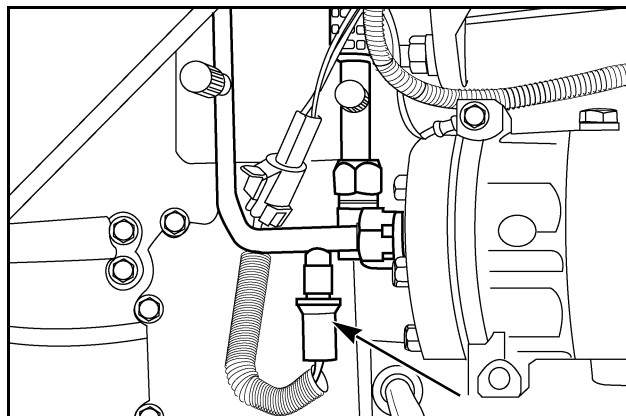


RD99N145

## High And Low Pressure Switch Clutch Latching Circuit

### Background

High pressure switch activation is generally caused by a restriction or clog on the high pressure side of the system. However, a refrigerant or SP-20 PAG oil overcharge, the presence of refrigerants other than R134A or engine cooling problems can also cause high pressure switch activation.

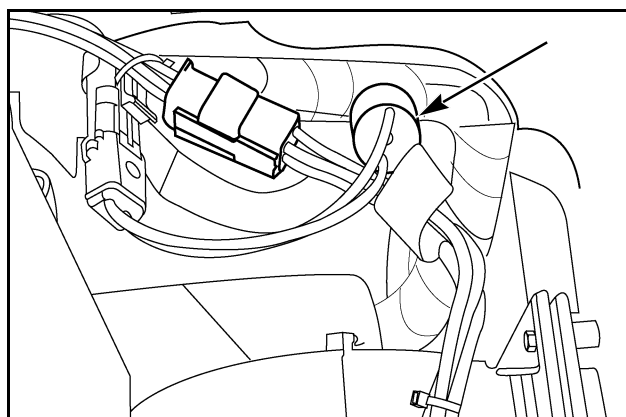


**High Pressure Switch at Compressor**

Low pressure switch activation is generally caused by low refrigerant level resulting from a leak(s). Sometime low pressure switch activation, however, is caused by a restriction, where because of the location either pressure switch may activate first. For example, a restriction at the output of the receiver-drier could cause either high or low pressure switch activation.

Refer to the **A/C Troubleshooting Foldout** and performance testing to locate the cause for your system.

When either pressure switch opens within the smart pressure counting conditions, a fault code displays on the Instrument Cluster Display, and the compressor clutch is latched OFF by the controller.



**Low Pressure Switch at Expansion Valve**



## Possible Failure Modes - Fault Codes 129 and 134

Fault Code	Description	
129	Controller has detected an open condition in <b>high pressure switch</b> circuit. Compressor clutch is latched OFF.	
	<b>Smart Pressure Switch Counting</b>	Code 129 is not activated until two occurrences within a 60 second interval, starting with the first occurrence. Actual interval may be as short as 10 seconds if open condition is constant. Controller must be fully initialized before first occurrence can be detected.
	<b>Causes</b>	<ol style="list-style-type: none"> <li>1. High pressure switch has opened because of high side system pressures. High pressure switch opens at system pressures above 400 psi <math>\pm</math> 10 (2758 kPa <math>\pm</math> 69). The switch closes when system pressure drops below 250 psi <math>\pm</math> 10 (1724 kPa <math>\pm</math> 69).</li> <li>2. Any intermittent open condition at a connector in the circuit appears the same to the controller.</li> </ol>
134	Controller has detected an open condition in <b>low pressure switch</b> circuit. Compressor clutch is latched OFF.	
	<b>Smart Pressure Switch Counting</b>	Code 134 is not activated until low pressure switch is open for >1 minute. Controller must be fully initialized before the first occurrence can be detected.
	<b>Causes</b>	<ol style="list-style-type: none"> <li>1. Low pressure switch has opened because of low side system pressures. Low pressure switch opens at system pressures below 4 psi <math>\pm</math> 2 (28 kPa <math>\pm</math> 14). The switch closes when system pressures rise above 20 psi <math>\pm</math> 3 (138 kPa <math>\pm</math> 21).</li> <li>2. Any intermittent open condition at a connector in the circuit appears the same to the controller.</li> </ol>
	<b>Exception</b>	<p>Code 02 may display when outside ambient air temperature is below 30° F (-1° C). The system does not require service. Toggle the ATC switch to OFF and then the desired operation position to reset the system.</p> <p><i>New Holland A/C systems are designed to prevent A/C compressor failure due to low pressure or low refrigerant charge. Operation on days below 40° F (4° C) may actuate the low pressure sensing system and shut down the A/C system. The system is not malfunctioning if this occurs. Toggle the ATC switch to OFF and then the appropriate operational mode to reset the system.</i></p>

Although system pressures may return to normal, the clutch remains latched OFF until the keyswitch or ATC switch is toggled OFF and then ON.

When installed in the A/C system under normal operating pressures, both pressure switches should test CLOSED.

The controller disables the clutch by denying ground to the clutch relay.

Cycling the power switch does not resolve the pressure problem, however, install the pressure test gauges and performance test the system.

### Switch Testing

When disconnected from the system, the low pressure switch will test normally open; the high pressure switch will test normally closed.

## Electrical Test

Refer to Schematic Sections 60 through 62 at the end of this section.

### Power and Ground

With **high pressure switch** activation, 5V is present at pin 33 at controller and pin 1 at the switch. The switch is grounded to the chassis.

With **low pressure switch** activation, 5V is present at pin 35 at the controller and pin B at the switch. The switch is grounded to 36 at the controller.

With no pressure switch activation, both circuits test 0.0V at the switch and at the controller.

## High Pressure Switch and Circuit Test

Steps and Test Point	Corrective Actions
1. Refer to A/C Troubleshooting Foldout and follow the conditions for performance testing. Install A/C high and low side pressure gauges. High reading above 400 psi $\pm$ 10 psi (2758 kPa $\pm$ 69 kPa)?	YES - Perform corrective actions from A/C Troubleshooting Foldout. NO - Go to next Step.
2. Shut off the tractor. Disconnect the switch from the harness and the unit. Check that switch is closed across pins A and B .	OK - Go to next Step. NOT OK - Replace switch.
3. Reinstall the switch in the unit; do not reconnect the harness. Keyswitch ON and ATC switch to "A." Is 5V present at pin B at the harness to the switch?	YES - Go to next Step. NO - Go to Step 5.
4. Keyswitch OFF. Measure resistance from pin 2 at the switch to ground. Less than 1 ohm?	YES - Go to next Step. NO - Locate open condition and repair between pin A and ground.
5. Keyswitch ON and ATC switch to "AUTO." Is 5V present at pin D1 at the controller?	YES - Locate open condition and repair between CJ8-34 and pin 1 at the switch. NO - Test the controller. See <b>ATC Controller Tests</b> in this section.

**Low Pressure Switch and Circuit Test**

Steps and Test Point	Corrective Actions
1. Refer to A/C Troubleshooting Foldout and follow the conditions for performance testing. Install A/C high and low side pressure gauges. Low reading below 4 psi $\pm$ 2 psi (28 kPa $\pm$ 14 kPa)?	YES - Perform corrective actions from A/C Troubleshooting Foldout. NO - Go to next Step.
2. Shut off the tractor. Disconnect the switch from the harness and the unit. Check that switch is open across pins A and B.	OK - Go to next Step. NOT OK - Replace switch.
3. Reinstall the switch in the unit; do not reconnect the harness. Keyswitch ON and ATC switch to "Auto." Is 5V present at pin B at the harness to the switch?	YES - Go to next Step. NO - Go to Step 5.
4. Keyswitch OFF. Measure resistance from pin A at the switch to HVAC ground. Less than 1 ohm?	YES - Go to next Step. NO - Locate open condition and repair between pin A and HVAC ground.
5. Keyswitch ON and ATC switch to "Auto." Is 5V present at pin C1?	YES - Locate open condition and repair between pin CJ8-36 at the controller and pin B at the switch. NO - Test the controller. See <b>ATC Controller Tests</b> in this section. Perform tests 1, 2 and 7.

## Heater Control Valve

### Operational Check

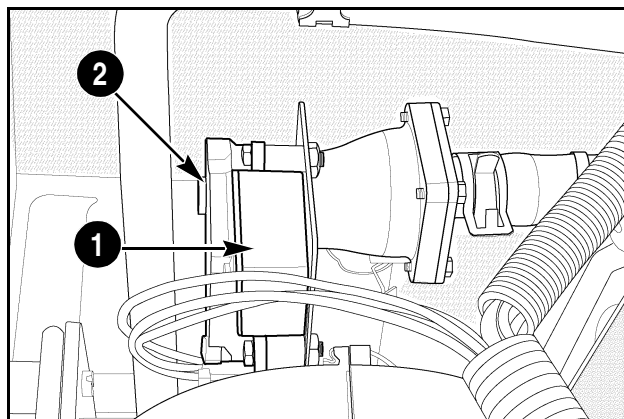
The controller opens or closes the heater control valve based on the operator selected input at the temperature control and the temperature sensed at the cab and evaporator sensors.

The heater control valve can fail mechanically in any position: open, closed or anywhere in the middle.

To confirm proper valve operation, observe the slot on the front of the valve. Rotation of the slot must mirror the movement of the temperature control.

The slot must rotate fully clockwise when the control is turned fully clockwise; the slot must rotate fully counterclockwise when the slot is turned fully counterclockwise.

If the valve does not mirror control movement or does not move, perform the valve motor electrical test.



1. HEATER CONTROL VALVE 2. SLOTTED ACTUATOR

RD99N053

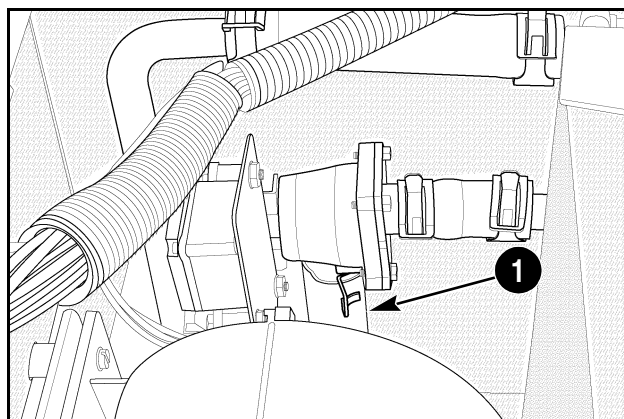
### Valve "Leak Through"

A common problem with the valve is hot coolant flow when cab cooling is desired. This usually occurs by a when a valve does not close completely. To test for leak through from the valve:

1. Operate the A/C system at maximum cooling and blower speed for 15 minutes. See conditions for Performance Testing.

**NOTE:** Do not clamp off the heater supply or return lines at the engine for this test.

2. Install a stem type thermometer in a mid-cab louver, and record the temperature.
3. Clamp off the coolant supply line before the valve with a vise grip pliers. (The supply line connects at the bottom of the valve.) Wait a few minutes and check the thermometer. If the temperature drops, valve leak through is the problem; replace the valve.



1. HEATER SUPPLY LINE

RD99N052

## Electrical Test

**NOTE:** See Electrical schematic sections 60 and 61.

### Power, Signal and Ground Circuit

The controller feeds 12V to the heater valve motor from pin 4 on the control module 36-pin connector to pin 10 on the motor.

The control signal (1.5 to 11.5V) is fed from the controller on pin 3 of the connector to pin 8 on the motor.

The motor is grounded from pin 7 at the motor to HVAC ground.

### Possible Failure Modes

1. Motor failure or valve physical failure.
2. Open condition in power, signal or ground to heater control valve.
3. Controller failure.

## Heater Control Valve Power, Signal and Ground Test

Steps and Test Point	Corrective Actions
<b>NOTE:</b> If both the heater control valve and mode door motor do not work, 12V from pin 4 at the controller is the likely suspect. Check power from pin 4 on wire 6D-Or.	
1. Keyswitch ON and ATC switch to "AUTO." Test from pin 8 on valve to chassis ground. While turning the temperature control from max cool to max heat setting, observe both voltmeter and slot on front of the valve. If voltage change but no slot movement or slot movement is irregular, heater valve has failed physically or actuator fault. Go to Step 2. If no voltage or no voltage change, go to Step 5. If voltage change and slot movement are continuous, heater valve tests okay.	
2. Keyswitch OFF. Disconnect harness connector to motor. Measure resistance through the motor from pin 7 to pin 10. Open line reading?	YES - Replace the heater control valve assembly. NO - Go to next Step.
3. Measure resistance from pin 7 on valve harness to HVAC ground. Less than 1 ohm?	YES - Go to next Step NO - Locate and repair open condition in ground from pin 7.
4. Keyswitch ON and ATC switch to "AUTO." Measure control signal at the harness connector on pin 8 from pin 3 at the controller, while turning the temperature control from max cool to max heat position. Is range from 11.5V (max cool) to 1.5V (max heat)?	YES - Go to Step 5. NO - Go to next Step.
5. Measure control signal at pin 3 at the controller while turning the control. Is range from 11.5V (max cool) to 1.5V (max heat)?	YES - Locate open condition and repair between pin 3 at controller and pin 8 at the heater valve. NO - Test the controller. See <b>ATC Controller Tests</b> .
6. Is 12V present at pin 10 at the harness connector?	YES - Incorrect reading taken. Retest. NO - Go to next Step.
7. Is 12V present at pin 4 at the controller?	YES - Locate open condition and repair between pin 4 at the controller and pin 10 at the valve. NO - Test the controller. See <b>ATC Controller Tests</b>

## Blower Speed And Temperature Control Potentiometers

### Background

#### Blower Speed Control

Blower speed is controller-selected in both automatic and defog operational modes, but the operator can override the selected speed by turning the control. Blower speed remains at the operator-selected speed until automatic or defog operation is reselected.

#### Common Features

The blower speed and temperature control potentiometers are identical. All three have the same resistance rating: 0-10K ohms. When a potentiometer fails or an open condition is detected in the control circuit, a fault code is displayed on the Display:

#### Temperature Control

The controller uses the setpoint input with the temperature control potentiometer and the input (resistance) from the cab and evaporator temperature sensors to maintain or drive to cab temperature.

### Possible Failure Modes - Fault Codes 120, 121

Fault Code	Description	
120	Controller has detected an open, or short to power condition in <b>blower speed control pot</b> circuit. Blower speed defaults to maximum output which cannot be varied with the control, but cooling/heating continue.	
	<b>Causes</b>	<ol style="list-style-type: none"> <li>1. Blower speed control potentiometer has failed.</li> <li>2. Open condition in power or ground to blower speed pot.</li> </ol>
121	Controller has detected an open, or short to power condition in the <b>temperature control pot</b> circuit. Controller provides a setpoint of 68° F (20° C) on the Instrument Cluster display which cannot be varied with the control; but cooling/heating continue.	
	<b>Causes</b>	<ol style="list-style-type: none"> <li>1. Temperature control potentiometer has failed.</li> <li>2. Open condition in power or ground to temperature control pot.</li> </ol>

## Electrical Test

**NOTE:** See *Electrical Schematic sections 60 and 61.*

### Power and Ground Circuit

The two pots are grounded from pin C, through C139-S, to HVAC Ground.

B+ read from the controller varies with the position of the pot: 0.0-3.xV.

**Blower Speed:** B+ is fed from CJ8-28 through C139H to pin B on the potentiometer.

**Temperature Control:** B+ is fed from CJ8-29 through C139T to Pin B on the potentiometer.

**Mode Door:** B+ is fed from CJ8-30 through C139T to Pin B on the potentiometer.

### Possible Failure Modes:

1. Control potentiometer failure.
2. Open condition in power or ground to control potentiometer.
3. Controller failure.

## Common Control Potentiometer and Circuit Test Procedure

Steps and Test Point	Corrective Actions
<b>NOTE:</b> If fault codes 120 and 121 display sequentially on the Display, the ground from Pin 18 at the controller through C139-S to the splice is the likely suspect and should be tested first for an open condition.	
1. Keyswitch ON and ATC switch to Auto. Turn the control pot while observing the Instrument Cluster display. If the fault code displays - <b>120 or 121</b> - only in certain locations, the pot is the likely suspect.	Go to next Step.
2. Open the overhead panel. Remove and resistance test the pot between pins B and C. Resistance must change smoothly ( 0-10K ohms) as the pot is turned from full CCW to full CW. Drop outs still present in certain locations?	YES - Replace the pot. NO - Go to next Step.
3. Reconnect the pot to the harness. Is 0.0-0.3V present between pin B at the and chassis ground while turning the control?	YES - Go to Step 5. NO - Go to next Step.
4. Measure resistance between pin C at the pot and pin 18 at the controller. Resistance greater than 11K ohms?	YES - Locate open condition and repair between pin C at the pot through C139-S to the controller at pin 18 NO - Go to next Step.
5. Keyswitch OFF. Measure resistance from pin 18 at controller to HVAC ground. Less than 1 ohm?	YES - Go to next Step. NO - Test the controller. See <b>ATC Controller Tests.</b>
6. Is 0.0-3.0V present at pin indicated below at the controller while turning the appropriate control? Blower Speed Pot ..... CJ8-28 Temperature Control Pot ..... CJ8-29	YES - Locate open condition and repair between pin B at the pot through C139 to the controller. NO - Test the controller. See <b>ATC Controller Tests.</b> Blower Speed Pot ..... Test 13 Temperature Control Pot ..... Test 12

## BLOWER AND BLOWER SPEED DRIVER

**NOTE:** See *Electrical Schematic sections 60 and 61*.

### Background

In automatic and defog/defrost modes, blower speed is selected by the controller based on the difference between the desired setpoint and the actual cab temperature. Refer to **ATC Operation** in this section for further information on how blower speed is selected, overridden and exceptions.

Various blower speeds are accomplished by modulating voltage to the blower motor with the blower speed driver. There are no fault codes for the blower motor or blower driver, although code **120** indicates a fault in the blower speed control circuit.

### Power, Signal and Ground Circuit

12V is fed to the blower motor and blower driver on pin A from fuse 26 (30 amp) whenever accessory power is present.

The voltage signal is fed from CJ8-5 to pin 3 on the blower speed driver.

The blower speed driver is grounded from SBC1-2 to chassis ground at ring terminal 173B. The blower motor is grounded within the speed driver.

**NOTE:** Refer to **Blower Speed, and Temperature Control Potentiometer** in this Section for troubleshooting the control potentiometer.

### Possible Failure Modes

1. Blower motor failure.
2. Blower speed driver failure.
3. Open condition in power, signal or ground to blower motor or blower speed driver.
4. Blower motor or blower speed driver shorted to ground.
5. Controller failure.



**Blower Motor/Blower Driver Power, Signal and Ground Test**

Steps and Test Point	Corrective Actions
<p><b>NOTE:</b> If blower motor intermittently cycles to full speed for short periods, blower speed driver may be entering thermal protection mode. Check for an intermittent short to chassis at blower motor on wire SBC-Or or wiring short to heat sink on the blower driver.</p> <p><b>NOTE:</b> The blower speed driver is equipped with a short crossover harness. When testing the blower speed driver, always test at the connector closest to the driver.</p>	
1. Keyswitch OFF. Disconnect the blower motor from the harness. Test resistance through the motor between pins A and B. Open line?	YES - Go to next Step. NO - Replace the blower motor.
2. Reconnect the blower motor to the harness. Is 12V present between pins 2 and 4 at the speed driver?	YES - Go to Step 6. NO - Go to next Step.
3. Keyswitch OFF. Measure resistance from pin 2 at driver connector, through C139-F, to chassis ground at ring terminal 173B. Less than 1 ohm?	YES - Go to next Step. NO - Locate open condition and repair between pin C and chassis ground.
4. Keyswitch ON. Is 12V present between pin A on the blower driver connector and chassis ground?	YES - Go to Step 6. NO - Go to next Step.
5. Is 12V present at fuse 49(30 amp)?	YES - Locate open condition and repair between pin A at blower driver and fuse 49 through C139-K. NO - Locate and correct problem from accessory relay to fuse 49.
6. Keyswitch ON and ATC switch to Auto. Measure voltage between pin B and pin A of the blower driver while turning the blower speed control. Does voltage follow pattern below?  Blower pot fully counterclockwise..... 12.8V Blower pot 1/4 turn clockwise..... 4.8V Blower pot fully clockwise..... 1.5V	YES - Go to Step 8. NO - Go to next Step.
7. Is voltage signal present (0-5V) at CJ8-5 at the ATC controller while turning the blower speed control?	YES - Locate open condition and repair on wire MTR-N between F1 at controller and pin D at connector. NO - Test the controller. See <b>ATC Controller Tests</b> .
8. Keyswitch OFF. Disconnect blower motor and speed driver from the harness. Measure resistance between pin B at motor to SBC2-2. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition.
9. Reconnect harness to blower speed driver. There must be no continuity between pin B at the motor harness and chassis ground with the keyswitch OFF. Measure resistance between pin B and chassis ground? Open line?	YES - Go to next Step. NO - Replace the blower speed driver.
10. ATC switch to Auto. Supply independent ground to pin 2 at blower speed driver. Does motor operate?	YES - Replace the blower speed driver. NO - Replace the blower motor.

## Cab And Evaporator Temperature Sensors

### Background

The cab temperature sensor (1), located behind and under the recirculation air filter, supplies a key value to the controller for heating and cooling. Another key value is the desired setpoint. The greater the difference between the desired setpoint and the temperature sensed at the cab sensor, the greater the ATC system response.

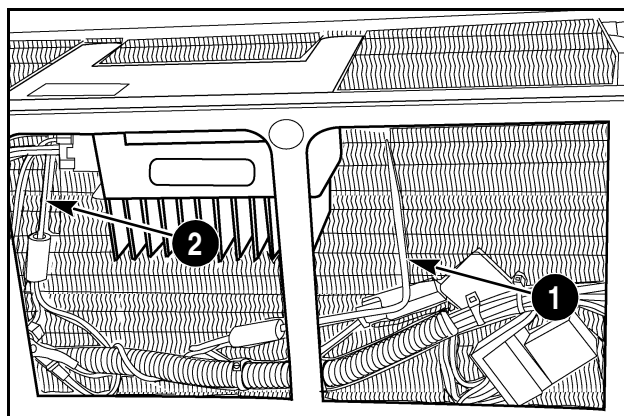
The evaporator temperature sensor (2), sometimes called the “freeze” or “core” sensor, is located in the evaporator/heater assembly. The sensor measures the effectiveness of system response to the current demand for heating or cooling, another key value which the controller uses to engage the compressor or open the heater valve.

### “Freeze” Control

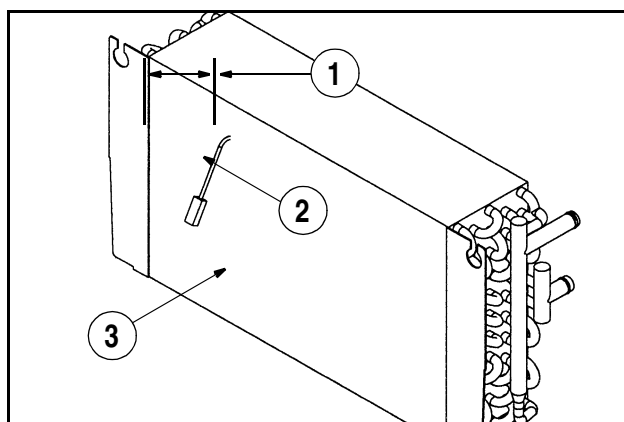
The evaporator sensor also prevents the system from operating in low ambient temperatures where damage to the system might occur. When temperature sensed at the evaporator falls to 32°F (0°C), the controller cycles the compressor clutch OFF. When temperature sensed at the evaporator rises to 37°F (3°C), the controller cycles the clutch back ON. In Defog mode or in Automatic mode at the maximum cooling setting where the compressor runs continuously, the freeze range controls the cycling of the compressor OFF or ON.

### Sensor Location

Proper location of the evaporator sensor is essential to system performance. The evaporator temperature sensor must be installed 4.2 inches (107 mm) from the left hand rear side of the evaporator. The sensor must be installed below the second refrigeration tube row at a 30° downward angle. Insert the sensor in the evaporator core up to the angled section, being careful not to kink the sensor.



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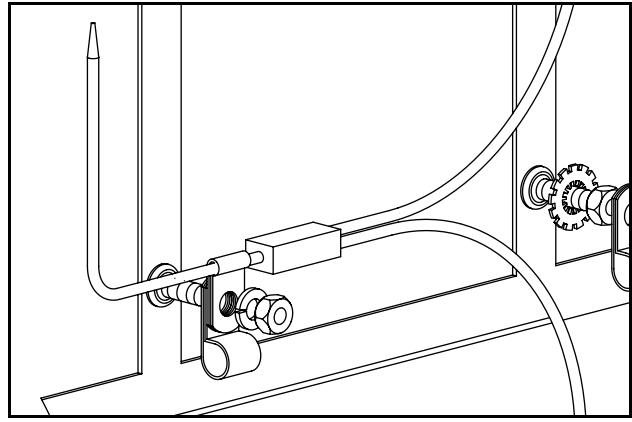
1. 4.2 INCH (107 MM)  
2. EVAP TEMP SENSOR

3. EVAPORATOR CORE

The cab temperature sensor must be installed in the recirculation air stream which enters the HVAC box at the rear. Do not install the sensor in contact with any metal surface; see illustration for view from inside the HVAC box.

Since the cab temperature sensor is located behind the recirculation air filter, any obstruction in the return air path will reduce system performance: The sensor will only detect air temperature in the HVAC box and not the true cab air temperature.

Check the area behind the operator's seat for obstructions at the recirculation filter, and check the filter for cleanness before testing the sensor.



RI03B039

## Electrical Test

Both sensors have the same resistance vs temperature response even though they look dramatically different. Both sensors should measure 10-25K ohms at room temperature for normal operation.

Both sensors are thermistors - thermal resistors. With these thermistors the colder the environment, the greater the electrical resistance; and the warmer the environment, the less electrical resistance.

If a fault 111, 115 or 116 is displayed, the most likely problem is wiring to the sensor. The out of range values are so high or low - 180° F (82°C) and -2° F (-19°C) - that occurrence is unlikely except as noted below in the fault code explanations.

More importantly, these sensors can fail without generating a fault code. Measure the resistance of the sensor and the ambient temperature at the sensor, and compare the readings to the Resistance versus Temperature table in this section. If the readings are not within the minus or plus 2.5% range, replace the sensor.

**NOTE:** *For the test to be valid, the thermometer used must be accurate, and the temperature recorded must be the temperature at the sensor.*

**NOTE:** *See Electrical Schematic section 60.*

## Power Circuit

Minimal voltage is fed to the sensors: about 0.5V at 70°F (21°C), and voltage drops as the temperature increases. Current is fed to the evaporator sensor from CJ8-23 and the cab sensor from CJ8-21.

### Service Note: Too Little Cooling/Too Much Heating Without Symptoms

The sensors should be suspect when the complaint is too little cooling when cooling and too much heating when heating ("the cab is too hot or too cold all the time"), and obvious symptoms are absent:

- System pressures are normal, and system is properly charged.
- Coolant system operating normally.
- No faults codes displayed on the Display.
- Compressor and heater valve are functioning normally.

The sensors fail in a consistent pattern: they sense a lower temperature than is actually present.

In cooling mode, actual cab temperature is 76°F (24°C), but the cab sensor senses 70°F (21°C) and the compressor is not engaged with sufficient frequency. In heating mode, actual cab temperature is 72°F (22°C), but the cab sensor senses 66°F (19°C) and heater valve is opened too widely.

Perform the resistance versus temperature test on both sensors.

**Possible Failure Modes - Fault Codes 111, 115 and 116**

Since input from the sensors is essential for automatic control of heating and cooling functions, the controller displays fault codes on the Instrument Cluster Display when it detects a sensor failure:

Fault Code	Description	
111	Controller has detected an open, or shorted to power condition in the <b>cab temperature sensor</b> circuit. Controller provides a default sensor value of 68° F (20° C); the setpoint must be adjusted to 73° F (23° C) or higher to enable cab heating, to 66° F (19° C) or lower to enable cab cooling. “AUTO” displays on the Instrument Cluster Display with ATC switch set to Automatic, but <b>automatic</b> temperature control does not function; operator must assume <b>manual</b> control.	
	<b>Cause</b>	1. Open condition in wiring to the cab temperature sensor. 2. Cab temperature sensor has failed out of range.
	<b>Exception</b>	At cab temperature below -2° F (-19° C) at the sensor, the fault code displays until the cab warms above this temperature. If fault code does not clear when cab warms, the sensor requires service.
115	Controller has detected an open, or shorted to power condition in the <b>evaporator temperature sensor</b> circuit. Compressor clutch does not engage for cooling, but heater valve opens and closes for cab heating. “A” displays on Instrument Cluster Display, but only heating is automatic.	
	<b>Cause</b>	1. Open condition in wiring to evaporator temperature sensor. 2. Evaporator temperature sensor has failed out of range.
116	Controller has detected a short to ground in the <b>evaporator temperature sensor</b> circuit. Compressor clutch does not engage for cooling, but heater valve opens and closes for cab heating. “A” displays on Instrument Cluster Display, but only heating is automatic.	
	<b>Cause</b>	1. Wiring shorted to evaporator temperature sensor. 2. Evaporator temperature sensor has failed out of range.
	<b>Exception</b>	At temperature above 180° F (82° C) at the sensor, the fault code displays until the evaporator cools below this temperature. If fault code does not clear when the evaporator cools, the sensor requires service.

**Cab Temperature Sensor and Circuit Test**

Steps and Test Point	Corrective Actions
1. Keyswitch OFF. Disconnect the cab temperature sensor from harness. Measure the resistance across the sensor leads. Measure the ambient temperature at the sensor. Compare the readings to the Temperature versus Resistance table on page 55. Is the resistance reading within the minus or plus 2.5% range in the table?	YES - Go to next Step. NO - Replace the sensor.
2. Keyswitch ON and ATC switch to "Auto". Measure voltage at female connector on sensor. Is voltage present?  <b>NOTE:</b> <i>Voltage reading will be very low: 0.5V at 70°F (21°C); and voltage decreases as temperature increases.</i>	YES - Go to next Step 4. NO - Go to next Step.
3. Measure voltage at CJ8-21 at the controller. Is voltage present?	YES - Locate and repair open condition between CJ8-21 at the controller and the sensor. NO - Test the controller. See <b>ATC Controller Test</b> in this Section. Perform tests 1, 2, and 10.
4. Measure resistance from ring terminal on the sensor to HVAC ground. Less than 1 ohm?	YES - Wrong reading taken. Retest. NO - Locate and repair open condition between sensor and HVAC ground.

## Evaporator Temperature Sensor and Circuit Test

Steps and Test Point	Corrective Actions
1. Keyswitch OFF. Disconnect the cab temperature sensor from harness. Measure the resistance across the sensor leads. Measure the ambient temperature at the sensor. Compare the readings to the Temperature versus Resistance table on page 55. Is the resistance reading within the minus or plus 2.5% range in the table?	YES - Go to next Step. NO - Replace the sensor.
2. Keyswitch ON and ATC switch to "Auto." Measure voltage at female connector on sensor. Is voltage present?  <b>NOTE:</b> <i>Voltage reading will be very low: 0.5V at 70°F (21°C); and voltage decreases as temperature increases.</i>	YES - Go to next Step 4. NO - Go to next Step.
3. Measure voltage at CJ8-23. Is voltage present?	YES - Locate and repair open condition between CJ8-23 and the sensor. NO - Test the controller. See <b>ATC Controller Tests</b> .
4. Measure resistance from the sensor to HVAC box ground stud. Less than 1 ohm?	YES - YES - Wrong reading taken. Test again. NO - Locate and repair open condition between sensor and HVAC box ground stud.
<b>NOTE:</b> <i>Verify that the evaporator temperature sensor is installed in the right location. The temperature sensor must be installed 4.2 inches (107 mm) from the right end of coil. The sensor must be properly installed. See evaporator sensor location in this section.</i>  <b>NOTE:</b> <i>While installing the sensor in the wrong location causes faulty system performance, it will not cause the sensor to fail or provide a faulty resistance reading for a given temperature. Replace the sensor if it tests out of range for a given temperature.</i>	

Temperature Versus Resistance Table

Ambient Temperature		Range		
°F	°C	-2.5%	Kohms	+2.5%
0	-17.78	170.820	175.200	179.580
1	-17.22	165.360	169.600	173.840
2	-16.67	160.095	164.200	168.305
3	-16.11	155.025	159.000	162.975
4	-15.56	150.150	154.000	157.850
5	-15.00	145.470	149.200	152.930
6	-14.44	140.985	144.600	148.215
7	-13.89	136.598	140.100	143.603
8	-13.33	132.308	135.700	139.093
9	-12.78	128.213	131.500	134.788
10	-12.22	124.313	127.500	130.688
11	-11.67	120.510	123.600	126.690
12	-11.11	116.805	119.800	122.795
13	-10.56	113.295	116.200	119.105
14	-10.00	109.785	112.600	115.415
15	-9.44	106.470	109.200	111.930
16	-8.89	103.350	106.000	108.650
17	-8.33	100.230	102.800	105.370
18	-7.78	97.227	99.720	102.213
19	-7.22	94.331	96.750	99.169
20	-6.67	91.533	93.880	96.227
21	-6.11	88.832	91.110	93.388
22	-5.56	86.219	88.430	90.641
23	-5.00	83.694	85.840	87.986
24	-4.44	81.247	83.330	85.413
25	-3.89	78.887	80.910	82.933
26	-3.33	76.596	78.560	80.524
27	-2.78	74.383	76.290	78.197
28	-2.22	72.248	74.100	75.953
29	-1.67	70.171	71.970	73.769
30	-1.11	67.470	69.200	70.930
31	-0.56	66.232	67.930	69.628
32	0.00	64.350	66.000	67.650
33	0.56	62.532	64.135	65.738
34	1.11	60.771	62.329	63.887
35	1.67	59.066	60.580	62.095
36	2.22	57.414	58.886	60.358
37	2.78	55.814	57.245	58.676
38	3.33	54.265	55.656	57.047
39	3.89	52.764	54.117	55.470
40	4.44	51.309	52.625	53.941
41	5.00	49.901	51.180	52.460
42	5.56	48.535	49.779	51.023
43	6.11	47.211	48.422	49.633
44	6.67	45.928	47.106	48.284
45	7.22	44.684	45.830	46.976
46	7.78	43.479	44.594	45.709
47	8.33	42.310	43.395	44.480
48	8.89	41.176	42.232	43.288
49	9.44	40.076	41.104	42.132
50	10.00	39.011	40.011	41.011
51	10.56	37.976	38.950	39.924
52	11.11	36.973	37.921	38.869
53	11.67	36.000	36.923	37.846
54	12.22	35.055	35.954	36.853
55	12.78	34.139	35.014	35.889
56	13.33	33.249	34.102	34.955
57	13.89	32.387	33.217	34.047
58	14.44	31.548	32.357	33.166
59	15.00	30.735	31.523	32.311
60	15.56	29.945	30.713	31.481

Ambient Temperature		Range		
°F	°C	-2.5%	Kohms	+2.5%
61	16.11	29.179	29.927	30.675
62	16.67	28.434	29.163	29.892
63	17.22	27.710	28.421	29.132
64	17.78	27.008	27.701	28.394
65	18.33	26.327	27.002	27.677
66	18.89	25.664	26.322	26.980
67	19.44	25.020	25.662	26.304
68	20.00	24.395	25.020	25.646
69	20.56	23.787	24.397	25.007
70	21.11	23.196	23.791	24.386
71	21.67	22.623	23.203	23.783
72	22.22	22.064	22.630	23.196
73	22.78	21.522	22.074	22.626
74	23.33	20.996	21.534	22.072
75	23.89	20.483	21.008	21.533
76	24.44	19.985	20.497	21.009
77	25.00	19.500	20.000	20.500
78	25.56	19.029	19.517	20.005
79	26.11	18.571	19.047	19.523
80	26.67	18.125	18.590	19.055
81	27.22	17.691	18.145	18.599
82	27.78	17.269	17.712	18.155
83	28.33	16.859	17.291	17.723
84	28.89	16.460	16.882	17.304
85	29.44	16.071	16.483	16.895
86	30.00	15.694	16.096	16.498
87	30.56	15.325	15.718	16.111
88	31.11	14.967	15.351	15.735
89	31.67	14.618	14.993	15.368
90	32.22	14.279	14.645	15.011
91	32.78	13.948	14.306	14.664
92	33.33	13.627	13.976	14.325
93	33.89	13.314	13.655	13.996
94	34.44	13.008	13.342	13.676
95	35.00	12.712	13.038	13.364
96	35.56	12.422	12.741	13.060
97	36.11	12.141	12.452	12.763
98	36.67	11.866	12.170	12.474
99	37.22	11.599	11.896	12.193
100	37.78	11.338	11.629	11.920
101	38.33	11.084	11.368	11.652
102	38.89	10.837	11.115	11.393
103	39.44	10.595	10.867	11.139
104	40.00	10.360	10.626	10.892
105	40.56	10.131	10.391	10.651
106	41.11	9.908	10.162	10.416
107	41.67	9.691	9.939	10.187
108	42.22	9.479	9.722	9.965
109	42.78	9.272	9.510	9.748
110	43.33	9.070	9.303	9.536
111	43.89	8.873	9.101	9.329
112	44.44	8.681	8.904	9.127
113	45.00	8.495	8.713	8.931
114	45.56	8.312	8.525	8.738
115	46.11	8.134	8.343	8.552
116	46.67	7.961	8.165	8.369
117	47.22	7.791	7.991	8.191
118	47.78	7.626	7.822	8.018
119	48.33	7.466	7.657	7.848
120	48.89	7.308	7.495	7.682
121	49.44	7.155	7.338	7.521



## Controller Power, Ground, And ATC Switch

**NOTE:** See *Electrical Schematic sections 60 and 61*.

### Background

HVAC ground is a grounding bolt at the back of the HVAC box. Ground is additionally provided from the common wires through CJ6R1 on wire 309- or to ring terminal C2.

Since so many controlled directed components interact, intermittent HVAC ground can make reliable troubleshooting very difficult.

The “intermittent” nature of the problem is further complicated since the fault can appear to move from component to component.

Early testing for a stable and consistent ground at the HVAC ground bolt and CJ6R1 to ring terminal C2 can greatly simplify troubleshooting.

### Power and Ground Circuit

#### ATC Controller

Whenever accessory power is present, 12V is fed the controller from fuse 47 (30 amp) through CJR6R1 to CJ8-17. The controller is grounded from CJ8-18 to HVAC ground.

#### ATC Switch

The controller feeds 5V CJ8-26 through CJ6R1-L to the switch at pin 4; grounding CJ8-26 with the switch provides the automatic mode request to the controller.

The controller feeds 5V from CJ8-25 through CJ6R1-M to the switch at pin 6; grounding CJ8-26 with the switch provides the Defog/Defrost mode request to the controller.

The switch is grounded from pin S to chassis at CJ6R1-S.

### Possible Failure Modes

1. Fuse 47 or open condition in power or ground to controller.
2. ATC switch failure.
3. Open condition in power or ground to switch.

### Controller Power Supply and Ground Test

Steps and Test Point	Corrective Actions
1. Keyswitch ON and ATC switch to “A.” Measure the voltage between CJ8-17 at the controller and chassis ground. Is 12V present?	YES - Go to Step 3. NO - Go to next Step.
2. Check fuse no. 47 (30 amp). Is 12V present?	YES - Locate and repair open condition between fuse 36 and pin CJ8-17 at the controller. NO - Locate and repair open condition from fuse 36 to switched B+. Go to next Step.
3. Measure resistance from pin 18 at the controller to HVAC ground. Less than 1 ohm?	YES - See <b>ATC Controller Tests</b> in this Section. Test the pins directly related to the faulty component at the controller. NO - Locate and repair open condition from pin 18 to HVAC ground.

**ATC Switch and Circuit Test**

<b>Steps and Test Point</b>	<b>Corrective Actions</b>
1. Disconnect ATC switch from harness. ATC switch to "AUTO." Measure resistance between pins 4 and 5 on switch? Less than 1 ohm?	YES - Go to next Step. NO - Replace switch.
2. Measure resistance from pin 5 at the ATC harness to terminal ground. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition between pin 5 and ground.
3. Keyswitch ON. Is 5V present between pin 4 and chassis ground at the harness connector.	YES - Go to next Step. NO - Go to Step 5.
4. Is 5V present between pin 26 at the controller and chassis ground?	YES - Locate and repair open condition between pin 26 at controller through C139-L and pin 4 at the switch. NO - Test the controller. See <b>ATC Controller Tests</b> in this Section.

**Defog/Defrost Switch and Circuit Test**

<b>Steps and Test Point</b>	<b>Corrective Actions</b>
1. Disconnect DEFOG/DEFROST switch from harness. DEFOG/DEFROST switch to "ON." Measure resistance between pins 2 and 3 on switch? Less than 1 ohm?	YES - Go to next Step. NO - Replace switch.
2. Measure resistance from pin 2 at the DEFOG/DEFROST harness to terminal ground. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition between pin 5 and ground.
3. Keyswitch ON. Is 5V present between pin 3 and chassis ground at the harness connector.	YES - Go to next Step. NO - Go to Step 5.
4. Keyswitch ON. Is 5V present between pin 31 at controller and chassis ground at the harness connector.	YES - Locate and repair open condition between pin 3 at controller through CJ6R-L and pin 4 at the switch. NO - Test the controller. See <b>ATC Controller Tests</b> in this Section.

## Cab Pressurizer Blower

### Background

Whenever engine rpm is greater than 500, the cab pressurizer motor should operate. The motor/blower assembly draws air from the cab cap through the left hand cab post and fresh air filter and feeds it directly to the HVAC box under the operator's seat. The motor/blower assembly is located under the instructional seat behind a trim panel.

The motor is energized by a relay, activated by the engine governor when proper rpm is present; and the engine controller controls both the governor and the relay.

If there is a wiring problem between the governor and relay, or if the controller detects a problem with the governor, the engine controller posts a fault code. See the engine service manual.

Only relay and blower motor troubleshooting are covered here.

**NOTE:** See *Electrical Schematic sections 60 and 61*.

### Power and Ground

Whenever accessory power is present, 12V is supplied the pressurizer motor from fuse 10 (15 amp) on pin A

Ground is supplied to the motor on pin B from the pressurizer relay (pin 5) to start the motor at the proper engine rpm. Ground to the relay is from ring terminal 173E; the relay is energized on pin 2, wire 304-Bk.

### Cab Pressurizer Blower & Relay Power Supply and Ground Test

Steps and Test Point	Corrective Actions
1. Operate the engine at rpm greater than 500 to engage the cab pressurizer blower. Check fuse 10 (15 amp). Is 12V present?	YES - Go to next Step. NO - Replace fuse 10 and/or locate and repair open condition to the fuse.
2. Measure the voltage on C90-A at the pressurizer motor. Is 12V present?	YES - Go to next Step. NO - Locate and repair open condition on 195 C.
3. Disconnect the motor from the harness and check for continuity through the motor between pins A and B. Is continuity present?	YES - Go to next Step. NO - Replace the motor.
4. Keyswitch OFF. Measure resistance between pin 5 at relay and pin B at the motor. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition between pin 5 at the relay and pin A at the motor on wire 130-Bk.
5. Measure resistance on pin 3 at the pressurizer relay to ring terminal ground 173B. Less than 1 ohm?	YES - Replace the relay. NO - Locate and repair open condition between pin 3 at relay and ring terminal.

## ACCESSING THE HVAC BOX

**NOTE:** The following procedure applies to both the standard control units and Automatic Temperature Control (ATC) systems.

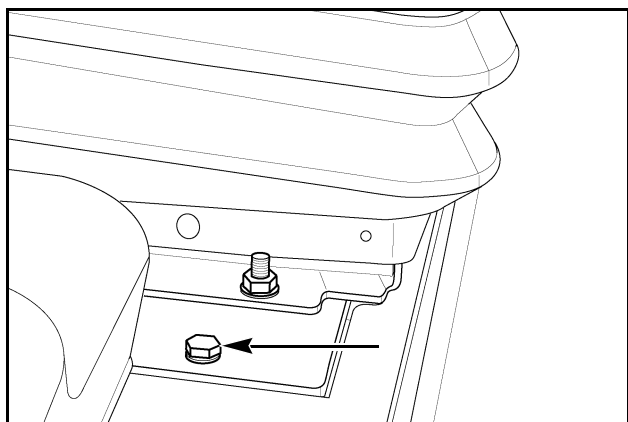
### STEP 1

Disconnect the harness to the right hand control console.

### STEP 2

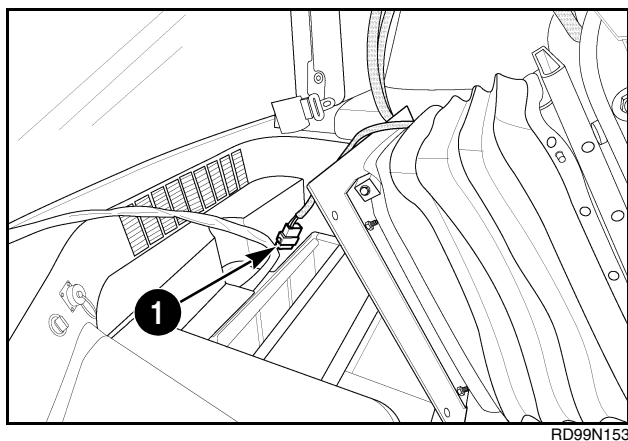
Tilt the steering wheel to the full upright position. Adjust seat to the full upright and back position.

### STEP 3



Remove four bolts in the seat base corners

### STEP 4



1. SEAT HARNESS

Disconnect the seat harness.

### STEP 5

Hinge seat forward and rest on steering wheel.

### STEP 6

After completion of service, reinstall the seat harness. Realign ATC controller mounting plate, if equipped, with mounting holes and reinstall seat mounting hardware. Reconnect right hand control harness. Ensure cab recirculation air filter is properly installed.

## STANDARD AIR CONDITIONING (STD) TROUBLESHOOTING

### Important Notes

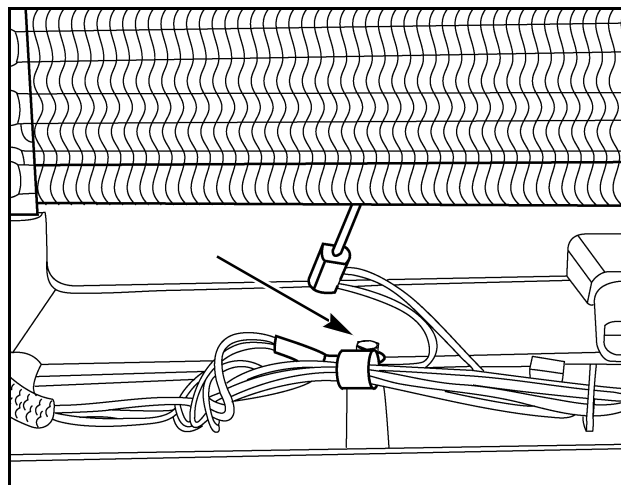
**ABBREVIATIONS:** Connectors and their pins or terminals are abbreviated throughout the troubleshooting section. C139-T represents pin T on connector 139; C333-15 represents pin 15 on connector 333.

**IMPORTANT:** The standard controller and many components are grounded to "HVAC ground." HVAC ground is both a grounding bolt at the rear of the HVAC box and chassis ground at ring terminal 172F – on wire 85\_CCU-N within the box and wire 177F-Bk outside the box. The stability of this ground is essential for reliable troubleshooting.

**WARNING:** All operating controls must be in neutral or park lock position when performing these tests.

**NOTE:** Use a multimeter (DVOM) for these tests. Do NOT use a self-powered test light for any of these tests.

**NOTE:** The batteries must be fully charged and all connections clean and tight. Inspect all connectors for damage, bent or dislocated pins or improper seating when troubleshooting.



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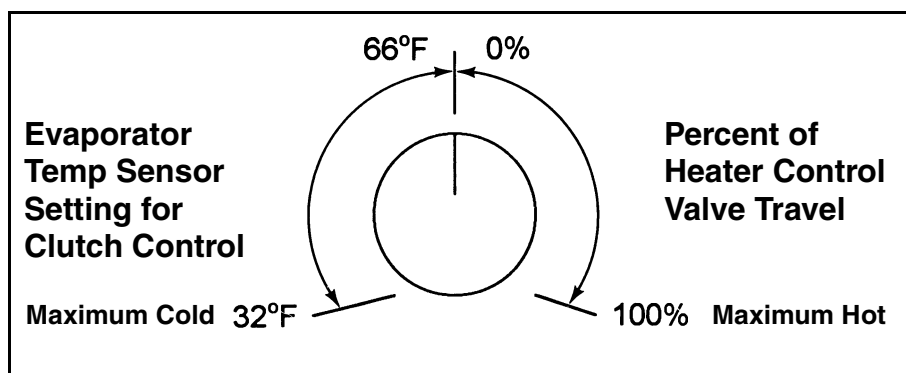
**Ground Stud at Rear of HVAC Box**

## Standard A/C Operation

The standard A/C controller is an open loop control device. The controller provides electronic thermostat control. The compressor clutch is engaged and disengaged by the standard controller. The clutch is cycled from 32° to 66° F (0° to 19° C) evaporator temperature sensor values proportional to the temperature control potentiometer position from 12 o'clock to full counterclockwise.

The standard controller opens the heater control valve from full closed to full open position proportional to the temperature control potentiometer position from 12 o'clock to full clockwise.

If cab temperature is to be made cooler or warmer or if blower speed is to be increased or decreased, it is the operator who makes the adjustment.



Standard A/C Temperature Control

RD99D022

## Smart Pressure Switch Cycling System

The standard A/C system is equipped with pressure switch cycle counters. The compressor is latched OFF after four activations of the low pressure switch within a 60 second interval. The compressor is also latched OFF after two activations of the high pressure switch within a 60 second interval. The 60 second interval starts with the first activation of the switch in both cases.

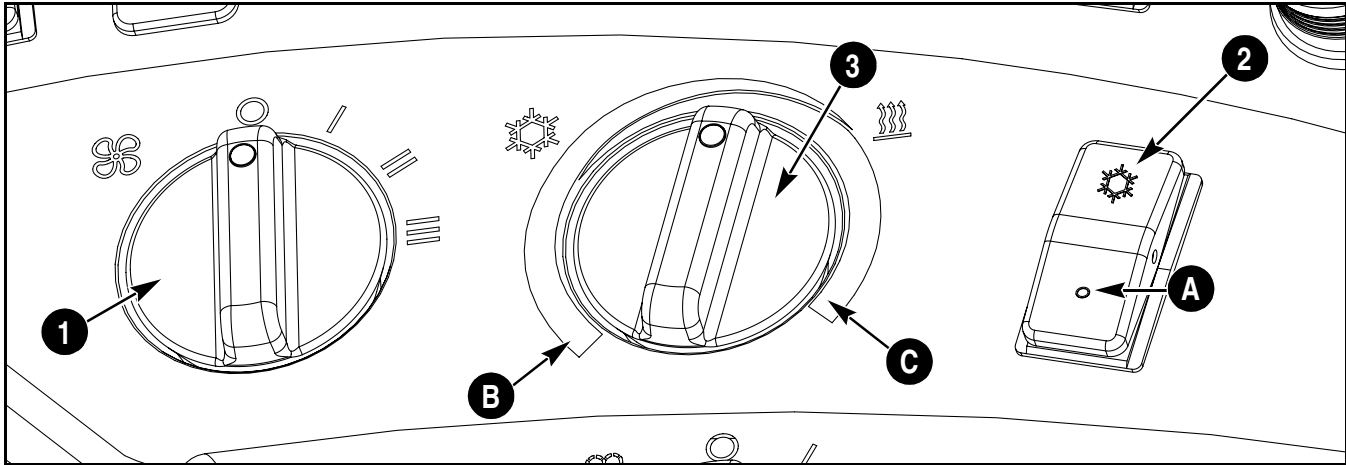
**IMPORTANT:** Actual interval may be as short as 10 seconds if the open condition is constant.

The controller flashes the pressure warning lamp (mounted in the A/C On/Off switch) slowly, approximately 7 times in a 10 second period for the low pressure switch, or quickly, approximately 13 times in a 10 second period for the high pressure switch.

The compressor clutch remains latched OFF until the A/C switch or keyswitch is toggled OFF and then ON. However, toggling the switch does not correct the pressure problem, and system service is required.

**NOTE:** Your A/C systems are designed to prevent A/C compressor failure due to low pressure or low refrigerant charge. Operation on days below 40° F (4° C) may actuate the low pressure sensing system and shut down the A/C system. The system is not malfunctioning if this occurs. Toggle the A/C switch OFF and then ON to reset the system.

## Standard A/C Controls and Their Function



RH03B058

<b>1. Blower Speed Control</b>	<p>Manual selection of blower speed: Low, Medium or High or OFF.</p> <p>With A/C switch in the OFF position and any blower speed selected, the control provides fresh air circulation for the cab with outside ambient air introduced with the cab pressurizer blower to the HVAC box.</p>	
<b>2. A/C ON/OFF Switch</b>	<p>Toggles cooling On or Off</p>	<p>A. Pressure Warning Indicator: the warning lamp blinks slowly, approximately 7 times in a 10 second period for low pressure switch activation, or quickly, approximately 13 times in a 10 second period for the high pressure switch activation.</p>
<b>3. Temperature Control</b>	<p>Compressor is engaged or heater valve is opened in direct proportion to the movement of the control.</p>	<p>B. Maximum Cooling Zone - 32° F (0° C); compressor runs continuously until the freeze setting at the evaporator temperature sensor cycles the clutch OFF. The clutch is cycled ON again when the evaporator thaws to 37° (3°C).</p>
		<p>C. Maximum Heating Zone, heater control valve at 100% open position</p>

## Symptom-Based Standard A/C Troubleshooting

Symptom	Possible Cause	Test or Reference
A/C system is inoperative	Blower speed switch defective Fuse 49	See <b>Blower Speed Switch and Blower Motor</b> , in this Section.
Compressor operates, but blower is inoperative.	Power and ground to blower motor Blower motor defective	See <b>Blower Speed Switch and Blower Motor</b> , in this Section.
Blower operates, compressor is inoperative.	High pressure switch activated locking out the clutch  Standard A/C controller blinks warning lamp (in the A/C ON/OFF switch) quickly, approximately thirteen times in a 10 second period	See <b>High and Low Pressure Clutch Latching</b> , in this Section.
	Low pressure switch activated locking out the clutch  Standard A/C controller blinks warning lamp (in the A/C ON/OFF switch) slowly, approximately seven times in a 10 second period	See <b>High and Low Pressure Clutch Latching</b> , in this Section.
	Evaporator temperature sensor "freeze" setting reached cycling the clutch OFF	See <b>Evaporator Temperature Sensor</b> in this Section.
	Open in switched ground to relay from controller Power and ground to clutch relay Clutch relay defective	See <b>Electrical Test for Clutch Relay</b> in this Section.
	Controller defective	See <b>Standard Controller Test</b> , , in this Section.
	Fuse 47 or power and ground to controller	See <b>Controller Power and Ground Test</b> , page 86, in this Section.
	Loose or broken drive belts	See <b>Operational Check</b> for compressor and clutch, in this Section.
	Compressor clutch defective	
	Compressor defective.	
Blower operates, no heat, too much heat or heat output cannot be changed.	Heater control valve defective (Control valve can fail in any position - open, closed, midway.) Power and ground to heater control valve	See <b>Heater Control Valve</b> , in this Section.
	Temperature control potentiometer disconnected or defective	See <b>Temperature Control Pot</b> , in this Section.
	Coolant not hot	See Engine Cooling Section in this manual.



## Section 50 - Climate Control - Chapter 1

Symptom	Possible Cause	Test or Reference
Blower operates but not at all speeds: no low speed and/or no medium speed but high speed operates.	Blower speed switch defective Open line from in-line connector to motor Motor resistor disconnected or defective	See <b>Blower Speed Switch and Blower Motor</b> , in this Section.
Too little cooling, too little heating with system pressures and components normal	Evaporator temperature sensor failing Open line to evaporator temperature sensor	See <b>Evaporator Temperature Sensor</b> , in this Section.
Cab pressurization blower does not run when switched B+ is present.	Power and ground to cab pressurizer blower. Fuse 10 Cab pressurizer relay disconnected or defective. Power and ground to cab pressurizer blower relay.	See <b>Cab Pressurizer Blower</b> , in this Section.

## Standard Controller Test

The following tests determine whether the A/C controller requires replacement, since it tests primary input and output circuits. Some test steps isolate system problems to specific circuits which can simplify general troubleshooting.

In general, the service technician should resist the temptation to replace the controller as the solution to all A/C system problems. Double check your test results to avoid a return service call. The absence of key control voltages or switched ground does require controller replacement.

**NOTE:** The following tests are performed with both connectors installed on the controller using an appropriate service probe and digital voltmeter.

Test Number	Pin ID		Description	Wire/Color	Test Points
	6-Pin Conn				
2	A	-->	Controller Power (+)	252-Or	Pin A to Battery GND
7	B	-->	Evaporator Temp Sensor	PB-S	Pin B to Battery GND
5	C	-->	High Pressure Switch	80-Or	Pin C to Battery GND
9	D	-->	Temperature Control Pot	103-Or	Pin D to Battery GND
11	E	-->	A/C On/Off Switch	112-Or	Pin E to Battery GND
1	F	-->	Controller Ground (-)	MOD-Bk	Pin F (6-pin) to HVAC ground
	5-Pin Conn		Description	Wire/Color	Test Points
8	A	-->	Comp Clutch Relay	1A-Or	Pin A (5-pin) to chassis ground
6	B	-->	Low Pressure Switch	LP-Or	Pin B (5-pin) to Battery GND
10	C	-->	Pressure Warning Lamp	111-Or	Pin C (5-pin) to Battery GND
4	D	-->	Heater Cont Valve Sig	9C-Or	Pin D (5-pin) to Battery GND
3	E	-->	(+) Heater Cont Valve Pwr	6D-Bk	Pin E (5-pin) to Battery GND
<b>*HVAC GROUND</b>					
<b>CHASSIS GROUND</b>					
<b>BATTERY GND - Battery Negative Post (-)</b>					

\* The standard controller and many components are grounded to "HVAC ground." HVAC ground is both a grounding stud at the rear of the HVAC box and chassis ground at ring terminal 172F through C139-F on wire 178-Bk.

Test	Instructions and Actions
①	<b>Test ground continuity to controller: Pin F (6-pin) to HVAC ground</b>
	Condition(s): A/C Switch OFF Expected Result: Less than 1 ohm <b>Action:</b> Restore clean ground and retry the unit.
②	<b>Confirm switched B+ is present at controller: Pin A to Battery GND</b>
	Condition(s): Keyswitch ON Expected Result: 12V <b>Action:</b> Restore 12V and retry the unit. See Controller Power and Ground, page 86, in this Chapter.

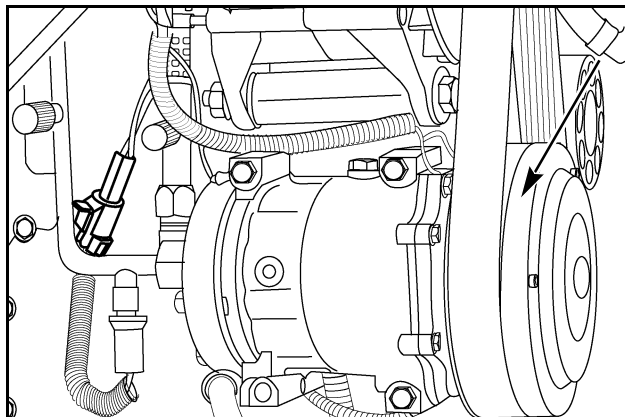
Test	Instructions and Actions
3	<b>Confirm power output to heater valve: Pin E (5-pin) to Battery GND</b>
	Condition(s): Keyswitch and A/C Switch ON Expected Result: 12V <b>Action:</b> If no voltage, replace the controller.
4	<b>Confirm control signal to heater control valve: Pin D (5-pin) to Battery GND</b>
	Condition(s): Keyswitch and A/C Switch ON Expected Result: 1.5 to 11.5V while turning temperature control from max heat to max cool setting <b>Actions:</b> If no voltage, replace the controller. If no voltage change or drop out, test the pot. See Temperature Control Pot, page 79.
5	<b>Test high pressure switch circuit: Pin C to Battery GND</b>
	Condition(s): Keyswitch and A/C Switch ON, disconnect harness to high pressure switch Expected Result: 5V <b>Action:</b> If no voltage, replace the controller. (Reconnect harness before continuing testing.)
6	<b>Test low pressure switch circuit: Pin B (5-pin) to Battery GND</b>
	Condition(s): Keyswitch and A/C Switch ON, disconnect harness to low pressure switch Expected Result: 5V <b>Action:</b> If no voltage, replace the controller. (Reconnect harness before continuing testing.)
7	<b>Test evaporator temperature sensor: Pin B to Battery GND</b>
	Condition(s): Keyswitch and A/C Switch ON Expected Result: 0.5V at 70°F (21°C) at the sensor. Voltage decreases as temperature increases. <b>Actions:</b> If no voltage, replace the controller. If voltage out of range for temperature, test sensor. See sensor test, page 83.
8	<b>Test controller switched ground to clutch relay: Pin A (5-pin) to chassis ground</b>
	Condition(s): Keyswitch ON Expected Result: 0.0V or 12V, see actions. <b>Actions:</b> A/C switch ON, with temperature control to max cool and normal pressures, 0.0V indicates proper operation. A/C switch OFF and keyswitch ON, 12V indicates proper operation; if no 12V, test relay control circuit, page 86. If circuit tests normal, replace the controller.
9	<b>Test temperature control output: Pin D to Battery GND</b>
	Condition(s): Keyswitch and A/C switch ON Expected Result: 5V <b>Actions:</b> If no voltage, replace the controller.
10	<b>Test the pressure warning lamp circuit in A/C switch: Pin C (5-pin) to Battery GND</b>
	Condition(s): Keyswitch and A/C switch ON, disconnect harness to either pressure switch Expected Result: 5V <b>Actions:</b> If no voltage, test the A/C switch circuit; see page 87. If circuit and switch test normal, and warning lamp does not blink with pressure switch harness disconnected, replace the controller. (Reconnect harness before continuing tests.)
11	<b>Test A/C switch control function: Pin E to Battery GND</b>
	Condition(s): Keyswitch ON Expected Result: 5V with A/C OFF, 0.0V with A/C switch ON <b>Actions:</b> Test the A/C switch circuit; see page 87. If circuit and switch test normal, but compressor does not engage with proper request and conditions, replace the controller.

## Compressor And Clutch

### Operational Check

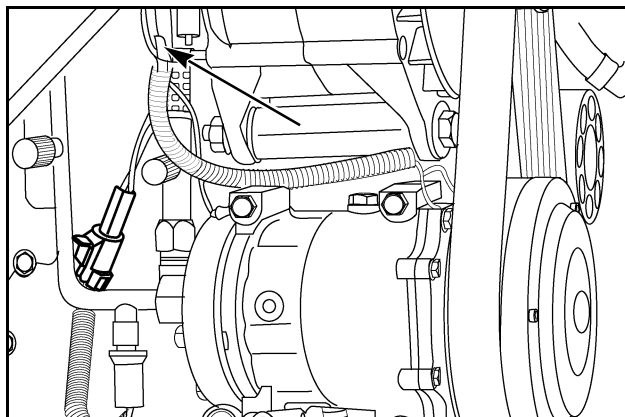
1. When functioning normally, the compressor clutch is always grounded to the chassis, and switched 12V is supplied by a controller-activated relay to energize the clutch coil and engage the compressor.

With keyswitch ON, A/C switch to ON temperature control on maximum cool, check that clutch is engaged and the compressor is operating.



RD02H026

2. Disconnect the clutch at the harness. The clutch should disengage smoothly with little noise from the pulley or the bearings. Reconnect the harness to the clutch. The clutch should engage rapidly, and operation should be smooth and quiet.



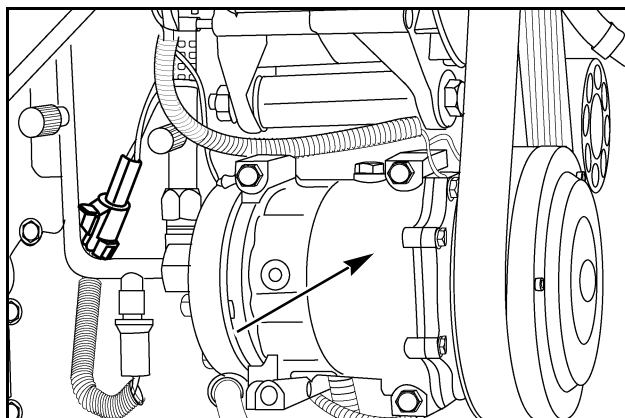
RD02H026

3. If operation is noisy, feel the compressor next to the clutch for vibration. If the compressor is vibrating next to the clutch and the noise changes when the clutch disengages, the clutch has failed. If the compressor is vibrating, the compressor has failed. The vibrating component is usually the source of the problem.



**WARNING:** Do NOT attempt to test the clutch directly with your hand. Rotating parts can cause severe personal injury.

M842



RD02H026

4. With the clutch still engaged, momentarily touch the suction and discharge hoses at the compressor for temperature difference. The suction line should be cool to cold, and the discharge line should be hot to very hot.



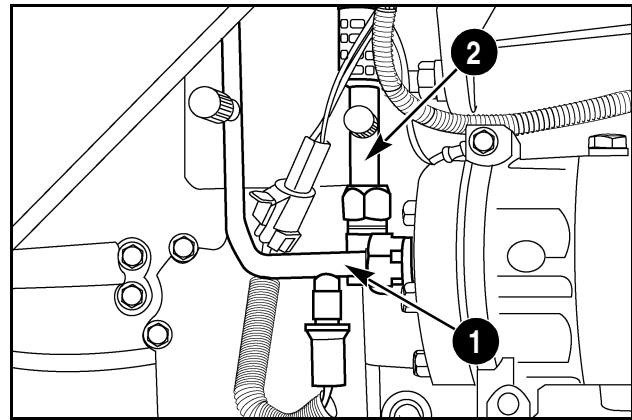
**WARNING:** *This is only a momentary contact with the hose.*

M636

Little or no temperature difference between the hoses is another indication of compressor failure: internal leakage between discharge and suction sides.

**NOTE:** *The compressor end plate is stamped with a "D" and "S" to indicate the discharge and suction ports.*

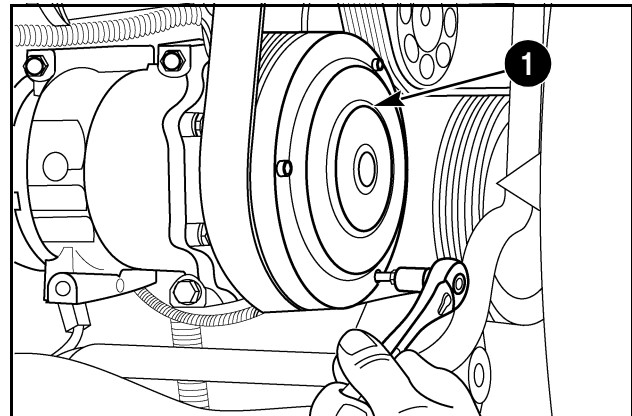
5. Verify an internal problem when compressor failure is suspected. Turn the A/C system and tractor OFF. Remove the three Torx® screws to remove dust cover from clutch. Use a wrench to slowly rotate the compressor clockwise. Compressor rotation should be smooth and not require much effort. If severe rough spots or catches are felt when turning the shaft, the compressor has been damaged internally and must be replaced.



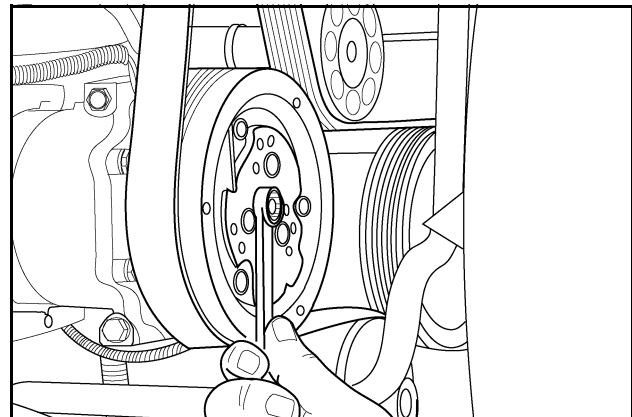
RD02H031

1. DISCHARGE/HIGH  
PRESURE LINE

2. SUCTION/LOW  
PRESSURE LINE



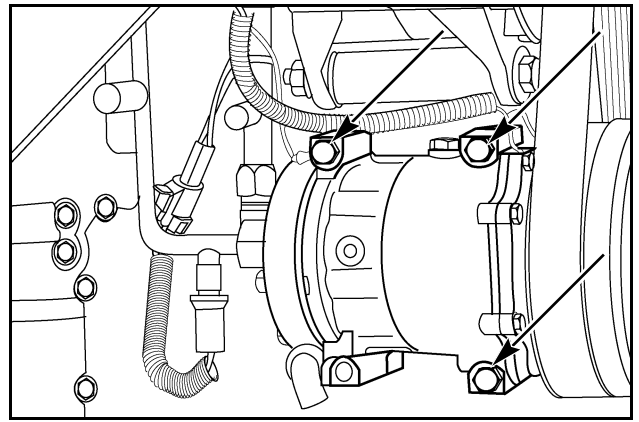
RD02H023



RD02H024

6. Check for loose mounting bolts on the compressor. Tighten the bolts to the correct torque.

**NOTE:** Loose mounting can cause a “knocking” sound at the compressor. A refrigerant overcharge also causes a knocking sound at the compressor.

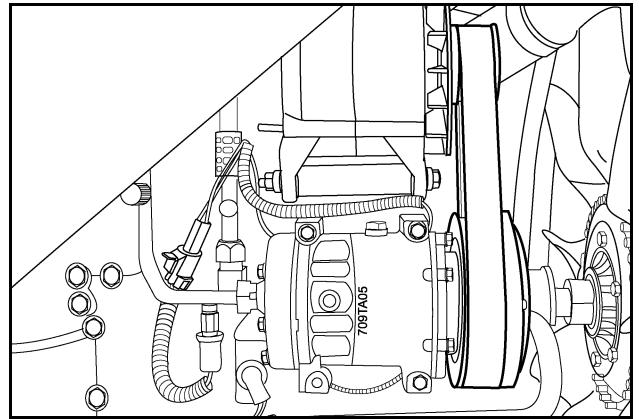


RD02H025

7. Clutch drive belt should be running smooth and straight. Clutch pulley and the drive pulley must be aligned within 1/16 inch (1.6 mm) of each other. Use a straight edge to check pulley alignment. Adjust the compressor on the mounting bracket if required.

The drive belt should be firmly seated in the clutch grooves.

Check for too much belt wear: cracking, cord wear, piling, chunking, glazing or separated layers. Replace a worn or deteriorated belt.



RD02H027

## Electrical Test – Compressor Clutch

**NOTE:** See *Electrical Schematic sections 58, 60 and 61.*

### Background

The compressor clutch is cycled On or Off by the controller based on the temperature sensed at the evaporator.

When functioning normally, the clutch is always grounded to the chassis through ring terminal 199F at the compressor mounting bolt.

The blower speed switch must be in any position but OFF to engage the compressor.

The controller grounds the compressor clutch relay to provide 12V from fuse 49 via the blower switch to energize the clutch coil and engage the compressor.

### Power and Ground Circuit

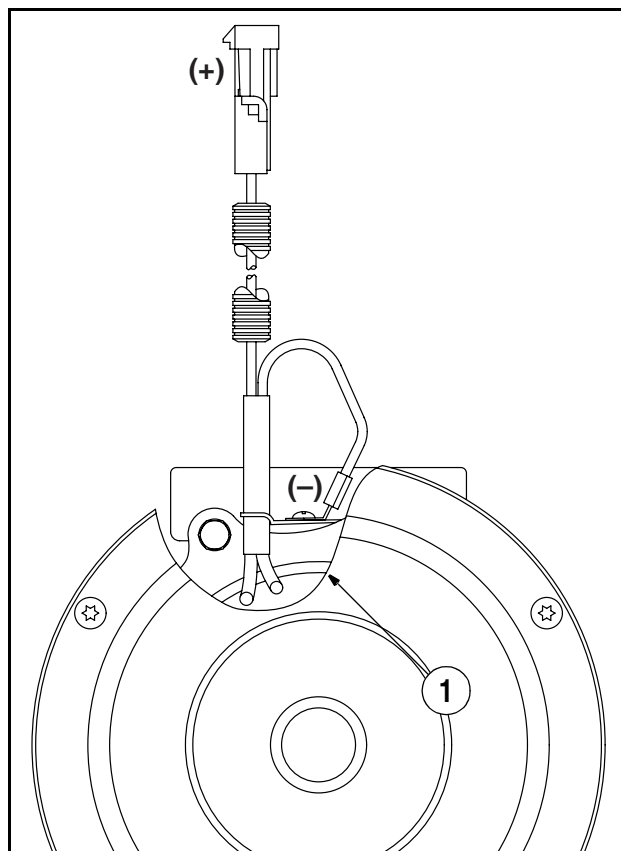
Switched 12V is fed to the compressor clutch relay on pins 3 and 2 through the blower switch from fuse 49.

The controller energizes the relay by supplying switched ground from pin A on CCU2 to pin 1 on the relay.

12V is fed from pin 5 on the relay – through C139-C, C10-84, and C333-15 – to energize the clutch coil at C72-A.

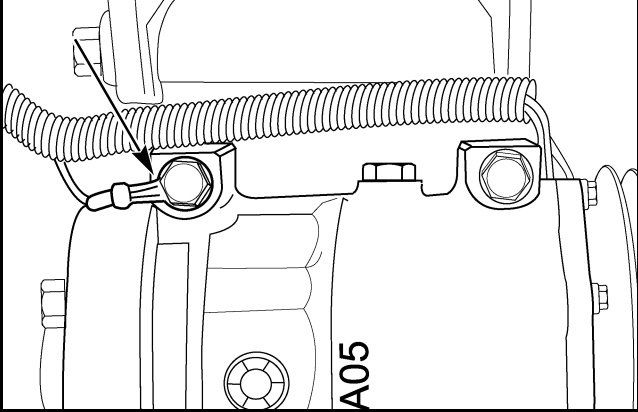
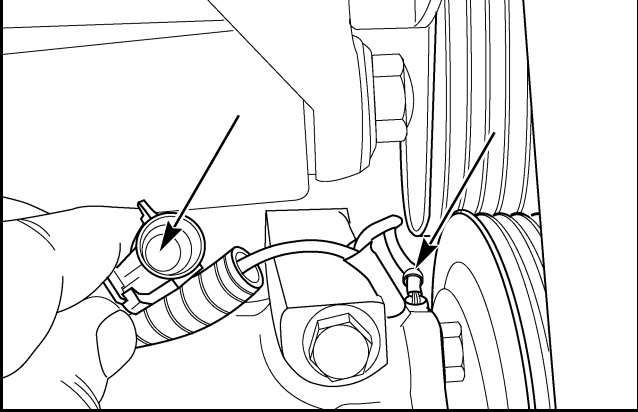
### Possible Failure Modes:

1. Short circuit or open circuit in clutch coil.
2. Open circuit in power and ground between clutch and relay.
3. Defective relay.
4. Controller fault.



RI03B037

## Clutch Relay Power Supply and Ground Test

Steps and Test Point	Corrective Actions
<p><b>NOTE:</b> If both the blower motor and the compressor are not operating, check fuse 49 and the blower control circuit before testing the clutch relay.</p> <p><b>NOTE:</b> This procedure assumes that the clutch has <i>NOT</i> been latched OFF by the controller due to high or low pressure switch activation and that the pressure warning lamp is not flashing on the A/C switch.</p>	
 <p>RD03B071</p> <p>1. Keyswitch and A/C switch OFF. Test continuity between ring terminal ground 199F on the top, rear compressor mounting bolt and chassis at Splice E1. Less than 1 ohm?</p>	<p>YES - Go to next Step.</p> <p>NO - Repair open circuit or replace wire. Retry the unit.</p> <p>NOT OK - Go to next Step.</p>
 <p>RH02G158</p> <p>2. Measure resistance from C72-A through clutch to ground screw on bracket. Is resistance between 3.6-4.2K ohms?</p>	<p>YES - Go to next Step.</p> <p>NO - If open line or resistance is severely out of range, replace the clutch.</p> <p><b>NOTE:</b> If clutch is shorted, also check condition of fuse 49 (30 amp). The clutch draws enough amperage to cause fuse 49 to blow.</p>
<p>3. Keyswitch and A/C switch ON; blower control on any speed but OFF, temperature control to maximum cooling. Is 12V present at male harness connector to clutch?</p>	<p>YES - Clutch tests okay. Check for flashing warning lamp on A/C switch.</p> <p>NO - Go to next Step</p>
<p>4. Is 12V present between pin A on CCU2 at controller and chassis ground?</p> <p><b>NOTE:</b> Refer to Accessing the HVAC Box at the end of this Section if required.</p>	<p>YES - Go to Step 6.</p> <p>NO - Go to next Step.</p>



Steps and Test Point	Corrective Actions
5. Is 12V present at pin 3 of compressor clutch relay?	YES - Go to next Step. NO - Locate and repair open condition between pin 3 on relay and pin F on blower speed switch, through C139-A.
6. A properly functioning relay can be heard engaging. Toggle the A/C switch OFF and ON, and listen for a clicking sound. Is the relay functioning?	YES - Relay coil functioning normally. Go to next Step. NO - Replace the relay.
7. Is 12V present at terminal 5 on the relay?	YES - Go to next Step. NO - Replace the relay.
8. Keyswitch OFF. Measure resistance between pin A on CCU2 and pin 1 at the relay. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition on wire 1A-Or between pin A and pin 1.
9. Keyswitch and A/C switch ON; blower control on any speed but OFF, temperature control to maximum cooling. Supply independent ground to pin A on the 5-pin connector at the controller. Does compressor clutch engage?	YES - Test the controller. See <b>Standard Controller Test</b> , page 65, in this Section. NO - Locate open condition and repair between pin 5 on relay and C72-A at the clutch, through C139-C, C10-84 and C333-15.

### Service Note: Adjusting Clutch Air Gap

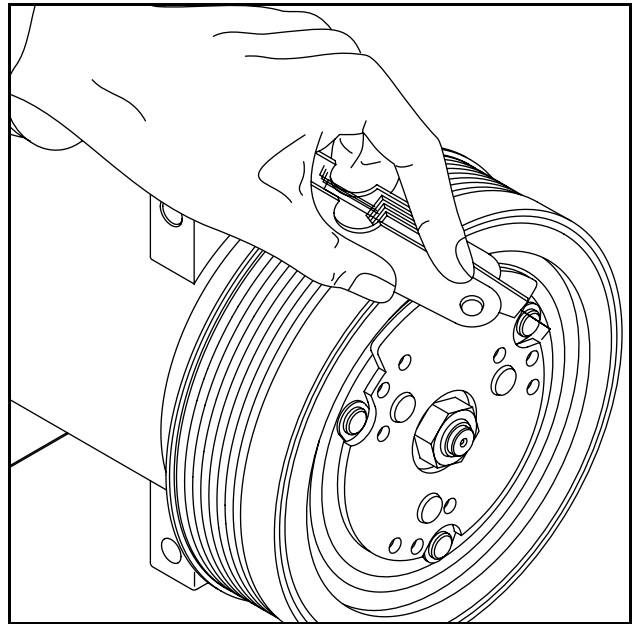
When replacing a clutch in the field, pay special attention to the air gap between the clutch plate and pulley. Too little gap will increase voltage draw at the the clutch, resulting in premature failure. Too much gap will introduce too much foreign material into the clutch.

A spark plug gauge with 90° wire feelers may be used to check the gap. Slip the wires between the clutch plate and the pulley, and check the gap at the three rivets. The gap must be 0.016 to 0.031 inch (0.41 to 0.79 mm). The gap must be even all the way around the plate. If necessary, lightly lift or push down on the plate to make the gap even.

**NOTE:** *If the gap does not meet the above specifications, remove the front plate and add or subtract clutch shims as required.*

#### Reference:

See Air Conditioner System Service Section for clutch disassembly and adjusting the air gap during clutch replacement.

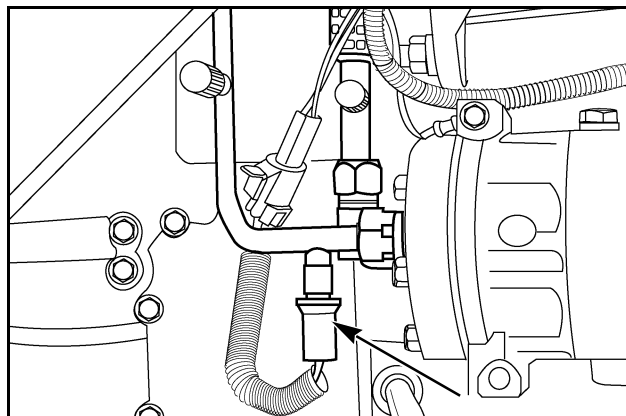


RI03B040

## High And Low Pressure Switch Clutch Latching Circuit

### Background

High pressure switch activation is generally caused by a restriction or clog on the high pressure side of the system. However, a refrigerant or SP-20 PAG oil overcharge, the presence of refrigerants other than R134A or engine cooling problems can also cause high pressure switch activation.



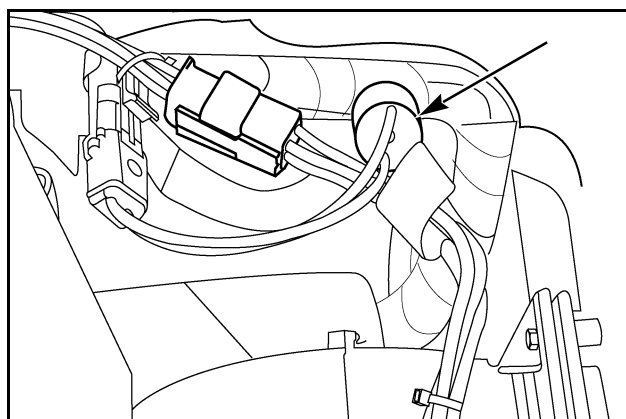
RD02H031

**High Pressure Switch at Compressor**

Low pressure switch activation is generally caused by low refrigerant level resulting from a leak(s). Sometime low pressure switch activation, however, is caused by a restriction, where because of the location either pressure switch may activate first. For example, a restriction at the output of the receiver-drier could cause either high or low pressure switch activation.

Refer to the **A/C Troubleshooting Foldout** and performance testing to locate the cause for your system.

**NOTE:** Your A/C systems are designed to prevent A/C compressor failure due to low pressure or low refrigerant charge. Operation on days below 40° F (4° C) may actuate the low pressure sensing system and shut down the A/C system. The system is not malfunctioning if this occurs. Toggle the A/C switch to OFF and then ON to reset the system.



RD02G096

**Low Pressure Switch at Expansion Valve**

When either pressure switch opens within the smart pressure counting conditions, the pressure warning lamp flashes on the A/C switch, and the compressor clutch is latched OFF by the controller.

## Possible Failure Modes - Flashing Pressure Warning Lamp

Warning Lamp	Description	
Warning lamp flashes rapidly, about 13 times in a 10 second period.	Controller has detected an open condition in <b>high pressure switch</b> circuit. Compressor clutch is latched OFF.	
	<b>Pressure Switch Counting</b>	Clutch latching is not activated until two occurrences within a 60 second interval, starting with the first occurrence. Actual interval may be as short as 10 seconds if open condition is constant.
	<b>Causes</b>	<ol style="list-style-type: none"> <li>1. High pressure switch has opened because of high side system pressures. High pressure switch opens at system pressures above 400 psi <math>\pm</math> 10 (2758 kPa <math>\pm</math> 69). The switch closes when system pressure drops below 250 psi <math>\pm</math> 10 (1724 kPa <math>\pm</math> 69).</li> <li>2. Any intermittent open at a connector in the circuit appears the same to the controller.</li> </ol>
Warning lamp flashes slowly, about 7 times in a 10 second period.	Controller has detected an open condition in <b>low pressure switch</b> circuit. Compressor clutch is latched OFF.	
	<b>Pressure Switch Counting</b>	Clutch latching is not activated until four occurrences within a 60 second interval, starting with the first occurrence. Actual interval may be as short as 10 seconds if open condition is constant.
	<b>Causes</b>	<ol style="list-style-type: none"> <li>1. Low pressure switch has opened because of low side system pressures. Low pressure switch opens at system pressures below 4 psi <math>\pm</math> 2 (28 kPa <math>\pm</math> 14). The switch closes when system pressures rise above 20 psi <math>\pm</math> 3 (138 kPa <math>\pm</math> 21).</li> <li>2. Any intermittent open at a connector in the circuit appears the same to the controller.</li> </ol>
	<b>Exception</b>	<b>NOTE:</b> <i>Your A/C systems are designed to prevent A/C compressor failure due to low pressure or low refrigerant charge. Operation on days below 40° F (4° C) may actuate the low pressure sensing system and shut down the A/C system. The system is not malfunctioning if this occurs. Toggle the A/C switch to OFF and then ON to reset the system.</i>

Although system pressures may return to normal, the clutch remains latched OFF until the keyswitch or A/C switch is toggled OFF and then ON.

The controller disables the clutch by denying ground to the clutch relay.

Cycling the power switch does not resolve the pressure problem, however, install the pressure test gauges and performance test the system.

### Switch Testing

When disconnected from the system, the low pressure switch will test normally open; the high pressure switch will test normally closed.

When installed in the A/C system under normal operating pressures, both pressure switches should test CLOSED.

## Electrical Test – Pressure Switches

**NOTE:** See *Electrical Schematic sections 58, 60 and 61.*

### Power and Ground

The controller feeds 5V from pin C (CCU1) to pin B on the high pressure switch. The switch is grounded to the chassis.

The controller feeds 5V from pin B (CCU2) to pin B on the low pressure switch. The switch is grounded to the grounding stud in the HVAC box.

### High Pressure Switch and Circuit Test

Steps and Test Point	Corrective Actions
1. Refer to A/C Troubleshooting Foldout and follow the conditions for performance testing. Install A/C high and low side pressure gauges. High reading above 400 psi $\pm$ 10 psi (2758 kPa $\pm$ 69 kPa)?	YES - Perform corrective actions from A/C Troubleshooting Foldout. NO - Go to next Step.
2. Shut off the tractor. Disconnect the switch from the harness and the unit. Check that switch is closed across pins A and B.	OK - Go to next Step. NOT OK - Replace switch.
3. Reinstall the switch in the unit; do not reconnect the harness. Keyswitch and A/C ON, blower control on any speed, and temperature control on maximum cool setting, Is 5V present at pin 1 at the harness to the switch?	YES - Go to next Step. NO - Go to Step 5.
4. Keyswitch OFF. Measure resistance from pin A at the switch to ground. Less than 1 ohm?	YES - Go to next Step. NO - Locate open condition and repair between pin A and ground.
5. Keyswitch ON. Is 5V present at pin C at the controller (CCU1)?	YES - Locate open condition and repair between pin C at the controller and pin B at the switch. NO - Test the controller. See <b>Standard Controller Test</b> in this Section.

**Low Pressure Switch and Circuit Test**

Steps and Test Point	Corrective Actions
1. Refer to A/C Troubleshooting Foldout and follow the conditions for performance testing. Install A/C high and low side pressure gauges. Low reading below 4 psi $\pm$ 2 psi (28 kPa $\pm$ 14 kPa)?	YES - Perform corrective actions from A/C Troubleshooting Foldout. NO - Go to next Step.
2. Shut off the tractor. Disconnect the switch from the harness and the unit. Check that switch is open across pins A and B.	OK - Go to next Step. NOT OK - Replace switch.
3. Reinstall the switch in the unit; do not reconnect the harness. Keyswitch and A/C ON, blower control on any speed, and temperature control on maximum cool setting, Is 5V present at pin B at the harness to the switch?	YES - Go to next Step. NO - Go to Step 5.
4. Keyswitch OFF. Measure resistance from pin A at the switch to the HVAC ground stud. Less than 1 ohm?	YES - Go to next Step. NO - Locate open condition and repair between pin A and HVAC ground stud.
5. Keyswitch ON. Is 5V present at pin B at the controller (CCU2)?	YES - Locate open condition and repair between pin B at the controller and pin B at the switch. NO - Test the controller. See <b>Standard Controller Test</b> 65 in this Section.

## Heater Control Valve

### Operational Check

The controller opens or closes the heater control valve based on the operator selected input at the temperature control and the temperature sensed at the evaporator sensor.

The heater control valve can fail mechanically in any position: open, closed or anywhere in the middle.

To confirm proper valve operation, observe the slot on the front of the valve. Rotation of the slot must mirror the movement of the temperature control.

**NOTE:** Mark the actuator, if required, to better observe rotation.

The slot must rotate fully clockwise when the control is turned fully clockwise; the slot must rotate fully counterclockwise when the slot is turned fully counterclockwise.

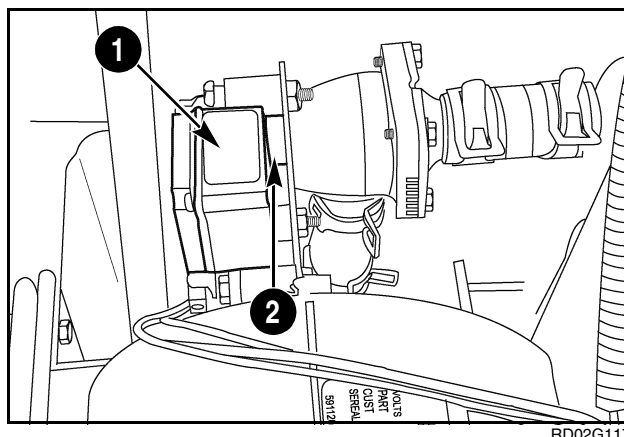
If the valve does not mirror control movement or does not move, perform the valve motor electrical test.

### Valve “Leak Through”

A common problem with the valve is hot coolant flow when cab cooling is desired. This usually occurs by a when a valve does not close completely. To test for leak through from the valve:

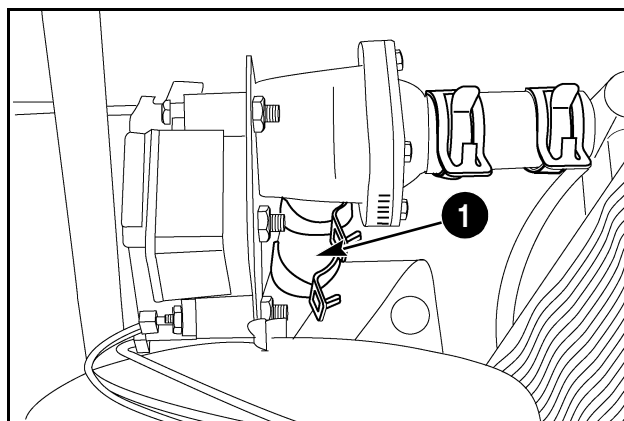
1. Operate the A/C system at maximum cooling and blower speed for 15 minutes. See conditions for Performance Testing.
2. Install a stem type thermometer in a cab louver, and record the temperature.
3. Clamp off the coolant supply line (1) before the valve with a vise grip pliers. (The supply line connects at the bottom of the valve.) Wait a few minutes and check the thermometer. If the temperature drops, valve leak through is the problem; replace the valve.

**NOTE:** Do not clamp off the heater supply line or close the heater return line valve at the engine for this test.



1. HEATER CONTROL VALVE

2. SLOTTED ACTUATOR



RD02G115

## Electrical Test

**NOTE:** See *Electrical Schematic* section 58, 60 and 61.

### Power, Signal and Ground Circuit

The controller feeds 12V to the heater valve motor from pin E (CCU2) to pin 10 on the motor.

The control signal (1.5 to 11.5V) is fed from the controller on pin D (CCU2) to pin 8 on the motor.

The motor is grounded from pin 7 at the motor to the HVAC ground stud.

### Possible Failure Modes

1. Motor failure or valve physical failure.
2. Open condition in power, signal or ground to heater control valve.
3. Controller failure.

### Heater Control Valve Power, Signal and Ground Test

Steps and Test Point	Corrective Actions
1. Keyswitch and Blower Speed Control ON. Test from pin 8 on valve to chassis ground. While turning the temperature control from max cool to max heat setting, observe both voltmeter and slot on front of the valve. If voltage change but no slot movement or slot movement is irregular, heater valve has failed physically or actuator fault. Go to Step 2. If no voltage or no voltage change, go to Step 5. If voltage change and slot movement are continuous, heater valve tests okay.	
2. Disconnect harness connector to motor. Measure resistance through the motor from pin 7 to pin 10. Open line?	YES - Go to next Step NO - Replace the heater control valve assembly.
3. Measure resistance from pin 7 on valve harness to HVAC ground stud. Less than 1 ohm?	YES - Go to next Step NO - Locate and repair open condition in ground from pin 7.
4. Keyswitch and A/C switch ON. Measure control signal at the harness connector on pin 8 from pin D at the controller, while turning the temperature control. Is range from 1.5 to 11.5V?	YES - Go to Step 5. NO - Go to next Step.
5. Measure control signal at pin D at the controller while turning the control. Is range from 1.5 to 11.5V?	YES - Locate open condition and repair between pin D at controller and pin 8 at the heater valve. NO - Test the controller. See <b>Standard Controller Test</b> 65 in this Section.
6. Is 12V present at pin 10 at the harness connector?	YES - Incorrect reading taken. Retest. NO - Go to next Step.
7. Is 12V present at pin E at the controller?	YES - Locate open condition and repair between pin E at the controller and pin 10 at the valve. NO - Test the controller. See <b>Standard Controller Test</b> 65 in this Section.

## Temperature Control Potentiometer

### Background

The controller uses the setting on the temperature control potentiometer and the input (resistance) from the evaporator temperature sensor to maintain cab temperature.

The resistance rating for the temperature control potentiometer is 0-10K ohms.

If the potentiometer fails, the controller attempts to maintain the last temperature request it received when it had input. If the heater valve was opened 40% at the last request, that is the position it maintains. An operator experiences this as cab temperature cannot be varied with the control.

An intermittent open condition in the control circuit and a faulty potentiometer act the same in this system.

### Electrical Test

**NOTE:** See *Electrical Schamatic* section 58, 60 and 61.

#### Power and Ground Circuit

The pot is grounded from pin C, through C139-S, to the HVAC ground stud.

B+ read from the controller will vary with the position of the pot: 0.0-3.xV. B+ is fed from pin D at the controller (CCU1), through C139-T, to pin B on the pot.

#### Possible Failure Modes:

1. Control potentiometer failure.
2. Open condition in power or ground to control potentiometer.
3. Controller failure.

#### Temperature Control Potentiometer and Circuit Test

Steps and Test Point	Corrective Actions
1. Keyswitch and A/C switch OFF. Open the right hand control panel. Disconnect the potentiometer from the harness. Check for variation in resistance (0 - 10K ohms) across B and C on connector 125F while turning the control.  <b>NOTE:</b> Turn the control slowly and check for any dead spots - points of infinite resistance - across the range of the potentiometer.	OK - Go to next Step. NOT OK - Replace potentiometer.
2. Keyswitch and A/C switch ON, blower control on any speed. Is 0.0-3.0V present between pin B at the harness and chassis ground while turning the control?	YES - Go to Step 4. NO - Go to next Step.
3. Is 0.0-3.0V present at pin D at the controller (CCU1)?	YES - Locate open condition and repair between pin B at the pot through C139-T to the controller. NO - Test the controller. See <b>Standard Controller Test</b> in this Section.
4. Keyswitch OFF. Measure resistance between pin C at the pot to the HVAC ground stud. Less than 1 ohm?	YES - Wrong reading taken. Retest. NO - Locate open condition and repair between pin C at the pot through C139-S to the HVAC ground stud.



## Blower Speed Switch And Blower Motor

**NOTE:** See *Electrical Schematic sections 58, 60 and 61.*

### Background

Various blower speeds are accomplished by passing voltage through step-down resistors for low and medium speeds. Voltage is jumpered directly to the motor for high speed.

If only high speed operates, resistor failure or an open condition in the in-line connector are the likely suspects. Resistor failure requires replacement of the motor.

### Power and Ground Circuit

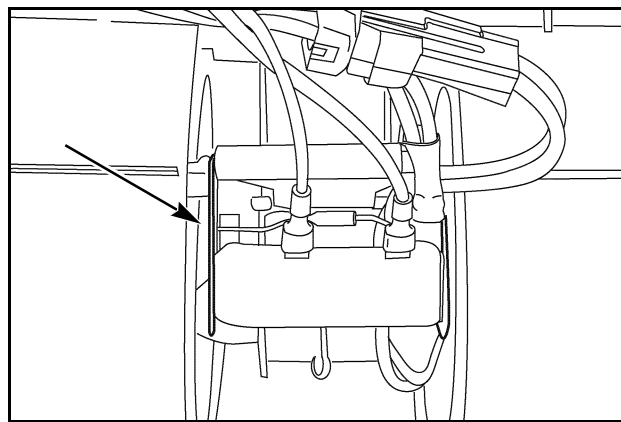
12V is fed to blower motor from fuse 49 (30 amp) whenever switched B+ is present and whenever the blower speed switch is set to any position other than OFF.

Based on the speed switch position, 12V is routed through the in-line connector to the step-down resistors.

The blower motor is grounded from pin B to the HVAC ground stud and ring terminal 172F chassis ground.

### Possible Failure Modes

1. Fuse 49 or power and ground to blower speed switch.
2. Switch failure.
3. Blower motor failure.
4. Open condition in power or ground to blower motor.
5. Resistor failure.



**Set-down Resistors**

RD02G097

**Blower Speed Switch and Power Circuit Test**

Steps and Test Point	Corrective Actions
<b>NOTE:</b> If the blower motor does not run at any speed, test the switch and power circuit - fuse 49. If the blower motor does not operate on all speeds, test the control circuit for the motor.	
1. Keyswitch ON. Measure voltage at blower speed switch on pin 2. Is 12V present?	YES - Go to Step 3. NO - Fuse no. 49 is bad or there is an open circuit in blower speed switch power supply circuit. Go to next Step.
2. Measure voltage at fuse 49 (30 amp). Is 12 volt present?	YES - Locate and repair open circuit in 820(R). NO - Locate and repair open circuit in switched B+ power to fuse.
3. While turning blower speed switch from LOW to MEDIUM to HIGH, is 12V present at pin 6 in all positions?	YES - Go to next Step. NO - Replace the switch.
4. Turn blower control to LOW. Measure voltage at blower speed switch pin 5. Is 12V present?	YES - Go to next Step. NO - Replace switch.
5. Turn blower control to MEDIUM. Measure voltage at blower speed switch pin 4. Is 12V present?	YES - Go to next Step. NO - Replace switch.
6. Turn blower control to HIGH. Measure voltage at blower speed switch pin 3. Is 12V present?	YES - Go to next Step. NO - Replace switch.

**Blower Motor Power, and Control Circuit Test**

Steps and Test Point	Corrective Actions
<b>NOTE:</b> If the blower motor does not run at any speed, test the switch and power circuit - fuse 49. If the blower motor does not operate on all speeds, test the control circuit for the motor.	
1. Keyswitch ON. Turn blower control to HIGH. Does blower motor operate at high speed?	YES - Go to Step 4. NO - Go to next Step.
2. Disconnect the motor from the connector. Is there continuity through the motor between pins A and B?	YES - Go to next Step. NO - Replace motor.
3. Measure voltage on connector to blower motor on pin A. Is 12V present?	YES - Go to next Step. NO - Go to next Step.
4. Turn blower control to LOW. Does blower motor operate at low speed?	YES - Go to Step 9. NO - Go to next Step.
5. Measure voltage at blower motor resistor terminal L. Is 12V present?	YES - Replace motor. NO - Go to next Step.
6. Measure voltage at terminal 2 of blower motor resistor in-line connector (CCU3,4). Is 12V present?	YES - Locate and repair open circuit between in-line connector terminal 2 and blower motor resistor terminal L. NO - Go to next Step.

<b>Steps and Test Point</b>	<b>Corrective Actions</b>
7. Measure voltage at in-line C139-D. Is 12V present?	YES - Repair open circuit between C139-D and in-line connector on terminal 2. NO - Go to next Step.
8. Measure voltage at blower speed switch pin 5. Is 12V present?	YES - Locate and repair open circuit between switch pin 5 and C139-D. NO - Test the Switch.
9. Turn blower control to MEDIUM? Does blower motor operate at medium speed?	YES - Go to Step 13. NO - Go to next Step.
10. Measure voltage at blower motor resistor on terminal M. Is 12V present?	YES - Replace blower motor. NO - Go to next Step.
11. Measure voltage at terminal 3 of blower motor resistor in-line connector (CCU3,4). Is 12V present?	YES - Locate and repair open circuit between in-line connector terminal 3 and blower motor resistor terminal M. NO - Go to next Step.
12. Measure voltage at C139-E. Is 12V present?	YES - Locate and repair open circuit between C139-E and in-line connector terminal 3. NO - Go to next Step.
13. Measure voltage at blower switch on pin 4. Is 12V present?	YES - Locate and repair open circuit between C139-E and the switch pin 4. NO - Test switch.
14. Turn blower control to HIGH. Does blower motor operate at high speed?	YES - Wrong reading taken. Retest. NO - Go to next Step.
15. Measure voltage at blower motor resistor in-line connector (CCU3,4) on terminal 4. Is 12V present?	YES - Locate and repair open circuit between in-line connector and blower motor resistor on terminal H. NO - Go to next Step.
16. Measure voltage at C139-G. Is 12V present?	YES - Locate and repair open circuit between C139-G and blower motor resistor in-line connector terminal 4. NO - Go to next Step.
17. Measure voltage at blower speed switch on pin 3. Is 12V present?	YES - Locate and repair open circuit between switch pin 3 and C139-G. NO - Test switch.

## Evaporator Temperature Sensor

### Background

The evaporator temperature sensor, sometimes called the “freeze” or “core” sensor, is located in the evaporator/heater assembly. The sensor measures the effectiveness of system response to the current demand for heating or cooling.

### “Freeze” Control

The evaporator sensor also prevents the system from operating in low ambient temperatures where damage to the system might occur. When temperature sensed at the evaporator falls to 32°F (0°C), the controller cycles the compressor clutch OFF. When temperature sensed at the evaporator rises to 37°F (3°C), the controller cycles the clutch back ON. At the maximum cooling setting where the compressor runs continuously, the freeze range controls the cycling of the compressor OFF or ON.

### Sensor Location

Proper location of the evaporator sensor is essential to system performance. The evaporator temperature sensor must be installed 4.2 inches (107 mm) from the left hand rear side of the evaporator. The sensor must be installed below the second refrigeration tube row at a 30° downward angle. Insert the sensor in the evaporator core up to the angled section, being careful not to kink the sensor.

### Electrical Test – Sensor

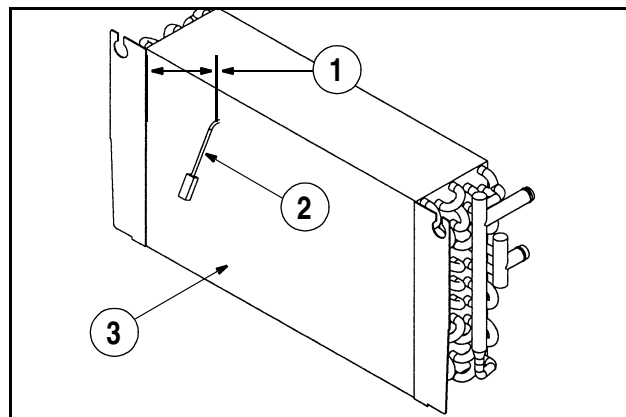
**NOTE:** See *Electrical Schematic* sections 58, 60 and 61.

The sensor has a well known resistance vs temperature response: It should measure 10-25K ohms at room temperature for normal operation.

The sensor is a thermistor - thermal resistors. With this thermistor, the colder the environment, the greater the electrical resistance; and the warmer the environment, the less electrical resistance.

The sensor can fail without indicating an open condition. Measure the resistance of the sensor and the ambient temperature at the sensor, and compare the readings to the Resistance versus Temperature table in this section. If the readings are not within the minus or plus 2.5% range, replace the sensor.

**NOTE:** For the test to be valid, the thermometer used must be accurate, and the temperature recorded must be the temperature at the sensor.



**Evaporator Core Rear View**

RH99D218

- |                      |                    |
|----------------------|--------------------|
| 1. 4.2 INCH (107 MM) | 3. EVAPORATOR CORE |
| 2. EVAP TEMP SENSOR  |                    |

## Power Circuit

The sensor is grounded to the HVAC ground stud.

Minimal voltage is fed to the sensor - about 0.5V at 70°F (21°C) - and voltage drops as the temperature increases. Current is fed to the evaporator sensor from pin B at the controller (CCU1).

## Service Note: Too Little Cooling/Too Much Heating without Symptoms

The sensor should be suspect when the complaint is too little cooling when cooling and too much heating when heating ("the cab is too hot or too cold all the time"), and obvious symptoms are absent:

- System pressures are normal, and system is properly charged.
- Coolant system operating normally.
- Compressor and heater valve are functioning normally.

The sensor fails in a consistent pattern: It senses a lower temperature than is actually present.

In cooling mode, actual temperature at the evaporator is 50°F (10°C), but the sensor senses 45°F (7°C) and the compressor is not engaged with sufficient frequency. In heating mode, actual evaporator temperature is 80°F (27°C), but the sensor senses 75°F (24°C) and heater valve is opened too widely.

Perform the resistance versus temperature test on the sensor.

## Evaporator Temperature Sensor and Circuit Test

Steps and Test Point	Corrective Actions
1. Keyswitch OFF. Disconnect the cab temperature sensor from harness. Measure the resistance across the sensor leads. Measure the ambient temperature at the sensor. Compare the readings to the Temperature versus Resistance table on page 85. Is the resistance reading within the minus or plus 2.5% range in the table?	YES - Go to next Step. NO - Replace the sensor.
2. Keyswitch and A/C switch ON. Measure voltage at pin 1 to sensor. Is voltage present?  <b>NOTE:</b> <i>Voltage reading will be very low: 0.5V at 70°F (21°C); and voltage decreases as temperature increases.</i>	YES - Go to next Step 4. NO - Locate open and repair.
3. Is voltage present at pin B (CCU1) at the controller?	YES - Go to next Step. NO - Locate and repair open condition between pin B and sensor.
4. Measure resistance from sensor to the HVAC ground stud. Less than 1 ohm?	YES - Test the controller. See <b>Standard Controller Test</b> in this Section. NO - Locate open circuit and correct.
<p><b>NOTE:</b> <i>Verify that the evaporator temperature sensor is installed in the right location. The temperature sensor must be installed 4.2 inches (107 mm) from the left hand rear side of the evaporator. The sensor must be installed below the second refrigeration tube row at a 30° downward angle. Insert the sensor in the evaporator core up to the angled section.</i></p> <p><b>NOTE:</b> <i>While installing the sensor in the wrong location causes faulty system performance, it will not cause the sensor to fail or provide a faulty resistance reading for a given temperature. Replace the sensor if it tests out of range for a given temperature.</i></p>	

Temperature Versus Resistance Table

Ambient Temperature		Range		
°F	°C	-2.5%	Kohms	+2.5%
0	-17.78	170.820	175.200	179.580
1	-17.22	165.360	169.600	173.840
2	-16.67	160.095	164.200	168.305
3	-16.11	155.025	159.000	162.975
4	-15.56	150.150	154.000	157.850
5	-15.00	145.470	149.200	152.930
6	-14.44	140.985	144.600	148.215
7	-13.89	136.598	140.100	143.603
8	-13.33	132.308	135.700	139.093
9	-12.78	128.213	131.500	134.788
10	-12.22	124.313	127.500	130.688
11	-11.67	120.510	123.600	126.690
12	-11.11	116.805	119.800	122.795
13	-10.56	113.295	116.200	119.105
14	-10.00	109.785	112.600	115.415
15	-9.44	106.470	109.200	111.930
16	-8.89	103.350	106.000	108.650
17	-8.33	100.230	102.800	105.370
18	-7.78	97.227	99.720	102.213
19	-7.22	94.331	96.750	99.169
20	-6.67	91.533	93.880	96.227
21	-6.11	88.832	91.110	93.388
22	-5.56	86.219	88.430	90.641
23	-5.00	83.694	85.840	87.986
24	-4.44	81.247	83.330	85.413
25	-3.89	78.887	80.910	82.933
26	-3.33	76.596	78.560	80.524
27	-2.78	74.383	76.290	78.197
28	-2.22	72.248	74.100	75.953
29	-1.67	70.171	71.970	73.769
30	-1.11	67.470	69.200	70.930
31	-0.56	66.232	67.930	69.628
32	0.00	64.350	66.000	67.650
33	0.56	62.532	64.135	65.738
34	1.11	60.771	62.329	63.887
35	1.67	59.066	60.580	62.095
36	2.22	57.414	58.886	60.358
37	2.78	55.814	57.245	58.676
38	3.33	54.265	55.656	57.047
39	3.89	52.764	54.117	55.470
40	4.44	51.309	52.625	53.941
41	5.00	49.901	51.180	52.460
42	5.56	48.535	49.779	51.023
43	6.11	47.211	48.422	49.633
44	6.67	45.928	47.106	48.284
45	7.22	44.684	45.830	46.976
46	7.78	43.479	44.594	45.709
47	8.33	42.310	43.395	44.480
48	8.89	41.176	42.232	43.288
49	9.44	40.076	41.104	42.132
50	10.00	39.011	40.011	41.011
51	10.56	37.976	38.950	39.924
52	11.11	36.973	37.921	38.869
53	11.67	36.000	36.923	37.846
54	12.22	35.055	35.954	36.853
55	12.78	34.139	35.014	35.889
56	13.33	33.249	34.102	34.955
57	13.89	32.387	33.217	34.047
58	14.44	31.548	32.357	33.166
59	15.00	30.735	31.523	32.311
60	15.56	29.945	30.713	31.481

Ambient Temperature		Range		
°F	°C	-2.5%	Kohms	+2.5%
61	16.11	29.179	29.927	30.675
62	16.67	28.434	29.163	29.892
63	17.22	27.710	28.421	29.132
64	17.78	27.008	27.701	28.394
65	18.33	26.327	27.002	27.677
66	18.89	25.664	26.322	26.980
67	19.44	25.020	25.662	26.304
68	20.00	24.395	25.020	25.646
69	20.56	23.787	24.397	25.007
70	21.11	23.196	23.791	24.386
71	21.67	22.623	23.203	23.783
72	22.22	22.064	22.630	23.196
73	22.78	21.522	22.074	22.626
74	23.33	20.996	21.534	22.072
75	23.89	20.483	21.008	21.533
76	24.44	19.985	20.497	21.009
77	25.00	19.500	20.000	20.500
78	25.56	19.029	19.517	20.005
79	26.11	18.571	19.047	19.523
80	26.67	18.125	18.590	19.055
81	27.22	17.691	18.145	18.599
82	27.78	17.269	17.712	18.155
83	28.33	16.859	17.291	17.723
84	28.89	16.460	16.882	17.304
85	29.44	16.071	16.483	16.895
86	30.00	15.694	16.096	16.498
87	30.56	15.325	15.718	16.111
88	31.11	14.967	15.351	15.735
89	31.67	14.618	14.993	15.368
90	32.22	14.279	14.645	15.011
91	32.78	13.948	14.306	14.664
92	33.33	13.627	13.976	14.325
93	33.89	13.314	13.655	13.996
94	34.44	13.008	13.342	13.676
95	35.00	12.712	13.038	13.364
96	35.56	12.422	12.741	13.060
97	36.11	12.141	12.452	12.763
98	36.67	11.866	12.170	12.474
99	37.22	11.599	11.896	12.193
100	37.78	11.338	11.629	11.920
101	38.33	11.084	11.368	11.652
102	38.89	10.837	11.115	11.393
103	39.44	10.595	10.867	11.139
104	40.00	10.360	10.626	10.892
105	40.56	10.131	10.391	10.651
106	41.11	9.908	10.162	10.416
107	41.67	9.691	9.939	10.187
108	42.22	9.479	9.722	9.965
109	42.78	9.272	9.510	9.748
110	43.33	9.070	9.303	9.536
111	43.89	8.873	9.101	9.329
112	44.44	8.681	8.904	9.127
113	45.00	8.495	8.713	8.931
114	45.56	8.312	8.525	8.738
115	46.11	8.134	8.343	8.552
116	46.67	7.961	8.165	8.369
117	47.22	7.791	7.991	8.191
118	47.78	7.626	7.822	8.018
119	48.33	7.466	7.657	7.848
120	48.89	7.308	7.495	7.682
121	49.44	7.155	7.338	7.521

## Controller Power, Ground And A/C Switch

**NOTE:** See Schematic Sections 58, 60 and 61.

### Background

#### HVAC Ground

HVAC ground is both a grounding stud at the rear of the HVAC box and chassis ground at ring terminal 172F through C139-F on wire 178-Bk.

#### Intermittent Ground

Intermittent HVAC ground can make reliable troubleshooting very difficult. The “intermittent” nature of the problem is further complicated since the fault can appear to move from component to component. Early testing for a stable and consistent ground at the ground bolt and ring terminal 172F can greatly simplify troubleshooting.

### Power and Ground Circuit

#### Standard Controller

Whenever switched B+ is present, 12V is fed the controller from fuse 47 (30 amp) through C139-R to pin A at the controller (CCU1).

The controller is grounded from pin F (CCU1) to the HVAC ground stud.

#### A/C Switch

The controller feeds 5V from pin E (CCU1) through C139-L to the switch at pin 6; grounding pin 6 with the switch provides the ON request to the controller.

The switch is grounded from pin 5 to chassis at Splice C14.

#### Pressure Warning Lamp

The controller provides switched ground from pin C on (CCU2) through C139-M to the switch at pin 9 for the pressure warning lamp.

The lamp is powered at pin 10 with switched B+ from Splice C43.

### Possible Failure Modes

1. Fuse 47 or open condition in power or ground to controller.
2. A/C switch failure.
3. Open condition in power or ground to switch or pressure warning lamp.

### Controller Power Supply and Ground Test

Steps and Test Point	Corrective Actions
1. Keyswitch ON. Measure the voltage between pin A at the controller (CCU1) and chassis ground. Is 12V present?	YES - Go to Step 3. NO - Go to next Step.
2. Check fuse no. 47 (30 amp). Is 12V present?	YES - Locate and repair open condition between fuse 47 and pin A at the controller. NO - Locate and repair open condition from fuse 47 to switched B+. Go to next Step.
3. Measure resistance from pin F at the controller (CCU1) to the HVAC ground stud. Less than 1 ohm?	YES - Test the controller. See <b>Standard Controller Test</b> in this Section. NO - Locate and repair open condition from pin F to HVAC ground.

**A/C Switch and Circuit Test**

<b>Steps and Test Point</b>	<b>Corrective Actions</b>
1. Disconnect A/C switch from harness. With switch ON, measure resistance across pins 5 and 6 on switch. Less than 1 ohm?	YES - Go to next Step. NO - Replace switch.
2. Measure resistance across pins 9 and 10 at switch. Less than 1 ohm?	YES - Go to next Step. NO - Replace switch.
3. Measure resistance from pin 5 at the harness connector to chassis ground. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition between pin 5 and ground.
4. Keyswitch ON. Is 5V present at pin 6 at the harness connector?	YES - Go to Step 6. NO - Go to next Step.
5. Is 5V present at pin E at the controller (CCU1)?	YES - Locate and repair open condition between pin E at controller and pin 6 at switch through C139-L and C322-A. NO - Test the controller. See <b>Standard Controller Test</b> in this Section.
6. Is 5V present at pin 10 at the harness connector to the switch?	YES - Go to next Step. NO - Locate and repair open condition in switched B+ to pin 10 at switch.
7. Reconnect the A/C switch to harness. Disconnect the harness to the low pressure switch. Keyswitch, A/C switch and blower control ON. Temperature control to maximum cool. Is 5V present between pin C at the controller (CCU2) and chassis ground?	YES - Test the controller. See <b>Standard Controller Test</b> in this Section. NO - Locate and repair open condition between pin C at controller and pin 9 at the switch through C322-A and C139-M.



## Cab Pressurizer Blower

**NOTE:** See *Electrical Schematic sections 58, 60 and 61*.

### Background

Whenever switched power is present, the cab pressurizer motor should operate. The motor/blower assembly draws air from the cab cap through the left hand cab post and fresh air filter and feeds it directly to the HVAC box under the operators seat. The motor/blower assembly is located behind the fresh air filter.

The motor is energized by a relay, activated by switched B+.

Only the pressurizer blower relay and motor troubleshooting are covered here.

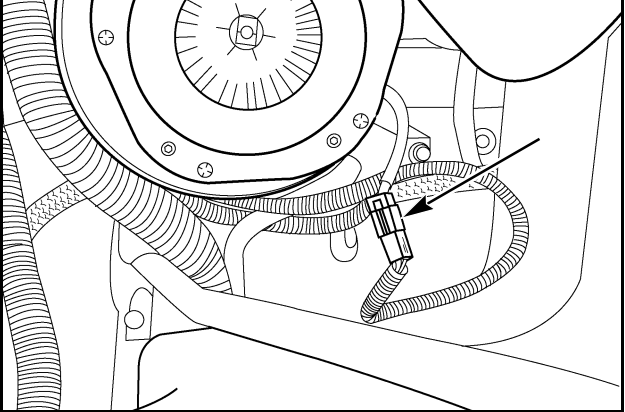
### Power and Ground

Unswitched B+ is continuously provided to the relay on pin A3 from fuse 10 (15 amp). The relay is grounded on pin A2 to the engine relay.

Whenever Switched B+ is present, the relay is energized on pin A1, and Unswitched B+ is supplied to the cab pressurizer motor on pin A through C10-85.

Clean ground is continuously supplied to the motor on pin B from the Splice F3.

## Cab Pressurizer Blower & Relay Power Supply and Ground Test

Steps and Test Point	Corrective Actions
1. Keyswitch ON. Check fuse 10 (15 amp). Is 12V present?	YES - Go to next Step. NO - Replace fuse 10 and/or locate and repair open condition to the fuse.
 <p>RD02E272</p>	
2. Measure the voltage on pin A at the pressurizer motor. Is 12V present?	YES - Go to next Step. NO - Go to Step 4.
3. Disconnect the motor from the harness and check for continuity through the motor between pins A and B. Is continuity present?	YES - Go to next Step. NO - Replace the motor.
4. Keyswitch OFF. Measure resistance between pin B at the motor and clean ground at Splice F3. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open condition between pin B at the motor and Splice F3 on wire 179-Bk.
5. Reconnect motor to the harness. Keyswitch ON. Is 12V present at pin A3 of the blower relay and chassis ground?	YES - Go to next Step/ NO - Locate and repair open between fuse 10 and relay on wire 195-K.
6. Is 12V present at pin A1 of the blower relay and chassis ground?	YES - Go to next Step. NO - Locate and repair open condition between the relay pin A1 and Splice C40 on wire 312-K.
7. Keyswitch OFF. Measure resistance between pin A2 at the motor relay and pin B2 at the engine relay. Less than 1 ohm?	YES - Go to next Step. NO - Locate and repair open between pin A2 and pin B2 at the relays on wire 177-Bk.
8. Measure resistance between pin A5 at relay and pin A at the motor. Less than 1 ohm?	YES - Replace the motor relay. NO - Locate and repair open condition between pin A5 at the relay and pin A at the motor on wire 195-K.

## NOTES

# **Section 50**

## **Chapter 2**

### **AIR CONDITIONER SYSTEM SERVICE**

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## SPECIFICATIONS

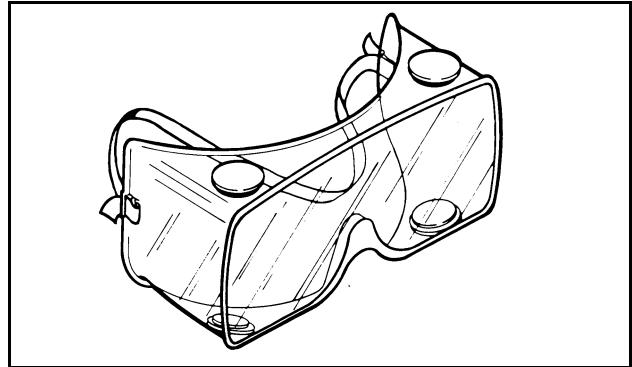
Air Conditioning System Refrigerant Capacity .....	4.63 lb. (U.S.) (2.1 kg.)
Clutch Front Plate Air Gap.....	0.016 to 0.031 inch (0.41 to 0.79 mm)

## SPECIAL TORQUES

Compressor Clutch Retaining Nut .....	15 to 20 Nm (11 to 15 lb. ft.)
Oil Filler Plug .....	15 to 24 Nm (11 to 18 lb. ft.)
Dust Cover Screws .....	7 to 11 Nm (5 to 8 lb. ft.)

## SPECIAL TOOLS

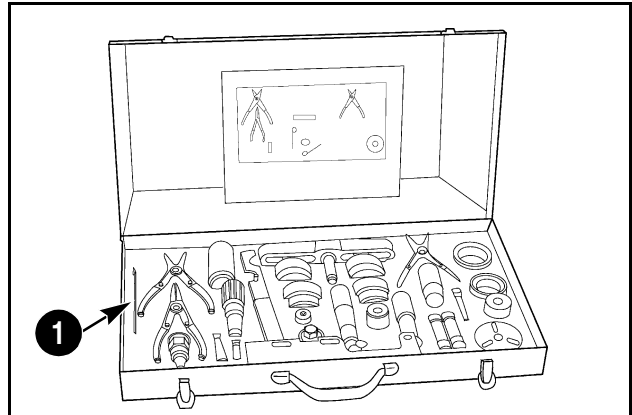
### Combination Impact and Chemical Splash Safety Goggles



109L7

### Compressor Tool Set, CAS10747A

The compressor dipstick (1) can be found in the Compressor Tool Set or purchased separately - CAS10747-19.

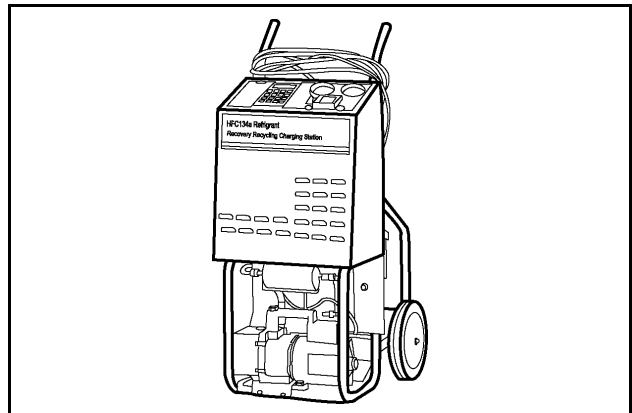


RD99K079

### Refrigerant Recovery Station, OEM1415

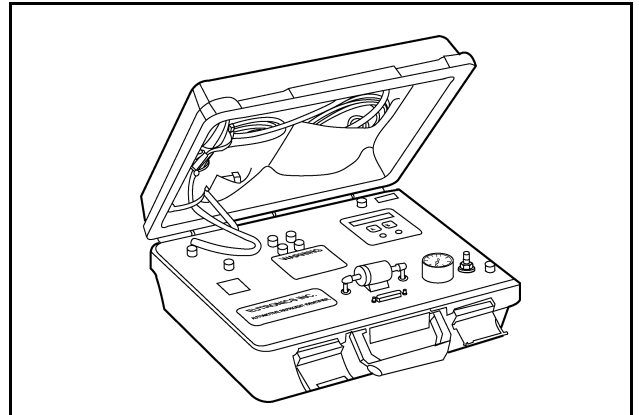
6 Foot Length, Quick Disconnect Refrigerant Charging Hoses: OEM1438 (Yellow), OEM1439 (Blue), OEM1440 (Red)

20 Foot Length, Quick Disconnect Refrigerant Hoses: OEM1442 (Set includes Yellow, Blue and Red hoses.)



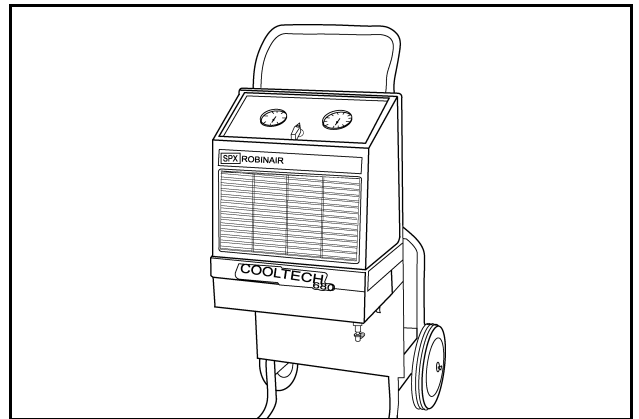
A22094

**Refrigerant Identifier OEM4450**



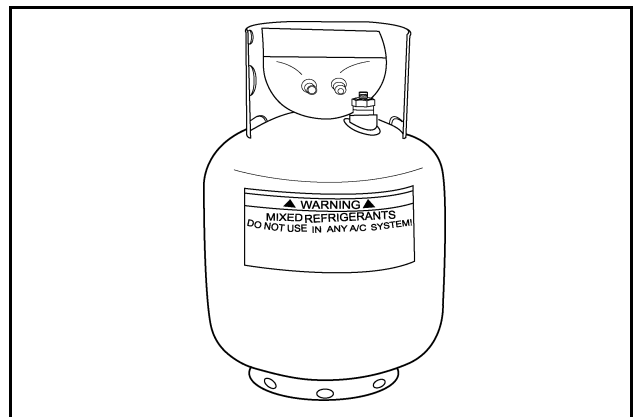
RR99M070

**Air-Powered Recovery Station with Tank  
OEM1691**



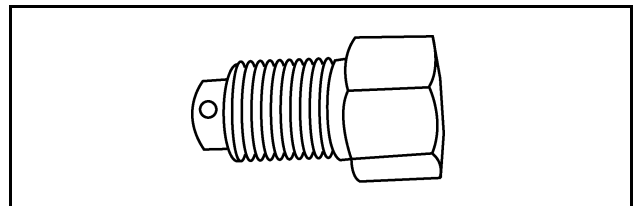
RR00D078

**Additional 50 lb. Contaminated Refrigerant Tanks  
OEM1692**



RR00E140

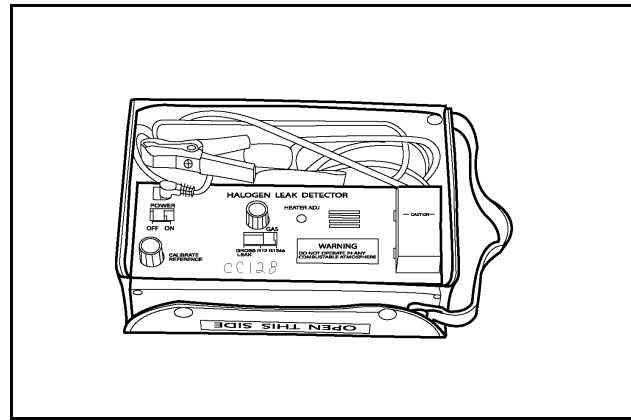
**1/4 Inch FFLX to 1/2 Inch Acme Adapter  
OEM1693**



RR00E139

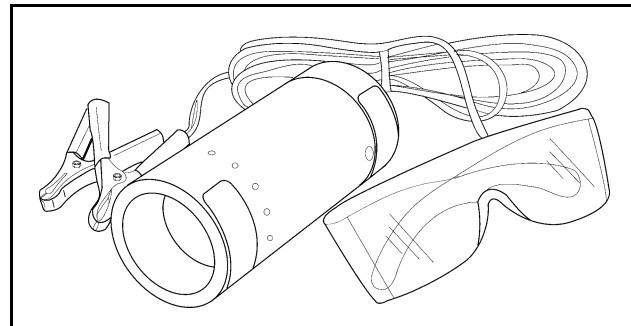


Electronic Leak Detector OEM1437



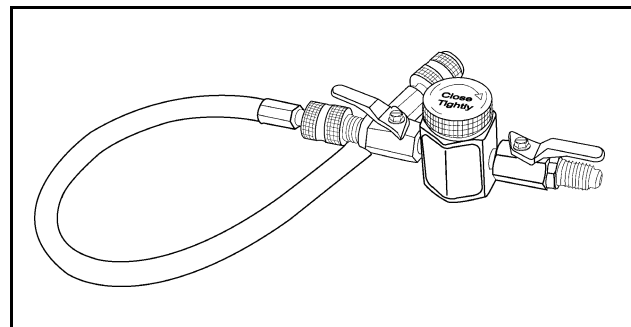
A22090

UV Leak Detection Lamp and Goggles  
BSL750



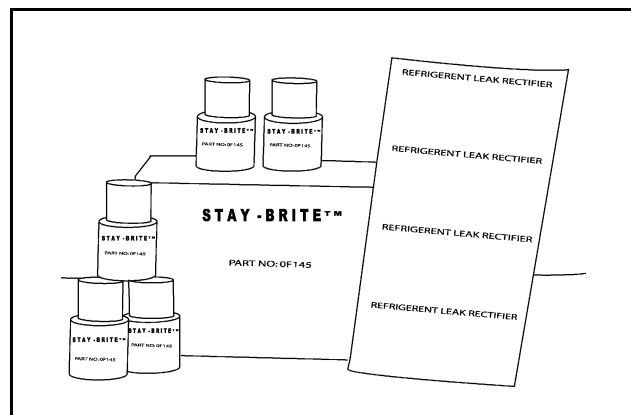
RR00F098

Recovery Station UV Dye Injector  
for R-134a Refrigerant - BSL734



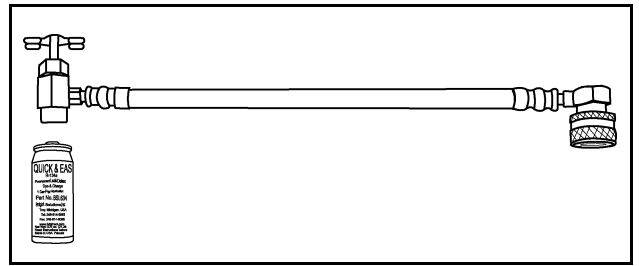
RR00F101

UV Leak Detection Dye for R-134a Refrigerant  
B726012



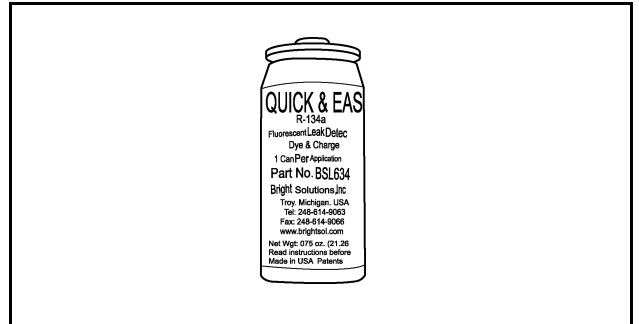
RR00F102

**R134a Quick and Easy Dye Injector Tool  
BSL738**



RD01F248

**Quick and Easy R134a Charge Cans -  
6-Pack BSL634**



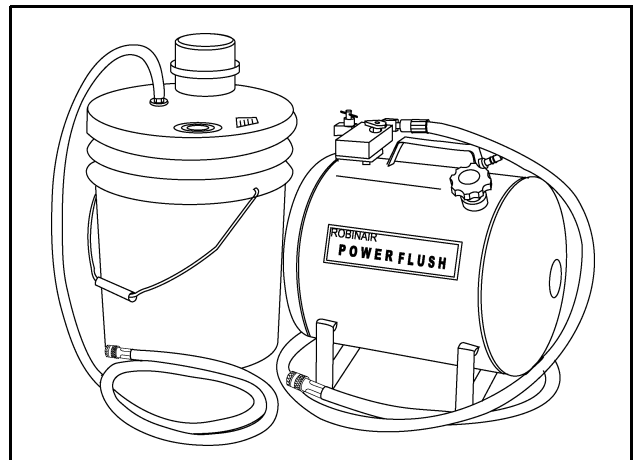
RD01F249

**UV Fluorescent Dye Cleaner - B795016**



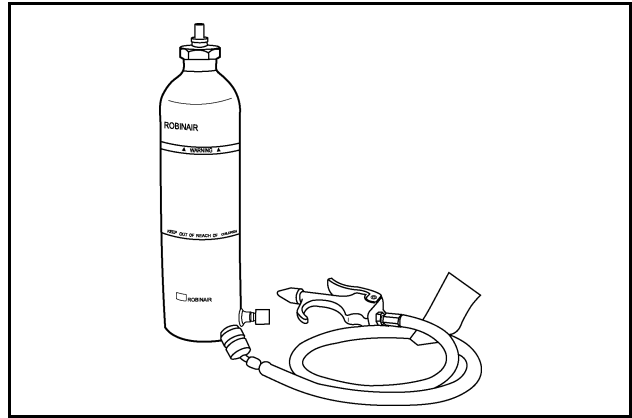
RR00F100

**Power Flush Model 17550  
BS33801 - A/C Flushing Solution,  
Case of Six 1-Gallon Containers**



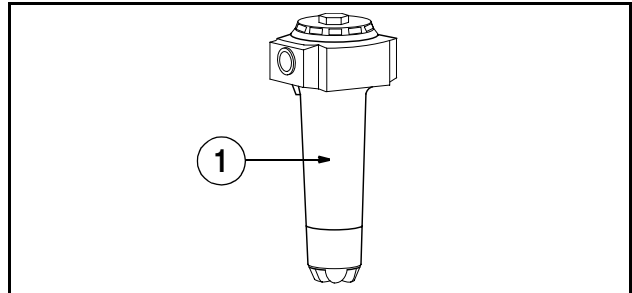
RR00F093

**Flush Gun Kit Model 17585  
BS33801 - A/C Flushing Solution,  
Case of Six 1-Gallon Containers**



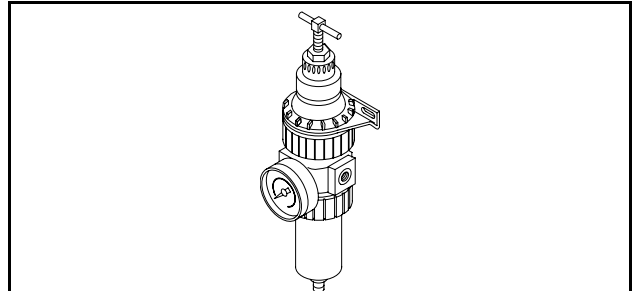
RP00G007

**Coalescing Air Filter/Dryer (1)  
Similar to Ingersoll-Rand Model IR5CHE  
or Grainger Model 4KR65**



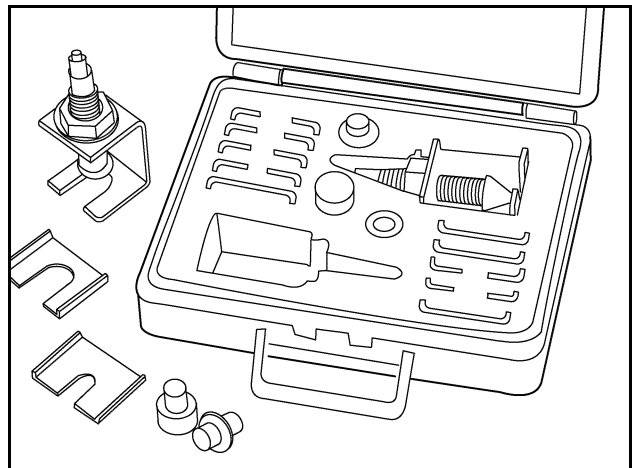
RI00F041

**Pressure Regulator Capable of Providing 45 psi  
at 4.0 cfm (310 kPa at 0.11 cmm)  
with Integrated Pressure Gauge**



RI00F042

**17582 Universal Flush Fitting Kit**



RR00F148

## SAFETY PROCEDURES



THIS SAFETY ALERT SYMBOL INDICATES IMPORTANT SAFETY MESSAGES IN THIS MANUAL. WHEN YOU SEE THIS SYMBOL, CAREFULLY READ THE MESSAGE THAT FOLLOWS AND BE ALERT TO THE POSSIBILITY OF PERSONAL INJURY OR DEATH.

M171B

**ATTENTION:** *Only authorized technicians certified by an approved training and certification organization may service or repair motor vehicle or mobile air conditioning systems.*

Refrigerant HFC-134a is the most stable and easiest to work with of the refrigerants now used in air conditioning systems. Refrigerant HFC-134a does not contain chlorofluorocarbons (CFC's) which are harmful to the earth's ozone layer.

Safety procedures must be followed when working with refrigerant HFC-134a to prevent possible personal injury.

1. Always wear combination impact and chemical splash safety goggles when doing any service work near an air conditioner system. Liquid refrigerant in the eyes can cause serious injury. Do the following if you get refrigerant near or in your eyes:

A. Flush your eyes with water for 15 minutes.

B. See a physician immediately. M779

2. Always recover all refrigerant prior to opening an A/C system. A drop of liquid refrigerant on your skin may cause frostbite burns. Open fittings carefully and slowly when servicing the air conditioning system. Your skin must be treated for frostbite burns or a physician must be seen if you get refrigerant on your skin. M799

3. Keep refrigerant containers in correct upright position. Always keep refrigerant containers away from heat and sunlight. The pressure in a container will increase with heat. M743

4. Always check refrigerant purity with OEM4450 Refrigerant Identifier before recovering refrigerant and before testing the system. M777

5. Use the air-powered OEM1691 ONLY to recover contaminated refrigerant. Do NOT use OEM1415 or OEM1418 recycling stations to recover contaminated refrigerant. If contaminated refrigerant contains more than 2% hydrocarbon (propane, butane, or isobutane), the mixture must be treated as flammable; if more than 4% hydrocarbon, the mixture must be treated as explosive; in both cases an electric-powered recovery station may NOT be used. Avoid heat, sparks and flame when working with this contaminated refrigerant. M800

6. Dangerous gas can form when refrigerant comes in contact with an open flame. Never inhale fumes. M745

7. Never leak test with compressed air or flame tester. Tests have indicated that compressed mixtures of HFC-134a and air can form a combustible gas. M746

## AIR CONDITIONER SYSTEM REFRIGERANT RECOVERY

**IMPORTANT:** *There are no repair procedures for the compressor or compressor clutch. If the clutch or compressor are defective, replace them.*



**WARNING:** *134a is the only refrigerant approved in 134a systems. Alternative refrigerants which boast better cooling capabilities are in most cases highly flammable. Do not expose contaminated refrigerant to spark, flame or yourself.* M748

**IMPORTANT:** *Refrigerant contamination has become an issue since the introduction of 134a as a replacement for R-12. Contamination refers to a refrigerant blend and/or mixture of alternative refrigerants and 134a. Typically, R-12 systems which are in need of repair or recharge are suspect to refrigerant contamination due to the number of so called "drop-in" replacements or substitutes for 134a. Systems designed for 134a, such as the MX MAGNUM, may be at lower risk for contamination, but precautions should be taken to prevent contamination of service equipment and/or other A/C systems.*

**IMPORTANT:** *A refrigerant identifier should be used to determine refrigerant contamination prior to recovery. It is recommended to use OEM4450 refrigerant identifier. If a refrigerant contamination level of 2% or greater is discovered, do not recover the system to a tank with pure 134a refrigerant. Recover only to a tank reserved for contaminated refrigerant with the air-powered station - OEM1691.*



**WARNING:** *OEM1415, and its predecessor OEM1418, were designed for the recovery and recycling of pure 134a refrigerant. Do NOT use OEM1415 and OEM1418 to recover contaminated refrigerant; you will void your warranty, you may damage the compressor and filter-drier in the recovery station, and you may expose yourself to the danger of an explosion.* M795



**WARNING:** *If the refrigerant identifier indicates the system contains more than 2% hydrocarbon (propane, butane or isobutane), the system and its contents must be treated as flammable; if more than 4% hydrocarbon, the system and its contents must be treated as explosive. Do not operate the vehicle or the A/C system. Do not recover this contaminated refrigerant with an electric-powered unit (OEM1415 or OEM1418). Use the air-powered station - OEM1691 - to recover this refrigerant. Avoid heat, sparks and open flame when working with this contaminated refrigerant.* M796

**IMPORTANT:** *If contaminated refrigerant is discovered and recovered with OEM1691, replace the receiver-drier in the tractor being serviced BEFORE you recharge the system with pure 134a refrigerant. OEM1415 or OEM1418 should be used to evacuate and recharge the system after the contaminated refrigerant has been safely recovered.*

**NOTE:** *Check with your local environmental agency for regulations on the proper disposition of contaminated refrigerant.*

**NOTE:** *In the United States, EPA regulations require that tanks of contaminated refrigerant be sent to a refrigerant reclaimer for the contents to be purified or destroyed. Call 1-800-296-1996 to locate a reclaimer in your area.*



**WARNING:** *Do NOT use a tank without a limit switch to recover contaminated refrigerant with OEM1691. The limit switch prevents overfilling the tank and protects your safety.* M797



**WARNING:** *When working with SP-20 PAG oil, follow these safety precautions: 1) Avoid contact with eyes, skin and clothing. 2) Avoid breathing vapor, aerosol and mist. 3) Do not swallow. 4) Use only with adequate ventilation. 5) Wear protective safety goggles and non-permeable gloves when handling SP-20 PAG oil.* M798

## Overview

In many countries, **recovery**, **recycling** and **reclamation** have legal definitions and standard meanings in the mobile A/C industry.

**Recovery** is transferring refrigerant in any condition from a system to a storage container without testing or purifying the refrigerant in any way.

**Recycling** is the cleaning of refrigerant for reuse by oil-separation, non-condensable gas removal and single or multiple passes through filter/moisture absorption devices.

**Reclamation** is processing refrigerant to a level equal to new product specifications as determined by chemical analysis, (testing to ARI 700).

In servicing A/C systems with OEM1415, when “recover” is depressed, the refrigerant in the vehicle is transferred to the recovery tank on the unit without testing or purifying. At the same time, SP-20 PAG oil is separated from the refrigerant and stored separately in the reservoir. This oil requires proper disposal and should never be returned to the vehicle.

When “vacuum” is depressed, the vacuum pump on OEM1415 evacuates the atmosphere in the vehicle A/C system to a vacuum of 28 to 29-1/2 inches of mercury (Hg). Air and moisture are removed in the process, and only SP-20 PAG oil remains in the vehicle’s A/C system.

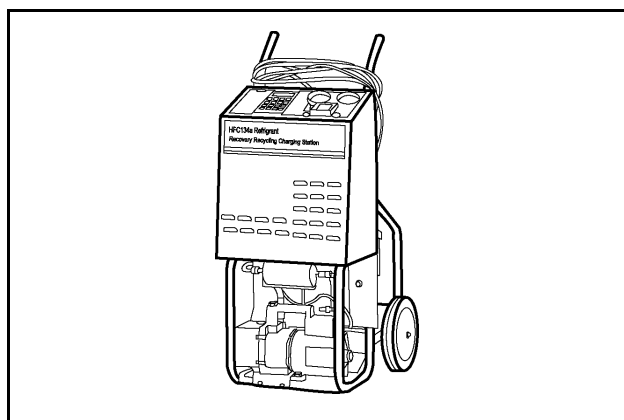
When “recycle” is depressed, the entire contents of the recovery tank on OEM1415 are “recycled.” The refrigerant in the tank is passed through a filter-drier in OEM1415 and cleaned; non-condensables are removed, and air is purged automatically. (Older recovery units like OEM1418 have manual air purge.)

**NOTE:** *In automatic operation, recycling begins about 5 seconds after the vacuum pump starts.*

**NOTE:** *During recycling, some additional SP-20 PAG oil is separated from the refrigerant and stored separately in the reservoir.*

Only new SP-20 PAG oil is added to replace the oil which was separated during recovery, and when “recharge” is depressed, only clean “recycled” refrigerant is returned to the vehicle’s A/C system.

OEM1415 (or OEM1418) does not perform “reclamation.”



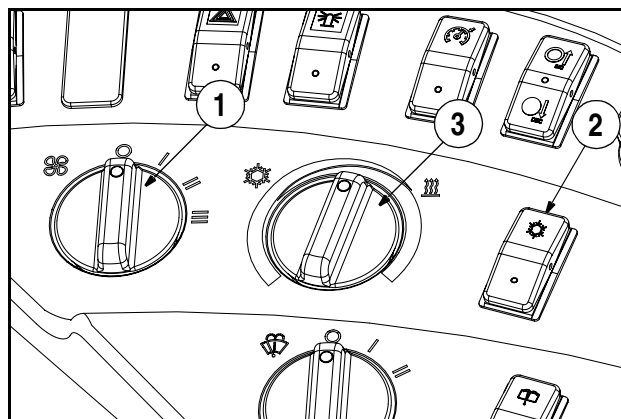
**OEM1415**

A22094

## RECOVERING PURE 134A REFRIGERANT

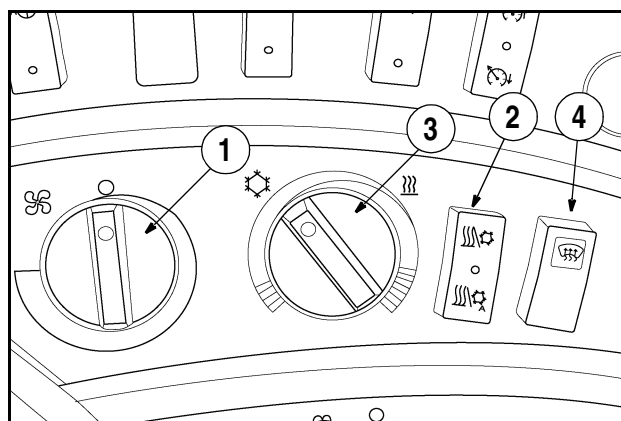
### STEP 1

Start the tractor and run the engine at 1500 RPM. If possible, operate the air conditioner for 15 minutes at maximum cooling and maximum blower speed. ATC switch set to DEFOG/DEFROST, standard A/C switch set to ON.



Standard A/C Controls

RH02J044



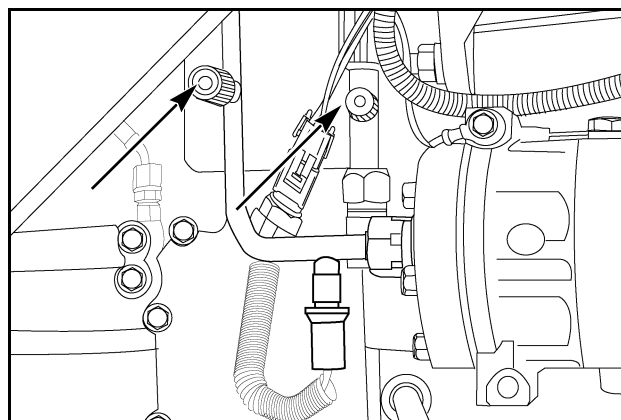
ATC A/C Controls

RH05J039

- |                               |                         |
|-------------------------------|-------------------------|
| 1. BLOWER CONTROL             | 3. TEMPERATURE CONTROL  |
| 2. ATC OR STANDARD A/C SWITCH | 4. DEFOG/DEFROST SWITCH |

### STEP 2

Clean the external surfaces of the compressor and hoses. Remove the caps from the service ports on the suction and pressure lines.



RD02H032

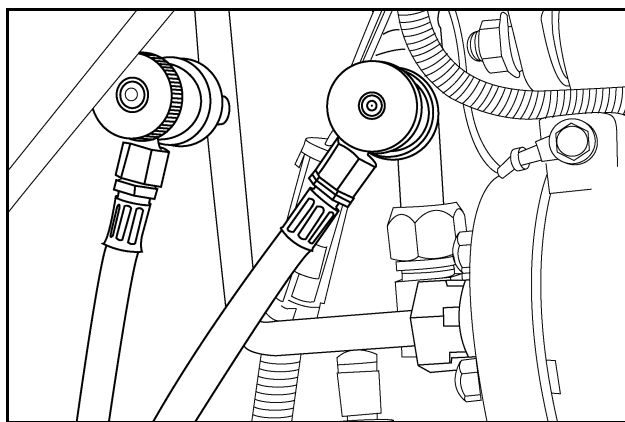
### STEP 3

**IMPORTANT:** Use Refrigerant Identifier OEM4450 to verify refrigerant purity. If refrigerant is 98% pure HFC-134a and/or the only non-condensibles test as air and moisture, then proceed with Step 4. If not, go to Step 12.

With the charging station manifold gauge valves in the closed position, connect the hoses from the test gauges to the service ports.

Connect the hose from the low pressure gauge to the port on the suction hose. Turn in valve depressor.

Connect the hose from the high pressure gauge to the port on the discharge hose. Turn in valve depressor.

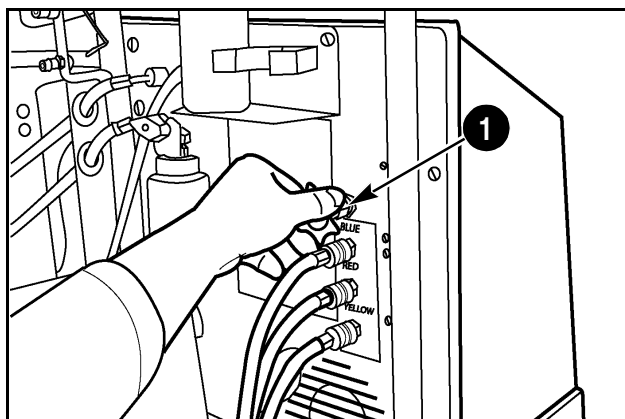


RD02H029

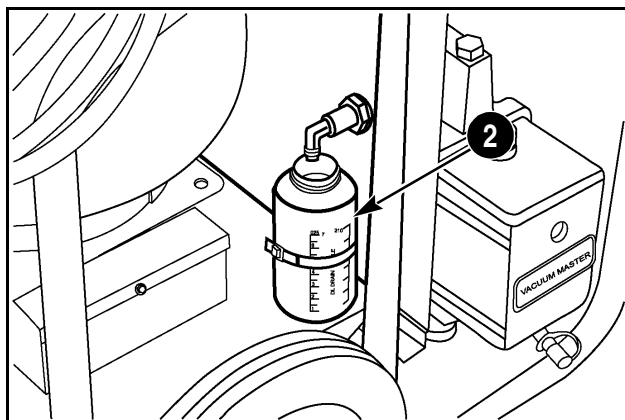
### STEP 4

Open the drain valve to make sure that the oil separator is drained prior to recovery. Oil may have mistakenly been left in the recovery unit itself from the previous service job. An oily mist will discharge if the separator has been drained.

Check that the oil reservoir has been drained prior to recovery to avoid returning additional oil to the system.



MK96C017



A22111

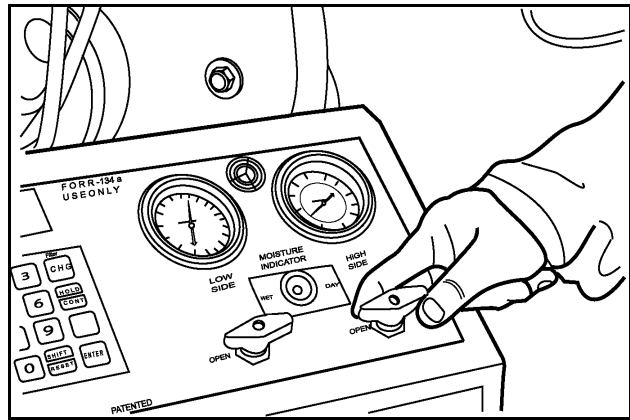
1. DRAIN VALVE

2. RESERVOIR DRAIN



## STEP 5

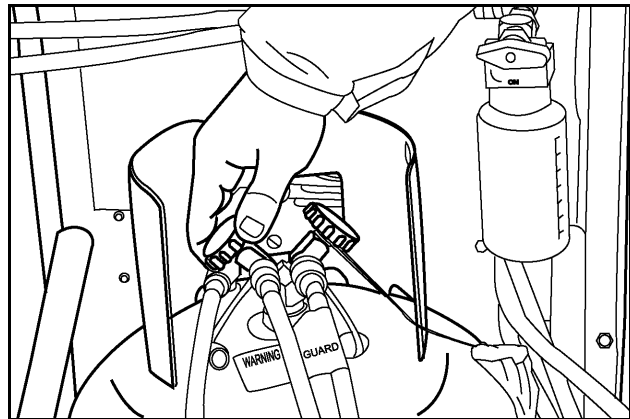
Open the high and low valves.



A22114

## STEP 6

Make certain the refrigerant tank gas and liquid valves are open.



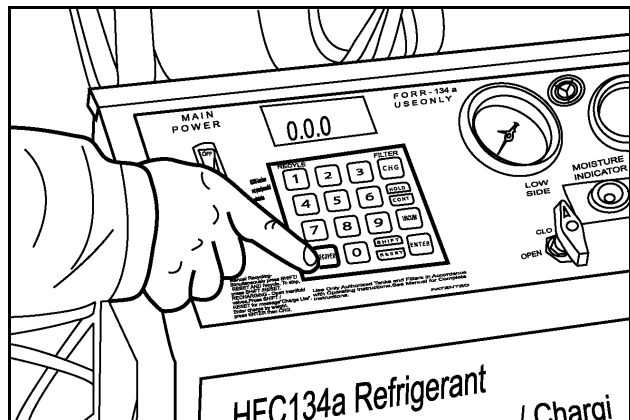
A22107

## STEP 7

Connect the main power plug to a 115 volt AC outlet. Move the main power switch to the ON position and depress the RECOVER switch.

The compressor will shut OFF automatically when recovery is complete. Wait for 5 minutes and observe the manifold pressure gauges for a pressure rise. If no pressure rise, recovery is complete. If pressure rises above 0 PSI, depress the HOLD/CONT switch and repeat until pressure holds for two minutes. Then wait for the compressor to automatically shut OFF.

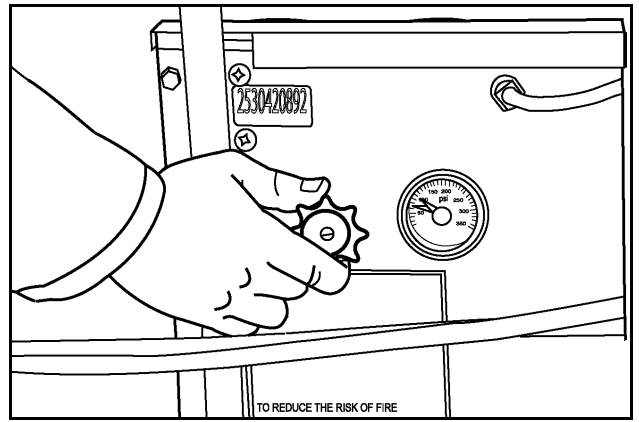
**NOTE:** Refrigerant may pool inside the tractor's A/C system. When the recovery unit's compressor is turned off, the refrigerant will vaporize in the ambient heat causing the system pressure to rise again. Repeat the recovery process until the system remains at a vacuum for at least two minutes.



A22112

## STEP 8

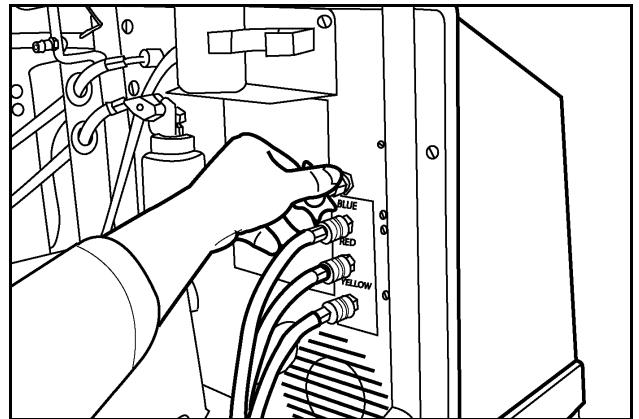
Some recovery units require a manual air purge to remove non-condensables from the recovery tank. Refer to the operators manual for your unit. Air purge is automatic on an OEM1415 when it evacuates the A/C system.



A22108

## STEP 9

Slowly open the oil drain valve and drain the oil into the reservoir. When the oil stops draining, close the oil drain valve completely.



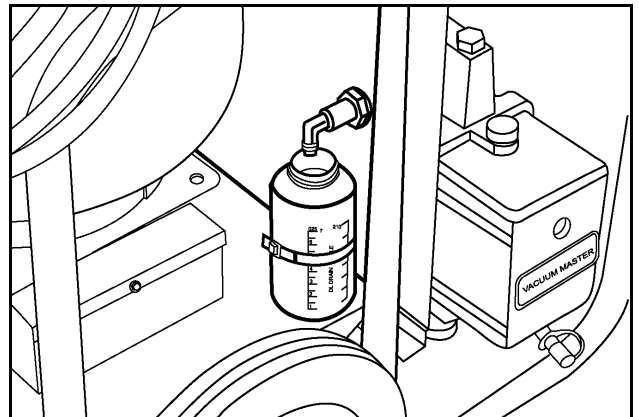
MK96C017

## STEP 10

Record the amount of oil in the reservoir. This amount of new oil should be added back to the system. Dispose of any oil in the bottle in an appropriate manner and return the bottle to the station.

## STEP 11

All refrigerant has been removed from the A/C system; replace components or make any repairs at this time.



A22111

## RECOVERING CONTAMINATED REFRIGERANT WITH OEM1691

**IMPORTANT:** When contaminated refrigerant is discovered with Refrigerant Identifier OEM4450, additional care is necessary to protect your safety and prevent the contamination of service equipment and your refrigerant supply. Recover the refrigerant with OEM1691 station to a recovery tank reserved for contaminated refrigerant. Do NOT use OEM1415 or OEM1418 to recover the contaminated refrigerant.

**IMPORTANT:** Read all safety warning and maintenance sections of the operator's manual before operating the station.



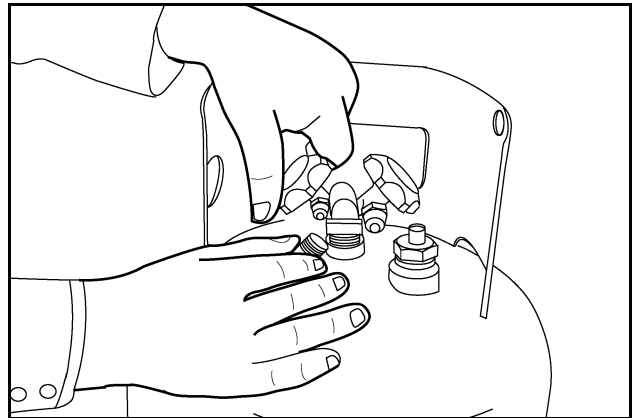
**WARNING:** Do NOT use a tank without a limit switch to recover contaminated refrigerant with OEM1691. The limit switch prevents overfilling of the tank and protects your safety.

M797

### Preparing the Tank

#### STEP 12

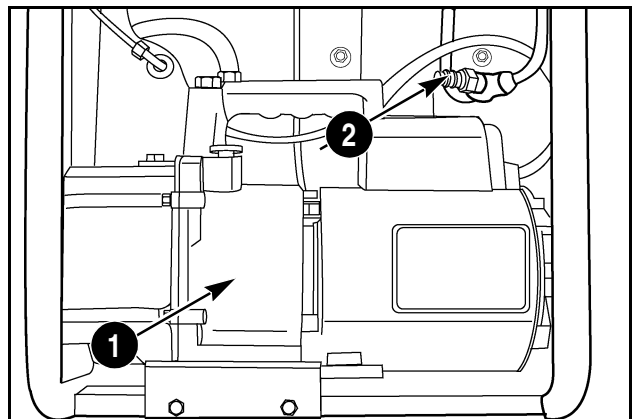
The tank for the station may be filled with 10 to 15 psi of dry nitrogen which must be removed before it can be used. Remove the cap from the red valve outlet. Open the tank valve to release the nitrogen. Close the tank valve.



RR00E127

#### STEP 13

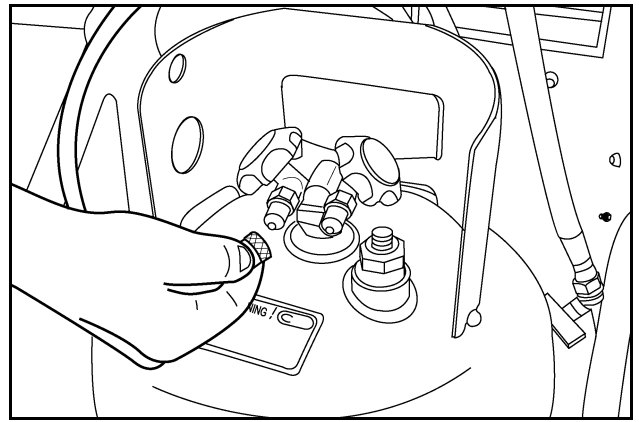
Use the vacuum pump (1) on OEM1415 or OEM1418 to pull a 5 minute vacuum on the tank. Connect the tank at the location (2) shown.



RR00E153

### STEP 14

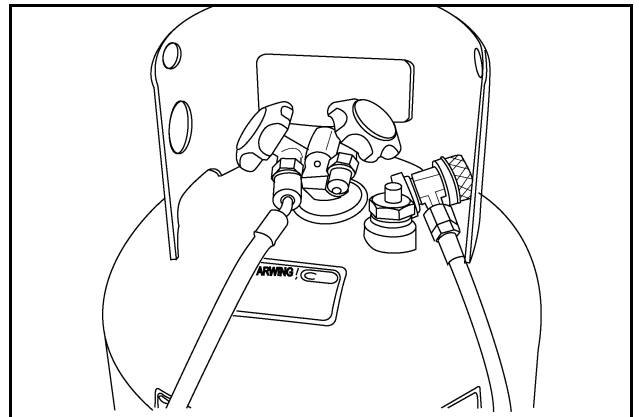
A 1/4 inch FFLX to 1/2 inch Acme adapter (OEM1693) should have been ordered with the unit. Connect the adapter to the red tank valve.



RR00E144

### STEP 15

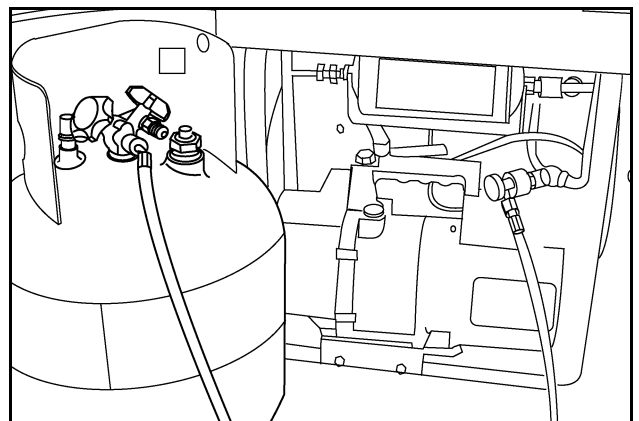
Connect the 96 inch (2.4 m) blue hose with the R134a service coupler to the adapter.



RR00E152

### STEP 16

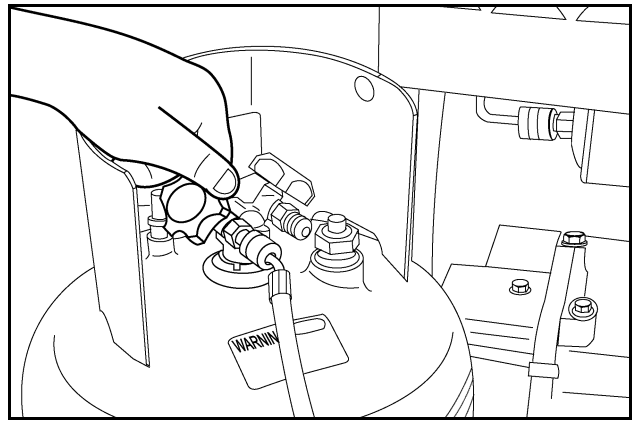
Connect the R134a service coupler to the tee fitting on top of the vacuum pump on OEM1415 or OEM1418. Open the valve on the service coupler by turning it clockwise.



RR00E154

## STEP 17

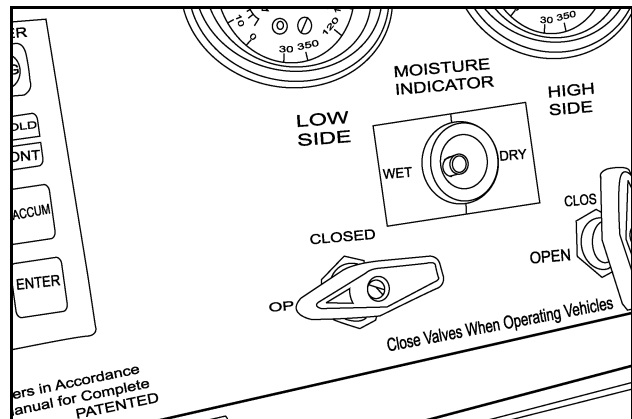
Open the valve on the tank.



RR00E155

## STEP 18

Open the low side manifold on the control panel of OEM1415 or OEM1418.



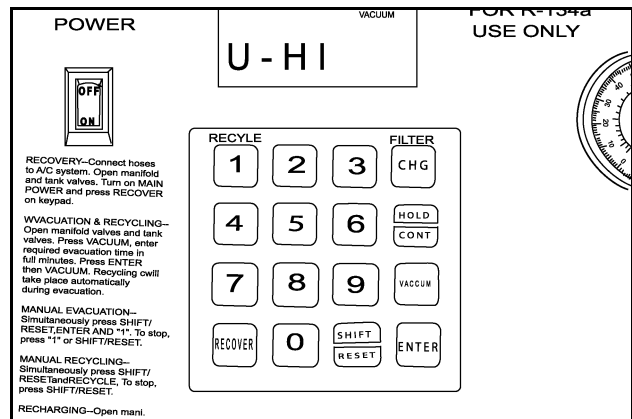
RR00E156

## STEP 19

Press SHIFT/RESET and ENTER at the same time.

Press 1. The vacuum pump starts and runs continuously until any other key is depressed.

Run the vacuum pump for a minimum of 5 minutes. Then press 1 to stop the pump.



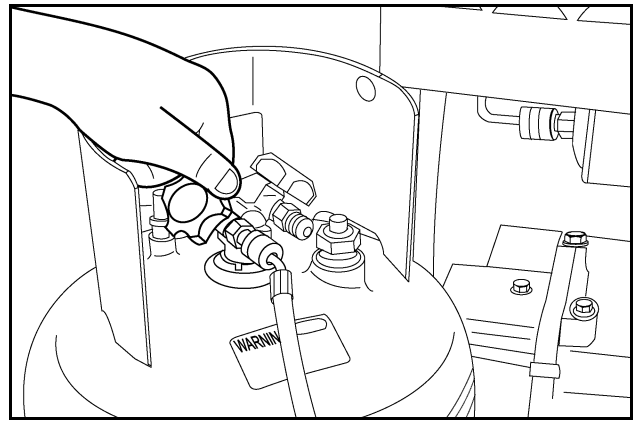
R00E141

## STEP 20

Press SHIFT/RESET again to return to the normal display mode.

Close the valve on the tank.

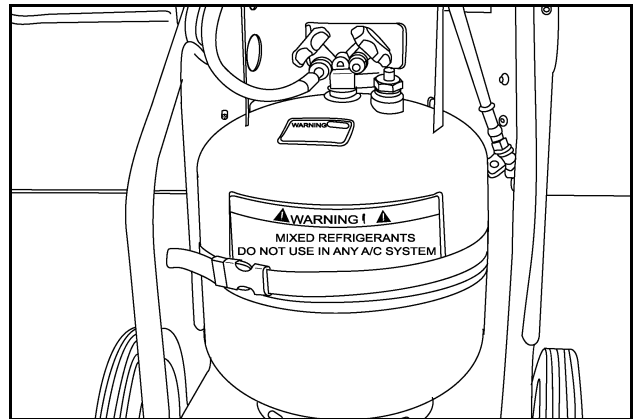
Close the valve on the service coupler by turning it counterclockwise and disconnect the blue hose from the vacuum pump.



RR00E155

## STEP 21

Set the tank on the platform at the rear of the station. Tighten the black strap securely around the tank.

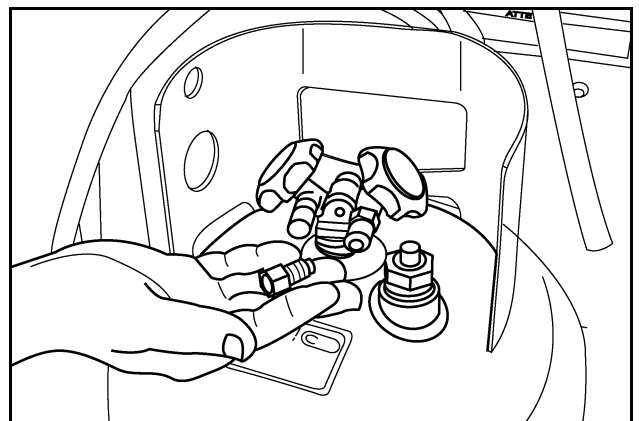


RR00E143

## STEP 22

Disconnect the R134a hose from the adapter. Disconnect the adapter from the tank and store for future use. Reinstall the cap on the red valve outlet port.

The tank is now prepared. See the operator's manual to prepare the recovery station for use.



RR00E145

## Recovery Process

**IMPORTANT:** If a recovery tank becomes full during a recovery, the float switch will automatically turn off the scavenger. See Step 35 for changing tanks in the middle of a recovery.

### STEP 23



**WARNING:** Do not operate the vehicle or the A/C system if the refrigerant identifier shows more than 2% hydrocarbon in the mixture.

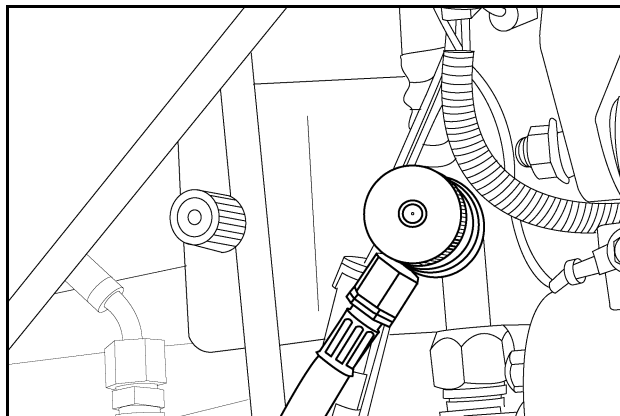
M801

Start the tractor and run the engine at 1500 RPM. If possible, operate the air conditioner for a few minutes at maximum cooling and maximum blower speed, with ATC switch set to DEFOG/DEFROST, or standard A/C switch to ON. Tests have shown that more refrigerant will be recovered if this action is performed.

**NOTE:** Turn the system and tractor OFF before connecting the station.

### STEP 24

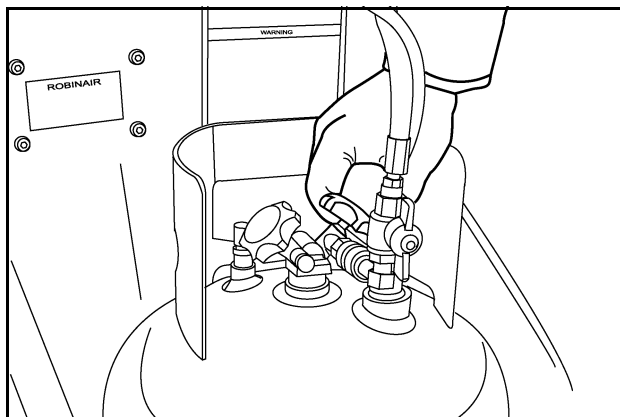
Remove the cap on the low pressure port at the compressor. Connect the blue R134a recovery hose from the station to the low side service port at the compressor.



RD02H030

### STEP 25

Open the tank valve for the R134a hose. Open the valve at the service port.

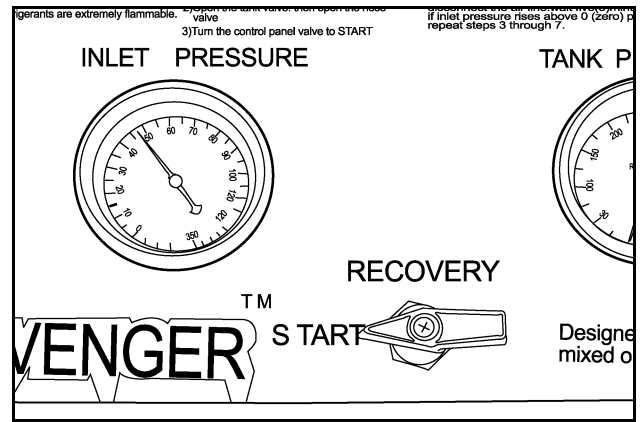


RR00E159

## STEP 26

Turn the control panel valve to START.

**NOTE:** *This will equalize pressure on both sides of the compressor for easier starting.*

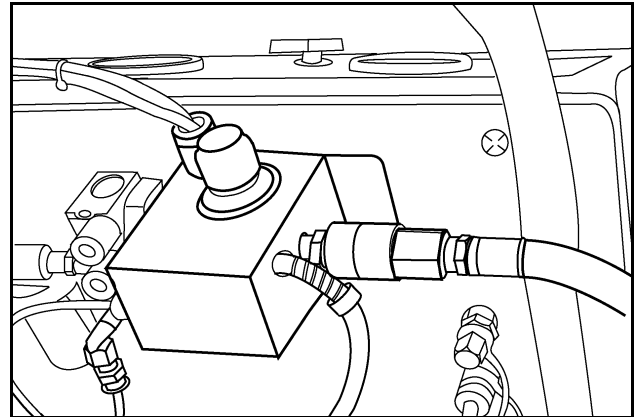


RR00E132

## STEP 27

Connect a compressed air line to the air inlet on the regulator at the rear of the station.

**NOTE:** *The air system must offer a minimum of 120 psi (827 kPa) and a maximum of 200 psi (1379 kPa) at sustained volume of 10 cfm (0.28 cmm).*



RR00E133

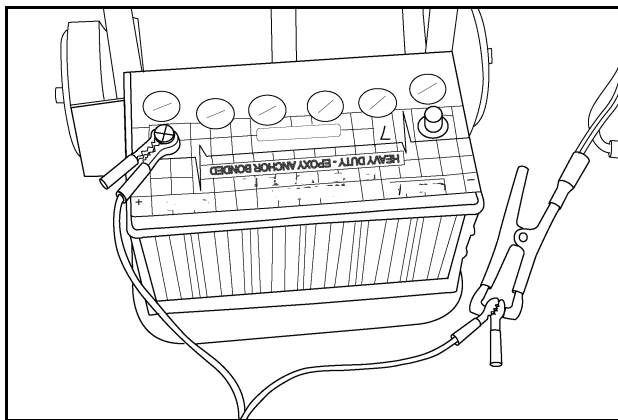


## STEP 28

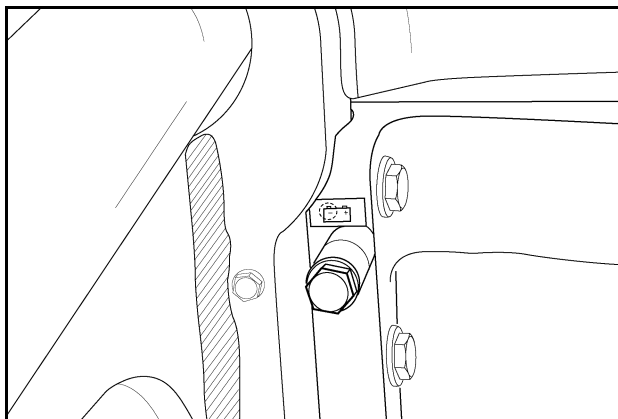
Connect the red power lead to the + (positive) post of the vehicle's battery or to another 12V DC power supply. Connect the black ground lead to a ground source away from the battery, NOT the battery - (negative) post. The compressor should start idling.

**NOTE:** Batteries generate explosive gases during normal battery operation. Use the remote ground to reduce the risk of sparks around the contaminated system.

**NOTE:** Use a jumper cable to extend the negative lead if necessary to reach an engine ground.



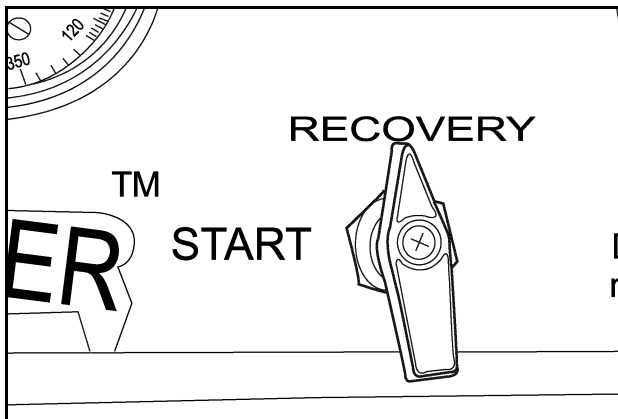
RR00E134R



RD02F032

## STEP 29

Turn the control panel valve to RECOVERY. The compressor sound should change. Inlet pressure gauge should decrease and tank pressure increase on the gauges.

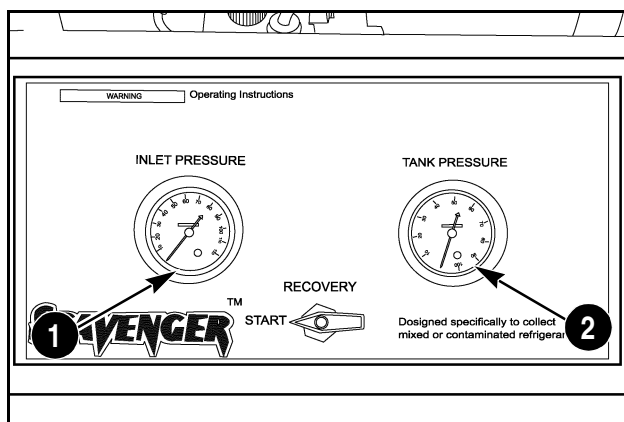


RR00E135

### STEP 30

When inlet pressure gauge shows a vacuum, disconnect the air line. Wait five minutes. If inlet pressure rises above 0 psi, repeat Steps 33 and 35.

**NOTE:** Refrigerant may pool inside the system. When the station is turned off, the refrigerant will vaporize in the ambient heat causing the system pressure to rise again. Repeat the recovery process until the system remains at a vacuum for at least two minutes.



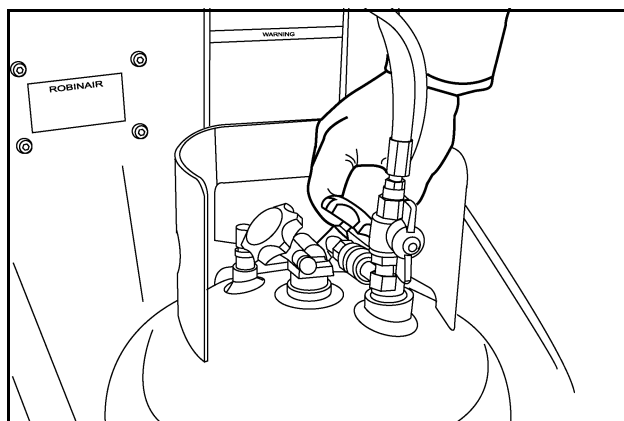
RR00E157

1. A/C SYSTEM PRESSURE  
GAUGE

2. TANK PRESSURE  
GAUGE

### STEP 31

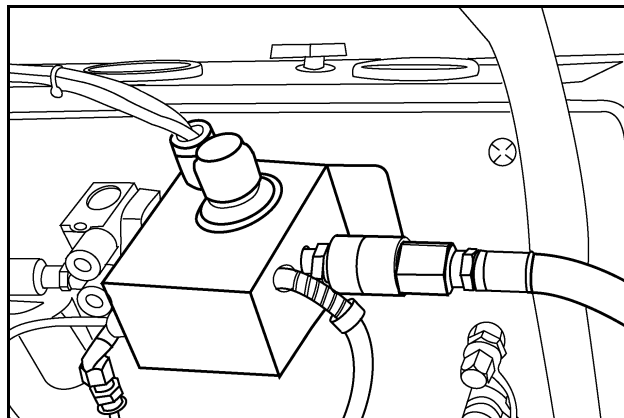
When the recovery process is complete, close the valve on the recovery tank. Close the low pressure hose valve and remove the hose from the port at the compressor.



RR00E159

### STEP 32

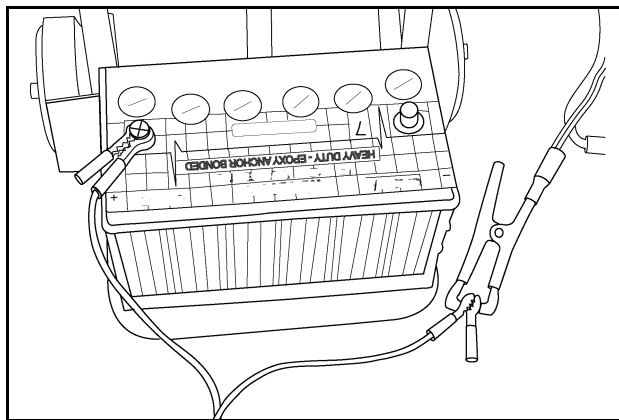
Disconnect the compressed air line from the inlet on the regulator.



RR00E133

### STEP 33

Disconnect the black ground lead. Disconnect the red power lead from the 12V power source.



RR00E134R

### STEP 34

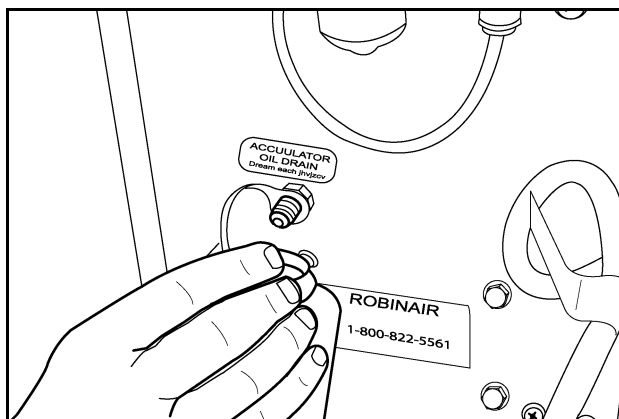
After each recovery, carefully open the accumulator oil drain and drain any collected compressor oil in a proper container.

**NOTE:** Small amounts of refrigerant may remain in the accumulator and build a slight pressure. Drain the accumulator when the inlet pressure gauge shows a vacuum. There may or may not be any oil to drain; this will vary from tractor to tractor. Dispose any oil drained in a proper manner.

**NOTE:** If any significant amount of oil is drained, measure and record that amount. Add that equivalent of new SP-20 PAG oil back into the system at the end of the evacuation process.

**IMPORTANT:** If the oil is suspected to be other than SP-20 PAG oil:

1. See the flushing procedures in this Section for complete circuit flushing to remove the oil.
2. Drain all oil from the compressor, and add back to the compressor 8.5 oz (250 ml) of new SP-20 PAG oil.
3. Back flush the thermal expansion valve.
4. Reintroduce the fluorescent dye for R-134a in the system.
5. Replace the receiver-drier before evacuating and recharging the system.
6. Operate the system for 15 minutes to circulate the new oil throughout the circuit.



RR00E137

## STEP 35

If a recovery tank becomes full during a recovery, the float switch will automatically turn off the station. To change a full tank in the middle of a recovery:

- A. Close the blue tank valve and the valve on the black hose from the station.
- B. Unscrew and remove the float cable from the tank.
- C. Disconnect the hose from the tank valve.
- D. Remove the tank from the station.
- E. Replace the tank with a properly prepared tank (dry nitrogen charge released and vacuum drawn and held for five minutes).
- F. Connect the tank valve hose and the float cable.
- G. Open the tank valve and the tank hose valve. Recovery will continue as soon as both valves are open.

**IMPORTANT:** *Do not use recovered contaminated refrigerant in any A/C system. Send full tanks to a reclamation center for purifying or disposal of the contents.*

## STEP 36

All refrigerant has been removed from the A/C system, replace components or make any repairs at this time.

**IMPORTANT:** *Replace the receiver-drier on the tractor being serviced before you evacuate or recharge the system with OEM1415 or OEM1418.*

## STEP 37

See evacuation and recharging in this Section to recharge the A/C system with pure R134a refrigerant using OEM1415 or OEM1418.

## AIR CONDITIONER SYSTEM EVACUATION AND RECHARGING

**IMPORTANT:** *Replace the receiver-drier if one or more of the following conditions occurs before you remove the air and moisture from the system:*

- A. The system has been opened for service before.
- B. Receiver-drier has operated two or more years.
- C. Disassembly of compressor shows small particles of moisture removing material (gold or brown particles).
- D. Large system leak (broken hose, break in line).
- E. Too much air or moisture in system.
- F. Removal of compressor or any other component caused the system to be open (uncapped) longer than 5 minutes.
- G. Testing with refrigerant identifier OEM4450 showed contamination.

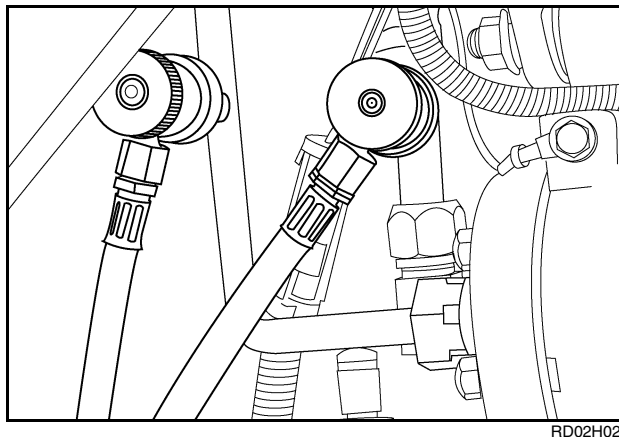
### STEP 38

With the charging station manifold gauge valves in the closed position, connect the hoses from the test gauges to the service ports as follows:

- 1. Connect the hose from the low pressure gauge to the port on the suction hose (blue).
- 2. Connect the hose from the high pressure gauge to the port on the discharge hose (red).
- 3. Turn in both thumbscrews to depress the service valves.

Removal of air and moisture from the system is necessary after the system has been opened for maintenance. A vacuum pump must be used to lower the pressure enough to change the moisture to vapor which can be removed from the system.

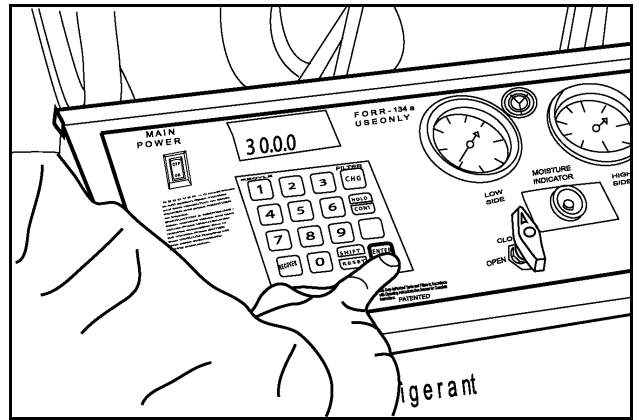
**NOTE:** *Refer to the vacuum pump manufacturer's user manual for additional information.*



RD02H029

### STEP 39

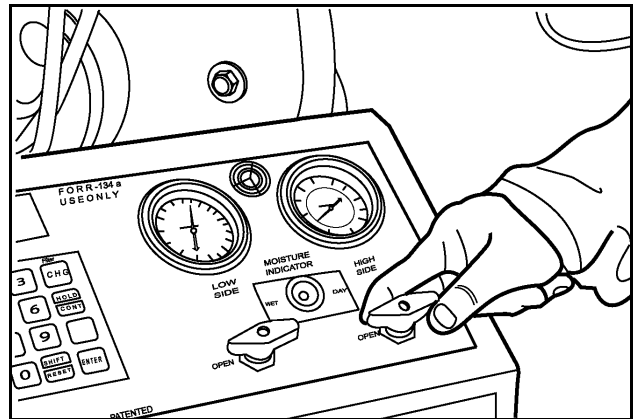
Connect the main power plug to a 115 volt AC outlet. Move the main power switch to the ON position. If program and vacuum do not appear at the top of the display press the VACUUM key. Program a minimum of 45 minutes and press the ENTER key. The display will flash once indicating the programmed data has been accepted.



A22113

### STEP 40

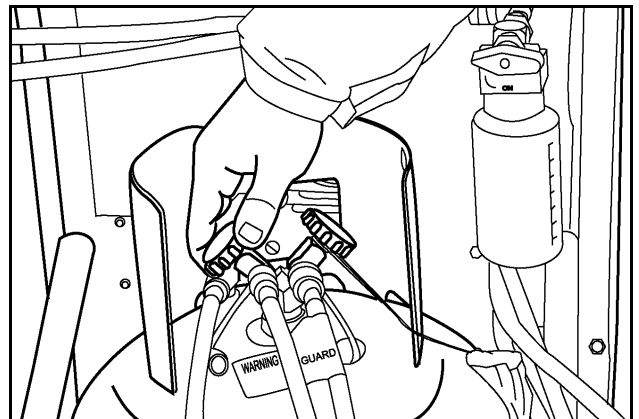
Fully open the low and high pressure valves.



A22114

### STEP 41

Open the red (vapor) and blue (liquid) valves on the tank.



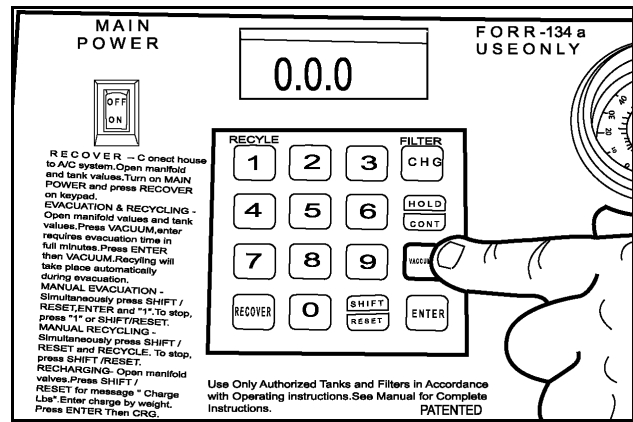
A22107

## STEP 42

Press the VACUUM key. Automatic will show on the display. VACUUM will appear on the display and after a slight delay, the vacuum pump will start. The display will show the amount of time programmed and begin a countdown to zero.

When the programmed time has elapsed, an automatic hold occurs. Check the low pressure gauge to see that the A/C system maintains a 28 to 29-1/2 inches of mercury (Hg).

**NOTE:** The low pressure gauge must not increase faster than one inch of mercury (Hg) in 15 minutes. If the system will not hold vacuum, a leak exists that must be corrected before recharging can begin. See leak test information in this section.



A22123

## STEP 43

**IMPORTANT:** Do not inject the PAG oil until the system will hold a proper vacuum.

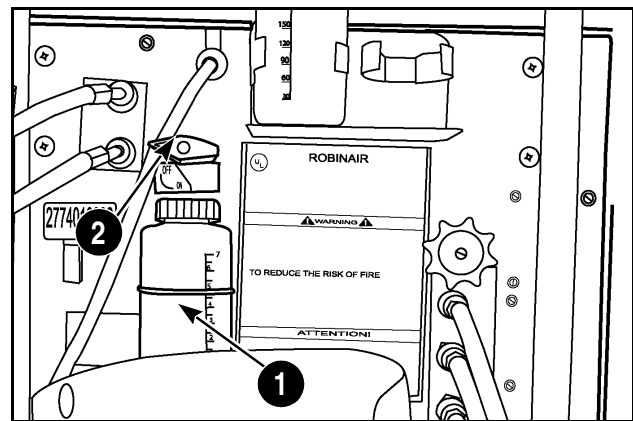
OEM1415 has an injection system to return new SP-20 PAG oil equal to the amount recovered at the end of the evacuation process.

To add the new oil, adjust the O-ring around the oil return bottle to the required oil charge level.

**NOTE:** If 2.4 oz (71 ml) was recovered in the oil reservoir, 2.4 oz (71 ml) of new SP-20 PAG must be returned.

Open the oil injection valve to add the oil into the system. Close the valve when the oil level reaches the O-ring.

**IMPORTANT:** Do not let oil level fall below the dip tube in the return bottle or air will be introduced into the refrigerant circuit.



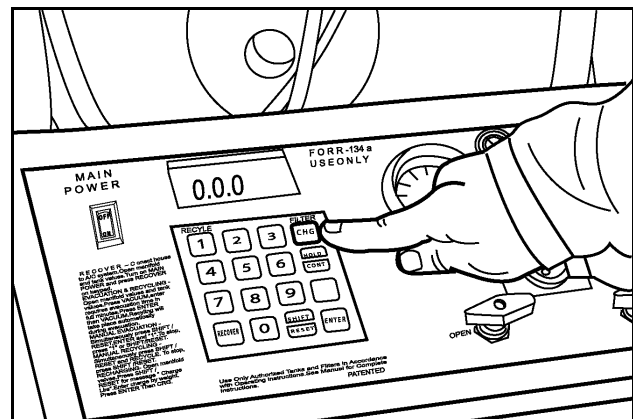
MK96C043

1. OIL RETURN BOTTLE

2. OIL INJECTION VALVE

## STEP 44

Press the CHARGE key. PROGRAM and CHARGE will appear on the display.



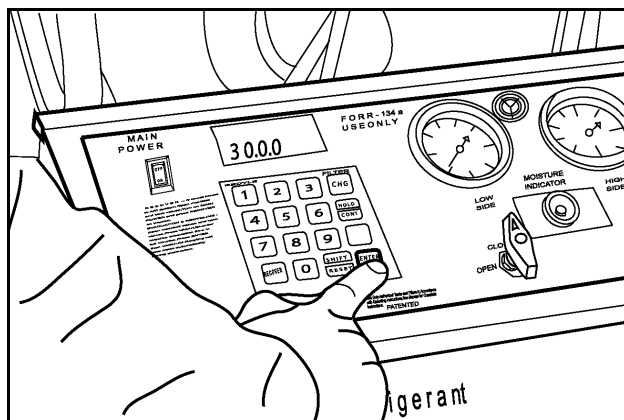
A22115

## STEP 45

Program the proper refrigerant amount for your tractor and press the ENTER key:

**All MX/Magnum Tractor Models ....4.63 lbs (2.1 kg)**

The display will flash once indicating the programmed data has been accepted.

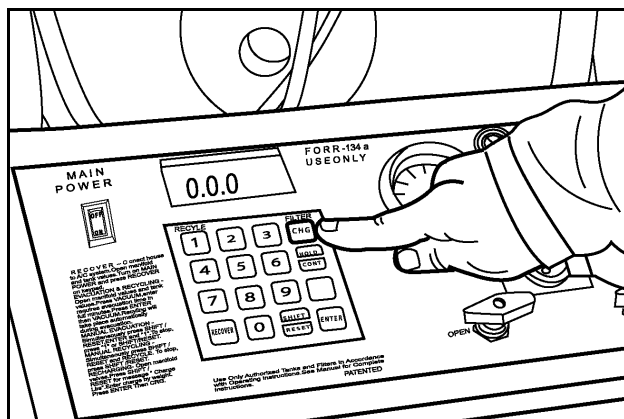


A22113

## STEP 46

Press the CHARGE key to begin refrigerant charging. AUTOMATIC and CHARGE will appear on the display. The display shows the programmed amount and counts down to zero as charging proceeds. When charging is completed, the display shows CPL.

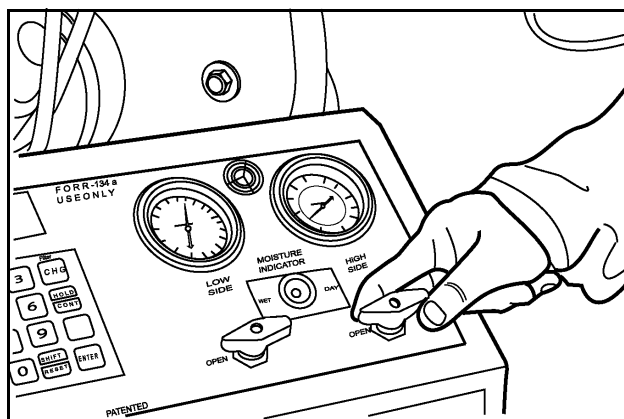
**IMPORTANT:** Check the OEM equipment manual before performing Step 47 to avoid damaging recovery unit. Pressure reading should be obtainable with valves closed. Damage may occur if the tractor is started with the valves accidentally open or if either or both valves are opened while the A/C system is operating.



A22115

## STEP 47

Completely close the high and low pressure manifold valves.



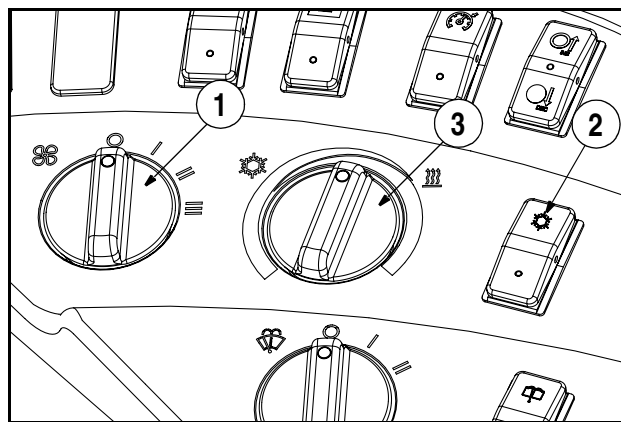
A22114



## STEP 48

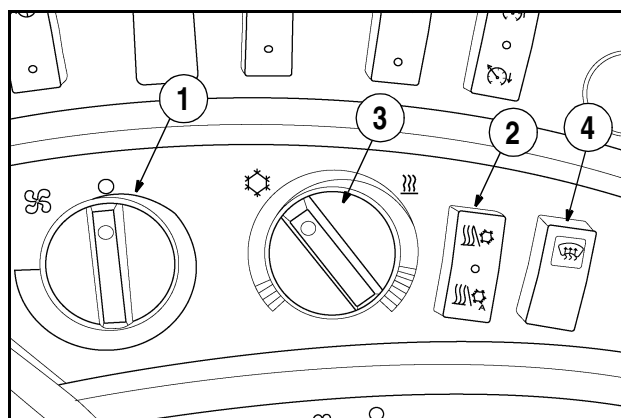
Start the tractor and run the engine at 1500 RPM. Operate the air conditioner system at maximum cooling setting and blower speed with the door and service door open, Standard A/C switch ON or ATC switch in DEFOG/DEFROST position.

**NOTE:** The compressor does not operate if the system pressure is too low or too high because the clutch is latched off by the controller. Standard A/C units blink the indicator light on the A/C ON/OFF switch indicating a system pressure problem. To restart the compressor, the switch must be turned to the OFF position and then ON. On ATC units, if the system pressure is too low or to high, a fault code will toggle between the current cab temperature setpoint and the fault code on the Instrument Cluster Display.



Standard A/C Controls

RH02J044



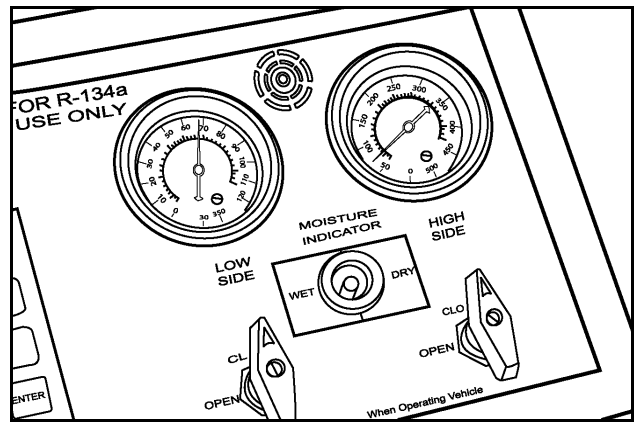
ATC A/C Controls

RH05J039

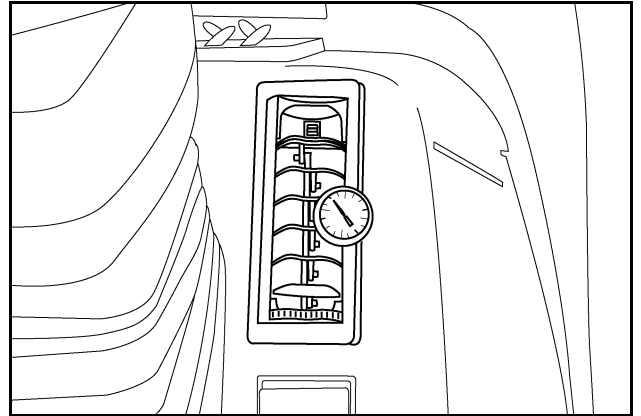
- |                               |                        |
|-------------------------------|------------------------|
| 1. BLOWER CONTROL             | 3. TEMPERATURE CONTROL |
| 2. ATC OR STANDARD A/C SWITCH | 4. DEFOG/DEFROST       |

## STEP 49

Observe the pressure gauge readings to determine that the correct amount of refrigerant has entered the system. See chart on page 33 for temperature and pressure variations. Check louver temperature for proper cooling at the mid-cab vents.



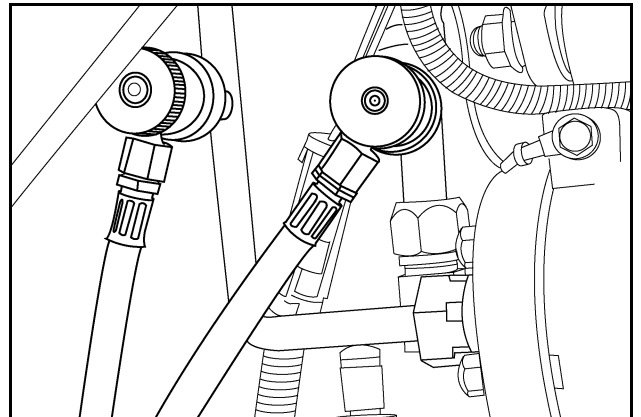
A22117



RD02F045

## STEP 50

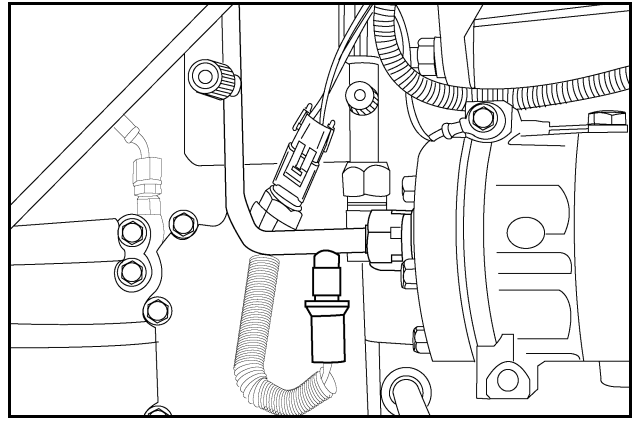
Close any open valves on the couplers and carefully remove the gauge hoses from the ports on the suction and discharge lines.



RD02H029

## STEP 51

Install the caps on the service ports on the suction and discharge lines.



RD02H032

## AIR CONDITIONING TEMPERATURE/PRESSURE CHART

Ambient Temperature	Normal Low Side Pressure		Normal High Side Pressure		Louver Temperature*	
	Low Relative Humidity**	High Relative Humidity	Low Relative Humidity**	High Relative Humidity	Low RH**	High RH
21°C (70°F)	117 to 138 kPa** (17 to 20 psig)	145 to 172 kPa (21 to 25 psig)	938 to 1117 kPa (136 to 162 psig)	1040 to 1214 kPa (151 to 176 psig)	13°C (55°F)	17°C (62°F)
27°C (80°F)	145 to 172 kPa (21 to 25 psig)	172 to 207 kPa (25 to 30 psig)	1158 to 1379 kPa (168 to 200 psig)	1262 to 1469 kPa (183 to 213 psig)	16°C (60°F)	19°C (67°F)
32°C (90°F)	179 to 207 kPa (26 to 30 psig)	207 to 234 kPa (30 to 34 psig)	1372 to 1641 kPa (199 to 238 psig)	1482 to 1724 kPa (215 to 250 psig)	19°C (67°F)	22°C (71°F)
38°C (100°F)	200 to 241 kPa (29 to 35 psig)	228 to 276 kPa (33 to 40 psig)	1593 to 1951 kPa (231 to 283 psig)	1662 to 2027 kPa (241 to 294 psig)	22°C (71°F)	25°C (76°F)
43°C (110°F)	228 to 276 kPa (33 to 40 psig)	255 to 319 kPa (37 to 45 psig)	1813 to 2213 kPa (263 to 321 psig)	1875 to 2289 kPa (272 to 332 psig)	25°C (77°F)	27°C (81°F)
49°C (120°F)	255 to 319 kPa (37 to 45 psig)	283 to 345 kPa (41-50 psig)	2034 to 2482 kPa (295 to 360 psig)	2089 to 2551 (303 to 370 psig)	28°C (82°F)	30°C (86°F)

\* Temperatures shown are highest normal temperatures expected; actual louver temperatures may be cooler.  
 Louver temperature measured in the louvers facing the operator.

\*\* Compressor clutch cycling may occur under low humidity, low temperature condition.

The pressure-temperature chart is based on the following conditions:

1. Engine operating at 1500 RPM.
2. No engine load.
3. Blower speed control in the highest speed position.
4. Door and rear window open.
5. Air conditioner temperature control set to maximum cooling.
6. Air conditioner control switch set to ON (Standard A/C) or DEFOG/DEFROST (ATC) mode.
7. Gauge readings taken 15 minutes after start up.
8. Hood closed with all side panels in position.
9. Heater supply line clamped and return valve closed at the engine.
10. All cab air louvers open.

## A/C SYSTEM FLUSHING PROCEDURE

When flushing is necessary, all effected components should be flushed to eliminate the possibility of contaminants remaining in the system.

There are two methods of A/C system flushing: **individual component** flushing and **complete circuit** flushing. The **complete circuit** is the system minus the compressor, receiver-drier and thermal expansion valve. The compressor, receiver-drier and thermal expansion valve are always bypassed (removed) during circuit flushing and serviced individually. The receiver-drier is always replaced anytime a system is flushed. The expansion valve, due to its small orifices, is removed from the system and cleaned (or replaced). The compressor is either replaced or reused, but is NEVER flushed.

The preferred method of system flushing is individual component flushing. Given the size of New Holland equipment and the distance between components, individual component flushing will dislodge and flush out more contamination than complete circuit flushing. Which individual components are flushed will depend on the source of the contamination and is left to the discretion of the technician.

For “mildly” contaminated systems, complete circuit flushing may be used, where the contamination is oxidized refrigerant oil or small amounts of receiver-drier desiccant. Complete circuit flushing requires little system disassembly, minimal special connectors and the least amount of service time.

The most likely sources of contamination are compressor failure and receiver-drier failure.

### Compressor Failure

A failed compressor generally sends debris downstream to the condenser, the receiver-drier and towards the thermal expansion valve. If the compressor fails internally, it must be replaced. Also individual flushing of the hose between the compressor and condenser, of the hose between the condenser and receiver-drier, of the condenser itself and replacing the receiver-drier are appropriate service actions for compressor failure.

For most New Holland condensers with a single flow path, flushing effectively removes debris. For condensers with parallel flow paths, since flushing takes the path of least resistance around any blockage, condenser replacement may be the only option.

The receiver-drier has a fine mesh screen to capture contaminants, but the contaminants may penetrated the screen. Check the discharge port of the receiver-drier to see if contaminants have penetrated the screen. If so, individual flushing of the hose between the receiver-drier and the expansion valve and cleaning the thermal expansion valve are appropriate. If the thermal expansion valve is damaged, replace it as well.

Additional flushing of the system beyond the thermal expansion valve is at the discretion of the service technician who can best judge how far the contamination has traveled.

### Receiver-Drier Failure

Receiver-driers should not normally fail if replaced:

- A. when system has been opened before.
- B. when receiver-drier has been in service two or more years.
- C. when the system has been open for a long period of time because of a leak (broken hoses, loose connection) that has permitted air and moisture to enter the system.
- D. when contaminated refrigerant was recovered from the system.

However, if the desiccant pouch is punctured by a debris from a failed compressor or fails from age, desiccant particles may flow downstream toward the thermal expansion valve and the evaporator. An indicator of receiver-drier failure is soft golden-brown particles found at its outlet. The thermal expansion valve should always be checked after receiver-drier failure.

If the receiver-drier fails, it must be replaced. Also individual flushing of the liquid hose between the receiver-drier and the thermal expansion valve and cleaning the valve are appropriate.

Check the suction line from the valve to the compressor and the compressor suction port. If golden brown particles is found, flush the evaporator and suction line individually. The compressor may be reused AFTER all contaminants are removed:

1. Use the dipstick to measure the compressor oil level.
2. Drain and refill the compressor with PAG oil until the drained oil is free of particles.

3. Rotate the compressor clockwise to check for binding caused by the presence of particles.
4. Drain or add PAG to return the compressor to measured dipstick level.

Additional system flushing is at the discretion of the service technician who can best judge how far the contamination has traveled and what components may have been damaged and require replacement.

**IMPORTANT:** *Flushing solvent CANNOT be used to remove compressor contaminants.*

## Required Tools

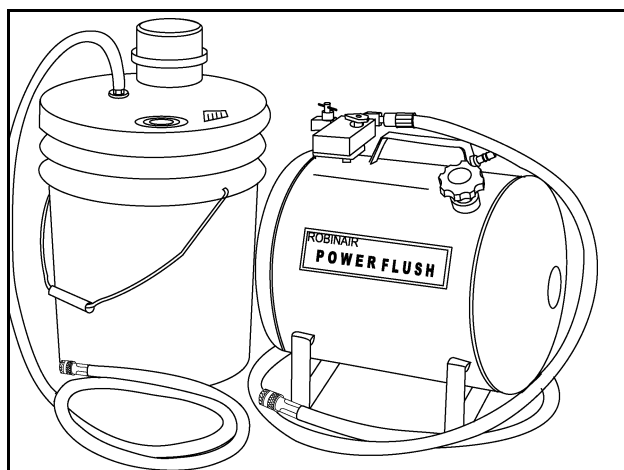
The following tools are required when flushing an A/C system or components:

- Power Flush 17550
- Flush Gun Kit 17585
- New Holland A/C Flushing Solvent, one case of six one gallon containers, BS33801
- Dry shop air source, use filter below or equivalent: Coalescing air filter/dryer (Ingersoll-Rand IR5CHE or Grainger 4KR65). Desiccant-type air driers should not be used.
- Adapters to connect flush unit to the various A/C system components. These adapters can be purchased in kit form or built in the shop.
- Clear Plastic Reinforced Hose to connect the tank to various components and small lengths for bypassing components like the receiver-drier or thermal expansion valve.

See **SPECIAL TOOLS**, page 4 in this Section.

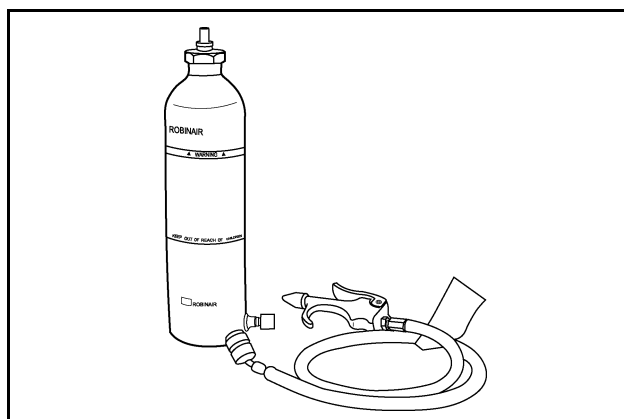
Optional tools include:

- Pressure regulator to control flow to the flush unit; regulator must be capable of delivering 45-90 psi (310-620 kPa) at 4.0 cfm (310 kPa at 0.11 cmm). Do not exceed 90 psi (620 kPa).
- Pressure indicator gauge (which may be integrated into the pressure regulator)



**Power Flush 17550**

RR00F093



**Flush Gun Kit 17585**

RP00G007

## Precautions



**WARNING:** *Do NOT use solvent containing alcohol, lacquer thinner, brake cleaner or other non-approved solvents. Use only New Holland approved flushing solvent. Other flushing agents or solvents may damage A/C system components.*

M815

New Holland A/C flushing solvent is a hazardous material. Read all warnings on the flushing solvent container prior to use and observe these safety precautions:

1. The flushing solvent is combustible. Avoid heat, sparks and open flame.
2. Use only in a well ventilated area. Mechanical exhaust and an appropriate respirator may be needed in warm and confined areas to protect your safety.
3. Avoid breathing mist and vapor.
4. Wear chemical splash safety goggles.
5. Wear rubber gloves and a rubber apron when handling the solvent or flushing components.
6. Observe all local, state and federal regulations regarding the safe disposal of used flushing solvent.

M802

The goal of flushing is to remove contaminants from the A/C system. Your shop air must be properly filtered and dried with coalescing filter, or you will simply replace one source of contamination with another using dirty, moisture saturated air.

The compressor, receiver-drier and thermal expansion valve must be bypassed (removed) when performing circuit flushing. The compressor and receiver-drier may never be flushed; the thermal expansion valve can be back flushed.

Keep the lid on the flushing recovery bucket closed when flushing to minimize the circulation of solvent vapors.

Never allow the flushing solvent to remain in or on the hoses for an extended period of time. Overexposure of the hoses to the solvent, especially the exterior, may cause hose swelling.

Do not open the fill cap on the flush reservoir when the reservoir is under pressure. Release pressure before removing cap.

## Component Flushing Procedure with Power Flush 17550

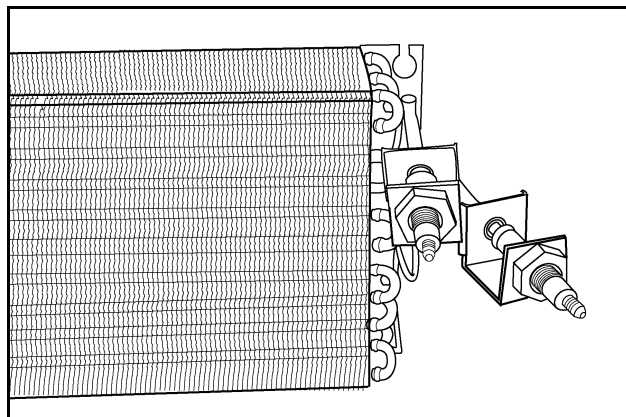
### STEP 52

All refrigerant must be recovered from the system before flushing.

### STEP 53

The 17550 power flush unit uses shop air to atomize the flushing solvent and a pulsing action to scrub residue and contaminants out of components.

Attach flushing adapters to the component to be flushed. These adapters can be shop built or a universal A/C flushing fitting set is available - Model 17582.

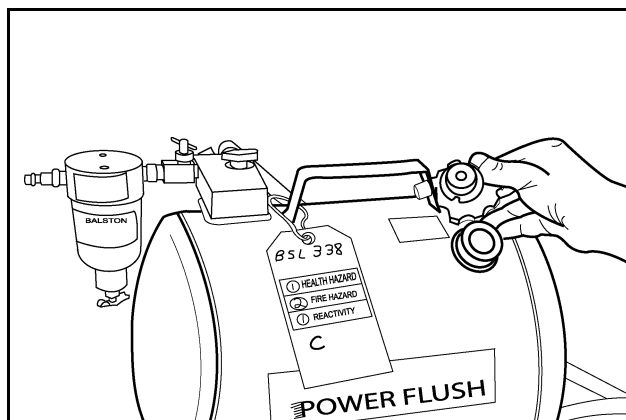


RP00G013

Evaporator and Universal Fittings Shown

### STEP 54

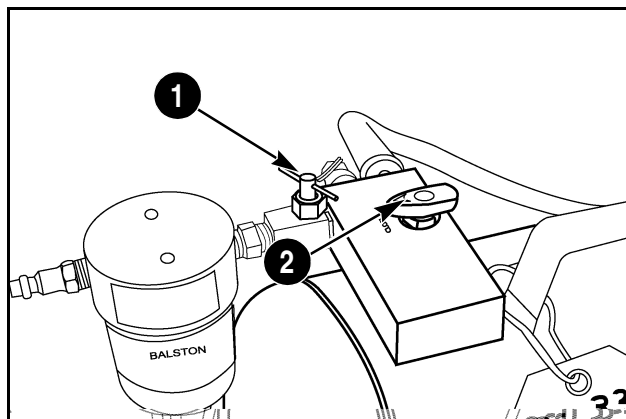
Fill the flushing reservoir 3/4 full with approved New Holland flushing solvent. **Do not overfill the reservoir or you will restrict the pulsing action of the unit.**



RD00H200

### STEP 55

Close the air and the flushing valves.



RD00H201

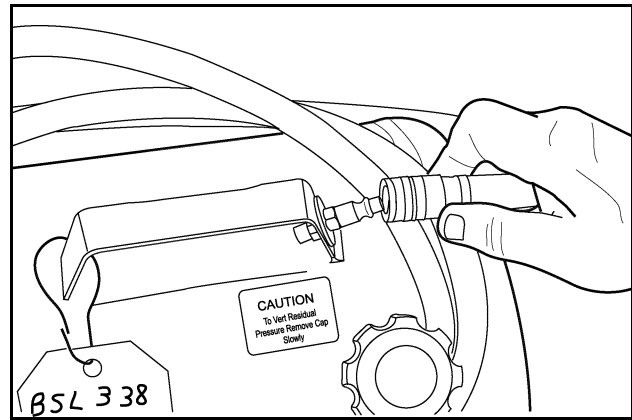
1. AIR VALVE

2. FLUSH VALVE



### STEP 56

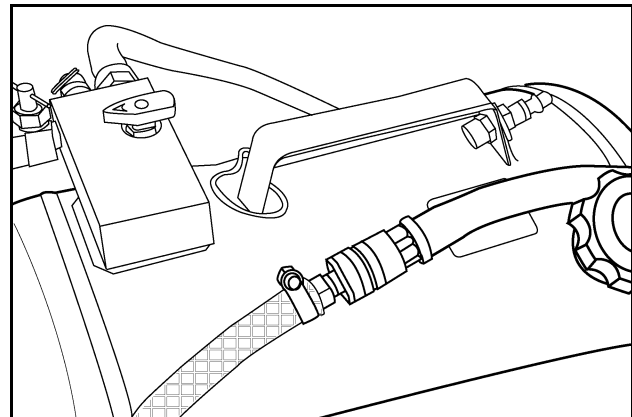
Remove the flushing tank hose quick coupler from the evaporation plug.



RP00G018

### STEP 57

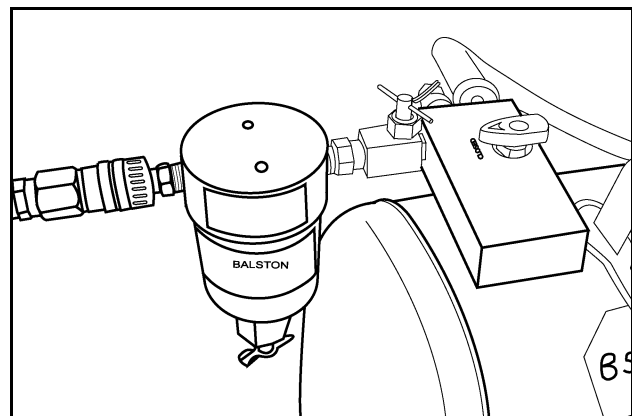
Connect the flushing tank hose quick coupler to an extension or an adapter hose.



RD00H203

### STEP 58

Connect CLEAN and DRY shop air supply to the quick coupler on the flushing valve.



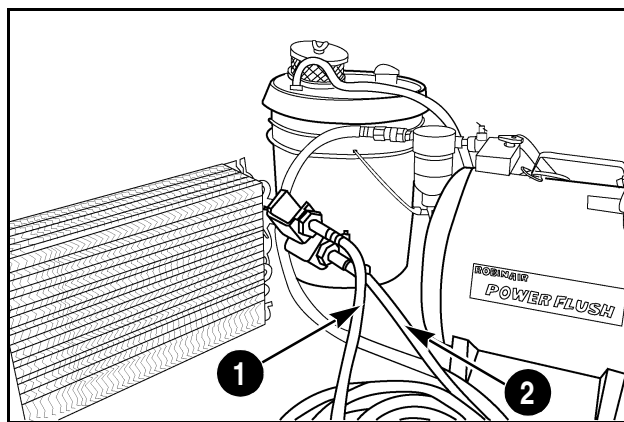
RD00H202

## STEP 59

Connect flushing and drain hoses to flushing adapters on component being flushed so the flushing solvent moves in the opposite direction of refrigerant flow - back flushing. Reinforced clear hose is preferred to monitor the condition and removal of the used solvent.

**IMPORTANT:** Secure the lid on the return bucket so all flush vapors pass through the bucket filter.

**NOTE:** Back flushing is done first to dislodge any contaminants, and then forward flushing is performed to remove the contaminants.



RD00H204

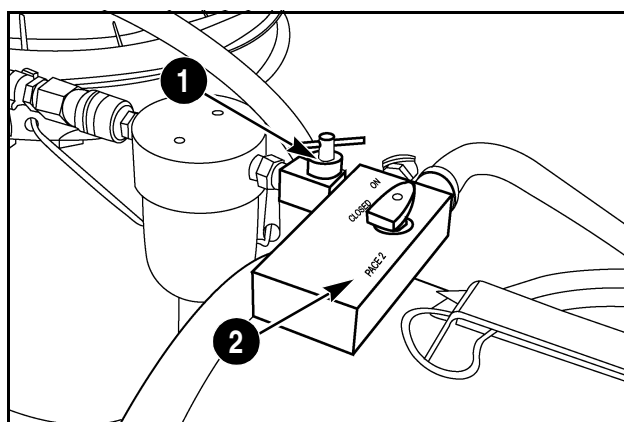
1. FROM THE FLUSH PUMP      2. TO THE RETURN BUCKET

## STEP 60

Open the air valve 1/2 to 3/4 turn.

**IMPORTANT:** Do not exceed this rate of air delivery. This rate delivers one gallon per minute of flush solvent which is ideal for the orifice openings on the components being flushed.

Turn the flushing valve to the FLUSH position and flush the component for 30 seconds.

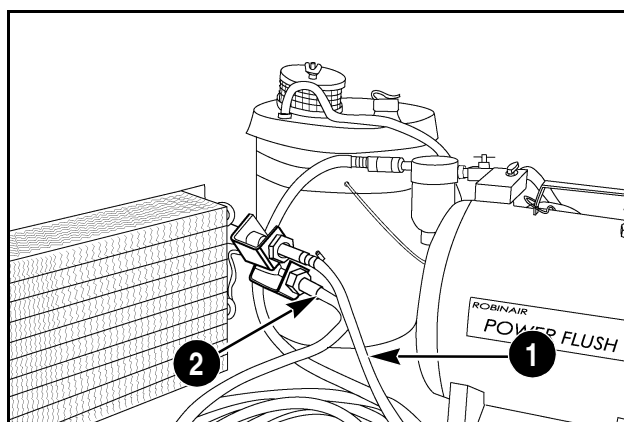


RD00H205

1. AIR VALVE      2. FLUSH VALVE

## STEP 61

Close the flushing and air valves. Reverse hose connections for forward flushing. Open flushing and air valves and repeat flushing until the solvent is clear.



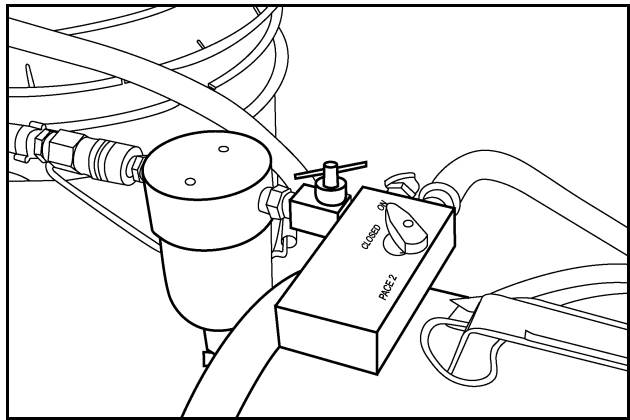
RD00H206

1. FROM THE FLUSH PUMP      2. TO THE RETURN BUCKET

## STEP 62

Turn the flushing valve to the AIR position. Allow air to flow through the component until no noticeable mist is discharged.

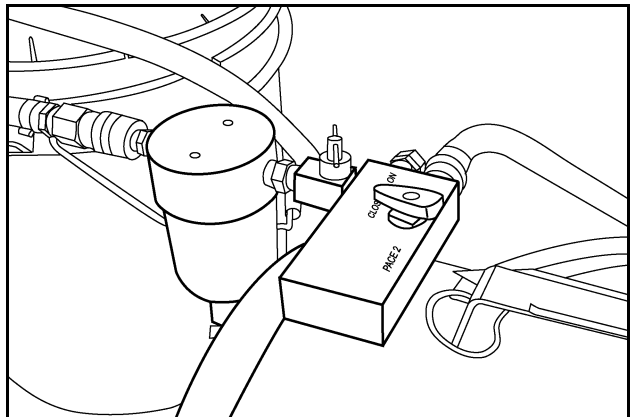
**NOTE:** Air pressure is the only means to remove the flushing solvent from the A/C system, and no solvent must remain in the system when it is evacuated and recharged. Turn the component so gravity can assist in solvent removal.



RD00H207

## STEP 63

Turn the flushing valve to the CLOSED position. Disconnect the flushing and drain hoses and adapters from the component.

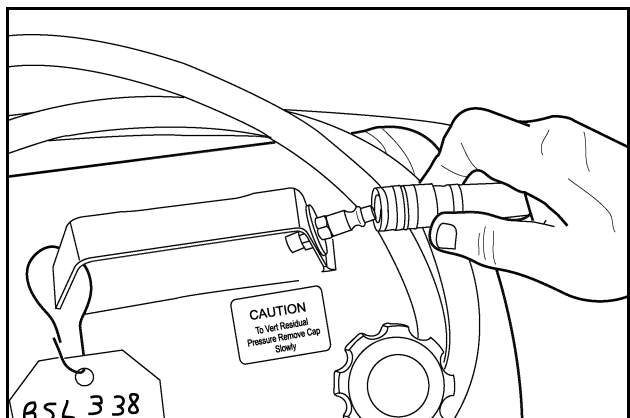


RD00H208

## STEP 64

Install the flushing tank hose quick coupler on the evaporation plug to prevent evaporation of the solvent remaining in the tank during storage.

See **Post Flushing Procedures**, page 48.



RP00G018

## Complete Circuit Flushing Procedure with Power Flush 17550

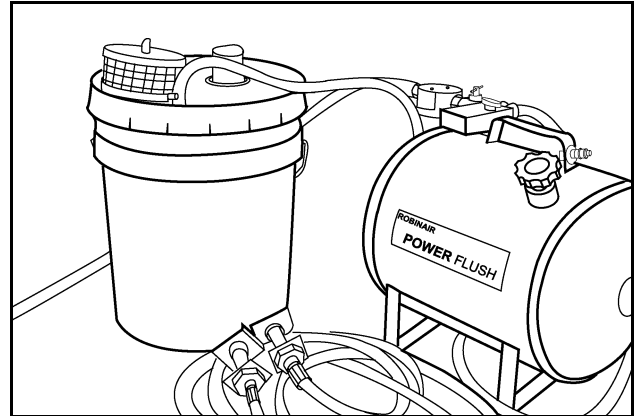
### STEP 65

All refrigerant must be recovered from the system before flushing.

### STEP 66

The 17550 power flush unit uses shop air to atomize the flushing solvent and a pulsing action to scrub residue and contaminants out of components.

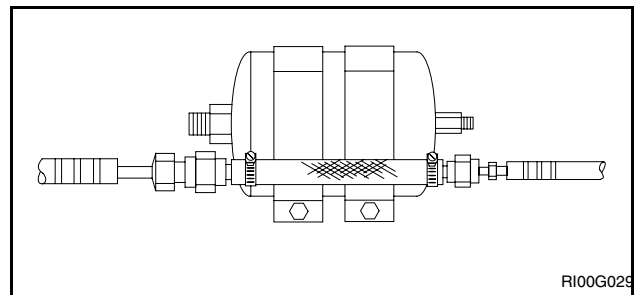
Fill the flushing reservoir 3/4 full with approved New Holland flushing solvent. **Do not overfill the reservoir or you will restrict the pulsing action of the unit.**



RD00H209

### STEP 67

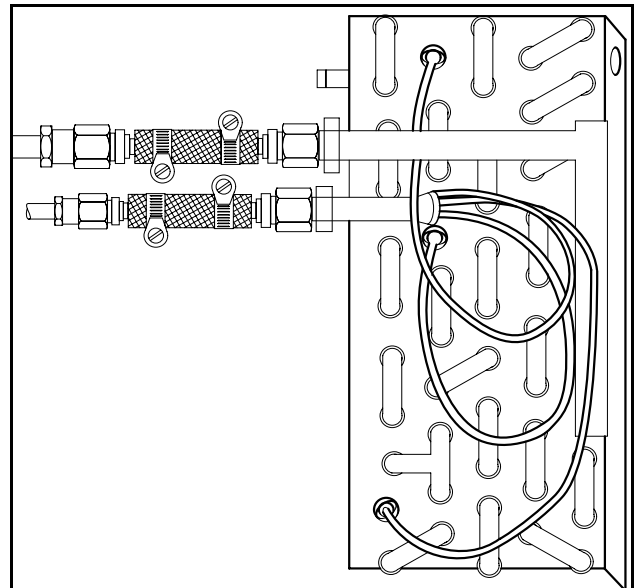
Remove the receiver-drier and join the hoses together with an adapter hose. Discard the receiver-drier.



RI00G029

### STEP 68

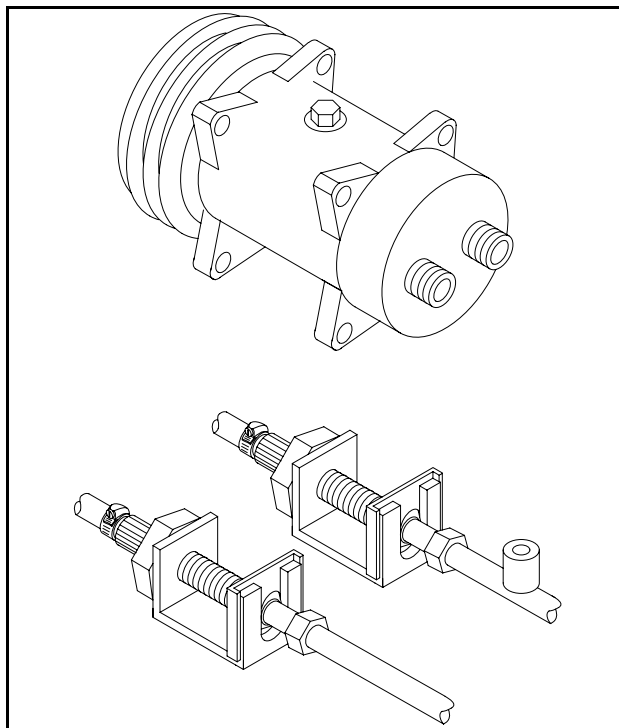
Remove the thermal expansion valve and use adapters to connect the hose lines to the evaporator.



RI00G018

## STEP 69

Disconnect the suction and discharge lines from the compressor. Attach flushing adapters to the lines.

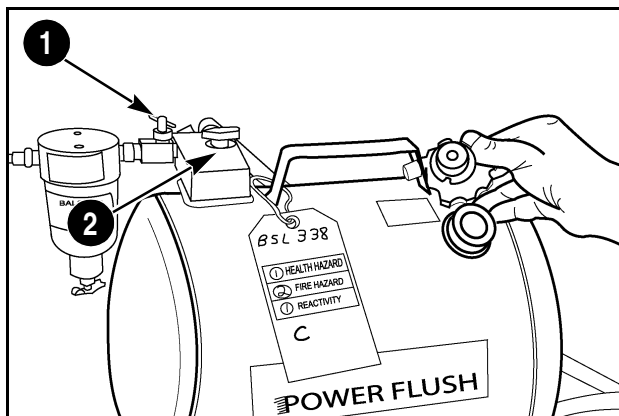


RH01F112

Universal A/C Flush Fittings Shown

## STEP 70

Close the air and the flushing valves.



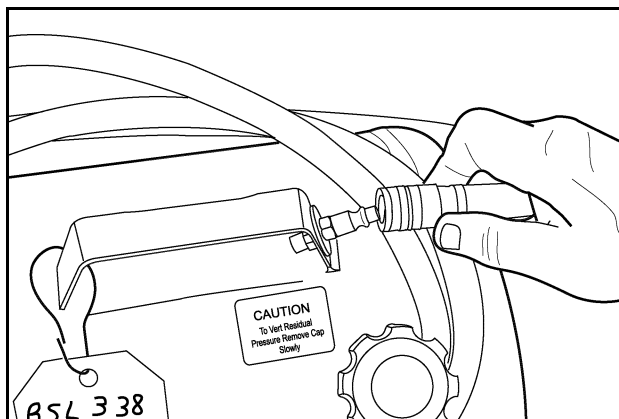
RD00H200

1. AIR VALVE

2. FLUSH VALVE

## STEP 71

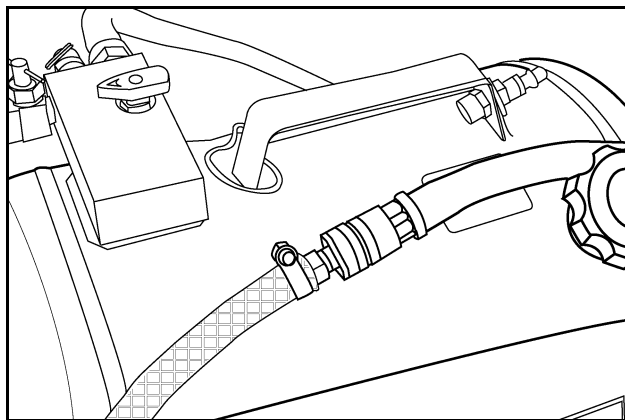
Remove the flushing tank hose quick coupler from the evaporation plug.



RP00G018

## STEP 72

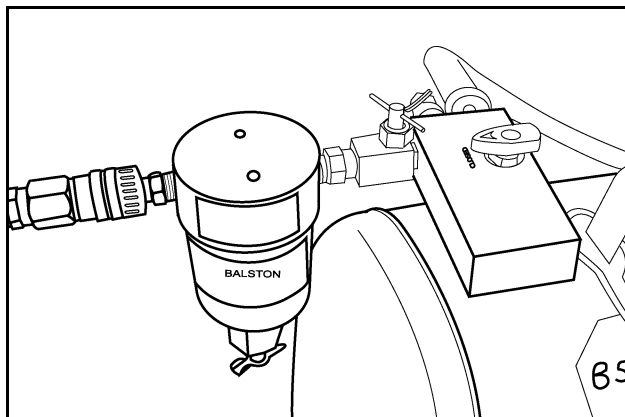
Connect the flushing tank hose quick coupler to an extension or adapter hose.



RD00H203

## STEP 73

Connect CLEAN and DRY shop air supply to the quick coupler on the flushing valve.



RD00H202

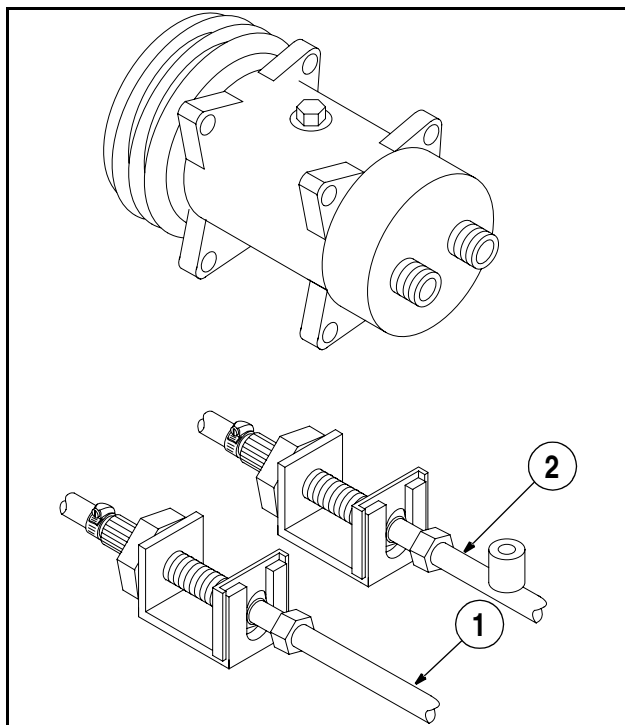
## STEP 74

Connect flushing and drain hoses to adapters on compressor lines so flushing solvent moves in the opposite direction of refrigerant flow - back flushing. Connect the hose from the flush tank to the suction line; connect the hose to the return bucket to the discharge line. Reinforced clear hose is preferred to monitor the condition and removal of the used solvent.

**NOTE:** Back flushing is done first to dislodge any contaminants, and then forward flushing is performed to remove the contaminants.

**NOTE:** The suction and discharge ports on the compressor are marked with the letters S and D, respectively.

**IMPORTANT:** Secure the lid on the return bucket so all flush vapors pass through the bucket filter.



RH01F112

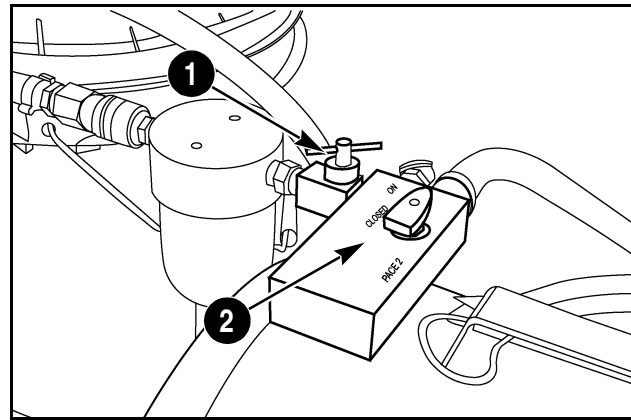
1. FROM THE FLUSH TANK 2. TO RETURN BUCKET

## STEP 75

Open the air valve 1/2 to 3/4 turn.

**IMPORTANT:** Do not exceed this rate of air delivery. This rate delivers one gallon per minute of flush solvent which is ideal for the orifice openings in the circuit being flushed.

Turn the flushing valve to the FLUSH position and flush the circuit until the solvent appears clear at the return hose to the solvent waste container.



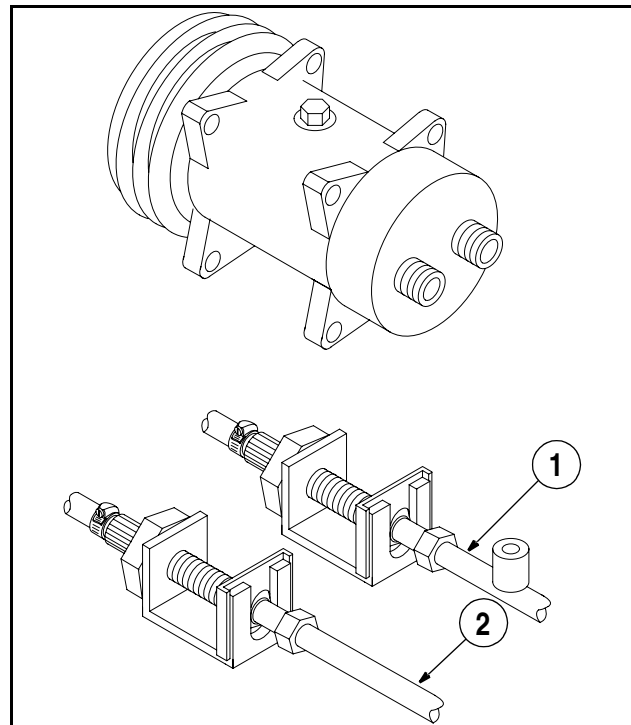
RD00H205

1. AIR VALVE

2. FLUSH VALVE

## STEP 76

Close the flushing and air valves. Reverse hose connections for forward flushing. Connect the hose from the flush tank to the discharge line; connect the hose to the return bucket to the suction line. Open flushing and air valves and repeat flushing until the solvent is clear.



RH01F112

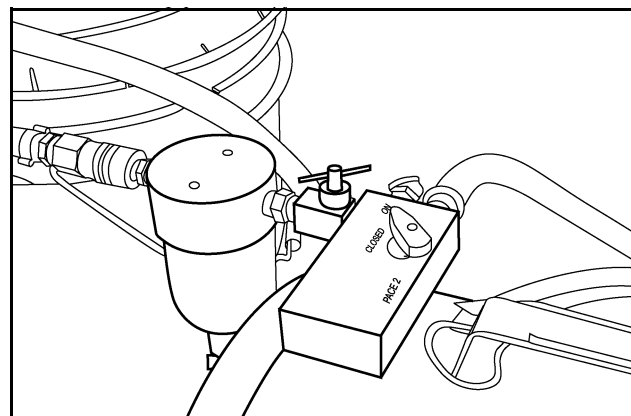
1. FROM THE FLUSH TANK

2. TO RETURN BUCKET

## STEP 77

Turn the flushing valve to the AIR position. Allow air to flow through the circuit until no noticeable mist is discharged.

**NOTE:** Air pressure is the only means to remove the flushing solvent from the A/C system, and no solvent must remain in the system when it is evacuated and recharged.



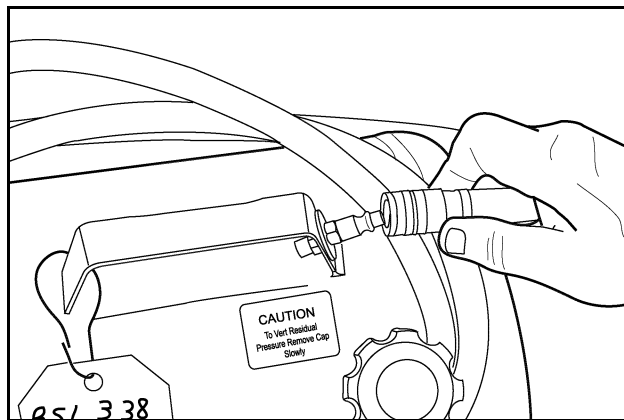
RD00H207

## STEP 78

Turn the flushing valve to the CLOSED position. Disconnect the flushing and drain hoses and adapters from the compressor lines.

Install the flushing tank hose quick coupler on the evaporation plug to prevent evaporation of the solvent remaining in the tank during storage.

See **Post Flushing Procedures**, page 48.



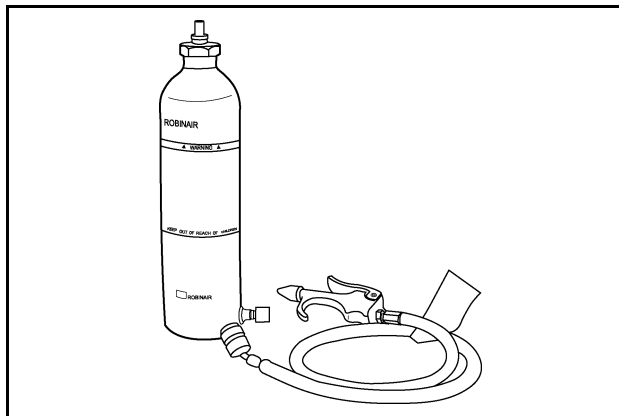
RP00G018



## Back Flushing the Thermal Expansion Valve or Refrigerant Line

### STEP 79

Flush gun 17585 can be used to back flush the thermal expansion valve or a refrigerant line. Solvent is added to the canister, and then the canister is pressurized with CLEAN and DRY shop air. Pulse the trigger on the flush gun for greater flushing effectiveness.



RP00G007

### STEP 80

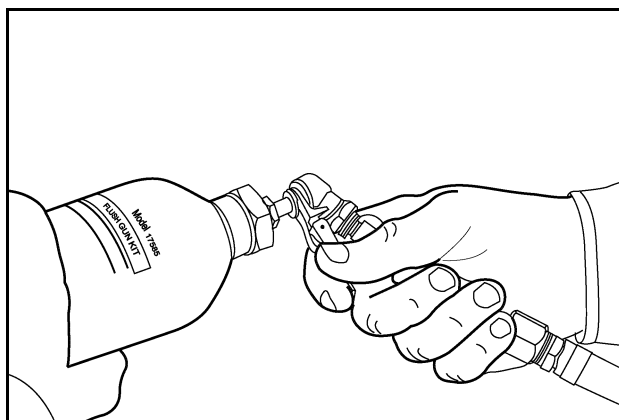
To fill the canister, remove the cap assembly. Add no more than 20 oz. (590 ml) of New Holland flushing solvent to the canister. Replace the cap assembly.



RP00G008

### STEP 81

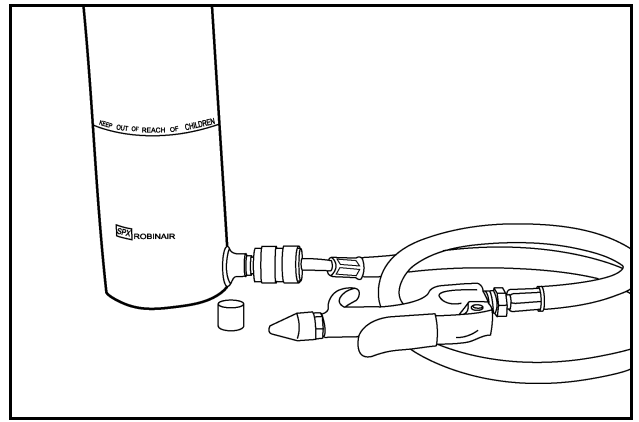
Pressurize the canister to a maximum of 90 psi (620 kPa) with CLEAN and DRY shop air.



RP00G009

## STEP 82

Connect the hose with flush gun to the canister.



RP00G010

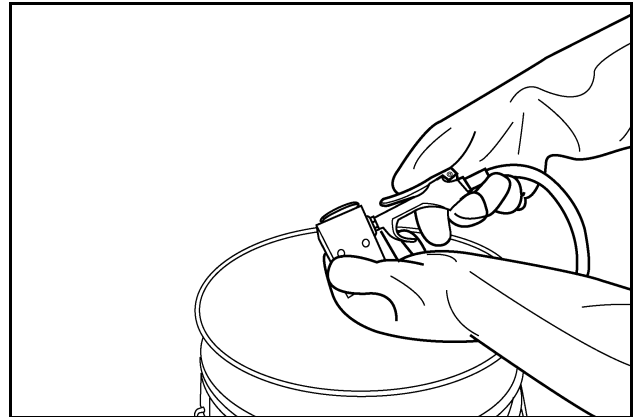
## STEP 83

**NOTE:** To prevent sprayback, press the rubber nose cone on the gun into the opening on the refrigerant line or thermal expansion valve when flushing.

When back flushing the thermal expansion valve, the suction and discharge ports must be flushed in different directions. Collect used solvent in a container for proper disposal.

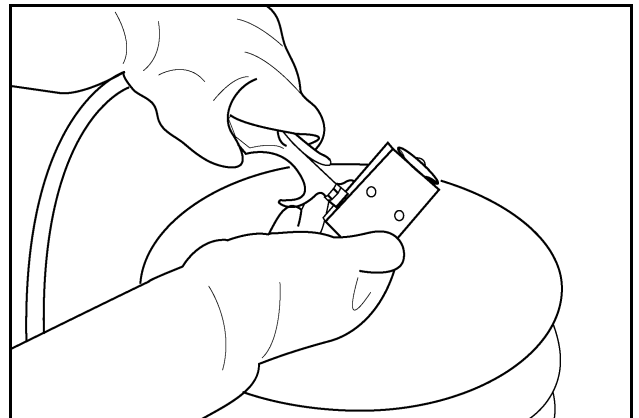
## STEP 84

Use CLEAN and DRY shop air to purge the solvent and dry the valve.



RP00G011

**Back flush the discharge port**



RP00G012

**Back flush the suction port**

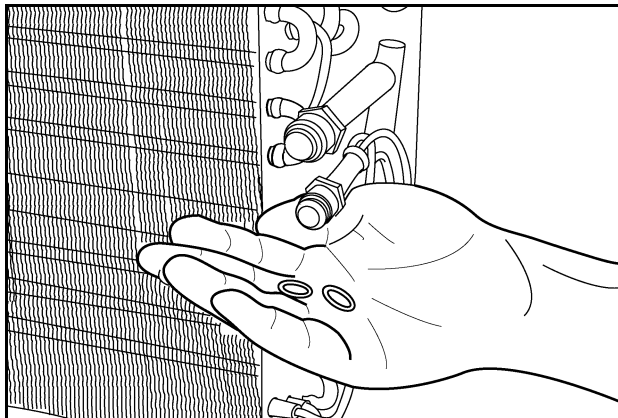
## Post Flushing Procedures

### STEP 85

Identify and remove the source of the contamination.

### STEP 86

Reconnect all fittings using new HNBR “green” HFC-134a compatible O-rings. Lubricate the O-rings with mineral oil prior to installation.

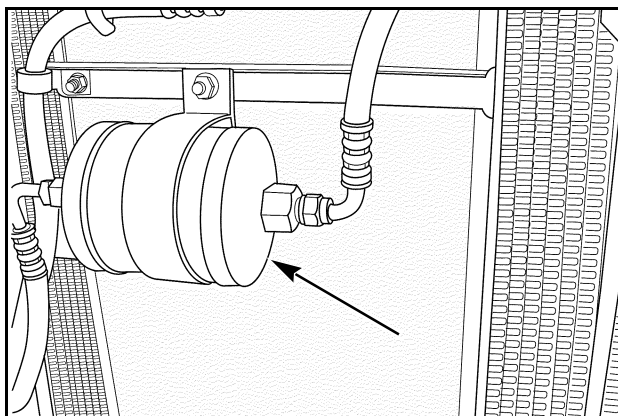


RP00G006

### STEP 87

Install a new receiver-drier.

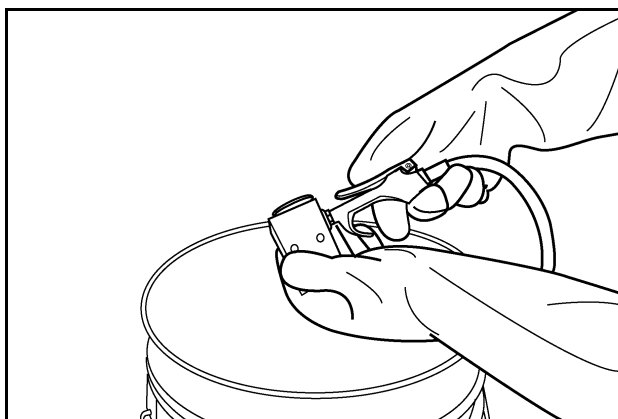
**NOTE:** *The receiver-drier should be replaced just before the system is drawn to a deep vacuum to avoid saturating it with moisture.*



RD05E030

### STEP 88

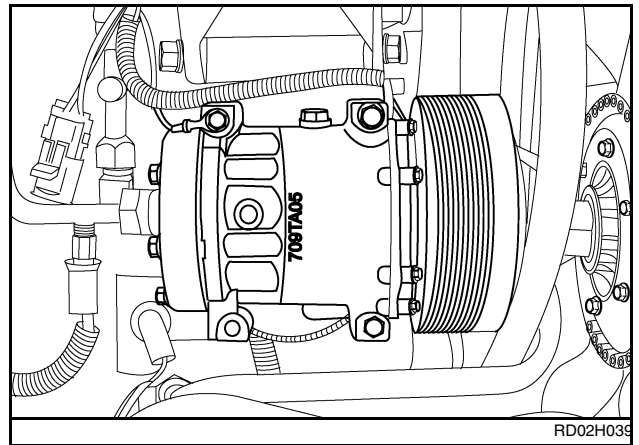
Clean or replace the thermal expansion valve.



RP00G011

## STEP 89

Install a new compressor if required.



## STEP 90

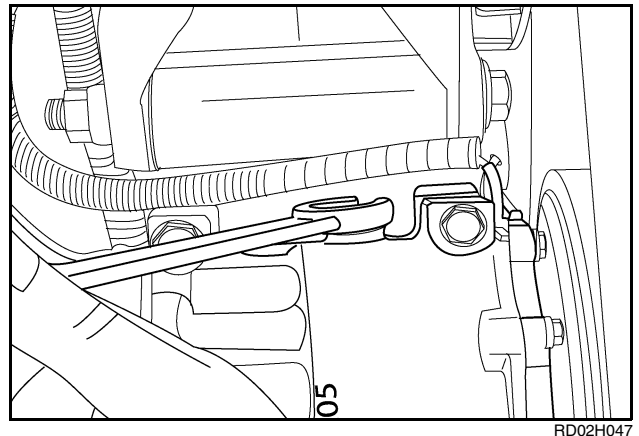
Adjust the level of SP-20 PAG oil in the system. When each component was flushed, some SP-20 PAG oil was removed from the system. Use the following guidelines when adjusting PAG oil:

If the compressor is to be replaced and the entire system was flushed, the new compressor will contain all the SP-20 PAG oil needed and no further adjustment is required.

If the compressor is not to be replaced and the entire system was flushed, drain the oil from the compressor to remove any remaining contaminants. Add back to the compressor one container, 8.5 oz (250 ml), of new SP-20 PAG oil. (Some oil, about 1.2 oz (35 ml), will remain in the compressor even after it has been drained.)

If the entire system was not flushed, drain the oil from the compressor to be installed. Add back new SP-20 PAG oil equal to 8.5 oz (250 ml) minus oil amounts still in the components that were not flushed. Use the table below.

**NOTE:** Total system PAG oil should be 9.6 oz (285 ml) and about 1.2 oz (35 ml) will remain in a drained compressor.



Component Flushed	Amount Of SP-20 PAG Oil To Add
Condenser	1.7 oz (50 ml)
Evaporator	1.4 oz (40 ml)
Receiver-Drier	0.85 oz (25 ml)
Each Hose	0.34 oz (10 ml)

Because the system has been open for a prolonged time, it is very important to draw the system to a deep vacuum to remove all moisture. Evacuate the system for at least 45 minutes to a vacuum of 29.5 inches (0.75 mm) of mercury.

### Final System Oil Check

After the system has been drawn to a deep vacuum and recharged,

1. Operate the A/C system for 15 minutes to thoroughly circulate the PAG oil throughout the system.
2. Install the gauge set and test the A/C system for proper operation referring to the pressure/temperature table on Page 33.

**IMPORTANT:** *If oil level was measured and adjusted properly according to the guidelines, Steps 3 and 4 are unnecessary.*

3. Recover refrigerant from the system. Use the dipstick method to check the PAG oil level in the compressor. If needed, adjust the oil level. See **Dipstick Method**, page 80. For all Tractor Models, the oil should cover five lines on the dipstick.

4. Evacuate and recharge the system.

### Flushing Solvent Disposal

Never reuse contaminated flushing solvent.

Good stewardship of our natural resources is everyone's business. New Holland flushing solvent is a hazardous material. Never dispose of this solvent by pouring it down the drain or treating it as water soluble waste. Observe all local, state and federal regulations when disposing the solvent.

In the United States, SAFETY-KLEEN will recycle used flushing solvent. For more information on SAFETY-KLEEN's recycling program, call 800-323-5040.

## LEAK DETECTION



**WARNING:** *Never leak test with an open flame or a flame-type detector.*

M816



**WARNING:** *When refrigerant comes in contact with an open flame, it can form dangerous gas. Never breathe these fumes.*

SM109A

Two methods are recommended to test the A/C system for refrigerant leaks: electronic leak testing with OEM1437 and UV-florescent leak detecting. Whatever method is used, the following components or areas should be checked, always looking for signs of leakage - oily residue, dust accumulation:

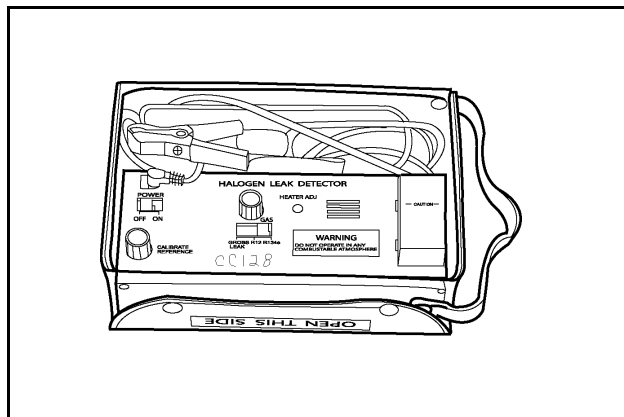
- A. Compressor: line connections, surfaces where parts are joined, compressor to clutch seal.

**NOTE:** *When checking compressor seal for a leak, remove the dust cover and rotate the compressor shaft clockwise.*

- B. Condenser: line connections, all welded joints, any visible damage.
- C. Receiver-drier: line connections.
- D. Thermal expansion valve: line connections.

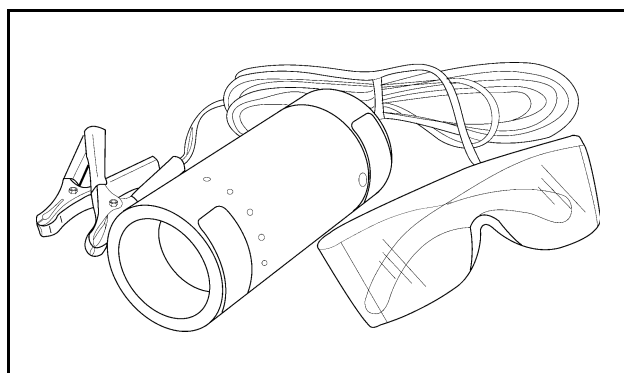
**NOTE:** *Remove the thermal insulation tape to check the expansion valve for leaks; replace the tape when completed.*

- E. Service ports: valve core under the caps.
- F. Low and high pressure switches: Check around the entire switch body where it is threaded into the line.
- G. Hoses: line connections where the hose end meets a metal connector, any area that shows damage or rubbing contact.



**OEM1437**

A22090



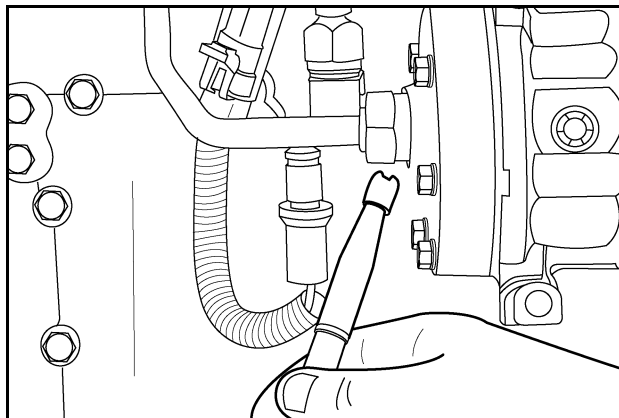
**UV Leak Detecting Lamp and Goggles**

RR00F098

## Electronic Testing with OEM1437

When performing electronic leak detection with OEM1437, follow these general guidelines:

1. There must be enough refrigerant in the system to produce normal pressures (at least 50 psi).
2. Leak test in an area free of wind and drafts.
3. Operate the tractor long enough to circulate the refrigerant and produce normal system pressures.
4. Shut the tractor and system off when leak testing.
5. Clean oily spots with dry shop cloths; solvents can leave a residue which may confuse OEM1437.
6. Hold the leak detector probe under the point being checked, since refrigerant is heavier than air.
7. The probe on the leak detector should never come into contact with the component being checked.
8. If OEM1437 indicates a leak, move the probe away, blow out the area with clean shop air and verify the leak with the detector.
9. If the leak cannot be found with OEM1437, use UV florescent leak testing to locate the problem.
10. Repair all leaks and recharge the system.



RD02H049

## Fluorescent Leak Detection

Fluorescent tracer or dye solutions are now commonly used to detect refrigerant leaks. Your MX tractor had an ultraviolet fluorescent tracer or dye introduced into the A/C system at the time of manufacture. This dye will glow a bright yellow/green at a leak location under ultraviolet light.

The dye has been tested for compatibility with HFC-134a systems and approved for use in all New Holland HFC-134a A/C systems. Special tools are also available to aid in injection and leak detection. See **SPECIAL TOOLS**, page 4 in this Section.

The dye, which dissolves into the SP-20 PAG oil in the system, is particularly helpful in detecting intermittent leaks that occur only when the system is running because of change of temperature, high system pressures, vibration or contact between components.



**WARNING:** *Wear safety goggles and non-permeable gloves when working with the fluorescent dye and leak testing.*

M817

This fluorescent dye will normally remain useful over the life of the system. However, due to a large refrigerant leak, system flush or major component failure, it may become necessary to reintroduce the dye into the refrigerant circuit.

## Fluorescent Dye Injection

Many methods are available to introduce the dye to a system for the first time or to reinject the dye into an A/C system. Select the method most appropriate to the needs of the A/C system and where you are in the service process:

1. Recovery Station Dye Injector Tool with a System in a Vacuum
2. Recovery Station Dye Injector Tool with a Charged System
3. Quick and Easy Dye Injector Tool with a Charged System
4. Compressor Oil Port
5. SP-20 PAG Oil Return Bottle



## Recovery Station Dye Injector Tool with a System in a Vacuum

The R134a dye injector tool is designed to be used with the OEM1415 recycling station.

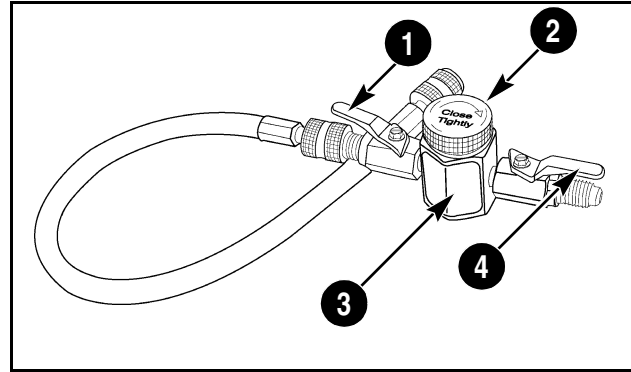
1. Disconnect the low pressure hose (blue) from the 1/2 inch Acme flare fitting on the rear of the station. Connect the dye injector to the fitting.
2. Connect the low pressure hose to the dye injector.

**NOTE:** *The dye injector can be permanently mounted on the recycling station with the two threaded holes on the bottom of the reservoir.*

3. Open the valves on either side of the reservoir on the dye injector.
4. Recover and recycle the refrigerant from the A/C system and evacuate the system.
5. With the system in a vacuum, close the valves on either side of the reservoir on the dye injector.
6. Remove the cap from the reservoir and fill the reservoir with the contents of one bottle of fluorescent dye. Reinstall the cap on the reservoir and tighten securely.
7. Open the valve on tractor side of the reservoir on the dye injector.
8. Recharge the A/C system with the proper amount of refrigerant. Start the recharging process and immediately open the valve on the station side of the dye injector to prevent drawing the dye into the charging station. The dye will be injected into the system while recharging.
9. Install the dye identification sticker on a clearly visible area on the compressor body close to the service ports. This will alert service personnel in the future to the presence of the dye in the system.
10. Operate the A/C system for about 15 minutes to circulate the dye throughout the system. Turn off the system and use the UV lamp and goggles to locate leaks. The exact location of the leak will be shown by a bright yellow/green glow of the dye.

**NOTE:** *The operating time needed for the dye to penetrate a leak and show will depend on the size of the leak. A very small leak could take hours or days of system operation to appear.*

11. After repairing the system, use fluorescent dye cleaner to remove any traces of dye from around the leak location to avoid false diagnosis in the future.



RR00F101

**Valves Shown in OPEN Position**

- |                                      |                            |
|--------------------------------------|----------------------------|
| 1. VALVE TOWARD<br>RECYCLING STATION | 3. VALVE TOWARD<br>TRACTOR |
| 2. RESERVOIR CAP                     | 4. RESERVOIR               |

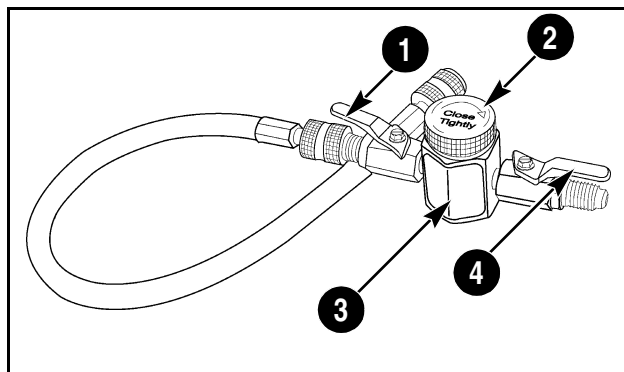
## Recovery Station Dye Injector Tool with a Charged System

The R134a dye injector tool is designed to be used with the OEM1415 recycling station.

1. Disconnect the low pressure hose (blue) from the 1/2 inch Acme flare fitting on the rear of the station.
2. Connect the dye injector to the fitting.
3. Connect the low pressure hose to the dye injector.

**NOTE:** *The dye injector can be permanently mounted on the recycling station with the two threaded holes on the bottom of the reservoir.*

4. Open the valves on either side of the reservoir on the dye injector.
5. Recover 0.5 lb. (0.23 kg.) of refrigerant from the system. This amount of refrigerant will act as a carrier to inject the dye.
6. Close the valve on the tractor side of the dye injector and continue to recover. This will draw the refrigerant out of the reservoir on the dye injector.
7. Close the valve on the station side of the dye injector and stop recovering.
8. Remove the cap from the reservoir and fill the reservoir with the contents of one bottle of fluorescent dye. Reinstall the cap on the reservoir and tighten securely.
9. Open the valve on tractor side of the reservoir on the dye injector.
10. Recharge the A/C system with the proper amount of refrigerant removed earlier - 0.5 lb. (0.23 kg.). Start the recharging process and immediately open the valve on the station side of the dye injector to prevent drawing the dye into the charging station. The dye will be injected into the system while recharging.
11. Install the dye identification sticker on a clearly visible area on the compressor body close to the service ports. This will alert service personnel in the future to the presence of the dye in the system.



**Valves Shown in OPEN Position**

RR00F101

- |                                      |                            |
|--------------------------------------|----------------------------|
| 1. VALVE TOWARD<br>RECYCLING STATION | 3. VALVE TOWARD<br>TRACTOR |
| 2. RESERVOIR CAP                     | 4. RESERVOIR               |

12. Operate the A/C system for about 15 minutes to circulate the dye throughout the system. Turn off the system and use the UV lamp and goggles to locate leaks. The exact location of the leak will be shown by a bright yellow/green glow of the dye.

**NOTE:** *The operating time needed for the dye to penetrate a leak and show will depend on the size of the leak. A very small leak could take hours or days of system operation to appear.*

13. After repairing the system, use fluorescent dye cleaner to remove any traces of dye from around the leak location to avoid false diagnosis in the future.

## Quick and Easy Dye Injector Tool with a Charged System

The quick and easy R134a dye injector tool is designed to insert the dye in a charged system. The dye injector tool has a quick coupler, for connecting to the low pressure port of the tractor A/C system, and a valve with T-handle on the other end.

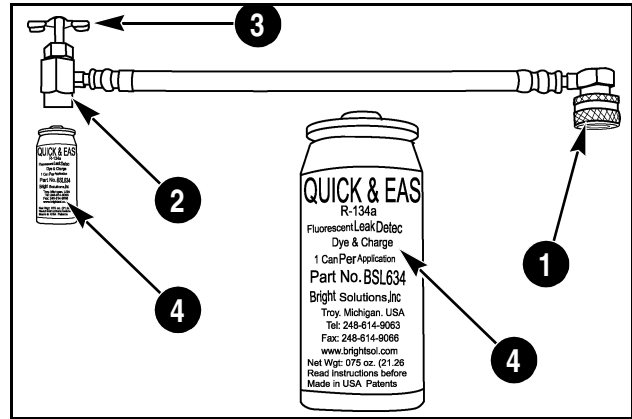
1. Examine the threaded end of the valve to see if the point of the valve stem is flush with the rubber washer. If not, turn the T-handle until the point is flush.
2. Screw the Quick and Easy can and the valve together until the can seats on the rubber washer.

**NOTE:** Do not turn the T-handle at this time to tap the can.

3. Connect the quick coupler to the low pressure service port under the instructional seat in the cab.
4. To purge air from the hose, slowly unscrew the untapped can a half turn or more. Allow refrigerant from the A/C system to force the air out of the hose, and then retighten the can on the valve.
5. Turn the T-handle clockwise to tap the can.
6. Hold the can upside down to allow the can contents to enter the A/C system. When complete, turn the T-handle counterclockwise to close the valve. Disconnect the tool from the low pressure port.

**NOTE:** You may have to operate the tractor and the A/C system for a few minutes to completely empty the can.

7. Install the dye identification sticker on a clearly visible area on the compressor body close to the service port. This will alert service personnel in the future to the presence of the dye in the system.
8. Operate the A/C system for about 15 minutes to circulate the dye throughout the system. Turn off the system and use the UV lamp and goggles to locate leaks. The exact location of the leak will be shown by a bright yellow/green glow of the dye.



1. QUICK COUPLER
2. VALVE

3. T-HANDLE
4. SUPPLY CAN

**NOTE:** The operating time needed for the dye to penetrate a leak and show will depend on the size of the leak. A very small leak could take hours or days of system operation to appear.

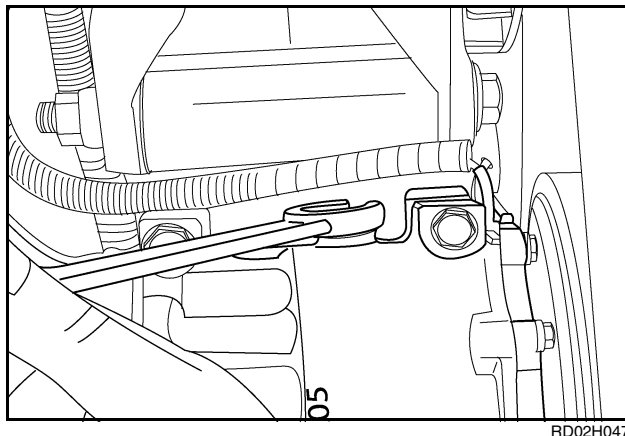
9. After repairing the system, use fluorescent dye cleaner to remove any traces of dye from around the leak location to avoid false diagnosis in the future.

## Compressor Oil Port

1. Recover the refrigerant from the A/C system.
2. Remove the oil filler plug and pour the contents of one bottle of fluorescent dye into the compressor.
3. Check the O-ring on the oil filler plug and replace if necessary. Reinstall the oil plug on the compressor and torque to 11 to 18 lb ft (15 to 24 Nm).
4. Evacuate and recharge the A/C system with the proper amount of refrigerant.
5. Install the dye identification sticker on a clearly visible area on the compressor body close to the service ports. This will alert service personnel in the future to the presence of the dye in the system.
6. Operate the A/C system for about 15 minutes to circulate the dye throughout the system. Turn off the system and use the UV lamp and goggles to locate leaks. The exact location of the leak will be shown by a bright yellow/green glow of the dye.

**NOTE:** *The operating time needed for the dye to penetrate a leak and show will depend on the size of the leak. A very small leak could take hours or days of system operation to appear.*

7. After repairing the system, use fluorescent dye cleaner to remove any traces of dye from around the leak location to avoid false diagnosis in the future.



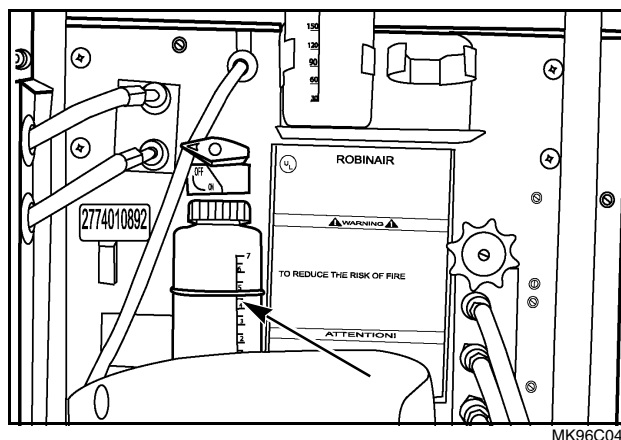
## SP-20 PAG Oil Return Bottle

**NOTE:** This is the least preferred method for injecting the dye since it requires very careful measurement of the PAG oil in the bottle and risks the introduction of air into the system if the dip tube in the bottle is exposed.

1. Recover the refrigerant from the A/C system.
2. Carefully measure the amount of SP-20 PAG oil in the reservoir which was separated from the refrigerant.
3. Pour the new replacement oil into the oil return bottle plus some additional oil to prevent uncovering the dip tube.
4. Pour the contents of one bottle of fluorescent dye into the oil return bottle and seal the bottle.
5. Evacuate the system and inject the oil and dye mixture into the system, making sure the oil level in the oil return bottle does not drop below the dip tube.
6. Recharge the A/C system with the proper amount of refrigerant.
7. Install the dye identification sticker on a clearly visible area on the compressor body close to the service ports. This will alert service personnel in the future to the presence of the dye in the system.
8. Operate the A/C system for about 15 minutes to circulate the dye throughout the system. Turn off the system and use the UV lamp and goggles to locate leaks. The exact location of the leak will be shown by a bright yellow/green glow of the dye.

**NOTE:** The operating time needed for the dye to penetrate a leak and show will depend on the size of the leak. A very small leak could take hours or days of system operation to appear.

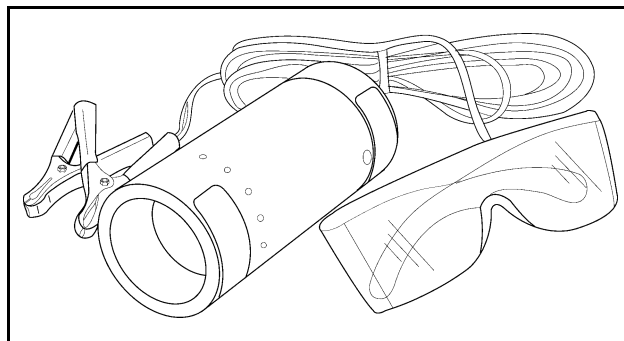
9. After repairing the system, use fluorescent dye cleaner to remove any traces of dye from around the leak location to avoid false diagnosis in the future.



## Fluorescent Leak Testing

To perform UV fluorescent leak testing:

1. Operate the tractor long enough to circulate the refrigerant and produce normal system pressures.
2. Shut the tractor and system off when leak testing.
3. Always wear fluorescent enhanced safety glasses when leak testing.
4. Attach the lamp to a fully charged 12V battery or an alternate 12V power supply for best lamp performance.
5. Shine the high intensity ultraviolet light at the various A/C components, hoses and lines to search for a glowing fluorescent trail or puddle which identifies the leak location.
6. The ultraviolet lamp is intended for intermittent use only. The lamp has a momentary contact push button switch to briefly light suspected leak locations.
7. Do not work with the lamp ON for more than 5 minutes. If the lamp heats up uncomfortably, cease operation.
8. Do not expose eyes or skin to ultraviolet light. Do not stare into an ultraviolet light beam or operate the lamp without the ultraviolet lens filter in place.
9. In direct sun sunlight or very bright ambient light, use a cover of any type over the suspected area to reduce this light.
10. If the lamp cannot be directed straight at a suspected leak location, use a mechanics mirror to reflect the light at the location. Or wipe the suspected leak site with a clean shop cloth, and shine the lamp at the cloth to check for traces of fluorescent dye.
11. The exact location of a small leak at a connection point or sealing point can be further narrowed by daubing a wet film of soap solution over the suspected area. Watch for bubbles to confirm the exact point of leakage.
12. Repair all leaks and recharge the system.
13. Use fluorescent dye cleaner to remove any traces of dye from around the leak location to avoid false diagnosis in the future.

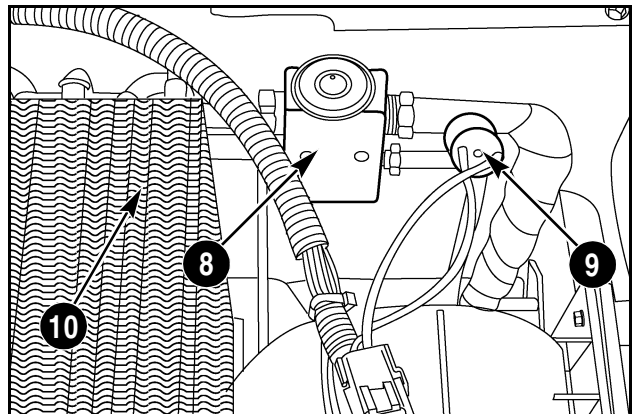
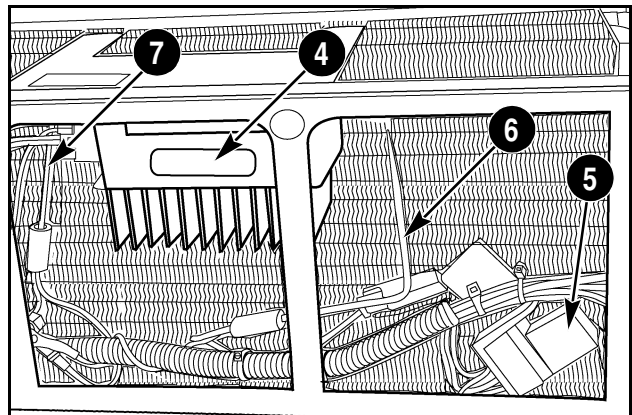
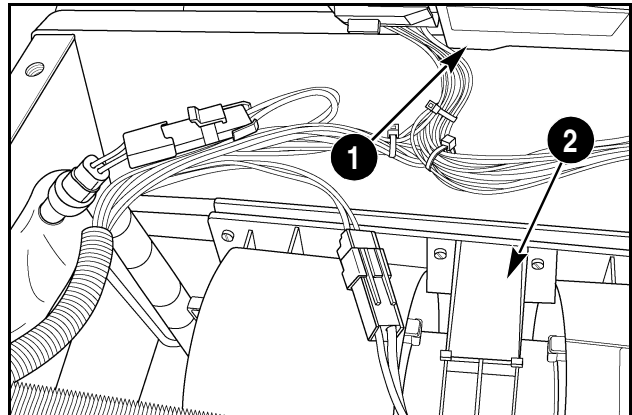


RR00F098

## A/C SYSTEM COMPONENTS

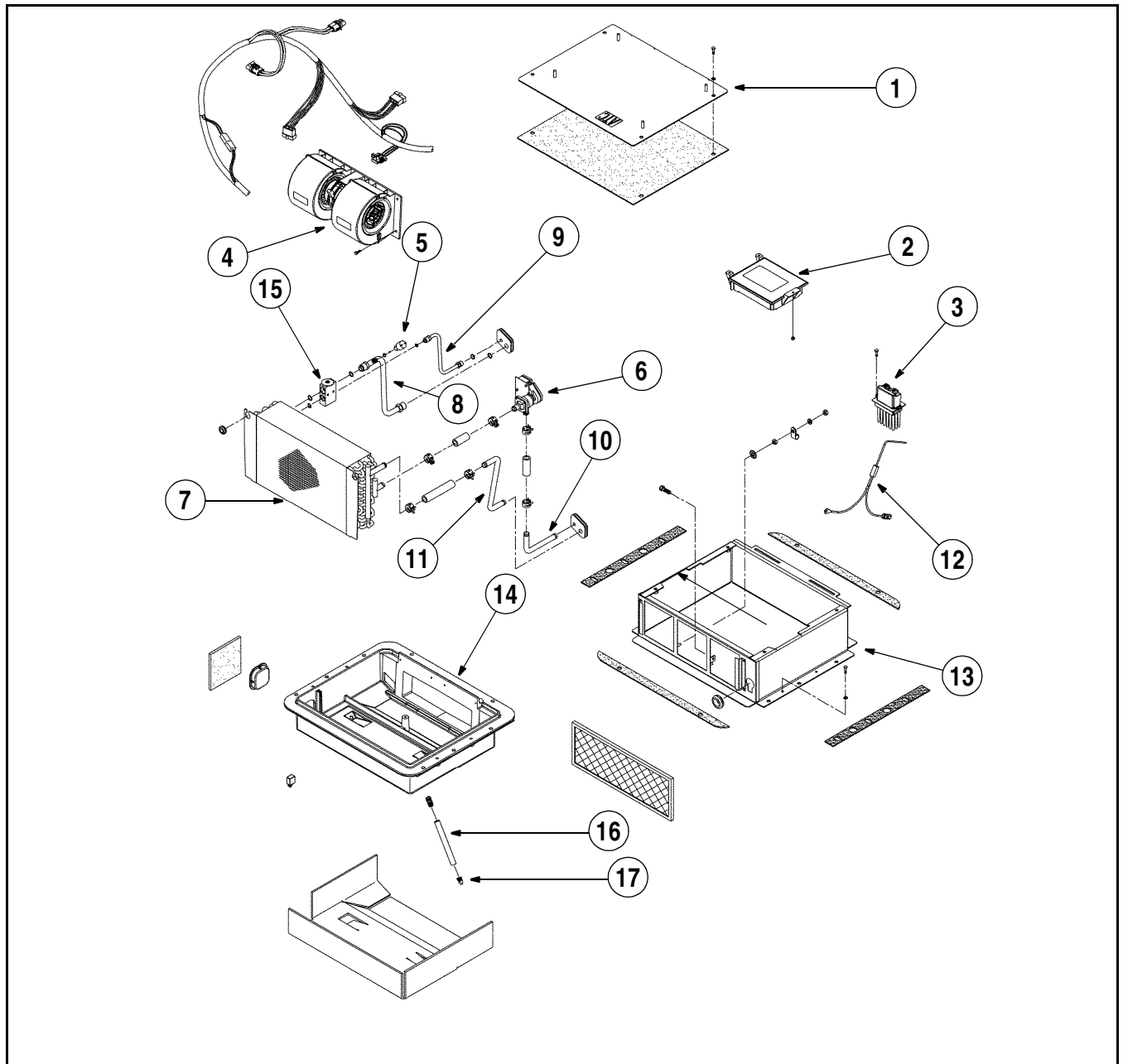
### Cab HVAC Box Components - Automatic Temperature Control

1. ATC CONTROLLER
2. BLOWER MOTOR/FAN ASSEMBLY
3. HEATER CONTROL VALVE (NOT SHOWN)
4. BLOWER SPEED DRIVER
5. COMPRESSOR CLUTCH RELAY
6. CAB TEMPERATURE SENSOR
7. EVAPORATOR TEMPERATURE SENSOR
8. THERMAL EXPANSION VALVE
9. LOW PRESSURE SWITCH
10. EVAPORATOR/HEATER ASSEMBLY



Thermal Tape Removed for Clarity

## Cab HVAC Box Components - Automatic Temperature Control



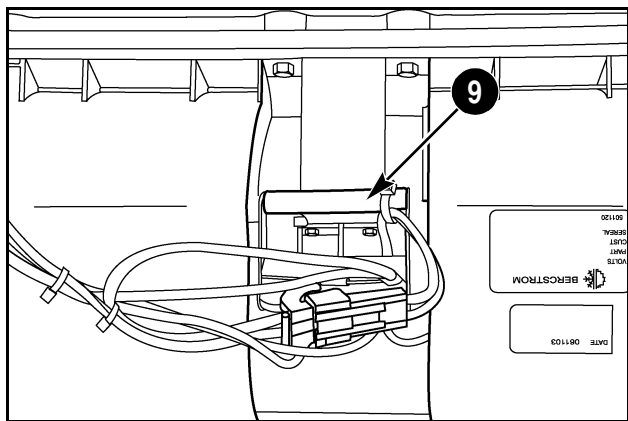
RH05H006

- |                               |                                |                             |
|-------------------------------|--------------------------------|-----------------------------|
| 11. LID ASSEMBLY              | 17. HEATER/EVAPORATOR ASSEMBLY | 23. BASE WELDMENT           |
| 12. ATC CONTROLLER            | 18. A/C SUCTION LINE TUBE      | 24. EVAPORATOR BOX ASSEMBLY |
| 13. BLOWER SPEED DRIVER       | 19. A/C LIQUID LINE TUBE       | 25. THERMAL EXPANSION VALVE |
| 14. BLOWER ASSEMBLY           | 20. HEATER SUPPLY HOSE         | 26. DRAIN HOSE              |
| 15. A/C LOW PRESSURE SWITCH   | 21. HEATER RETURN HOSE         | 27. CHECK VALVE             |
| 16. HEATER CONTROL VALVE ASSY | 22. EVAPORATOR TEMP. SENSOR    |                             |

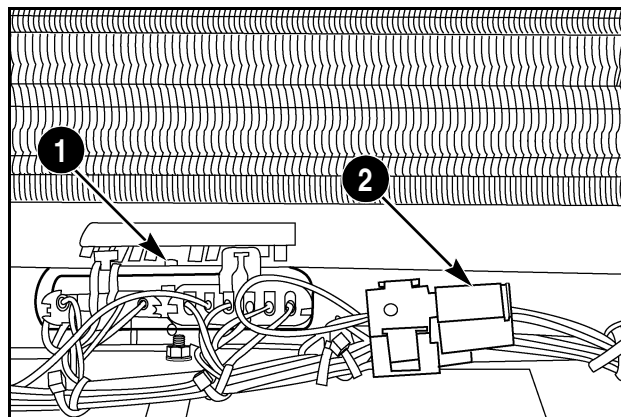


## Cab HVAC Components - Standard Systems

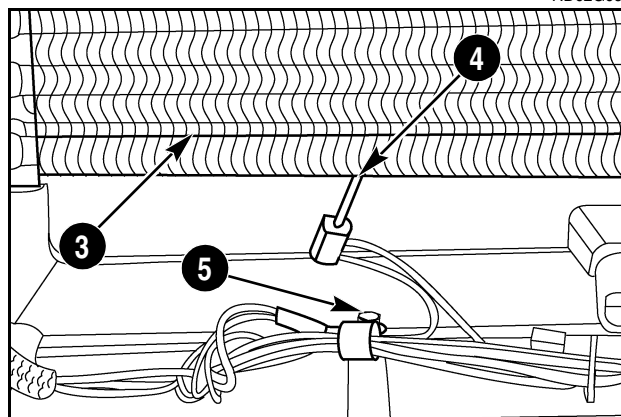
1. STANDARD CONTROLLER
2. COMPRESSOR CLUTCH RELAY
3. EVAPORATOR/HEATER ASSEMBLY
4. EVAPORATOR TEMPERATURE SENSOR
5. HVAC BOX GROUND
6. HEATER CONTROL VALVE
7. THERMAL EXPANSION VALVE
8. LOW PRESSURE SWITCH
9. BLOWER MOTOR ASSY WITH RESISTORS



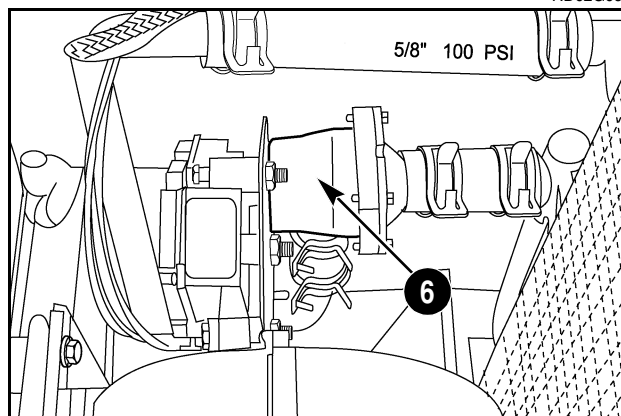
RD02G090



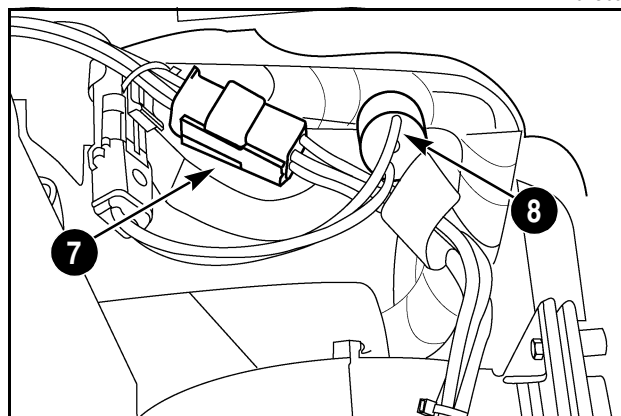
RD02G092



RD02G093

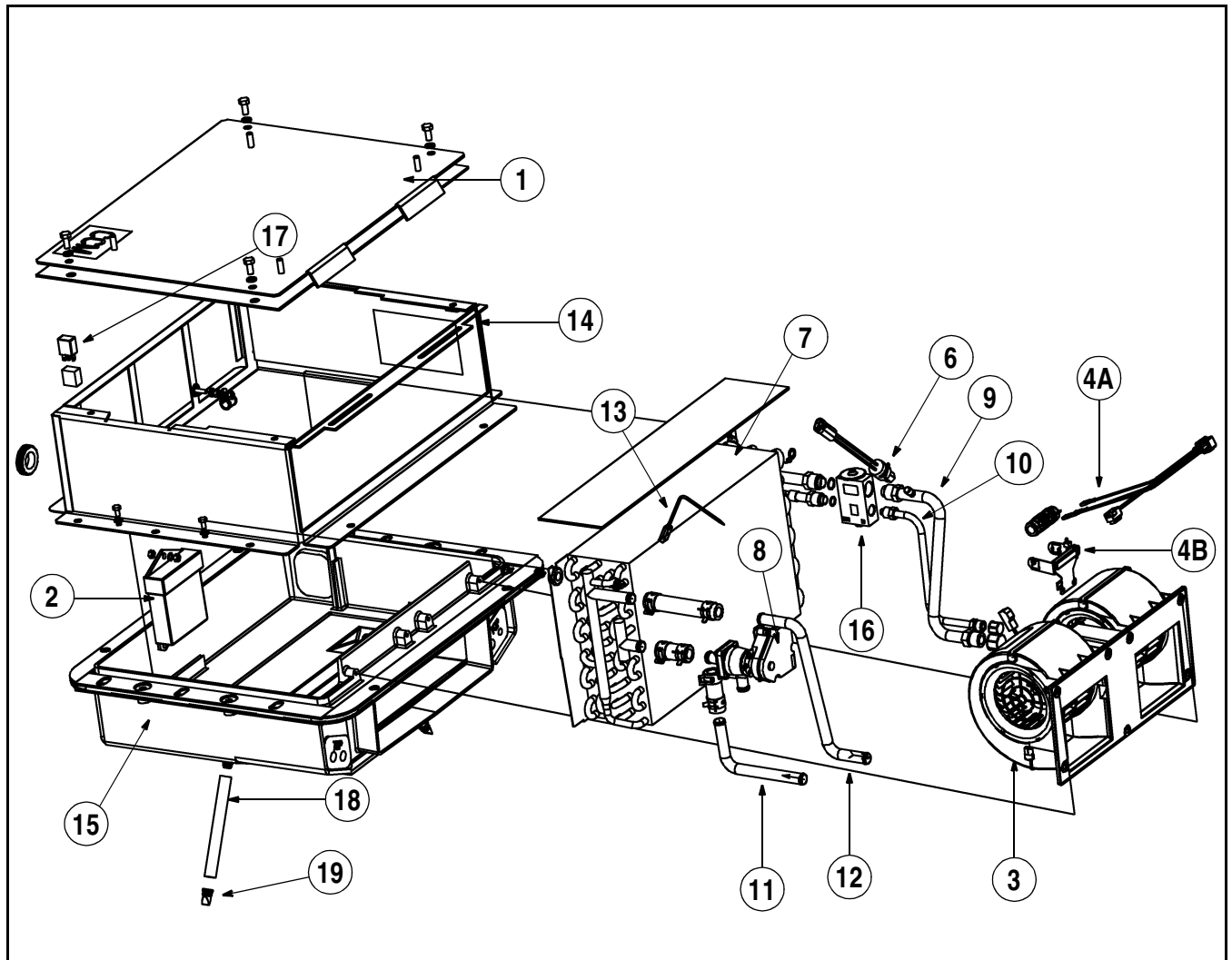


RD02G095



RD02G096

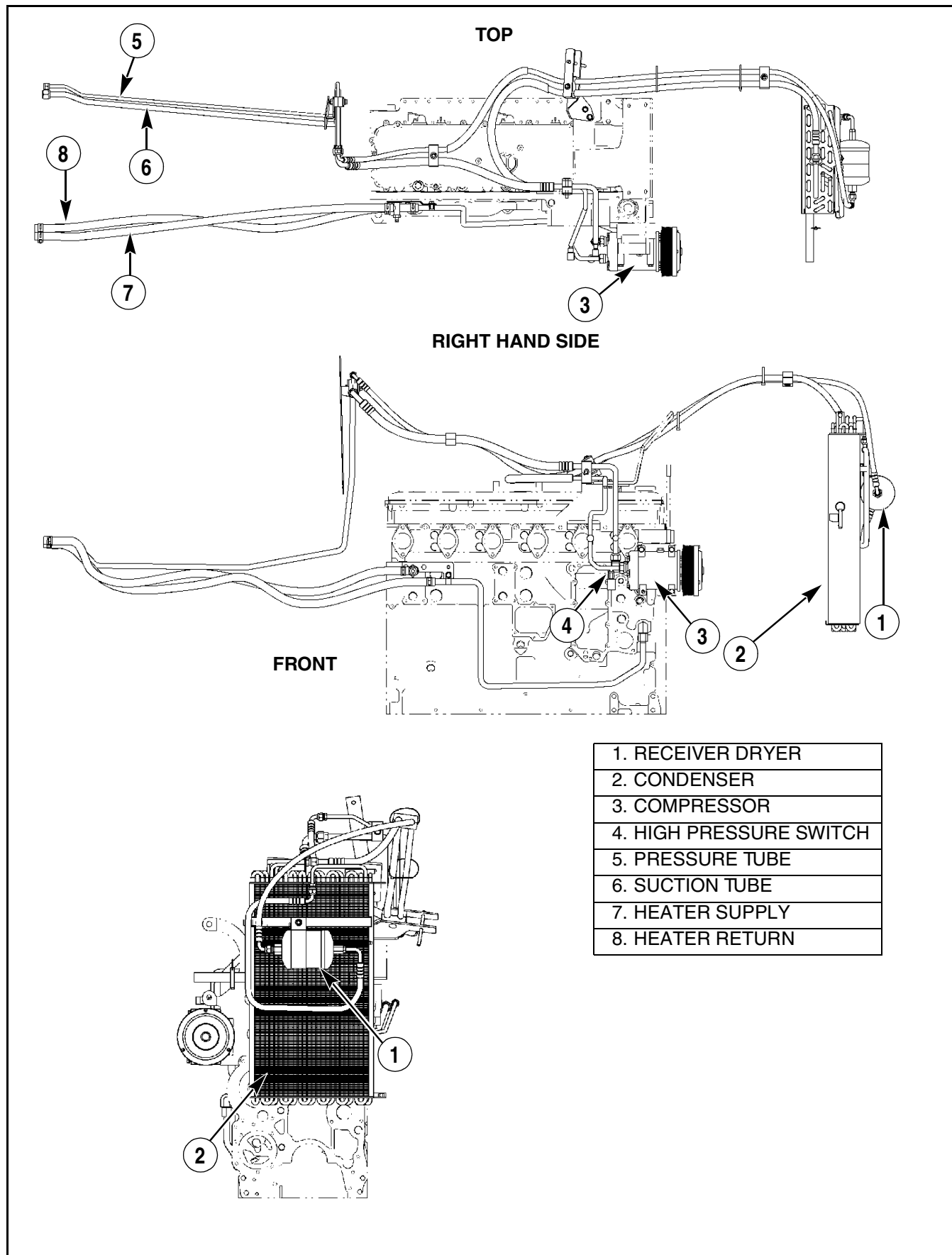
## Cab HVAC Components - Standard Systems



RI99M043

- |                             |                                |                             |
|-----------------------------|--------------------------------|-----------------------------|
| 1. LID ASSEMBLY             | 6. LOW PRESSURE SWITCH         | 13. EVAPORATOR TEMP SENSOR  |
| 2. STANDARD A/C CONTROLLER  | 7. HEATER/EVAPORATOR COIL ASSY | 14. BASE WELDMENT           |
| 3. BLOWER ASSEMBLY          | 8. HEATER CONTROL VALVE ASSY   | 15. EVAPORATOR BOX ASSEMBLY |
| 4. RESISTOR ASSEMBLY        | 9. A/C SUCTION LINE TUBE       | 16. THERMAL EXPANSION VALVE |
| A. RESISTOR                 | 10. A/C LIQUID LINE TUBE       | 17. CLUTCH RELAY            |
| B. MOUNTING BRACKET         | 11. HEATER SUPPLY HOSE         | 18. DRAIN HOSE              |
| 5. WIRE HARNESS (NOT SHOWN) | 12. HEATER RETURN HOSE         | 19. CHECK VALVE             |

## Chassis Components



RI06A027, RI06A028, RI06A029

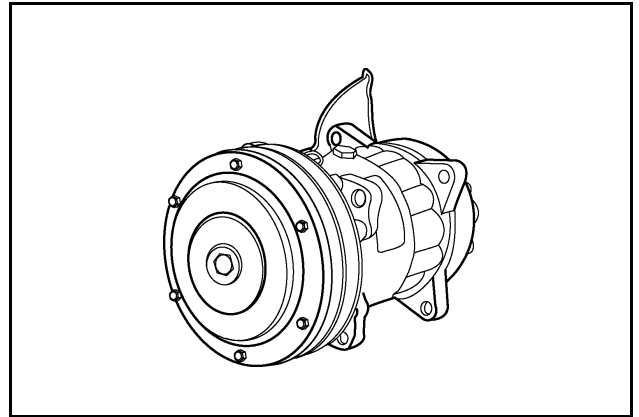
## A/C COMPRESSOR CLUTCH

### Clutch Removal

**NOTE:** This procedure shows a compressor with six screws holding the dust cover on the clutch. Your unit has three Torx® screws for attaching the dust cover and only differs in this manner.

#### STEP 91

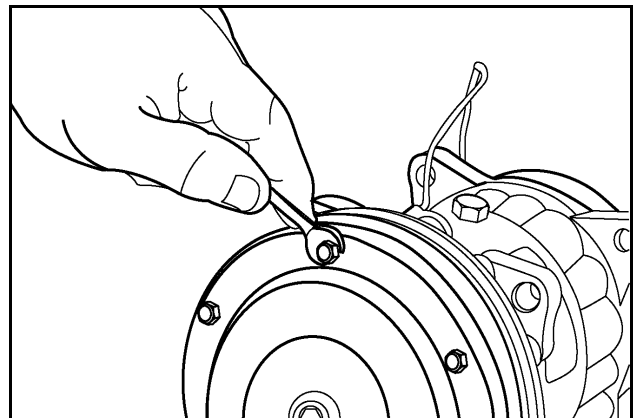
See this section for compressor removal. Clean the external surfaces of the compressor before doing any work on the compressor.



A21250

#### STEP 92

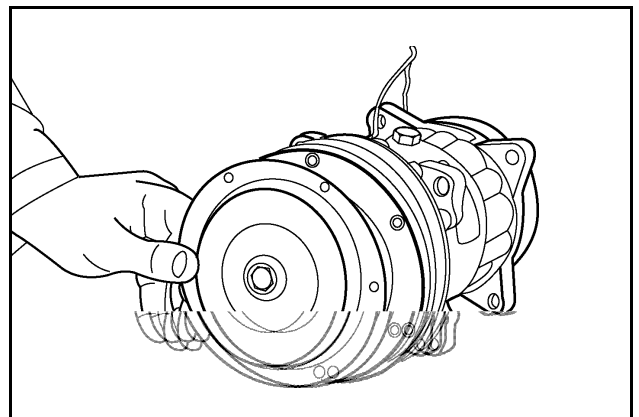
Remove the three Torx® screws for the clutch dust cover.



A21251

#### STEP 93

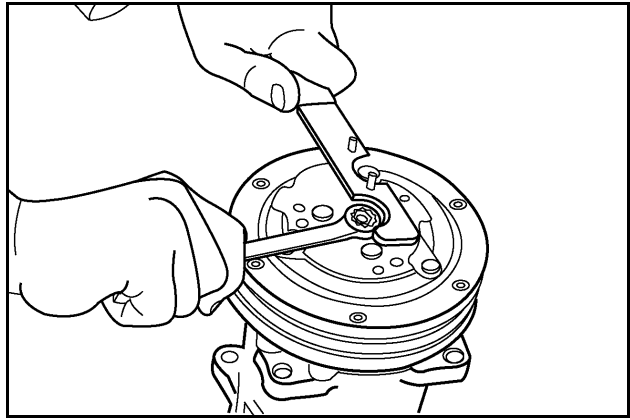
Remove the clutch dust cover.



A21252

### STEP 94

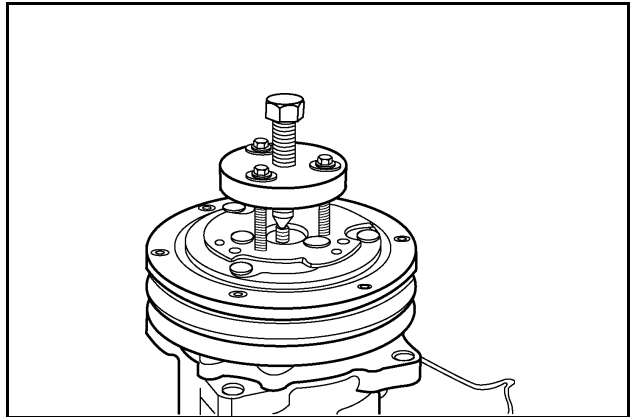
Remove the retaining nut for the front plate. Use the special spanner wrench from the service tool set to keep the plate and shaft from turning.



A21253

### STEP 95

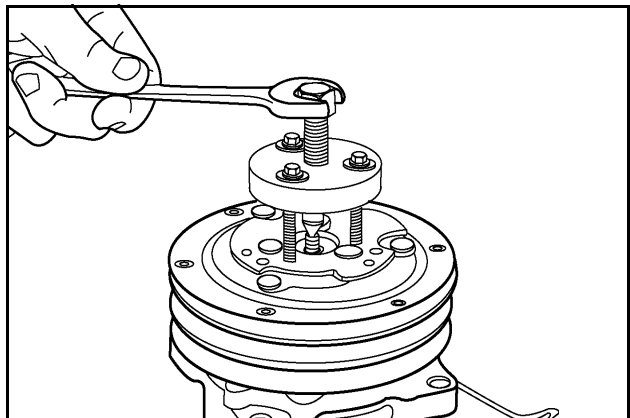
Install the special puller from the service tool set on the clutch front plate.



A21254

### STEP 96

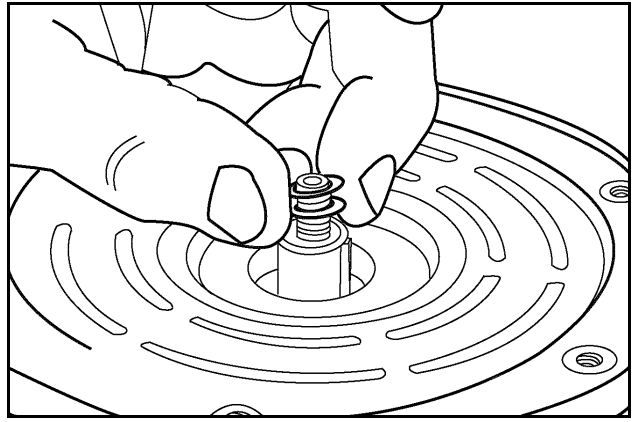
Turn the center screw to pull the clutch front plate.



A21255

**STEP 97**

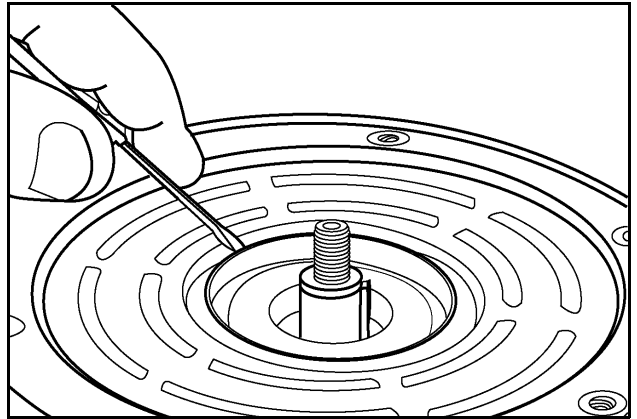
Remove the shim(s) from the shaft.



A21256

**STEP 98**

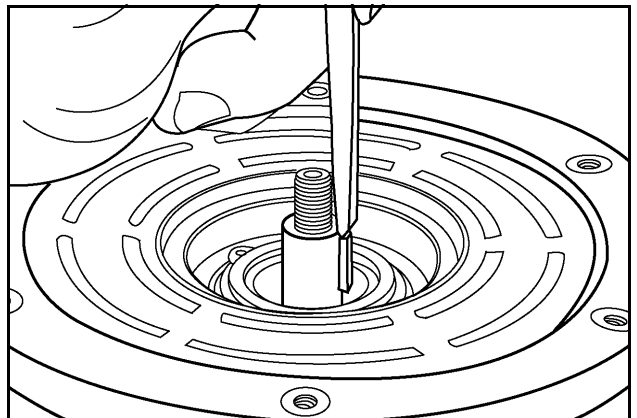
Carefully remove the dust cover.



A21257

**STEP 99**

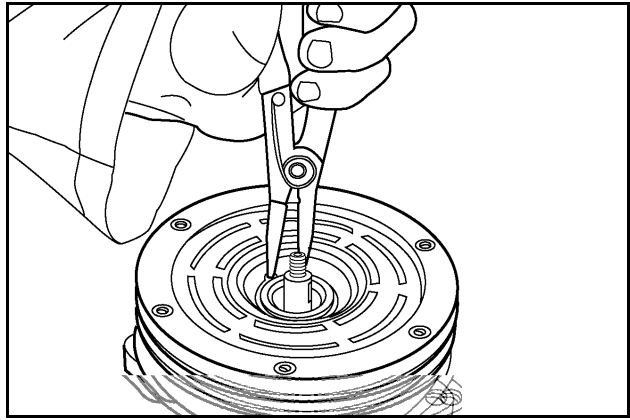
Remove the key from the rotor shaft.



A21258

### STEP 100

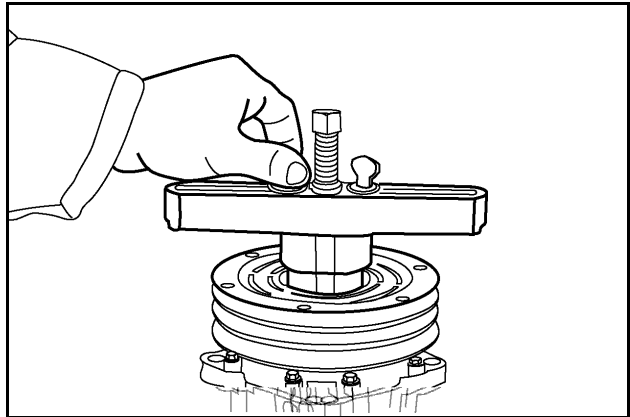
Remove the external snap ring for the bearing and pulley assembly.



A21260

### STEP 101

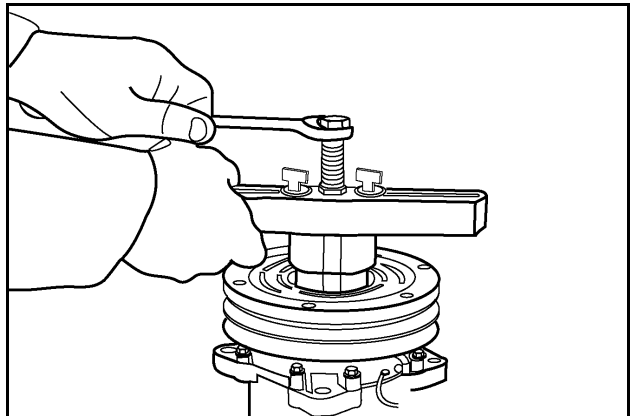
Install the special puller internal collars into the groove in the pulley. Install the special tool onto the shaft. Tighten the mounting screws finger tight.



A21261

### STEP 102

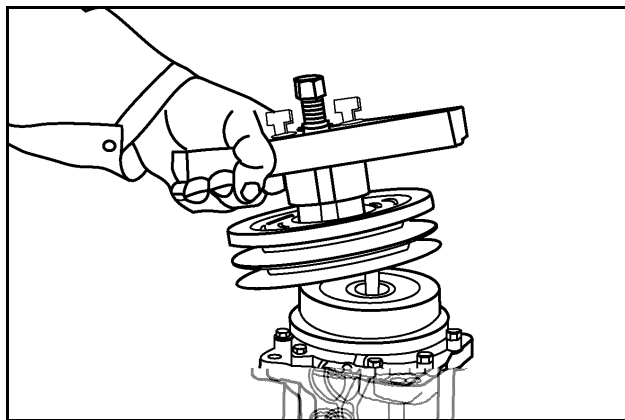
Turn the center screw on the puller.



A21262

### STEP 103

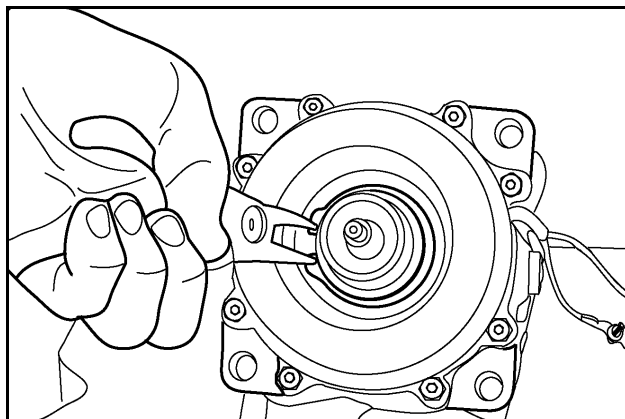
Remove the pulley and bearing assembly.



A21263

### STEP 104

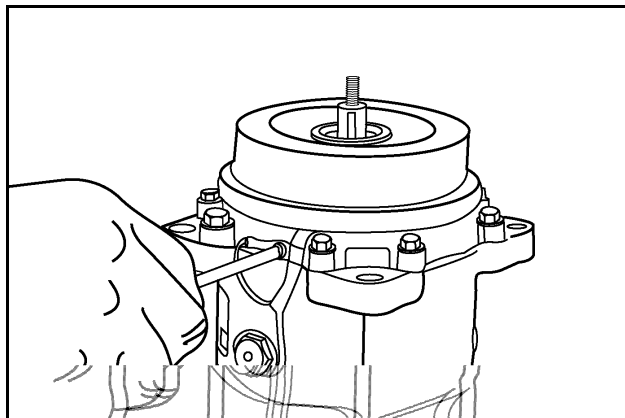
Remove the snap ring for the clutch coil assembly.



A21265

### STEP 105

Disconnect the clip for the lead wire.

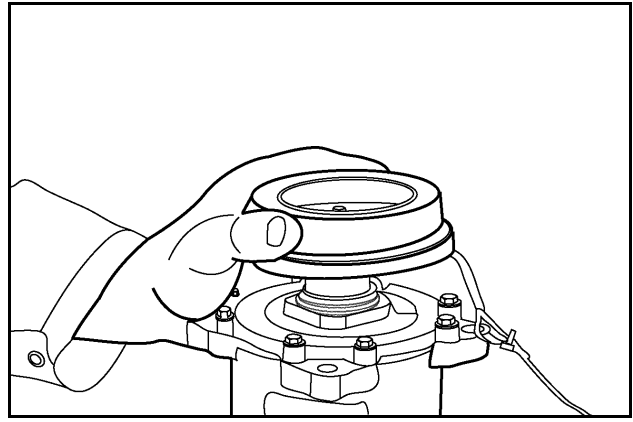


A21264



### STEP 106

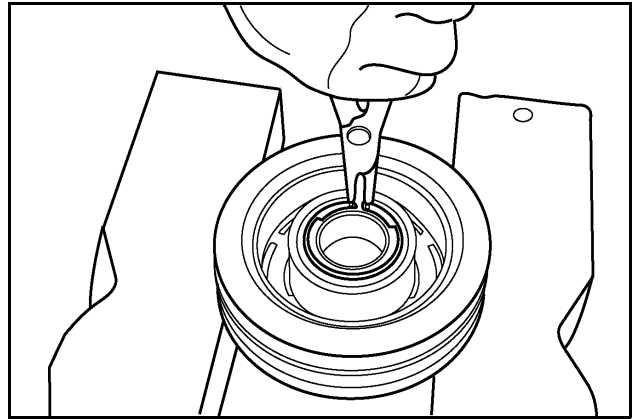
Remove the clutch coil assembly.



A21266

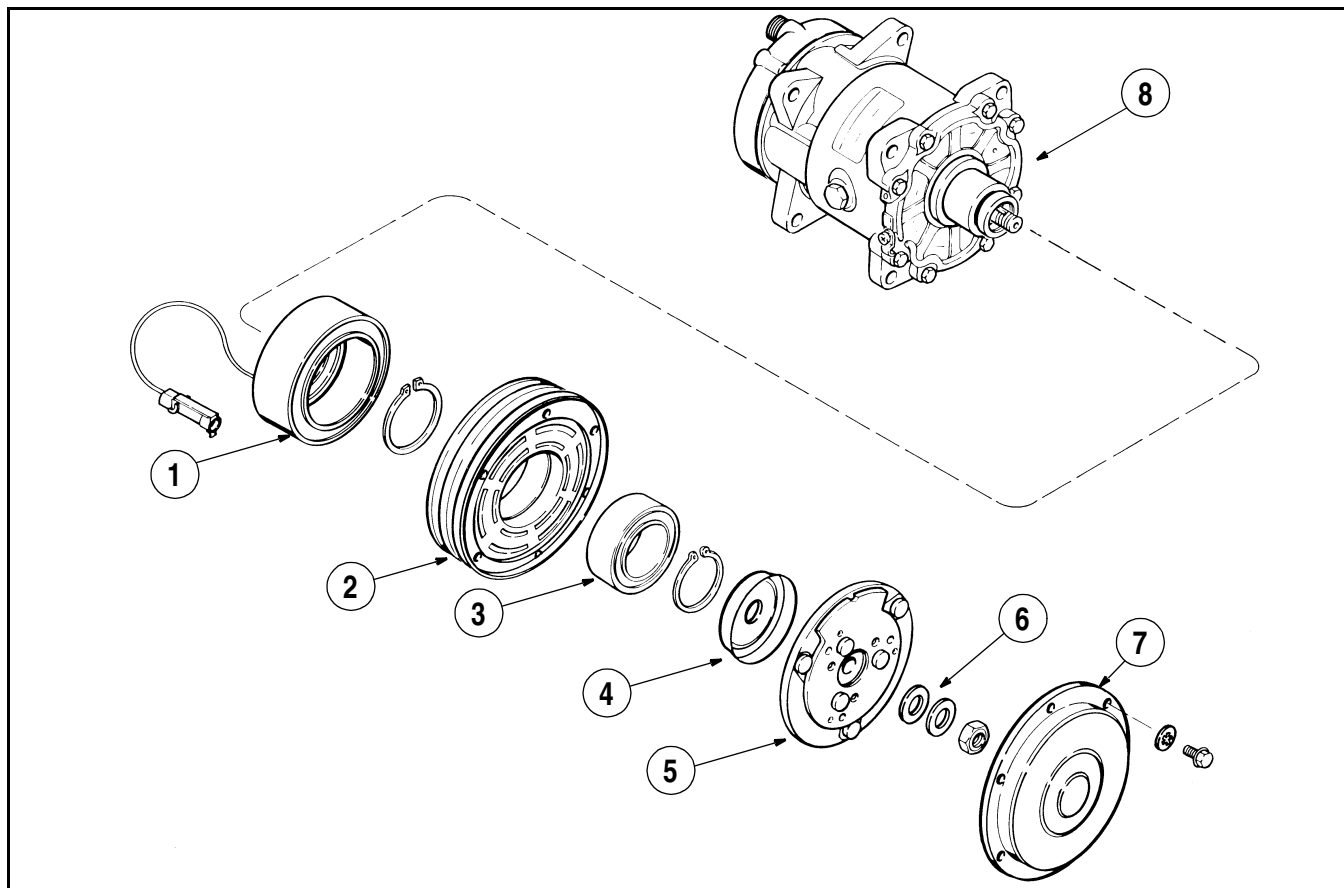
### STEP 107

Remove the internal snap ring and remove the bearing from the pulley.



A21267

## Exploded View of Clutch



1016L9

- 1. COIL ASSEMBLY
- 2. PULLEY
- 3. BEARING

- 4. BEARING DUST COVER
- 5. FRONT PLATE
- 6. SHIM(S)

- 7. DUST COVER
- 8. COMPRESSOR

## Compressor Clutch Replacement

### STEP 108

**Method 1:** Use a ammeter, voltmeter and a 12 volt battery to check the amperage of the clutch coil. The current draw must be 3.6 to 4.2 amperes at 12 volts.

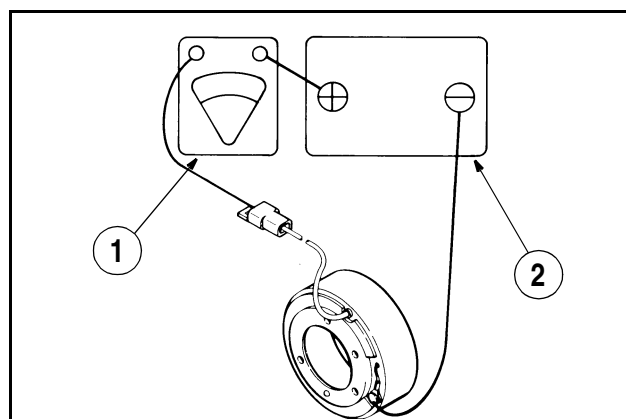
A reading of more than 4.2 amperes indicates a short within the coil.

No amperage reading indicates an open circuit in the coil.

Replace the clutch coil if the amperage reading is not correct.

OR

**Method 2:** Measure resistance. Resistance must be 2.86 to 3.3 ohms. Replace the clutch coil if the resistance reading is not correct.



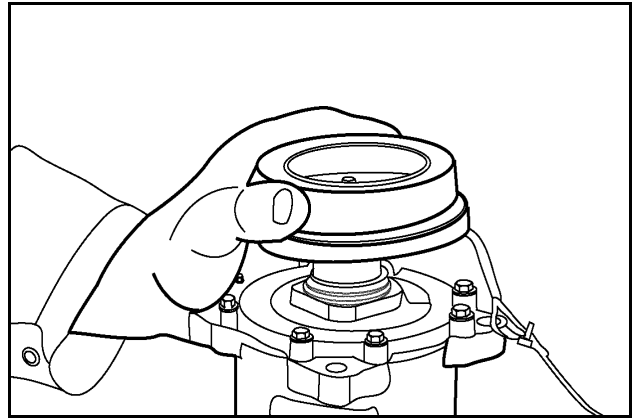
102L7

- 1. AMMETER

- 2. 12V BATTERY

### STEP 109

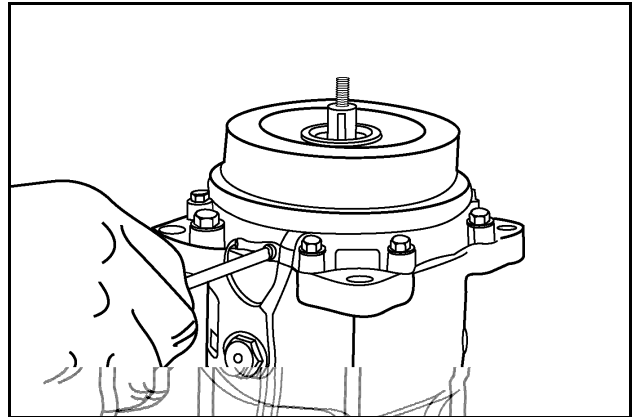
Install a new clutch coil assembly. Align the coil so the lead wire is next to the clip mounting hole.



A21266

### STEP 110

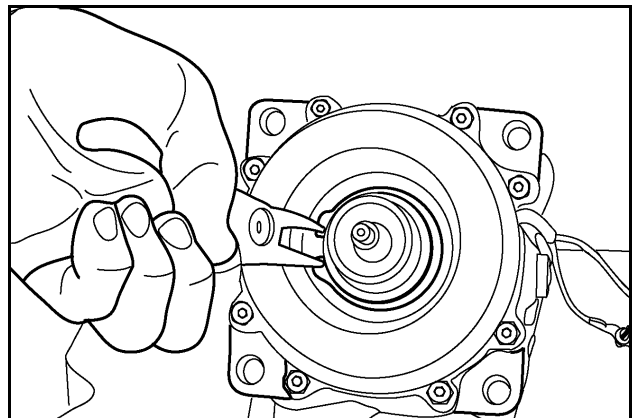
Install the clip for the coil lead wire.



A21264

### STEP 111

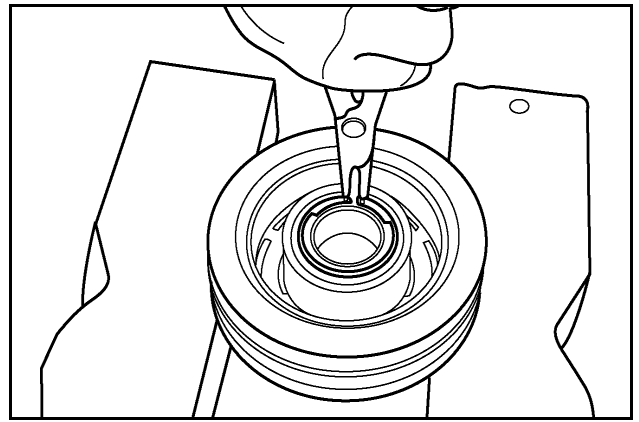
Install the snap ring for the clutch coil assembly.



A21265

### STEP 112

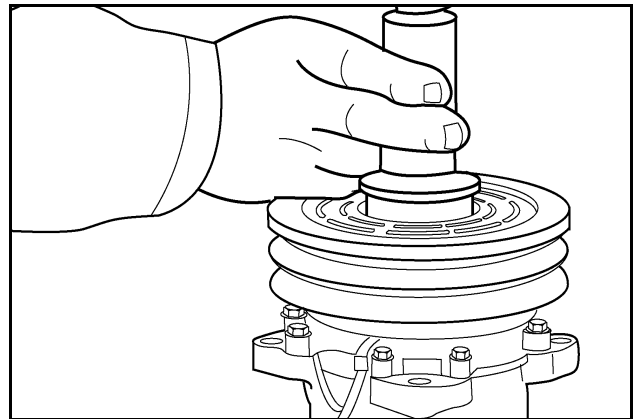
Install the bearing in the pulley and install the internal snap ring.



A21267

### STEP 113

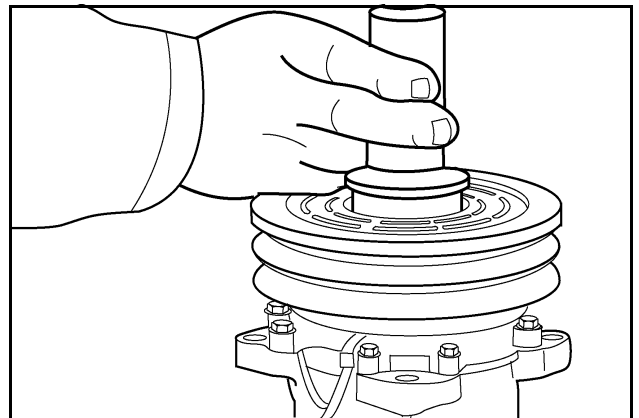
Put the pulley and bearing assembly on the front housing hub. Install a driver on the pulley assembly. Make sure that the tool is on the inner race of the bearing.



RR99D245

### STEP 114

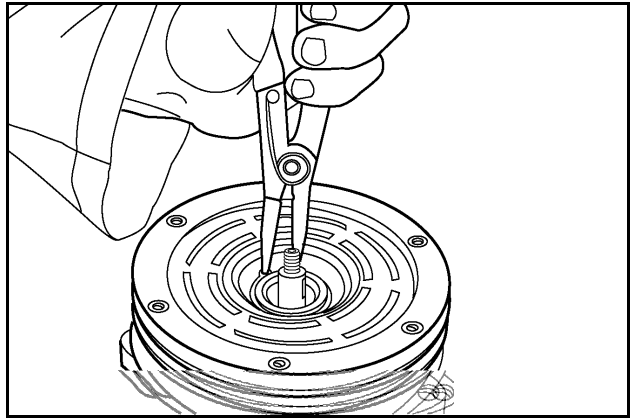
Support the compressor on the four mounting ears at the compressor rear. Press the pulley assembly on the front housing hub. Make sure the bearing is against the bottom of the hub.



RR99D245

### STEP 115

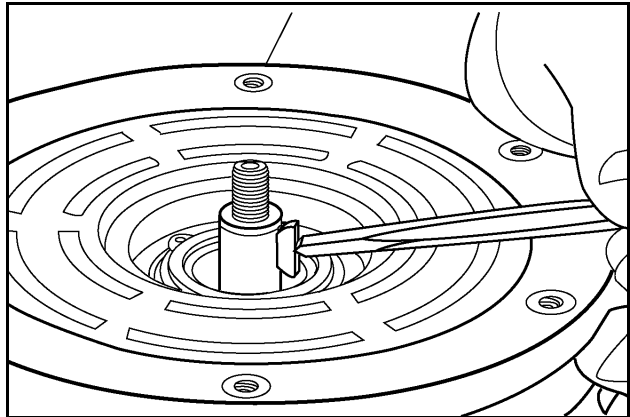
Install the external snap ring on the front housing hub.



A21260

### STEP 116

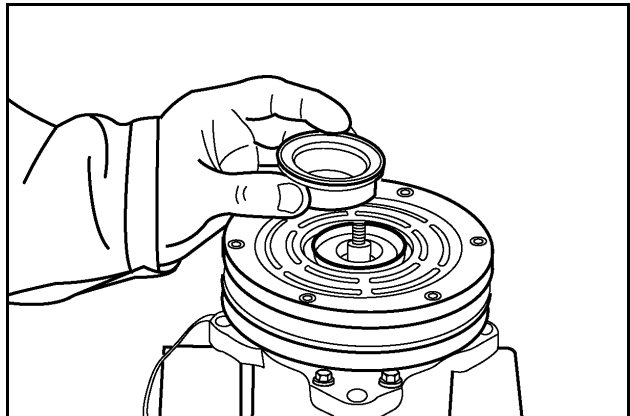
Install the key in the rotor shaft.



A21259

### STEP 117

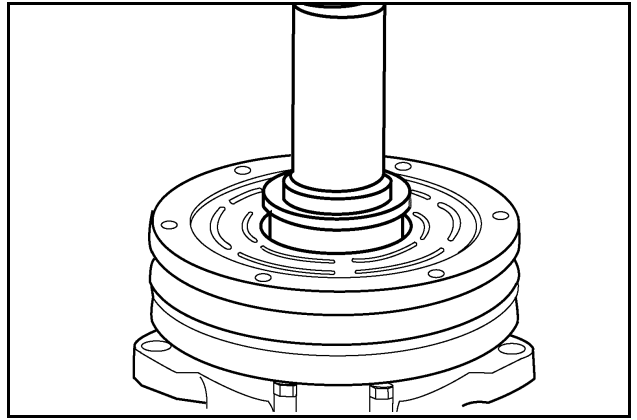
Place the bearing dust cover in the bore. Place driver from special tool kit over the dust cover.



A21269

### STEP 118

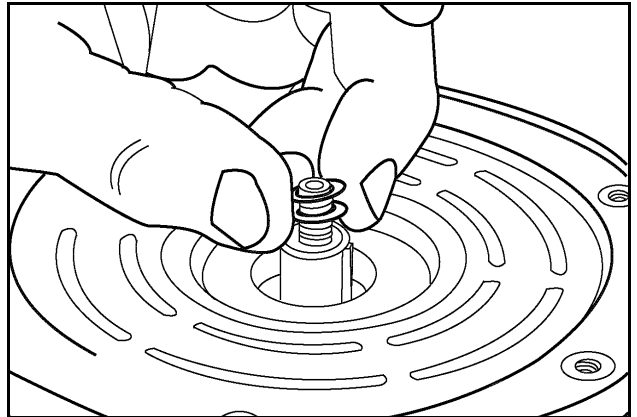
Install the dust cover.



A21270

### STEP 119

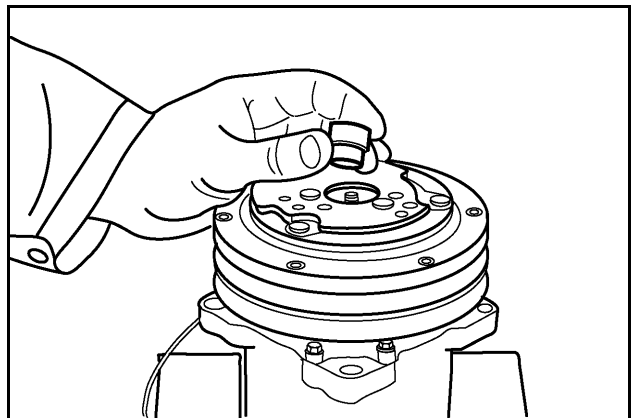
Install the shim(s) on the rotor shaft.



A21256

### STEP 120

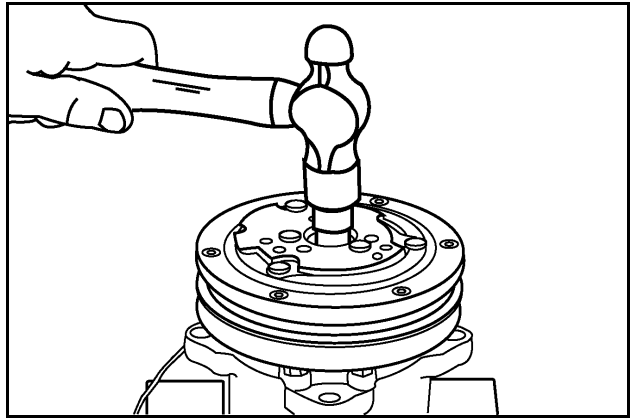
Install the front plate on the rotor shaft. Make sure the keyway in the plate is aligned with the key in the shaft. Install the driver over the shaft.



A21271

### STEP 121

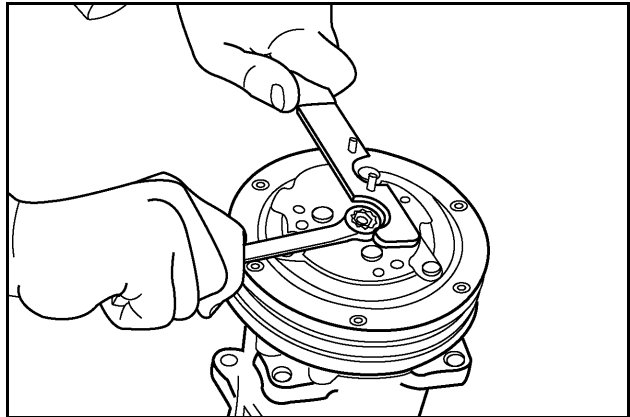
Use a hammer to tap the plate onto the shaft. Make sure the plate is against the clutch shims. As the plate is tapped onto the shaft you can hear the difference in sound when the plate is fully installed.



A21272

### STEP 122

Install the nut on the rotor shaft. Use the spanner wrench and a torque wrench to tighten the nut to a torque of 11 to 15 lb. ft. (15 to 20 Nm).



A21253

**STEP 123**

Two methods can be used to measure and adjust the air gap between the clutch plate and pulley:

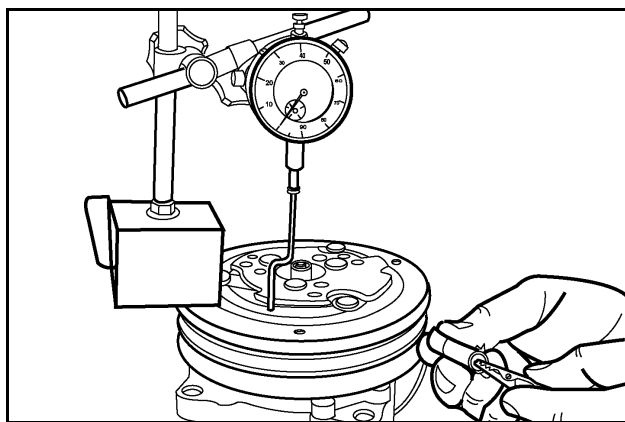
**Magnetic Dial** - Mount a magnetic base dial indicator on the outer face of the pulley so that there is no interference with the clutch plate. Apply battery ground to compressor body and 12V B+ to clutch wire lead. Position the dial indicator pointer on the flat surface on the outer diameter of the clutch plate midway between any two outer rivets or on one of the outer rivet heads. Clutch plate travel should measure from 0.016 to 0.031 inch (0.41 to 0.79 mm). This measurement should be taken between each of the three rivets or on each outer rivet head to get an average measurement. If necessary, lightly lift or push down on plate to even the gap.

**Spark Plug Gauge** - If a dial indicator is not available to check air gap clearance, a spark plug gauge with 90° wire feelers may be used to check initial air gap in the field. Slip the wire between the clutch plate and the pulley and check the gap at the three rivets. The gap must be 0.016 to 0.031 inch (0.41 to 0.79 mm). The gap must be even all the way around the plate. If necessary, lightly lift or push down on the plate to make the gap even.

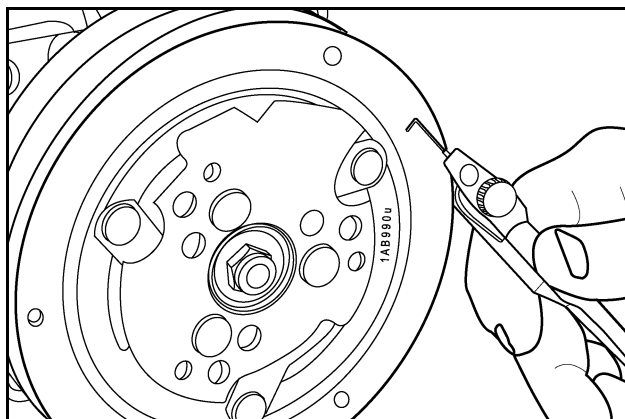
**NOTE:** *If the gap does not meet the above specifications remove the front plate and add or subtract clutch shims as required.*

**STEP 124**

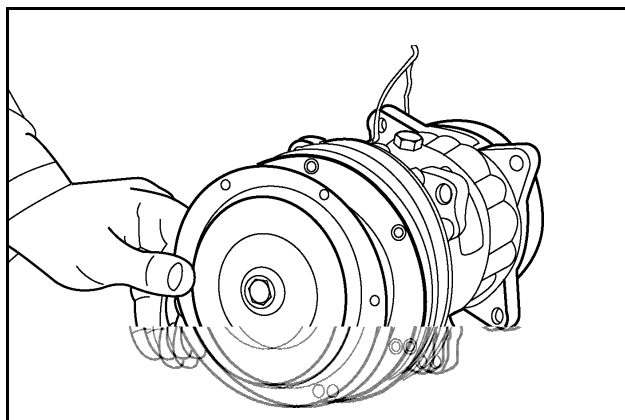
Install the clutch dust cover.



MK98E341



RD99M052

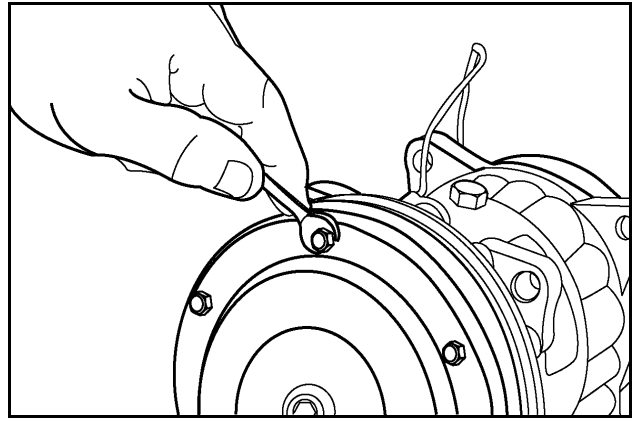


A21252



## STEP 125

Install and tighten the three Torx® screws that attach the dust cover to the compressor clutch. Torque to 5 to 8 lb. ft. (7 to 11 Nm).



A21251

## A/C COMPRESSOR

### Oil Level Check or Adjustment

Since the refrigerant is recovered as a gas, during a typical recovery only about 25% of the oil in the vehicle's A/C system is recovered and separated. The other 75% remains in the closed system normally on the low pressure side. (These percentages are representative and will vary from recovery unit manufacturer to manufacturer.) The only reliable method for determining if the A/C system has the correct amount of oil is the dipstick method.

Too much oil in the closed system causes poor condensation and reduced cooling since the oil accumulates on the evaporator and condenser surfaces. Too little oil in the system causes poor lubrication which equates to poor refrigerant circulation and reduced compressor efficiency and high pressures. Both conditions cause more system wear and shorter system life.

These conditions are not self-correcting.

### Injection Method

#### STEP 126

OEM1415 has an injection system to return new SP-20 PAG oil equal to the amount recovered at the end of the evacuation process.

To add the new oil, adjust the O-ring around the oil return bottle to the required oil charge level.

**NOTE:** If 2.4 oz (71 ml) was recovered in the oil reservoir, 2.4 oz (71 ml) of new SP-20 PAG must be returned.

Open the oil injection valve to add the oil into the system. Close the valve when the oil level reaches the O-ring.

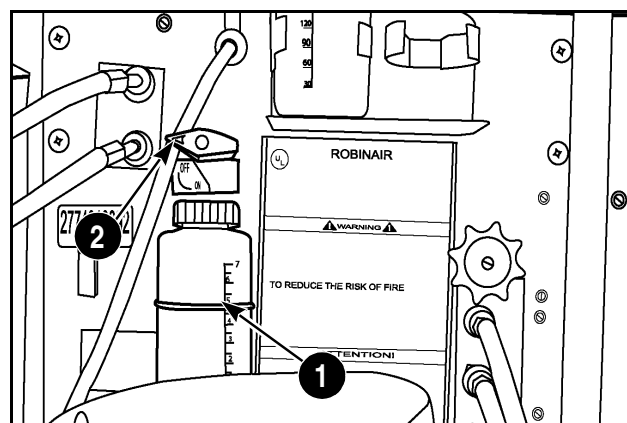
**IMPORTANT:** Do not let oil level fall below the dip tube in the return bottle or air will be introduced into the refrigerant circuit.

During normal servicing - recovery, evacuation and recharge, oil is simply injected back into the system during the recharge process. Use the dipstick method to check the compressor oil level or to adjust oil level when any of the following occurred:

- A. Broken refrigerant hose.
- B. Large refrigerant leak.
- C. Compressor leak.
- D. Damage to or replaced system components.
- E. New compressor installed.

**IMPORTANT:** If a new compressor is to be installed, its oil level must be adjusted to match the oil volume of the removed compressor.

**NOTE:** SP-20 PAG oil must be added whenever a component is replaced.



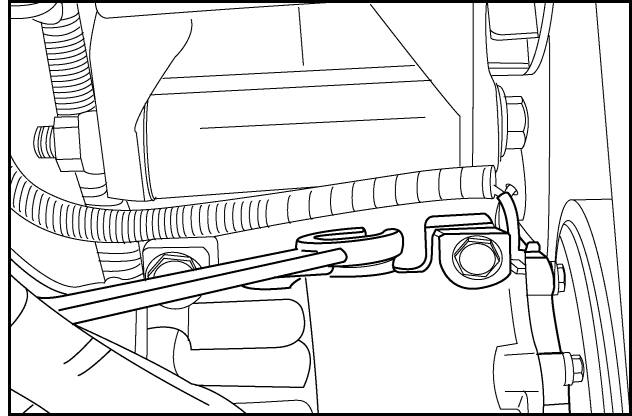
1. OIL RETURN BOTTLE

2. OIL INJECTION VALVE

## Dipstick Method

### STEP 127

When all refrigerant has been recovered, remove the oil filler plug.

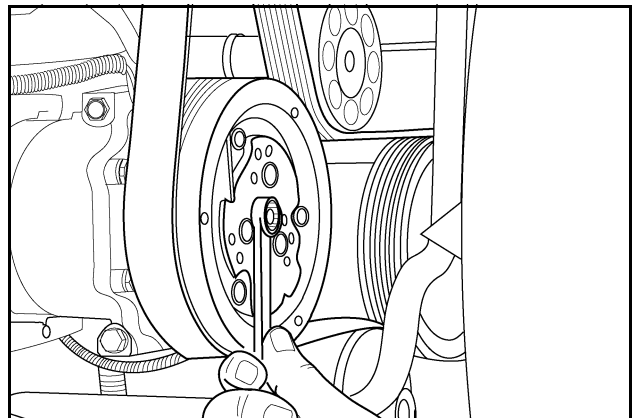


RD02H047

### STEP 128

Use a Torx® socket to remove the three screws, and remove the dust cover from the clutch. Use a wrench to rotate the compressor shaft clockwise until the internal parts are in a position to allow dipstick insertion.

ALTERNATE METHOD: Use a jumper wire to supply 12V B+ to the compressor clutch and rotate by hand.



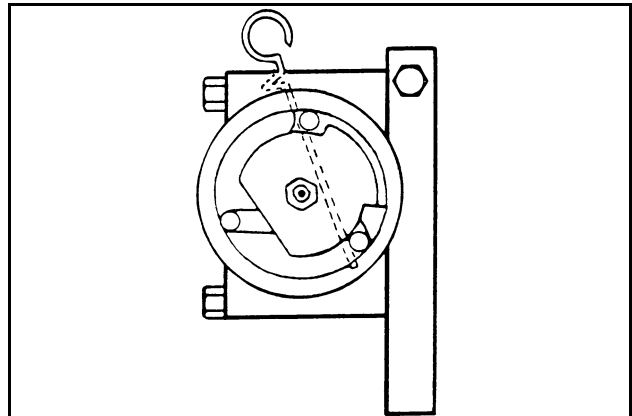
RD02H024

### STEP 129

Put the dipstick in the oil filler hole to the stop position. Make sure the dipstick is inserted all the way to the stop. The dipstick stop should be flush with the filler hole boss.

Take several readings for accuracy. **The oil level should cover five lines on the dipstick.**

**NOTE:** The illustration shows a front view of the compressor with the dust cover removed and the proper positions of the counterweight for insertion of the dipstick.



RB99N057

**IMPORTANT:** When compressor is replaced, the old compressor oil should be drained and the oil volume measured. This amount of new oil should be put into the replacement compressor after it has been drained. Or use the dipstick to measure and match the replacement compressor oil level to the old compressor oil level.

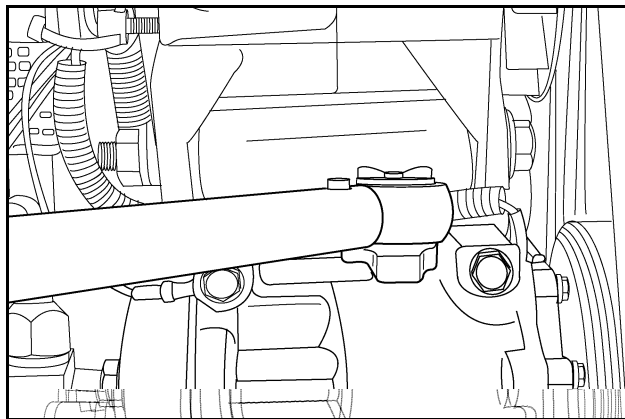
### STEP 130

If the oil level is not correct, add or subtract oil to the correct level described above. Always add oil in small quantities to avoid overfilling; to subtract oil the compressor must be removed and drained.

**IMPORTANT:** *Use only SP-20 PAG oil.*

### STEP 131

Check O-ring on the oil filler plug and replace if necessary. Install the plug and tighten to a torque of 11 to 18 lb. ft. (15 to 24 Nm).



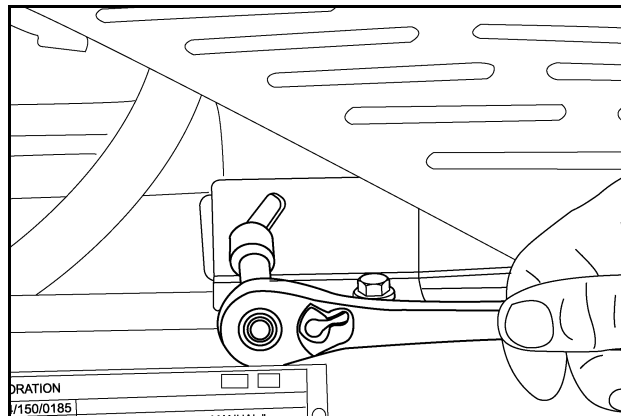
RD02H046

## Compressor Removal

### STEP 132

Open the hood and remove the right hand panel for access to the fan drive belt.

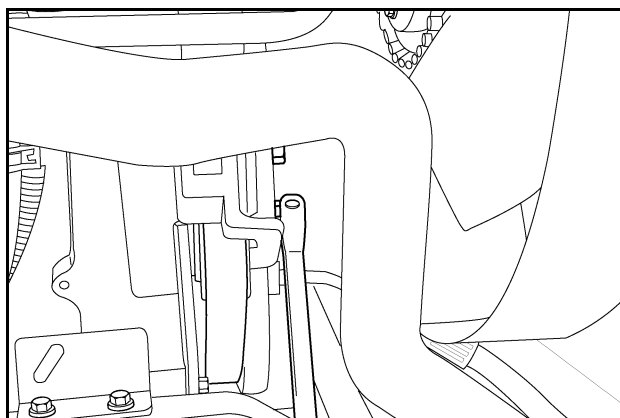
Recover the refrigerant.



RD02H035

### STEP 133

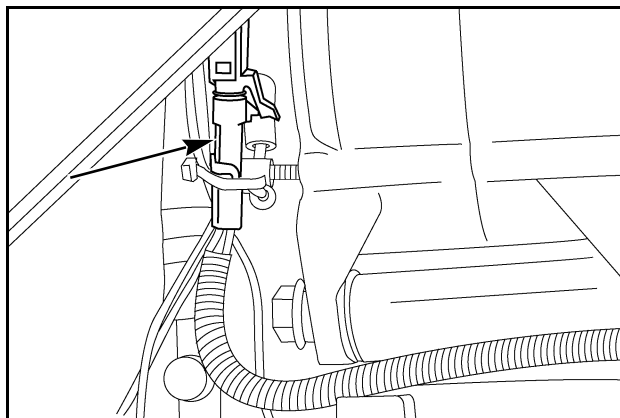
Use a 1/2 inch ratchet drive in the belt tensioner to relieve pressure on the belt and remove the belt from the compressor pulley.



RD02H038

### STEP 134

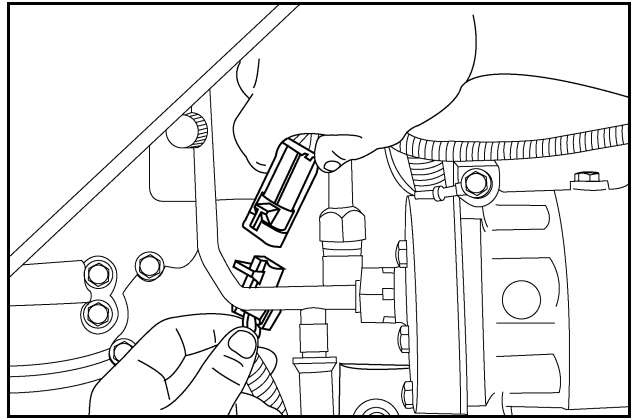
Disconnect the compressor clutch wire above the test ports on the suction and discharge lines.



RD02H034

### STEP 135

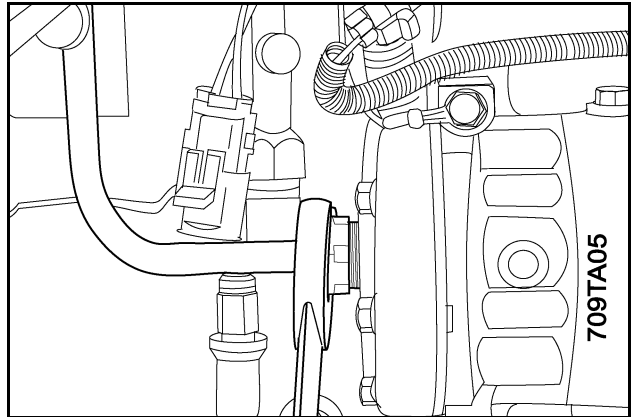
Disconnect the high pressure switch at the connector.



RD02H033

### STEP 136

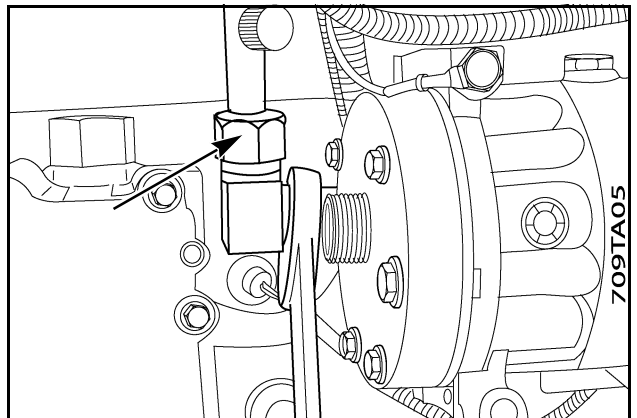
Disconnect the high pressure line from the discharge port. Install protective caps on the open port and line.



RD02H040

### STEP 137

Support the 90° fitting to the suction port, and disconnect the low pressure line from the fitting. Remove the 90° fitting from the suction port. Install protective caps on the open ports and lines.

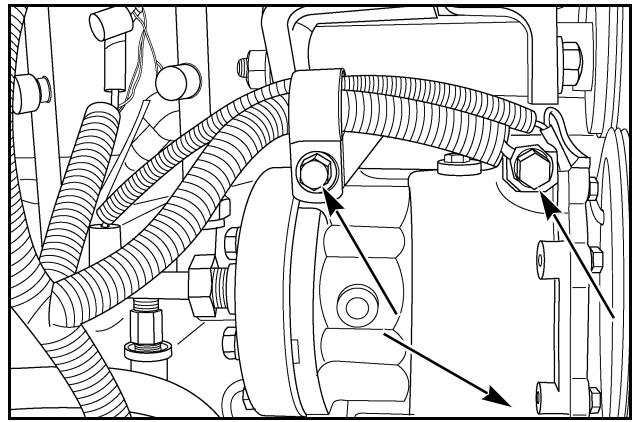


RD02H042

## STEP 138

Remove the three mounting bolts (lower front bolt not shown) and remove the compressor/clutch assembly from the tractor for service or replacement.

**NOTE:** *Note the location of the ring terminal ground on the upper front mounting bolt.*



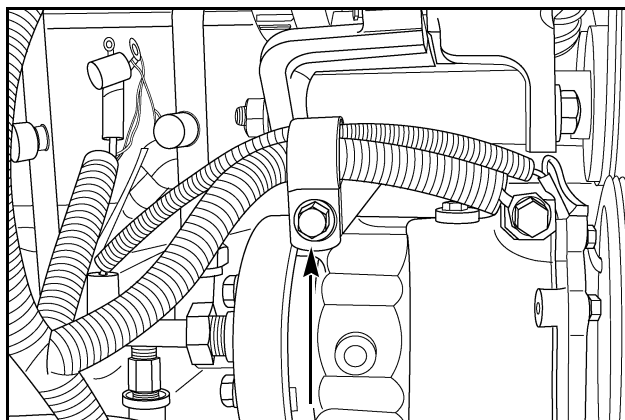
## Compressor Installation

**IMPORTANT:** If a new compressor is to be installed, its oil level must be adjusted to match the removed compressor. See **Oil Level Check or Adjustment**, page 79.

### STEP 139

Install the compressor with the three bolts removed earlier. Torque to  $29 \pm 4$  ft lb ( $39 \pm 4$  Nm).

**IMPORTANT:** Install the ring terminal ground to the upper front bolt when installing the compressor.

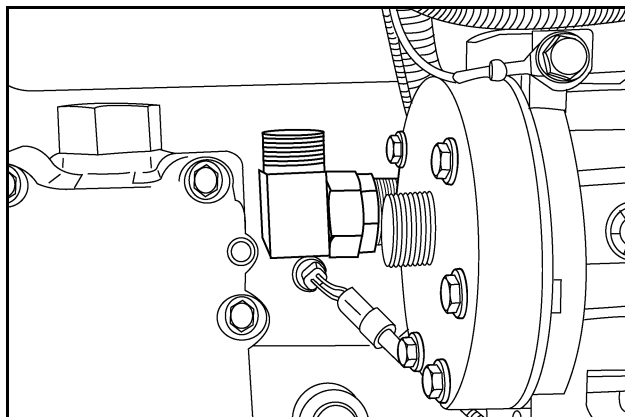


RD02H045

### STEP 140

Slowly remove the protective cap, and install the 90° elbow in the suction port on the compressor.

**NOTE:** Use caution when removing the caps on a new compressor; new compressors are pressurized when shipped.

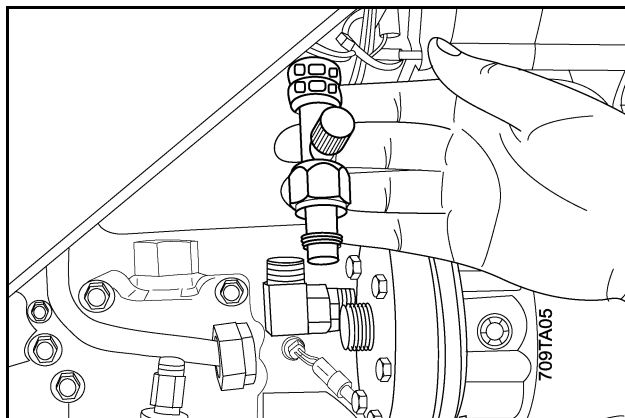


RD02H043

### STEP 141

Install a new O-ring and connect the low pressure line to the 90° elbow. Support the elbow with a wrench when connecting the line.

**NOTE:** Lubricate the O-ring with mineral oil before installation.



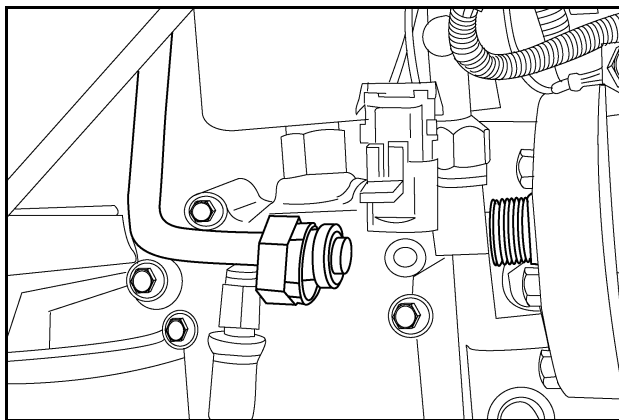
RD02H044



### STEP 142

Install a new O-ring and connect the high pressure line to the discharge port on the compressor.

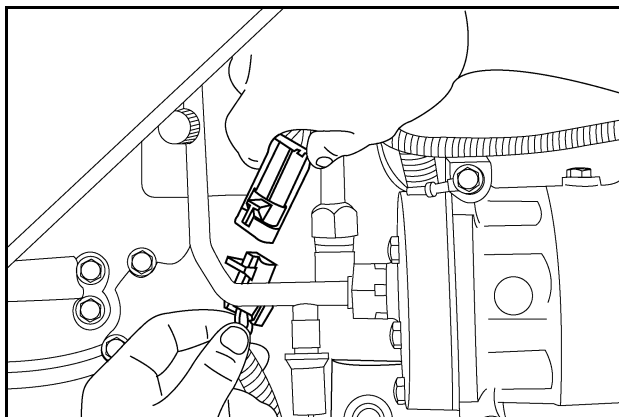
**NOTE:** *Lubricate the O-ring with mineral oil before installation.*



RD02H041

### STEP 143

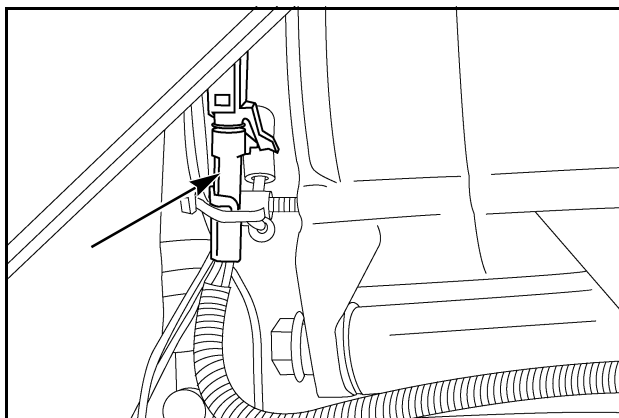
Reconnect the high pressure switch at the connector.



RD02H033

### STEP 144

Reconnect the clutch at the connector.



RD02H034

### STEP 145

Use a 1/2 inch ratchet drive on the belt tensioner to release tension and install the belt over the clutch pulley.

Reinstall the right hand panel.

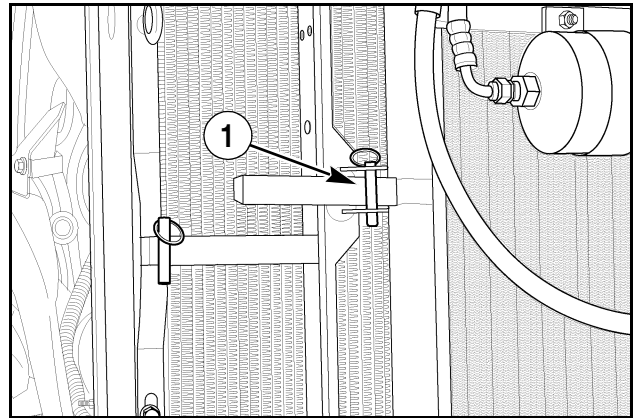
## CONDENSER AND RECEIVER-DRIER

### Condenser

#### STEP 146

Keep the condenser (and fuel cooler) fins clean and straight to make sure that there is maximum air flow through the condenser and radiator at all times. Use compressed air or a soft brush to clean the condenser. Also check and clean the grille screen and radiator. Maximum air flow prevents engine overheating and offers the most efficient A/C operation. Remove the pin (1) and swing the condenser open to facilitate cleaning.

**IMPORTANT:** *Because condenser fins bend easily and have sharp edges, be careful when cleaning the condenser.*



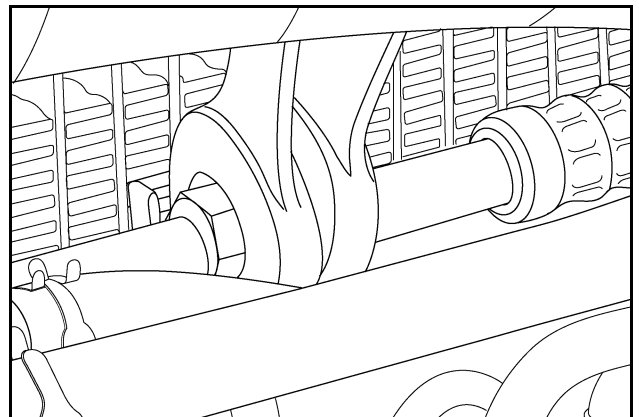
RD05J056

#### STEP 147

Recover all refrigerant before replacing/servicing the condenser/fuel cooler.

Use the two hand, two wrench method to disconnect and reconnect the lines to the condenser.

Cap all A/C lines while the condenser/fuel cooler is disconnected from the circuit.

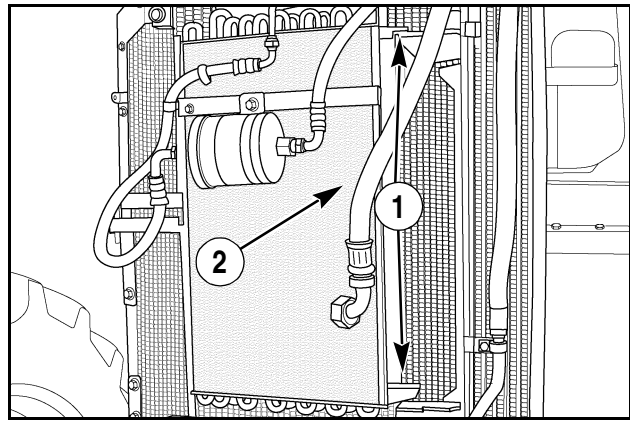


RD05A170

## STEP 148

Remove the upper and lower bolts (1) of the condenser/fuel cooler to replace the unit.

**NOTE:** Hydraulic cooling line (2) shown removed, does not need to be removed for this procedure.



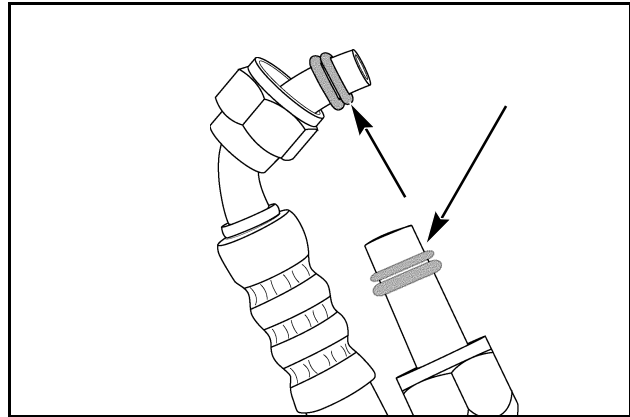
RD05N017

## STEP 149

When installing a new condenser, also install new O-rings on the A/C lines before connecting. Lubricate the O-rings with clean mineral oil prior to installation.

Use the two hand, two wrench method when connecting the line from the compressor and to the receiver-drier.

## Receiver-Drier



RD06A172

## STEP 150

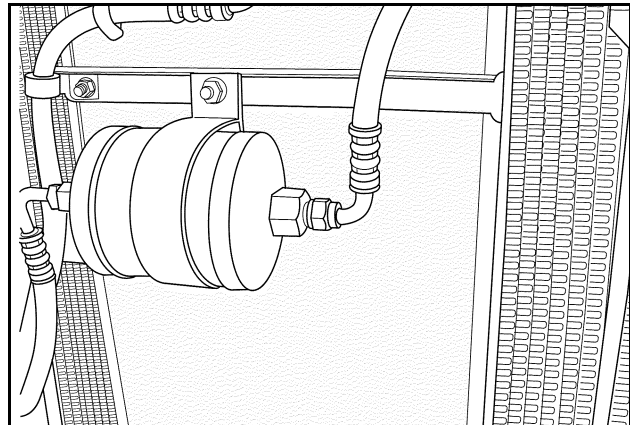
Replace the receiver-drier if:

- A. System has been opened before.
- B. Receiver-drier has been used two or more years.
- C. Disassembly show small particles of moisture removing material (gold or brown particles).
- D. If the system has been open for a long period of time because of a leak (broken hoses, loose connection) that has permitted air and moisture to enter the system.
- E. If contaminated refrigerant was recovered from the system.

The receiver-drier orientation is critical. Make sure the outlet flange is within 5 degrees of true level (the decal should face up).

The receiver-drier must be installed with the inlet connected to the hose from the condenser and the outlet connected to the hose going to the thermal expansion valve.

The receiver-drier is normally the last item replaced when servicing the system, just before the system is evacuated. This prevents saturating the drier with moisture.

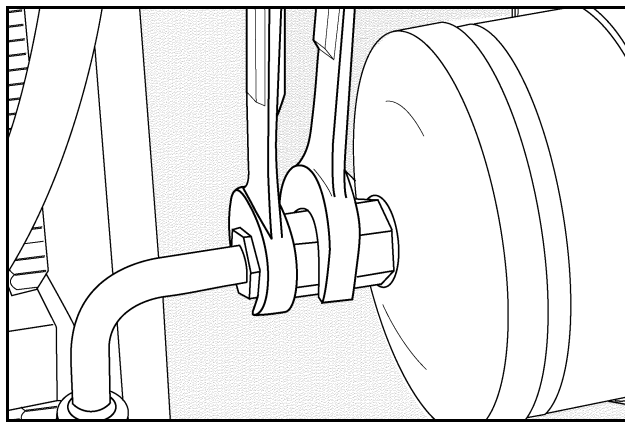


RD05N020

## STEP 151

Use the two hand, two wrench method to prevent damage to the tubes and fittings when you loosen or tighten the tube connections.

Always install new O-rings when the receiver-drier is connected to the system. Lubricate the O-rings with clean mineral oil prior to installation.



RD06A171

## ACCESSING THE HVAC BOX

**NOTE:** The following procedure applies to both the standard and Automatic Temperature Controlled (ATC) systems.

### STEP 152

Disconnect the harness to the right hand control console.

### STEP 153

For tractors equipped with mechanical remote hydraulic controls, the right hand control console must be disconnected from the seat:

- A. Loosen the 13 mm nut at the front of the right hand side of the seat.
- B. Remove the 18 mm bolt at the right hand rear of the seat and remove the console. The console can be rested on the rear shelf or slid out the rear window and rested on the three-point hitch for better access to the HVAC box.

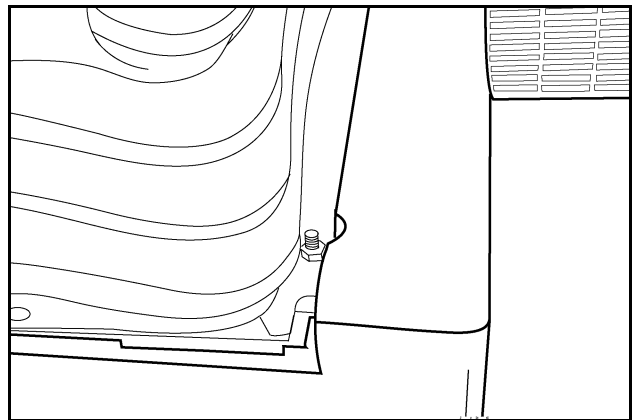
### STEP 154

Tilt the steering wheel to the full upright position. Adjust seat to the full upright and back position.

### STEP 155

Remove the floor mat wrap (1) which surround the seat base.

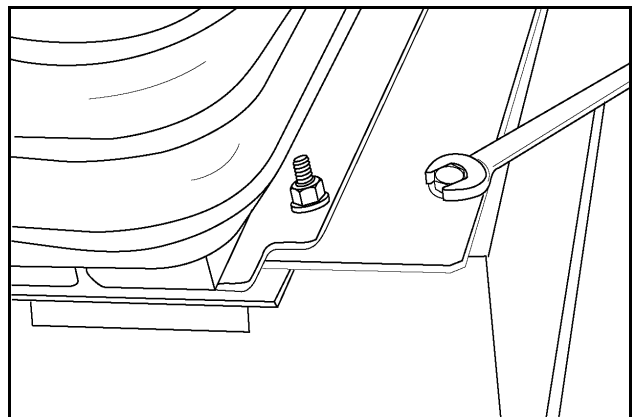
**NOTE:** If the return air filter covers are dislodged, be sure to reinstall later.



RD02F029

### STEP 156

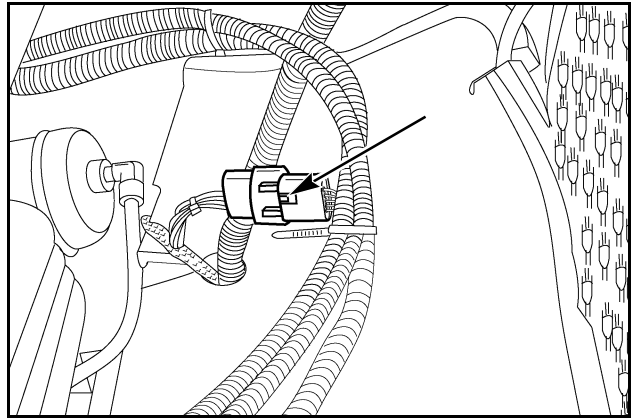
Remove four bolts in the seat base corners.



RP99E013

## STEP 157

Disconnect the seat harness.

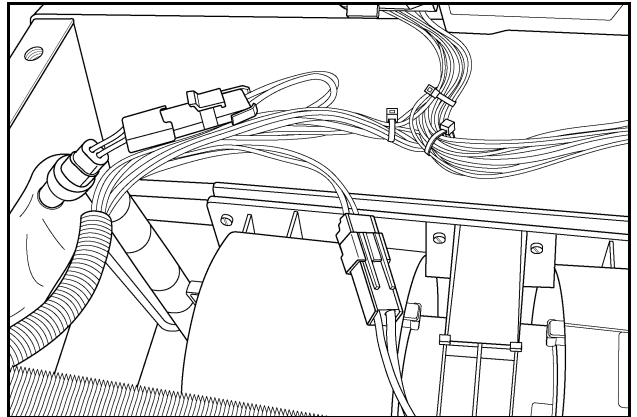


RD02F049

## STEP 158

Hinge seat forward and rest on steering wheel for access to the box.

**NOTE:** *Seat may have to be braced to prevent it from falling.*



RD06A191

**ATC HVAC Box Shown**

## STEP 159

After completion of service:

- A. Return the seat to its operating position, and reinstall the four bolts removed earlier.
- B. Reinstall the seat harness and floor mat wrap.
- C. Reinstall right hand control console (if applicable).
- D. Reconnect right hand control harness.
- E. Ensure cab recirculation air filter is properly installed.

## THERMAL EXPANSION VALVE TESTING

**IMPORTANT:** The following test is performed with the thermal expansion valve mounted in the system. No repair or adjustment is recommended for the valve.

### STEP 160

See **ACCESSING THE HVAC BOX**, page 90.

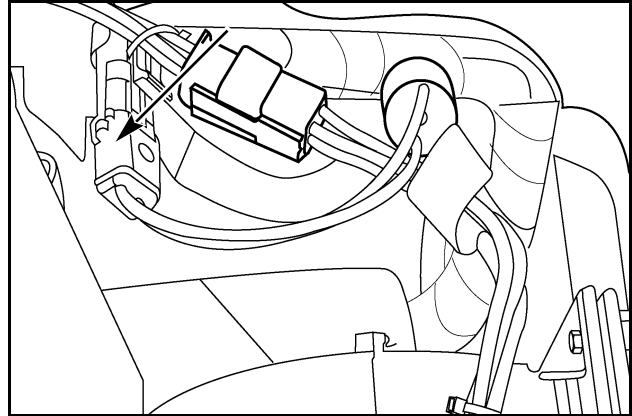
### STEP 161

Disconnect the low pressure cutout switch. Install a jumper wire across the harness leads.

### STEP 162

Start the tractor and run the engine at 1500 RPM. Turn blower speed control to maximum position, temperature control valve fully clockwise, ATC switch to DEFOG/DEFROST or Standard A/C switch to ON, and check the low pressure gauge reading.

Compare the gauge readings to the Temperature/Pressure chart for your ambient temperature and humidity.



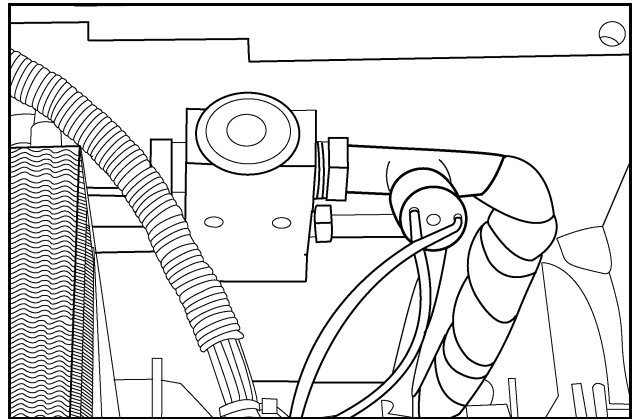
Standard HVAC Box Shown

RD02G096

### STEP 163

Remove thermal insulation tape from top of valve. Use the palm of your hand to warm the expansion valve and watch the low pressure gauge.

The valve will open and pressure should rise.



RD02G101

### STEP 164

Use ice to cool the expansion valve and watch the low pressure gauge.

Within seconds, the expansion valve will close and the pressure must drop at the low pressure gauge.

### STEP 165

If there is little or no change at low pressure gauge, the thermal expansion valve must be replaced.

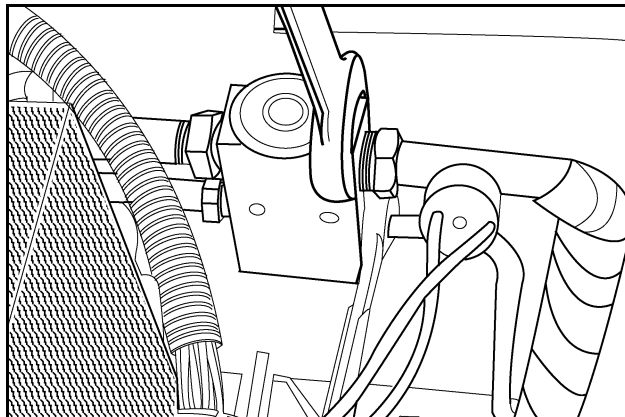
## THERMAL EXPANSION VALVE REPLACEMENT

### STEP 166

Recover all refrigerant from the system. Remove the thermal insulation tape from the fittings and expansion valve to replace the expansion valve.

### STEP 167

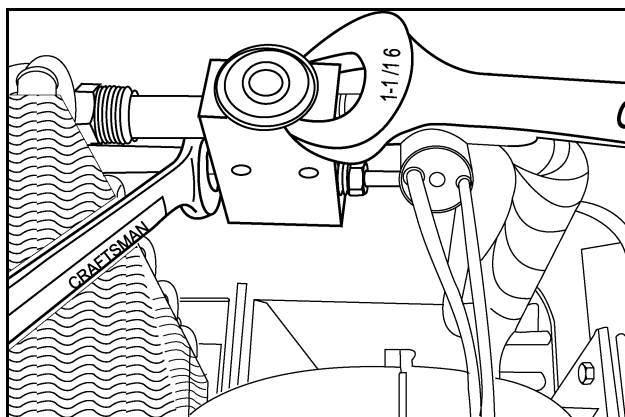
Using the two hand, two wrench method, disconnect the liquid and suction lines from the thermal expansion valve. Discard the O-rings in the fittings.



RD02G104

### STEP 168

Using the two hand, two wrench method, disconnect the thermal expansion valve from the evaporator tubes. Discard the O-rings on the tubes.

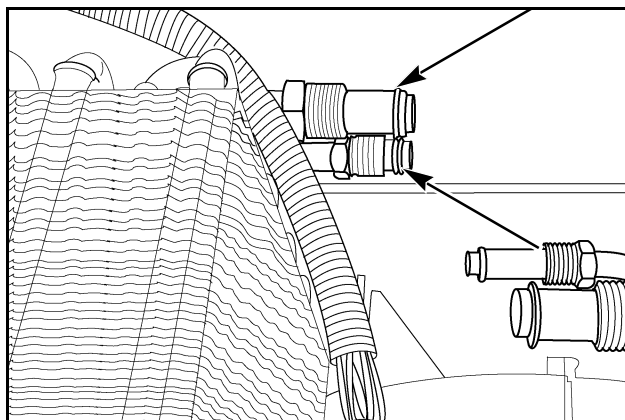


RD02G111

### STEP 169

**IMPORTANT:** *Lubricate O-rings with mineral oil NOT SP-20 PAG.*

Lubricate new O-rings with clean mineral oil and install between the evaporator core and thermal expansion valve. Connect the new valve to the evaporator using the two hand, two wrench method.



RD02G109



### STEP 170

Lubricate new O-rings with clean mineral oil and install in the fittings on the suction and liquid lines. Connect the liquid and suction lines to the expansion valve using the two hand, two wrench method.

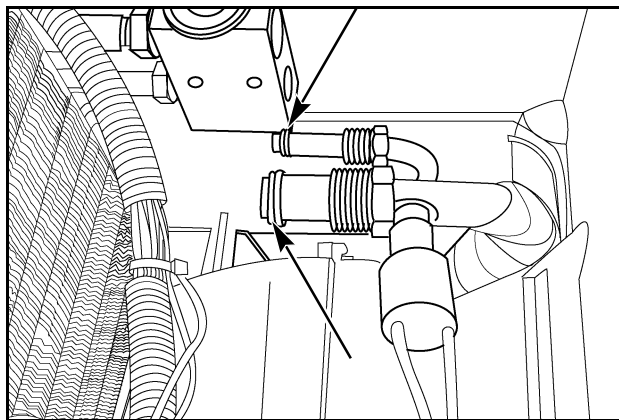
### STEP 171

Remove air and moisture from the system and charge the system. Leak test all connections with OEM1437 before reapplying any thermal insulation tape.

### STEP 172

Replace all thermal insulation tape and reconnect the low pressure cutout switch.

**NOTE:** *The thermal insulation tape is available in 30 ft. (9150 mm) bulk rolls - 1954475C1 - 0.12 x 2.5 inches x 30 ft. [3 x 63.5 x 9150 mm].*



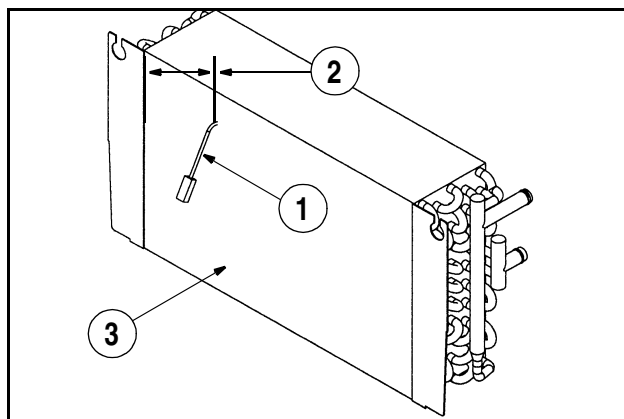
RD02G106

## EVAPORATOR AND CAB TEMPERATURE SENSOR LOCATION

### STEP 173

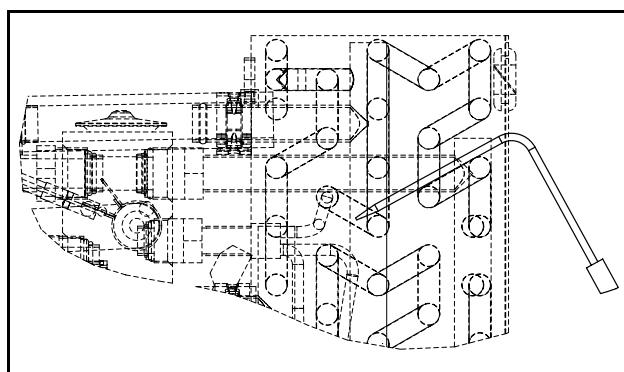
The evaporator temperature sensor **MUST** be installed 4.2 inches (107 mm) from the left hand rear side of the evaporator. The sensor must be installed below the second refrigeration tube row at a 30° downward angle.

Insert the sensor in the evaporator up to the angled section, being careful not to kink the sensor.



RH99D218

Rear View



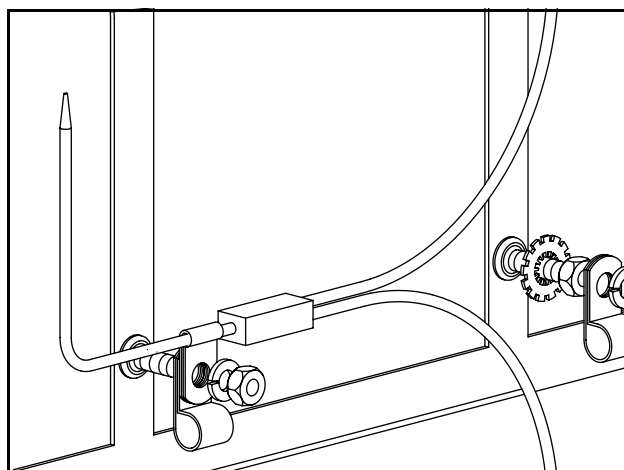
RI00A055

Side View

- 1. EVAPORATOR TEMPERATURE SENSOR
- 2. 4.2 INCH (107 MM)
- 3. EVAPORATOR CORE

### STEP 174

The cab temperature sensor must be installed without contact with any box components in the return air stream at the rear of the HVAC box.



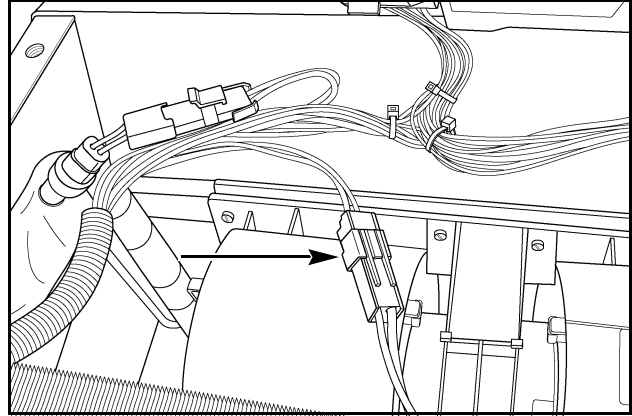
RI03B039

## BLOWER MOTOR REPLACEMENT

### STEP 175

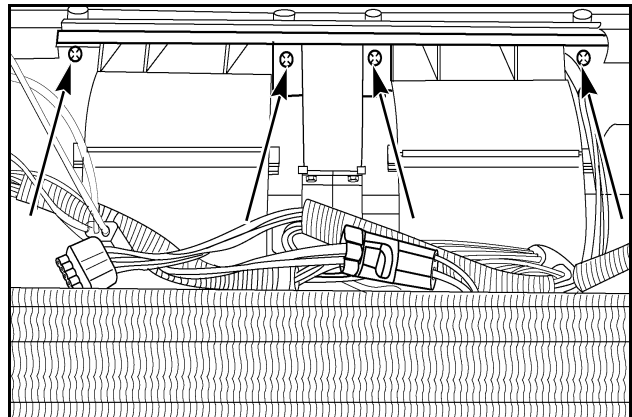
To replace the blower motor:

1. See **ACCESSING THE HVAC BOX**, page 90.
2. Disconnect the blower motor assembly from the harness at the connector.



RD06A191

3. Remove the four screws across the top of the motor assembly and two screws (not visible on photo) at the sides, and remove the assembly.
4. Install a new motor assembly with the existing hardware and connect the motor to the harness.



RD02G114

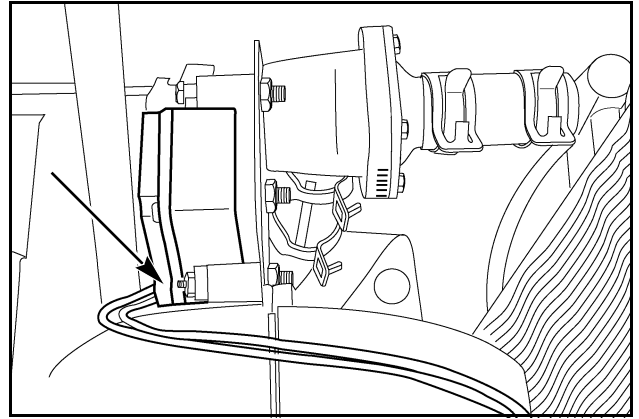
## HEATER CONTROL VALVE REPLACEMENT

### STEP 176

To replace the heater control valve:

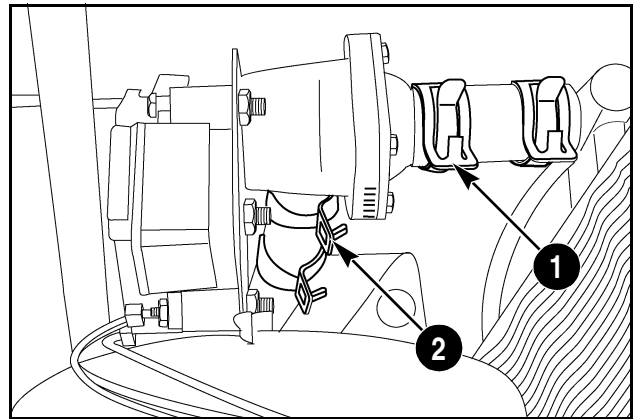
1. See **ACCESSING THE HVAC BOX**, page 90.
2. Move the controller mounting plate forward to gain better access to the valve.
3. Disconnect the control valve from the harness.

**NOTE:** *Be prepared to collect a small amount of coolant when the valve hoses are disconnected.*



RD02G116

4. Pinch the clamp (1) and disconnect the inlet hose to the core from the valve. Pinch the clamp (2) and disconnect the supply hose at the bottom of the valve. Remove the valve.
5. Install a new heater control valve to the same connecting hoses. Connect the valve to the harness.



RD02G115

## EVAPORATOR/HEATER ASSEMBLY

### Evaporator/Heater Assembly Removal

**NOTE:** The thermal expansion valve, heater valve and evaporator/heater assembly are located under the operator seat. See **ACCESSING THE HVAC BOX**, page 90.

**NOTE:** Rotate the cab temperature control to the Maximum Heat position before shutting off the tractor for service. This fully opens the heater control valve and allows more coolant to drain from the evaporator/heater assembly.

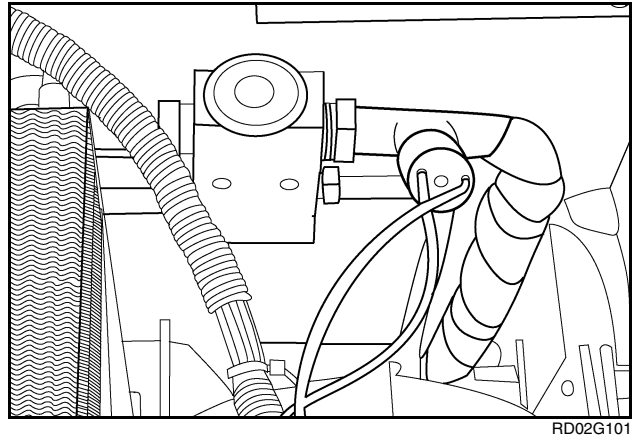
#### STEP 177

Use a vise clamp to clamp off the heater supply hose on the right hand side of the engine. Close the valve on the heater return hose at the engine. See component locations in this Section for your engine.

#### STEP 178

Remove the thermal insulation tape from the expansion valve and the evaporator lines.

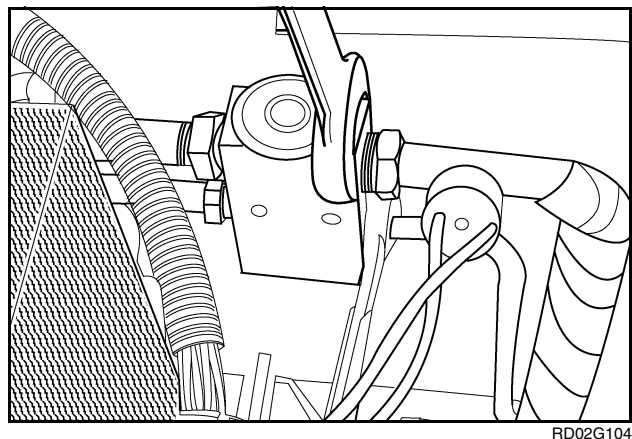
To test the valve see thermal expansion valve testing in this section. Recover the A/C system to remove the evaporator heater core.



#### STEP 179

Using the two hand, two wrench method, disconnect the air conditioning suction and liquid lines at the thermal expansion valve. Remove and discard the O-rings. Cap or plug the lines to prevent dirt and moisture from entering the system.

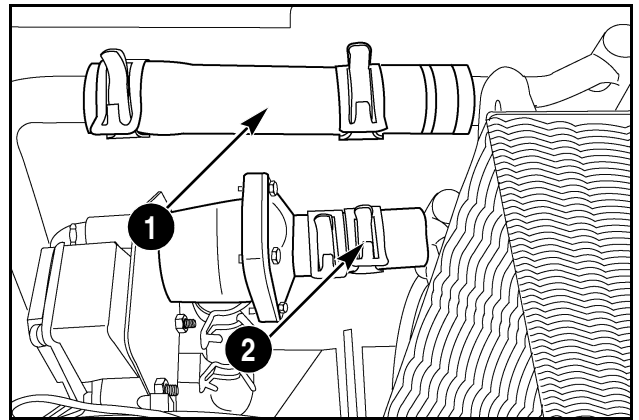
**NOTE:** Clean packaging tape may be used to seal the expansion valve ports.



## STEP 180

Pinch the clamp with a pliers to open it and move it to the side. Disconnect the heater return line (1) from the evaporator heater core.

Loosen the clamp and disconnect the short hose (2) between the heater valve and evaporator/heater core. Be prepared to collect a small amount of coolant that will drain into the HVAC box.

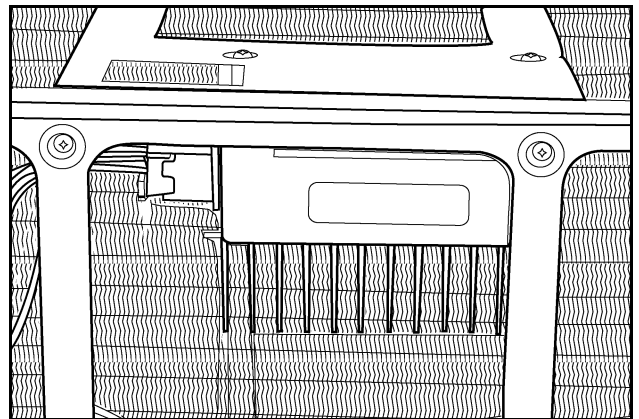


RD02G124

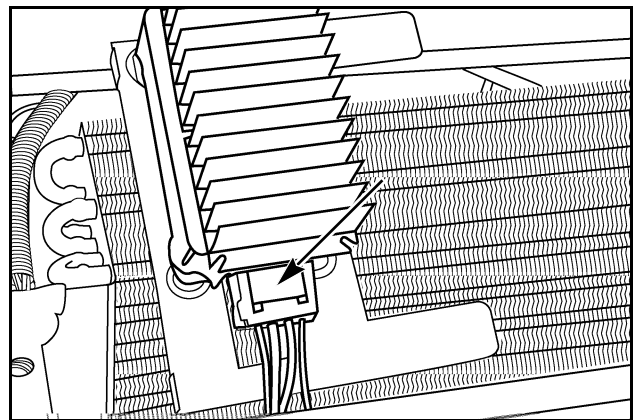
## STEP 181

Remove the two screws securing the blower speed driver and its mounting plate at the rear of the box.

Remove the 6-pin connector from the driver and move the blower driver assembly out of the way.



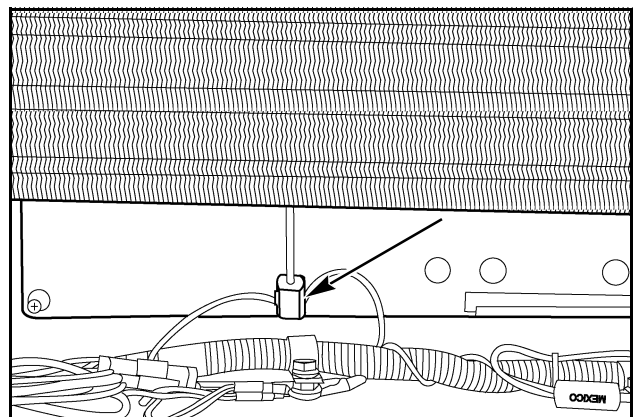
RD02G073



RD02G074

## STEP 182

Remove the evaporator temperature sensor from the evaporator/heater assembly.



RD02G078

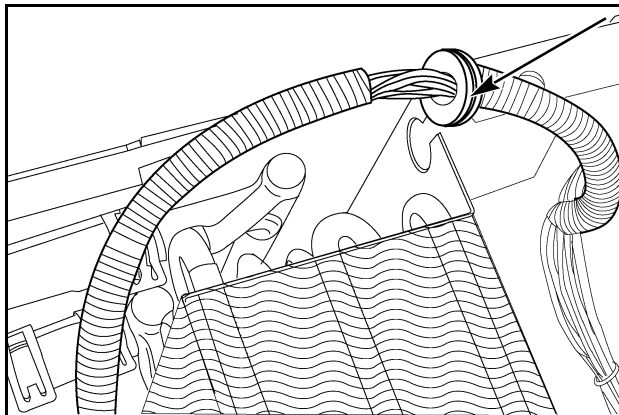
### STEP 183

Remove the evaporator top gasket and save for reinstallation. Remove the grommet (1) and sensor harness from the evaporator by sliding it out of the slot opening.

**NOTE:** *The gasket seals the top of the evaporator and forces the air to move through the core rather than around it. Replace the gasket if it is worn or damaged.*

### STEP 184

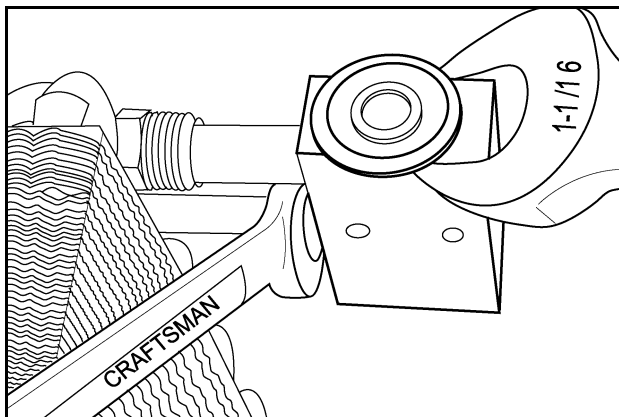
Slide the evaporator assembly straight up and out of its side mounting brackets.



RD02G119

### STEP 185

Put the assembly on a clean bench. Remove the expansion valve from the evaporator heater core. Use the two wrench, two hand method when removing the thermal expansion valve to prevent damage to the tubes.

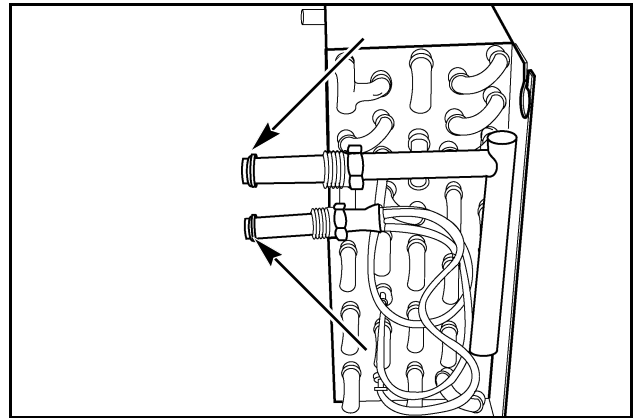


RD02B146

## Evaporator/Heater Assembly Installation

### STEP 186

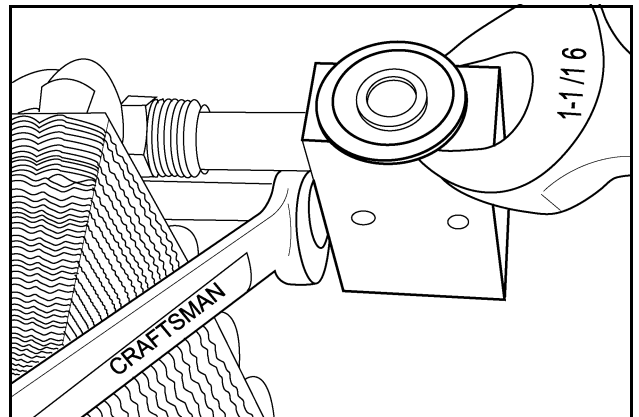
Lubricate new O-rings with clean mineral oil and install new O-rings on the evaporator suction and discharge lines.



RD02G128

### STEP 187

Install the expansion valve. Tighten the fittings to a torque of 18 to 25 lb ft (25 to 34 Nm). Use the two wrench, two hand method when installing the expansion valve to prevent damage to evaporator lines.



RD03B146

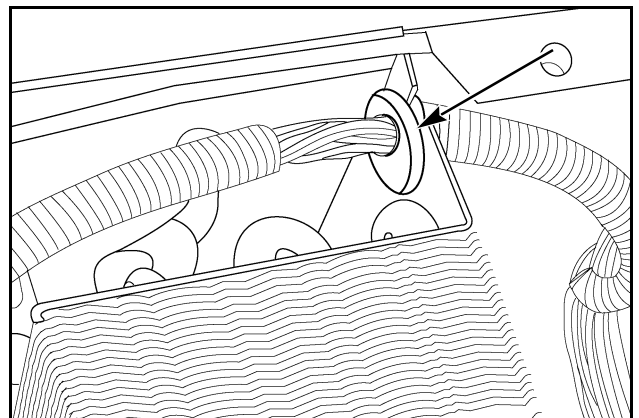
### STEP 188

Install the evaporator/heater assembly into the slide mounting brackets of the HVAC box.

### STEP 189

Install the sensor harness with grommet in slot in the the evaporator. Reinstall the top gasket on the evaporator.

**NOTE:** *The gasket seals the top of the evaporator and forces the air to move through the core rather than around it. Replace the gasket if it is worn or damaged.*



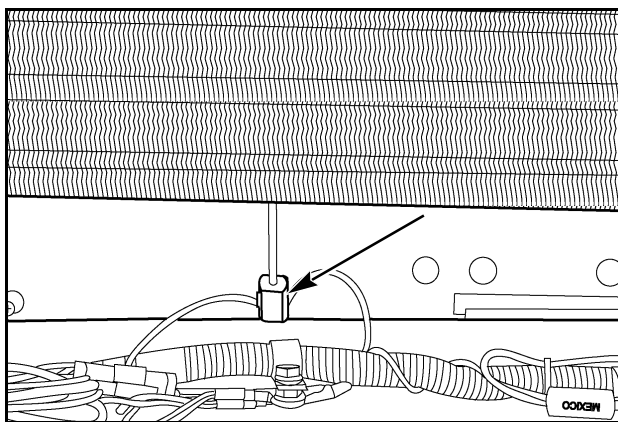
RD02G118



## STEP 190

Install the evaporator temperature sensor in the evaporator/heater assembly. The evaporator temperature sensor **MUST** be installed 4.2 inches (107 mm) from the left hand rear side of the evaporator. The sensor must be installed below the second refrigeration tube row at a 30° downward angle.

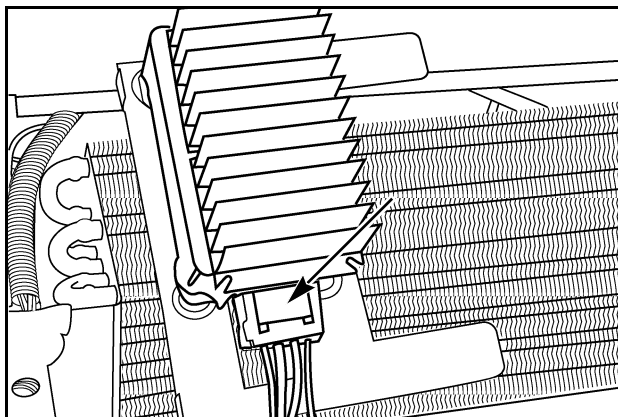
Insert the sensor in the evaporator up to the angled section, being careful not to kink the sensor.



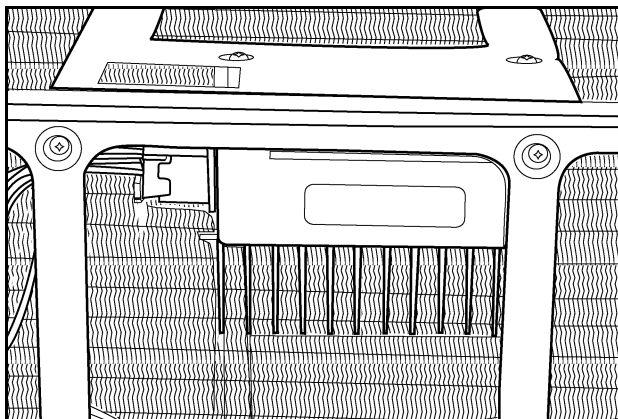
RD02G078

## STEP 191

Install the 6-pin connector on the blower speed driver. Install the two screws to secure the driver and its mounting plate at the rear of the box.



RD02G074

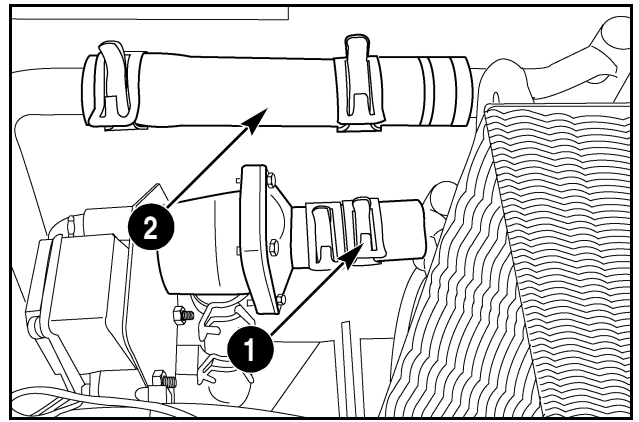


RD02G073

### STEP 192

Connect the short hose (1) from the heater valve to the evaporator/heater core. Pinch the clamp to open it and secure the hose at the evaporator line.

Connect the heater return line (2) to the evaporator heater core and secure with the clamp.

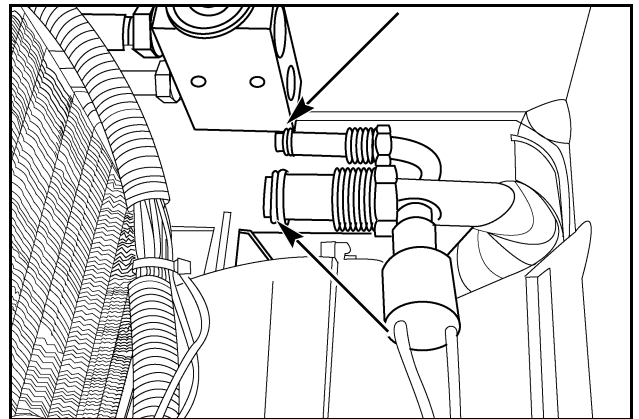


RD02G124

### STEP 193

Remove the caps or plugs from the liquid and suction lines to the thermal expansion valve.

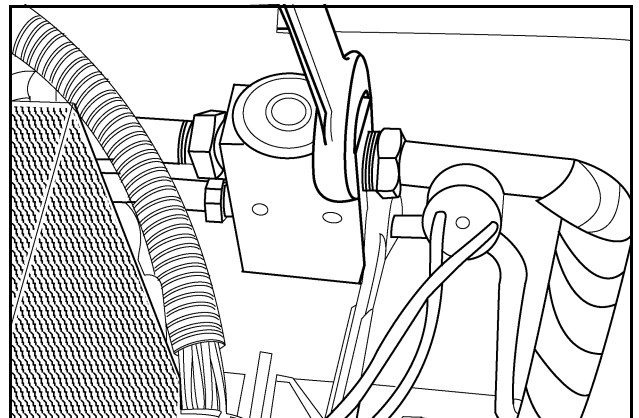
Install new O-rings on the lines before reconnecting. Lubricate the O-rings with clean mineral oil prior to installation.



RD02G106

### STEP 194

Using the two hand, two wrench method, reconnect the air conditioning suction and liquid lines to the valve.



RD02G104

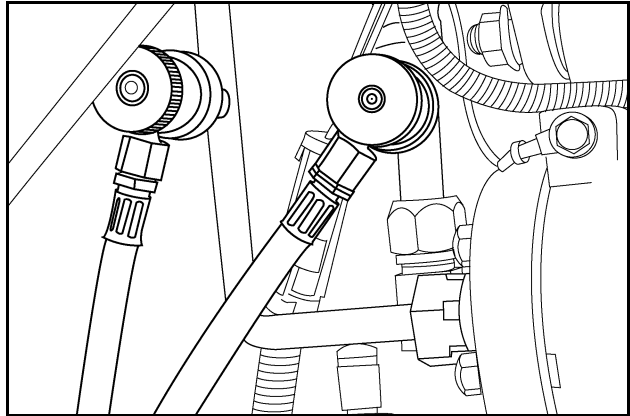
## Post Replacement Procedures

### STEP 195

Since the evaporator assembly has been replaced, adjust compressor oil level.

Evacuate and charge the air conditioning system. Test system performance following procedures on the foldout.

Leak test the valve and evaporator connections with OEM1437.

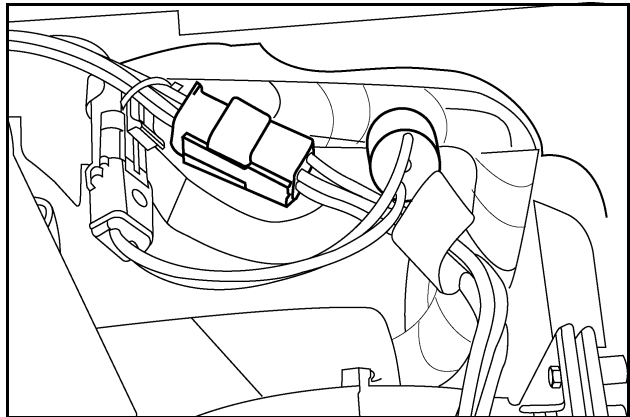


RD02H029

### STEP 196

The thermal expansion valve and line along with the inlet and outlet to the evaporator must be insulated for maximum evaporator performance. Apply thermal insulation tape around the expansion valve, connectors, and the inlet and outlet lines of the evaporator.

**NOTE:** The thermal insulation tape is available in 30 ft (9150 mm) bulk rolls - 1954475C1 - 0.12 x 2.5 inches x 30 ft (3 x 63.5 x 9150 mm).



RD02G096

### STEP 197

To remove air from the cooling system after installation of a replacement evaporator/heater assembly:

- A. Fill the radiator completely and fill the coolant recovery bottle to the full line.
- B. Operate the engine for 10 minutes.
- C. Stop the engine and allow the radiator to cool.
- D. Top off radiator and recovery bottle.

## EVAPORATOR/HEATER ASSEMBLY SEALING AND CLEANING

### Sealing

The top and bottom of the evaporator/heater assembly must be properly sealed to allow air movement through the assembly but not around it.

Check the condition of the foam seal on the top of the assembly where it seals with the HVAC box cover.

Check the condition of the sealing strip at the front of the evaporator/heater bottom.

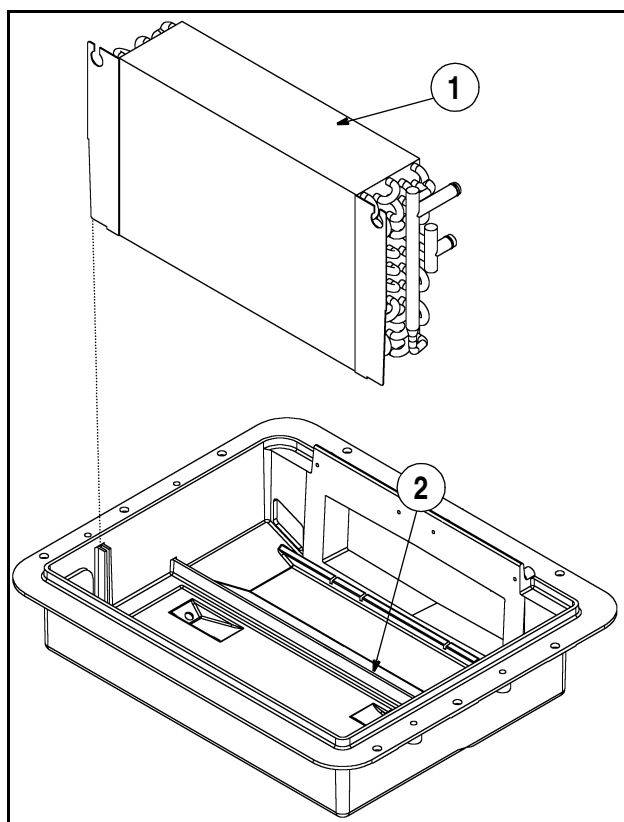
Replace/repair any seal which has deteriorated with age or which no longer seals properly.

### Cleaning

If the evaporator/heater assembly is plugged with dirt and debris, locate the source of the debris, correct and then clean the assembly. See **CAB PRESSURIZATION TEST**, page 111.

If the assembly is dry, clean with low pressure compressed air. If the assembly is wet, flush with water using a low pressure hose.

**NOTE:** Check that the condensate drain valves are not plugged before cleaning the assembly with low pressure wash.

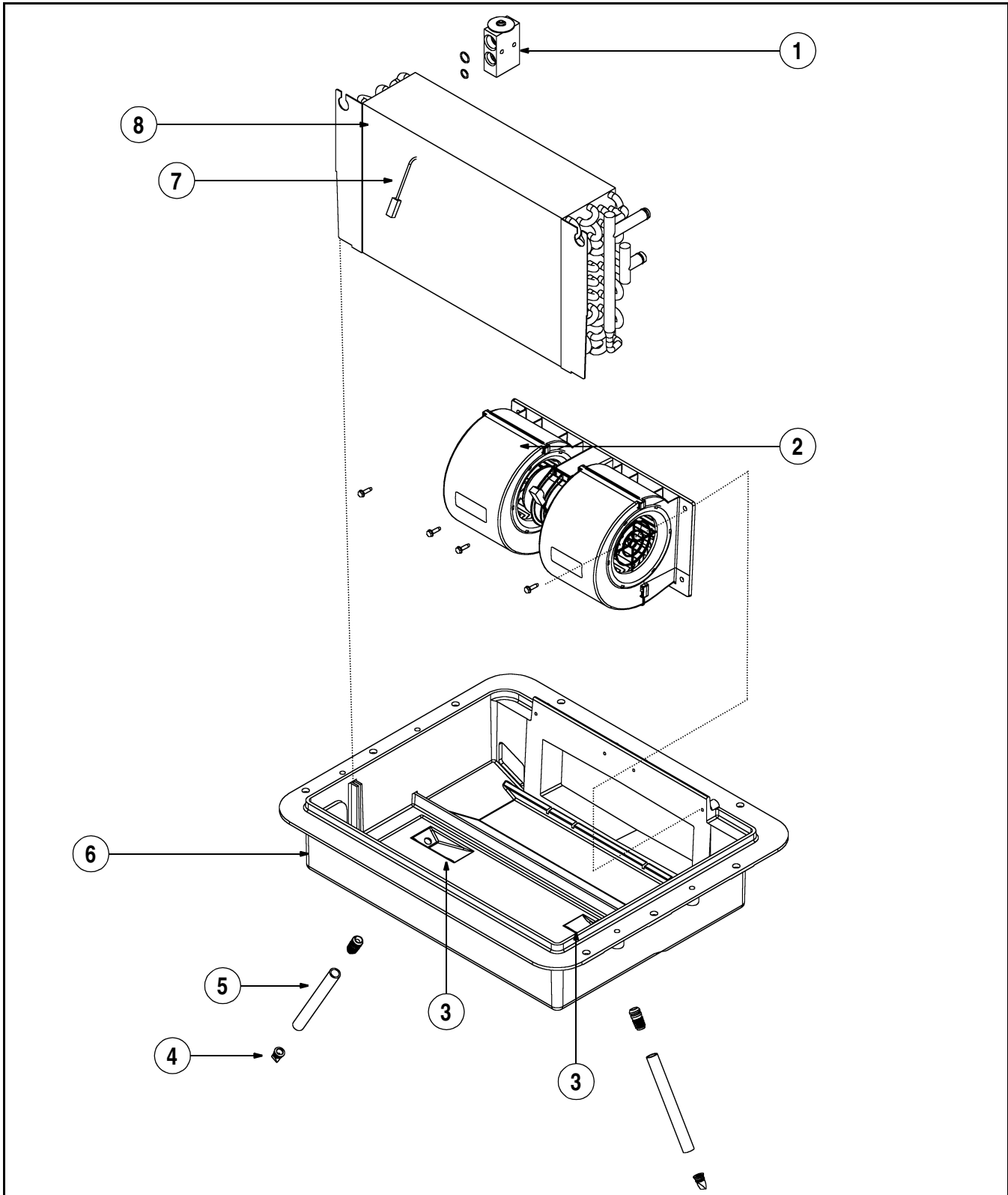


RH01G098

1. TOP FOAM SEAL

2. SEALING STRIP

## BLOWER AND EVAPORATOR REFERENCE ILLUSTRATION



RI99D080

- |                            |                            |                           |
|----------------------------|----------------------------|---------------------------|
| 1. THERMAL EXPANSION VALVE | 4. CHECK VALVE             | 7. EVAPORATOR TEMP SENSOR |
| 2. BLOWER MOTOR            | 5. CONDENSATE DRAIN TUBE   | 8. EVAPORATOR CORE        |
| 3. BOX DRAINAGE            | 6. EVAPORATOR BOX ASSEMBLY |                           |

## CONTROLLER AND BLOWER SPEED DRIVER REPLACEMENT

### ATC Controller

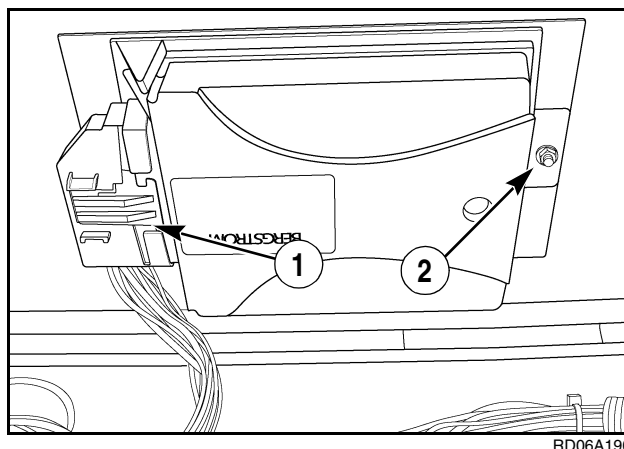
#### STEP 198

With the ignition switch in the OFF position, to replace the ATC controller:

- A. See **ACCESSING THE HVAC BOX**, page 90.
- B. Disconnect the multi-pin wiring harnesses (1) connected to the ATC controller.

**IMPORTANT:** *Do not touch exposed pins on ATC controller to avoid static electricity voltage spikes. Voltage spikes may result in equipment damage.*

- C. Remove the nut (2) securing the ATC controller and remove the controller.
- D. Install a new ATC controller using the existing hardware. Reconnect the harnesses. Reinstall the seat with existing hardware.



### Standard A/C Controller

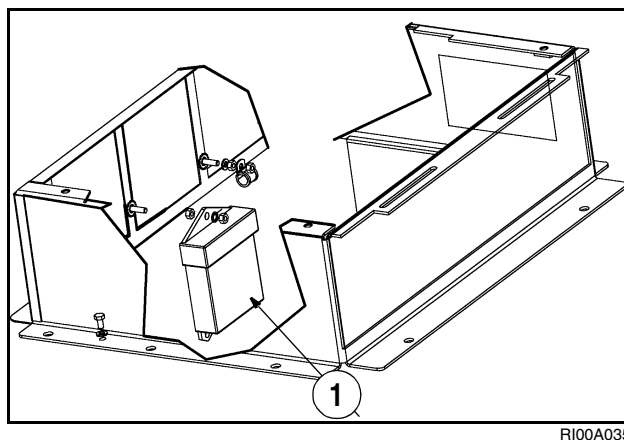
#### STEP 199

The standard A/C controller is located behind the evaporator and is mounted to the rear of the HVAC upper case. With the ignition switch in the OFF position, to replace the standard controller:

- A. See **ACCESSING THE HVAC BOX**, page 90.
- B. Disconnect the 6 pin and 5 pin wiring harnesses connected to the standard controller.

**IMPORTANT:** *Do not touch exposed pins on the controller to avoid static electricity voltage spikes. Voltage spikes may result in equipment damage.*

- C. Remove the single nut securing the controller to the mounting stud and remove the controller.
- D. Install a new controller using the existing hardware. Reconnect the harnesses. Reinstall the seat with existing hardware.

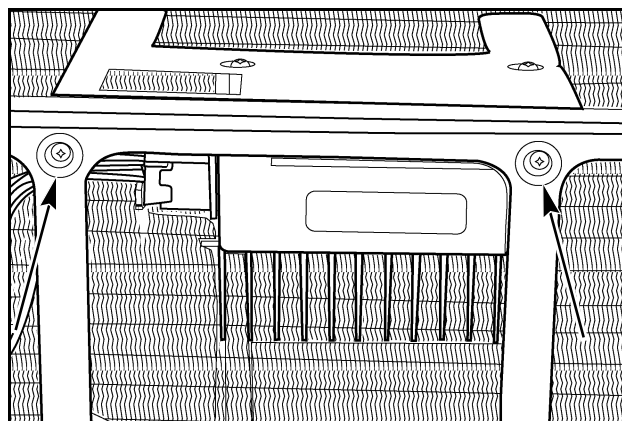


## Blower Speed Driver (ATC Units Only)

### STEP 200

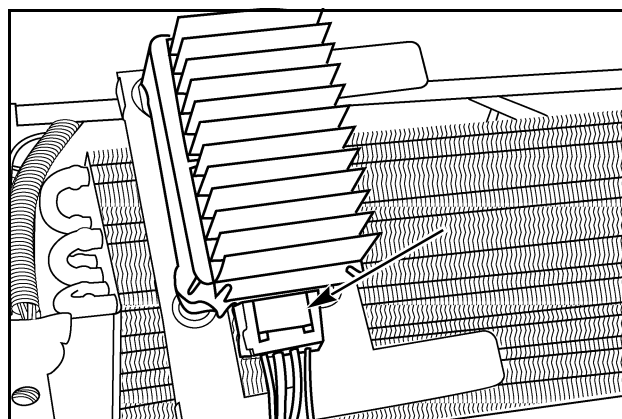
To replace the blower speed driver in ATC systems, with the keyswitch in the OFF position:

- A. See **ACCESSING THE HVAC BOX**, page 90.
- B. Remove the two screws securing the blower speed driver assembly to the rear of the HVAC box.



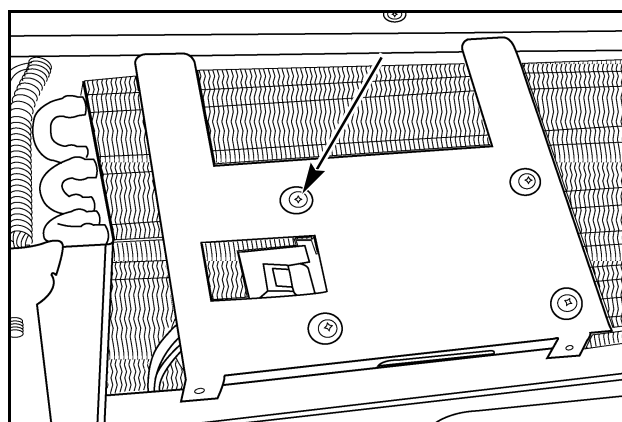
RD02G073

- C. Disconnect the six pin connector to the blower speed driver.



RD02G074

- D. Remove the four screws securing the driver to the mounting plate.
- E. Install a new blower speed driver with the existing hardware. Install the 6-pin connector on the driver, and secure the assembly to the HVAC box rear with the two screws removed earlier. Reinstall the seat.



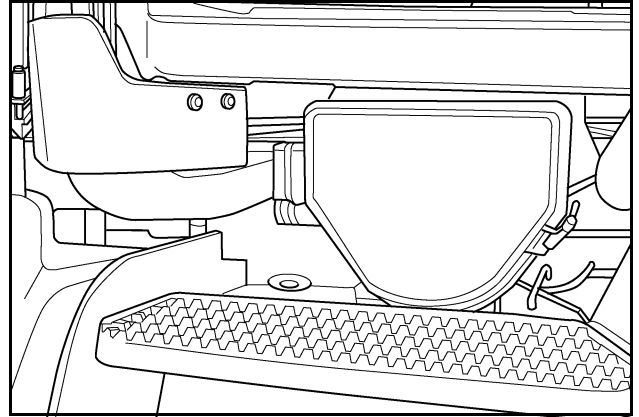
RD02G076

## CAB AIR FILTER SERVICE

**NOTE:** The cab intake air filter will need service at different intervals according to local operating conditions. Clean the filter as required. Replace the filter if there is damage or when the filter cannot be cleaned for efficient operation.

### STEP 201

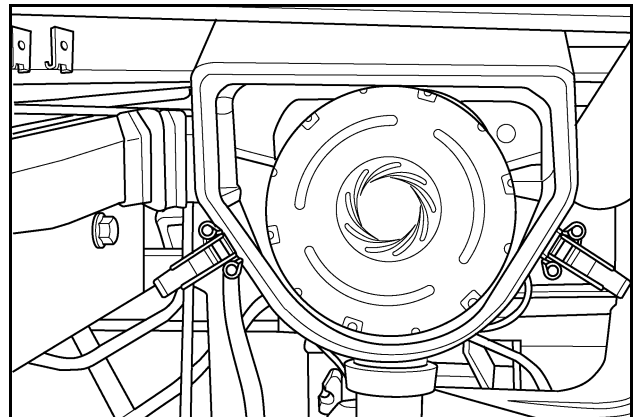
The cab air filter is located under the cab entry door. The cab pressurizer blower draws outside air from the vents in the cab cap through the filter and feeds it directly to the HVAC box.



RH02H196

### STEP 202

Open the two retaining clamps and remove the cover.

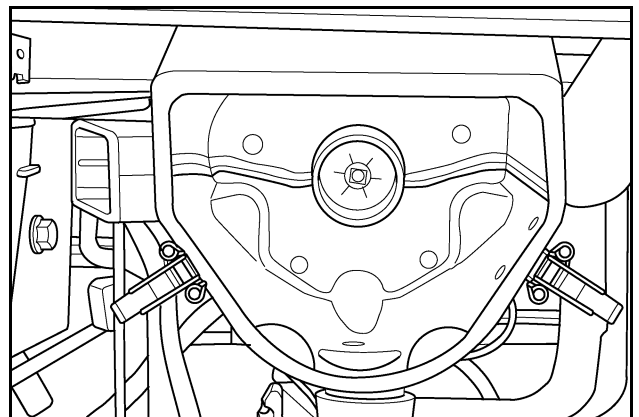


RH02H198

### STEP 203

Pull the filter straight out. Clean the inside of the filter housing.

Install a new filter by pushing straight in until it seats in the upper gasket. Close the cover and the retaining clamps.



RH02H199



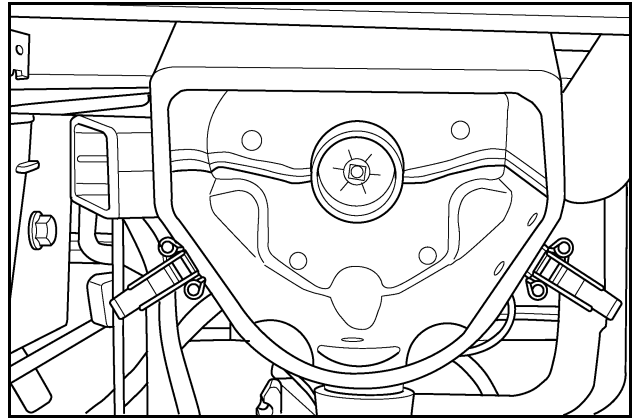
## STEP 204

Clean the filter element by one of two methods:

- A. Tap the outside of the filter. This method can be used to clean the filter when most of the dirt is dust. Tap the filter against a flat surface. Do not use force that can cause damage to the filter.
- B. Clean with compressed air. The compressed air method is used if most of the dirt is dust. Direct the air flow from the inside of the filter outward.

**IMPORTANT:** *The maximum air pressure at the nozzle must not be more than 35 PSI (242 kPa). Too much air pressure will cause damage to the filter.*

**IMPORTANT:** *Do not use a washing method with filter washing compound to clean the filter.*

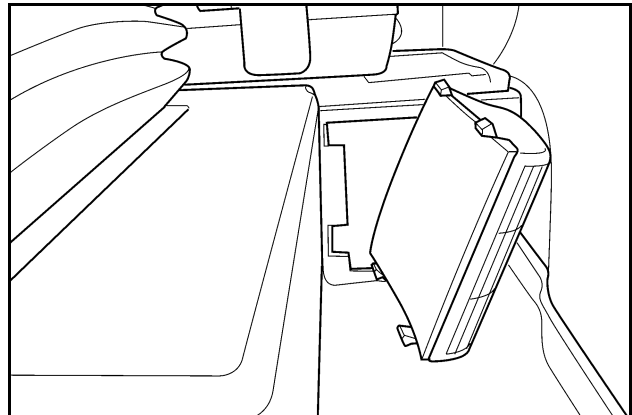


RH02H199

## CAB RECIRCULATION AIR FILTER SERVICE

### STEP 205

- A. Remove the vent and the recirculation air filter on both sides of the operators seat.
- B. Clean the filter as frequently as required by operating conditions or whenever the cab air filter is serviced.
- C. Use mild soap and water. Rinse with clear water and squeeze out the excess.
- D. Reinstall the filters and vents.



RH02J130

**NOTE:** *Never place objects in front of the recirculation vents that could block air flow.*

## CAB PRESSURIZATION TEST

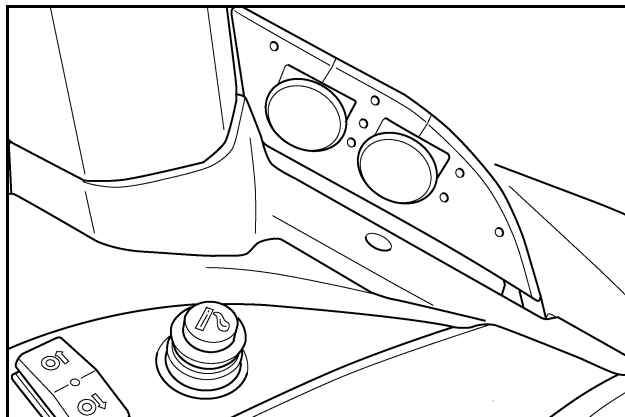
**NOTE:** Perform the cab pressurization test whenever an unusual amount of dirt accumulates in the cab or in the evaporator box or if the evaporator core is plugged.

**NOTE:** When performing this test, the door and window must be closed and latched.

### STEP 206

Insert the sensing tube from a digital manometer through the access panel in the right hand corner of the rear cab window provided for monitor harness routing between the cab and the implement.

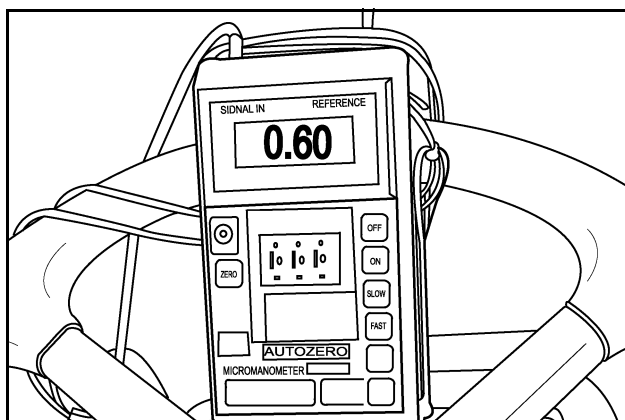
**NOTE:** Do not attempt this test through the door since the metal reinforcement in the seal will pinch off the sensing tube.



RH02H175

### STEP 207

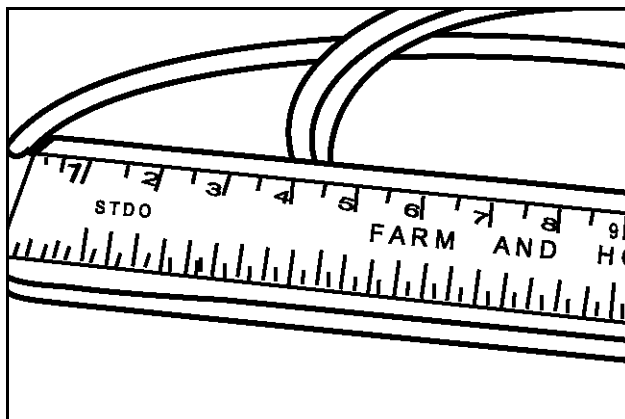
Start the engine. Take a reading from the digital manometer. Cab pressurization must be between 0.25 (6 mm) and 1 inch (25.4 mm) of H<sub>2</sub>O.



RD03B168

### STEP 208

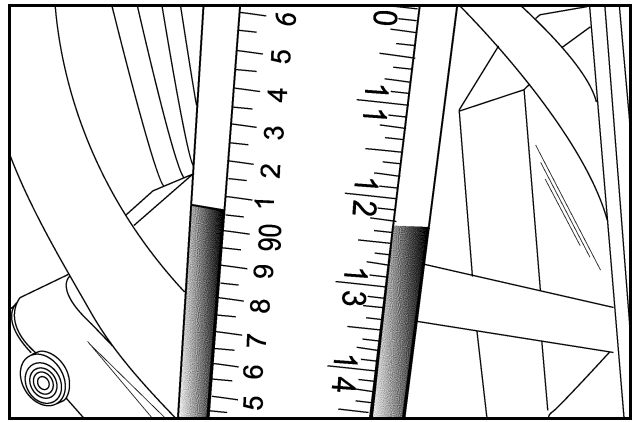
If a digital manometer is not available, a simple one can be made with 8 ft (2.8 m) of 3/8 inch OD clear vinyl tubing and a yard stick. Tape the vinyl tubing to a yard stick as shown.



RD99M029

## STEP 209

Partially fill the looped section of tubing with water. (Food coloring may be added to the water to improve visibility.)

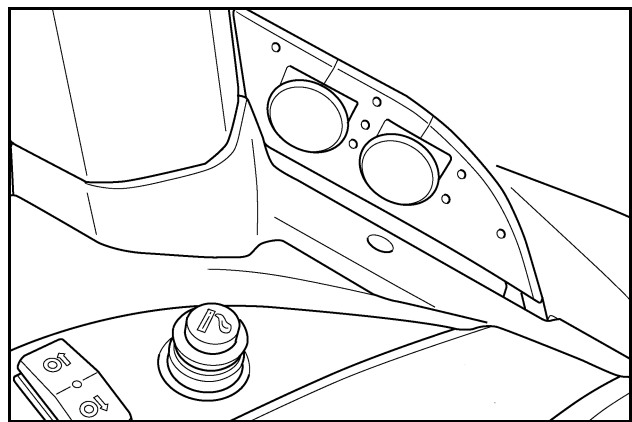


RD99M025

## STEP 210

Insert the long end of the tube through the access panel in the right hand corner of the rear cab window provided for monitor harness routing between the cab and the implement.

**NOTE:** Do not attempt this test through the door since the metal reinforcement in the seal will pinch off the sensing tube.



RH02H175

## STEP 211

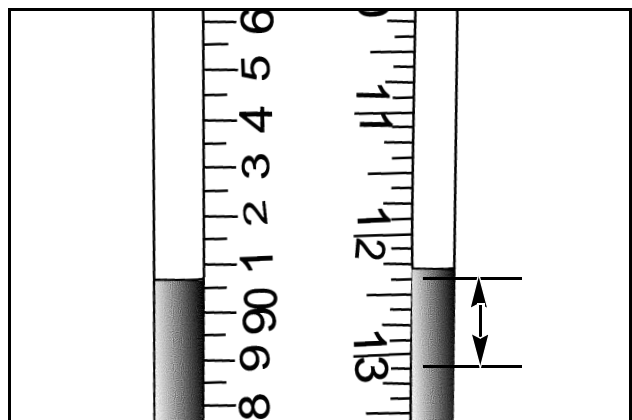
Hold the yard stick vertical. Record the water level reading without the engine running. Start the engine and measure the movement of water on one side of the yard stick. Multiply that value by two. Cab pressurization must be between 0.25 (6 mm) and 1 inch (25.4 mm) of  $H_2O$ .

## STEP 212

If the reading is below 0.25 inch of  $H_2O$ , check the following seals and retest:

- Door and rear window seals
- Window seals
- Customer supplied radio/telephone antenna cable routing

If the reading is above 1 inch (25.4 mm) of  $H_2O$ , check for extra cab sealing, missing filter or broken fresh air inlet.



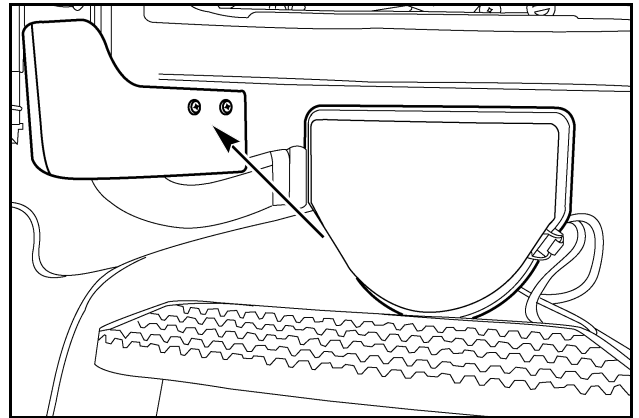
RD99M027

## CAB PRESSURIZER MOTOR REPLACEMENT

**NOTE:** The cab pressurizer motor is located under the cab entry and behind the cab air filter. To replace the motor/blower assembly, the cab fresh air filter must be removed.

### STEP 213

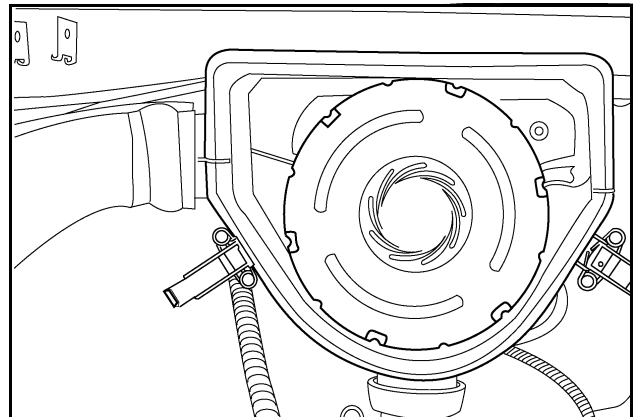
Remove the two screws and remove the trim panel at the filter front.



RD02E266

### STEP 214

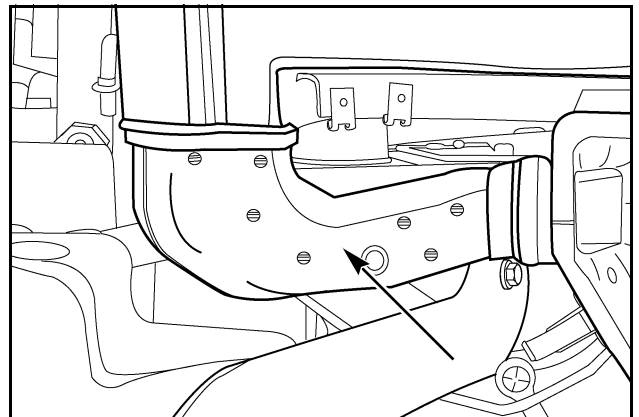
Open the two clamps and remove the cover for the fresh air filter.



RD02E268

### STEP 215

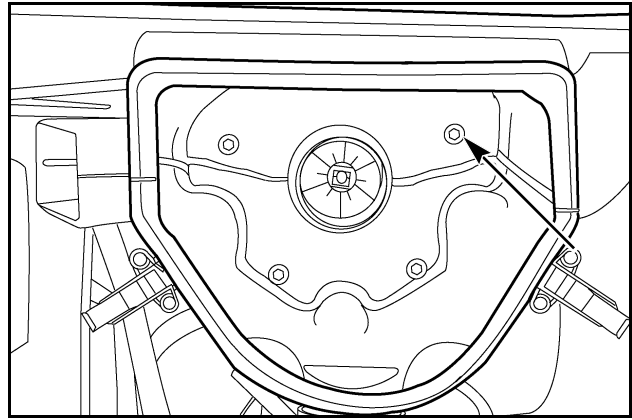
Remove the air intake line from the cab filter housing the post. Remove the filter.



RD02E269

### STEP 216

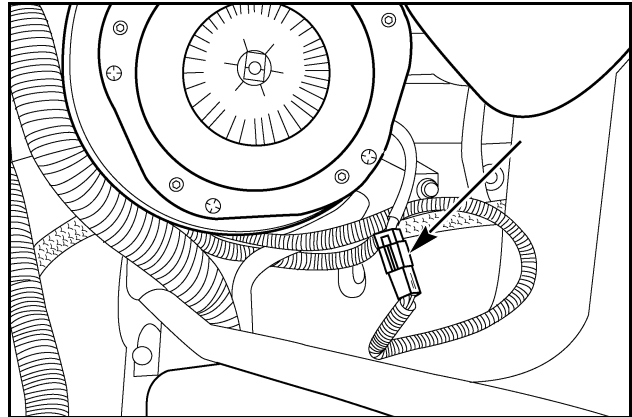
Remove the four bolts and remove the filter housing.



RD02E270

### STEP 217

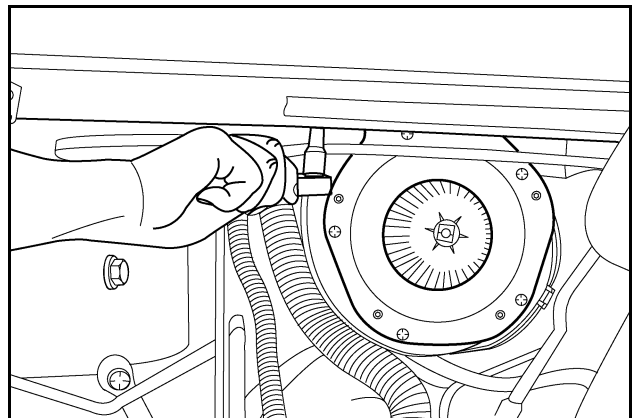
Disconnect the motor assembly from the harness.



RD02E272

### STEP 218

Remove the bolt, nut and washer and remove the assembly from the tractor.



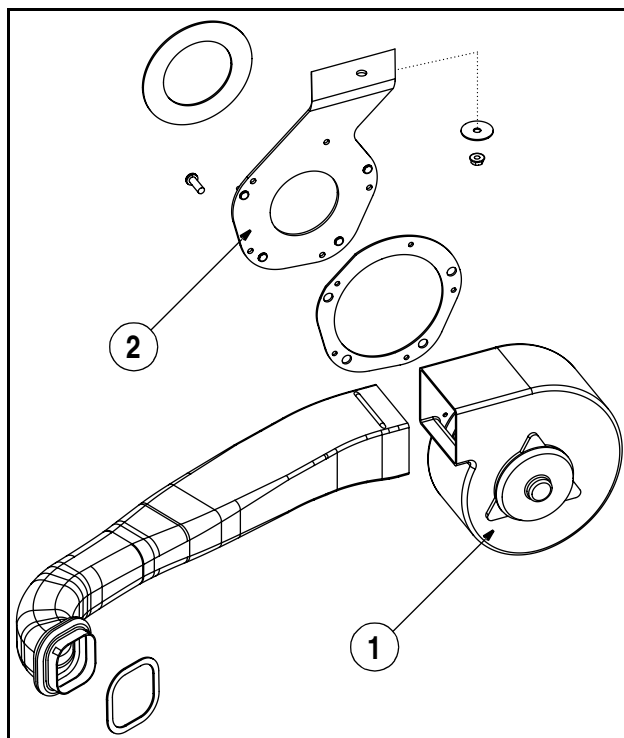
RD02E273

### STEP 219

Remove the four screws to disconnect the motor/blower assembly (1) from the mounting bracket (2).

### STEP 220

Reverse the steps to install a replacement motor/blower assembly.



RI03B043

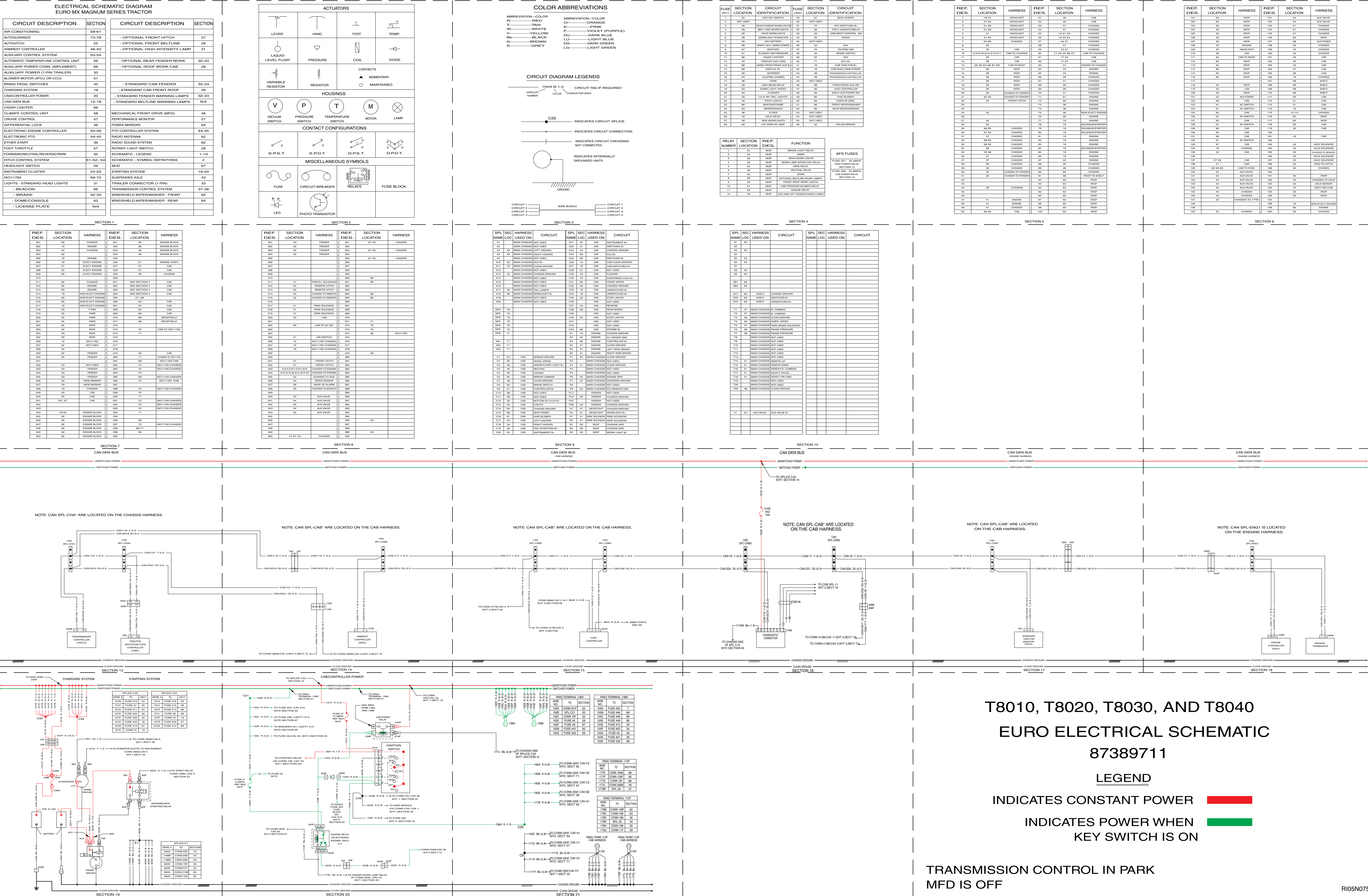
## VISCOUS FAN DRIVE

Since the viscous fan creates air flow at the condenser, a properly functioning fan drive is essential to proper air conditioning performance. A defective fan drive can cause engine overheating and/or high pressure switch activation. But a plugged grille, radiator, condenser and oil cooler can also cause the same.

To separate a fan drive problem from other possible causes, perform the **Viscous Fan Drive Test** in this manual.

**NOTE:** *When performing the viscous fan drive test, the air conditioning system should be OFF.*





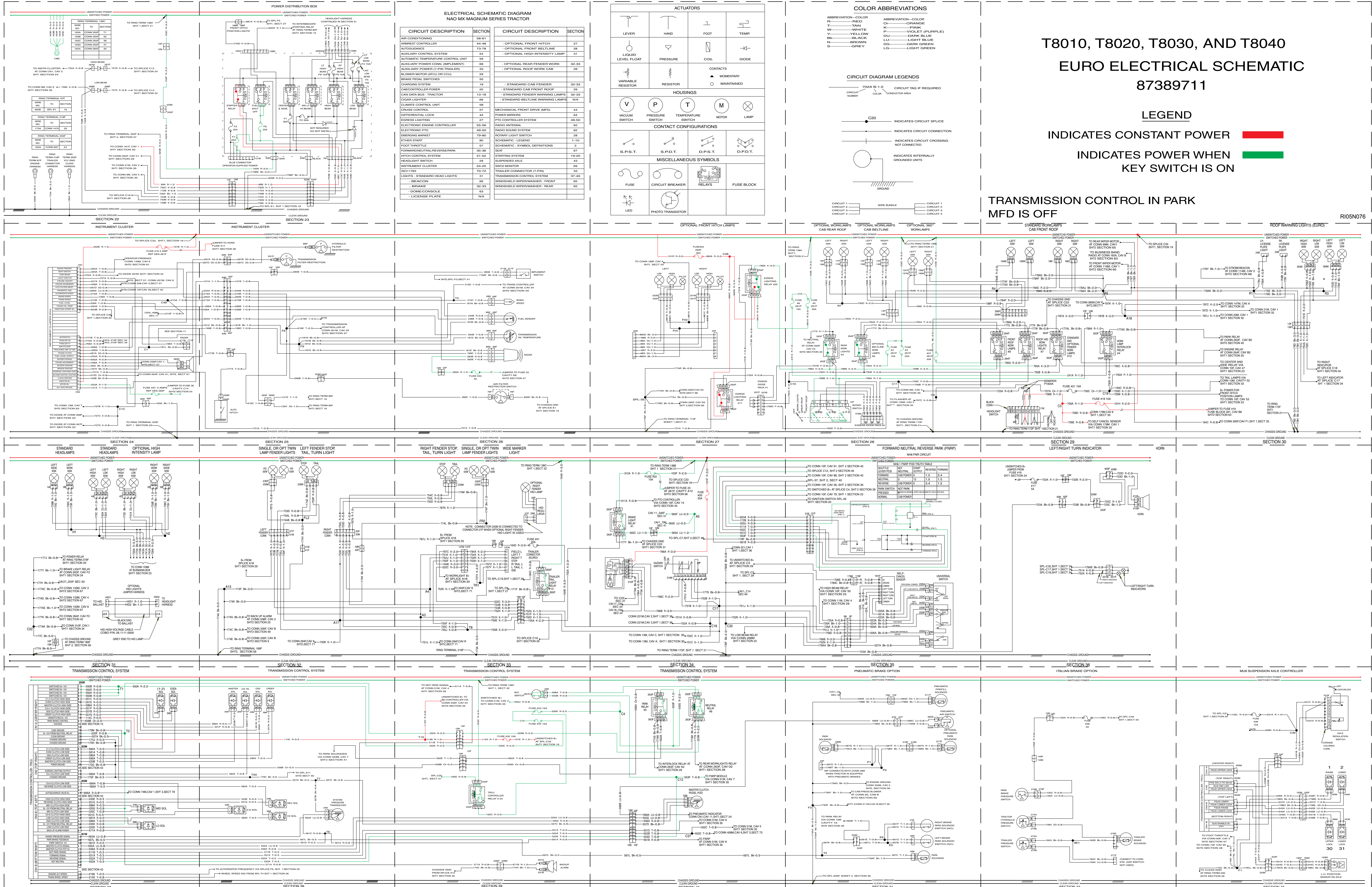


# T8010, T8020, T8030, AND T8040 EURO ELECTRICAL SCHEMATIC 87389711

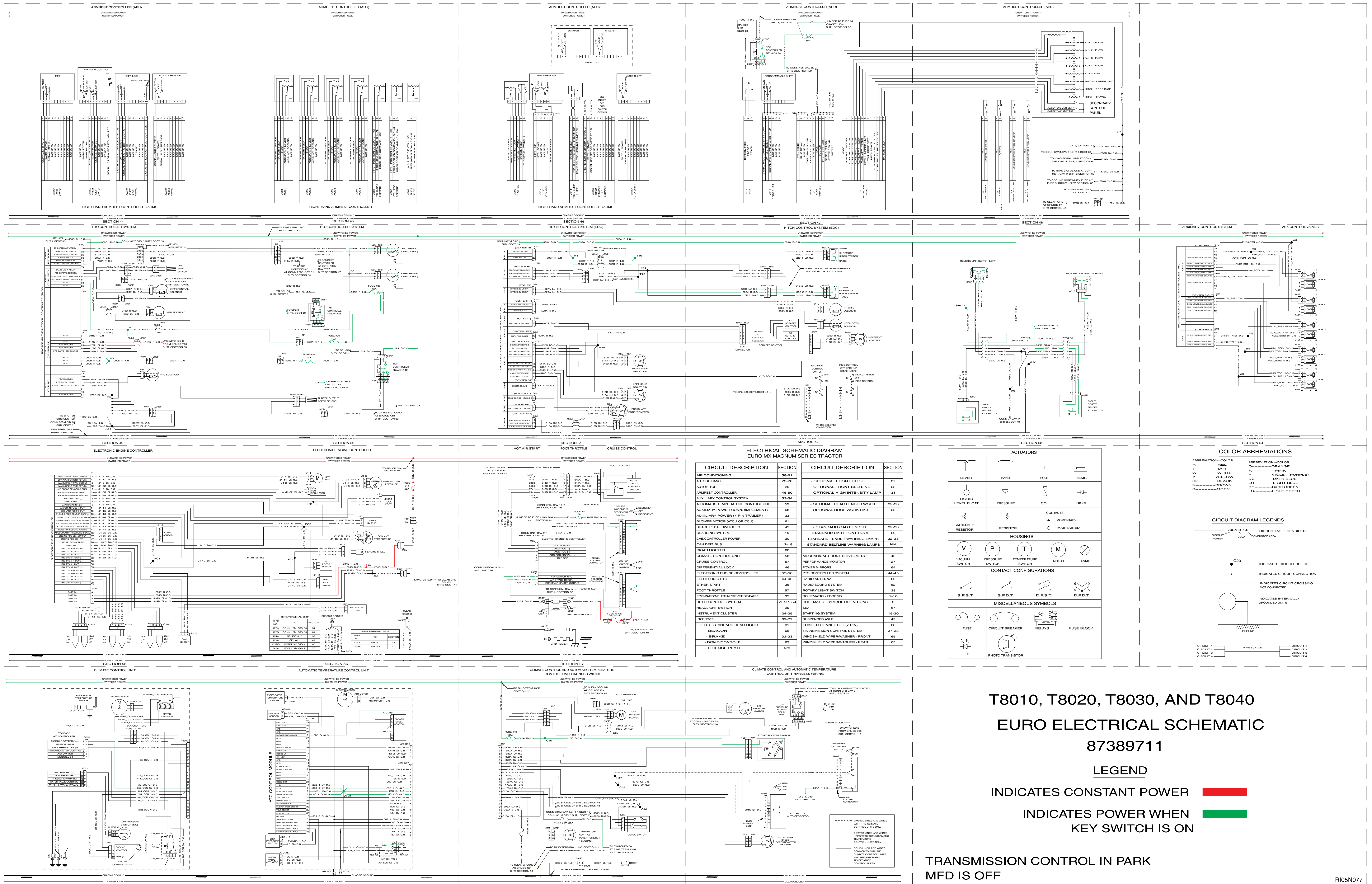
LEGEND  
INDICATES CONSTANT POWER  
INDICATES POWER WHEN  
KEY SWITCH IS ON

TRANSMISSION CONTROL IN PARK  
MFD IS OFF

RI05N076







# T8010, T8020, T8030, AND T8040

## EURO ELECTRICAL SCHEMATIC

### 87389711

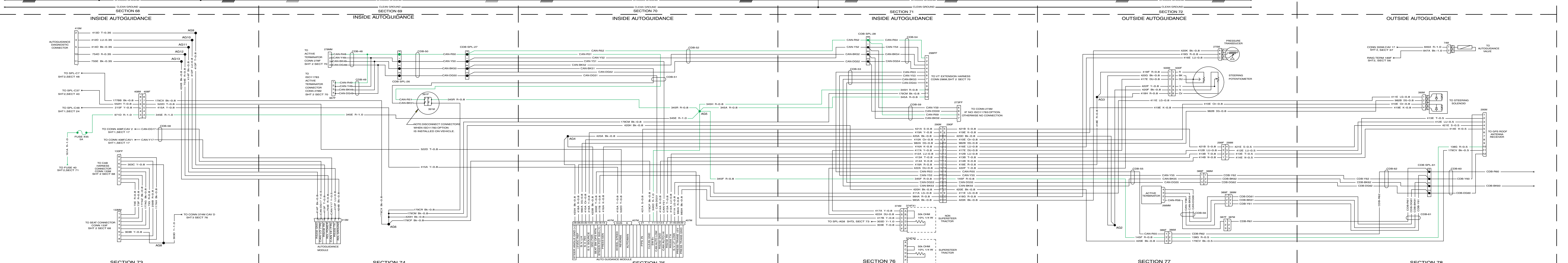
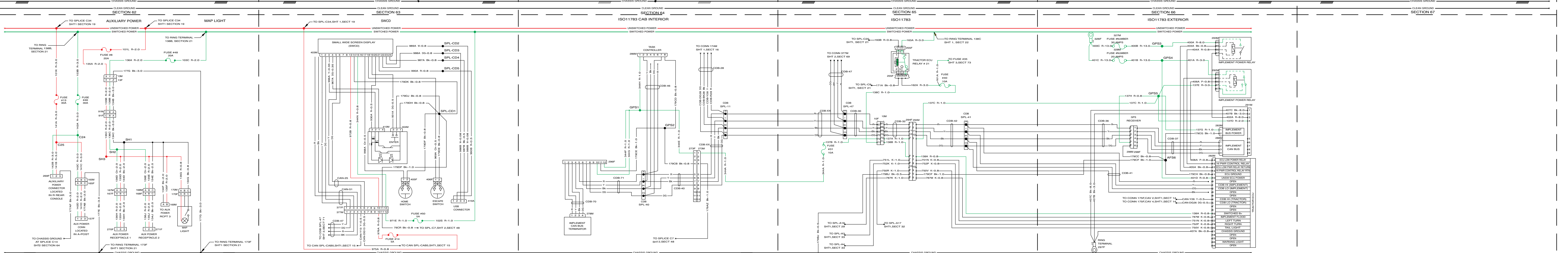
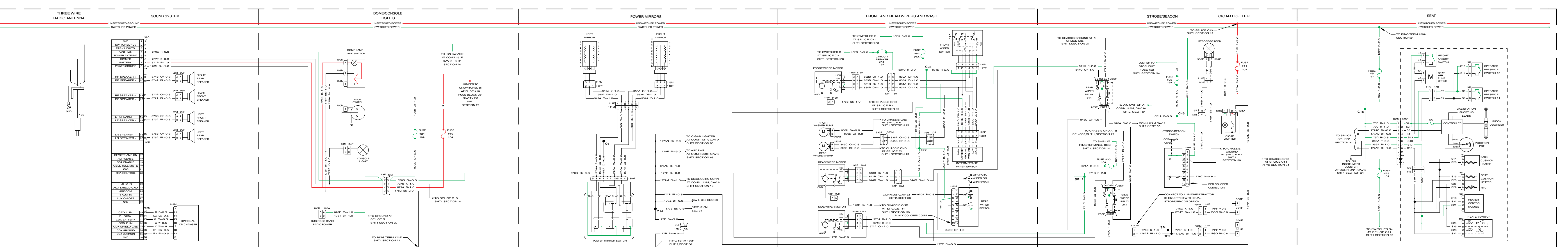
LEGEND

INDICATES CONSTANT POWER

INDICATES POWER WHEN KEY SWITCH IS ON

TRANSMISSION CONTROL IN PARK  
MFD IS OFF





CIRCUIT DESCRIPTION	SECTION	CIRCUIT DESCRIPTION	SECTION
AIR CONDITIONING	58-61	- OPTIONAL FRONT HITCH	27
AUTOGUIDANCE	73-78	- OPTIONAL FRONT BELTLINE	28
AUTOMATCH	25	- OPTIONAL HIGH INTENSITY LAMP	31
ARMREST CONTROLLER	46-50	- OPTIONAL REAR FENDER WORK	32-33
AUXILIARY CONTROL SYSTEM	53-54	- OPTIONAL ROOF WORK CAB	28
AUTOMATIC TEMPERATURE CONTROL UNIT	56		
AUXILIARY POWER CONN. (IMPLEMENT)	68		
AUXILIARY POWER (7-PIN TRAILER)	33		
BLOWER MOTOR (ATCU OR DCU)	61		
BRAKE PEDAL SWITCHES	45	- STANDARD CAB FENDER	32-33
CHARGING SYSTEM	19	- STANDARD CAB FRONT ROOF	29
CAB/CONTROLLER POWER	20	- STANDARD FENDER WARNING LAMPS	32-33
CAN DATA BUS	12-18	- STANDARD BELTLINE WARNING LAMPS	N/A
CIGAR LIGHTER	66		
CLIMATE CONTROL UNIT	58	- STANDARD CAB FRONT DRIVE	46
CRUISE CONTROL	57	PERFORMANCE MONITOR	27
DIFFERENTIAL LOCK	46		
ELECTRONIC ENGINE CONTROLLER	55-56	PTO CONTROLLER SYSTEM	44-45
ELECTRONIC PTO	44-45	RADIO ANTENNA	62
ETHER START	36	RADIO SOUND SYSTEM	62
FOOT THROTTLE	57	ROTARY LIGHT SWITCH	28
FORWARD/NEUTRAL/REVERSE/PARK	35	SCHEMATIC - LEGEND	1-10
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ISO11783	69-72	SUSPENDED AXLE	43
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- BEACON	66	TRANSMISSION CONTROL SYSTEM	37-38
- BRAKE	32-33	WINDSHIELD WIPER/WASHER - FRONT	65
- DOME/CONSOLE	63	WINDSHIELD WIPER/WASHER - REAR	65
- LICENSE PLATE	N/A		

ACTUATORS			
LEVIER	HAND	FOOT	TEMP
LIQUID LEVEL FLOAT	PRESSURE	COIL	DIODE
VARIABLE RESISTOR	RESISTOR	CONTACTS	
		▲	MOMENTARY
		○	MAINTAINED
HOUSINGS			
V	P	T	M
VACUUM SWITCH	PRESSURE SWITCH	TEMPERATURE SWITCH	MOTOR
CONTACT CONFIGURATIONS			
S.P.S.T.	S.P.D.T.	D.P.S.T.	D.P.D.T.
MISCELLANEOUS SYMBOLS			
FUSE	CIRCUIT BREAKER	RELAYS	FUSE BLOCK
LED	PHOTO TRANSISTOR		

COLOR ABBREVIATIONS			
ABBREVIATION - COLOR			
R	RED	O	ORANGE
T	TAN	K	PINK
W	WHITE	V	VIOLET (PURPLE)
Y	YELLOW	D	DARK BLUE
BK	BLACK	LU	LIGHT BLUE
N	BROWN	DG	DARK GREEN
G	GREY	LG	LIGHT GREEN

**CIRCUIT DIAGRAM LEGENDS**

702A B-1.0      CIRCUIT TAG IF REQUIRED

CIRCUIT NUMBER      COLOR      CONDUCTOR AREA

● C20      INDICATES CIRCUIT SPLICE

—      INDICATES CIRCUIT CONNECTION

—      INDICATES CIRCUIT CROSSING NOT CONNECTED

○      INDICATES INTERNALLY GROUNDED UNITS

GROUND

CIRCUIT 1      WIRE BUNDLE      CIRCUIT 1

CIRCUIT 2      CIRCUIT 2

CIRCUIT 3      CIRCUIT 3

CIRCUIT 4      CIRCUIT 4

# T8010, T8020, T8030, AND T8040

## EURO ELECTRICAL SCHEMATIC

### 87389711

**LEGEND**

INDICATES CONSTANT POWER

INDICATES POWER WHEN KEY SWITCH IS ON

TRANSMISSION CONTROL IN PARK  
MFD IS OFF

R105N078

# **Section 55**

## **Chapter 1**

### **ELECTRICAL SYSTEM**

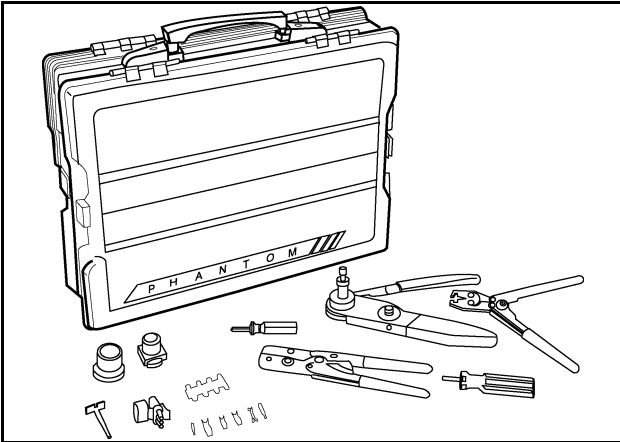
#### **How It Works And Troubleshooting**

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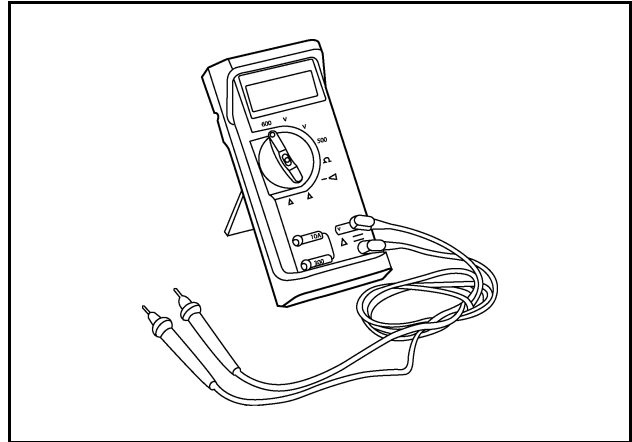
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## SPECIAL TOOLS



RD05C001

Electrical Connector and Terminal Repair Kit AJI1400004. See the Parts Merchandiser Catalog for ordering information and identification of components.



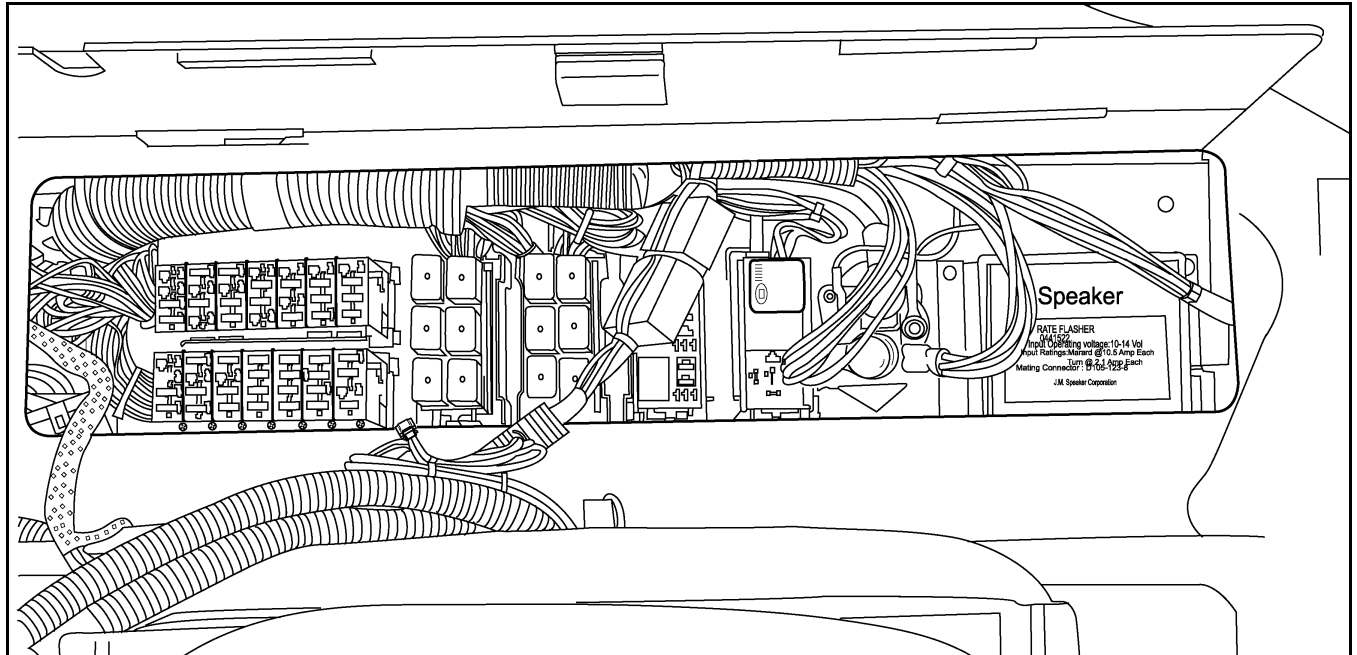
RD05C002

Digital Multimeter CAS-1559.

## FUSES AND RELAY IDENTIFICATION

### Cab Fuses/Relay Location

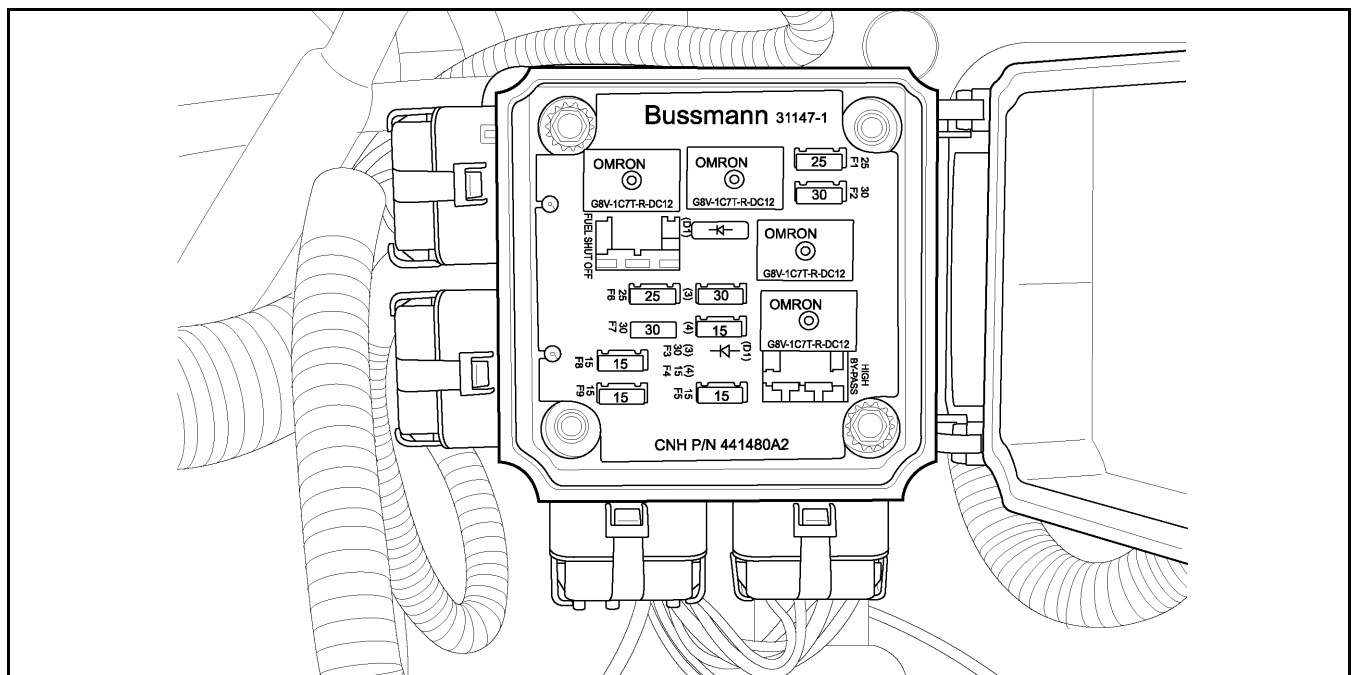
Fuses and relays are located to the rear of the operator's seat, under the floor cover mat and metal cover.



RD02E266

### Engine Compartment Fuse/Relay Identification (Power Distribution Box)

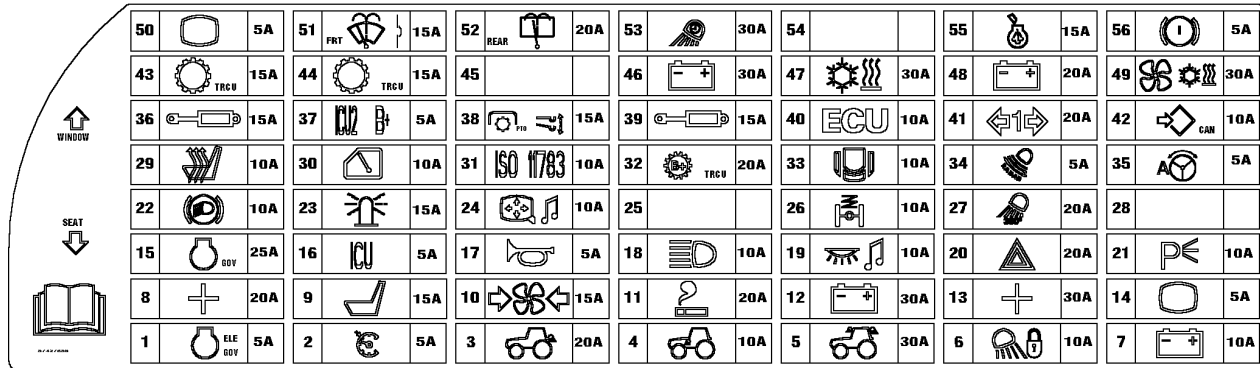
Additional fuses and relays are located in the Power Distribution box on the left hand side of the tractor engine.



RD05J114



## Fuse Identification



RI05G042

Fuse No.	Circuit	Fuse Amp
1	Electronic Governor	5
2	Constant Engine Speed	5
3	Rear Fender Worklights	20
4	Beltline Worklights	30
5	Roof Worklights	30
6	Worklight/Headlight Interlock	10
7	Battery Power to Key Switch	10
8	Headliner Shelf Auxiliary Power/3-Pin/Cigar Outlets (1)	20
9	Seat Power & Operator Presence	15
10	Cab Pressurizer Blower	15
11	Cigar Lighter/RH Fender Console	20
12	Exterior 7-Pin Connector (2)	30
13	RH Front Post/RH Fender 3-Pin Auxiliary Connectors (1)	30
14	Virtual Terminal	5
15	Governor	25
16	Instrumentation Cluster (2)	5
17	Horn	5
18	Battery Power to Headlight Switch	10
19	Dome Light/Map Light/Radio (1)	10
20	Amber Flashers	20
21	Tail Lights	10
22	Stop Lights	10
23	Beacon	15
24	Power Mirror/Radio	10
25	Blank	
26	Suspended Axle B+	10
27	Side Roof HID Lamps	20
28	Blank	
29	Seat Heater	10
30	Side Wiper	10

Fuse No.	Circuit	Fuse Amp
31	ISO 17783	10
32	Trans Controller B+	20
33	RH Armrest Controller (2)	10
34	True Ground Radar	5
35	Autoguidance	5
36	TMF Remote System Controller	15
37	Instrumentation Cluster (2)	5
38	TMF PTO/Diff Lock/FWD System	10
39	TMF Hitch System Controller	10
40	ECU Controller	10
41	Trailer Tail Lamps	20
42	Data Bus Diagnostic Connector	10
43	Transmission Controller	15
44	Transmission Controller	15
45	Blank	
46	RH Front Post/RH Fender 3-Pin Connectors (2)	30
47	HVAC Controller	30
48	Headliner Shelf 3-Pin Connectors (2)	20
49	HVAC Blower	30
50	SWDC Monitor	5
51*	Front Wiper/Washer	15
52	Rear Wiper/Washer	15
53	Egress Lighting	30
54	Blank	
55	Emerging Market	15
56	Italian Brakes	5

(1) - Unswitched power (Continuous).

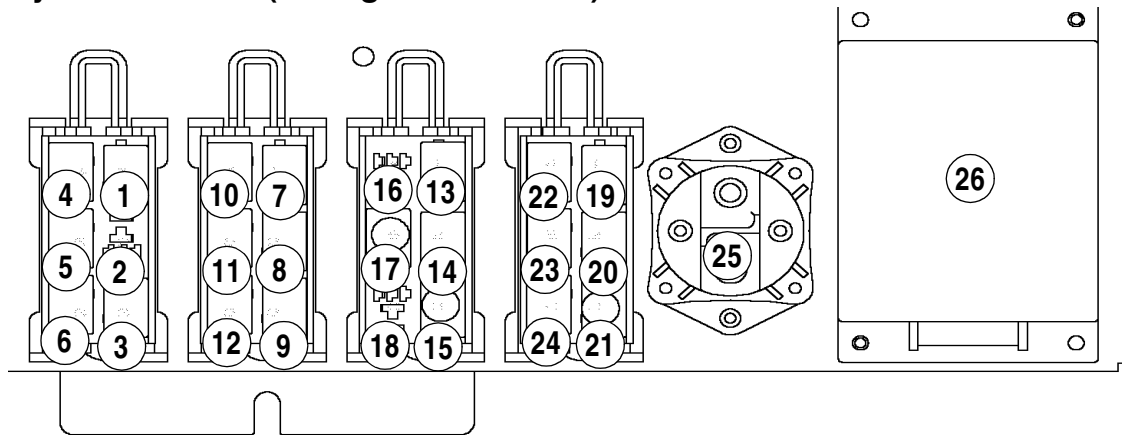
(2)- Power available when keyswitch is in "ON" position.

\* = Circuit Breaker

## Relays

The 20 amp relays are located to the rear of the operator's seat, under the floor cover mat and metal cover.

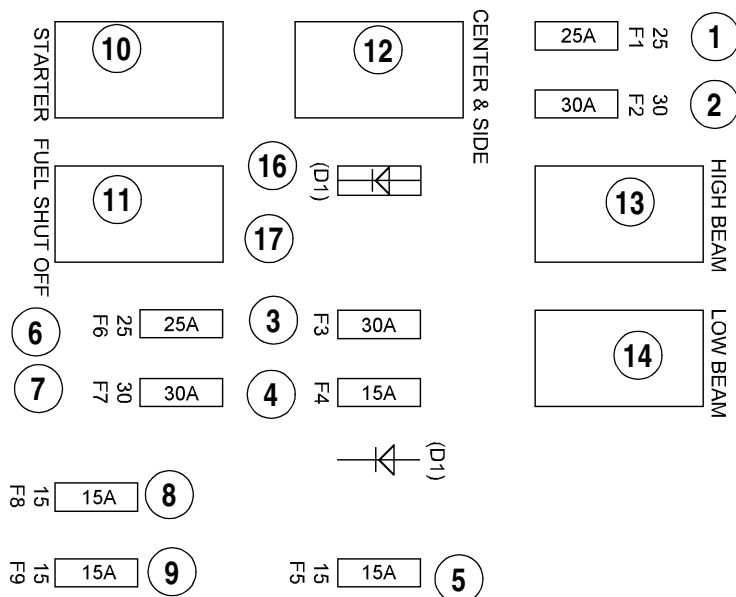
### Cab Relay Identification (Facing Rear Window)



RI05G040

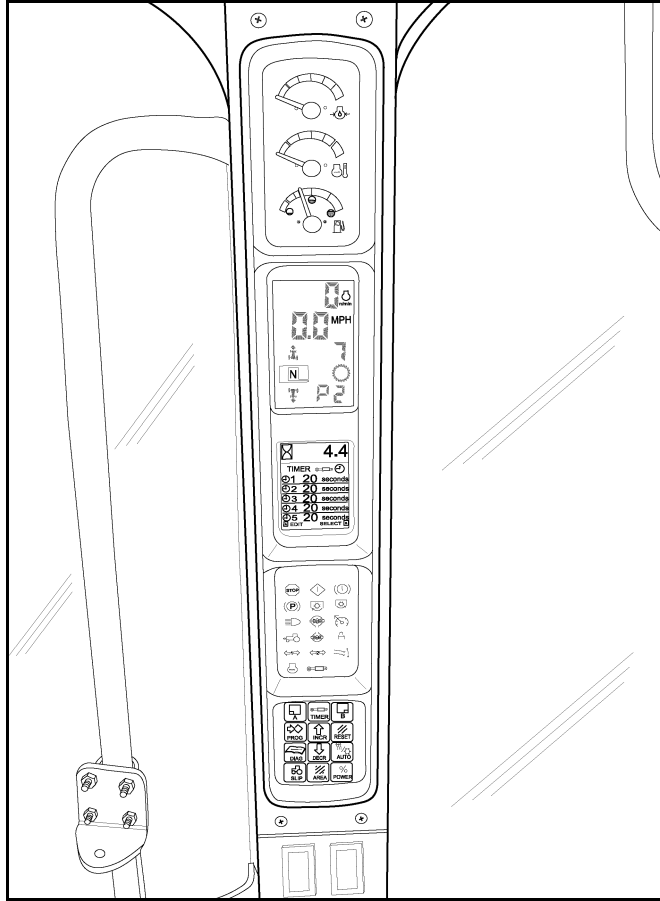
- |                          |                            |                               |
|--------------------------|----------------------------|-------------------------------|
| 1. BRAKE LAMPS           | 10. CAB PRESSURIZER BLOWER | 19. CONTROLLER POWER TMF/ICU  |
| 2. OPEN                  | 11. GOVERNOR (KEY SWITCH)  | 20. EGRESS LIGHTING           |
| 3. REAR ROOF WORK LAMPS  | 12. FENDER WORK LAMPS      | 21. AUTOGUIDANCE TRACTOR ECU  |
| 4. WORK LAMP INTERLOCK   | 13. FENDER TAIL LAMPS      | 22. TMF                       |
| 5. PARK LATCH            | 14. REAR WIPER             | 23. TRUC                      |
| 6. NEUTRAL RELAY         | 15. SIDE WIPER             | 24. RADAR/ARU                 |
| 7. FRONT ROOF HID LAMPS  | 16. OPEN                   | 25. SWITCH SOLENOID (100 AMP) |
| 8. BELTLINE WORK LAMPS   | 17. EGRESS LIGHTING        | 26. FLASHER MODULE INTERFACE  |
| 9. FRONT ROOF WORK LAMPS | 18. OPEN                   |                               |

### Engine Compartment Fuse/Relay Identification (Power Distribution Box)



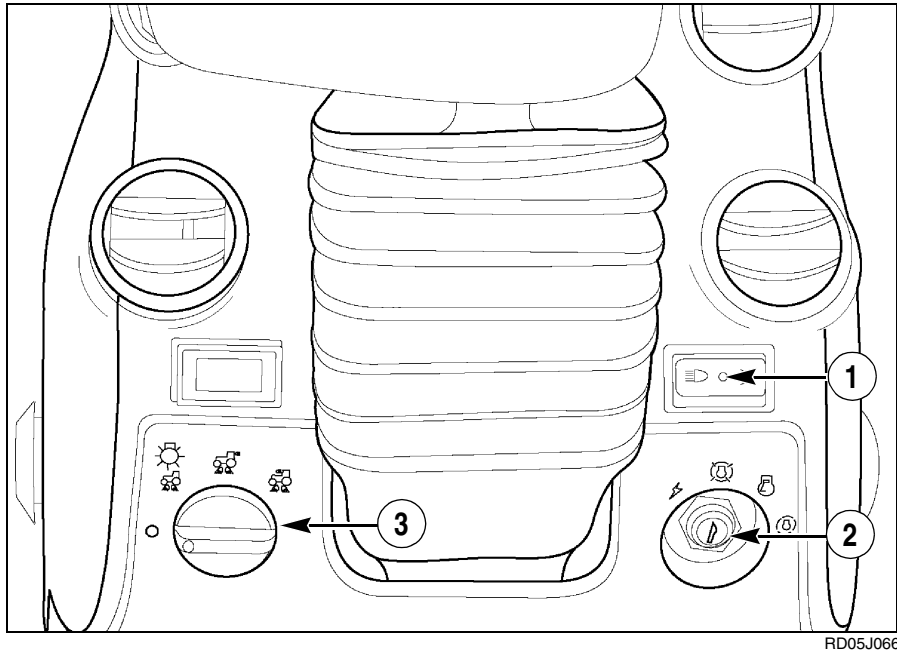
- |                                       |                                   |                               |
|---------------------------------------|-----------------------------------|-------------------------------|
| 1. CENTER & SIDE WORK LAMP FUSE       | 8. RH LOW BEAM RELAY FUSE         | 14. LOW BEAM RELAY            |
| 2. HIGH/LOW BEAM & BYPASS RELAYS FUSE | 9. LH LOW BEAM RELAY FUSE         | 15. OPEN                      |
| 3. STARTER RELAY FUSE                 | 10. STARTER RELAY                 | 16. DIODE NO. 1 (IF EQUIPPED) |
| 4. RH HIGH BEAM FUSE                  | 11. FUEL SHUTOFF RELAY            | 17. DIODE NO. 2 (IF EQUIPPED) |
| 5. LH HIGH BEAM FUSE                  | 12. CENTER & SIDE WORK LAMP RELAY |                               |
| 6. FUEL SHUTOFF RELAY FUSE            | 13. HIGH BEAM RELAY               |                               |
| 7. STARTER RELAY FUSE                 |                                   |                               |

## INSTRUMENTATION AND CONTROLS



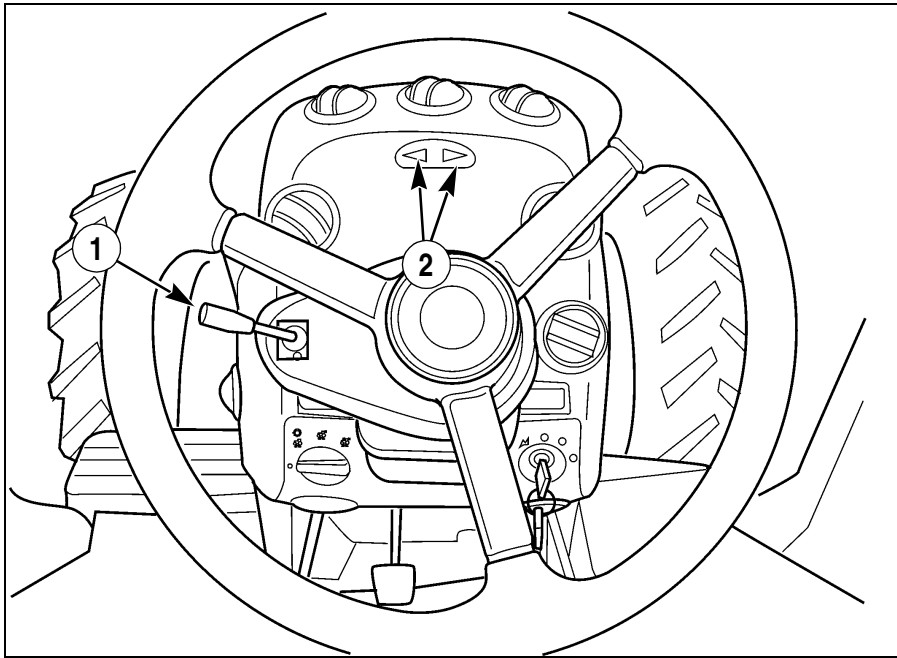
RD05J040

**INSTRUMENTATION CLUSTER**



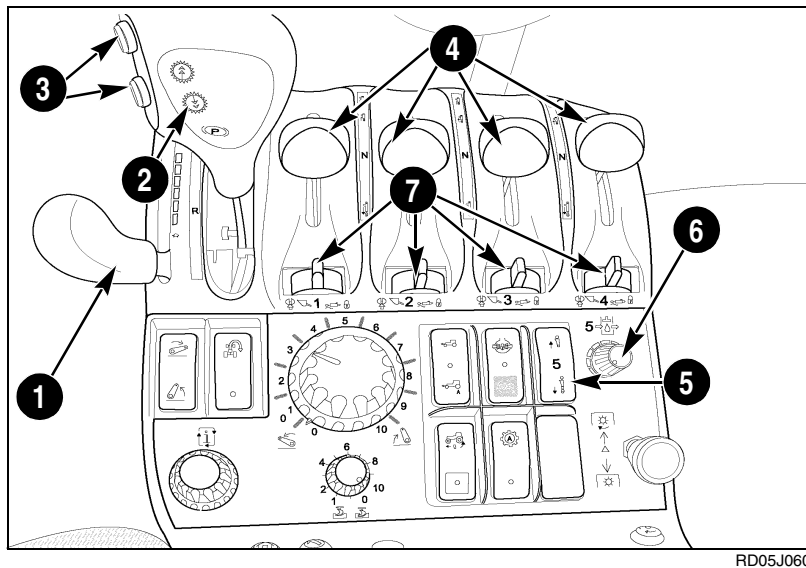
### INSTRUMENT PANEL CONTROLS

1. ROAD LAMPS/AMBER WARNING LAMPS SWITCH
2. KEY SWITCH
3. WORK LAMP SWITCH



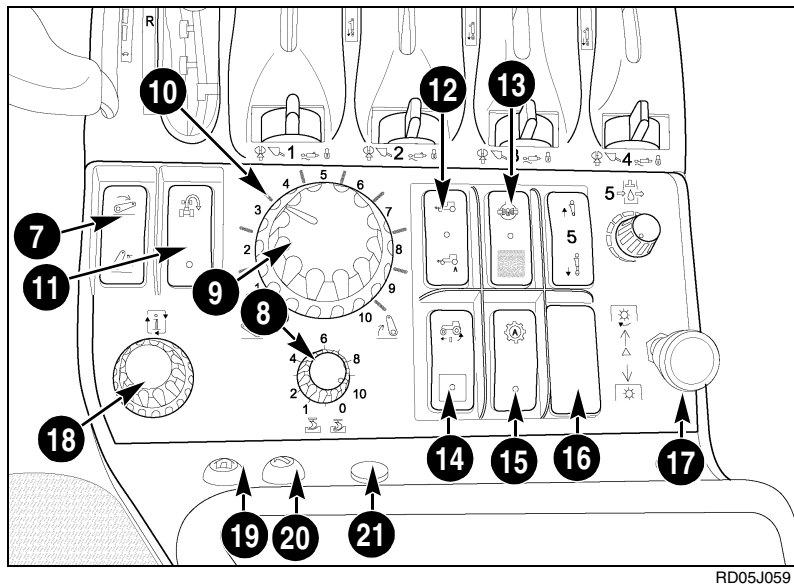
### STEERING COLUMN CONTROLS

1. DIRECTION TURN SIGNAL LEVER; HORN BUTTON; HIGH/LOW BEAM SWITCH
2. TURN SIGNAL INDICATORS



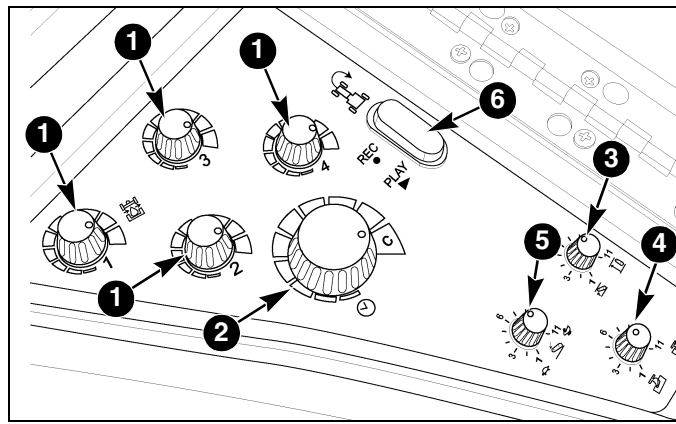
### ARM REST CONTROLS

1. HAND THROTTLE LEVER
2. TRANSMISSION CONTROL LEVER
3. GEAR SELECT BUTTON
4. REMOTE CONTROL LEVERS (1-4)
5. FIFTH REMOTE CONTROL
6. 5TH REMOTE FLOW CONTROL
7. REMOTE FUNCTION CONTROL (1-4)



### ARM REST CONTROLS

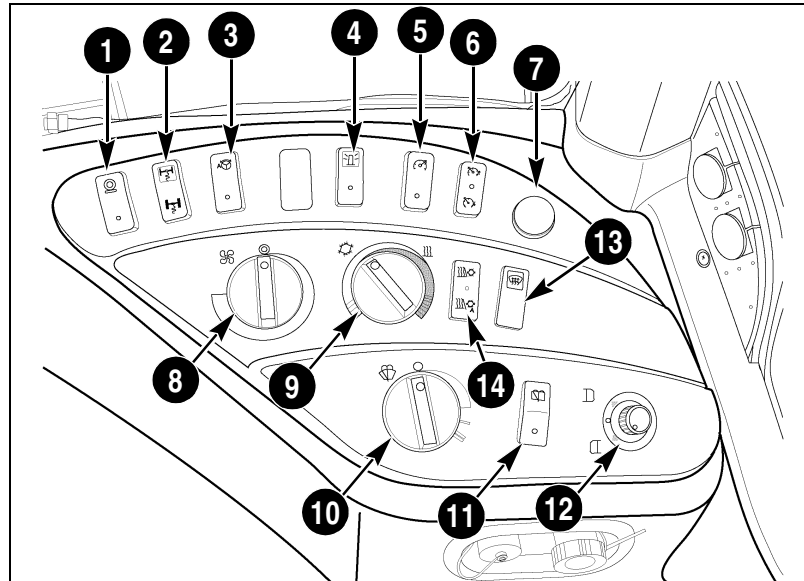
- |   |   |
|---|---|
| 8. HITCH UP /DOWN CONTROL   | 16. AUTO SHIFT CONTROL                        |
| 9. HITCH LOAD CONTROL   | 17. REMOTE AUTO MODE CONTROL                  |
| 10. HITCH POSITION CONTROL  | 18. PTO CONTROL                               |
| 11. HITCH LOWER LIMIT POSITION RING   | 19. DISPLAY SELECTION KNOB FOR INTELLIVIEW II |
| 12. PROGRAMMABLE SHIFT CONTROL OR ELECTRONIC END OF ROW STEP SWITCH (IF EQUIPPED) | 20. HOME SWITCH FOR INTELLIVIEW II            |
| 13. FWD CONTROL   | 21. ESCAPE SWITCH FOR INTELLIVIEW II          |
| 14. DIFFERENTIAL LOCK CONTROL   | 22. INTELLISTEER ENGAGE SWITCH                |
| 15. SLIP LIMIT CONTROL  |   |



RD05J092

### ARM REST CONTROLS (SECONDARY PANEL)

1. HYDRAULIC FLOW CONTROLS
2. HYDRAULIC VALVE TIMER CONTROL
3. HITCH UPPER LIMIT
4. HITCH TRAVEL CONTROL
5. HITCH DROP SPEED /TRANSPORT LOCK CONTROL
6. RECORD/PLAY STANDBY CONTROL (IF EQUIPPED)

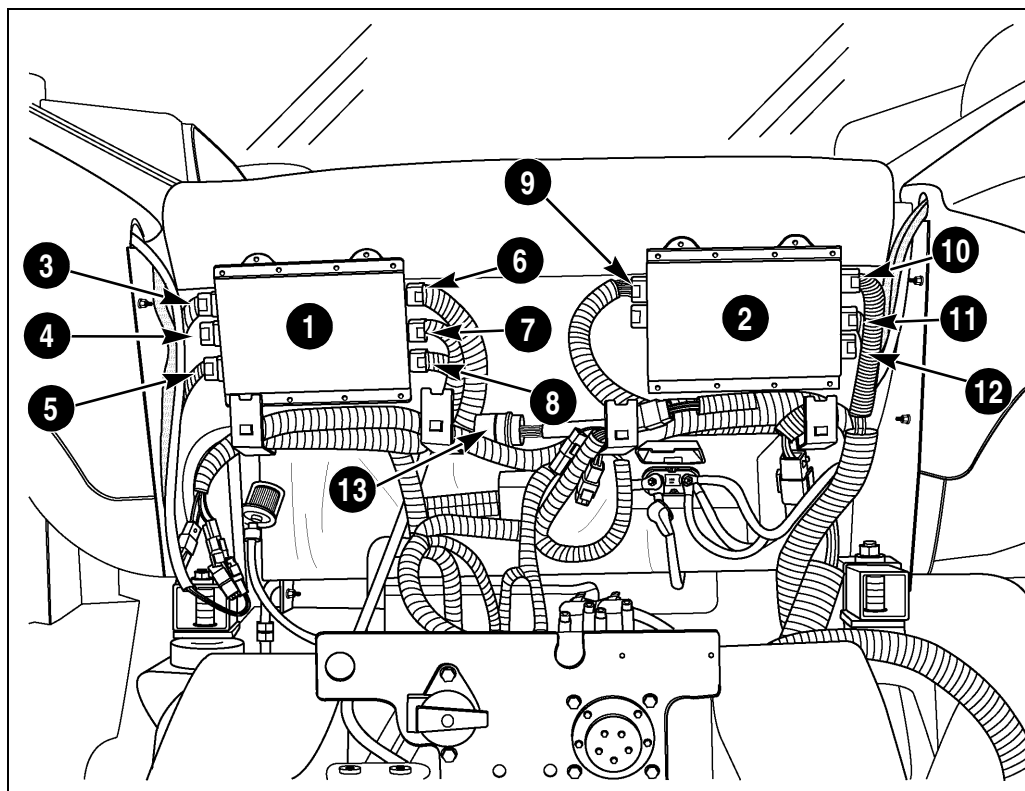


RD05J033

### RIGHT HAND FENDER CONTROLS

1. RIDE CONTROL SWITCH (IF EQUIPPED)
2. SUSPENDED AXLE SWITCH (IF EQUIPPED)
3. AUTOGUIDANCE (IF EQUIPPED)
4. BEACON LIGHT SWITCH
5. ENGINE CONSTANT SPEED ON/OFF SWITCH (IF EQUIPPED)
6. ENGINE CONSTANT SPEED ADJUST SWITCH (IF EQUIPPED)
7. CIGAR LIGHTER
8. BLOWER SPEED CONTROL KNOB
9. TEMPERATURE CONTROL KNOB
10. FRONT WINDSHIELD WIPER CONTROL
11. REAR WINDSHIELD WIPER CONTROL
12. POWER MIRROR SWITCH (IF EQUIPPED)
13. DEFOG CONTROL SWITCH
14. AUTOMATIC TEMPERATURE CONTROL SWITCH (IF EQUIPPED)

## CONNECTOR AND COMPONENT LOCATIONS

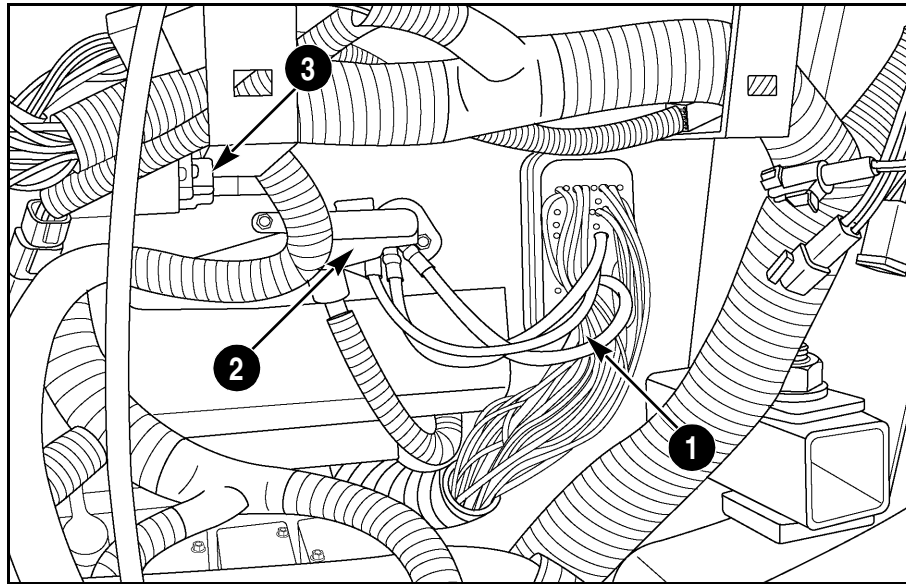


RD05M054

### REAR OF CAB

- |   |                       |
|---|-----------------------|
| 1. *AUX/HITCH/PTO CONTROLLER (TMF CONTROLLER) | 8. CONNECTOR NO. 57   |
| 2. TRANSMISSION AND FRONT AXLE CONTROLLER     | 9. CONNECTOR NO. 355  |
| 3. CONNECTOR NO. 54                           | 10. CONNECTOR NO. 353 |
| 4. CONNECTOR NO. 55                           | 11. CONNECTOR NO. 350 |
| 5. CONNECTOR NO. 56                           | 12. CONNECTOR NO. 351 |
| 6. CONNECTOR NO. 58                           | 13. CONNECTOR NO. 335 |
| 7. CONNECTOR NO. 53                           |                       |

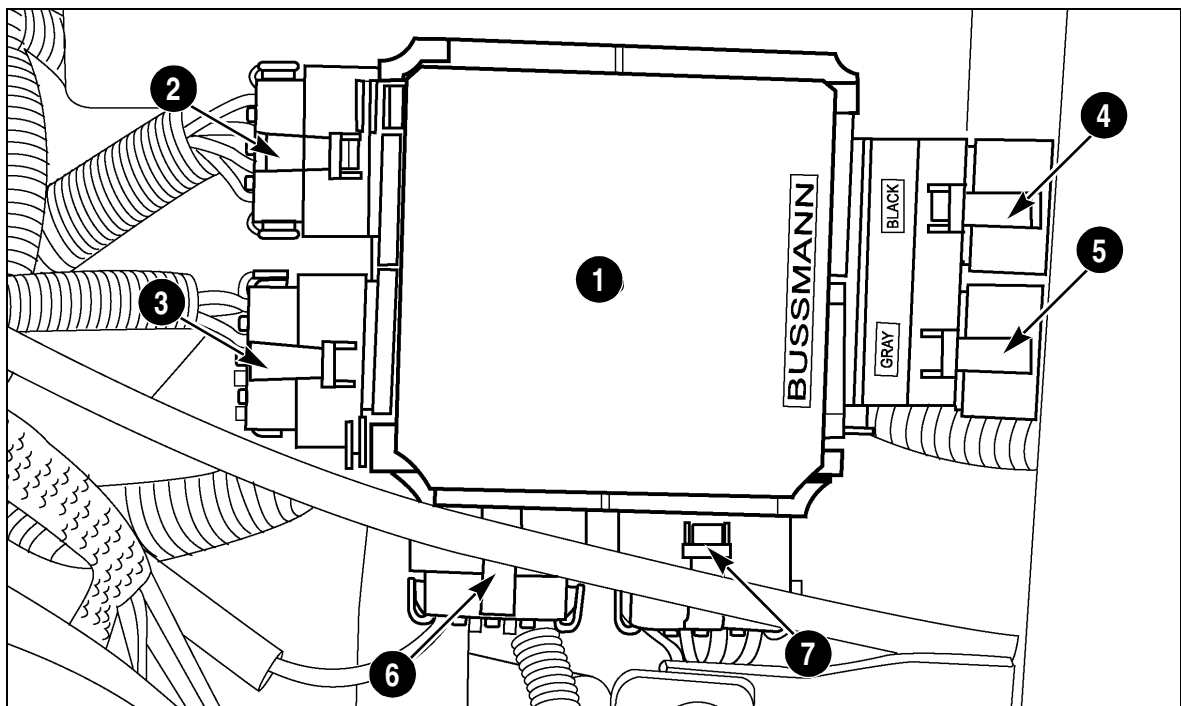
\*The functions of the AUX, HITCH and PTO controllers have been integrated into one controller also known as the Tractor Multi Function (TMF) controller.



RD06A187

### REAR CAB AREA BELOW CONTROLLERS

1. CHASSIS TO CAB HARNESS CONNECTOR NO. 10
2. BUSSMAN FUSE 100 AMP (SECTION 19 OF SCHEMATIC)
3. TRACTOR ECU (ISO11783) CONNECTOR NO. 282



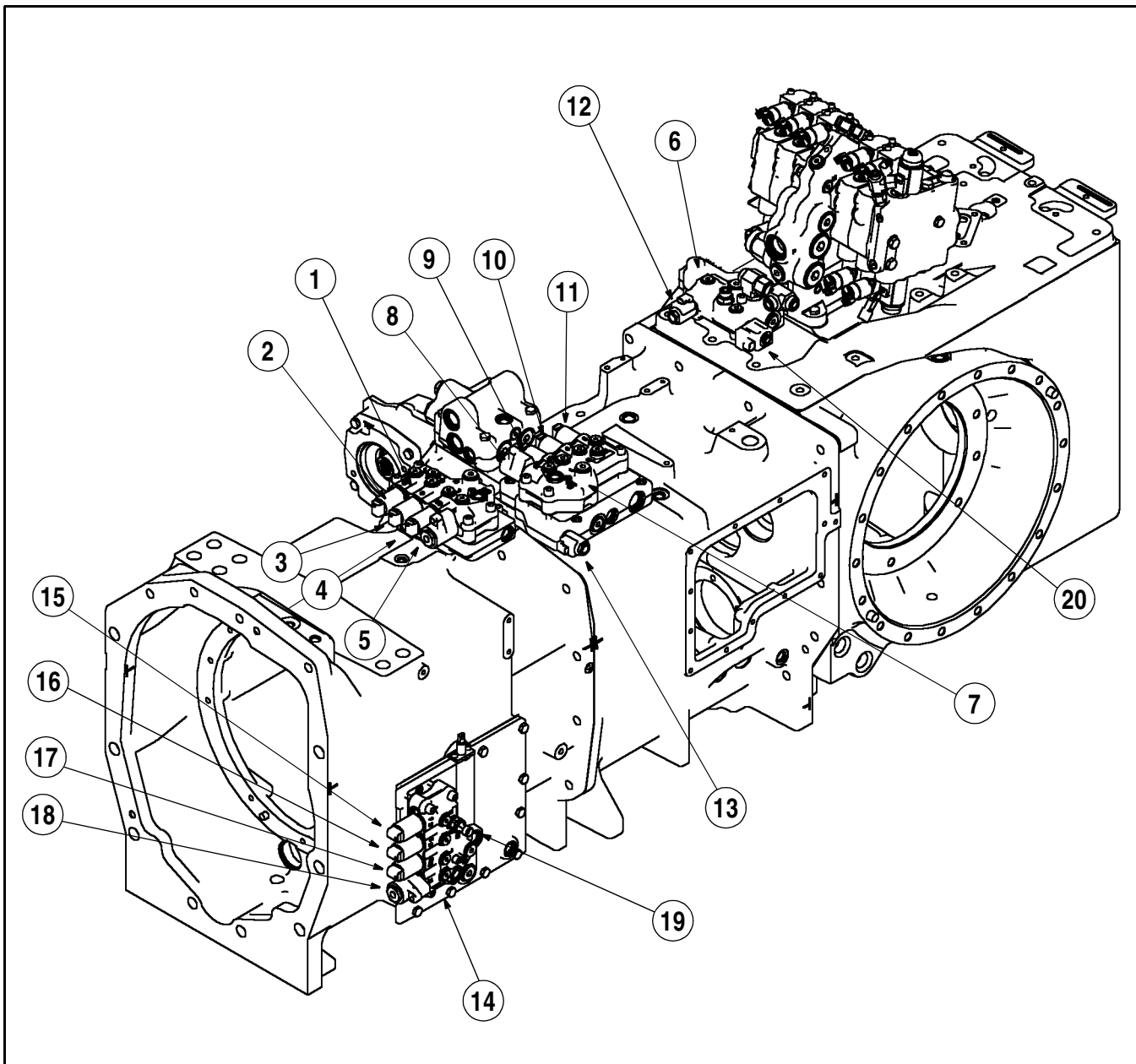
RD02E267

### POWER DISTRIBUTION BOX - LEFT SIDE ENGINE COMPARTMENT

1. ENGINE FUSE BOX
2. POWER DISTRIBUTION-CONNECTOR NO.7M (BLACK)
3. ENGINE CONNECTOR NO.108 (GRAY)
4. SWITCHED POWER CONNECTOR NO.64 (BLACK())
5. UNSWITCHED POWER CONNECTOR NO.65 (GRAY)
6. OPERATOR SUPPLIED POWER CONNECTOR NO.121 (BLUE)
7. LIGHTING CONNECTOR NO. 109 (GREEN)

**NOTE:** See Fuse Identification in this section for more information.

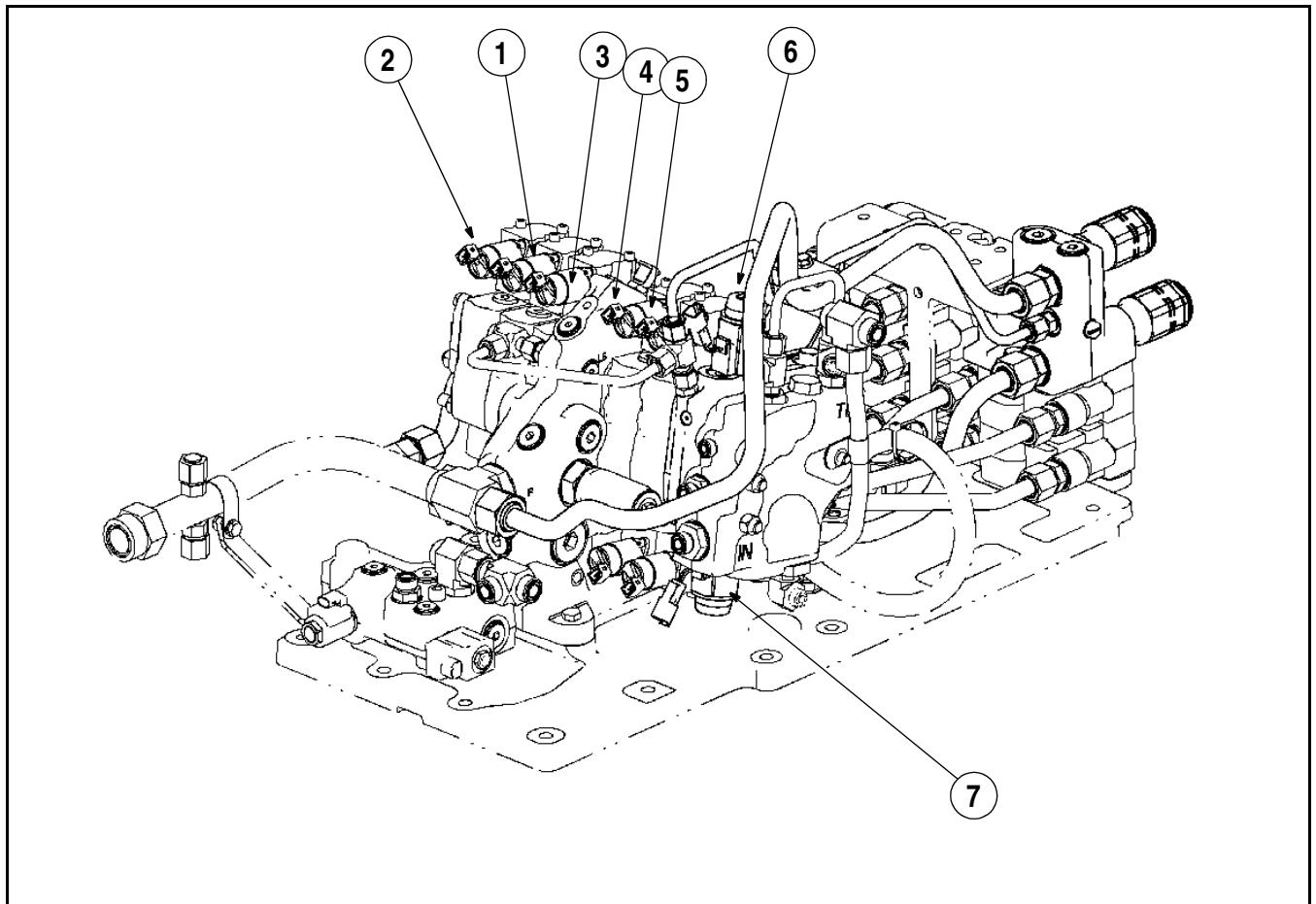




RI02E086A

### TRANSMISSION SOLENOID LOCATIONS AND CONNECTOR IDENTIFICATIONS

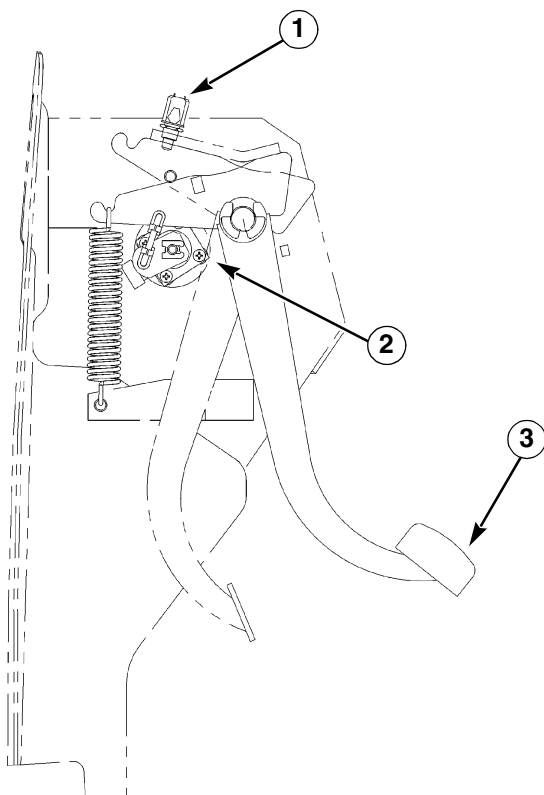
- |   |   |
|---|---|
| 1. POWERSHIFT VALVE ODD/EVEN                | 12. PTO SOLENOID (CONNECTOR NO. 159)              |
| 2. EVEN CLUTCH SOLENOID (CONNECTOR NO. 30)  | 13. MASTER CLUTCH SOLENOID (CONNECTOR NO. 35)     |
| 3. ODD CLUTCH SOLENOID (CONNECTOR NO. 29)   | 14. POWERSHIFT VALVE SPEED                        |
| 4. CREEP CLUTCH SOLENOID (CONNECTOR NO. 39) | 15. C1 CLUTCH SOLENOID (CONNECTOR NO. 31)         |
| 5. PARK BRAKE SOLENOID (CONNECTOR NO. 49)   | 16. C3 CLUTCH SOLENOID (CONNECTOR NO. 32)         |
| 6. PTO/DIFF LOCK VALVE                      | 17. C5 CLUTCH SOLENOID (CONNECTOR NO. 33)         |
| 7. POWERSHIFT VALVE RANGE                   | 18. REVERSE SOLENOID (CONNECTOR NO. 34)           |
| 8. FWD SOLENOID (CONNECTOR NO. 160)         | 19. SYSTEM PRESSURE TRANSDUCER (CONNECTOR NO. 44) |
| 9. LOW CLUTCH SOLENOID (CONNECTOR NO. 36)   | 20. DIFF LOCK SOLENOID (CONNECTOR NO. 158)        |
| 10. MID CLUTCH SOLENOID (CONNECTOR NO. 37)  |   |
| 11. HIGH CLUTCH SOLENOID (CONNECTOR NO. 38) |   |



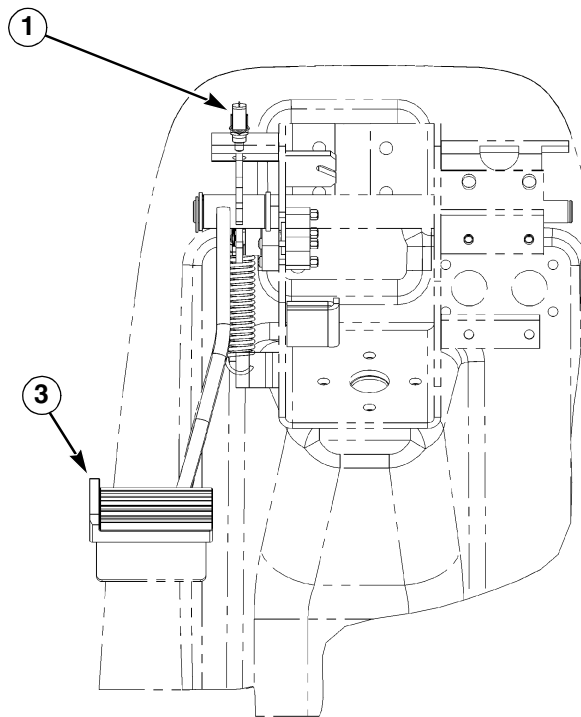
RH02H281

#### REMOTE AND HITCH VALVE CONNECTOR IDENTIFICATIONS

1. REMOTE SECTION NO. 1, TOP CONNECTOR 140, LOWER CONNECTOR 340
2. REMOTE SECTION NO. 2, TOP CONNECTOR 141, LOWER CONNECTOR 341
3. REMOTE SECTION NO. 3, TOP CONNECTOR 142, LOWER CONNECTOR 342
4. REMOTE SECTION NO. 4, TOP CONNECTOR 143, LOWER CONNECTOR 343
5. REMOTE SECTION NO. 5, TOP CONNECTOR 144, LOWER CONNECTOR 344
6. HITCH LOWER - CONNECTOR 152
7. HITCH RAISE - CONNECTOR 151



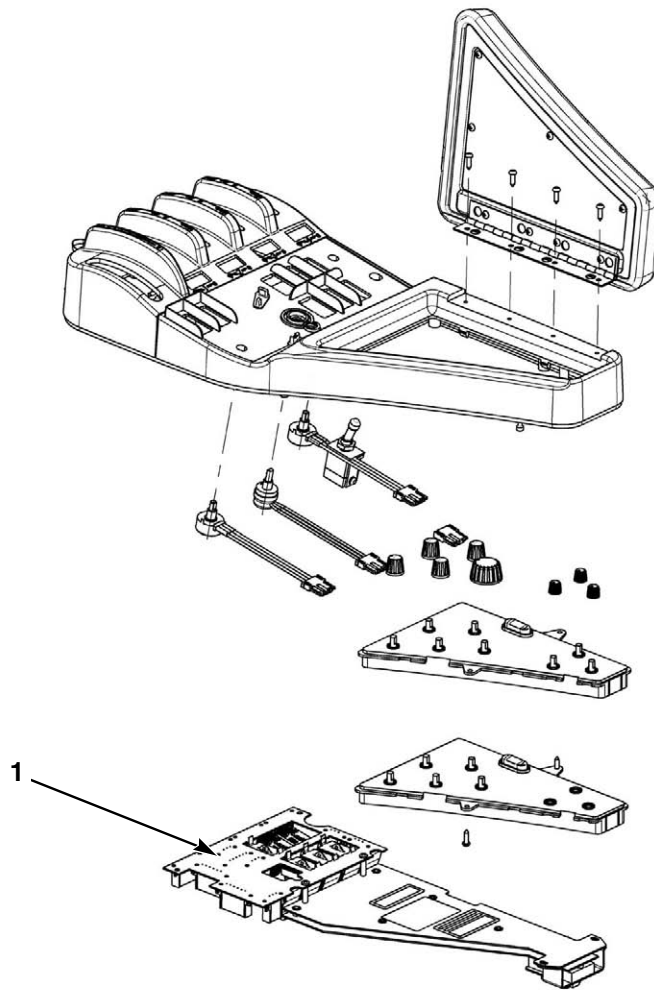
RT97K033



RT97K034

### INCHING PEDAL

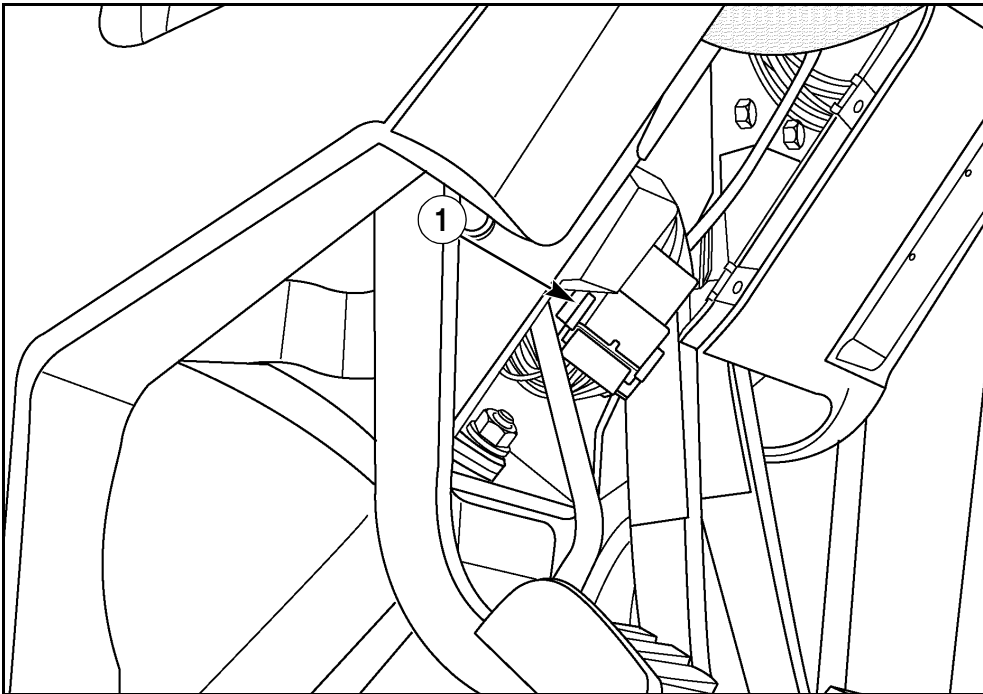
- |   |                  |
|---|------------------|
| 1. CONNECTOR NO. 50 - BOC SWITCH                    | 3. INCHING PEDAL |
| 2. CONNECTOR NO. 52 - CLUTCH POSITION POTENTIOMETER |                  |



## RIGHT HAND CONSOLE

1. ARMREST CONTROLLER

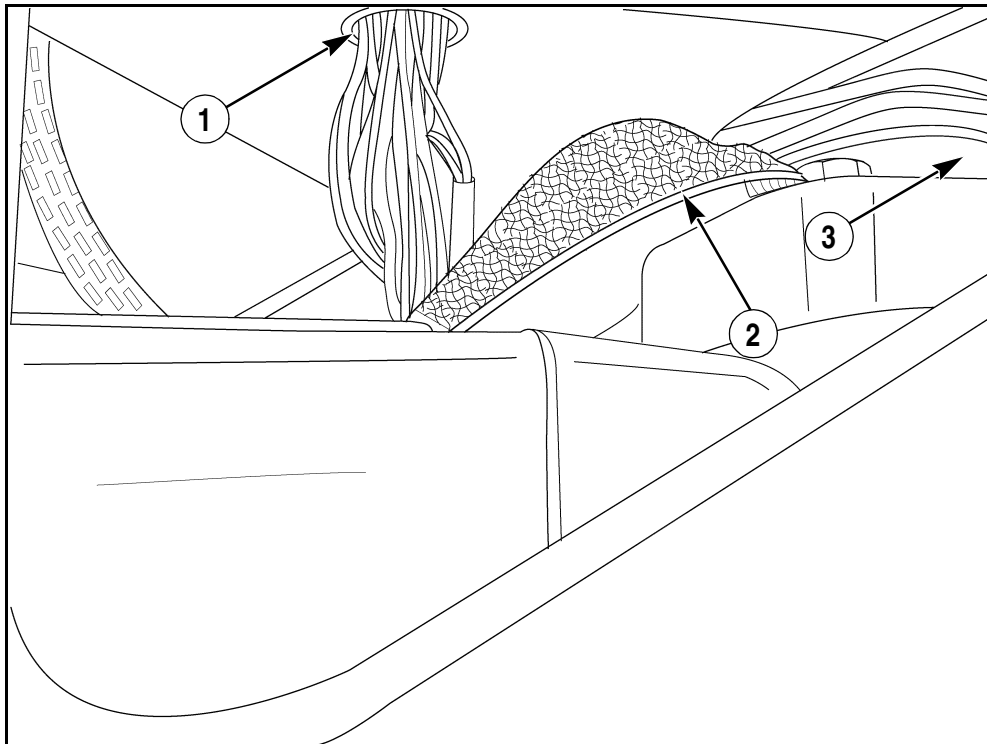
ARMRST



RD98H143

**LOWER FRONT CONSOLE**

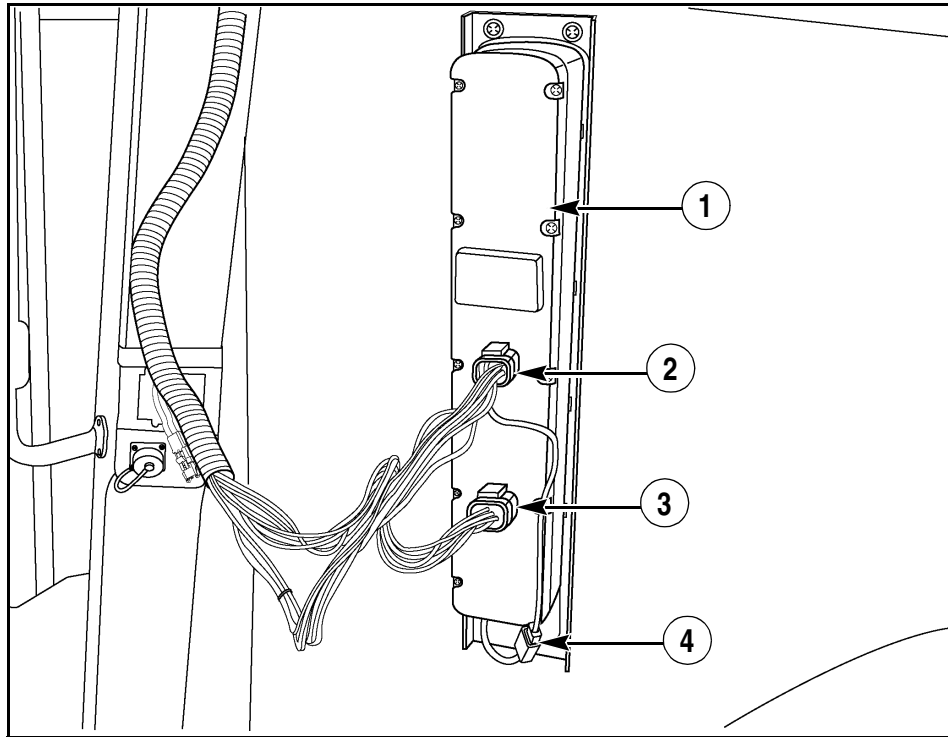
1. TO TRANSMISSION CONTROL LEVER



RD02H179

**BOTTOM RH FRONT CORNER OF CAB**

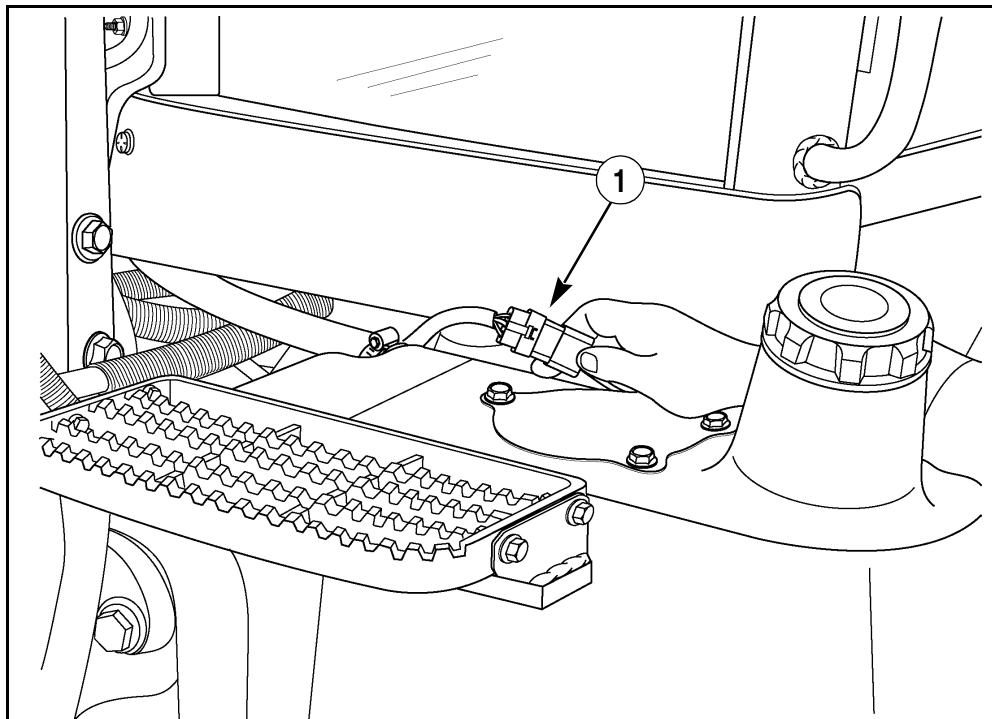
1. CONNECTOR NO. 60 - IN-LINE CONNECTOR (FRONT TO REAR HARNESS)
2. BRAIDED GROUND STRAP
3. CAB MOUNT GROUNDS (NOT SHOWN, SEE CAB MOUNT)



RD06B002

### INSTRUMENTATION CLUSTER

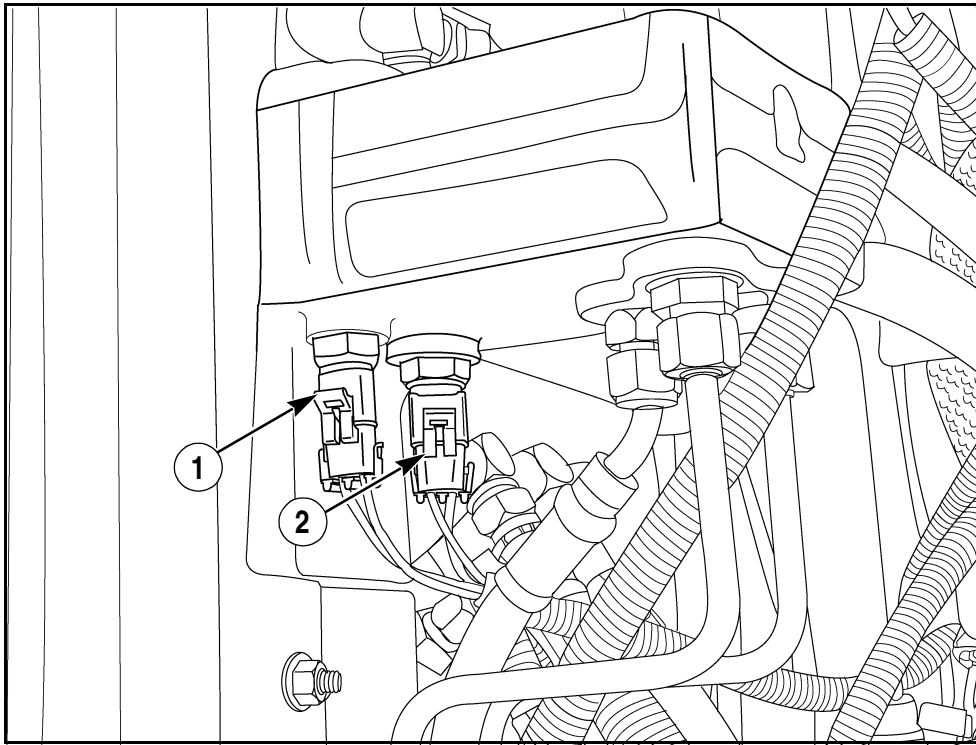
- |                            |                       |
|----------------------------|-----------------------|
| 1. INSTRUMENTATION CLUSTER | 3. CONNECTOR NO. CN 2 |
| 2. CONNECTOR NO. CN 1      | 4. CONNECTOR NO. 380  |



RD05J085

### TOP OF FUEL TANK

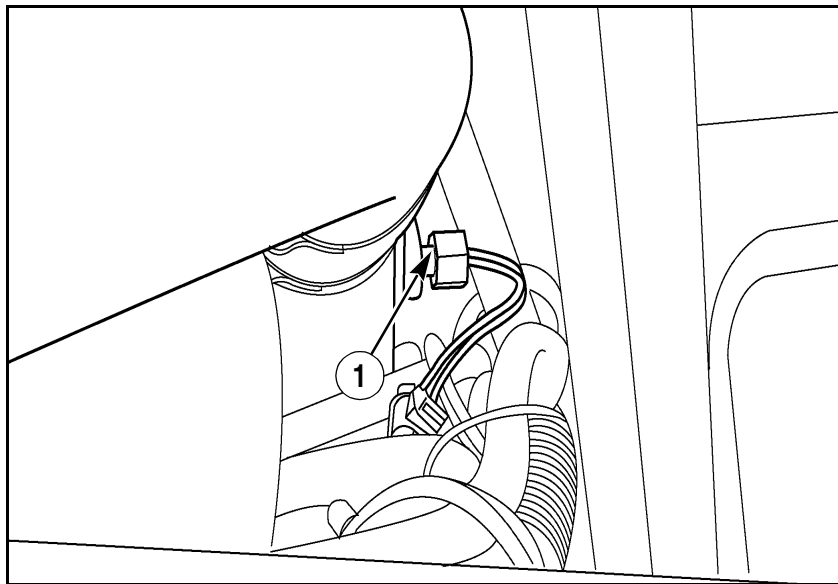
1. CONNECTOR NO. 66 - FUEL SENDER



RD02H177

### BRAKE VALVE SWITCH CONNECTIONS

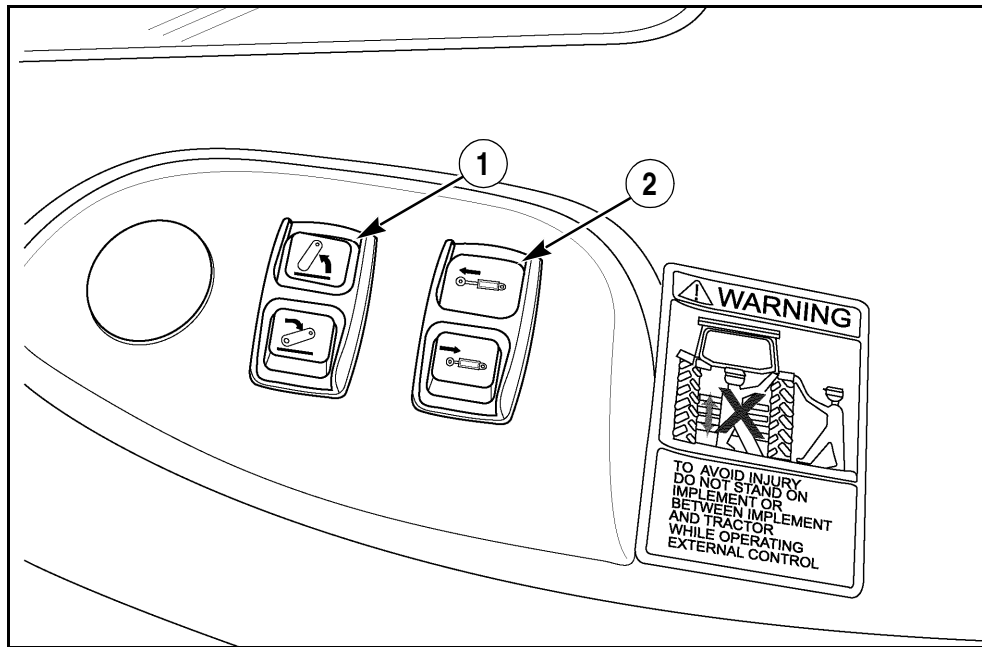
1. RIGHT BRAKE SWITCH #1, CONNECTOR 47      2. LEFT BRAKE SWITCH #2, CONNECTOR 48



RD02H216

### LEFT HAND SIDE OF ENGINE

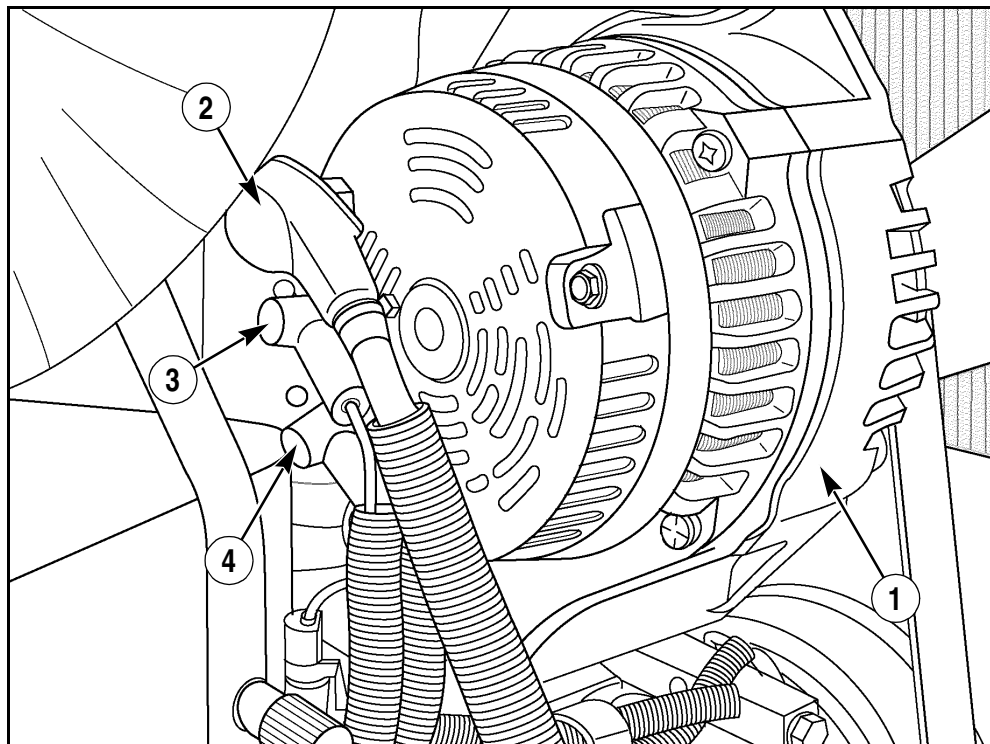
1. AIR TO AIR TEMP SENSOR-CONNECTOR NO.75  
(EMERGING MARKET ONLY)



RD05J139

### REMOTE FENDER MOUNT SWITCHES

1. REMOTE HITCH SWITCHES - LEFT CONNECTOR NO. 313A, RIGHT NO. 313B
2. HYDRAULIC TOP LINK - LEFT CONNECTOR NO. 399, RIGHT NO. 401

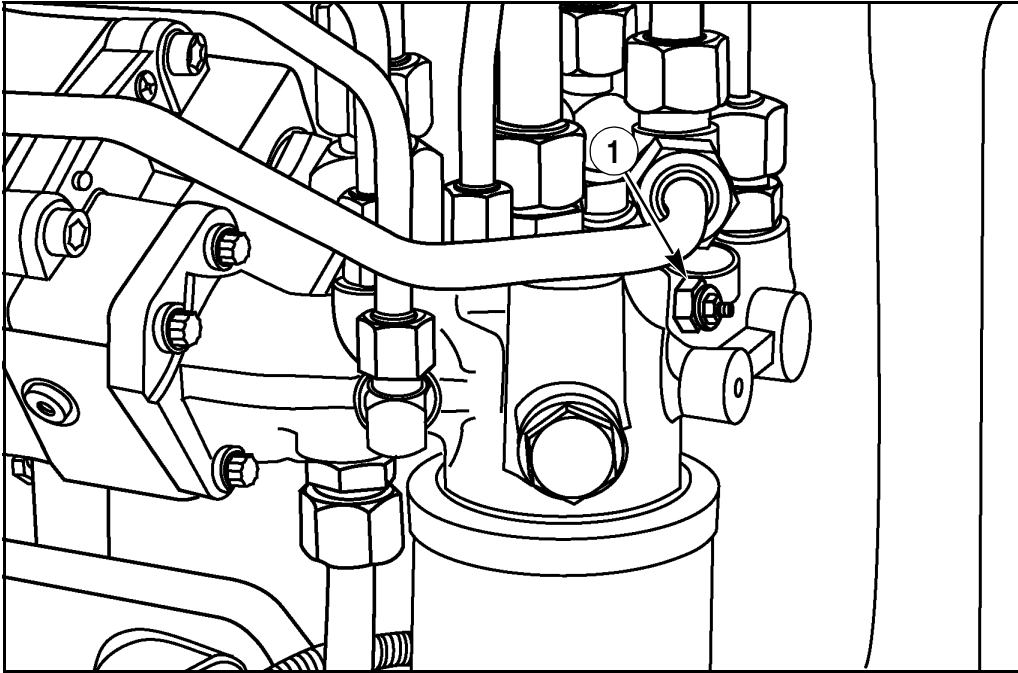


RD06A176

### ALTERNATOR

1. ALTERNATOR
2. REGULATOR
3. CONNECTOR NO. 77 - ALTERNATOR B+
4. CONNECTOR NO. 85 - ALTERNATOR EXCITE (D+)
5. CONNECTOR NO. 86 - ALTERNATOR W FREQUENCY (ENGINE RPM)

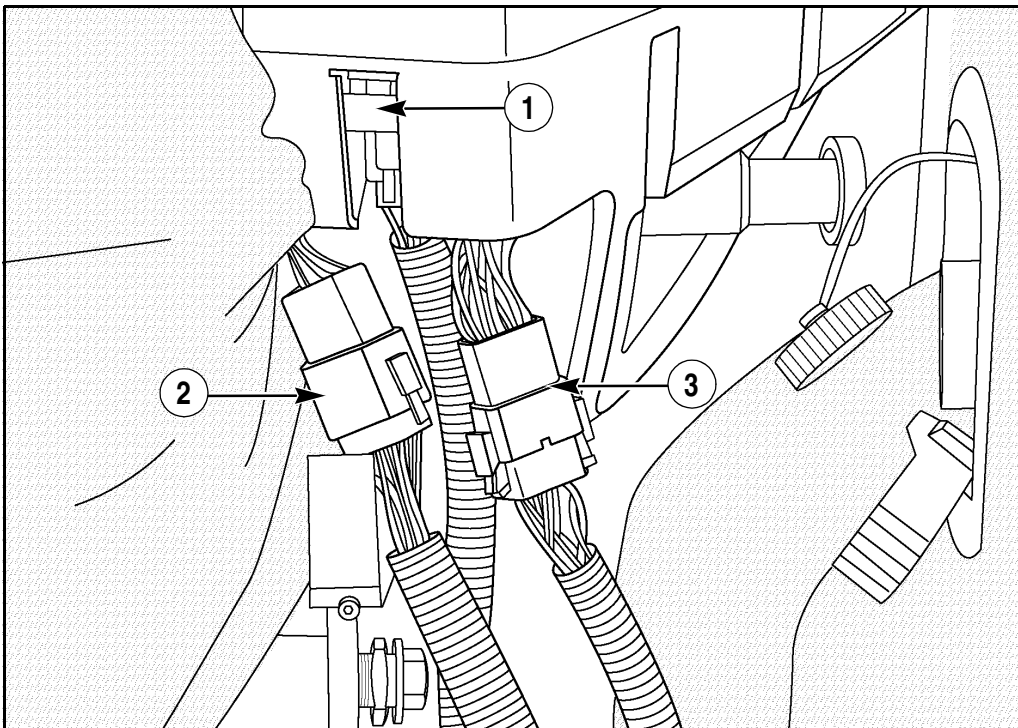




RD98E030

**RIGHT HAND SIDE OF TRANSMISSION**

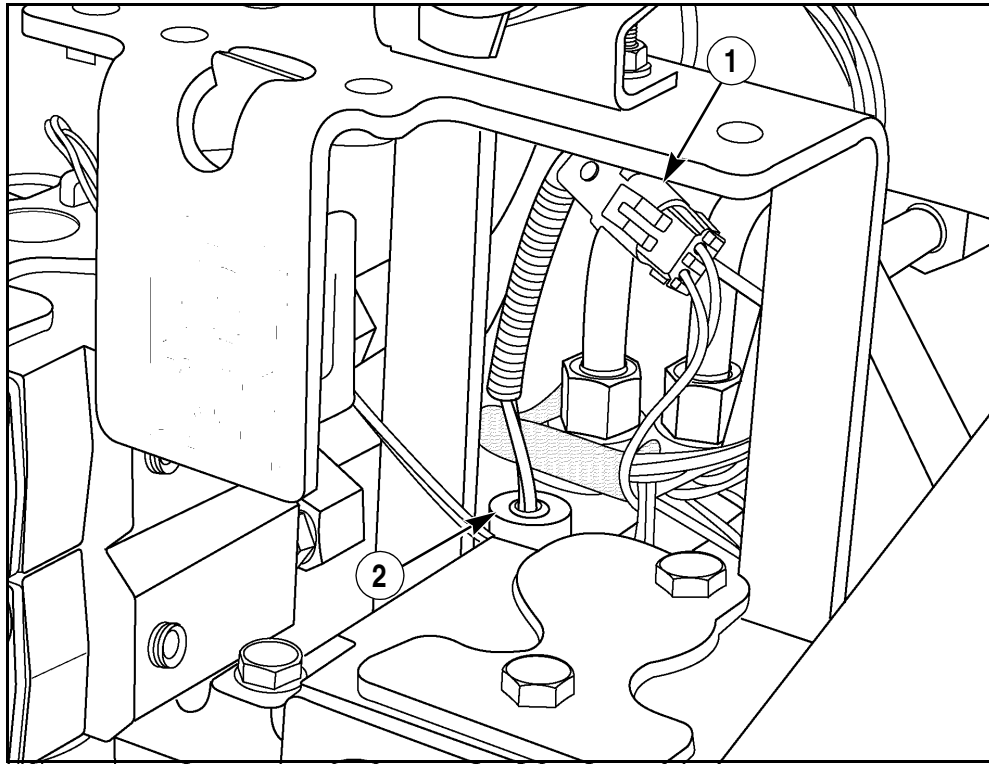
1. CONNECTOR NO. 88 - TRANSMISSION FILTER RESTRICTION SENSOR



RD06A177

**OPERATOR SEAT**

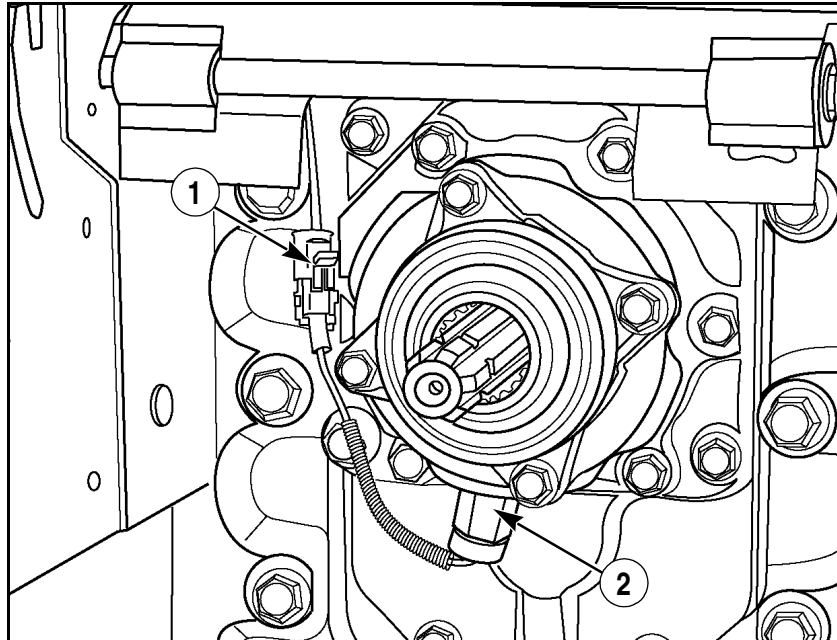
1. CONNECTOR NO. 137      3. CONNECTOR NO. 377  
2. CONNECTOR NO. 51



RD98G022A

**TOP REAR OF TRANSMISSION**

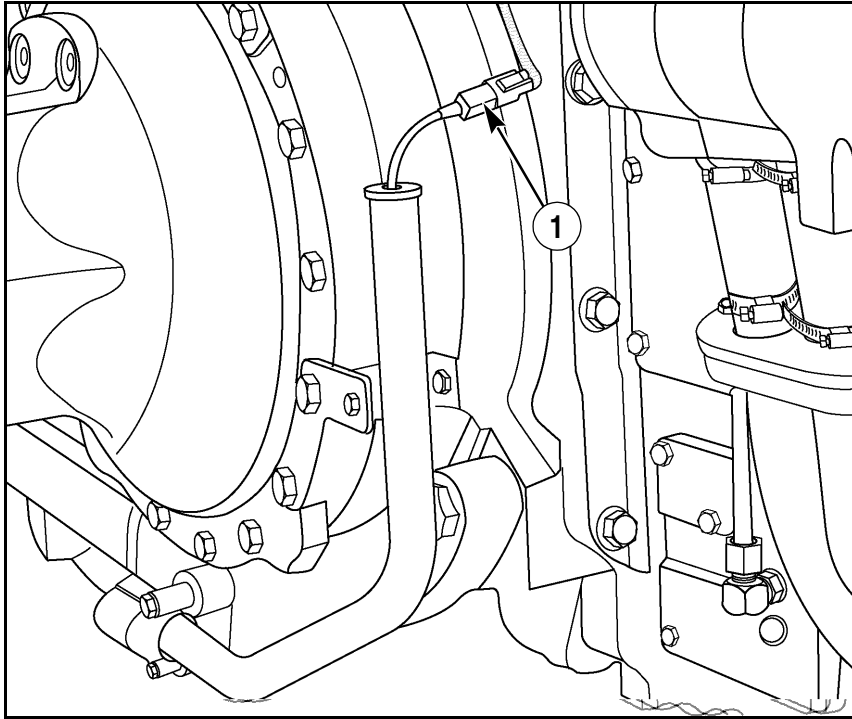
1. CONNECTOR NO. 145 - TO PTO SHAFT SPEED SENSOR    2. PTO SHAFT SPEED SENSOR



RD97K112

**PTO SHAFT**

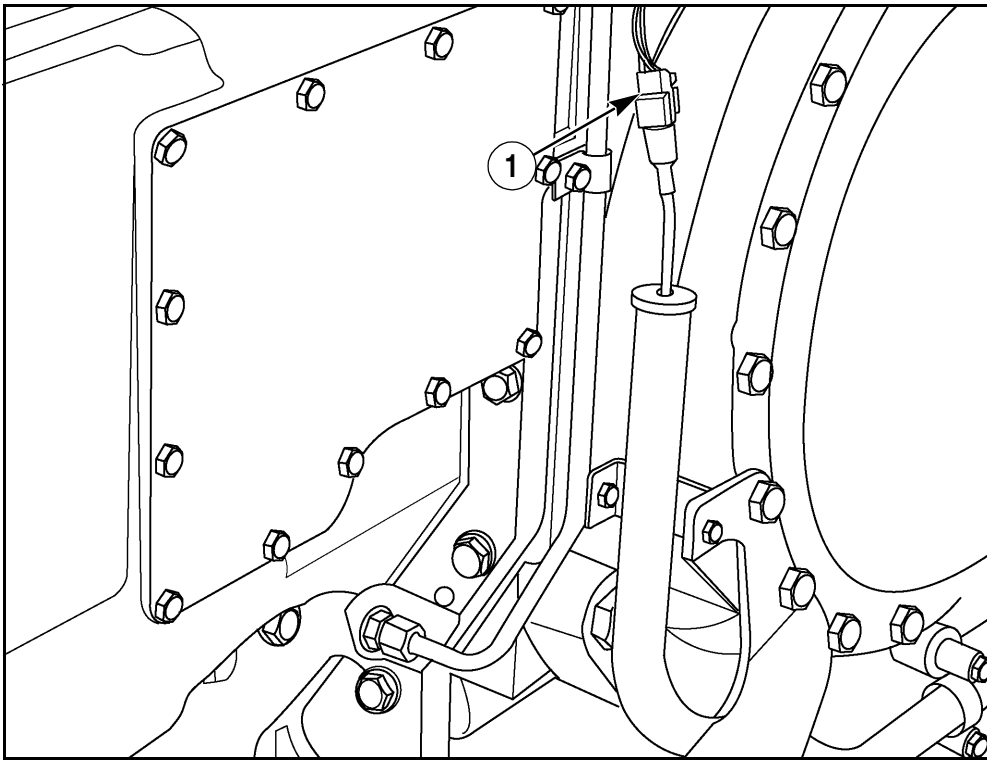
1. CONNECTOR NO. 146 - TO PTO DUAL SPEED SENSOR    2. PTO DUAL SPEED SENSOR



RD98E024

**RIGHT HAND SIDE NEAR AXLE**

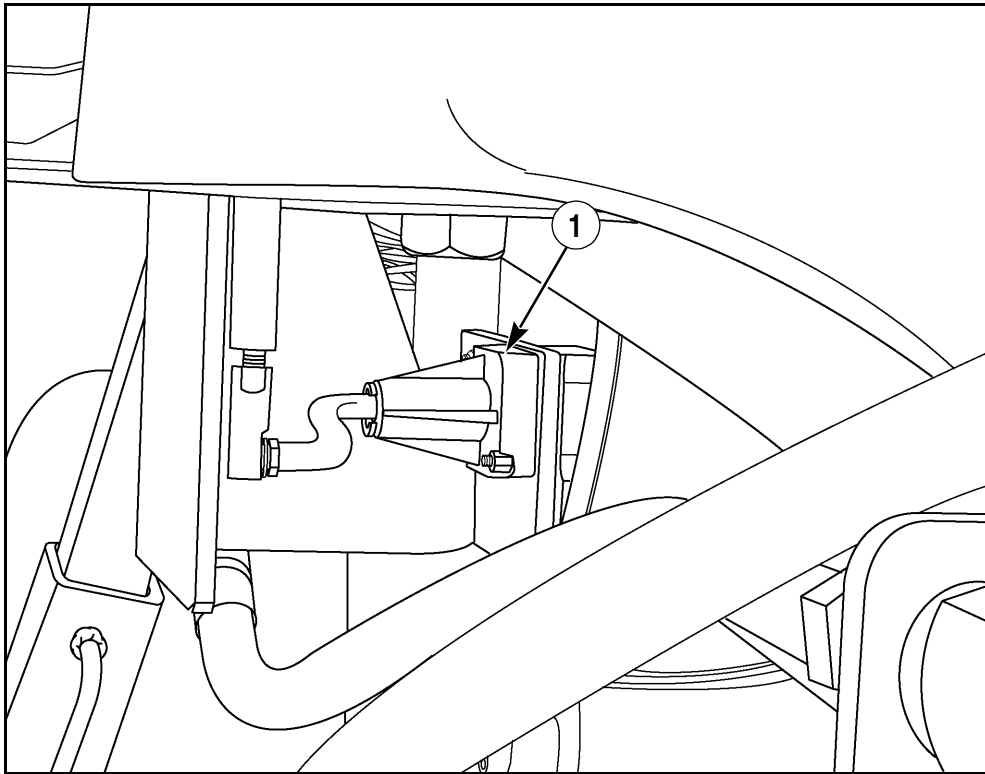
1. CONNECTOR NO. 153 - TO RH DRAFT PIN



RD98E005

**LEFT HAND SIDE NEAR AXLE**

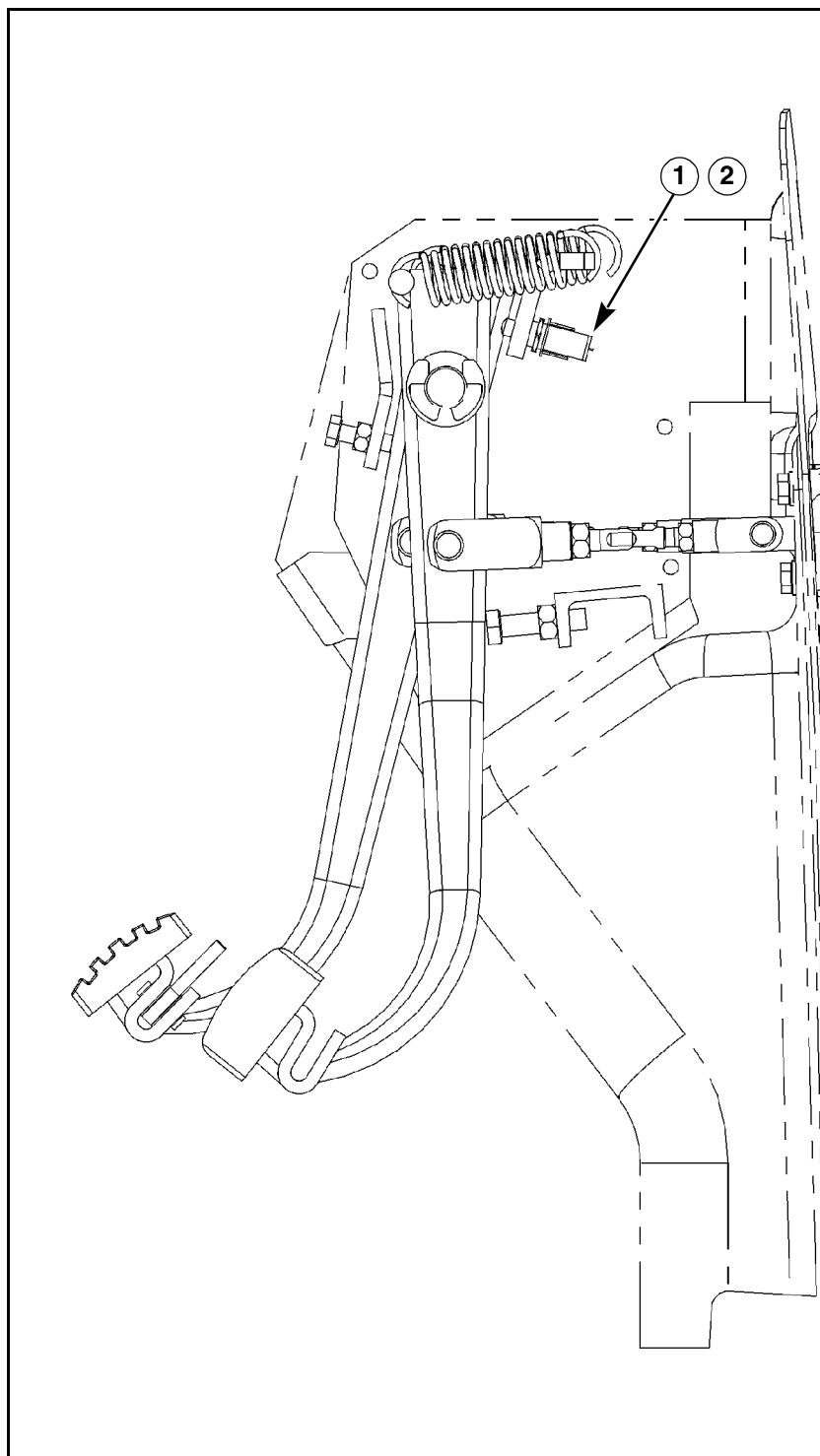
1. CONNECTOR NO. 154 - TO LH DRAFT PIN



RD98E025

**RIGHT HAND SIDE AT ROCKSHAFT**

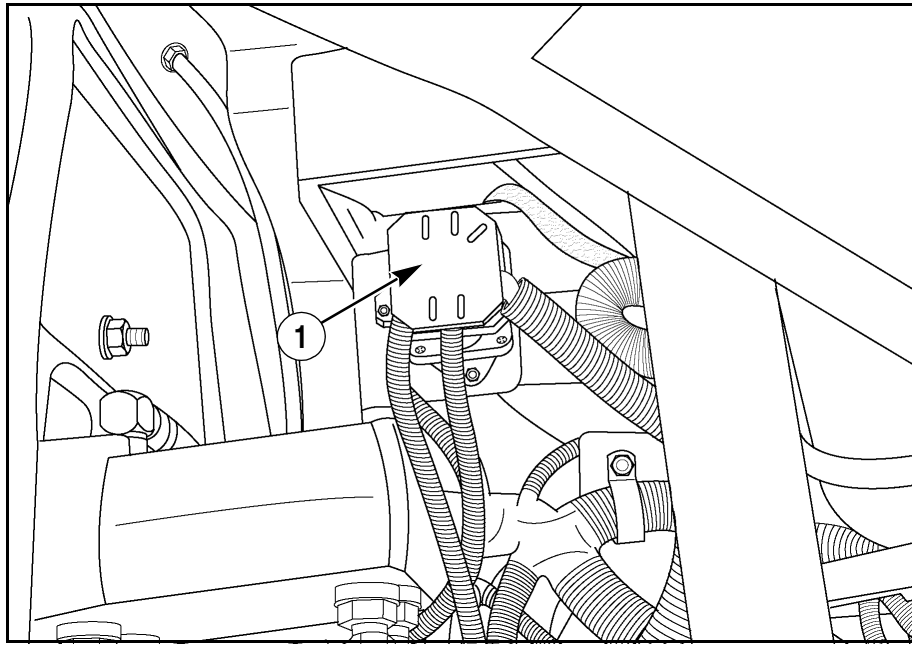
1. CONNECTOR NO. 155 - ROCKSHAFT POTENTIOMETER (BEHIND COVER)



RT97K036

### **BRAKE PEDALS**

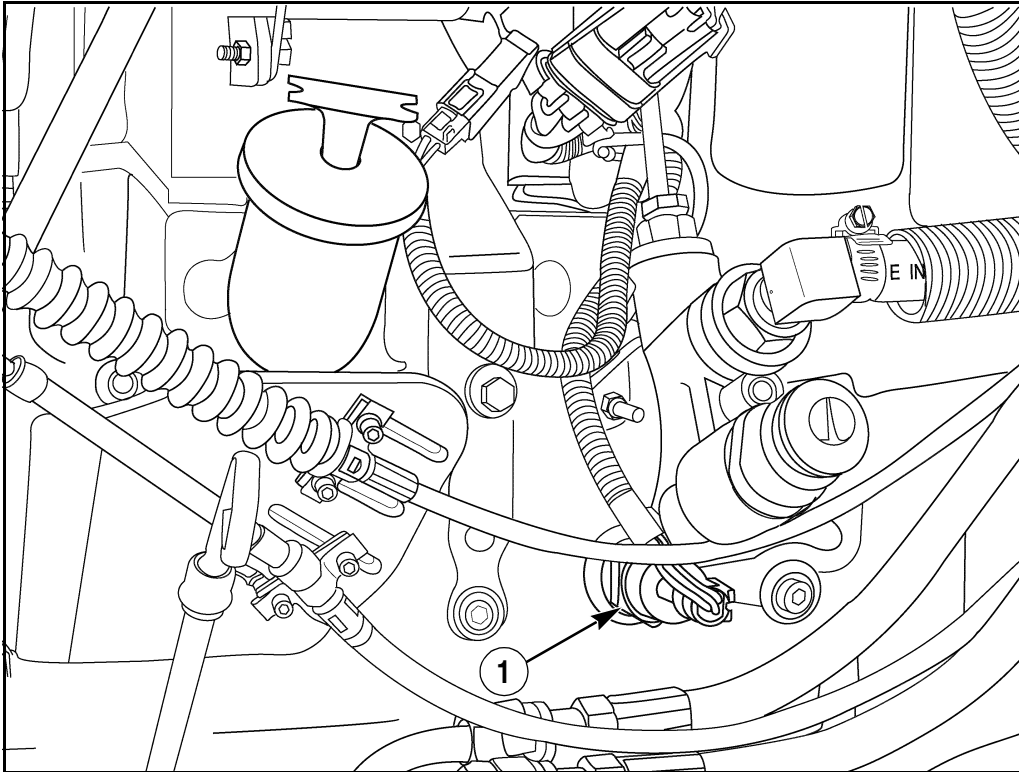
- 1. CONNECTOR NO. 162 - LEFT BRAKE SWITCH
- 2. CONNECTOR NO. 163 - RIGHT BRAKE SWITCH



RD06A178

**UNDER HOOD**

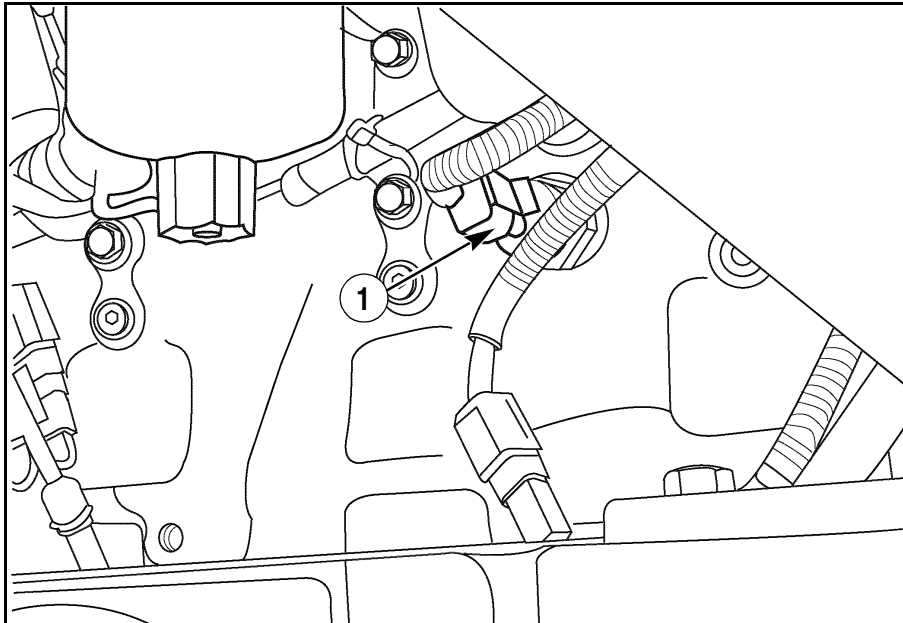
1. INTERMEDIATE STARTING RELAY



RD02H178

**NON-ELECTRONIC ENGINE**

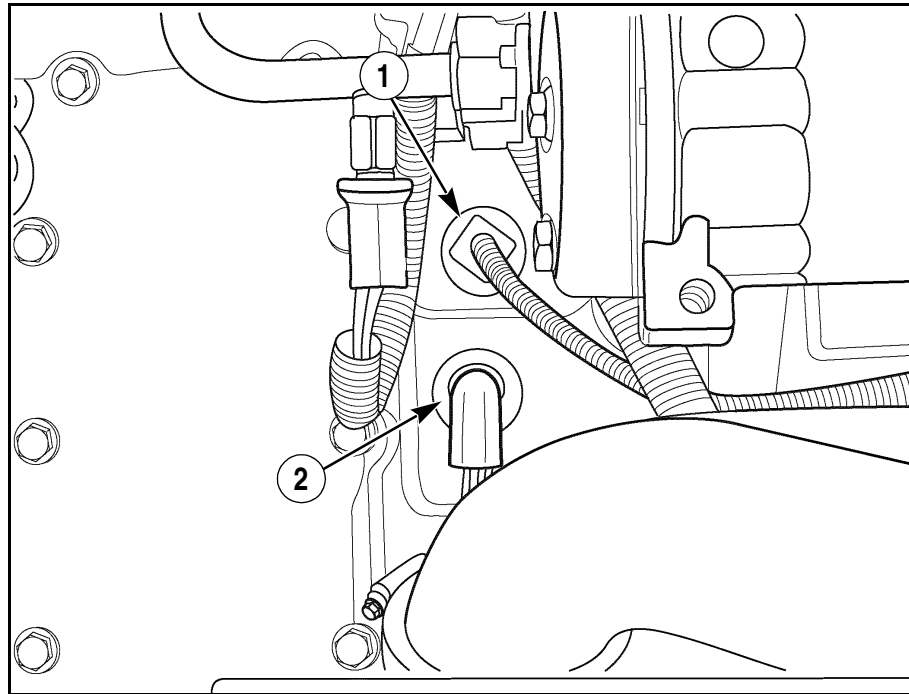
1. ENGINE OIL PRESSURE SWITCH (EMERGING MARKET)



RD02H220

**ELECTRONIC ENGINE**

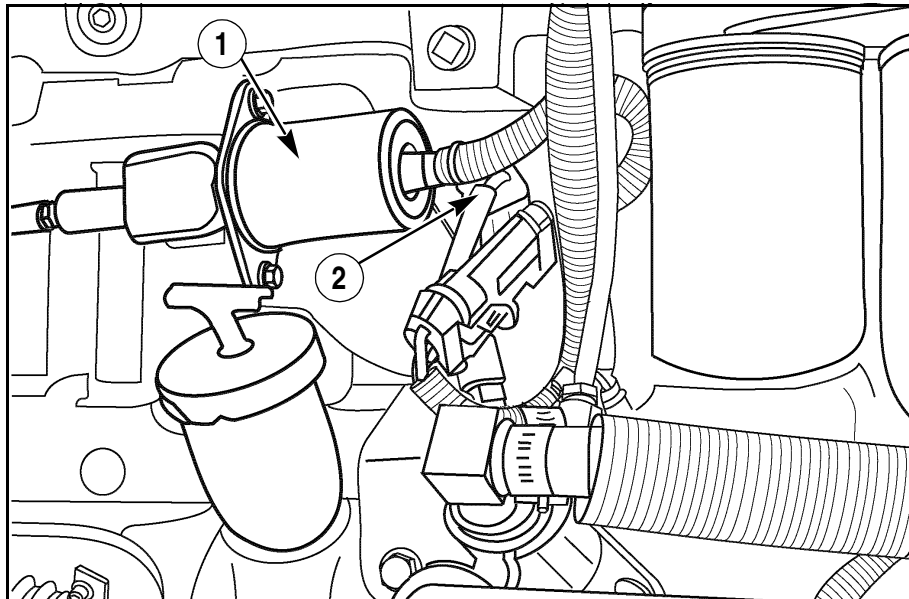
1. ENGINE OIL PRESSURE SWITCH



RD02H223

### NEAR A/C COMPRESSOR

- |  |                               |
|--|-------------------------------|
| 1. CONNECTOR NO. 215 - ENGINE<br>COOLANT TEMPERATURE SENSOR<br>(ELECTRONIC ENGINE) | 2. BLOCK HEATER (ALL ENGINES) |
|--|-------------------------------|

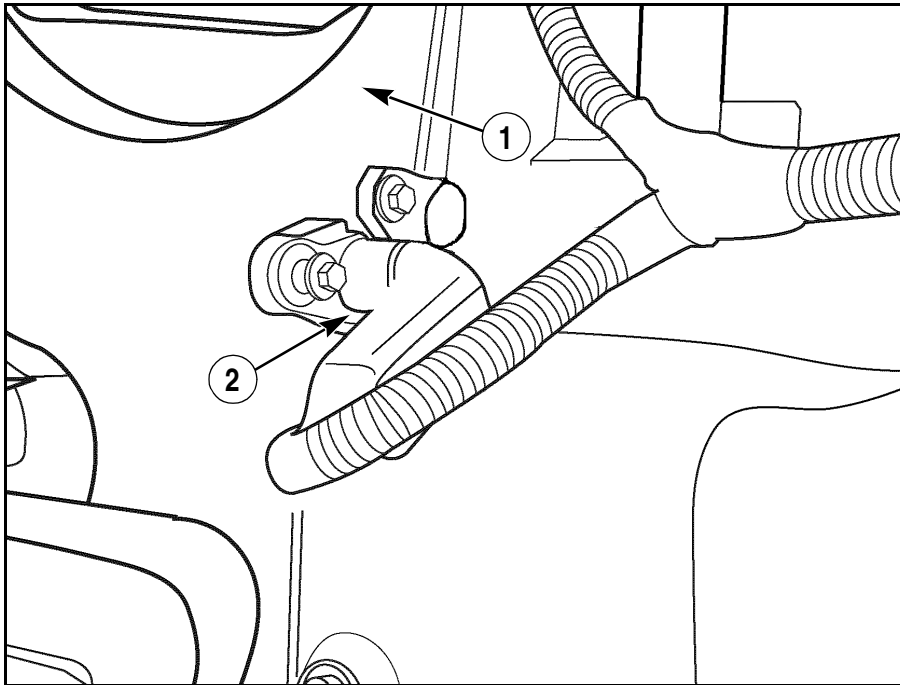


RD02H227

### NON-ELECTRONIC ENGINE

- |   |
|---|
| 1. INJECTION PUMP SOLENOID - CONNECTOR NO.214                                 |
| 2. CONNECTOR NO. 215 - ENGINE COOLANT TEMPERATURE<br>SENSOR (EMERGING MARKET) |

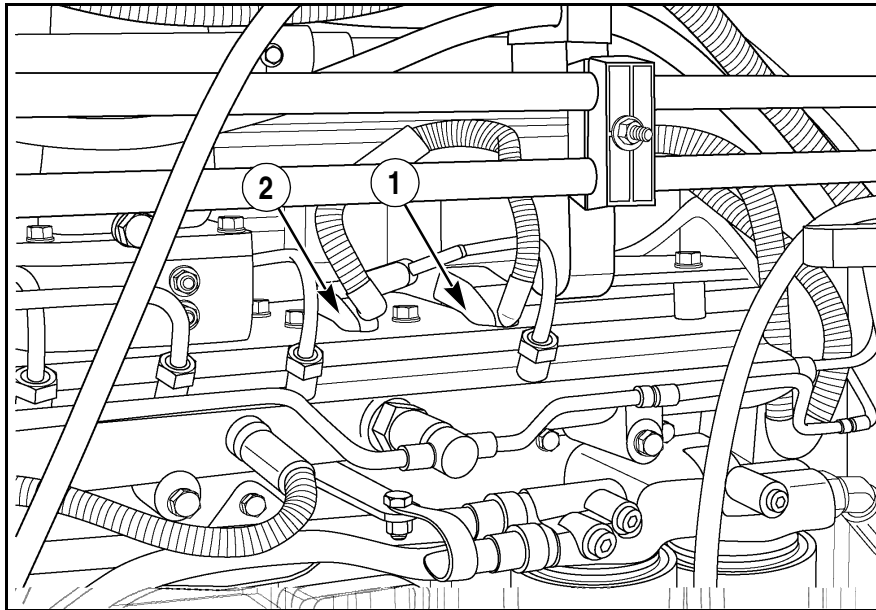




RD02H217A

**LEFT SIDE OF ENGINE**

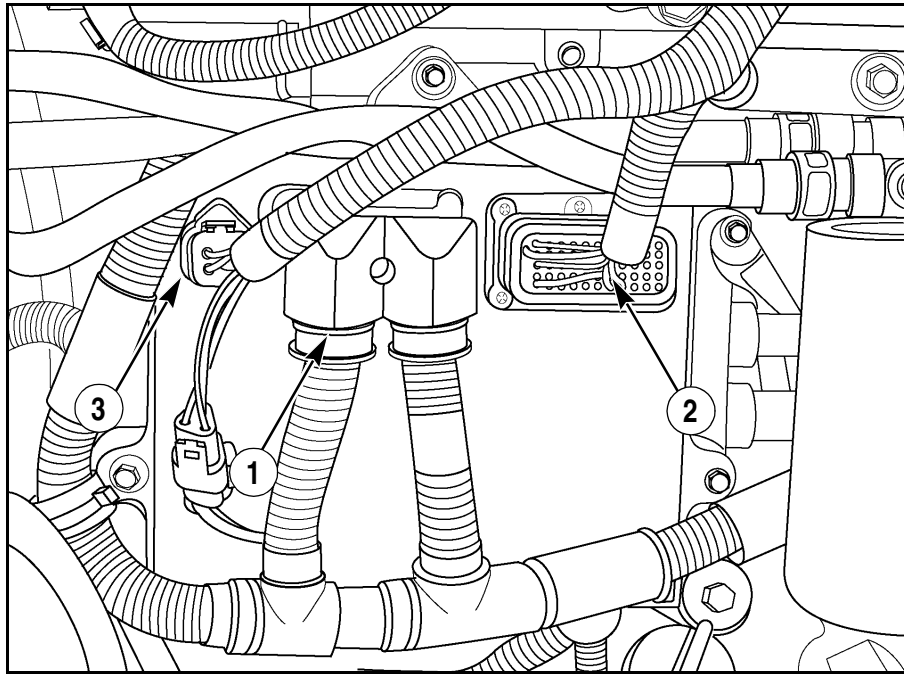
1. REAR OF TIMING GEAR COVER      2. CONNECTOR NO. 246 - ENGINE SPEED SENSOR



RD06A186

**LEFT SIDE OF ENGINE**

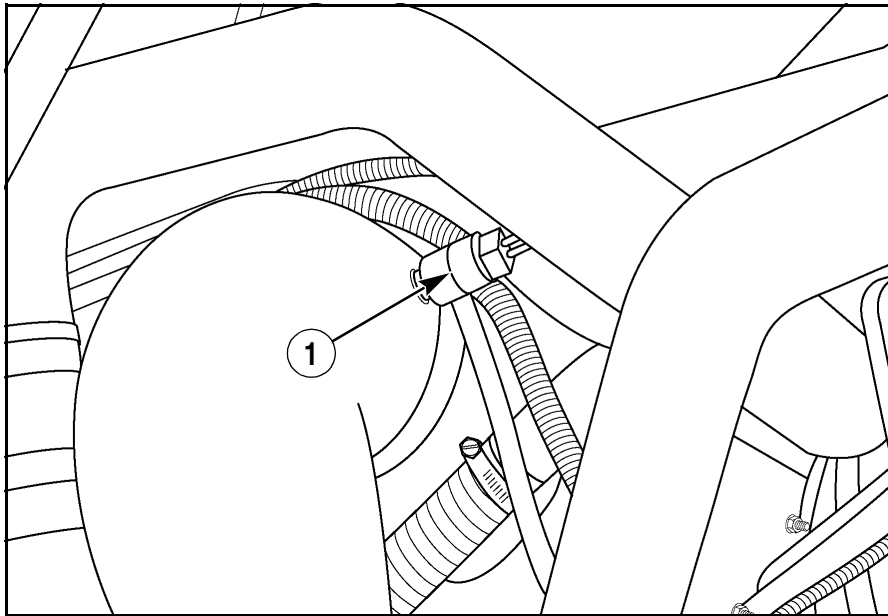
1. INTAKE MANIFOLD AIR TEMP/BOOST PRESSURE- CONNECTOR NO. C4  
2. AMBIANT AIR PRESSURE SENSOR - CONNECTOR NO. C29



RD06A179

### LEFT SIDE ELECTRONIC ENGINE

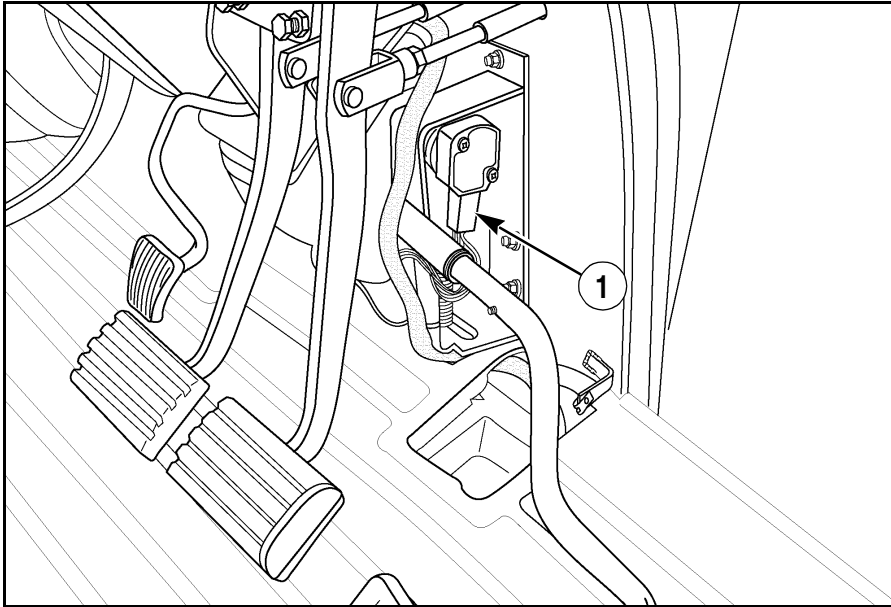
1. ENGINE CONTROLLER CONNECTOR J1
2. ENGINE CONTROL MODULE CONNECTOR NO. 256
3. ENGINE CONTROLLER POWER AND GROUND CONNECTOR NO. 204



RD06A185

### AIR INTAKE

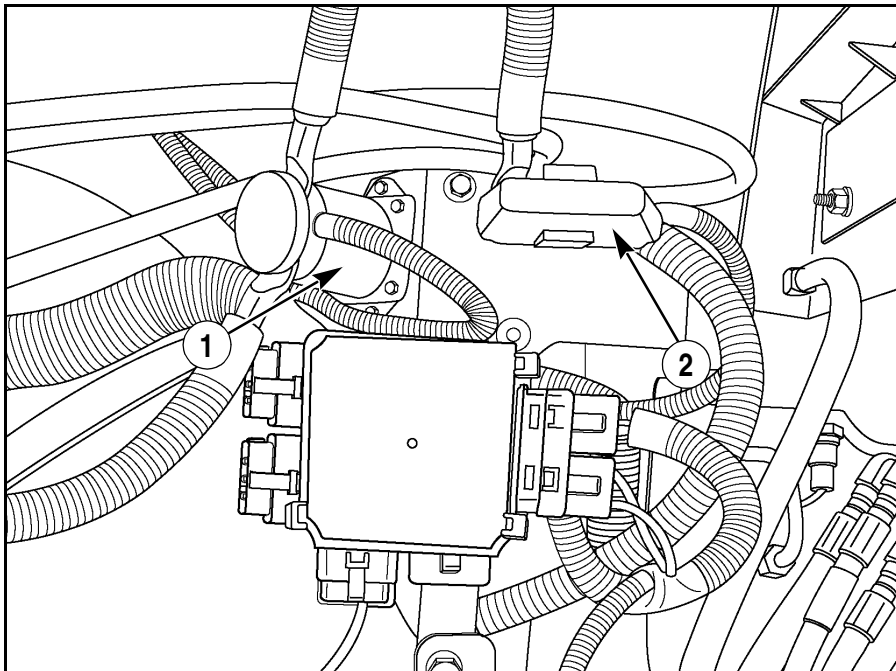
1. AIR FILTER RESTRICTION SWITCH



RD06B001

**RIGHT SIDE OF FRONT CONSOLE**

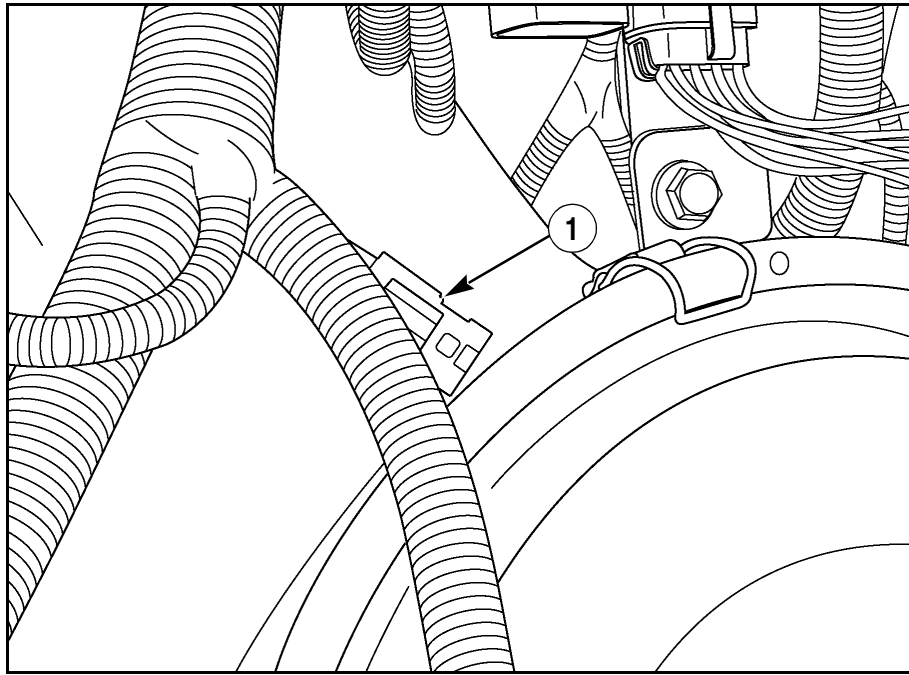
1. FOOT THROTTLE CONNECTOR NO. 256



RD06A172

**GRID RELAY**

1. GRID RELAY  
2. FUSE NO. 370 - 200 AMP

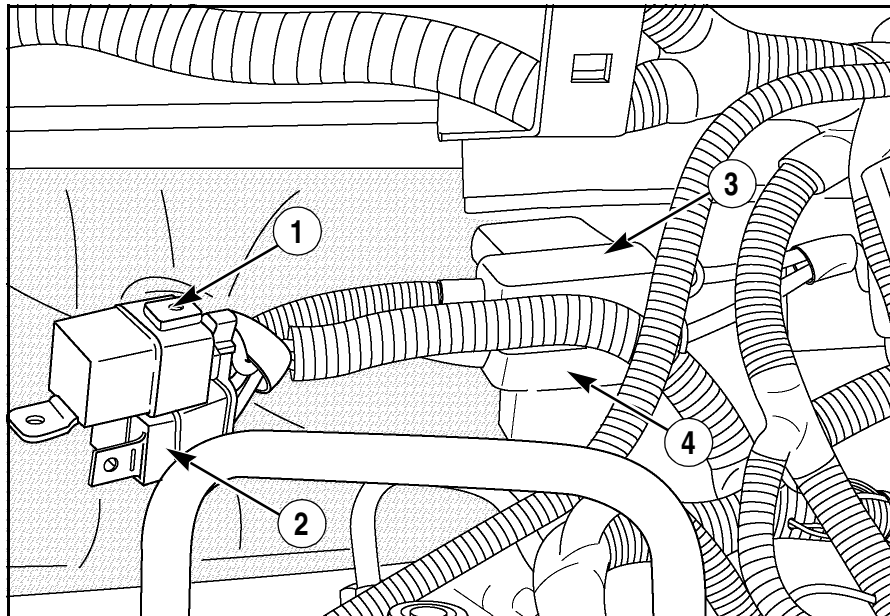


RD06B003

**UNDER HOOD NEAR DISTRIBUTION BOX**

1. PASSIVE TERMINATOR CONNECTOR NO. 175

**NOTE:** *This photo is from TG !!! It is in same location on MX, but unsure if it works for both !!*



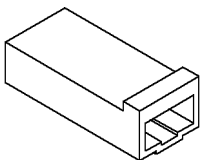
RD06A182

**REAR OF TRACTOR BELOW CONTROLLERS**

- |                                      |                             |
|--------------------------------------|-----------------------------|
| 1. IMPLEMENT RELAY CONNECTOT NO. 282 | 3. RELAY FUSE 327M - 30 AMP |
| 2. IMPLEMENT RELAY CONNECTOR NO. 283 | 4. RELAY FUSE 328M - 20 AMP |

## ELECTRICAL CONNECTORS

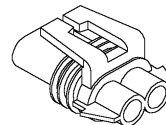
1S  
631801C1  
SOCKET HOUSING  
631801C1



681801C1

CONNECTOR 1S - 631801C1		
SEAT HEIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S1	SWITCHED B+

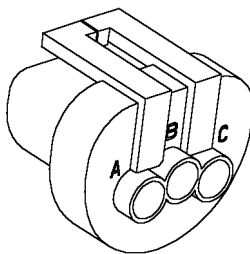
3M  
294250A1  
SOCKET HOUSING  
HEADLAMP HARNESS



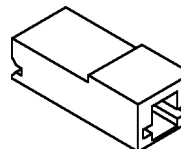
294250A1

CONNECTOR 3M - 294250A1		
RH SIDE HID LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	738G	SIDE LAMP B+
B	170G	GROUND

2M  
198714A1  
SOCKET HOUSING



3S  
SOCKET HOUSING  
CAB HARNESS  
230227A1

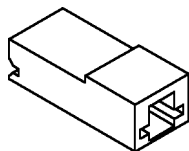


279658A1

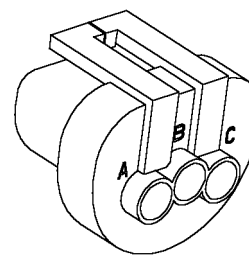
CONNECTOR 2M - 198714A1		
RH HEADLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	740A	LOW BEAM
B	170K	GROUND
C	741A	HIGH BEAM

CONNECTOR 3S - 230227A1		
SEAT COMPRESSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S5	COMMON

2S  
230227A1  
SOCKET HOUSING  
CAB HARNESS



4M  
198714A1  
SOCKET HOUSING

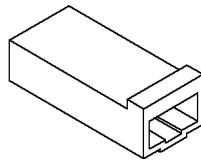


CONNECTOR 2S - 230227A1		
SEAT COMPRESSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S5	SWITCHED B+

279658A1

CONNECTOR 4M - 198714A1		
LH HEADLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	743A	LOW BEAM
B	170J	GROUND
C	740J	HIGH BEAM

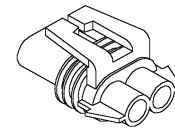
4S  
631801C1  
SOCKET HOUSING  
631801C1



681801C1

CONNECTOR 4S - 631801C1		
SEAT COMPRESSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S4	GROUND

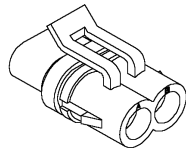
6M  
294250A1  
SOCKET HOUSING  
HEADLAMP HARNESS



294250A1

CONNECTOR 6M - 294250A1		
HID CENTER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	738F	CENTER HID LIGHT B+
B	170H	GROUND

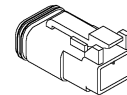
5M  
294250A1  
SOCKET HOUSING  
HEADLAMP HARNESS



198435A1

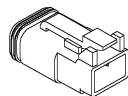
CONNECTOR 5M - 294250A1		
LH SIDE HID LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	738E	SIDE LAMP B+
B	170F	GROUND

6S  
225316C1  
SOCKET HOUSING



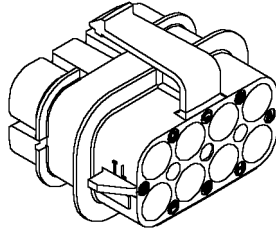
CONNECTOR 6S - 225316C1		
OPERATOR PRESENCE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	S10	B+
B	S11	GROUND

5S  
225316C1  
SOCKET HOUSING



CONNECTOR 5S - 225316C1		
OPERATOR PRESENCE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	S6	B+
B	S8	GROUND

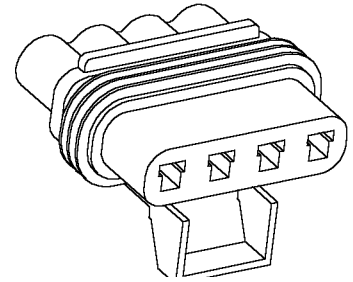
7M  
409089A1  
BLACK  
SOCKET HOUSING



230227A1

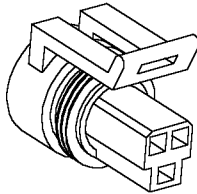
CONNECTOR 7M - 409089A1		
POWER DISTRIBUTION		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	750B	FRONT HITCH POSITION
B	602C	ICU SHUT DOWN (FUEL)
C	728D	LOW BEAM RELAY
D	89C	START RELAY
E	172C	START OUTPUT
F	792E	CENTER/SIDE RELAY
G	726C	HIGH BEAM RELAY
H	728D	HIGH DIODE/HIGH RELAY

8S  
182077A1  
SOCKET HOUSING

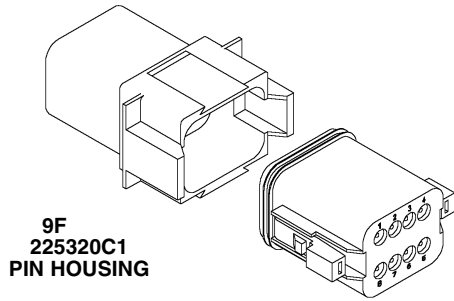


CONNECTOR 8S - 182077A1		
SEAT HEATER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	S15	HEATER B+
B	S20	HEATER GROUND
C	S26	HEATER B+
D	S29	HEATER GROUND

7S  
198456A1  
SOCKET HOUSING



CONNECTOR 7S - 198456A1		
BACK HEATER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	S14	B+
B	S28	GROUND



**9F**  
**225320C1**  
**PIN HOUSING**

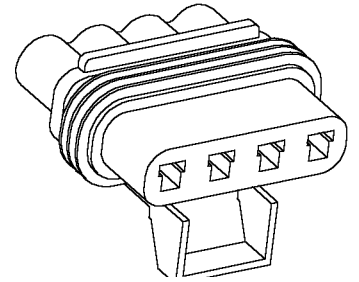
**9M**  
**225319C1**  
**BLACK SOCKET**  
**HOUSING**

225320C1

CONNECTOR 9F - 225320C1		
TURN SIGNAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	20A	TURN SIGNAL COMMON (B+)
2	21A	LEFT TURN SWITCH
3	22A	RIGHT TURN SWITCH
4	23A	HEADLIGHT SWITCH (B+)
5	24A	HIGH BEAM
6	25A	LOW BEAM
7	26A	HEADLIGHT DIPPING (B+)
8	27A	GROUND

CONNECTOR 9M - 225319C1		
TURN SIGNAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	766B	TURN SIGNAL COMMON (B+)
2	768A	LEFT TURN SWITCH
3	767A	RIGHT TURN SWITCH
4	725A	HEADLIGHT SWITCH (B+)
5	726A	HIGH BEAM
6	728A	LOW BEAM
7	706D	HEADLIGHT DIPPING (B+)
8	178AA	GROUND

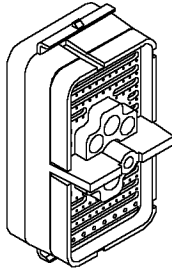
**9S**  
**182077A1**  
**SOCKET HOUSING**



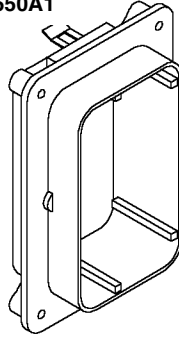
CONNECTOR 9S - 182077A1		
HEATER CONTROL MODULE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	S16	HEATER B+
B	S27	HEATER GROUND
C	S21	HEATER B+
D	S25 S26	SWITCH SIGNAL



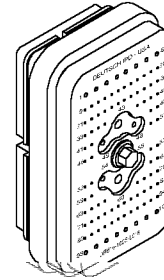
**10M - 437552A1  
PIN HOUSING  
CAB HARNESS**



**FLANGE  
437550A1**



**10F - 437551A1  
SOCKET HOUSING  
MAIN CHASSIS  
HARNESS**

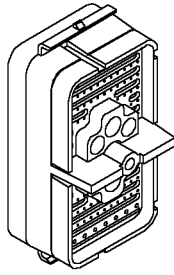


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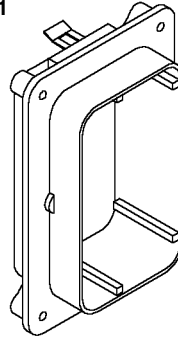
CONNECTOR 10M - 437552A1		
CHASSIS TO CAB		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	220A	NEUTRAL RELAY B+
2		OPEN
3	222C	TRAILER AUX B+
4	787B	FENDER WORKLIGHT B+
5		OPEN
6	102P	SWITCHED B+
7	204B	ELECT GOV B+ 30A
8		OPEN
9	500B	EDC POWER B+
10	509A	LEFT BRAKE SW
11	510A	RIGHT BRAKE SW
12	550A	TRCU POWER B+
13		OPEN
14	702A	PTO BRAKE RELAY-EURO
15	599A	PTO POWER B+
16	561D	PARK RELAY (COMMON)
17		OPEN
18		OPEN
19	531F	AXLE SENSOR B+
20	114B	UNSWITCHED B+ 12V
21	536B	AUTO SUSPENION LAMP
22		OPEN
23		OPEN
24	532B	AXLE LOCK/UNLOCK
25		OPEN
26	511B	PARK SIGNAL SW
27		OPEN
28	565A	PNEUMATIC BRAKE B+
29	293A	PTO "ON" ARMREST
30	566B	PNEU BRAKE IND-EURO
31		OPEN
32		OPEN

CONNECTOR 10M - 437552A1		
CHASSIS TO CAB HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
33	547B	CRUISE ON/OFF
34	358B	CRUISE INCREMENT
35	489B	CRUISE DECREMENT
36	267B	HYDRAULIC FILTER
37	267C	TRANSMISSION FILTER
38	555A	CLUTCH POT SIGNAL
39	556A	
40	557C	CLUTCH POT GND
41	754B	RIGHT TURN LAMP
42	752H	RIGHT HAZARD
43	101AA	UNSWITCHED BATTERY B+
44	753B	LEFT TURN LAMP
45	751H	LEFT HAZARD
46	755C	RIGHT STOP
47	792D	CENTER/SIDE RELAY
48	101CC	UNSWITCHED BATTERY B+
49	101BB	UNSWITCHED BATTERY B+
50	726B	HIGH BEAM RELAY
51	728C	LOW BEAM RELAY
52	750E	FENDER TAIL LIGHTS
53	750N	FRONT HITCH POS LAMPS
54	177A	CHASSIS GROUND
55	177B	CHASSIS GROUND
56	724C	HIGH BEAM
57	755F	TRAILER STOP
58	777A	AUTO HITCH (EURO)
59	755J	LEFT STOP
60		POWER CAVITY NOT USED
61		OPEN
62		OPEN
63	RED	CDB BATT (TRACTOR0
64	YELLOW	CDB HI (TRACTOR)

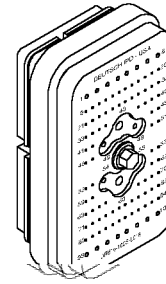
**10F - 437552A1  
SOCKET HOUSING  
MAIN CHASSIS  
HARNESS**



**FLANGE  
437550A1**



**10M - 437551A1  
PIN HOUSING CAB**

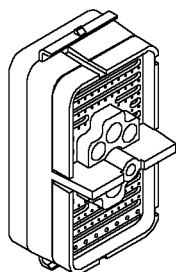


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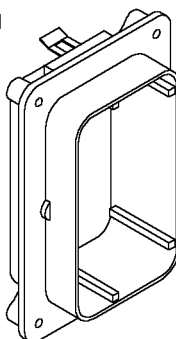
<b>CONNECTOR 10M - 437552A1</b>		
<b>CHASSIS TO CAB HARNESS</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
65	BLACK	CDB GND (TRACTOR)
66	GREEN	CDB LO (TRACTOR)
67	RED	CDB BATT (IMPLEMENT)
68	YELLOW	CDB HI (IMPLEMENT)
69	BLACK	CDB GN (IMPLEMENT)
70	GREEN	CDB LO (IMPLEMENT)
71	138B	1S011783 SWITCHED B+
72	137A	1S0 11783 UNSWITCHED B+
73		OPEN
74	518A	PICKUP HITCH LATCH
75	512A	RIDE CONTROL
76	900E	AUX CONTROLLER B+
77	223B	GOV. ING. SW SIG.
78	89B	KEY BATTERY
79	172A	FNRP START OUTPUT
80	722B	HORN POWER B+
81	836B	FRONT WASHER
82	845B	REAR WASHER
83	283B	RADAR B+
84	835B	TO HVAC CLUTCH
85	195C	CAB PRESSURE BLOWER
86	802B	HVAC HIGH PRESS SW OUT
87	285B	IMPLEMENT SWITCH
88	551A	FNRP SHUTTLE - F
89	553A	FNRP - NOT NEUTRAL

<b>CONNECTOR 10M - 437552A1</b>		
<b>CAB BULKHEAD</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
90	552A	FNRP SHUTTLE - R
91	561A	FNRP SWITCH 5V
92	558B	PARK RELAY COIL
93		OPEN
94		OPEN
95	179K	CLEAN GROUND
96		OPEN
97		OPEN
98		OPEN
99		OPEN
100		OPEN
101		OPEN
102		OPEN

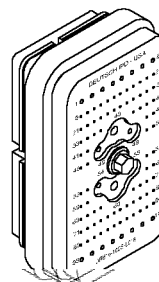
**10F - 437551A1  
SOCKET HOUSING  
MAIN CHASSIS  
HARNESS**



**FLANGE  
437550A1**



**10M- 437552A1  
PIN HOUSING CAB**

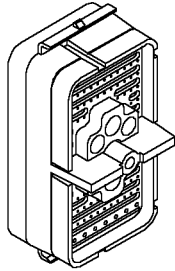


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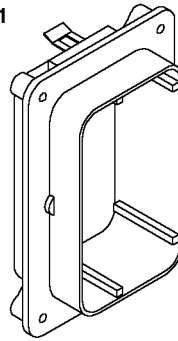
CONNECTOR 10F - 437551A1		
CAB BULKHEAD		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	220M	NEUTRAL RELAY B+
2		OPEN
3	222B	TRAILER AUX SWITCHED B+
4	787A	FENDER WORKLIGHT B+
5		OPEN
6	102C	SWITCHED B+
7	204A	ELECT GOV B+ 30A
8		OPEN
9	596A	EDC POWER B+
10	509B	LEFT BRAKE B+
11	510B	RIGHT BRAKE B+
12	550C	TRCU POWER B+
13		OPEN
14	311A	PTO BRAKE RELAY EURO
15	599B	PTO POWER B+
16	561H	PARK RELAY (COMMON)
17		OPEN
18		OPEN
19	531B	AXLE SENSOR B+
20	114A	TRANS CONT UNSW B+
21	536A	AUTO SUSPENSION LAMP
22		OPEN
23		OPEN
24	532A	AXLE LOCK/UNLOCK
25	533A	OPEN
26	511A	PARK SIGNAL SW
27	568C	BOT OF CLUTCH RLY (NC)
28	565C	PNEUMATIC BRAKE B+
29	293B	PTO "ON" ARMREST
30	566A	PNEU BRAKE IND-EURO
31		OPEN
32		OPEN

CONNECTOR 10F - 437551A1		
CAB BULKHEAD		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
33	547A	CRUISE ON/OFF
34	358A	CRUISE INCREMENT
35	489A	CRUISE DECREMENT
36	267A	HYD FILTER RESTRICT
37	267D	TRANS FILTER RESTRICT
38	555D	CLUTCH POT SIG
39	556D	CLUTCH POT B+ (8V)
40	557D	CLUTCH POT GND
41	754A	RIGHT TURN LAMPS
42	752G	RIGHT HAZARD
43	101A	UNSWITCHED BATTERY B+
44	753A	LEFT TURN LAMPS
45	751F	LEFT HAZARD
46	755B	RIGHT STOP
47	792C	CENTER/SIDE RELAY
48	101N	UNSWITCHED BATTERY B+
49	101P	UNSWITCHED BATTERY B+
50	726A	HIGH BEAM RELAY
51	728B	LOW BEAM RELAY
52	750D	FENDER TAIL LAMPS
53	750M	FRONT HITCH POS LAMPS
54	177C	CHASSIS GROUND
55	177D	CHASSIS GROUND
56	724B	HIGH BEAM
57	755E	TRAILER STOP
58		AUTO HITCH
59	755H	LEFT STOP
60		POWER CAVITY (NOT USED)
61		OPEN
62		OPEN
63	RED	CDB BATT (TRACTOR)
64	YELLOW	CDB HI (TRACTOR)

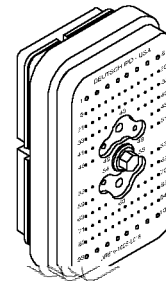
**10M - 437552A1  
SOCKET HOUSING  
MAIN CHASSIS  
HARNESS**



**FLANGE  
437550A1**



**10F - 437551A1  
437551A1  
PIN HOUSING CAB**

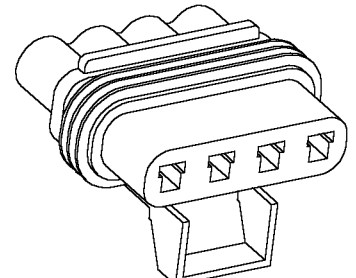


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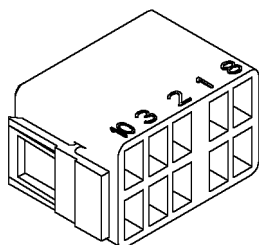
CONNECTOR 10F - 437551A1		
CAB BULKHEAD		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
65	BLACK	CDB GND (TRACTOR)
66	GREEN	CDB LO (TRACTOR)
67	RED	CDB BATT (IMPLEMENT)
68	YELLOW	CDB HI (IMPLEMENT)
69	BLACK	CDB GND (IMPLEMENT)
70	GREEN	CDB LO (IMPLEMENT)
71	138C	IS011783 SWITCHED B+
72	137B	IS011783 UNSWITCHED B+
73		OPEN
74	518B	PICKUP HITCH LATCH
75	512C	RIDE CONTROL
76	900D	AUX CONTROLLER B+
77	223A	GOV ING SW ING
78	89A	KEY BATTERY
79	172B	FNRP START OUTPUT
80	722A	HORN POWER B+
81	836A	FRONT WASHER
82	845A	REAR WASHER
83	283A	RADAR B+
84	835A	TO HVAC CLUTCH
85	195B	CAB PRESSURE BLOWER
86	802A	HVAC HIGH PRESS SW OUT
87	285A	IMPLEMENT SWITCH
88	551D	FNRP SHUTTLE - F
89	553D	FNRP - NOT NEUTRAL
90	552B	FNRP SHUTTLE - R
91	561B	FNRP SWITCH 5V
92	558A	PARK RELAY COIL
93		OPEN

CONNECTOR 10F - 437551A1		
CAB BULKHEAD		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
94		OPEN
95	179Y	CLEAN GROUND
96		OPEN
97		OPEN
98		OPEN
99		OPEN
100		OPEN
101		OPEN
102		OPEN

**10S  
182077A1  
SOCKET HOUSING**



CONNECTOR 10S - 182077A1		
SEAT HEATER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	S24	SWITCH B+
B	S25	SIGNAL
C	S23	LED B+
D	S22	LED GROUND

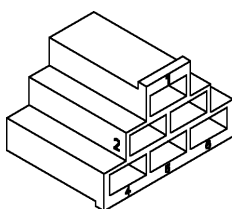


**11M**  
**BLACK SOCKET**  
**HOUSING**  
**CAB HARNESS**  
**382391A1**

382391A1

CONNECTOR 11M - 382391A1		
HEADLIGHT SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	703A	HAZARD LED
2	751G	HAZARD SIGNAL
3	703A 703B	HAZARD LED
4	725A 725B	ROAD LIGHTS
5	706B	UNSWITCHED B+
6	707B 707D	HAZARD / TAIL
7	178J	LED GROUND
8	703B	HAZARD LED
9		OPEN
10		OPEN

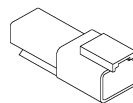
475083C1



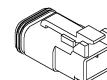
**12F**  
**475083C1**  
**SOCKET HOUSING**  
**CAB HARNESS**

CONNECTOR 12F - 475083C1		
ROTARY WORKLIGHT SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
B1	789B	LOWER WORKLIGHT B+
B2	789A 789B	WORKLIGHT B+
H/L	791A	ROOF REAR WORKLIGHT
R	790A	FRONT ROOF WORKLIGHT
T		OPEN
W	792A	LOWER WORKLIGHT

**SOCKET HOUSING**  
**FRONT TO REAR**  
**HARNESS 225315C1**



**SOCKET HOUSING**  
**225316C1**



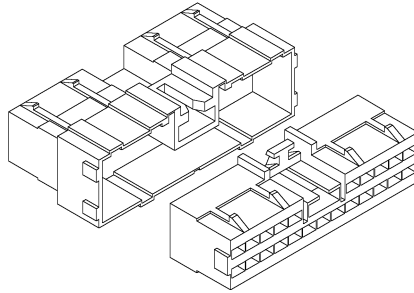
CONNECTOR 11S - 225316C1		
SEAT SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S12	SWITCH B+
2	S13	PRESENCE SIGNAL

CONNECTOR 12S - 225315C1		
SEAT SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S7	SWITCH B+
2	S9	PRESENCE SIGNAL

CONNECTOR 13S - 225316C1		
SEAT HEATER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S17	HEATER B+
2	S18	HEATER GROUND

CONNECTOR 14S - 225315C1		
SEAT HEATER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S30	HEATER B+
2	S19	HEATER GROUND

**13F  
PIN HOUSING  
ROOF HARNESS  
179483A1**



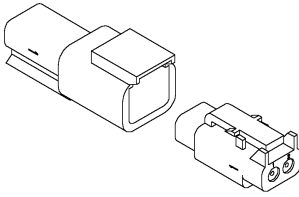
**13M  
SOCKET HOUSING  
CAB HARNESS  
196155A1**

179483A1

CONNECTOR 13F - 179483A1		
ROOF HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	751D 751E	LEFT TURN B+
B		OPEN
C	752D 752E	RIGHT TURN B+
D	783D 783C	A-POST WORKLIGHTS B+
E	784B	FRONT ROOF WORKLIGHTS B+
F	178Z	CHASSIS GROUND
G	793B 793C	REAR WORKLIGHTS B+
H	176B	STROBE/BEACON +
J	844B	REAR WIPER BRAKE
K	841B	REAR WIPER PARK
L	843B	REAR
M	178G	CHASSIS GROUND
N	834B	FRONT WIPER BRAKE
P	831B	FRONT WIPER PARK
R	833B	FRONT WIPER LOW
S	832B	FRONT WIPER HIGH
T	726D 726E	RIGHT CONSOLE LIGHT & RADIO
U	178N 178	RIGHT CONSOLE LIGHT & RADIO GND
V	871B 871C	DOME LIGHT & RADIO UNSWITCHED B+
W	870C	RADIO SWITCHED B+
X	135B	ROOF AUX POWER (UNSWITCHED B+)
Y	136B	ROOF AUX POWER (SWITCHED B+)
Z	134B	AUXILIARY POWER GROUND

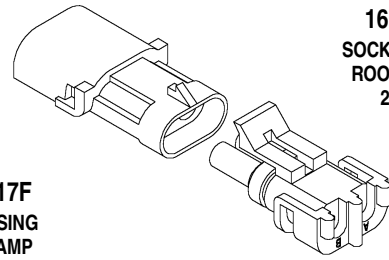
CONNECTOR 13M - 196155A1		
CAB HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	751C	LEFT ROOF HAZARD/TURN+
B		OPEN
C	752C	RIGHT ROOF HAZARD/TURN+
D	783A	A-POST WORKLIGHTS
E	784A	FRONT ROOF WORKLIGHTS
F	178H	CHASSIS GROUND
G	793A	REAR WORKLIGHTS +
H	776A	STROBE/BEACON
J	844C	REAR WIPER BRAKE
K	841A	REAR WIPER PARK
L	843C	REAR WIPER LOW
M	178D	CHASSIS GROUND
N	834A	FRONT WIPER BRAKE
P	831A	FRONT WIPER PARK
R	833A	FRONT WIPER LOW
S	832A	FRONT WIPER HIGH
T	727B	RIGHT CONSOLE LIGHT & RADIO
U	178C	DOME, RADIO GROUND
V	871A	DOME, MAP, RADIO (UNSW B+)
W	870B 870D	RADIO SWITCHED B+
X	135A	CIGAR, AUXILIARY UNSW B+
Y	136A	AUXILIARY SWITCHED B+
Z	177M	AUXILIARY GROUND

**14F & 15F  
PIN HOUSING  
LAMP  
222136A1**



**14M & 15M  
SOCKET HOUSING  
ROOF HARNESS  
222135A1**

222135A1 136A1



**16F & 17F  
PIN HOUSING  
WORKLAMP  
245483C1**

**16M & 17M  
SOCKET HOUSING  
ROOF HARNESS  
245482C1**

245482C1

CONNECTOR 14M - 222135A1		
RIGHT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	783C	B+
2	178AE	GROUND

CONNECTOR 14F - 222136A1		
RIGHT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	B+
2	LAMP	GROUND

CONNECTOR 15M - 222135A1		
LEFT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	783B	B+
2	178AD	GROUND

CONNECTOR 15F - 222136A1		
LEFT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	B+
2	LAMP	GROUND

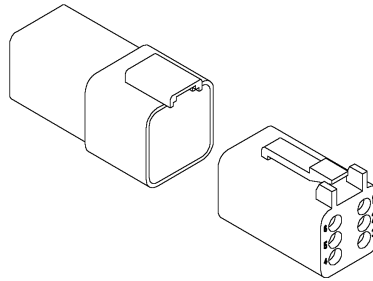
CONNECTOR 16M - 245482C1		
LEFT REAR WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	793C	B+
B	178AL	GROUND

CONNECTOR 16F - 245483C1		
LEFT REAR WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	LAMP	B+
B	LAMP	GROUND

CONNECTOR 17M - 245482C1		
RIGHT REAR WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	793B	B+
B	178AM	GROUND

CONNECTOR 17F - 245483C1		
RIGHT REAR WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	LAMP	B+
B	LAMP	GROUND

**20F, 21F  
PIN HOUSING  
225350C1**



**20M, 21M  
SOCKET HOUSING  
225351C1**

CONNECTOR 20F - 225350C1		
RIGHT FENDER HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	787	RIGHT WORKLIGHT B+
2	753	RIGHT TURN
3	751	WIDE MARKER LIGHT
4	755	STOP LIGHT
5	750	RIGHT TAIL

CONNECTOR 21F - 225350C1		
LEFT FENDER HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	787	LEFT WORKLIGHT B+
2	753	LEFT WORKLIGHT GROUND
3	751	WIDE MARKER LIGHT
4	755	STOP LIGHT
5	750	LEFT TAIL

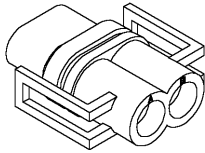
225350C1 350C1

CONNECTOR 20M - 225351C1		
RIGHT FENDER HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	787J	RIGHT WORKLIGHT B+
2	754B	RIGHT TURN
3	752L	WIDE MARKER LIGHT
4	755 C	STOP LIGHT
5	750H	RIGHT TAIL

CONNECTOR 21M - 225351C1		
LEFT FENDER HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	787D	LEFT WORKLIGHT B+
2	753B	LEFT TURN
3	751M	WIDE MARKER LIGHT
4	755J	STOP LIGHT
5	750F	LEFT TAIL



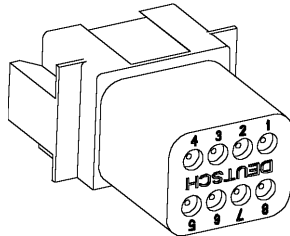
**18M**  
**SOCKET HOUSING**  
**ROOF HARNESS**  
**239449A1**



239449A1

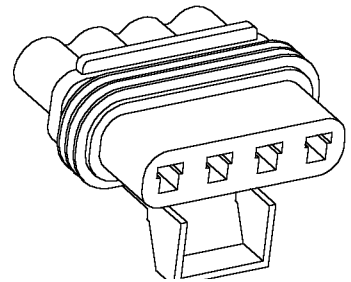
CONNECTOR 18M - 239449A1		
RIGHT FRONT ROOF WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	784C	B+
B	178AH	GROUND

**22M**  
**225320C1**  
**SOCKET HOUSING**



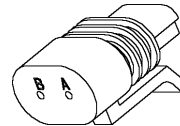
CONNECTOR 22M - 225319C1		
FRONT HITCH LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	743B	LEFT HIGH BEAM
2	742B	LEFT LOW BEAM
3	738F	WORKLIGHTS
4	740B	RIGHT LOW BEAM
5	741B	RIGHT HIGH BEAM
6	180F	CHASSIS GROUND
7	176C	CHASSIS GROUND
8	744A	PILOT

**8S**  
**182077A1**  
**SOCKET HOUSING**



CONNECTOR 22F - 225320C1		
FRONT HITCH LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		OPEN
3	738F	WORKLAMPS
4		OPEN
5		OPEN
6	180F	CHASSIS GROUND
7		OPEN
8		OPEN

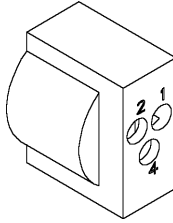
**25M**  
**256342A1**  
**SOCKET HOUSING**



12162194

CONNECTOR 25M - 256342A1		
FENDER HID BALLAST		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	RED	HID B+
B	BLACK	GROUND

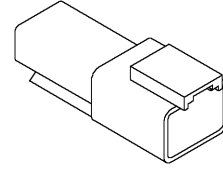
**26F  
86993701  
SOCKET HOUSING**



CONNECTOR 26F - 86993701		
FENDER HID BALLAST		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	RED	
2	WHITE	
4	BLACK	

12162194

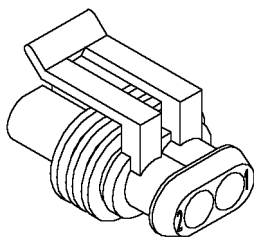
**27F  
225315C1  
PIN HOUSING**



CONNECTOR 27F - 225315C1		
FENDER HID LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	RED	B+
2	BLACK	GROUND

12162194

29, 30, 31, 32, 33,  
34, 36, 37, 38, 39  
371614A1  
SOCKET HOUSING  
ROOF HARNESS



371614A1

CONNECTOR 29M - 371614A1		
ODD SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201B)	HIGH SIDE
2	580A	LOW SIDE

CONNECTOR 31M - 371614A1		
1 - 2 SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201C	HIGH SIDE
2	582A	LOW SIDE

CONNECTOR 33M - 371614A1		
5 - 6 SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201D	HIGH SIDE
2	584A	LOW SIDE

CONNECTOR 35M - 87416876		
MASTER SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	586A	HIGH SIDE
B	220B	LOW SIDE

CONNECTOR 37M - 371614A1		
MEDIUM SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	588A	HIGH SIDE
2	220C	LOW SIDE

CONNECTOR 39M - 371614A1		
CREEP SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201N	HIGH SIDE
2	590A	LOW SIDE

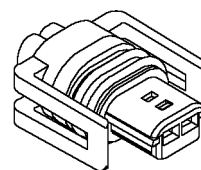
CONNECTOR 30M - 371614A1		
EVEN SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201E	HIGH SIDE
2	581A	LOW SIDE

CONNECTOR 32M - 371614A1		
3 - 4 SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201F)	HIGH SIDE
2	583A	LOW SIDE

CONNECTOR 34M - 371614A1		
REVERSE SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	201G	HIGH SIDE
2	585A	LOW SIDE

CONNECTOR 36M - 371614A1		
LOW SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	587A	HIGH SIDE
2	220D	LOW SIDE

CONNECTOR 38M - 371614A1		
HIGH SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	220E	HIGH SIDE
2	589A	LOW SIDE

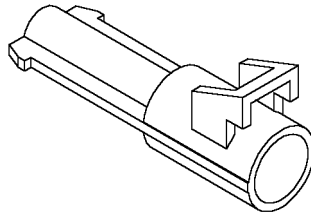


35M  
87416876  
SOCKET HOUSING

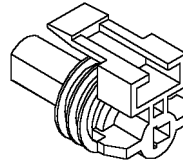
198456A1

CONNECTOR 35M - 87416876		
MASTER SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	586A	HIGH SIDE
2	220B	LOW SIDE

**40F AND 41F  
182064A1  
PIN HOUSING**



**40M AND 41M  
182066A1  
SOCKET HOUSING**

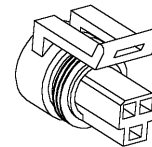


CONNECTOR 40F - 182064A1		
RIGHT FENDER GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	174K	GROUND

CONNECTOR 40M - 182066A1		
RIGHT FENDER GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	174	GROUND

CONNECTOR 41F - 182064A1		
LEFT FENDER GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	174F	GROUND

CONNECTOR 41M - 182066A1		
LEFT FENDER GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	174	GROUND



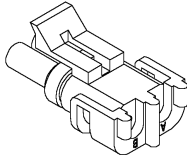
**44M  
198456A1  
SOCKET HOUSING**

198456A1

CONNECTOR 44M - 198456A1		
SYSTEM PRESSURE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	557B	SYSTEM PRESSURE GROUND
B	561C	SYSTEM PRESSURE B+
C	563A	SYSTEM PRESSURE SIGNAL

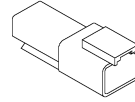
245483C1

**47M  
335461A1  
SOCKET HOUSING**

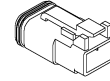


335461A1

**49F  
SOCKET HOUSING  
FRONT TO REAR  
HARNESS 225315C1**



**49M  
SOCKET HOUSING  
225316C1**



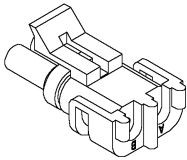
225316C1

CONNECTOR 47M - 335461A1		
RIGHT BRAKE PARK SOLENOID SWITCH #1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	561F	PARK B+
B	567A	TO SOLENOID

CONNECTOR 49F - 225315C1		
PARK SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	567D	PARK B+
2	179BT	GROUND

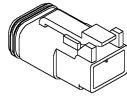
CONNECTOR 49M - 225316C1		
PARK SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	567C	PARK B+
2	179AE	GROUND

**48M  
335461A1  
SOCKET HOUSING**



335461A1

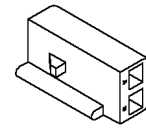
CONNECTOR 48M - 335461A1		
LEFT BRAKE PARK SOLENOID SWITCH #2		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	561G	PARK B+
B	567B	TO SOLENOID



**49MM  
225316C1  
SOCKET HOUSING**

225316C1

CONNECTOR 49MM - 225316C1		
PARK SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	567G	PARK B+
2	179CA	GROUND

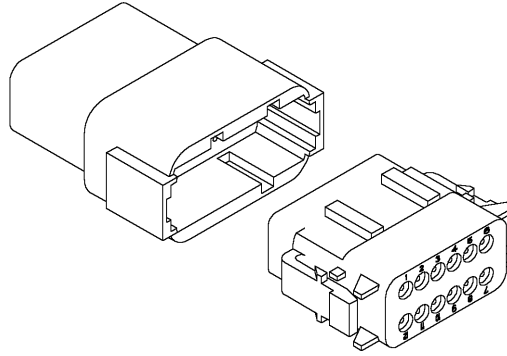


**50M  
SOCKET HOUSING  
227429A1**

227429A1

CONNECTOR 50M - 227429A1		
BOTTOM OF CLUTCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	553B	BOTTOM OF CLUTCH
B	568A	NOT NEUTRAL SIGNAL

**51F**  
PIN HOUSING  
FNRP HARNESS  
223672A1

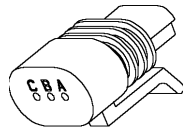


**51M**  
SOCKET HOUSING  
CAB HARNESS  
223671A1

CONNECTOR 51F - 223672A1		
FNRP SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		START INPUT
2		START OUTPUT
3		RUN INPUT
4		FNRP - NOT PARK
5		FNRP-REVERSE
6		FNRP-FORWARD
7		FNRP-NOT NEUTRAL
8		FNRP GROUND
9		HORN
10		RT/LT TURN COMMON GND
11		FNRP RIGHT TURN INDICATOR
12		FNRP LEFT TURN INDICATOR

CONNECTOR 51M - 223671A1		
FNRP SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	623A	START INPUT
2	172B	START OUTPUT
3	550J	RUN INPUT
4	511A	FNRP - NOT PARK
5	552B	FNRP-REVERSE
6	551D	FNRP-FORWARD
7	553F	FNRP-NOT NEUTRAL
8	561B	FNRP GROUND
9	723A	HORN
10	178AB	RT/LT TURN COMMON GND
11	752A	FNRP RIGHT TURN INDICATOR
12	751A	FNRP LEFT TURN INDICATOR

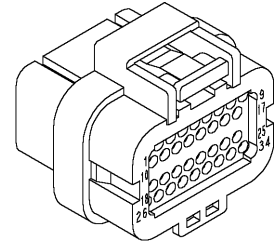
**52M - 198550A1**  
SOCKET HOUSING  
198550A1



198550A1

CONNECTOR 52M - 198550A1		
ELECTRIC CLUTCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	557D	CLUTCH POTENTIOMETER GROUND
B	555D	CLUTCH POSITION
C	556D	SUPPLY (8V DC)

**53M**  
SOCKET HOUSING 87410948,



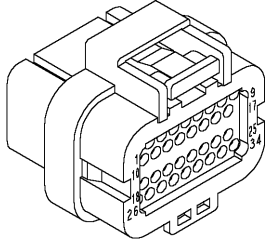
223671A1

CONNECTOR 53M - 87410948		
TMF (TRACTOR MULTI-FUNCTION) CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	900A	INTERLOCKED SWITCHED B+
2	900B	INTERLOCKED SWITCHED B+
3	900C	INTERLOCKED SWITCHED B+
4	AUX1-TOP1	EHR 1 RAISE SOURCE
5	525B	EDC RAISE SOL SOURCE
6	AUX3 BOT 1	EHR 3 LOWER SOURCE
7	AUX4 TOP 1	EHR 4 RAISE SOURCE
8	501E	INTERLOCKED SWITCHED B+
9	595C	EHR ENABLE
10	AUX1 BOT 1	EHR 1 LOWER SOURCE
11	AUX2 BOT 1	EHR 2 LOWER SOURCE
12	528B	EDC LOWER SOL SOURCE
13	597A	PTO CLUTCH SOL SOURCE
14	114D	BATTERY B+
15	YELLOW	CAN HI (TRACTOR)
16	GREEN	CAN LO (TRACTOR)
19	174R	CHASSIS GROUND
20	599F	SWITCHED B+
23	517A	SENSOR GROUND
25	179H	POWER GROUND
26	179G	POWER GROUND



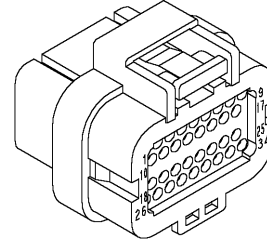
**54M**

SOCKET HOUSING 87410947,



**55M**

SOCKET HOUSING 87410948,



**CONNECTOR 54M - 87410947**

**J2 - TMF (TRACTOR MULTI-FUNCTION) CONTROLLER - BLACK**

CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX6 - TOP2	EHR 6 RAISE SOL SINK
2	AUX3 - TOP2	EHR 3 RAISE SOL SINK
3	AUX5 - TOP 2	EHR 5 RAISE SOL SINK
4	AUX5 - BOT2	EHR 5 LOWER SOL SINK
5	AUX3 - TOP1	EHR 3 RAISE SOL SOURCE
6	AUX2 - TOP1	EHR 2 RAISE SOL SOURCE
7	AUX5 - BOT1	EHR 5 LOWER SOL SOURCE
8	540A	FRONT WHEEL DRIVE CLUTCH SOL
9	530A	REAR DIFF LOCK CLUTCH SOL
10	AUX2 - TOP2	EHR 2 RAISE SOL SINK
13	AUX4 - BOT1	EHR 4 LOWER SOL SOURCE
14	AUX6 - TOP1	EHR 6 RAISE SOL SOURCE
15	AUX5 - TOP1	EHR 5 RAISE SOL SOURCE
16	AUX6 - BOT1	EHR 6 LOWER SOL SOURCE
17	702A	BRAKE LIGHT RELAY
18	AUX4 - BOT2	EHR 4 LOWER SOL SINK
21	294A	PTO SHAFT SIZE FREQ
23		
25	501D	INTERLOCKED SWITCHED B+
34	501C	INTERLOCKED SWITCHED B+

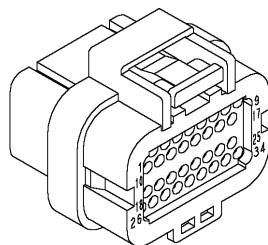
223671A1

**CONNECTOR 55M - 87419488**

**TMF (TRACTOR MULTI-FUNCTION) CONTROLLER**

CAV	WIRE NUMBER	CIRCUIT REFERENCE
14		
23		
24	512A	EDC AUTO HITCH SW
25	518A	EDC RIDE CONTROL SW

**56M, 57M, 58M  
SOCKET HOUSING**

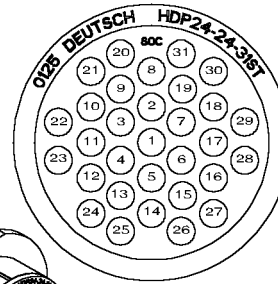
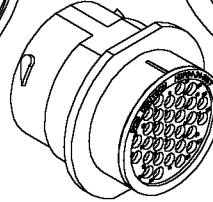
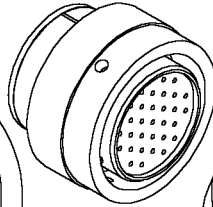
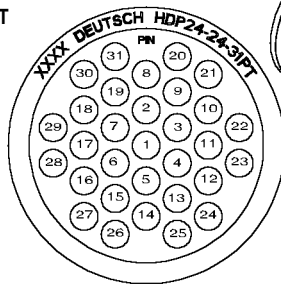


CONNECTOR 56M - 87419489		
TMF (TRACTOR MULTI-FUNCTION) CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	506A	EDC POS POT HIGH SIDE

CONNECTOR 58M - 87410949		
TMF (TRACTOR MULTI-FUNCTION) CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX1 - BOT2	EHR 1 LOWER SOL SINK
2	508A	EDC POS POT LOW SIDE
3	AUX2 - BOT2	EHR 2 LOWER SOL SINK
4	527B	EHR CYL 1 FEEDBACK
5	529B	EHR CYL 2 FEEDBACK
6	AUX3 - BOT2	EHR 3 LOWER SOL SINK
7	598A	PTO CLUTCH VALVE
8	AUX1 - TOP2	EHR 1 RAISE SOL SINK
9	534A	DB9 (RS232 IN)
10	533A	DB9 (RS232 OUT)
13	AUX4 - TOP2	EHR 4 RAISE SINK
20	295A	PTO CLUTCH OUTPUT SPEED
21	179F	POWER GROUND
25	179AL	POWER GROUND
26	179AC	POWER GROUND

CONNECTOR 57M - 87410946		
TMF (TRACTOR MULTI-FUNCTION) CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
2	507A	EDC POSITION POT WIPER
4	918A	EHR CYL 1 FEEDBACK
5	919A	EHR CYL 2 FEEDBACK
9	515A	EDC LEFT DRAFT PIN SIG
10	514A	EDC LEFT DRAFT PIN SIG
16	920A	5 VOLT REFERENCE
18		
22	513A	EDC REMOTE RAISE SW
23	526A	EDC REMOTE LOWER SW
25	516B	8 VOLT REFERENCE
26	510A	LEFT BRAKE PEDEL SWITCH
28	509A	RIGHT BRAKE PEDEL SWITCH
29		
30	293A	ENG SPEED ALT W TERMINAL
31	516C	8 VOLT REFERENCE
33	216D	ENG SPEED ALT W TERM

**60F**  
PIN HOUSING  
FRONT TO REAR  
HARNESS  
HDP26-24-31PT



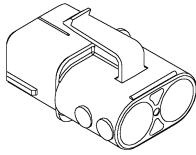
**60M**  
SOCKET HOUSING  
CAB HARNESS  
HDP24-24-31ST

60F\_60M.tif

CONNECTOR 60F - HDP26 - 24 - 31PE		
CHASSIS TO CAB		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2	183A	ICU CLEAN GROUND
3	179L	CLEAN GROUND
4	181B	ICU SENSOR GND
5	PLUG	OPEN
6	945B	IDLE VALIDATION OFF
7	266B	AIR FILTER
8	234B	FUEL LEVE 8VDC
9	944B	FOOT THROTTLE SIGNAL
10	121B	ALTERNATOR EXCITE
12	216B	ALT W FREQ
13	236B	FUEL LEVEL SIGNAL
14	PLUG	OPEN
15	215B	WHEEL SPEED SIGNAL
16	723B	HORN RETURN
17	943B	ACC POS (-)
18	PLUG	OPEN
19	942B	ACC POS (+)
20	GREEN	CDB LO (TR)
21	941B	IDLE ON SWITCH
22	264B	TRANS OIL TEMP
23	PLUG	OPEN
24	PLUG	OPEN
25	199D	RADAR SIGNAL FREQ
26	PLUG	OPEN
27	YELLOW	CDB HI (TR)
28	262B	RADAR PRESENT
30	267B	TRANS FILTER RESTRICTION SW
31	267C	HYDRAULIC FILTER RESTRICTION SW

CONNECTOR 60M - HDP24 - 24 - 31SE		
CAB TO CHASSIS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	PLUG	OPEN
2	183B	ICU CLEAN GROUND
3	179S	CLEAN GROUND
4	181A	ICU SENSOR GND
5	PLUG	OPEN
6	945A	IDLE VALIDATION OFF
7	266A	AIR FILTER
8	234A	FUEL LEVE 8VDC
9	944A	FOOT THROTTLE SIGNAL
10	121A	ALTERNATOR EXCITE
12	216A	ALT W FREQ
13	236A	FUEL LEVEL SIGNAL
14	452A	OPEN
15	215A	WHEEL SPEED SIGNAL
16	723A	HORN RETURN
17	943A	ACC POS (-)
18	PLUG	OPEN
19	942A	ACC POS (+)
20	GREEN	CDB LO (TR)
21	941A	IDLE ON SWITCH
22	264A	TRANS OIL TEMP
23	PLUG	OPEN
24	PLUG	OPEN
25	199B	RADAR SIGNAL FREQ
26	PLUG	OPEN
27	YELLOW	CDB HI (TR)
28	262A	RADAR PRESENT
30	267A	TRANS FILTER RESTRICTION SW
31	267D	HYDRAULIC FILTER RESTRICTION SW

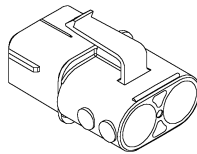
**64M  
409086A1  
BLACK SOCKET  
HOUSING**



409086A1

CONNECTOR 64M - 409086A1		
SWITCHED POWER (BLACK CONN)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	620B	UNSWITCHED B+
C	600B	TO GROUND

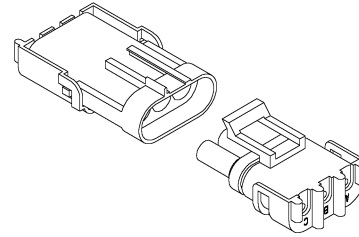
**65M  
409084A1  
GRAY SOCKET HOUSING**



409086A1

CONNECTOR 65M - 409084A1		
UNSWITCHED POWER (GRAY CONN)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	600C	GROUND
C	102N	SWITCHED B+

**66F  
PIN HOUS-  
ING  
FUEL  
SENDER  
245485C1**



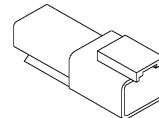
**66M  
SOCKET  
HOUSING  
FRONT TO  
REAR  
HARNESS  
245484C1**

245484C1

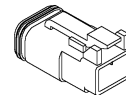
CONNECTOR 66M - 245484C1		
FUEL SENDER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	234B	FUEL SENDER 8V
B	236B	FUEL SENDER SIGNAL
C	181M	FUEL SENDER GROUND

CONNECTOR 66F - 245485C1		
FUEL SENDER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SENSOR	FUEL SENDER B+
B	SENSOR	FUEL SENDER SIGNAL
C	SENSOR	FUEL SENDER GROUND

**67F  
PIN HOUSING  
225315C1**



**67M  
SOCKET HOUSING  
225316C1**

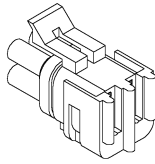
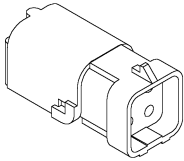


225315C1

CONNECTOR 67F - 225315C1		
PNEUMATIC AIR SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	566C	SOLENOID B+
2	179AB	CHASSIS GROUND

CONNECTOR 67M - 225316C1		
PNEUMATIC AIR SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	566B	AIR SWITCH B+
2	179BA	AIR SWITCH GROUND

**68F**  
PIN HOUSING  
RADAR  
245716C1



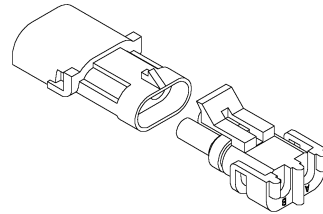
**68M**  
SOCKET  
HOUSING  
FRONT TO  
REAR

245716C1

CONNECTOR 68F - 245716C1		
RADAR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	RADAR	RADAR GROUND
B	RADAR	RADAR SIGNAL
C	RADAR	RADAR B+
D	RADAR	RADAR PRESENT

CONNECTOR 68M - 245715C1		
RADAR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	181J	RADAR GROUND
B	199D	RADAR SIGNAL
C	283B	RADAR B+
D	262B	RADAR PRESENT

**69F**  
PIN HOUSING  
245483C1



**69M**  
SOCKET  
HOUSING

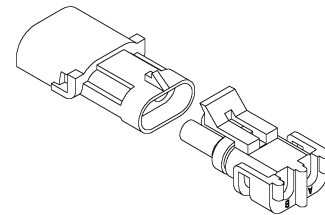
245482C1

CONNECTOR 69F - 245483C1		
WHEEL SPEED		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SENSOR	WHEEL SPEED SIGNAL
B	SENSOR	WHEEL SPEED GROUND

CONNECTOR 69M - 245482C1		
WHEEL SPEED		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	215C	WHEEL SPEED SIGNAL
B	181N	WHEEL SPEED GROUND

**70M**  
SOCKET HOUSING  
245482C1

**70F**  
SOCKET HOUSING  
FRONT TO REAR  
HARNESS 245483C1

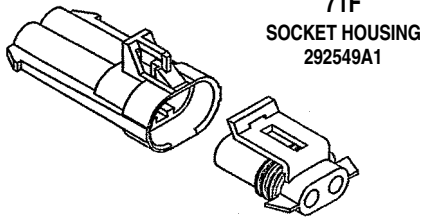


335461A1

CONNECTOR 70F - 245483C1		
PNEUMATIC PREFILL SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	565D	B+
B	179B5	CHASSIS GROUND

CONNECTOR 70M - 245482C1		
PNEUMATIC PREFILL SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	565A	B+
B	179BB	GROUND

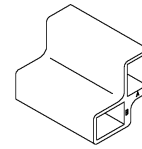
**71M**  
PIN HOUSING  
292548A1



RH99M024.tif

CONNECTOR 71F - 292549A1		
COMPRESSOR HI-PRESSURE SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	179AJ	CHASSIS GROUND
B	802C	A/C PRESSURE SWITCH IN

**73F**  
SOCKET HOUSING  
475075C1

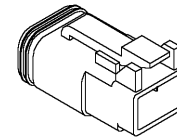


475075C1

CONNECTOR 73F - 475075C1		
ETHER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	600D	GROUND
B	641C	ETHER SOLENOID B+

CONNECTOR 71M - 292548A1		
COMPRESSOR HI-PRESSURE SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SWITCH	CHASSIS GROUND
B	SWITCH	A/C PRESSURE SWITCH IN

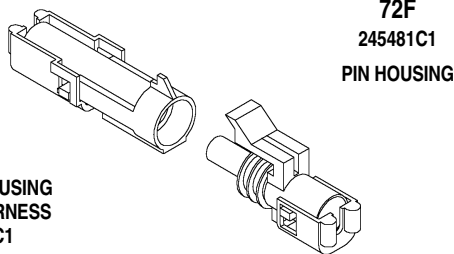
**74M**  
SOCKET  
ENGINE HOUSING



RI00E015.EPS

CONNECTOR 74M - 225316C1		
AUTOGUIDANCE VALVE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	846A	SOLENOID B+
2	847A	GROUND

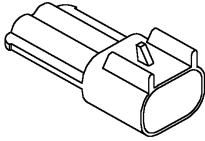
**72M**  
SOCKET HOUSING  
ENGINE HARNESS  
245480C1



245480C1

CONNECTOR 72F - 245481C1		
A/C COMPRESSOR CLUTCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	COMP	A/C COMPRESSOR CLUTCH B+

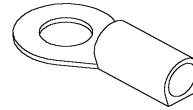
CONNECTOR 72M - 245480C1		
A/C COMPRESSOR CLUTCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	835C	A/C COMPRESSOR CLUTCH B+



**75M**  
PIN HOUSING  
ENGINE HARNESS 182068A1

182068A1

CONNECTOR 75M - 182068A1		
AIR TO AIR (EM)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	240C	AIR TO AIR SENSOR
B	181W	AIR TO AIR GROUND

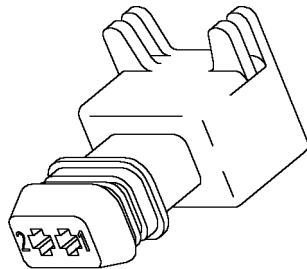


**77F, 78F, 79F, 81F AND 81A**  
RING TERMINAL

200338.TIF

CONNECTOR 77F AMP_327175		
ALTERNATOR OUTPUT B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	120A	B+

**76F**  
PIN HOUSING  
291718A1

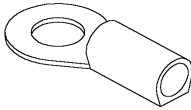


CONNECTOR 78F - 200338		
INTERMEDIATE STARTING RELAY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	620A	B+

CONNECTOR 76F - 291718A1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	600D	AIR RESTRICT GROUND
2	266C	AIR FILTER REST

CONNECTOR 79F - 200312		
STARTER START TERMINAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	625A	B+

CONNECTOR 81A - 225068C1		
ALTERNATOR OUTPUT B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	BATT	B+



81F, 83F, 84F, 87F

RING TERMINAL

200338.TIF

CONNECTOR 81F - AMP_327175		
BATTERY B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	120A	B+

CONNECTOR 82F - 446658		
INTERMEDIATE SOLENOID IGNITION		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	622A	B+

CONNECTOR 83F - 225065C1		
RELAY GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	600A	B+

CONNECTOR 84F - 225065C1		
STARTER START TERMINAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	625A	B+

CONNECTOR 85F - 200329		
ENGINE RPM		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	126 W	B+

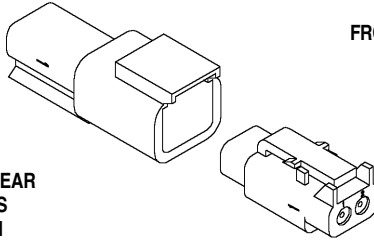
CONNECTOR 86F - 446658		
ALTERNATOR EXCITE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	121 D	B+

CONNECTOR 87F - 225065C1		
CHASSIS GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	600E	CHASSIS GROUND

CONNECTOR 88F - 225072C1		
TRANSMISSION FILTER RESTRICTION		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	267B	GROUND



**89F**  
FRONT TO REAR  
HARNESS  
222316A1



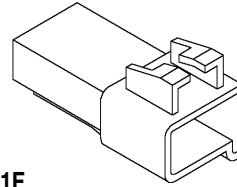
**89M**  
FRONT TO REAR  
HARNESS  
222315A1

222135A1

CONNECTOR 89F - 225315C1		
TRANSMISSION TEMP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	SENSOR	TRANSMISSION OIL TEMPERATURE
2	SENSOR	ICU SENSOR GROUND

CONNECTOR 89M - 225316C1		
TRANSMISSION TEMP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	264B	TRANSMISSION OIL TEMPERATURE
2	181D	ICU SENSOR GROUND

**91F**  
PIN HOUSING  
227729A1

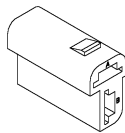


**91M**  
SOCKET HOUSING  
227728A1

227729A1 AND 728A1

CONNECTOR 91F - 227729A1		
ROOF AUXILIARY POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	134C	GROUND
B	136C	SWITCHED B+
C	135C	UNSWITCHED B+

CONNECTOR 91M - 227728A1		
ROOF AUXILIARY POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	134B	GROUND
B	136B	SWITCHED B+
C	135B	UNSWITCHED B+

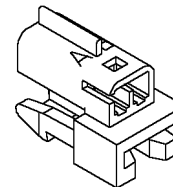


**90M**  
PIN HOUSING  
FRONT TO REAR  
HARNESS  
872290R1

872290R1

CONNECTOR 90F - 872290R1		
PRESSURIZATION BLOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	195C	BLOWER B+
B	179AY	BLOWER GROUND

CONNECTOR 90M - 877291R1		
PRESSURIZATION BLOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	BLOWER	BLOWER B+
B	BLOWER	BLOWER GROUND



**92F**  
SOCKET HOUSING

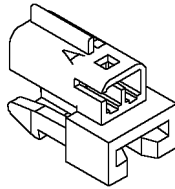
**92M**  
PIN HOUSING

12052833

CONNECTOR 92M - 298079A1		
RIGHT REAR SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	874B	SPEAKER +
B	874A	SPEAKER -

CONNECTOR 92F - 12052833		
RIGHT REAR SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SPEAKER	SPEAKER +
B	SPEAKER	SPEAKER -

**93M**  
PIN HOUSING



**93F**  
SOCKET HOUSING

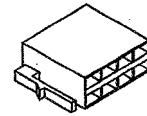
12052833

CONNECTOR 93M - 298079A1		
LEFT REAR SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	875B	SPEAKER +
B	875A	SPEAKER -

CONNECTOR 93F - 12052833		
LEFT REAR SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SPEAKER	SPEAKER +
B	SPEAKER	SPEAKER -

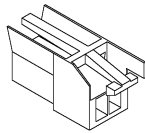
**95A AND 95B**  
SOCKET HOUSING  
292495A1 AND 292494A1



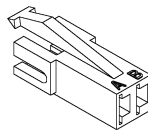
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CONNECTOR 95A - 292495A1		
DELCO RADIO		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		OPEN
3		OPEN
4	870C	SWITCHED B+
5		OPEN
6	727E	DIMMER
7	871B	UNSWITCHED B+
8	178M	POWER GROUND

**94F**  
SOCKET HOUSING  
291729A1



**94M**  
SOCKET HOUSING  
255442C1



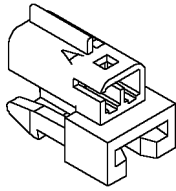
291729A1

CONNECTOR 94F - 291729A1		
RIGHT HAND CONSOLE LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	LIGHT	LIGHT B+
B	LIGHT	GROUND

CONNECTOR 95B - 291494A1		
DELCO RADIO		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
9	874B	RR SPEAKER +
10	874A	RR SPEAKER -
11	872B	RF SPEAKER +
12	872A	RF SPEAKER -
13	873B	LF SPEAKER +
14	873A	LF SPEAKER -
15	875B	LR SPEAKER +
16	875A	LR SPEAKER -

CONNECTOR 94M - 255442C1		
RIGHT HAND CONSOLE LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	726D	LIGHT B+
B	178N 178P	GROUND

**96M**  
PIN HOUSING



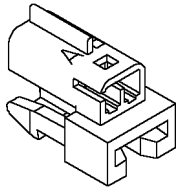
**96F**  
SOCKET HOUSING

12052833

CONNECTOR 96M - 298079A1		
RIGHT FRONT SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	872B	SPEAKER +
B	872A	SPEAKER -

CONNECTOR 96F - 12052833		
RIGHT FRONT SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SPEAKER	SPEAKER +
B	SPEAKER	SPEAKER -

**97M**  
PIN HOUSING



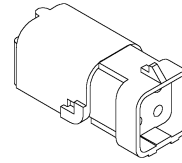
**97F**  
SOCKET HOUSING

12052833

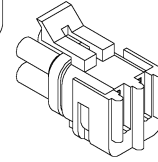
CONNECTOR 97M - 298079A1		
LEFT FRONT SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	873B	SPEAKER +
B	873A	SPEAKER -

CONNECTOR 97F - 12052833		
LEFT FRONT SPEAKER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SPEAKER	SPEAKER +
B	SPEAKER	SPEAKER -

**98F**  
PIN HOUSING



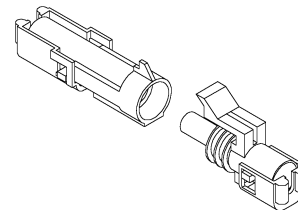
**98M**  
SOCKET HOUSING  
245715C1



245715A1 AND 716A1

CONNECTOR 98F - 245716C1		
REAR WIPER MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		REAR WIPER HIGH
B	WIPER	REAR WIPER LOW
C	WIPER	REAR WIPER PARK
D	WIPER	REAR WIPER BRAKE

CONNECTOR 98M - 245715C1		
REAR WIPER MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		OPEN
B	843 B	REAR WIPER LOW
C	841 B	REAR WIPER PARK
D	844 B	REAR WIPER BRAKE



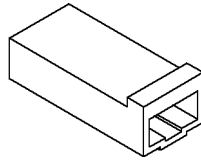
**99M**  
SOCKET HOUSING  
ROOF HARNESS  
245480C1

245480C

CONNECTOR 99M - 245480C1		
REAR WIPER GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	178R	GROUND

CONNECTOR 99F - 245481C1		
REAR WIPER GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	WIPER	GROUND

100M, 101M,  
102M, 103M  
SOCKET HOUSING  
631801C1



681801C1

CONNECTOR 100M - 631801C1		
DOOR SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	715A	GROUND

CONNECTOR 101M - 631801C1		
DOOR SWIPE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	715A	GROUND

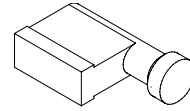
  

CONNECTOR 102M - 631801C1		
DOME LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	781C	UNSWITCHED B+

CONNECTOR 103M - 631801C1		
RIGHT HAND CONSOLE LIGHT GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	178P	GROUND

104F, 105F, 106F,  
&107F  
1/4 FLAG TERM.  
SOCKET  
ROOF HARNESS



RI00E015

CONNECTOR 104F - FLAG_TERM		
RIGHT HAND REAR TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	752E	RIGHT HAND REAR TURN SIG B+

CONNECTOR 105F - FLAG_TERM		
RIGHT HAND REAR TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	178X	GROUND

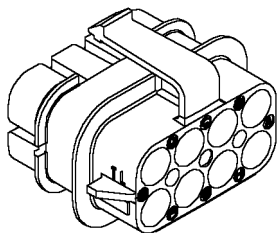
  

CONNECTOR 106F - FLAG_TERM		
LEFT HAND REAR TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	751E	LEFT HAND REAR TURN SIG B+

CONNECTOR 107F - FLAG_TERM		
LEFT HAND REAR TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	178W	GROUND

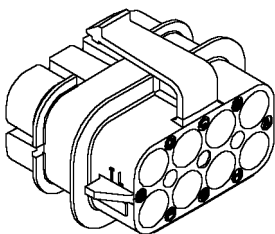
**108M**  
**GRAY SOCKET HOUSING**  
**409090A1**



409089A1

CONNECTOR 108M - 409090A1		
ENGINE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		OPEN
B		OPEN
C	456A	FUEL SHUTOFF
D	744D	POSITION LAMPS
E	622A	START RELAY
F		OPEN
G		OPEN
H		OPEN

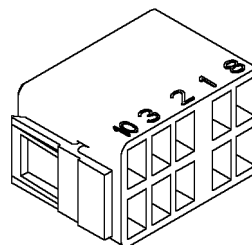
**109M**  
**GREEN SOCKET HOUSING**  
**409105A1**



409089A1

CONNECTOR 109M - 409105A1		
LIGHTING		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	170A	GROUND
B	738A	CENTER & SIDE
C	742A	LEFT LOW BEAM
D	740A	RIGHT LOW BEAM
E	741A	RIGHT HIGH BEAM
F		OPEN
G	743A	LEFT HIGH BEAM
H	170B	GROUND

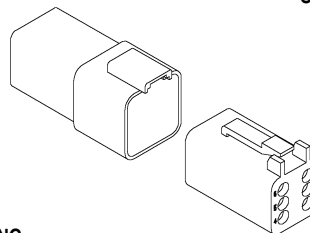
**110M**  
**END SOCKET HOUSING**  
**429026A1**



429026A1

CONNECTOR 110M - 87426882		
ETHER SWITCH (EM ONLY)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
2	720A	ETHER FUSE
3	641A	TO ETHER SOLENOID

**111M**  
**SOCKET HOUSING CAB HARNESS**  
**225351A1**



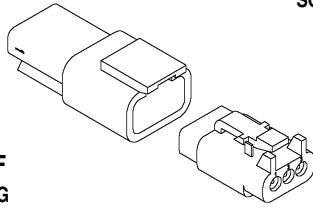
**111F**  
**PIN HOUSING**  
**225350A1**

225350A1

CONNECTOR 111F - 225350C1		
POWER MIRROR CONNECTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	949A	LEFT MIRROR VERTICAL
2	950A	LEFT MIRROR COMMON
3	951A	LEFT MIRROR HORIZONTAL
4	952A	RIGHT MIRROR VERTICAL
5	953A	RIGHT MIRROR COMMON
6	954A	RIGHT MIRROR HORIZONTAL

CONNECTOR 111M - 225351C1		
POWER MIRROR CONNECTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	275A	LEFT MIRROR VERTICAL
2	58B	LEFT MIRROR COMMON
3	277A	LEFT MIRROR HORIZONTAL
4	278A	RIGHT MIRROR VERTICAL
5	58C	RIGHT MIRROR COMMON
6	280A	RIGHT MIRROR HORIZONTAL

**112F, 113F**  
PIN HOUSING  
276426A1



**112M, 113M**  
SOCKET HOUSING  
276424A1

276426A1

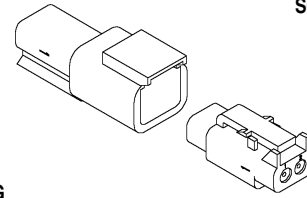
CONNECTOR 112F - 276426A1		
LEFT POWER MIRROR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	951A	LEFT MIRROR HORIZONTAL
2	950A	LEFT MIRROR COMMON
3	949A	LEFT MIRROR VERTICAL

CONNECTOR 112M - 276424A1		
LEFT POWER MIRROR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	MIRROR H	LEFT MIRROR HORIZONTAL
2	MIRROR C	LEFT MIRROR COMMON
3	MIRROR V	LEFT MIRROR VERTICAL

CONNECTOR 113F - 276426A1		
RIGHT POWER MIRROR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	954A	RIGHT MIRROR HORIZONTAL
2	953A	RIGHT MIRROR COMMON
3	952A	RIGHT MIRROR VERTICAL

CONNECTOR 113M - 276424A1		
RIGHT POWER MIRROR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	MIRROR H	RIGHT MIRROR HORIZONTAL
2	MIRROR C	RIGHT MIRROR COMMON
3	MIRROR V	RIGHT MIRROR VERTICAL

**114F**  
PIN HOUSING  
222136A1



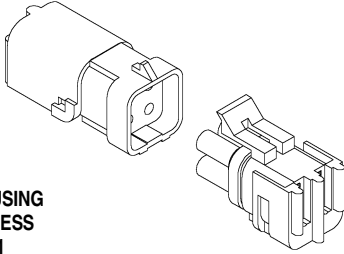
**114M**  
SOCKET HOUSING  
222135A1

222136A1

CONNECTOR 114F - 222136A1		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	PPP	STROBE/BEACON +
2	GGG	GROUND

CONNECTOR 114M - 222135A1		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	776B	STROBE/BEACON +
2	178Y	GROUND

CONNECTOR 114FF - 222136A1		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	BEACON	STROBE/BEACON +
2	BEACON	GROUND

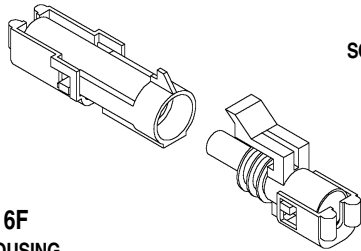


**115M**  
SOCKET HOUSING  
ROOF HARNESS  
245715C1

245715C1

CONNECTOR 115M - 245715C1		
FRONT WIPER MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	832B	FRONT WIPER HIGH
2	833B	FRONT WIPER LOW
3	831B	FRONT WIPER PARK
4	834B	FRONT WIPER BRAKE

CONNECTOR 115F - 245716C1		
FRONT WIPER MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	WIPER	FRONT WIPER HIGH
2	WIPER	FRONT WIPER LOW
3	WIPER	FRONT WIPER PARK
4	WIPER	FRONT WIPER BRAKE



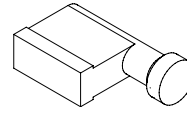
**116M**  
SOCKET HOUSING  
245480C1

**116F**  
PIN HOUSING  
245481C1

245480C1

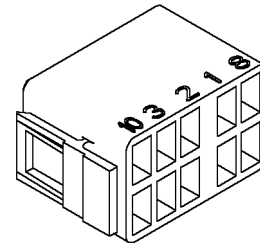
CONNECTOR 116F - 245481C1		
FRONT WIPER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	WIPER	GROUND

CONNECTOR 116M - 245480C1		
FRONT WIPER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	178S	GROUND



**118F**  
1/4 FLAG TERM.

CONNECTOR 118F - FLAG TERM		
LEFT HAND FRONT TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	751D	LEFT FRONT TURN SIGNAL B+

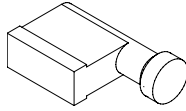


**119M**  
WHITE  
SOCKET HOUSING  
429025A1

429025A1

CONNECTOR 119M - 429025A1		
RIDE CONTROL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	518B	PICKUP HITCH LATCH
2	531H	SWITCH B+
3	512C	RIDE CONTROL
4		OPEN
5		OPEN
6		OPEN
7		OPEN
8		OPEN
9		OPEN
10		OPEN

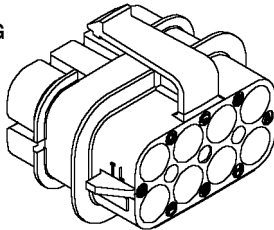
**120F**  
1/4 FLAG TERM.  
SOCKET HOUSING  
ROOF HARNESS



RI00E016

CONNECTOR 120F - FLAG_TERM		
LEFT HAND FRONT TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	178U	GROUND

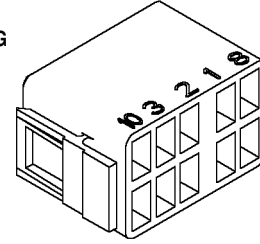
**121M**  
BLUE  
SOCKET HOUSING  
409107A1



409089A1

CONNECTOR 121M - 448262A1		
AUX POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		UNSWITCHED B+
B		UNSWITCHED B+
C		SWITCHED B+
D		SWITCHED B+
E		OPEN
F		OPEN
G		OPEN
H		OPEN

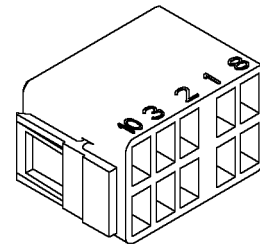
**122M**  
BLACK  
SOCKET HOUSING  
CAB HARNESS  
382391A1



382391A1

CONNECTOR 122M - 382391A1		
REAR WIPER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	844A	BRAKE INPUT
2	843A	WIPER ON
3	841F, 841G	WIPER B+
4		OPEN
5	845A	WASHER ON
6	841G	WASHER B+
7		OPEN
8		OPEN
9		OPEN
10		OPEN

**123M**  
BLUE SOCKET  
HOUSING  
CAB HARNESS  
429029A1

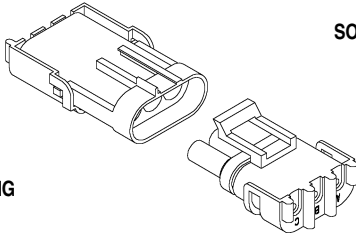


382391A1

CONNECTOR 123M - 429029A1		
CLIMATE CONTROL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		OPEN
3		OPEN
4	826C	CLIMATE CONTROL AUTO
5	801C 801E	CHASSIS GROUND
6	827C	A/C ENABLE (DEHUMIDIFY)
7		OPEN
8		OPEN
9		OPEN
10		OPEN



**124F**  
PIN HOUSING  
245485C1



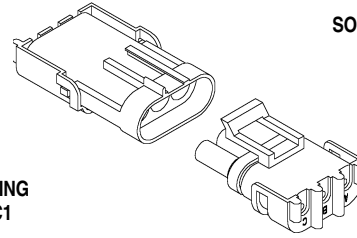
**124M**  
SOCKET HOUSING  
245484C1

245485C1

CONNECTOR 124F - 245485C1		
BLOWER SPEED POT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	PLUG	OPEN
B	850B	SIGNAL
C	803C	TEMP CONTROL GROUND

CONNECTOR 124M - 245484C1		
BLOWER SPEED POT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		OPEN
B	BLACK	ATC BLOWER SIGNAL
C	BLACK	TEMP CONTROL (BLOWER) GROUND

**125F**  
PIN HOUSING  
245485C1



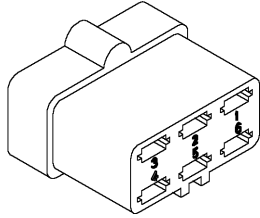
**125M**  
SOCKET HOUSING  
245484C1

245485C1

CONNECTOR 125F - 245485C1		
TEMP CONTROL POTENTIOMETER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		OPEN
B	BLACK	SIGNAL
C	BLACK	TEMPERATURE CONTROL GROUND

CONNECTOR 125M - 245484C1		
TEMP CONTROL POTENTIOMETER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		OPEN
B	807A	SIGNAL
C	803B	TEMPERATURE CONTROL GROUND

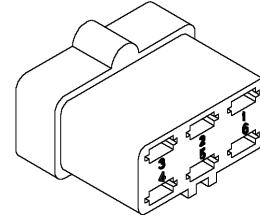
**126F**  
SOCKET HOUSING  
CAB HARNESS  
449797C1



449797C1

CONNECTOR 126F - 449797C1		
STD A/C BLOWER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2	820D	B+
3	824B	HIGH SPEED
4	823B	MEDIUM SPEED
5	822B	LOW SPEED
6	800B	A/C CLUTCH

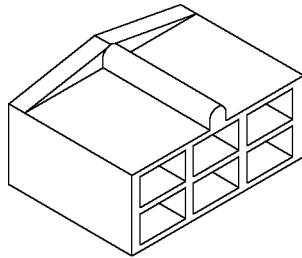
**127F**  
SOCKET HOUSING  
CAB HARNESS  
449797C1



449797C1

CONNECTOR 127F - 449797C1		
FRONT WIPER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2	836A 836C	BATTERY (B)
3	833A 833C	HIGH (H)
4	832A 832C	MEDIUM (M)
5	834A 834C	LOW (L)
6	831D	CLUTCH (C)

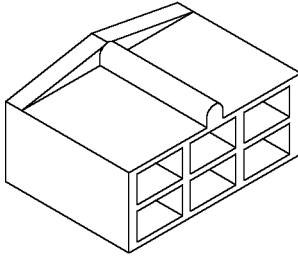
**126M**  
SOCKET HOUSING  
CAB HARNESS  
892136C1



449797C1

CONNECTOR 126M - 892136C1		
STD A/C BLOWER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	SWITCH	OPEN
2	SWITCH	B+
3	SWITCH	HIGH SPEED
4	SWITCH	MEDIUM SPEED
5	SWITCH	LOW SPEED
6	SWITCH	A/C CLUTCH

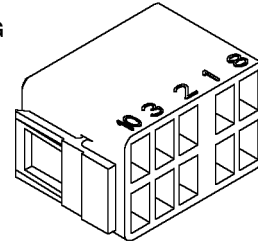
**127M**  
SOCKET HOUSING  
CAB HARNESS  
892136C1



449797C1

CONNECTOR 127M - 892136C1		
FRONT WIPER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2	SWITCH	B+
3	SWITCH	HIGH SPEED
4	SWITCH	MEDIUM SPEED
5	SWITCH	LOW SPEED
6	SWITCH	A/C CLUTCH

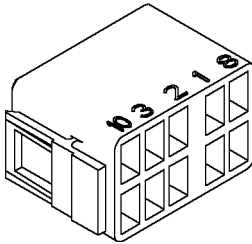
**129M**  
SOCKET HOUSING  
CAB HARNESS  
429026A1



382391A1

CONNECTOR 129M - 429026A1		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2	821E	SWITCH POWER
3	776A	SIGNAL, BEACON/STROBE
4		OPEN
5		OPEN
6		OPEN
7	177P	LAMP GROUND
8	776C	LAMP B+
9		OPEN
10		OPEN

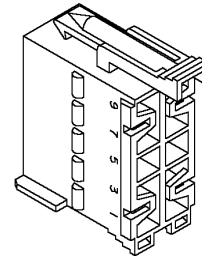
**128M**  
BLUE SOCKET  
HOUSING  
CAB HARNESS  
429029A1



382391A1

CONNECTOR 128M - 429029A1		
HVAC CUTOUT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		
3		OPEN
4		OPEN
5	801B	CHASSIS GROUND
6	826B	A/C AUTO ON
7		OPEN
8		OPEN
9		OPEN
10		OPEN

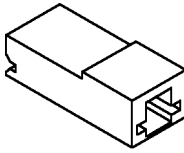
**130M**  
SOCKET HOUSING  
CAB HARNESS  
375601A1



375601A1

CONNECTOR 130M - 375601A1		
POWER MIRRORS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		OPEN
3	177AA	GROUND
4	277A	LEFT MIRROR HORIZONTAL
5	280A	RIGHT MIRROR HORIZONTAL
6		OPEN
7	58A	MIRROR COMMON
8	275A	LEFT MIRROR VERTICAL
9	870B	MIRROR FUSE (B+)
10	278A	RIGHT MIRROR VERTICAL

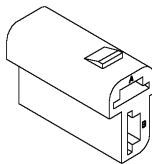
**131B**  
SOCKET HOUSING  
CAB HARNESS  
279658A1



279658A1

CONNECTOR 131B - 279658A1		
CIGAR LIGHTER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	821F	CIGAR LIGHTER B+

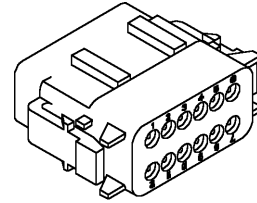
**131A**  
SOCKET  
CAB HARNESS  
877291R1



877291R1

CONNECTOR 131A - 877291R1		
CIGAR LIGHTER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	177AN	CHASSIS GROUND
B	207A	UNSWITCHED B+

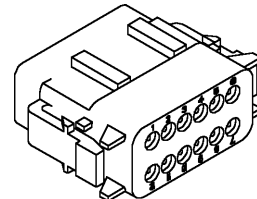
**133M**  
SOCKET HOUSING  
CAB HARNESS  
225389C1



223671A1

CONNECTOR 133M - 225389C1		
SEAT POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	73B	SEAT POWER B+ (FEED)
2	73C	SEAT POWER B+ (FEED)
3	177AC	SEAT GROUND
4	177AD	SEAT GROUND
5	73D	SEAT SWITCH OPS B+
6	303A	SEAT SWITCH OPS RETURN
7	259A	SEAT HEATER B+
8	177AE	SEAT HEATER GROUND
9	PLUG	OPEN
10	PLUG	OPEN
11	PLUG	OPEN
12	PLUG	OPEN

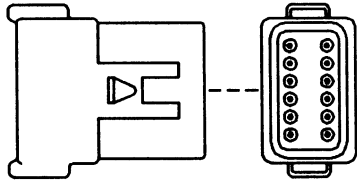
**133M**  
SOCKET HOUSING  
CAB HARNESS  
225389C1



223671A1

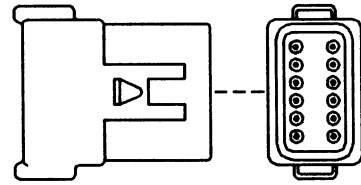
CONNECTOR 133MM - 225388C1		
SEAT POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	73E	SEAT POWER B+ (FEED)
2	73F	SEAT POWER B+ (FEED)
3		SEAT GROUND
4	177AG	SEAT GROUND
5	73G	SEAT SWITCH OPS B+
6	303B	SEAT SWITCH OPS RETURN
7	259B	SEAT HEATER B+
8	177AH	SEAT HEATER GROUND

**133F**  
SOCKET HOUSING  
CAB HARNESS  
225388C1



687L95

**133FF**  
SOCKET HOUSING  
CAB HARNESS  
225388C1



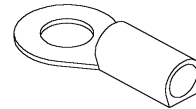
CONNECTOR 133F - 225388C1		
SEAT POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	S1	SEAT POWER B+ (FEED)
2	S2	SEAT POWER B+ (FEED)
3	S3	SEAT GROUND
4	S4	SEAT GROUND
5	S12	SEAT SWITCH OPS B+
6	S13	SEAT SWITCH OPS RETURN
7	S17	SEAT HEATER B+
8	S18	SEAT HEATER GROUND
9		OPEN
10		OPEN
11		OPEN
12		OPEN

**CONNECTOR 133FF - 225389C1**

**SEAT POWER**

CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	73E	SEAT POWER B+ (FEED)
2	73F	SEAT POWER B+ (FEED)
3		SEAT GROUND
4	177AG	SEAT GROUND
5	73G	SEAT SWITCH OPS B+
6	303C	SEAT SWITCH OPS RETURN
7	259B	SEAT HEATER B+
8	117AH	SEAT HEATER GROUND

**134F**  
42913-2  
RING TERMINAL



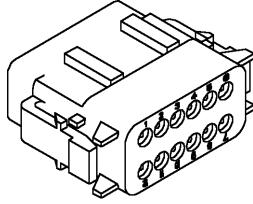
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**CONNECTOR 134F - 42913-2**

**UNSWITCHED CAB B+**

CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	101B 101C 101D 101E 101F 101G 101BB	UNSWITCHED B+

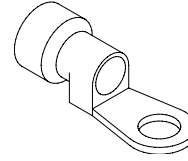
**135M**  
225402C1  
SOCKET HOUSING  
CAB HARNESS



223671A1

CONNECTOR 135M - 225402C1		
FLASHER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	753A	LEFT TURN LAMP
2	754A	RIGHT TURN LAMP
3	707C	HAZARD
4	767A	RIGHT TURN
5	768A	LEFT TURN
6	177AK	GROUND
7	766D	B+
8	766C	B+
9	752B	RIGHT HAZARD LAMP
10	752N	RIGHT HAZARD LAMP
11	751B	LEFT HAZARD LAMP
12	751J	LEFT HAZARD LAMP

**138A, 138B, AND  
138C**  
225067C1



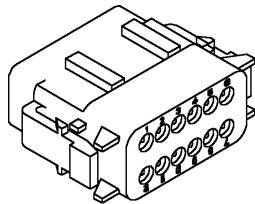
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CONNECTOR 138A - 225067C1		
SWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	102B 102M 102E 102A 102F 102N 102C	SWITCHED B+

CONNECTOR 138B - 225067C1		
SWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	103S 103G 103B 103C 103D 103F 103E 103K	SWITCHED B+

CONNECTOR 138C - 225067C1		
SWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	163A 163B 163C 163D 164A 200A	SWITCHED B+

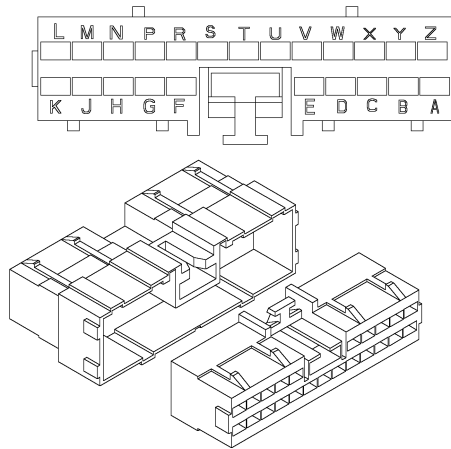
**137M**  
SOCKET HOUSING  
CAB HARNESS  
225389C1



223671A1

CONNECTOR 137M - 225389C1		
RIGHT ARM CONSOLE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		OPEN
3		OPEN
4	YELLOW	CDB HIGH (TRACTOR)
5	GREEN	CDB LOW (TRACTOR)
6		OPEN
7	293B	PTO ON
8		OPEN
9		OPEN
10		OPEN
11	179Z	CLEAN GROUND
12	65A	ARCU SWITCHED B+

**139F**  
PIN HOUSING  
CAB HARNESS  
179483A1



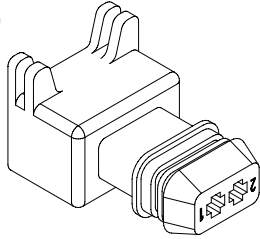
**139MM**  
SOCKET HOUSING  
HVAC ATC UNIT  
196155A1

179483A1

CONNECTOR 139F - 179483A1		
HVAC		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	800A	AC CLUTCH FROM BLOWER SWITCH
B	802A	HVAC HIGH PRESSURE SWITCH OUT
C	835A	TO AC CLUTCH
D	822A	BLOWER LOW SPEED FROM SWITCH
E	823A	BLOWER MED SPEED FROM SWITCH
F	178B	CHASSIS GROUND
G	824A	BLOWER HIGH SPEED FROM SWITCH
H	850A	ATC BLOWER SIGNAL
J	177F	ATC CHASSIS GROUND
K	820C	B+ MTR PWM (ATC)
L	826A	TO AC CUTOFF SW/AUTO
M	827A	AC IND LT (GND)/DEHUMIDIFY
N	179AV	MODE DOOR GROUND (ATC)
P	179AU	MODE DOOR GROUND (ATC)
R	825A	HVAC CONTROLLER B+
S	803A 803B	TEMP CONTROL
T	807A	TEMP CONTROL POT. SIGNAL
U	804A	GROUND FOR DISPLAY
V	805A	5V DISPLAY PWR
W	806A	DATA TO DISPLAY
X	765A	EURO CELCIUS (-)
Y		OPEN
Z		OPEN

CONNECTOR 139MM - 196155A1		
HVAC ATC UNIT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	70	OPEN
B	80	HI PRESSURE (-)
C	82	COMPRESSOR CLUTCH B+
D	83	MOTOR (LOW)
E	84	MOTOR (MEDIUM)
F	85	GROUND
G	110	MOTOR (HIGH)
H		OPEN
J		OPEN
K		OPEN
L	112	A/C SWITCH
M	111	PRESSURE WARNING
N		OPEN
P		OPEN
R	252	MODULE BATTERY B+
S	105 5CA	POTENTIOMETER GROUND
T	103	POTENTIOMETER CONTROL
U		OPEN
V		OPEN
W		OPEN
X		OPEN
Y	MD	OPEN
Z		OPEN

**140F, 141F, 142F,  
143F, AND 144F  
SOCKET HOUSING  
AUX/PTO HARNESS  
291718A1**



RI99H129

CONNECTOR 140F - 291718A1		
AUX 1 MOTOR RAISE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX1 TOP1	B+ AUX 1 B RAISE
2	AUX1 TOP2	RETURN AUX 1 B RAISE

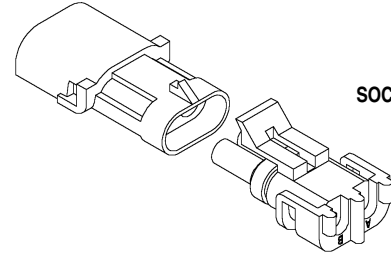
CONNECTOR 141F - 291718A1		
AUX 2 MOTOR RAISE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX2 TOP1	B+ AUX 2 B RAISE
2	AUX2 TOP2	RETURN AUX 2 B RAISE

CONNECTOR 142F - 291718A1		
AUX 3 MOTOR RAISE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX3 TOP1	B+ AUX 3 B RAISE
2	AUX3 TOP2	RETURN AUX 3 B RAISE

CONNECTOR 143F - 291718A1		
AUX 4 MOTOR RAISE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX4 TOP1	B+ AUX 4 B RAISE
2	AUX4 TOP2	RETURN AUX 4 B RAISE

CONNECTOR 144F - 291718A1		
AUX 5 MOTOR RAISE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX5 TOP1	B+ AUX 5 B RAISE
2	AUX5 TOP2	RETURN AUX 5 B RAISE

**145F  
PIN HOUSING  
245483C1**



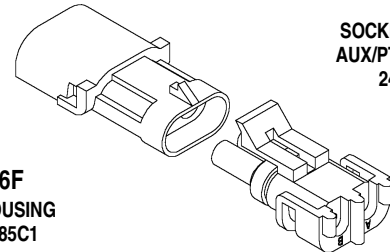
**145M  
SOCKET HOUSING  
245482C1**

245482C1

CONNECTOR 145F - 245483C1		
DUAL SPEED PTO		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SENSOR	PTO SHAFT SPEED
B	SENSOR	SENDER GROUND

CONNECTOR 145M - 245482C1		
PTO SPEED SENSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	295A	PTO SHAFT SPEED
B	174E	SENDER GROUND

**146M  
SOCKET HOUSING  
AUX/PTO HARNESS  
245484C1**



**146F  
PIN HOUSING  
245485C1**

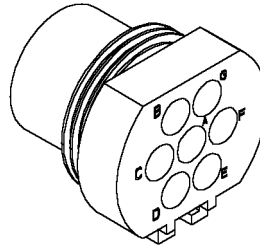
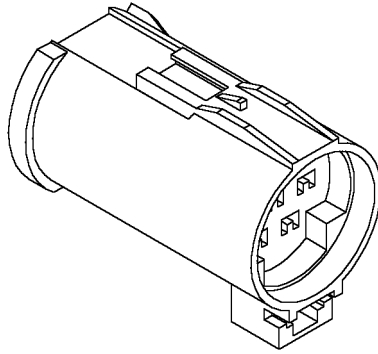
12162194

CONNECTOR 146F - 245485C1		
PTO DUAL SPEED		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	294B	PTO SPEED SIGNAL
B	174D	SENSOR GROUND
C		OPEN

CONNECTOR 146M - 245484C1		
PTO DUAL SPEED		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	294A	PTO SPEED SIGNAL
B	174C	SENSOR GROUND
C		OPEN



**147F**  
PIN HOUSING  
AUX/PTO HARNESS  
182085A1



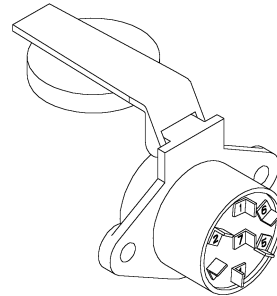
**147M**  
SOCKET HOUSING  
182087A1

182085A1 AND 87A1

CONNECTOR 147F - 182085A1		
TRAILER CONNECTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	787C	WORK LIGHTS
B	751K	LEFT TURN
C	752J	RIGHT TURN
D	755F	STOP LIGHTS
E	750G	TAIL LIGHTS
F	222C	AUXILIARY SWITCHED B+

CONNECTOR 147M - 182087A1		
TRAILER CONNECTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	787S	WORK LIGHTS
B	751S	LEFT TURN
C	752M	RIGHT TURN
D	755G	STOP LIGHTS
E	750S	TAIL LIGHTS
F	222G	AUXILIARY UNSWITCHED B+

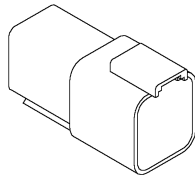
**147A**  
SOCKET HOUSING  
121645C1



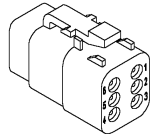
121645C1

CONNECTOR 147A - 121645C1		
7-PIN TRAILER CONNECTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	173A	LEFT TURN
2	787S	FIELD LIGHTS
3	751S	CHASSIS GROUND
4	755G	RIGHT TURN
5	752M	RH TAIL LIGHTS
6	750S	STOP LIGHTS
7	222G	LH TAIL LIGHTS

**150F**  
PIN HOUSING  
280453A1



**150M**  
SOCKET HOUSING  
AUX/PTO HARNESS  
280451A1



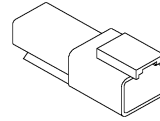
280451A1

CONNECTOR 150F - 280453A1		
IMPLEMENT POTENTIOMETER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	FEEDBACK	#1 FEEDBACK SENSE
2	PLUGGED	#1 FEEDBACK SOURCE
3	PLUGGED	#2 FEEDBACK SENSE
4	FEEDBACK	#2 FEEDBACK SOURCE
5	5V	5 VOLT REFERENCE
6	GND	SENSOR GROUND

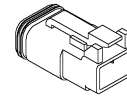
  

CONNECTOR 150M - 280451A1		
IMPLEMENT POTENTIOMETER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	918A	#1 FEEDBACK SENSE
2	920A	#1 FEEDBACK SOURCE
3	919A	#2 FEEDBACK SENSE
4	916A	#2 FEEDBACK SOURCE
5	915A	5 VOLT REFERENCE
6	917A	SENSOR GROUND

**151F**  
PIN HOUSING  
225315C1



**151M**  
SOCKET HOUSING  
TRANSMISSION/  
HITCH  
HARNESS  
225316C1

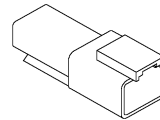


225315C1

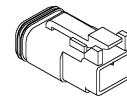
CONNECTOR 151F - 225315C1		
HITCH UP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	SOLENOID	HITCH SOLENOID (B+)
2	SOLENOID	HITCH SOLENOID UP

CONNECTOR 151M - 225316C1		
HITCH UP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	828B	HITCH SOLENOID (B+)
2	527A	HITCH SOLENOID UP

**152F**  
PIN HOUSING  
225315C1



**152M**  
SOCKET HOUSING  
TRANSMISSION/  
HITCH  
HARNESS  
225316C1

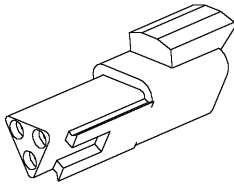


225315C1

CONNECTOR 152F - 225315C1		
HITCH DOWN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	SOLENOID	HITCH SOLENOID (B+)
2	SOLENOID	HITCH SOLENOID DOWN

CONNECTOR 152M - 225316C1		
HITCH DOWN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	528A	HITCH SOLENOID (B+)
2	529A	HITCH SOLENOID DOWN

**153F**  
PIN HOUSING  
225294C1



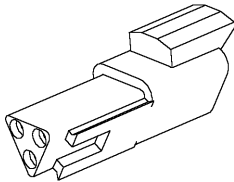
**153M**  
SOCKET HOUSING  
TRANSMISSION/  
HITCH  
HARNESS  
225295C1

225294C1

CONNECTOR 153F - 225294C1		
RIGHT HAND EDC PIN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SENSOR	GROUND
B	SENSOR	SIGNAL
C	SENSOR	+8V

CONNECTOR 153M - 225295C1		
RIGHT HAND EDC PIN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	517C	GROUND
B	514A	SIGNAL
C	516B	+8V

**154F**  
PIN HOUSING  
225294C1

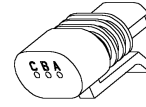


**154M**  
SOCKET HOUSING  
TRANSMISSION/  
HITCH  
HARNESS

225294C1

CONNECTOR 154F - 225294C1		
LEFT HAND EDC PIN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SENSOR	GROUND
B	SENSOR	SIGNAL
C	SENSOR	+8V

CONNECTOR 154M - 225295C1		
LEFT HAND EDC PIN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	517B	GROUND
B	515A	SIGNAL
C	516C	+8V

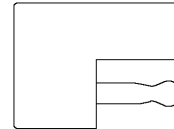


**155M**  
SOCKET HOUSING  
TRANSMISSION/HITCH  
HARNESS- 198550A1

198550A1

CONNECTOR 155M - 198550A1		
ROCKSHAFT POTENTIOMETER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	506A	HIGH
B	507A	SIGNAL
C	508A	LOW

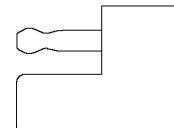
**165A**  
LEONI 3661367



3661367

CONNECTOR 165A - 3661367		
BUSINESS BAND B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	870E	B+
B	187T	GROUND

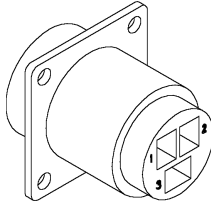
**165B**  
LEONI 3661256



3661256

CONNECTOR 165B - 3661256		
BUSINESS BAND B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		B+
B		GROUND

**157F**  
PIN HOUSING  
225164C1

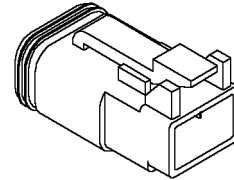


225164C1

CONNECTOR 157F - 225164C1		
IMPLEMENT AUXILIARY POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	142D	SWITCHED B+
2	141D	UNSWITCHED B+
3	177AB	GROUND

**160M**

SOCKET HOUSING  
TRANSMISSION/HITCH  
HARNESS -225316C1

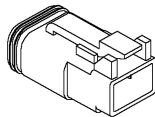


225316C1

CONNECTOR 160M - 225316C1		
FWD SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	540A	FWD SOL - HIGH (B+)
2	175D	FWD CHASSIS GROUND

**158M**

SOCKET HOUSING  
TRANSMISSION/HITCH  
HARNESS -225316C1

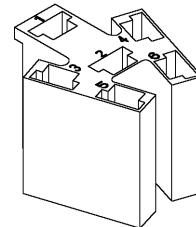


225316C1

CONNECTOR 158M - 225316C1		
DIFFERENTIAL SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	530A	DIFF SOLENOID - HIGH (B+)
2	175E	GROUND

**161F**

SOCKET HOUSING  
CAB HARNESS -225253C1

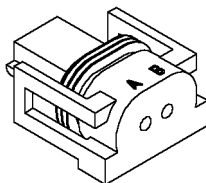


225253C1

CONNECTOR 161F - 225253C1		
IGNITION SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	89A 107A	BATTERY
2	623A	START INPUT
3		OPEN
4		OPEN
5	105A	IGNITION
6	106A 106B	IGNITION FEED

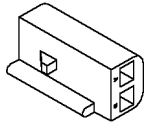
**159M**

SOCKET HOUSING  
TRANSMISSION/HITCH  
HARNESS - 199707A1



199707A1

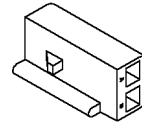
CONNECTOR 159M - 371614A1		
PTO SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	597A	HIGH B+
B	598A	LOW GROUND



**162M**  
SOCKET HOUSING  
CAB HARNESS - 227429A1

227429A1

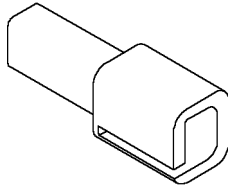
CONNECTOR 162M - 227429A1		
LEFT BRAKE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	509B	LEFT BRAKE SWITCH
B	599C	LEFT BRAKE B+



**163M**  
SOCKET HOUSING  
CAB HARNESS - 227429A1

227429A1

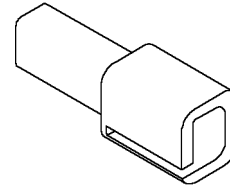
CONNECTOR 163M - 227429A1		
RIGHT BRAKE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	599D	RIGHT BRAKE B+
B	510B	RIGHT BRAKE SWITCH



**162F**  
SOCKET HOUSING  
CAB HARNESS - 227430A1

227429A1

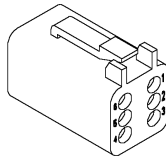
CONNECTOR 162F - 227430A1		
LEFT BRAKE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SWITCH	RIGHT BRAKE SWITCH
B	SWITCH	RIGHT BRAKE B+



**163F**  
SOCKET HOUSING  
CAB HARNESS - 227430A1

227429A1

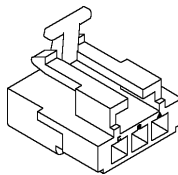
CONNECTOR 163F - 227430A1		
RIGHT BRAKE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SWITCH	RIGHT BRAKE B+
B	SWITCH	RIGHT BRAKE SWITCH



**164M**  
SOCKET HOUSING  
CAB HARNESS - 225351C1

225351C1

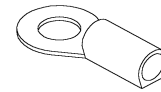
CONNECTOR 164M - 225351C1		
FOOT THROTTLE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179AD	IVS GROUND (CLN)
2	945A	IVS #1
3	944A	FOOT THROTTLE SIGNAL
4	943A	FOOT THROTTLE GROUND
5	942A	FOOT THROTTLE B+
6	941A	IVS #2



**165M**  
SOCKET HOUSING  
227728A1

227728A1

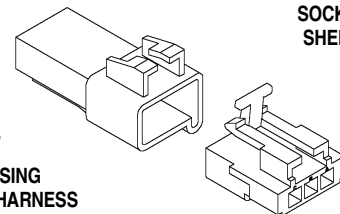
CONNECTOR 165M - 227728A1		
AUXILIARY POWER (A-POST)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	142C	SWITCHED B+
B	141C	UNSWITCHED B+
C	177E	GROUND



**166F**  
42913-2 RING TERMINAL

200338.TIF

CONNECTOR 166F - 42913-2		
UNSWITCHED CAB B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	101CC	UNSWITCHED B+



**167F**  
PIN HOUSING  
EXTENSION HARNESS  
227729A1

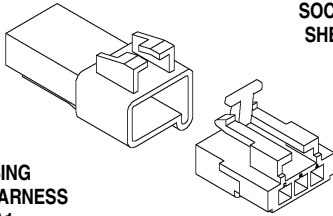
**167M**  
SOCKET HOUSING  
SHELF HARNESS  
227728A1

227729A1

CONNECTOR 167F - 227729A1		
AUXILIARY POWER #1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	136H	SWITCHED B+
B	135H	UNSWITCHED B+
C	134H	GROUND

CONNECTOR 167M - 227728A1		
AUXILIARY POWER #1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	136D	SWITCHED B+
B	135D	UNSWITCHED B+
C	134D	GROUND

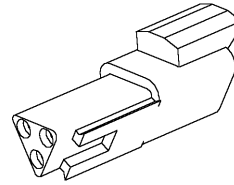
**168F**  
PIN HOUSING  
EXTENSION HARNESS  
227729A1



**168M**  
SOCKET HOUSING  
SHELF HARNESS  
227728A1

227729A1

**170M**  
SOCKET HOUSING  
SHELF HARNESS  
225295C1



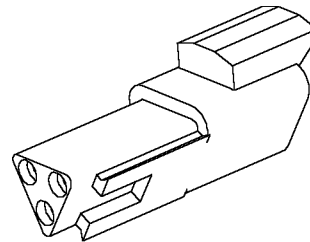
225295C1

CONNECTOR 168F - 227729A1		
AUXILIARY POWER #2		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	136J	SWITCHED B+
B	135J	UNSWITCHED B+
C	134J	GROUND

CONNECTOR 170M - 225295C1		
MAP LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	135G	UNSWITCHED B+
B		OPEN
C	134G	GROUND

CONNECTOR 168M - 227728A1		
AUXILIARY POWER #2		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	136E	SWITCHED B+
B	135E	UNSWITCHED B+
C	134E	GROUND

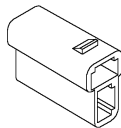
**170F**  
SOCKET HOUSING  
SHELF HARNESS  
225294C1



CONNECTOR 170F - 225294C1		
MAP LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	WHITE	UNSWITCHED B+
B	BLACK	DOOR JAM SW
C	BLACK	GROUND

225294C1

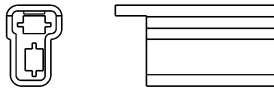
**169M**  
SOCKET HOUSING  
SHELF HARNESS  
314908A1



314908A1

CONNECTOR 169M - 314908A1		
AUXILIARY POWER #3		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	134F	GROUND
B	135F	UNSWITCHED B+

**171F**  
**SOCKET HOUSING**  
**CAB HARNESS - 877290R1**



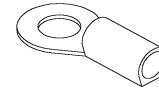
**171M**  
**SOCKET HOUSING**  
**CAB HARNESS - 877291R1**

877291R1

CONNECTOR 171F - 872290R1		
RADAR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	RADAR	CLEAN GROUND
B	RADAR	SIG FREQ TO ICU

CONNECTOR 171M - 877291R1		
RADAR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	179T	CLEAN GROUND
B	199A 199B	SIG FREQ TO ICU

**172F & 173F**  
**RING TERMINAL CAB**  
**HARNESS - 200338**

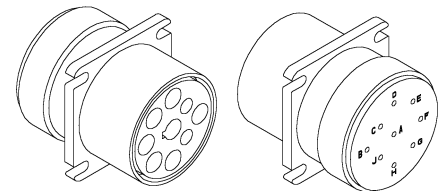


200338

CONNECTOR 172F - 200338		
CHASSIS GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	178B 178C 178D 178F 178J 178H	GROUND

CONNECTOR 173F - 200338		
CHASSIS GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	177E 177F 177G	GROUND

**174M**  
**SOCKET HOUSING**  
**310057A1**

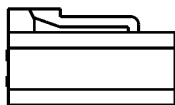


310057A1

CONNECTOR 174M - 310057A1		
CDB DIAGNOSTIC CONN		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	177AM	CHASSIS GROUND
B	152A	DIAGNOSTIC B+ (UNSWITCHED)
C	YELLOW	CDB HIGH (TRACTOR)
D	GREEN	CDB LOW (TRACTOR)
E		
F		
G		
H	YELLOW	CDB HIGH (IMPLEMENT)
J	GREEN	CDB LOW (IMPLEMENT)



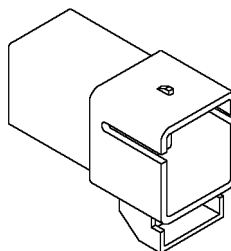
**175M**  
SOCKET HOUSING  
239451A1



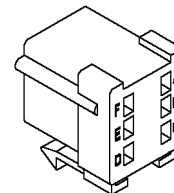
225326C1

CONNECTOR 175M - 239451A1		
PASSIVE TERMINATOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	RED	CDB BATTERY (TRACTOR)
2	YELLOW	CDB HIGH (TRACTOR)
3	BLACK	CDB GROUND (TRACTOR)
4	GREEN	CDB LOW (TRACTOR)

**178F**  
PIN HOUSING  
227393A1



**178M**  
SOCKET HOUSING  
227392A1

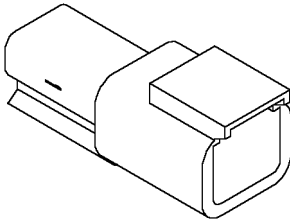


227393A1

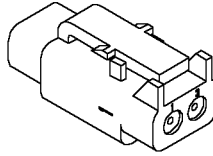
CONNECTOR 178F - 227393A1		
INTERMITTANT WIPER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	832C	HIGH
B	833C	LOW
C	836C	WASHER
D	177AU	GROUND
E	831E	BATTERY
F	834C	PARK

CONNECTOR 178M - 227392A1		
INTERMITTANT WIPER SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	WHITE	HIGH
B	YELLOW	LOW
C	BROWN	WASHER
D	BLACK	GROUND
E	RED	BATTERY
F	BLUE	PARK

**179F**  
PIN HOUSING  
222136A1



**179M**  
SOCKET HOUSING  
222135A1



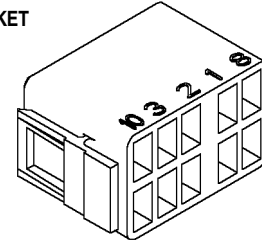
222136A1 AND 135A1

CONNECTOR 179F - 222136A1		
SELF CANCEL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	R	B+
2	N	GROUND

CONNECTOR 179M - 222135A1		
SELF CANCEL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	706E	B+
2	178AC	GROUND

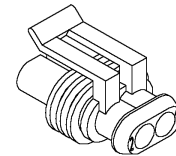
**181M**  
ORANGE SOCKET  
HOUSING  
429028A1



382391A1

CONNECTOR 181M - 429028A1		
AXLE REGULATION SW		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2	531C 531D	SWITCH B+
3	532A	LOCK/UNLOCK
4		OPEN
5		OPEN
6		OPEN
7	536A	LAMP GROUND
8	531D	LAMP B+
9		OPEN
10		OPEN

**183M & 184M**  
SOCKET HOUSING  
371614A1



371614A1

CONNECTOR 183M - 371614A1		
SUS RAISE (1)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	538C	FSUS RAISE
2	179BK	RETURN

CONNECTOR 184M - 371614A1		
SUS LOWER (2)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	537C	FSUS LOWER
2	179BL	RETURN

**185M**  
**SOCKET HOUSING**  
225295C1



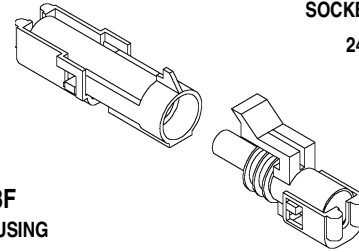
**185F**  
**PIN HOUSING**  
225294C1

291718A1

CONNECTOR 185F - 225294C1		
FRONT AXLE POS SENSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	531F	B+
B	179CL	CLEAN GROUND
C	544A	SENSOR SIGNAL

CONNECTOR 185M - 225295C1		
FRONT AXLE POS SENSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	543C	B+
B	179BC	CLEAN GROUND
C	544C	SENSOR SIGNAL

**188M**  
**SOCKET HOUSING**  
245480C1



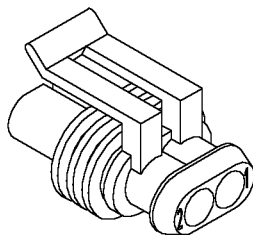
**188F**  
**PIN HOUSING**  
245481C1

245480C1

CONNECTOR 188F - 245481C1		
POSITION LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		LAMP B+

CONNECTOR 188M - 245480C1		
POSITION LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	744D	LAMP B+

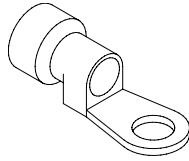
**186M & 187M**  
**SOCKET HOUSING**  
371614A1



371614A1

CONNECTOR 186M - 371614A1		
UPPER LOCK (30)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	541B	B+
2	548B	RETURN

CONNECTOR 187M - 371614A1		
LOWER LOCK (31)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	542B	B+
B	546B	RETURN

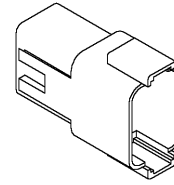


RI00E014

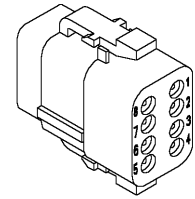
CONNECTOR 189F - AMP_327175		
CLEAN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	177A 174A 177B	CLEAN GND

CONNECTOR 191F - SELF_CANCEL		
SELF CANCEL SENSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
20	20A	RIGHT TURN OUT
20	20A	TURN COM IN
21	21A	LEFT TURN IN
21	21A	LEFT TURN OUT
22	22A	RIGHT TURN IN
22	22A	TURN COM OUT
N	N	SELF CNCL GND
R	R	SELF CNCL B+

192F  
PIN HOUSING  
280458A1



192M  
SOCKET HOUSING  
280456A1

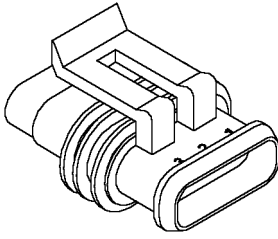


280458A1

CONNECTOR 192F - 280458A1		
FRONT AXLE SOL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	538C	S1 SOL B+ (RAISE)
2	179BK	S1 SOL GND (RAISE)
3	357C	S2 SOL B+ (LOWER)
4	179BL	S2 SOL GND (LOWER)
5	542B	LOWER LOCK SOL
6	546B	LOWER LOCK SOL
7	541B	UPPER LOCK SOL
8	548B	UPPER LOCK SOL

CONNECTOR 192M - 280456A1		
FRONT AXLE SOL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	538A	S1 SOL B+ (RAISE)
2	179BG	S1 SOL GND (RAISE)
3	357A	S2 SOL B+ (LOWER)
4	179BH	S2 SOL GND (LOWER)
5	542A	LOWER LOCK SOL
6	546A	LOWER LOCK SOL
7	548A	UPPER LOCK SOL
8	541A	UPPER LOCK SOL

**193M**  
**SOCKET HOUSING**  
**291719A1**

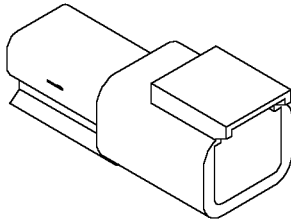


291719A1

CONNECTOR 193M - 291719A1		
AXLE SENSOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179BC	GROUND
2	543C	OUTPUT
3	544C	SUPPLY VOLTAGE

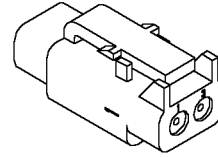
CONNECTOR 195M - 239449A1		
LEFT FRONT ROOF WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	784E	B+
B	178AF	GROUND

**197F**  
**RING TERMINAL**  
**222136A1**



CONNECTOR 197F - 222136A1		
RIGHT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	B+
2	LAMP	GROUND

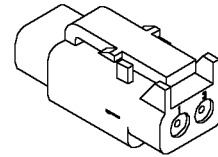
**197M**  
**RING TERMINAL**  
**222135A1**



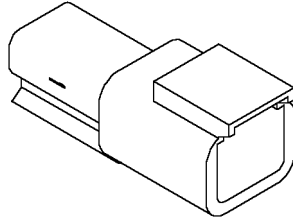
CONNECTOR 197M - 222135A1		
LEFT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	786E	B+
2	177AX	GROUND

RI00E014

**198M**  
**RING TERMINAL**  
**222135A1**



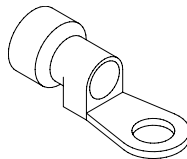
CONNECTOR 198M - 222135A1		
RIGHT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	786F	B+
2	177AY	GROUND



**198F**  
222136A1

RI00E014

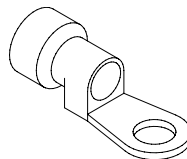
CONNECTOR 198F - 222136A1		
RIGHT A-POST WORKLIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	B+
2	LAMP	GROUND



**199F**  
RING TERMINAL  
AMP 327175

CONNECTOR 199F - AMP_327175		
CLEAN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	600J	CLEAN GND

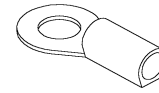
**200F**  
FRONT TO REAR HAR-  
NESS



RI00E014

CONNECTOR 200F - AMP_327175		
CLEAN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179A 179J 179AA 179AF	CHASSIS GROUND

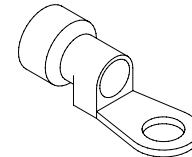
**201F**  
RING TERMINAL  
225072C1



200338.TIF

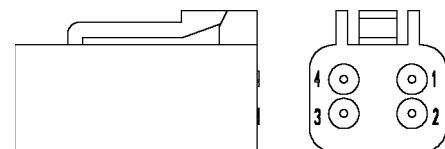
CONNECTOR 201F - 225072C1		
SECONDARY TRANS FILTER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	267C	GROUND

**203F**  
RING TERMINAL  
378852A1



RI00E014

CONNECTOR 203F - 378852A1		
ICU CLEAN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	216F	ICU CLEAN GROUND



**204F**  
87448363

CONNECTOR 204F - 87448363		
ENGINE CONTROLLER B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179AM	CLEAN GROUND
2	179AN	CLEAN GROUND
3	204D	BATT B+
4	204E	BATT B+

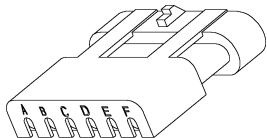
205M



RE97H023

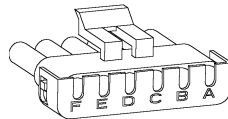
CONNECTOR 205M - 239451A1		
PASSIVE TERMINATOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	GREEN	CDB LOW (TRACTOR)
2	YELLOW	CDB HIGH (TRACTOR)

291718A1



**207F**  
PIN HOUSING  
245489C1

**207M**  
SOCKET HOUSING  
245488C1



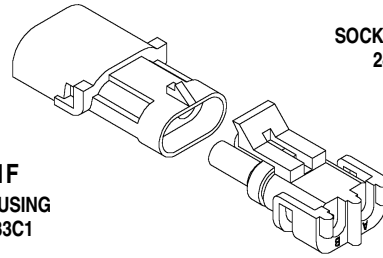
182077A1

CONNECTOR 207F - 245489C1		
EGRESS 1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A		DIODE
B		DIODE
C		DIODE
D		DIODE

CONNECTOR 207M - 245488C1		
EGRESS DIODE PACK 1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	732A	EGRESS B+
B	791B	EGRESS B+
C	792G	EGRESS B+
D	790D	EGRESS B+

**211M**  
SOCKET HOUSING  
245482C1



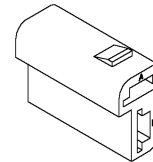
**211F**  
PIN HOUSING  
245483C1

245483C1

CONNECTOR 211F - 245483C1		
IMPLEMENT ICU		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SWITCH	B+ FROM ICU
B	SWITCH	GROUND

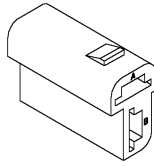
CONNECTOR 211M - 245482C1		
IMPLEMENT ICU		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	285B	B+ FROM ICU
B	179AT	GROUND

**212M**  
SOCKET HOUSING  
FRONT TO REAR  
HARNESS - 877291R1



877291R1

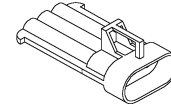
CONNECTOR 212M - 877291R1		
FRONT WASH MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	600H	GROUND
B	836D	FRONT WASH B+



**213M**  
SOCKET HOUSING  
FRONT TO REAR  
HARNESS - 877291R1

877291R1

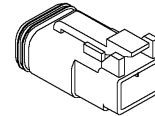
CONNECTOR 213M - 877291R1		
REAR WASH MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	600G	GROUND
B	845C	REAR WASH B+



**214M**  
SOCKET HOUSING  
ENGINE HARNESS  
411986A1

411986A1

CONNECTOR 214M - 411986A1		
FUEL SHUT OFF SOL (EM)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	456B	SOL +
B	604A	SOL +
C	600B	SOL GROUND



**215M**  
SOCKET HOUSING  
SENSOR  
225316C1

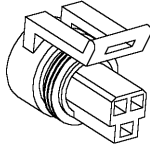
**215F**  
PIN HOUSING  
ENGINE HARNESS  
225315C1

225315C1

CONNECTOR 215M - 225316C1		
ENGINE COOLANT TEMP (EM)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	235C	SIGNAL
B	181Y	GROUND



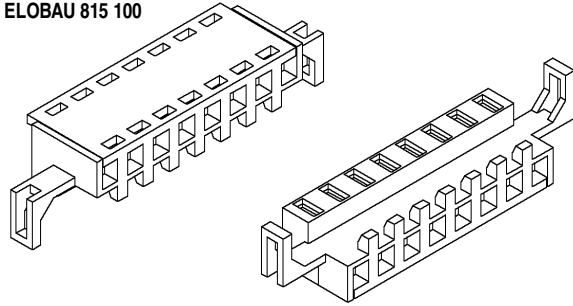
**216M**  
SOCKET HOUSING  
198456A1



198456A1

CONNECTOR 216M - 198456A1		
ENGINE OIL PRESS (EM)		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	181AA	OIL GROUND
B	255C	OIL B+
C	256C	OIL SIGNAL

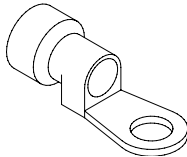
**219F**  
SOCKET HOUSING  
ELOBAU 815 100



219.TIF

CONNECTOR 219F - ELOBAU_815-100		
FNRP MODULE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	1	FNRP - R
2	2	RUN INPUT
3	3	FNRP - N
4	4	START INPUT
5	5	START OUTPUT
6	6	FNRP - F
7	7	FNRP - P
8	8	FNRP - GROUND

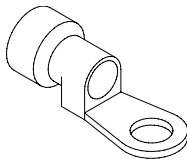
**217F**  
ENGINE HARNESS  
225067C1



RI00E014

CONNECTOR 217F - 225067C1		
CLEAN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	270C	HOT AIR B+

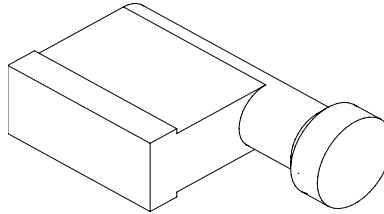
**218F**  
ENGINE HARNESS  
225065C1



RI00E014

CONNECTOR 218F - 225065C1		
CHASSIS GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	173A	GROUND

220A, 220B, 220C, 220D, 220E, 220F,  
220G, 220H AND 220J  
SOCKET



RI00E016

CONNECTOR 220A - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	20A	TURN SIGNAL COMMON

CONNECTOR 220H - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	009A	TURN SIGNAL COMMON

CONNECTOR 220B - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	21A	TURN SIGNAL COMMON

CONNECTOR 220J - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	027A	TURN SIGNAL COMMON

CONNECTOR 220C - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	22A	TURN SIGNAL COMMON

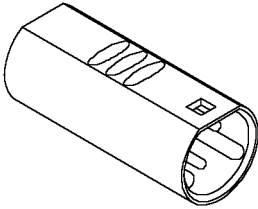
CONNECTOR 220D - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	23A	TURN SIGNAL COMMON

CONNECTOR 220E - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	24A	TURN SIGNAL COMMON

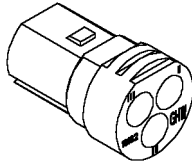
CONNECTOR 220F - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	25A	TURN SIGNAL COMMON

CONNECTOR 220G - 1-4_FLAG		
UNIVERSAL SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	26A	TURN SIGNAL COMMON

**221F**  
PIN HOUSING TURN  
INDICATORS

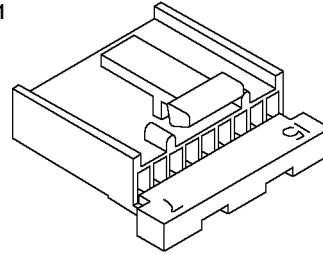


**221M**  
SOCKET HOUSING  
GHW 16182



221F 221M.tif

**222M**  
SOCKET HOUSING TO  
CD CHANGER  
379421A1

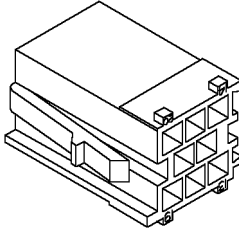


379421A1

CONNECTOR 221F - GHW_16183		
INDICATOR LIGHTS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP COM	COMMON
2	R LAMP	RIGHT TURN
3	L LAMP	LEFT TURN
CONNECTOR 221M - 16182-559-501		
TURN SIGNAL INDICATOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	010A	COMMON
2	011A	RIGHT TURN
3	012A	LEFT TURN

CONNECTOR 222M - 379421A1		
CD PLAYER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
7		OPEN
8		OPEN
9	CLEAR	SHIELD GROUND
10	WHITE	RIGHT AUDIO
11	RED	LEFT AUDIO
12	BLACK	AUDIO COMMON
13	BLACK	GROUND
14	LIGHT GREEN	E & C DATA
15	ORANGE	BATTERY

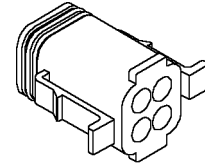
**223M**  
SOCKET HOUSING  
TO RADIO  
380431A1



380431A1

CONNECTOR 223M - 3804331A1		
CD PLAYER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
13	RED	LEFT AUDIO
14	LIGHT GREEN	E & C DATA
15	ORANGE	BATTERY
16	WHITE	RIGHT AUDIO
17	CLEAR	SHIELD GROUND
18	BLACK	GROUND
19	BLACK	AUDIO COMMON
20		OPEN

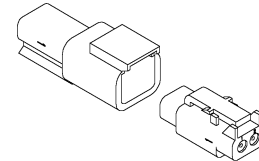
**228M**  
SOCKET HOUSING  
426708A1



375602A1

CONNECTOR 228M - 426708A1		
LEFT STOP/TAI LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	174Z	GROUND
2	753D	TURN/HAZARD
3	750P	TAIL
4	755L	STOP

**229F**  
PIN HOUSING  
222136A1

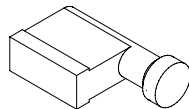


**229M**  
SOCKET HOUSING  
222135A1

222136A1 AND 135A1

**224F AND 225F**

SOCKET  
1/4 FLAG TERM



RI00E016

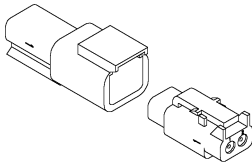
CONNECTOR 224F - FLAG_TERM		
RIGHT HAND FRONT TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	752D	RIGHT FRONT TURN SIGNAL B+

CONNECTOR 225F - FLAG_TERM		
RIGHT HAND FRONT TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	178V	GROUND

CONNECTOR 229F - 222136A1		
LEFT FENDER REAR MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	751	MARKER LIGHT B+
2	174	GROUND

CONNECTOR 229M - 222135A1		
LEFT FENDER REAR MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	751R	MARKER LIGHT B+
2	174X	GROUND

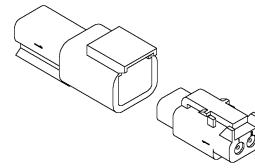
**230F**  
PIN HOUSING  
222315C1



**230M**  
SOCKET HOUSING  
222316C1

222136A1 AND 135A1

**234F**  
PIN HOUSING  
225316A1



**234M**  
SOCKET HOUSING  
225315A1

222136A1 AND 135A1

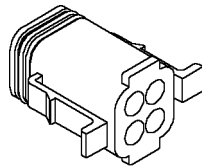
CONNECTOR 230F - 225315C1		
LEFT REAR FENDER WORKLAMP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	MARKER LIGHT B+
2	LAMP	GROUND

CONNECTOR 230M - 225316C1		
LEFT REAR FENDER WORKLAMP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	787	MARKER LIGHT B+
2	174	GROUND

CONNECTOR 234F - 222136A1		
RIGHT FENDER WIDE MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	751	MARKER LIGHT B+
2	174	GROUND

CONNECTOR 234M - 222135A1		
RIGHT FENDER WIDE MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	754F	MARKER LIGHT
2	174U	GROUND

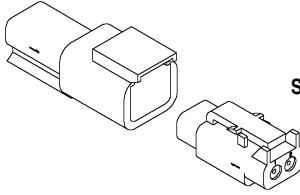
**233M**  
SOCKET HOUSING  
FENDER HARNESS  
426708A1



375602A1

CONNECTOR 233M - 426708A1		
RH TAIL LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	174M	GROUND
2	754C	TURN/HAZARD
3	750L	TAIL
4	755D	STOP

**235M**  
PIN HOUSING  
222136A1



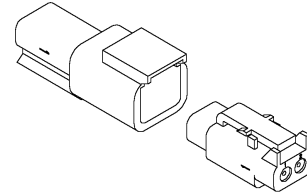
**235F**  
SOCKET HOUSING  
222135A1

222136A1 AND 135A1  
A1

CONNECTOR 235F - 225135C1		
RIGHT FENDER REAR WORKLAMP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP LEADS	WORK LIGHT B+
2	LAMP LEADS	GROUND

CONNECTOR 235M - 225136C1		
RIGHT FENDER REAR WORKLAMP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	787	WORK LIGHT B+
2	174	GROUND

**237F**  
PIN HOUSING  
222136A1



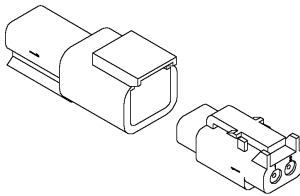
**237M**  
SOCKET HOUSING  
222135A1

222136A1 AND 135A1

CONNECTOR 237F - 222136A1		
RIGHT FENDER WIDE MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	754F	MARKER LIGHT B+
2	174U	GROUND

CONNECTOR 237M - 222135A1		
RIGHT FENDER WIDE MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP LEADS	MARKER LIGHT B+
2	LAMP LEADS	GROUND

**236F**  
PIN HOUSING  
222136A1



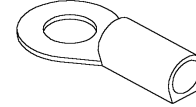
**236M**  
SOCKET HOUSING  
222135A1

222136A1 AND 135A1

CONNECTOR 236F - 222136A1		
LEFT FENDER WIDE MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	751R	MARKER LIGHT B+
2	174X	GROUND

CONNECTOR 236M - 222135A1		
LEFT FENDER WIDE MARKER LIGHT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP LEADS	MARKER LIGHT B+
2	LAMP LEADS	GROUND

**238A, 238F, 239F  
AND 240F**  
CAB HARNESS



200338.TIF

CONNECTOR 238A - RING TERM_7MM		
UNSWITCHED CAB B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	BATT	B+

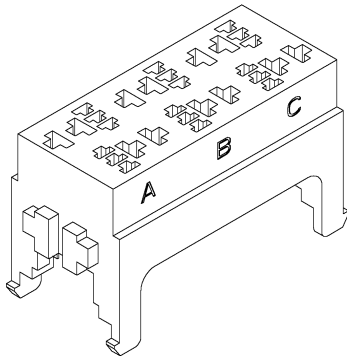
CONNECTOR 238F - RING TERM_8MM		
UNSWITCHED CAB B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	101AA	B+

CONNECTOR 239F - 225072C1		
IGNITION FEED		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	104A	B+

CONNECTOR 240F - 19193-0219		
UNSWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	101A	UNSWITCHED B+

255F

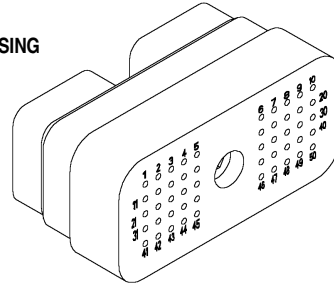
144417A1



144417A1

CONNECTOR 255F - 144417A1		
RELAY BLOCK		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A1	171B	CHASSIS GROUND
A2	160C	RELAY IGNITION FEED
A3	163B	RELAY B+
A4		OPEN
A5	162B	CONTROLLER SW B+
B1	171C	CHASSIS GROUND
B2	160D	RELAY IGNITION FEED
B3	163C	RELAY B+
B4		OPEN
B5	162D	CONTROLLER SW B+
C1	171A	CHASSIS GROUND
C2	160B	RELAY IGNITION FEED
C3	163A	RELAY B+
C4		OPEN
C5	162A	CONTROLLER SW B+
D1	171A	CHASSIS GROUND
D2	160B	RELAY IGNITION FEED
D3	163A	RELAY B+
D4		OPEN
D5	162A	CONTROLLER SW B+
E1	177AB	EGRESS RELAY GROUND
E2	731B	EGRESS SIGNAL
E3	788A	REAR WORKLIGHTS B+
E4	961A	FRONT/REAR WORKLIGHTS B+ RELAY
E5	960B	EGRESS UNSW B+
F1	177H	CONTROLLER RELAY GROUND
F2	160A	RELAY IGNITION FEED
F3	102A	CONTROLLER POWER
F4		OPEN
F5	200B	CONTROLLER POWER

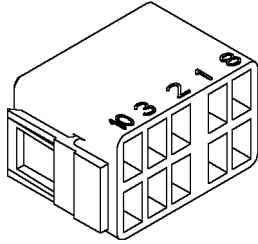
256M  
SOCKET HOUSING  
242580A1



242580A1

CONNECTOR 256M - 242580A1		
FOOT THROTTLE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		STOP LAMP
4		MAINTENANCE LAMP
9		REMOTE THROTTLE PEDAL POS INPUT
11		WAIT TO START LAMP
22		OPEN
23		INTERN SPEED CONTROL 3
24		OPEN
25	945C	IDLE SWITCH (NO)
39	223C	KEY SWITCH INPUT
40	273A	INTAKE AIR HEATER OUTPUT
42	272A	ECM RETURN
46		AUX GOVERNOR ON/OFF
47		INTERM SPEED CONT 2

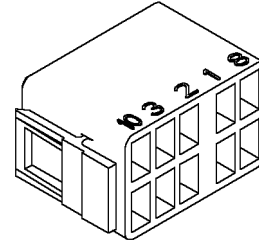
**257F**  
WHITE SOCKET  
HOUSING CAB  
HARNESS  
87426881



382391A1

CONNECTOR 257F - 87426881		
CRUISE, ON / OFF		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		OPEN
2		OPEN
3		OPEN
4		OPEN
5	179BR	CLEAN GROUND
6	547A	ON/OFF SIGNAL
7		OPEN
8		OPEN
9		OPEN
10		OPEN

**258F**  
GREEN SOCKET  
HOUSING CAB  
HARNESS  
87426889

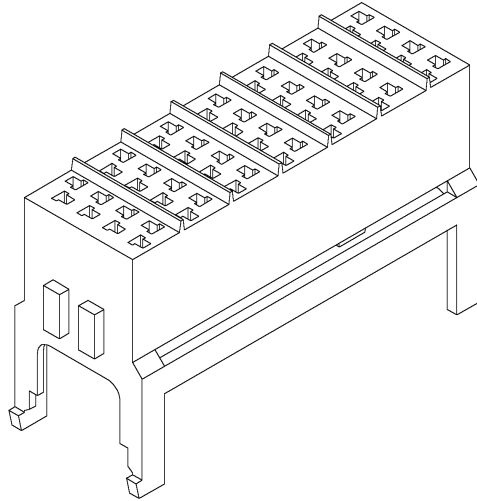


382391A1

CONNECTOR 258F - 87426889		
CRUISE, INCREMENT / DECREMENT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	489A	DECREMENT SIGNAL
2	179BP 179BR	CLEAN GROUND
3	358A	INCREMENT SIGNAL
4		OPEN
5		OPEN
6		OPEN
7		OPEN
8		OPEN
9		OPEN
10		OPEN



**261**  
**FUSE BLOCK**  
**144421A1**

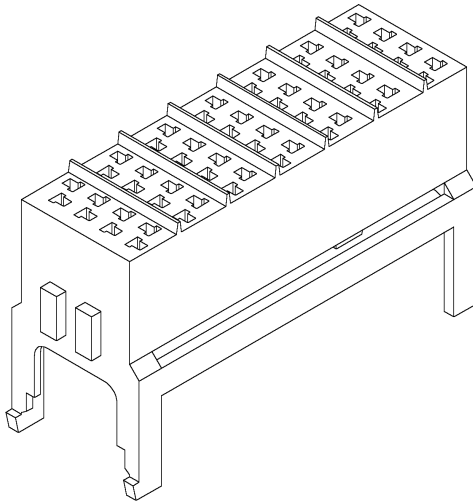


**WIRE NUMBERS  
IDENTIFIED AS A  
"J" NUMBER, ARE  
JUMPER WIRES ON  
THE FUSE BLOCK**

144421A1

FUSE BLOCK 261F - 144421A1			FUSE BLOCK 261F - 144421A1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE	CAV	WIRE NUMBER	CIRCUIT REFERENCE
A1	765A	FUSE #28 CELCIUS/FAHRENHEIT GRD	C3	141A	FUSE #13
A2	179AW		C4	101K	FRONT/REAR AUX PWR (UNSW)
A3		NOT USED	C5	222B	FUSE #12 TRAILER AUXILIARY (SWITCHED)
A4			C6	103E	
A5	531A	FUSE #26 SUSPENDED AXLE	C7	207A	FUSE #11
A6	JUMPER		C8	101D	CIGAR LIGHTER (UNSWITCHED)
A9	870D	FUSE #24 MIRROR/RADIO (SWITCHED)	C9	195A	FUSE #10
A10	106B		C10	101M	BLOWER CAB PRESSURE
A11	821C	FUSE #23 BEACON/STROBE	C11	73A	FUSE #9
A12	JUMPER		C12	102F	SEAT/OPS
A13	312A	FUSE #22 STOP LIGHTS	C13	135A	FUSE #8
A14	103F		C14	101L	AUX SHELF POWER (UNSWITCHED)
B1	750C	FUSE #21 LH AND RH TAIL/POSITION LIGHTS	D1	107A	FUSE #7
B2	707A		D2	101C	KEY BATTERY
B3	766A	FUSE #20 FLASHER	D3	241A	FUSE #6
B4	101F		D4	JUMPER	WORKLIGHT INTERLOCK
B5	871 A	FUSE #19 DOME LIGHT, MAP, AND RADIO (UNSW)	D5	788A	FUSE #5
B6	JUMPER		D6	102E	ROOF WORKLIGHTS
B7	706A	FUSE #18 HEADLIGHTS	D7	794A	FUSE #4
B8	101A		D8	JUMPER	BELT LINE WORKLIGHTS
B9	722A	FUSE #17 HORN	D9	795A	FUSE #3
B10	JUMPER		D10	103G	REAR FENDER WORKLIGHTS
B11	202B	FUSE #16 ICU / PMU (UNSW)	D11	102H	FUSE #2
B12	101B		D12	JUMPER	CRUISE CONTROL
B13	204A	FUSE #15 GOVERNOR	D13	268A	FUSE #1
B14	101J		D14	102G	GOVERNOR KEYSWITCH

**262**  
**FUSE BLOCK**  
**144421A1**

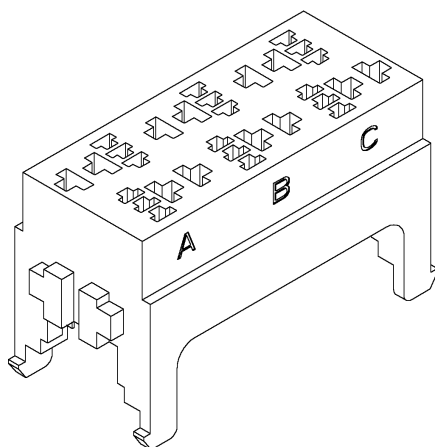


**WIRE NUMBERS  
IDENTIFIED AS A  
“J” NUMBER, ARE  
JUMPER WIRES ON  
THE FUSE BLOCK**

144421A1

FUSE BLOCK 262F - 144421A1			FUSE BLOCK 262F - 144421A1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE	CAV	WIRE NUMBER	CIRCUIT REFERENCE
A9	841C	FUSE #52	C7	596A	FUSE #39
A10	JUMPER	REAR WIPER/WASHER	C8	JUMPER	ELECTRONIC DRAFT CONTROL (HITCH)
A11	831C	FUSE #51	C9	599E	FUSE #38
A12	102K	FRONT WIPER/WASHER	C10	200C	PTO
B1	820A	FUSE #49	C11	203B	FUSE #37
B2	103D	HVAC BLOWER	C12	JUMPER	ICU / PMU (SWITCHED)
B3	136A	FUSE #48	C13	900D	FUSE #36
B4	103C	SHELF AUX POWER (SWITCHED)	C14	200B	AUXILIARY
B5	102M	FUSE #47	D3	283A	FUSE #34
B6	142A	HVAC CONTROLLER	D4	JUMPER	RADAR
B7	142A	FUSE #46	D5	65A	FUSE #33
B8	103B	FRONT/REAR AUXILIARY (SWITCHED)	D6	200F	ARM-REST CONT UNIT
B11	550C	FUSE #44	D7	114A	FUSE #32
B12	JUMPER	TRANS CONTROL UNIT	D8	101E	TRANS UNSW B+
B13	550K	FUSE #43	D13	259A	FUSE #29
B14	200D	TRANS CONTROL UNIT	D14	102J	SEAT HEATER
C1	152A	FUSE #42			
C2	101G	DATA BUS DIAG CONN POWER			

**263F**  
**RELAY BLOCK**  
**144417A1**



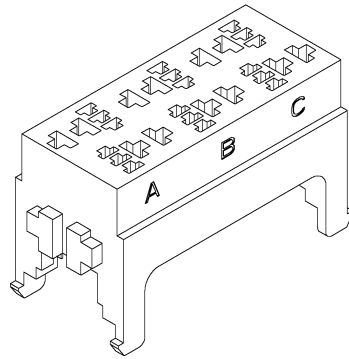
**264F**  
**RELAY BLOCK**

144417A1

CONNECTOR 263F - 144417A1			CONNECTOR 264F - 144417A1		
RELAY BLOCK			RELAY BLOCK		
CAV	WIRE NUMBER	CIRCUIT REFERENCE	CAV	WIRE NUMBER	CIRCUIT REFERENCE
A1	750K	POS / HAZ COIL B+	A1	312D	SWITCHED B+
A2	177AS	COIL GROUND	A2	177AT	COIL GROUND
A3	241A	WORK LIGHTS INTERLOCK	A3	195A	UNSWITCHED B+
A4	789A	ROTARY WORKLIGHTS	A4		OPEN
A5		OPEN	A5	195B	BLOWER B+
B1	558A	PARK RELAY COIL	B1	104B	GOV SW COIL
B2	177AS 177AW	COIL GROUND	B2	117AT 177AL	COIL GROUND
B3	550F	PARK RELAY COMMON	B3	268A	GOV KEYSWITCH
B4		OPEN	B4		OPEN
B5	561H	PARK RELAY (NO)	B5	223A	GOV IGN SW SIGNAL
C1	568B	FNRP-NO NEUTRAL COIL	C1	792B 792C	FENDER WORKLIGHTS COIL
C2	177X 177AW	COIL GROUND	C2	177W 177AL	COIL GROUND
C3	550G	NEUTRAL RELAY COMMON	C3	795A	FENDER WORK LIGHTS
C4		OPEN	C4		OPEN
C5	220M	NEUTRAL RELAY (NO)	C5	787A	REAR FENDER WORK LIGHTS
D1	791A	ROOF WORKLIGHTS COIL	D1	790B	FRONT ROOF WORK LIGHTS COIL
D2	177X 177AR	COIL GROUND	D2	177V 177W	COIL GROUND
D3	788A 788B	ROOF WORKLIGHTS B+	D3	788B	FRONT ROOF WORK LIGHTS COIL
D4		OPEN	D4		OPEN
D5	793A	REAR ROOF WORKLIGHTS	D5	784A	FRONT ROOF WORK LIGHTS COIL
E1		OPEN	E1	792A 792B	LOWER WORK LIGHTS COIL
E2		OPEN	E2	177U 177V	COIL GROUND
E3		OPEN	E3	794A	BELTLINE WORK LIGHTS
E4		OPEN	E4		OPEN
E5		OPEN	E5	783A	BELTLINE WORK LIGHTS
F1	311A	PTO SIGNAL	F1	790C	HID ON
F2	177Y 177AP	COIL GROUND	F2	177U 177V	COIL GROUND
F3	312B	BRAKE B+	F3	785A	SWITCHED B+
F4	565C	PNEUMATIC SIG	F4		OPEN
F5	755A	BRAKE LAMP SIG	F5	786A	HID B+

265F

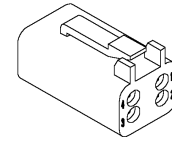
144417A1



144417A1

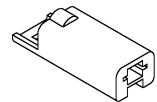
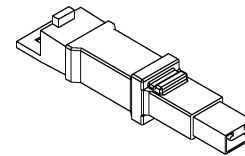
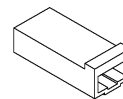
CONNECTOR 265F - 144417A1		
RELAY BLOCK		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
B1	731B	EGRESS ON
B2	177BE	COIL GROUND
B3	312E	UNSWITCHED B+
B4	830A	BLOWER SIGNAL
B5	732A	EGRESS SIGNAL ON
D1	OPEN	OPEN
D2	177BD	COIL GROUND
D3	OPEN	OPEN
D4	OPEN	OPEN
D5	OPEN	OPEN
E1	OPEN	OPEN
E2	177BC	COIL GROUND
E3	OPEN	OPEN
E4	OPEN	OPEN
E5	OPEN	OPEN
F1	164C	INTERLOCK ON
F2	171F	COIL GROUND
F3	164A	SWITCHED B+
F4	OPEN	OPEN
F5	164B	SWITCHED B+

266MM  
SOCKET HOUSING  
239451A1



239451A1

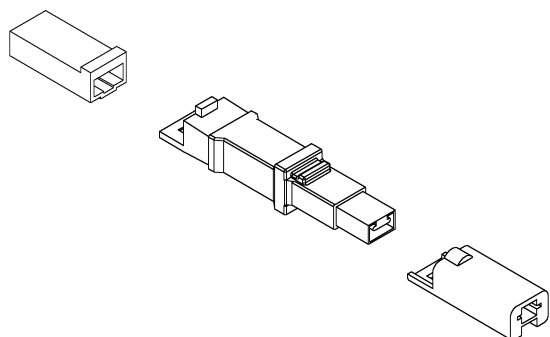
CONNECTOR 266MM - 239451A1		
ACTIVE TERMINATOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R56	CAN B+ (AUTO)
2	CAN-Y56	CAN HI (AUTO)
3	CAN-BK56	CAN GROUND (AUTO)
4	CAN-DG56	CAN LO (AUTO)



382391A1

CONNECTOR 266M - 631801C1		
RECTIFIER ASSEMBLY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	105A	IGNITION SWITCH

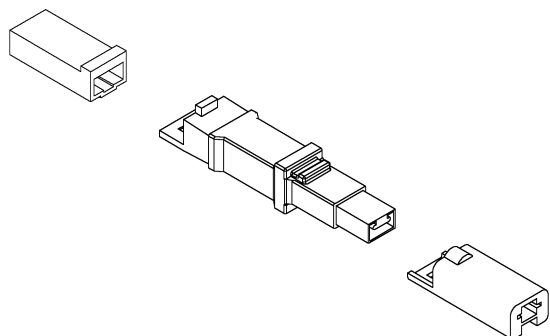
CONNECTOR 266F - 739070C1		
RECTIFIER ASSEMBLY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	104A 104B	IGNITION FEED



382391A1

CONNECTOR 267M - 631801C1		
RECTIFIER ASSEMBLY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	724A 724B	HIGH BEAM DIMMING/INDICATOR

CONNECTOR 267F - 739070C1		
RECTIFIER ASSEMBLY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	727D	HIGH BEAM DIMMING

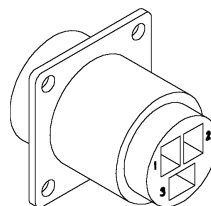


382391A1

CONNECTOR 268M - 631801C1		
RECTIFIER ASSEMBLY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	728A 728B	LOW BEAM DIMMING

CONNECTOR 268F - 739070C1		
RECTIFIER ASSEMBLY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	727C	LOW BEAM DIMMING

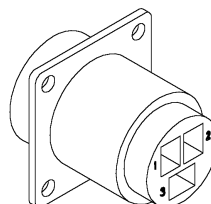
**269F**  
PIN HOUSING  
225164C1



225164C1

CONNECTOR 269F - 225164C1		
TO AUXILIARY POWER CONNECTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	142B	SWITCHED B+
2	141B	UNSWITCHED B+
3	177AF	GROUND

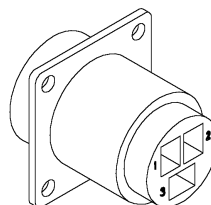
**270F**  
PIN HOUSING  
225164C1



225164C1

CONNECTOR 270F - 225164C1		
IMPLEMENT AUXILIARY POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	136H	SWITCHED B+
2	135H	UNSWITCHED B+
3	134H	GROUND

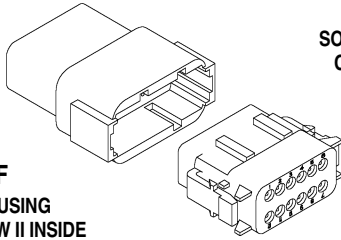
**271F**  
PIN HOUSING  
225164C1



225164C1

CONNECTOR 271F - 225164C1		
IMPLEMENT AUXILIARY POWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	136J	SWITCHED B+
2	135J	UNSWITCHED B+
3	134J	GROUND

**273F**  
PIN HOUSING  
INTELLIVIEW II INSIDE  
CAB 223672A1



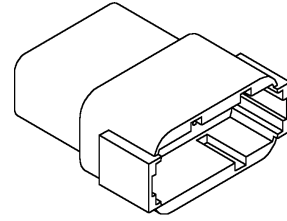
**273M**  
SOCKET HOUSING  
CAB HARNESS  
223671A1

223671A1

CONNECTOR 273F - 223672A1		
CAB/ ISO 11783		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	344E	UNSWITCHED B+
2		RADAR SIGNAL
3		SWITCHED B+
4	179CB	CLEAN GROUND
5	RED	CDB BATT B+ (IMP)
6	YELLOW	CDB HI (IMP)
7	BLACK	CDB GND (IMP)
8	GREEN	CDB LOW (IMP)
9		OPEN
10		OPEN
11		OPEN
12		OPEN

CONNECTOR 273M - 223671A1		
CAB/ ISO 11783		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	344A	UNSWITCHED B+
2		RADAR SIGNAL
3		SWITCHED B+
4	179AZ	CLEAN GROUND
5	RED	CDB BATT B+ (IMP)
6	YELLOW	CDB HI (IMP)
7	BLACK	CDB GND (IMP)
8	GREEN	CDB LOW (IMP)
9		OPEN
10		OPEN
11		OPEN
12		OPEN

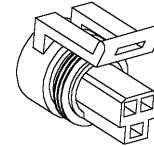
**273FF**  
PIN HOUSING  
223672A1



223672A1

CONNECTOR 273FF - 223672A1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
5	CDB-R59	CAN IMP B+
6	CDB-Y59	CAN IMP HIGH
7	CDB-BK59	CAN IMP GROUND
8	CDB-DG59	CAN IMP LOW

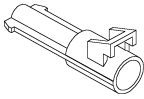
**275M**  
PIN HOUSING  
198456A1



198456A1

CONNECTOR 275M - 198456A1		
PRESSURE TRANSDUCER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	420K	CLEAN GROUND
B	418G	+5 VOLTS REF
C	416E	PRESSURE SENSE SIGNAL

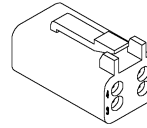
**276F**  
PIN HOUSING  
182064A1



**276M**  
SOCKET HOUSING  
182066A1



**278MM**  
SOCKET HOUSING  
239451A1



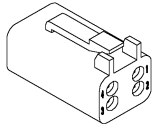
382391A1

CONNECTOR 276F		
TO FNRP		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	522J	REVERSE

CONNECTOR 276M		
REVERSE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	522AA	REVERSE

CONNECTOR 278MM - 239451A1		
TO ACTIVE TERMINATOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R48	CAN AUTO B+
2	CAN-Y48	CAN AUTO HI
3	CAN-BK48	CAN AUTO GROUND
4	CAN-DG48	CAN AUTO LO

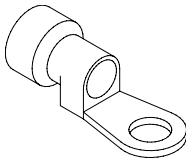
**278M**  
SOCKET HOUSING  
239451A1



382391A1

CONNECTOR 278M - 239451A1		
TO ACTIVE TERMINATOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	RED	CDB B+ (IMP)
2	YELLOW	CDB HI (IMP)
3	BLACK	CDB GND (IMP)
4	GREEN	CDB LOW (IMP)

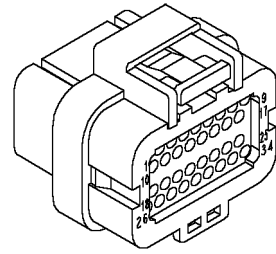
**279F**  
CAB HARNESS



382391A1

CONNECTOR 279F - 225072C1		
CHASSIS GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	177J	CHASSIS GROUND

**282M**  
SOCKET HOUSING  
AMP 4-1437290-0

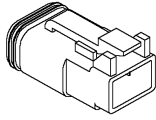


282M.tif

CONNECTOR 282M - 4-1437291-0		
TRACTOR ECU		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	YELLOW	CAN H (IMP)
2	GREEN	CAN L (IMP)
3		CAN SHIELD
4	YELLOW	CAN H (TR)
5	GREEN	CAN L (TR)
6		CAN SHIELD
7		RS232 RX
8		RS232 TX
9		RS232 GND
10	401D	ECU PWR
11	179CH	ECU GND
12	403A	PWR CONTROL RELAY
13	404A	PWR CONTROL RELAY RTN
14	406A	ECU PWR RELAY
15	405A	ECU PWR RELAY RTN
16	138A	KEY SWITCH
17	787M	IMPLEMENT FLOOD
18		OPEN
19	752P	RIGHT TURN
20	750V	TAIL LIGHTS
21	407A	CHASSIS GROUND
22	751N	LEFT TURN
23		OPEN
33		WARNING LIGHT SWITCH
34		OPEN



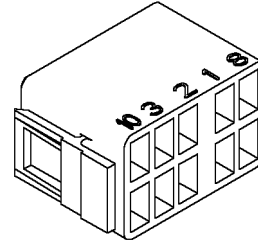
**283M**  
**SOCKET HOUSING**  
**225316C1**



225316C1

CONNECTOR 283M - 225316C1		
BREAKAWAY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	137G	ECU PWR
2	179CG	ECU GND

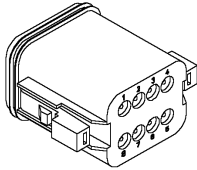
**287M**  
**SOCKET HOUSING**  
**382391A1**



382391A1

CONNECTOR 287M - 382391A1		
MANUAL SWITCH		
2	345B	SW B+
3	-	AUTO/MAN

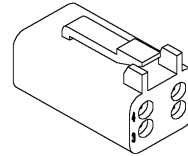
**286M**  
**SOCKET HOUSING**  
**225319C1**



225319C1

CONNECTOR 286M - 225319C1		
TASK CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	344H	ECU PWR
2	YELLOW	CAN LO (IMP)
3		OPEN
4		OPEN
5		OPEN
6		OPEN
7	GREEN	CAN HI (IMP)
8	179CD	ECU GND

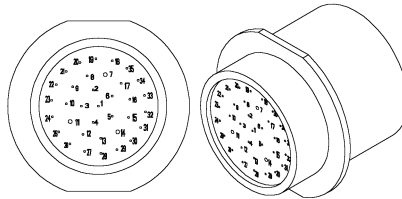
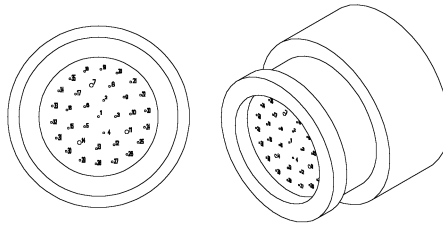
**288M**  
**SOCKET HOUSING**  
**239451A1**



239451A1

CONNECTOR 288M - 239451A1		
BREAKAWAY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	RED	CAN TBC PWR
2	YELLOW	CAN LO (IMP)
3	BLACK	CAN TBC RTN
4	GREEN	CAN HI (IMP)

**290F  
SOCKET HOUSING  
380841A1**

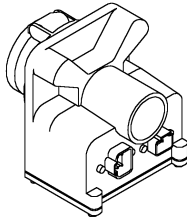


**290M  
PIN HOUSING  
380842A1**

380841A1

CONNECTOR 290F - 380841A1			CONNECTOR 290M - 380842A1		
TO INSIDE AUTOGUIDANCE HARNESS			TO OUTSIDE AUTOGUIDANCE HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE	CAV	WIRE NUMBER	CIRCUIT REFERENCE
5	421B	PPS IN	5	421A	PPS IN
6	419E	S.V. SOURCE	6	419A	S.V. SOURCE
			7		
8	410E	S.V. RH SINK	8	410A	S.V. RH SINK
9	411E	S.V. LH SINK	9	411A	S.V. LH SINK
10	416E	PRESSURE SENSOR	10	416A	PRESSURE SENSOR
11	417E	STEER POT SIGNAL (1)	11	417A	STEER POT SIGNAL (1)
12	412B	RS232 TX	12	412A	RS232 TX
13	413B	RS232 RX	13	413A	RS232 RX
14	414B	RS232 GND	14	414A	RS232 GND
15	418E	+5VDC REF	15	418A	+5VDC REF
16	422F	STEER POT SIGNAL (2)	16	422A	STEER POT SIGNAL (2)
18	CAN-R55	CAN AUTO B+	18	CAN-R53	CAN AUTO B+
20	CAN_Y55	CAN AUTO HI	20	CAN_Y53	CAN AUTO HI
21	145F	SWITCHED B+	21	345F	SWITCHED B+
23	CAN-DG55	CAN AUTO LOW	23	CAN-DG53	CAN AUTO LOW
24	CAN-BK55	CAN AUTO GND	24	CAN-BK53	CAN AUTO GND
27	179CU	CLEAN GROUND	27	179CT	CLEAN GROUND
31		OPEN	31		OPEN
32		OPEN	32		OPEN
33		OPEN	33		OPEN
34		OPEN	34		OPEN

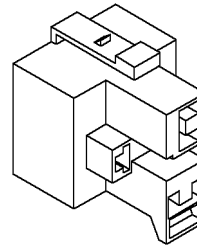
**291M**  
**SOCKET HOUSING**  
**323597A1**



323597A1

CONNECTOR 291M - 279043A1		
BREAKAWAY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	407C	CHASSIS GROUND
2	407B	ECU GROUND
3	402A	POWER
4	137D	ECU POWER
5	-	OPEN
6	-	TBC POWER
7	-	TBC RETURN
8	-	CAN HIGH (IMP)
9	-	CAN LOW (IMP)

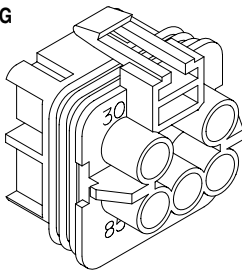
**293M**  
**SOCKET HOUSING**  
**INSIDE CAB 310220A1**



310220A1

CONNECTOR 293M - 310220A1		
INTELLIVIEW II POWER RELAY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
30	400A	IMP B+ SWITCHED
85	403A	IMP POWER ACT
86	404A	SWITCHED B+
87	402A	UNSWITCHED B+

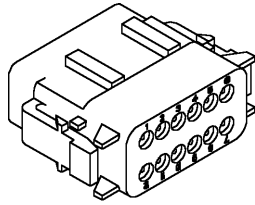
**292M**  
**SOCKET HOUSING**  
**297910A1**



RI99H136

CONNECTOR 292M - 297910A1		
INTELLIVIEW II POWER RELAY		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
30	401A	LOW IMP B+ SWITCH
85	405A	COIL B+
86	406A	IMP POWER ACT
87	137E	COM IMP B+ SWITCH
87A	OPEN	

**294M**  
**SOCKET HOUSING**  
**223682A1**

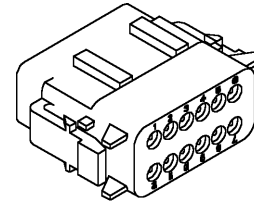


223671A1

<b>CONNECTOR 294M - 223682A1</b>		
<b>TO ISO 11783 OUTSIDE HARNESS</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		CAN IMP B+
2		CAN IMP HI
3		LOW ECU SW POWER
4		SWB+
5		CLEAN GND
6		WORKLIGHT B+
7		LEFT TURN
8		RIGHT TURN
9		TAIL LIGHT
10		OPEN
11		CAN IMP GND
12		CAN IMP LO

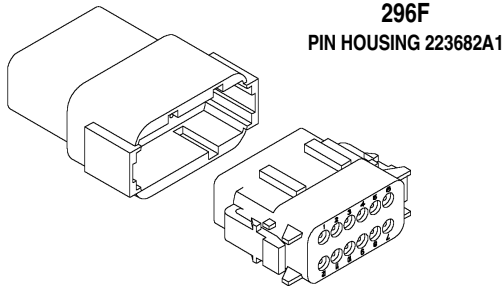
<b>CONNECTOR 294F - 223679A1</b>		
<b>TO ISO 11783 HARNESS</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R32	CAN IMP B+
2	CAN-Y32	CAN IMP HI
3	137A	LOW ECU SW POWER
4	138B	SWB+
5	1798J	CLEAN GND
6	787K	WORKLIGHT B+
7	751L	LEFT TURN
8	752K	RIGHT TURN
9	750R	TAIL LIGHT
10	PLUG	OPEN
11	CAN-BK32	CAN IMP GND
12	CAN-DG32	CAN IMP LO

**295M**  
**SOCKET HOUSING**  
**223671A1**



223671A1

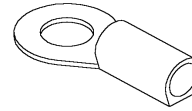
<b>CONNECTOR 295M - 223671A1</b>		
<b>GPS ANTENNA RECEIVER</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-Y60	IMP CAN HI A
2	413E	RS232 RX
3	412E	RS232TX
4	421E	PPS IN
5	414E	RS232 GROUND
6	OPEN	CAN LO B
7	OPEN	CAN HI B
8	OPEN	CTS (IN)
9	OPEN	EVENT IN
10	138G	SWITCH LO ECU B+
11	179CK	CLEAN GROUND
12	CAN-DG60	IMP CAN LO A



223671A1

CONNECTOR 296F - 223682A1 TO VT JUMPER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-51R	CDB IMP B+
2	CDB-51Y	CDB IMP HI
3	CDB-51BK	CDB IMP GROUND
4	CDB-51DG	CDB IMP LO
5	CDB-52R	CDB IMP B+
6	CDB-52Y	CDB IMP HI
7	CDB-52BK	CDB IMP GROUND
8	CDB-52DG	CDB IMP LO
9	PLUG	OPEN
10	344G	SWITCHED B+
11	179CE	GROUND
12	344F	SWITCHED B+

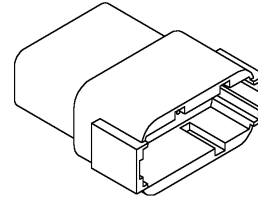
297F  
RING TERMINAL  
200338



200338

CONNECTOR 297F - 200338 RING TERMINAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	407A, 407B, 407C	CLEAN GROUND

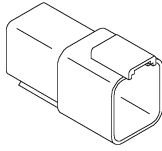
298FF  
PIN HOUSING  
223682A1



223672A1

CONNECTOR 298FF - 223682A1 TO VT EXTENSION HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R52	CAN AUTO B+
2	CAN-Y52	CAN AUTO HI
3	CAN-BK52	CAN AUTO GROUND
4	CAN-DG52	CAN AUTO LOW
5	CAN-R52	CAN AUTO B+
6	CAN-Y53	CAN AUTO HI
7	CAN-BK53	CAN AUTO GROUND
8	CAN-DG53	CAN AUTO LOW
9		OPEN
10	345H	SWITCHED B+
11	179CM	CLEAN GROUND
12	345A	SWITCHED B+

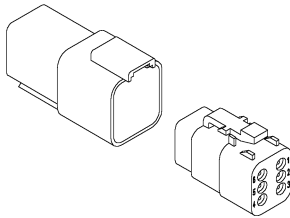
**298F**  
PIN HOUSING  
280453A1



223672A1

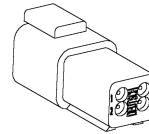
CONNECTOR 298F - 280453A1		
GPS ANTENNA		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-37R	CAN BATT (IMP)
2	CDB-37Y	CAN HI (IMP)
3	CDB-37BK	CAN GND (IMP)
4	CDB-37DG	CAN LOW (IMP)
5	PLUG	OPEN
6	PLUG	OPEN

**298M**  
PIN HOUSING  
280453A1



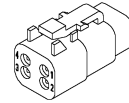
223672A1

CONNECTOR 298M - 280451A1		
GPS RECEIVER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-36R	CAN BATT (IMP)
2	CDB-36Y	CAN HI (IMP)
3	CDB-36BK	CAN GND (IMP)
4	CDB-36DG	CAN LOW (IMP)
5	137H	SW B+
6	179CC	CLEAN GROUND



**299F**  
PIN HOUSING  
277904A1

**299M**  
PIN HOUSING  
277905A1



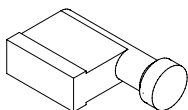
277905A1 AND 904A1

CONNECTOR 299F - 277904A1		
GPS RECEIVER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	414B	RS232 GND
2	413B	RS232 RX
3	412B	RS232 TX
4	421B	PPS IN

CONNECTOR 299M - 277905A1		
GPS RECEIVER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	414E	RS232 GND
2	413E	RS232 RX
3	412E	RS232 TX
4	421E	PPT IN

**301F, 302F, 303F,  
AND 304F**

1/4 FLAG TERM.



RI00E016

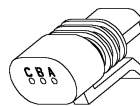
CONNECTOR 301F		
TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	754C	B+

CONNECTOR 302F		
TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		GROUND

CONNECTOR 303F		
TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		B+

CONNECTOR 304F		
TURN SIGNAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		GROUND

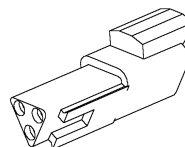
CONNECTOR 311F - WEBCO_894-601-021-2		
PNEUMATIC BRAKES		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	565A	B+
B	179BS	CHASSIS GROUND

**313MA & 313MB  
SOCKET HOUSING  
REMOTE HITCH  
SWITCH HARNESS  
198550A1**


198550A1

CONNECTOR 313MA-198550A1		
CENTER REMOTE HITCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	513G	LOWER (DOWN)
B	500J	CENTER B+
C	526G	RAISE (UP)

CONNECTOR 313MB - 198550A1		
CENTER REMOTE HITCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	526E	LOWER (DOWN)
B	500K	CENTER B+
C	513E	RAISE (UP)

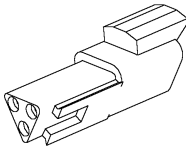
**314M  
SOCKET HOUSING  
225295C1**

**314F  
PIN HOUSING  
225294C1**

225294C1

CONNECTOR 314F - 225294C1		
REMOTE HITCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	513C	RAISE REMOTE UP
B	500G	COMMON B+
C	526C	LOWER REMOTE DOWN

CONNECTOR 314M - 225295C1		
REMOTE HITCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	513F 513G	RAISE REMOTE UP
B	500H 500J	COMMON B+
C	526F 526G	LOWER REMOTE DOWN

**315F**  
PIN HOUSING  
225294C1



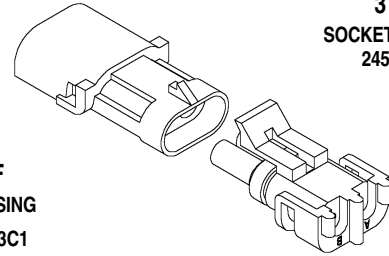
225294C1

CONNECTOR 315F - 225294C1		
REMOTE HITCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	526B	RAISE REMOTE UP
B	500E	COMMON B+
C	513B	LOWER REMOTE DOWN

CONNECTOR 315M - 225295C1		
REMOTE HITCH SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	526E	RAISE REMOTE UP
B	500K	COMMON B+
C	513E	LOWER REMOTE DOWN

**315M**  
SOCKET HOUSING  
225295C1

**318F**  
PIN HOUSING  
245483C1



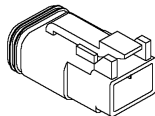
245483C1

CONNECTOR 318F - 245483C1		
PNEUMATIC PARK SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	567F	PARK BRAKE FEEDBACK
B	179BV	CLEAN GROUND

CONNECTOR 318M - 245482C1		
PNEUMATIC PARK SOLENOID SW #2		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	567H	PARK BRAKE FEEDBACK
B	179BW	CLEAN GROUND

**318M**  
SOCKET HOUSING  
245482C1

**317F**  
SOCKET HOUSING  
225316C1

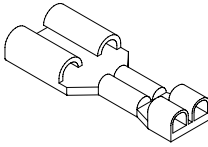


225316C1

CONNECTOR 317F - 225316C1		
PNEUMATIC PARK SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	567H	AUTO HITCH B+
B	179BW	INDICATOR GROUND



**325A & 325B**  
AMP 41274-0

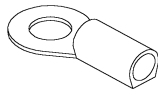


RI00E015

CONNECTOR 325A - 41274-0		
PNEUMATIC AIR SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	566C	B+

CONNECTOR 325B - 41274-0		
PNEUMATIC AIR SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179AB	GROUND

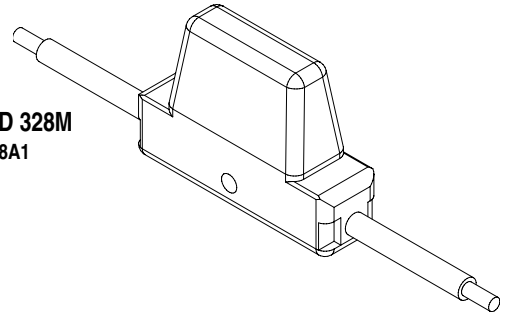
**326F**  
RING TERMINAL  
200338



200338.TIF

CONNECTOR 326F - 200338		
RING TERMINAL		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	400C 401C	INTELLIVIEW II B+

**327M AND 328M**  
300518A1

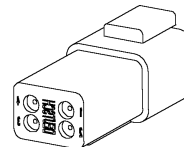


300518A1

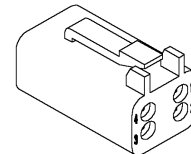
CONNECTOR 327M - 300518A1		
INTELLIVIEW II FUSE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	400B	UNSWITCHED B+
2	400C	UNSWITCHED B+

CONNECTOR 328M - 300518A1		
INTELLIVIEW II FUSE		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	401B	UNSWITCHED B+
2	401C	UNSWITCHED B+

**331M**  
SOCKET HOUSING  
239451A1



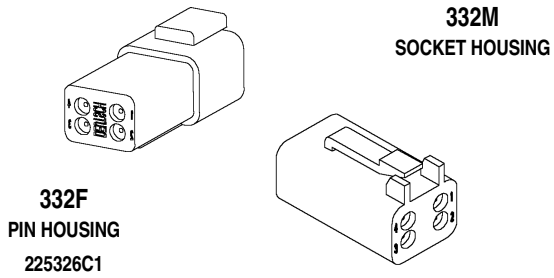
**331F**  
PIN HOUSING  
225326C1



225326C1

CONNECTOR 331F - 225326C1		
RIGHT FRONT HITCH LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	740B	LOW BEAM B+
2	741B	HIGH BEAM B+
3	744C	PILOT
4	176E	GROUND

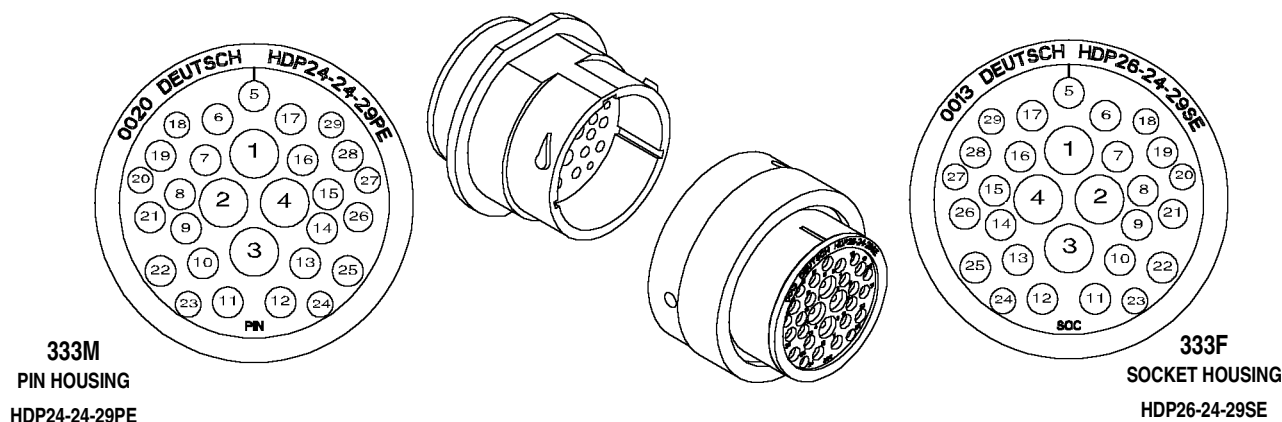
CONNECTOR 331M - 239451C1		
RIGHT FRONT HITCH LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	LOW BEAM B+
2	LAMP	HIGH BEAM B+
3	LAMP	PILOT
4	LAMP	GROUND



225326C1

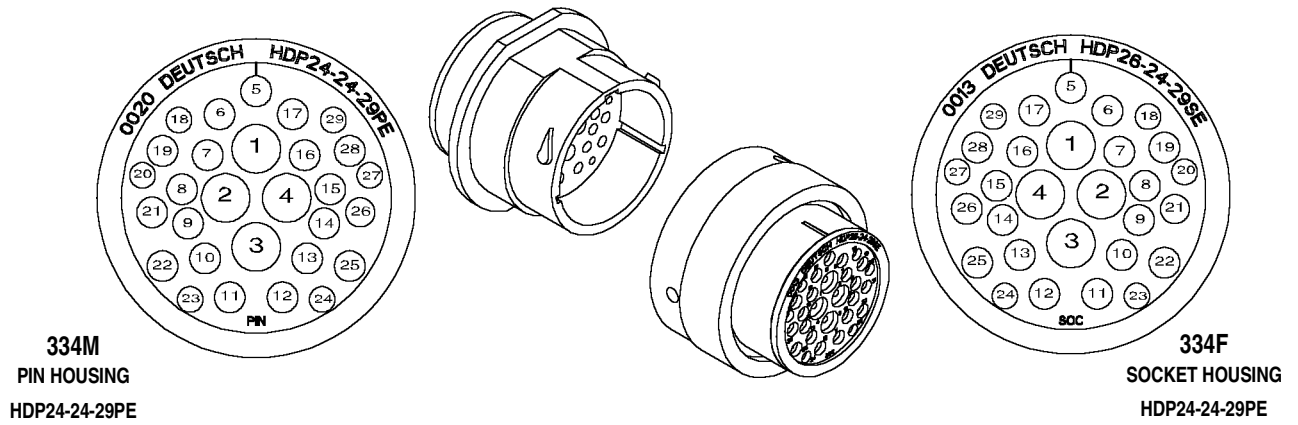
CONNECTOR 332F - 225326C1		
LEFT FRONT HITCH LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	742B	LOW BEAM B+
2	743B	HIGH BEAM B+
3	744B	PILOT
4	176D	GROUND

CONNECTOR 332M - 239451C1		
LEFT FRONT HITCH LAMPS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	LAMP	LOW BEAM B+
2	LAMP	HIGH BEAM B+
3	LAMP	PILOT
4	LAMP	GROUND



333M\_333F

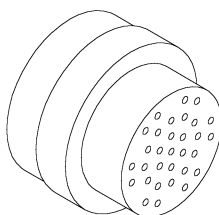
CONNECTOR 333M - 87426722			CONNECTOR 333F - 87426768		
TO ENGINE HARNESS			TO CHASSIS HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE	CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	204B	BATT B+ (ENG GOV)	1	204C	BATT B+ (ENG GOV)
2	179AG	ENGINE GOV GND	2	179AK	ENGINE GOV GND
3	102P	SW B+	3	102N	SW B+
4	722B	HORN B+	4	722C	HORN B+
5	223B	ENG GOV B+ IG SW	5	223C	ENG GOV B+ IG SW
6	945B	IDLE VLAD OFF	6	945C	IDLE VLAD OFF
7	562B	BRAKE ACTUATION	7	561E	BRAKE ACTUATION
8	567K	BRAKE FB	8	567J	BRAKE FB
9	531H	SUS AXLE B+	9	531F	SUS AXLE B+
10	544D	SUS AXLE SEN SIG	10	544A	SUS AXLE SEN SIG
11	179CN	SUS AXLE SEN GND	11	179CL	SUS AXLE SEN GND
12	723B	OPEN	12	723C	OPEN
13	89B	UNSW B+	13	89C	UNSW B+
14	172A	SW B+	14	172C	SW B+
15	266B	AIR FILTER REST	15	266C	AIR FILTER REST
16	836B	FR WASH PUMP B+	16	836D	FR WASH PUMP B+
17	845B	REAR WASH PUMP B+	17	845C	REAR WASH PUMP B+
18	CAN-Y22	CAN HI	18	CAN-Y23	CAN HI
19	724C	HIGH BEAM ON	19	724D	HIGH BEAM ON
20	CAN-DG22	CAN LO	20	CAN-DG23	CAN LO
21	726C	HIGH BEAM SW	21	726C	HIGH BEAM SW
22	728C	LOW BEAM SW	22	728D	LOW BEAM SW
23	944B	ACC POS SIG	23	944C	ACC POS SIG
24	943B	ACCEL POS (-)	24	943C	ACCEL POS (-)
25	792D	WORKLIGHT	25	792E	WORKLIGHT
26	750N	FR HITCH POS LTS	26	750B	FR HITCH POS LTS
27	942B	ACCEL POS (+)	27	942C	ACCEL POS (+)
28	452B	OPEN	28	452C	OPEN
29	941B	IDLE VALD SIG	29	941C	IDLE VALD SIG



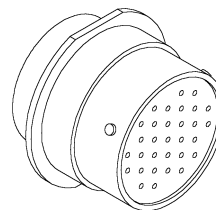
333M\_333F

CONNECTOR 334M - 225319C1			CONNECTOR 334F - 225320C1		
CAV	WIRE NUMBER	CIRCUIT REFERENCE	CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	450B	ENGINE OIL PRESS +5V	1	255C	ENGINE OIL PRESS +5V
2	641B	ETHER SOLENOID B+	2	641C	ETHER SOLENOID B+
3	181P	AIR TO AIR GND	3	181W	AIR TO AIR GND
4	453B	ENG COOLANT TEMP INPUT	4	235C	ENG COOLANT TEMP INPUT
5	454B	ENG AIR INTAKE TEMP	5	240C	ENG AIR INTAKE TEMP
6	455B	ENG OIL PRESS INPUT	6	256C	ENG OIL PRESS INPUT
7	181R	COOLANT TEMP GND	7	181Y	COOLANT TEMP GND
8	181T	ENG OIL PRESS GND	8	181AA	ENGINE OIL PRESS GND

**335F**  
PIN HOUSING  
HDP26-24-31SE



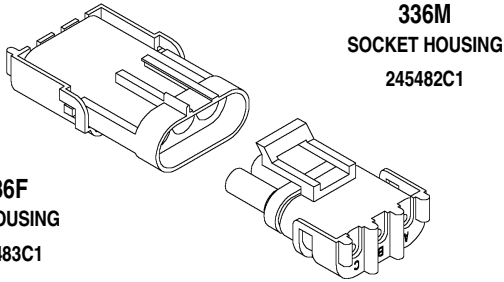
**335M**  
SOCKET HOUSING  
HDP24-24-31PE



CONNECTOR 335F - 87426768		
TO AUX HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	501B	VD/VT B+
2	179CY	POWER GROUND
3	900F	VF B+
4	179CW	POWER GROUND
7	599P	VH B+
8	175M	DIFF SOLENOID
9	174E	PTO CLUTCH OUTPUT GND
10	175N	CHASSIS GROUND
11	565F	PNEUMATIC BRAKE B+
15	510C	RH BRAKE PEDAL SWITCH
16	702B	BRAKE LIGHT RELAY
17	540B	FWD SOLENOID SOURCE
18	216K	ENGINE SPEED ALT W TERM
19	518B	EDC RIDE CONTROL SWITCH
20	509C	LH BRAKE PEDAL SW
21	513D	EDC REMOTE RAISE SW
22	526D	EDC REMOTE LOWER SW
23	293C	PTO ON SWITCH
24	114D	VP B+
25	174C	SHAFT SIZE GROUND
26	512B	EDC AUTO HITCH SW
27	CAN - Y5	CAN HI
28	599S	VH B+
29	CAN-DG5	CAN LOW

CONNECTOR 335M - 87426772		
AUXILIARY CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	501F	VD/VT B+
2	179CS	POWER GROUND
3	900D	VF B+
4	179CT	POWER GROUND
7	599H	VH B+
8	175E	DIFF SOLENOID
9	174A	PTO CLUTCH OUTPUT GND
10	174R	CHASSIS GROUND
11	565H	PNEUMATIC BRAKE B+
15	510A	RH BRAKE PEDAL SW
16	702A	BRAKE LIGHT RELAY
17	540A	FWD SOLENOID SOURCE
18	216D	ENGINE SPEED ALT W TERMINAL
19	518A	EDC RIDE CONTROL SW
20	509A	LH BRAKE PEDAL SW
21	513A	EDC REMOTE RAISE SW
22	526A	EDC REMOTE LOWER SW
23	293A	PTO ON SW
24	114D	VP B+
25	174C	SHAFT SIZE GND
26	512A	EDC AUTO HITCH SW
27	CAN_HI	CAN HI
28	599K	VH B+
29	CAN_LO	CAN LO

**336F**  
PIN HOUSING  
245483C1

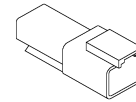


245483C1

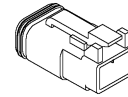
CONNECTOR 336F - 245483C1		
DUAL SPEED PTO		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	SENSOR	PTO SHAFT SPEED
B	SENSOR	SENDER GROUND

CONNECTOR 336M - 245482C1		
DUAL SPEED PTO		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	249B	PTO SHAFT SPEED
B	174D	SENDER GROUND

**338F**  
PIN HOUSING  
225315C1



**338M**  
SOCKET HOUSING  
225316C1

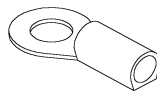


225315C1

CONNECTOR 338F - 225315C1		
BACKUP ALARM		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	571A	ALARM POWER
2	174G	ALARM GND

CONNECTOR 338M - 225316C1		
BACKUP ALARM		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	571B	ALARM POWER
2	174H	ALARM GND

**337A & 337B**  
RING TERMINAL  
225058C1

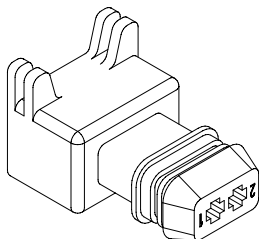


200338

CONNECTOR 337A - 225058C1		
BACKUP ALARM		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	571B	ALARM POWER

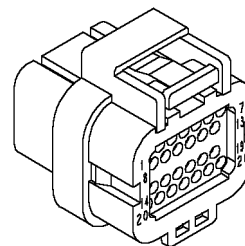
CONNECTOR 337B - 225058C1		
BACKUP ALARM		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	174H	CHASSIS GROUND

**340F, 341F, 342F,  
343F AND 344F  
SOCKET HOUSING  
291718A1**



291718A1

**350M  
CNH 87410948  
TYCO  
3-1437290-7**



350M

CONNECTOR 340F - 291718A1		
AUX 1 MOTOR LOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX1 BOT1	B+ AUX 1 A LOWER
2	AUX1 BOT2	RETURN AUX 1 A LOWER

CONNECTOR 341F - 291718A1		
AUX 2 MOTOR LOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX2 BOT1	B+ AUX 2 B LOWER
2	AUX2 BOT2	RETURN AUX 2 A LOWER

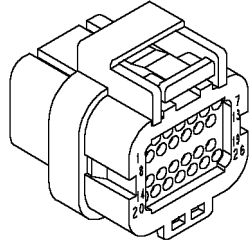
CONNECTOR 342F - 291718A1		
AUX 3 MOTOR LOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX3 BOT1	B+ AUX 3 B LOWER
2	AUX3 BOT2	RETURN AUX 3 A LOWER

CONNECTOR 343F - 291718A1		
AUX 4 MOTOR LOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX4 BOT1	B+ AUX 4B LOWER
2	AUX4 BOT2	RETURN AUX 4 A LOWER

CONNECTOR 344F - 291718A1		
AUX 5 MOTOR LOWER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	AUX5 BOT1	B+ AUX 5 B LOWER
2	AUX5 BOT2	RETURN AUX 5 A LOWER

CONNECTOR 350M - 3-1437290-7		
TRANSMISSION CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	550B	SWITCHED B+ 12V
2	550D	SWITCHED B+ 12V
3	550H	SWITCHED B+ 12V
4	558B	PARK BRAKE CONTROL
5	586A	MASTER CLUTCH HIGH SIDE
6	201C	C1-2 CLUTCH HIGH SIDE
7	201F	C3-4 CLUTCH HIGH SIDE
8	550M	SWITCHED B+ 12V
9	201B	ODD CLUTCH HIGH SIDE
10	201E	EVEN CLUTCH HIGH SIDE
11	201N	CREEP CLUTCH HIGH SIDE
13	548A	SUS AXLE UPPER LOCK
14	114B	UNSWITCHED B+ 12V
15	YELLOW	CAN + HIGH SIDE
16	GREEN	CAN - LOW SIDE
19	179M	CASE GROUND
20	220F	B+ 12V FROM NEUTRAL RELAY
23	557A	CLEAN GROUND
24		OPEN
25	175J	CHASSIS GROUND
26	175H	CHASSIS GROUND

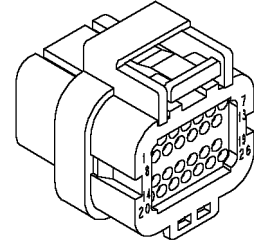
**351M**  
**CNH 87410946**  
**TYCO 4-1437290-0**  
**SOCKET HOUSING**



350M

CONNECTOR 351M - 4-1437290-0		
TRANSMISSION CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	555A	MASTER CLUTCH SIGNAL
2		OPEN
11	563A	RANGE PRESSURE SIGNAL
12	552A	REVERSE SIGNAL
13	551A	FORWARD SIGNAL
16	561D	FNRP SWITCH 5V
17	556A	MASTER CLUTCH POT 5V
22	511B	NOT PARK SIGNAL
23	553A	NOT NEUTRAL
24		OPEN
26	532B	SUS LOCK / UNLOCK
28	567L	PARK BRAKE FEEDBACK
33	216E	ENGINE ALT SPEED
34	215D	TRANS WHEEL SPEED

**353M**  
**CNH 87410949**  
**TYCO 3-1437290**  
**SOCKET HOUSING**

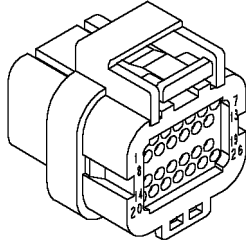


350M

CONNECTOR 353M - 3-1437290-8		
TRANSMISSION CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	581A	EVEN CLUTCH LOW SIDE
2	544A	AXLE SENSOR SIGNAL
3	590A	CREEP CLUTCH LOW SIDE
4	220B	MASTER CLUTCH LOW SIDE
6	582A	C1 - 2 LOW SIDE
7	541A	SUS AXLE UPPER LOCK
8	580A	ODD CLUTCH LOW SIDE
11		
13	583A	C3 - 4 CLUTCH LOW SIDE
18	536B	SUS INDICATION LED
21	175F	CHASSIS GROUND
26	175G	CHASSIS GROUND

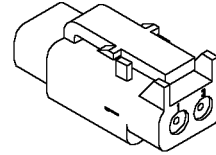


**355M**  
**CNH 87410947**  
**TYCO**  
**POLARITY 2 KEYING**  
**SOCKET HOUSING**  
**4-1437290-0**



350M

**364M & 365M**  
**222135A1**  
**SOCKET HOUSING**



CONNECTOR 355M - 4-1437290-1		
TRANSMISSION CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	584A	C5 - 6 CLUTCH LOW SIDE
2	585A	REVERSE CLUTCH LOW SIDE
3	546A	FSUS LOWER LOCK
4	589A	HIGH CLUTCH LOW SIDE
5	201G	REVERSE CLUTCH HIGH SIDE
6	588A	MID CLUTCH HIGH SIDE
7	537A	FSUS LOWER
8	538A	FSUS RAISE
9	571A	BACK UP ALARM (POWER)
10	220C	MID CLUTCH LOW SIDE
13	201D	C5 - 6 CLUTCH HIGH SIDE
14	587A	LOW CLUTCH HIGH SIDE
15	542A	FSUS LOWER LOCK
16	220E	HIGH CLUTCH HIGH SIDE
18	220D	LOW CLUTCH LOW SIDE
25	220G	B+ 12V FROM NEUTRAL RELAY
34	220H	NEUTRAL RELAY +12

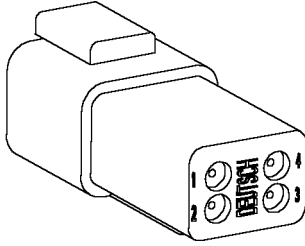
CONNECTOR 364M - 222135A1		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	776B	STROBE/BEACON B+
2	178Y	GROUND

CONNECTOR 365M - 222135A1		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	776B	STROBE/BEACON +
2	178Y	GROUND

CONNECTOR 360F - AMP_41274-0		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	XXX	GROUND

CONNECTOR 361F - AMP_41274-0		
STROBE/BEACON		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	XXX	STROBE/BEACON B+

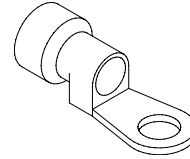
367F  
225326C1



350M

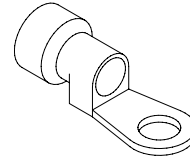
CONNECTOR 367F - 225326C1 TO ISO11783 ACTIVE TERM		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R49	CAN AUTO B+
2	CAN-Y49	CAN AUTO HI
3	CAN-BK49	CAN AUTO GND
4	CAN-DG49	CAN AUTO LO

372F  
225067C1



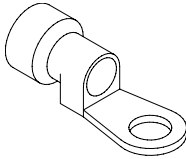
CONNECTOR 372F - 225067C1 HOT AIR UNSWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	270A	HOT AIR B+

373F  
225067C1



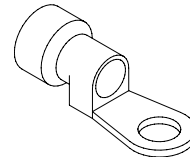
CONNECTOR 373F - 225067C1 HOT AIR UNSWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	270B	HOT AIR B+

369F  
225067C1



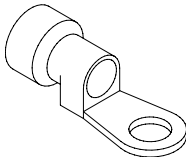
CONNECTOR 369F - 225067C1 CLEAN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	270C	HOT AIR B+

374F  
225067C1



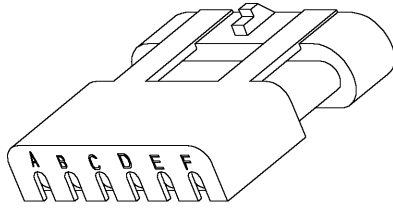
CONNECTOR 374F - 225067C1 HOT AIR UNSWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	270B	HOT AIR B+

371F  
225067C1

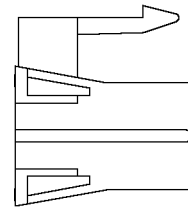
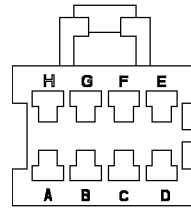


CONNECTOR 371F - 225067C1 HOT AIR UNSWITCHED B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	270A	HOT AIR B+

**374M**  
**245489C1**  
**PIN HOUSING**



**375M**  
**197503A1**

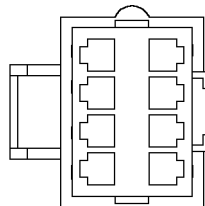
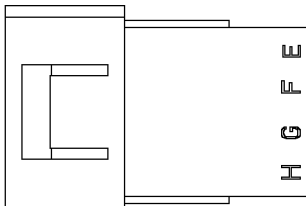


350M

CONNECTOR 374M - 245489C1		
TO STEERING POT JUMPER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	417A	STEERING POT SIG (1)
B	422A	STEERING POT SIG (2)
C	417B	STEERING POT CONTROLLER
D	303D	SEAT SW OPS RTN
E	303E	SEAT SW OPS RTN TO CONTROL- LER
F		OPEN

CONNECTOR 375M - 197503A1		
ROOF HID WORKLIGHTS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	786A	ROOF HID B+
B	177L	ROOF HID GND
C		
D		
E		
F		
G		
H		

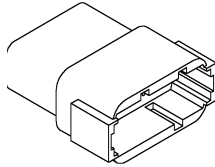
**375F**  
**196153A1**



350M

CONNECTOR 375F - 196153A1		
ROOF HID WORKLIGHTS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	786B	ROOF HID B+
B	177M	ROOF HID GND
C		
D		
E		
F		
G		
H		

**377F**  
**223672A1**  
**PIN HOUSING**

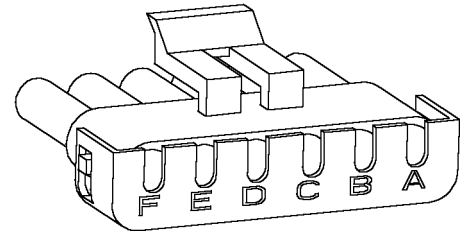


350M

<b>CONNECTOR 377F - 223672A1</b>		
<b>TO CAB HARNESS</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-Y51	CAN HI (IMP)
2	CDB-DG51	CAN LO (IMP)
3	CDB-R51	CAN B+
4	CDB-BK51	CAN GROUND
5	CDB-Y52	CAN HI (TR)
6	CDB-DG52	CAN LO (TR)
7		OPEN
8		OPEN
9		OPEN
10	344N	SWITCHED B+
11	179DP	CLEAN GROUND
12	972B	UNSWITCHED B+

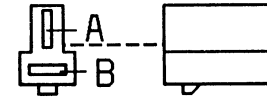
<b>CONNECTOR 377M - 223671A1</b>		
<b>TO CAB HARNESS</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-Y47	CAN HI (IMP)
2	CDB-DG47	CAN LO (IMP)
3	CDB-R47	CAN B+
4	47	CAN GROUND (IMP)
5	CDB-Y13	CAN HI (TR)
6	CDB-DG13	CAN LO (TR)
7		OPEN
8		OPEN
9		OPEN
10	976A	SWITCHED B+
11	79CR	CLEAN GROUND
12	971E	UNSWITCHED B+

**379M**  
**245488C1**



<b>CONNECTOR 379M - 245488C1</b>		
<b>EGRESS DIODE PACK #2</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	792A	FENDER/BELTLINE LTS
B	792J	FENDER/BELTLINE LTS
C	791A	REAR WORKLIGHTS
D	791C	REAR WORKLIGHTS
E	790A	REAR WORKLIGHTS
F	790E	REAR WORKLIGHTS

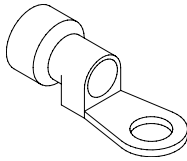
**380M**  
**877291R1**



<b>CONNECTOR 380M - 877291R1</b>		
<b>RADAR</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179T	CLEAN GROUND
2	199A 199B	SIG FREQ TO ICU

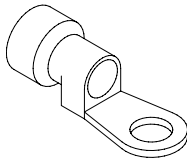
<b>CONNECTOR 381M - 239451A1</b>		
<b>PASSIVE TERMINATOR</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	RED	CDB BATTERY (TRACTOR)
2	YELLOW	CDB HIGH (TRACTOR)
3	BLACK	CDB GROUND (TRACTOR)
4	GREEN	CDB LOW (TRACTOR)

382F  
225072C1



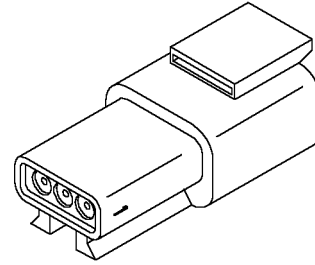
CONNECTOR 382F - 225072C1		
INTAKE AIR HEATER COIL B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	273C	HOT AIR COIL RETURN

383F  
225072C1



CONNECTOR 383F - 225072C1		
INTAKE AIR HEATER COIL B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	273D	HOT AIR COIL B+

386F  
87428138  
PIN HOUSING



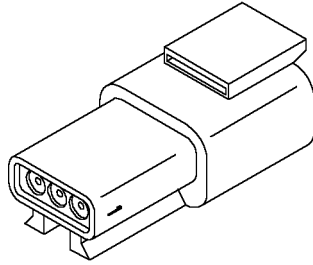
350M

CONNECTOR 386F- 87428138		
GPS RECEIVER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R55	CAN BATT AUTO
2	145F	SW B+
3	420E	CLEAN GND

CONNECTOR 386M - 87428139		
TO GPS RECEIVER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-R62	CAN B+ (IMP)
2	138G	SWITCHED B+
3	179CV	CLEAN GROUND

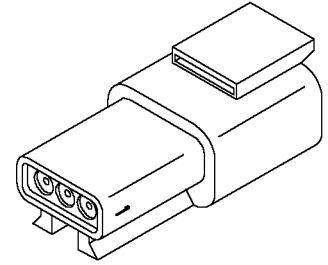
CONNECTOR 387F - 87428139		
CAN SPL61		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R56	CAN BATT (IMP)
2		OPEN
3		OPEN

**387M**  
**87428138**  
PIN HOUSING



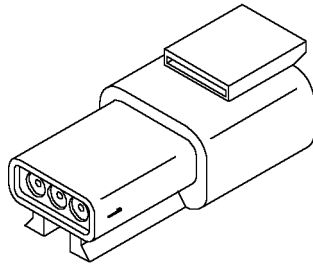
CONNECTOR 387M - 87428138		
CAN SPL56		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-R61	CAN B+ (IMP)
2		OPEN
3		OPEN

**389F**  
**276426A1**  
PIN HOUSING



CONNECTOR 389F - 276426A1		
CAN SPL56		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-Y56	CAN HI (IMP)
2	CAN-BK56	CAN GND (IMP)
3	CAN-DG56	CAN LO (IMP)

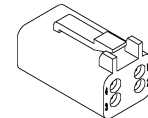
**388M**  
**276426A1**  
PIN HOUSING



CONNECTOR 388M - 276426A1		
CAN SPL62		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		CAN HI (IMP)
2		CAN GND (IMP)
3		CAN LO (IMP)

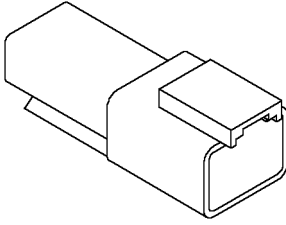
CONNECTOR 389M - 276424A1		
CAN SPL61		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN-Y61	CAN HI (IMP)
2	CAN-BK61	CAN GND (IMP)
3	CAN-DG61	CAN LO (IMP)

**390M**  
**239451A1**  
PIN HOUSING

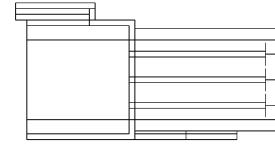
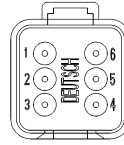


CONNECTOR 390M - 239451A1		
TO STEERING SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	411E	LH STEER VALVE LOW
2	419F	L COIL HIGH
3	410E	RH STEER VALVE LOW
4	419G	R COIL HIGH

**391F**  
**225315C1**



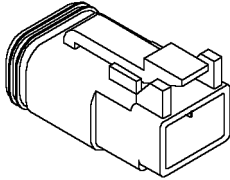
**395F**  
**225350C1**



CONNECTOR 391F -225315C1		
TO CDB-SPL51		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CAN R51	CDB AUTO B+
2	CAN-B51	CDB AUTO GND

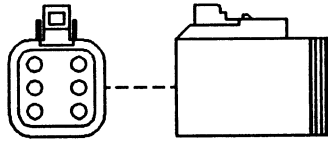
CONNECTOR 395F -225350C1		
ALT/COMP HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	835B	A/C CLUTCH B+
2	810B	A/C HI PRESSURE SW GND
3	802B	A/C PRESS SW IN
4	179DB	A/C COMP CLUTCH GND
5	121B	ALT EXCITE B+
6	216C	ALT FREQ (W)

**391M**  
**225316C1**



CONNECTOR 391M -225316C1		
TO CDB-SPL51		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	345R	SW B+
2	179CR	CLEAN GND

395M  
225351C1



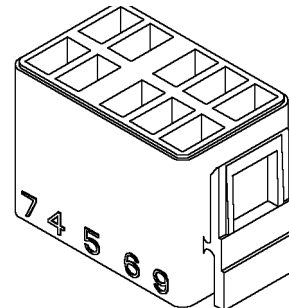
CONNECTOR 395M -225351C1		
ALT/COMP HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	835C	CLUTCH B+
2	179CL	HI PRESSURE SW GND
3	802D	HI PRESS
4	179CK	A/C COMP GND
5	121E	ALT EXCITE (D+)
6	126Y	ALT FREQ (W)

CONNECTOR 396M -280451A1		
LT FENDER EHR/PTO SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	599W	B+
2		PTO SW OUT (NC)
3		PTO SW OUT (NO)
4	957A	EHR EXTEND
5	958A	EHR RETRACT
6		OPEN

CONNECTOR 397F -280453A1		
TO RT REMOTE EHR SW		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	599V	B+
2		OPEN
3		OPEN
4		OPEN
5	957B	REMOTE EHR NO
6	958B	REMOTE EHR NC

CONNECTOR 397M -280451A1		
TO AUX HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	599AC	REMOTE EHR B+
2		OPEN
3		OPEN
4		OPEN
5	397D	REMOTE EHR NO (EXTEND)
6	958D	REMOTE EHR NC (RETRACT)

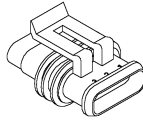
398M  
87426882



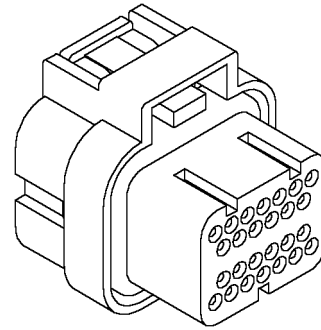
CONNECTOR 398M - 87426882		
DEFOG SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	177AC	GROUND
2	963A	DEFOG B+
3	177AD	LED GND
4	962A	LED B+



**399F**  
**291719A1**



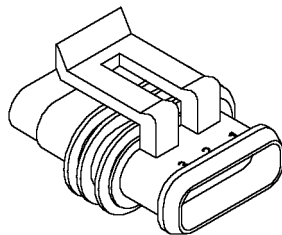
**403M**  
**87410948**



CONNECTOR 399F - 291719A1		
LT REMOTE LINK SW		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	399F	REMOTE EHR NO
2	397E	B+
3	958E	REMOTE EHR NC

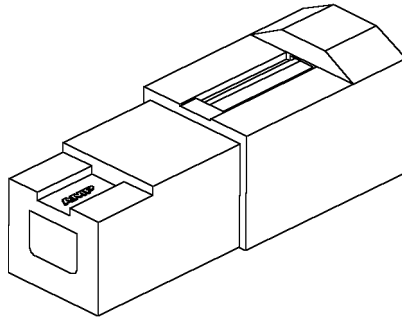
CONNECTOR 403M -87410948		
TO SWCD		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-Y51	CAN IMP HI
2	CDB-DG51	CAN IMP LO
3	966A	ROTARY SIGNAL 1
4	967A	ROTARY SIGNAL 2'
5	CDB-Y52	CAN TR HI
6	CDB-DG52	CAN TR LO
7	OPEN	OPEN
8	OPEN	OPEN
13	972B	UNSWITCHED B+
14	179DK	GROUND
15	968A	SWITCHED B+
16	OPEN	OPEN
17	968A	HOME SWITCH
18	969A	ESCAPE SWITCH
19	970C	ENTER SWITCH
20	971E	+5V SUPPLY OUT
21	990 A	USB POWER 5V
22	988A	USB +
23	989A	USB -
24	987A	USB GROUND

**401M**  
**291719A1**

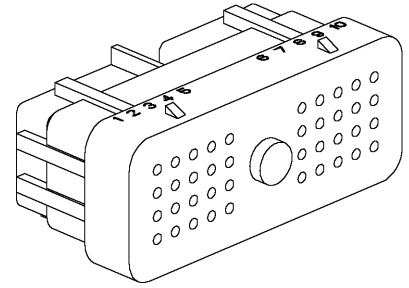


CONNECTOR 401M -291719A1		
RT REMOTE LINK SW		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	397D	REMOTE EHR NO
2	599AC	B+
3	958D	REMOTE EHR NC

**405F**  
**8745344**

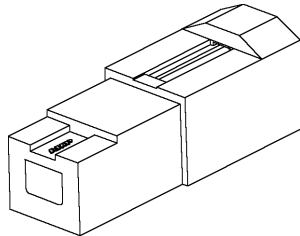


**407M**  
**198459A1**



CONNECTOR 405F- 8745344		
HOME SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	968A	SWCD HOME
2	179DF	SWCD HOME GROUND

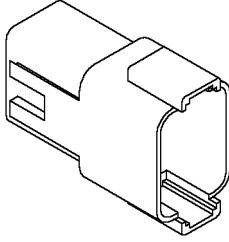
**406F**  
**87454342**



CONNECTOR 406F- 87454342		
ESCAPE SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	969A	SWCD ESCAPE
2	179DE	SWCD ESCAPE GROUND

CONNECTOR 407M- 198459A1		
AUTOGUIDANCE CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	179CP	CLEAN GROUND
2	413A	RS232 RX
3	CAN-Y51	CAN HI (AUTO)
6	986A	AUTO MAN
9	423B	POWER GND
10	419A	S. V. RT SOURCE
11	345D	SWB+
12	414A	RS232 GND
13	CAN-DG51	CAN LO (AUTO)
16	415A	WHEEL SPEED
18	417B	STEER POT SIG (+)
19	416A	PRESS SEN
20	982A	S.V. LT SOURCE
21	421A	PPS IN
26	522D	REVERSE
28	423A	STEER ANGLE GND +
29	984A	PRESS TRAN +5V
30	410A	S. V. RT LOW
31	412A	RS232 TX
35	303E	OPS PRESENT SW
38	418A	+5VDC REF
39	983A	PRESS TRAN GND
40	411A	S. V. LT LOW

**408F**  
**280458A1**



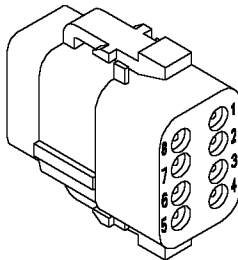
**409F**  
**182068A1**



CONNECTOR 408F- 280458A1		
TO CAB HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-Y57	CAN HI (TR)
2	CDB-DG57	CAN LO (TR)
3	345E	TR SW B+
4	420J	CHASSIS GROUND
5	415A	WHEEL SPEED
6	522D	REVERSE
7	179CX	CLEAN GROUND
8		OPEN

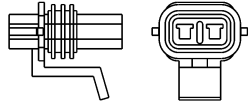
CONNECTOR 409F - 182068A1		
TO ENGINE HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	722C	HORN B+
B	723C	HORN GROUND

**408M**  
**280456A1**



CONNECTOR 408M- 280456A1		
TO INSIDE AUTOGUIDANCE HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	CDB-Y	CAN HI (TR)
2	CDB-DG	CAN LO (TR)
3	971D	TRACTOR SW B+
4	177BE	CHASSIS GROUND
5	215F	WHEEL SPEED
6	552H	REVERSE
7	177BB	CLEAN GROUND
8		OPEN

409M  
182069A1



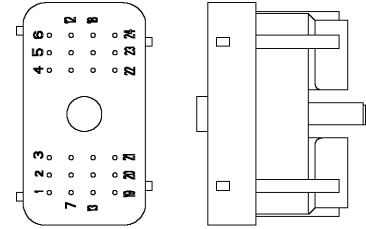
CONNECTOR 409M - 182069A1		
TO ENGINE HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	722D	HORN B+
B	723D	HORN GROUND

CONNECTOR 410M- AMP_174922-2		
SWCD ROTARY SWITCH		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	970C	SWCD ENTER
2	179DJ	SWCD ENTER GROUND
3	179DH	SWCD GROUND
4	PLUG	OPEN

CONNECTOR 412A- AMP_41274-0		
HORN GROUND		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	722C	HORN GROUND

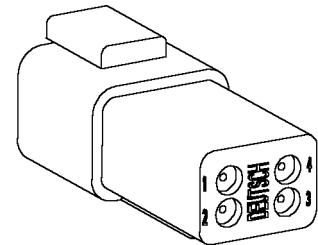
CONNECTOR 412B- AMP_41274-0		
HORN B+		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	723C	HORN B+

413M  
244615A1



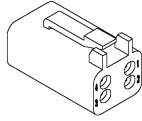
CONNECTOR 413M- 244615A1		
AUTOGUIDANCE CONTROLLER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	424B	RDL GROUND
2	412F	RS232TX
5	CDB-Y58	CAN HI (TR)
7	754E	RDL POWER
8	413F	RS232 RX
11	CDB-DG58	CAN LO (TR)
14	414F	RS232 GROUND

414A  
225326C1



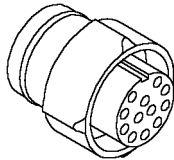
CONNECTOR 414A - 225326C1		
SIDE WIPER MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		SIDE WIPER HIGH
2	WIPER	SIDE WIPER LOW
3	WIPER	SIDE WIPER PARK
4	WIPER	SIDE WIPER BRAKE

**414B**  
**239451A1**



CONNECTOR 414B - 239451A1		
SIDE WIPER MOTOR		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	177R	OPEN
2	971C	SIDE WIPER LOW
3	973A	SIDE WIPER PARK
4	972A	SIDE WIPER BRAKE

**415M**  
**87431893**



CONNECTOR 415M - 87431893		
TO REMOTE DATA LOGGER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
2	413D	RS232 RX
3	412D	RS232 TX
5	414D	RS232 GROUND
10	754D	RDL POWER
11	755E	RDL GROUND

CONNECTOR 419A - LCOM_SP24431		
TO USB HARNESS		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1		SIDE WIPER HIGH
2	WIPER	SIDE WIPER LOW
3	WIPER	SIDE WIPER PARK
4	WIPER	SIDE WIPER BRAKE

**CONNECTOR 430M - PACKARD-12059183**

**LEFT SIDE LIGHT**

CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	738B	B+
B	170D	GROUND

**CONNECTOR 431M - PACKARD-12059183**

**CENTER LIGHT**

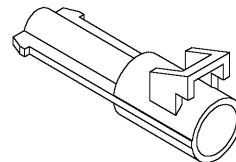
CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	738C	B+
B	170F	GROUND

**CONNECTOR 432M - PACKARD-12059183**

**RIGHT SIDE LIGHT**

CAV	WIRE NUMBER	CIRCUIT REFERENCE
A	738D	B+
B	170H	GROUND

**450F**  
**182064A1**

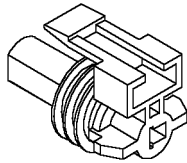


**CONNECTOR 450F - 182064A1**

**FUEL SHUT OFF SOLENOID**

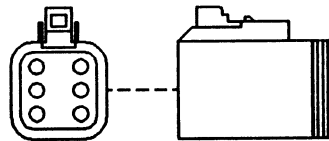
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	456A	FUEL SHUTOFF SOLENOID

**450M  
182066A1**



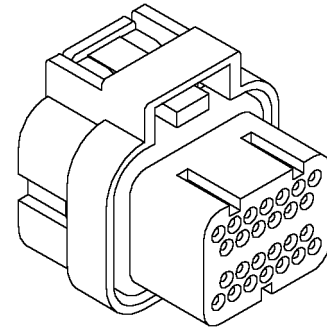
CONNECTOR 450M - 182066A1		
FUEL SHUT OFF SOLENOID		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	456B	FUEL SHUTOFF SOLENOID

**500M  
225351C1**



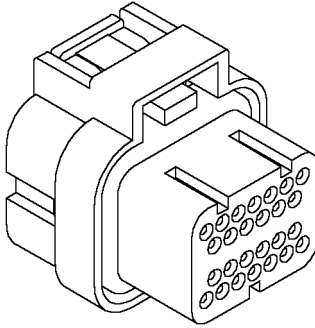
CONNECTOR 500M -225351C1		
TO STEERING POT		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	418F	+5V REF SP (1)
2	420G	CLEAN GND (1)
3	417E	STEER POT SIG (1)
4	422F	STEER POT SIG (2)
5	420F	CLEAN GND (2)
6	418H	+5V REF SP (2)

**CN1  
87410948**



CONNECTOR CN1 -87410948		
INSTRUMENT CLUSTER		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	262A	RADAR PRESENT
2	303A	SEAT SWITCH
3	724A	HIGH BEAM
5	727A	LIGHT SWITCH
7	547A	CRUISE ON/OFF
8	358A	CRUISE INCREMENT
10	267D	HYD FILTER REST
11	566A	PNEUMATIC IND.
12	215E	TRANS SPEED
13	199A	RADAR SPEED
14	CAN-DG24	CAN LO (TR)
15	CAN-Y24	CAN HI (TR)
19	216A	ALTERNATOR SPEED
20	453A	ENGINE COOLANT TEMP (EN)
21	454A	ENGINE AIR INTAKE (EM)
22	236A	FUEL LEVEL
23	455A	ENG OIL PRESSURE (EM)
24	264A	TRANS OIL TEMP
26	623B	IGNITION START B+

**CN2**  
**87410949**



<b>CONNECTOR CN2 -87410949</b>		
<b>INSTRUMENT CLUSTER</b>		
CAV	WIRE NUMBER	CIRCUIT REFERENCE
1	121A	ALT EXCITATION
2	203A	KEYED B+
3	202A	UNKEYED B+
4	183B	CLEAN GND
5	808C	BLOWER MOTOR CONTROL
6	731A	EGRESS LIGHTING CONTROL
8	450A	ENG OIL PRESS (EM TRACTORS)
10	181K	SENSOR GROUND
13	452A	FUEL RELAY SOL (EM)
14	655	BUZZER GROUND
19	489A	CRUISE DECREMENT
20	656A	BUZZER SIGNAL
21	234A	FUEL LEVEL SUPPLY
23	267A	TRANS FILTER
24	285A	TRAILED IMP UP SW
26	266A	AIR FILTER

## **ELECTRICAL SYSTEMS SCHEMATICS AND DIAGNOSTICS**

### **Power Distribution System Circuit Operation**

Power distribution consists of the following:

1. Unswitched battery power. Unswitched power is available at all times. The battery positive terminal is connected to the unswitched power bus from which all unswitched power circuits are energized.

Power is available to all of the following fuses 7, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 32, 42, and 53 regardless of the ignition switch position. If equipped with an GPS harness, fuses 327 and 328 also see unswitched power. These fuses are contained in a fuse holder that is part of the GPS harness.

2. Switched battery power. This power is supplied to the system when the ignition system is ON. This switching is controlled by relay.

When the ignition is switched ON the cab power relay is energized, supplying battery power to the switched power bus which in turn supplies power to fuses 1, 2, 3, 4, 5, 6, 9, 12, 22, 23, 24, 25, 26, 27, 29, 30, 31, 34, 35, 37, 39, 41, 43, 44, 45, 46, 47, 48, 49, 50 and 52. Additionally the controller relay is energized and power is distributed to fuses 33, 36, 38, 40, 43 and 44.

The front wiper/wash circuit is also supplied with switched power through circuit breaker 51.

### **Power Distribution Circuit Troubleshooting**

Before troubleshooting the power distribution system make sure that the following operating conditions are met:

1. The batteries are fully charged and all connections are clean and tight.
2. Transmission in neutral or park.
3. Check all connectors for full installation, loose, corroded or pushed out terminals.
4. Determine if the power source being investigated is switched or unswitched.
5. If the power source problem is a switched power source, the relay controlling the circuit needs to be determined and tested.

### **Power Distribution Schematic**

See Electrical Schematic 87389710.



## POWER DISTRIBUTION SYMPTOM CHART

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
No power at one fuse.	Power supply to fuse	Go to fuse/circuit chart to determine power supply circuit.
No power at switched fuses 1, 2, 3, 4, 5, 6, 9, 12, 20, 22, 23, 24, 25, 26, 29, 31, 37, 39, 41, 43, 44, 45, 46, 47, 48, 49 or 52.	Cab power relay	Go to cab power relay test.
No power at switched fuses 30, 33, 34, 35, 36, 38, 39, 40 and 43.	Controller relay	Go to controller relay test.
	Cab power relay	Go to cab power relay test.

## Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Cab Power Relay Test

	Test Point	Good Reading	Possible Cause of Bad Reading
1	Check for 12 volts at cab power relay terminal 240.	12 volts If good reading, continue with next step.	Open circuit 101A(R).
2	Ignition ON. Check for 12 volts at cab power relay terminal 239.	12 volts If good reading, continue with next step.	Open 105A(R), diode 266, or 104A(R) circuit between ignition switch connector 161 terminal 5 and cab power relay terminal 239, or 12 volts not available from terminal 5 of ignition switch connector 161. Refer to ignition switch test.
3	Check for chassis ground at cab power relay terminal 279.	Less than 1 ohm resistance. If good reading continue with next step.	Open 177J(B) circuit from cab power relay terminal 279 to ground.
4	Check for 12 volts at cab power relay terminal 138.	12 volts If good reading, cab power relay is operating properly.	Faulty cab power relay.

**B - Controller Relay Test**

	<b>Test Point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b>	Unplug the Controller relay from the relay base. Ignition switch in Run. Check for 12 volts at controller relay base terminal A3.	12 volts If good reading, continue with next step.	Open circuit 163B(R) between controller relay terminal A3 and switched power bus.
<b>2</b>	Ignition switch in Run or Acc. Check for 12 volts at controller relay base terminal A2.	12 volts If good reading, continue with next step.	Open 106C(R) circuit between ignition switch connector 161 terminal 6 and controller relay terminal A2. 12 volts not available from terminal 6 of ignition switch connector 161. Refer to ignition switch test.
<b>3</b>	Check for chassis ground at relay terminal A1.	Less than 1 ohm resistance between controller relay terminal A1 and chassis ground.	Open 171B circuit from controller relay terminal A1 to ground.

**NOTE:** *If all three checks are good, replace relay.*

## AUDIO SYSTEM

### Audio System Circuit Operation

The audio system is a four speaker AM/FM stereo with cassette. The audio system is energized by switched power. The audio system display is linked to the instrument panel light so that it dims when the instrument panel lights are dimmed.

### Audio System Circuit Troubleshooting

Before troubleshooting the Audio system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Transmission in neutral or park.
- C. Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.
- D. Check fuses #19, 24
- E. Refer to NAO Electrical Schematic 87389710, schematic sections 62 & 63.

### Audio System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
<b>Audio unit is inoperative</b>	Fuse/Power Supply	A - Audio System Power and Ground Supply Test
	Audio Unit	If A - Audio System Power and Ground Supply Test results are good, Audio unit is bad.
<b>Blank display, radio/tape player operates</b>	Audio unit	
<b>Audio operates, tape player does not operate</b>	Audio unit	
<b>Audio unit illumination inoperative</b>	Illumination circuit	F - Audio System Illumination Test
	Audio unit	If F - Audio System Illumination Test results are good, Audio unit is bad.
<b>Noisy reception</b>	Antenna	G - Antenna Test
	Audio Unit	If G - Antenna Test is good, audio unit is bad.

Symptom	Possible Cause	Reference/Test
<b>Noisy reception, FM only</b>	Antenna	G - Antenna Test
	Audio unit	If G - Antenna Test is good, audio unit is bad.
	Poor reception area	
<b>Poor quality/distorted sound - one or more speakers</b>	Audio speaker	H - Speaker Resistance Test Substitute known good speaker(s).
	Circuit	Perform relevant speaker circuit test(s).
	Audio unit	If speaker(s) and circuit(s) are good, audio unit is bad.
<b>Poor quality/distorted sound from all speakers</b>	Audio speakers	H - Speaker Resistance Test Substitute known good speaker(s).
	Circuit	Perform relevant speaker circuit test(s).
	Audio unit	If speaker(s) and circuit(s) are good, audio unit is bad.
<b>No sound from speakers</b>	Speakers	H - Speaker Resistance Test Substitute known good speaker(s).
	Circuit	Perform relevant speaker circuit test(s).
	Audio unit	If speaker(s) and circuit(s) are good, audio unit is bad.

## Audio System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Audio System Power and Ground Supply Test

Test Point	Good Reading	Possible Cause of Bad Reading
1 Measure resistance between radio connector 95A, terminal 8 and ground.	Less than 1 ohm If good reading, go to test point 3.	Open 178M(B) or 178C(B) circuit.  Continue with next test point.
2 Measure resistance between connector 95A, terminal 8 and connector 13M, terminal U.	Less than 1 ohm If good reading, repair open in 178C(B) circuit to ground.	Open 178M(B) circuit from connector 95A to connector 13M. Repair open.
3 Measure voltage at radio connector 95A, terminal 7.	12 volts If good reading, go to test point 5.	Blown fuse #19, or Open 871A(R) or 871B(R) circuit from connector 95A, terminal 7 to unswitched B+. Check fuse. Continue with next test point.
4 Will the dome light illuminate?	Yes. Fuse 19 and connector 13 are okay. Locate the open in 871B (R)	Continue with next test point.
5 Ignition switch in Run position. Measure voltage at radio connector 95A, cavity 4.	12 volts If good reading, power and grounds to audio system are operating properly.	Open 870 circuit between radio connector 95A, terminal 4 and switched B+. Continue with next test point.
6 Measure voltage at connector 13F, terminal W.	12 volts If good reading, repair open in 870C(R) circuit.	Open 870D(R) circuit between connector 95A, terminal 4 and switched B+. Continue with next test point.
7 Measure voltage at fuse 24	12 volts If good reading, repair open in 870D(O).	Open in jump wire 106B(O) to ignition.

### B - Left Front Speaker Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Disconnect connector 95B from the radio, and connector 97F from the left front speaker. Measure resistance between radio connector 95B, terminal 13 and left front speaker connector 97F, terminal A.	Less than 1 ohm  If good reading, go to test point 2.	Open/short to ground in circuit 873B(O) between connectors 95B and 97F.  Continue with next test point.
2 Measure resistance between speaker connector 97F, terminal B and radio connector 95B, terminal 14.	Less than 1 ohm  If good reading, left front speaker wiring is okay.	Open/short to ground in circuit 873A(B) between connectors 95B and 97F(B).

### C - Right Front Speaker Circuit

Test point	Good Reading	Possible Cause of Bad Reading
1 Disconnect connector 95B from the radio, and connector 96F from the right front speaker. Measure resistance between radio connector 95B, terminal 11 and right front speaker connector 96F, terminal A.	Less than 1 ohm  If good reading, go to test point 2.	Open/short to ground in circuit 872B(O) between connectors 95B and 96F.
3 Measure resistance between speaker connector 96F, terminal B and radio connector 95B, terminal 12.	Less than 1 ohm If good reading, right front speaker wiring is okay.	Open/short to ground in circuit 872A(B) between connectors 95B and 96F.

### D - Right Rear Speaker Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Disconnect connector 95B from the radio, and connector 92F from the right rear speaker. Measure resistance between radio connector 95B, terminal 9 and left front speaker connector 92F, terminal A.	Less than 1 ohm  If good reading, go to test point 2.	Open/short to ground in circuit 874B(O) between connectors 95B and 92F.  Continue with next test point.

### D - Right Rear Speaker Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
2 Measure resistance between speaker connector 92F, terminal B and radio connector 95B, terminal 10.	Less than 1 ohm  If good reading, right rear speaker wiring is okay.	Open/short to ground in circuit 874A(B) between connectors 95B and 92F(B).

### E - Left Rear Speaker Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Disconnect connector 95B from the radio, and connector 93F from the left rear speaker.  Measure resistance between radio connector 95B, terminal 15 and left rear speaker connector 93F, terminal A.	Less than 1 ohm  If good reading, go to test point 2.	Open/short to ground in circuit 875B(O) between connectors 95B and 93F.  Continue with next test point.
2 Measure resistance between speaker connector 97F, terminal B and radio connector 95B, terminal 16.	Less than 1 ohm  If good reading, left front speaker wiring is okay.	Open/short to ground in circuit 875A(B) between connectors 95B and 93F(B).

### F - Audio System Illumination Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Access connector 95A. Attach test light to ground and probe cavity 6. Turn head lamps on and off.	Test lamp will glow full bright with headlights off, and glow dimly with headlights on.  If good reading audio system illumination circuits operating properly.	Check for loose, damaged, pushed out, corroded, or bent terminals, or  Open in dimmer circuit from connector 95A terminal 6 to instrument cluster.

### G - Antenna Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Disconnect antenna from radio.  Measure resistance between center terminal of antenna (radio end) and antenna mast.	Less than 1 ohm  If good reading, go to next test point.	Antenna.



### G - Antenna Test

	Test point	Good Reading	Possible Cause of Bad Reading
2	Measure resistance from antenna ground wire to chassis ground.	Less than 1 ohm Antenna is good.	Open circuit between antenna and frame ground.

### H - Speaker Resistance Test

	Test point	Good Reading	Possible Cause of Bad Reading
1	Disconnect suspect speaker electrical connector.  Measure resistance between the A and B terminals of the speaker.	Between 4 and 8 ohms  If good reading, speaker good electrically.	Bad circuit in speaker.

## CHARGING SYSTEM

### Charging System Circuit Operation

The alternator B+ terminal is connected to the battery via terminal 81F on the starter motor.

The alternator is grounded by its mounting frame.

Terminal 86 (D+) of the alternator receives field excitation voltage from connector CN2, terminal 1 of the Instrument cluster (ICU2). Charging system output is controlled by an integral voltage regulator/brush assembly. The regulator is set to 14.2 volt regulation. The alternator is temperature compensated so that output will drop as the alternator warms up.

If alternator output goes below or above specification, the reconfigurable display will show an ISO symbol for the charging system and a message of "High or Low." Additionally a short audible alarm will sound.

Terminal 85 sends a pulsed rpm signal to connector CN1, terminal 19 of the instrument cluster (ICU2). The ICU2 uses this signal to determine engine rpm.

### Charging System Circuit Troubleshooting

Before troubleshooting the starting system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Transmission in neutral or park.
- C. Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.
- D. Refer to Electrical Schematic sections 19 and 20.

## Charging System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
<b>System not charging or charging poorly. Battery goes dead.</b>	Alternator belt	See engine repair section of Service Manual to replace or adjust belt.
	B+ circuit	A - Charging System Output Test, test points 2-4.
	D+ circuit	B - Excitation Circuit (D+) Test.
	Excitation control	D - Instrument Cluster (ICU) Excitation Control Test.
	Alternator	A - Charging System Output Test, test points 4-6.
<b>System overcharging</b>	D+ circuit	Check for short to power in Excitation Circuit (D+).
	Excitation Control	D - Instrument Cluster (ICU) Excitation Control Test.
<b>High or Low message and symbol in reconfigurable display</b>	Alternator belt	See Engine Repair section of Service Manual to replace or adjust belt.
	B+ circuit	A - Charging System Output Test, test points 2-4.
	D+ circuit	B - Excitation Circuit (D+) Test.
	Excitation control	D - Instrument Cluster (ICU) Excitation Control Test.
	Alternator	A - Charging System Output Test.

## Charging System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Charging System Output Test

Test Point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Place transmission in PARK. Start engine and set at 1000 rpm. Measure voltage at battery.	12.8-14.5 volts If good reading, charging system is operating properly.	High resistance between battery and B+ terminal at alternator.  Go to next test point.
<b>2</b> Place negative lead of DVOM to battery positive terminal and positive lead to starter terminal 81A. Read voltage.	Less than 0.4 volts  If good reading, circuit is good. Go to next test point.	High resistance between battery and starter terminal 81A. Repair/replace wiring as needed.
<b>3</b> Attach negative lead of DVOM to starter terminal 81A and positive lead to starter terminal 81F. Read voltage.	Less than 0.4 volts  If good reading, circuit is good. Go to next test point.	High resistance in starter solenoid. Clean connections, repair/replace as needed.
<b>4</b> Attach positive lead of DVOM to B+ terminal of alternator and negative lead to terminal 81F of starter. Read voltage.	Less than 0.4 volts  If good reading, go to next test point.	High resistance in circuit 120A(R). Repair/replace wiring as needed.
<b>5</b> Measure voltage at alternator terminal 86 (D+) while turning various load on and off (lights, heater fans etc.)	Voltage varies between 12.8 and 14.5 volts in response to load applied. If good reading go to next test point.	121E(Y) circuit between alternator (D+) and instrument cluster connector 61, terminal 1, or Excitation circuit, Perform B - Excitation Circuit (D+) Test, or Voltage regulator
<b>6</b> Measure resistance between alternator housing and chassis ground.	Less than 1 ohm If good reading, charging system is operating properly.	High resistance from alternator to chassis ground. Clean surfaces between alternator and frame. Ensure that all mountings are clean and tight.

## B - Excitation Circuit (D+) Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition in Off position. Disconnect wiring from alternator connector 86 (D+) and instrument cluster connector 61. Measure resistance between connector 86 and connector 61 terminal 1.	Less than 1 ohm  If good reading, excitation circuit wiring is okay.	Open 121E(Y) circuit between alternator and instrument cluster.  Continue with next test point.
<b>2</b> Measure resistance between alternator connector 86 and in-line connector 395M, terminal 5.	Less than 1 ohm  If good reading, go to next test point.	Open 121E(Y) circuit between connector 86 and connector 395.
<b>3</b> Measure resistance between in-line connector 395 terminal 5, and in-line connector 60M terminal 10.	Less than 1 ohm  If good reading, go to next test point.	Open 121B(Y) circuit between connector 395 and connector 60.
<b>4</b> Measure resistance between in-line connector 60M, terminal 10, and instrument cluster connector CN1, terminal 1.	Less than 1 ohm  If good reading, check all connectors for full installation, loose, corroded, pushed out, or bent terminals.	Open 121A(Y) circuit between connector 60 and connector CN1.

### C - RPM Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition in Off position. Disconnect alternator connector 85 and instrument cluster connector 61. Measure resistance between alternator connector 85 and instrument cluster connector CN1, terminal 19.	Less than 1 ohm  If good reading, alternator rpm circuit wiring okay.	Open circuit in alternator rpm circuit.  Check all connectors for full installation, loose corroded, pushed out, or bent terminals.  Continue with next test point.
<b>2</b> Measure resistance between alternator connector 85 and in-line connector 395M terminal 6.	Less than 1 ohm  If good reading, go to next test point.	Open 126Y(DG) circuit between connector 85 and connector 395.
<b>3</b> Measure resistance between in-line connector 395F, terminal 6 and splice F6.	Less than 1 ohm  If good reading, go to next test point.	Open 216C(Y) circuit between connector 395 and splice F6.
<b>4</b> Measure resistance between splice F6 and in-line connector 60M, terminal 12.	Less than 1 ohm  If good reading, go to next test point.	Open 216B(Y) circuit between splice F6 and connector 60.
<b>5</b> Measure resistance between in-line connector 60, terminal 12 and Instrument Cluster (ICU2) connector CN1, terminal 19.	Less than 1 ohm  If good reading, alternator rpm circuit wiring okay.	Open 216A(Y) circuit between connector 60 and connector CN1.  Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.

## D - Instrumentation Cluster (ICU) Excitation Control Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Place transmission in PARK. Start engine and set at 1000 rpm. Backprobing at Instrumentation Cluster (ICU2) connector CN2 terminal 1 and measure voltage. Turn on various loads (lights, heaters, etc.)	Voltage varies between 12.8 and 14.5 volts in response to load applied.  If good reading, excitation control circuit is operating properly.	Instrument Cluster (ICU2).

## EXTERIOR LIGHTING SYSTEM

### Exterior Lighting System Circuit Operation

Exterior lighting consists of the following:

- Headlights (high beam, low beam and center)
- Turn signals front and rear
- Tail lights
- Left and right marker lights
- Cab fender work lamps
- Cab front roof work lamps
- High intensity discharge lamp (optional)
- Cab rear fender work lamps (optional)
- Cab beltline work lamps (optional)
- Cab rear roof work lamps (optional)

The various lamps are controlled by switches and operated via relays as follows:

- Head lamps use unswitched power and are usable whether the ignition is On or Off.
- The road lights/flashers (Headlight) switch has three positions, Off, On and Headlights.
- When the headlight switch is in the On or Headlight position the left and right tail fender lights, roof warning lights and the left and right marker lights are On.
- The work lamp (Rotary) switch controls the optional beltline work lamps, center and optional fender work lamps, center and side work lamps, rear work lights and front roof work lamp and high beams.
- The rotary switch controlled lamps are locked out when the headlight switch is On.

### Exterior Lighting System Circuit Troubleshooting

Before troubleshooting the Exterior Lighting system make sure that the following operating conditions are met:

- The batteries are fully charged and all connections are clean and tight.
- Transmission in neutral or park.
- Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.

- Fuses 3, 4, 5, 6, 18, 20, 22, 23, 53, and 54 are intact and have power.
- If one of the work lamp circuits is not working, try swapping a relay from a working system for a quick and easy relay check. Otherwise, follow the circuit diagnostic tests to determine the fault.
- If a bulb is not working, substitute with a known good bulb to verify circuit operation.

**NOTE:** Refer to *Electrical Schematic sections 24 through 35.*



## Exterior Lighting System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

## Exterior Lighting System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) or an unpowered test light for these tests.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### Work Lamp Switch Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition in Run position. Headlight switch Off. Rotary switch Off. Measure voltage at rotary switch terminal B1.	12 volts If good reading, go to test point 4.	Open circuit from switched B+. Go to next test point.
<b>2</b> Measure voltage at rotary switch connector 12 terminal B2.	12 volts If good reading, repair open in 789.	Open circuit from switched B+. Go to next test point.
<b>3</b> Measure voltage at work lamp interlock relay (relay #4) terminal 4.	12 volts If good reading, repair open in 789.	Open circuit from switched B+.
<b>4</b> Rotary switch in second position. Measure voltage at rotary switch connector 12, terminal W.	12 volts If good reading, go to next test point.	Rotary switch
<b>5</b> Rotary switch in third position. Measure voltage at rotary switch connector 12, terminal W.	12 volts If good reading, go to next test point.	Rotary switch

**Work Lamp Switch Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>6</b> Measure voltage at rotary switch connector 12, terminal HL.	12 volts If good reading, go to next test point.	Rotary switch
<b>7</b> Rotary switch in fourth position. Measure voltage at rotary switch connector 12, terminal W.	12 volts If good reading, go to next test point.	Rotary switch
<b>8</b> Measure voltage at rotary switch connector 12, terminal HL.	12 volts If good reading, go to next test point.	Rotary switch
<b>9</b> Measure voltage at rotary switch connector 12, terminal R.	12 volts If good reading, rotary switch is operating properly.	Rotary switch

**Electronic Flasher Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Measure voltage at electronic flasher connector 135 terminal 8.	12 volts If good reading, go to test point 3.	Open in unswitched B+ supply circuit. Go to next test point.
<b>2</b> Measure voltage at fuse #20.	12 volts If good reading, repair open in 766(R) circuit.	Fuse #20, or Open in 766 circuit from unswitched B+.
<b>3</b> Measure resistance from electronic flasher connector 135 terminal 6 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from connector 135 terminal 6 to ground.
<b>4</b> Headlight switch in any position (except Off). Measure voltage at electronic flasher connector 135 terminal 3.	12 volts If good reading, go to next test point.	Open in 707(K) circuit.

## Electronic Flasher Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>5</b> Headlight switch Off. Universal switch in left turn position. Measure voltage at electronic flasher connector 135 terminal 5.	12 volts If good reading, go to test point 10.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>6</b> Measure voltage at in-line connector 9 terminal 2.	12 volts If good reading, repair open in 768A circuit.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>7</b> Measure voltage at universal switch terminal 220B.	12 volts If good reading, repair open in 21(A) circuit.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>8</b> Measure voltage at universal switch terminal 220A.	12 volts If good reading, replace universal switch.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>9</b> Measure voltage at in-line connector 9 terminal 1.	12 volts If good reading, repair open in 20(B) circuit.	Open in 769A(R) circuit from in-line connector 9 terminal 1 to electronic flasher connector 136 terminal 3.
<b>10</b> Headlight switch Off. Universal switch in right turn position. Measure voltage at electronic flasher connector 135 terminal 4.	12 volts If good reading, go to test point 15.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>11</b> Measure voltage at in-line connector 9 terminal 3.	12 volts If good reading, repair open in 767A circuit.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>12</b> Measure voltage at universal switch terminal 220C.	12 volts If good reading, repair open in 22A circuit.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>13</b> Measure voltage at universal switch terminal 220A.	12 volts If good reading, replace universal switch.	Open circuit between electronic flasher and universal switch. Go to next test point.
<b>14</b> Measure voltage at in-line connector 9 terminal 1.	12 volts If good reading, repair open in 20(B) circuit.	Open in 766B circuit from in-line connector 9 terminal 1 to electronic flasher connector 135M terminals 7 or 8.

### Electronic Flasher Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>15</b> Universal switch in right turn position. Backprobe electronic flasher connector 135 terminal 2 with test light.	Test light flashes. If light flashes, go to next test point.	Electronic flasher.
<b>16</b> Universal switch in left turn position. Backprobe electronic flasher connector 135 terminal 1 with test light.	Test light flashes. If light flashes, go to next test point.	Electronic flasher.
<b>17</b> Headlight switch in any position (except Off). Backprobe electronic flasher connector 135 terminals 9, 10 with test light.	Test light flashes. If light flashes, go to next test point.	Electronic flasher.
<b>18</b> Backprobe electronic flasher connector 135, terminals 11, 12 with test light.	Test light flashes. If light flashes, electronic flasher operating properly.	Electronic flasher.

### Universal Switch Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Disconnect electrical connector from universal switch. Place universal switch in left turn position. Measure resistance between terminals 220A and 220B.	Less than 1 ohm. If good reading, go to next test point.	Open circuit in universal switch.
<b>2</b> Place universal switch in right turn position. Measure resistance between terminals 220A and 220 C.	Less than 1 ohm. If good reading, go to next test point.	Open circuit in universal switch.
<b>3</b> Place universal switch in high beam position. Measure resistance between terminals 220D and 220E.	Less than 1 ohm. If good reading, go to next test point.	Open circuit in universal switch.

### Universal Switch Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>4</b> Place universal switch in low beam position. Measure resistance between terminals 220D and 220F.	Less than 1 ohm.  If good reading, go to next test point.	Open circuit in universal switch.
<b>5</b> Place universal switch in head lamp dipping position. Measure resistance between terminals 220E and 220G.	Less than 1 ohm.  If good reading, go to next test point.	Open circuit in universal switch.
<b>6</b> Press horn button. Measure resistance between terminals 220H and 220J.	Less than 1 ohm.  If good reading, universal switch is okay.	Open circuit in universal switch.

## INSTRUMENTATION AND WARNING SYSTEM

### Instrumentation and Warning System Circuit Troubleshooting

Before troubleshooting the instrumentation and warning system make sure that the following operating conditions are met:

1. The batteries are fully charged and all connections are clean and tight.
2. Transmission in neutral or park.
3. Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.
4. Fuses #15, #16 and #37 intact and receiving power.

**NOTE:** Refer to NAO Electrical Schematic 87389710, schematic sections 24, 25, 26, 55 and 56.

### Instrumentation and Warning System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
<b>Coolant temperature gauge does not operate</b>	Sending unit	B - Engine Coolant Temperature Sender Circuit Test
	Instrument cluster	A - Instrumentation and Warning System Power and Ground Supply Test
	Gauge unit	B - Engine Coolant Temperature Sender Circuit Test
	Circuit	B - Engine Coolant Temperature Sender Circuit Test
<b>Oil pressure gauge does not operate</b>	Sending unit	C - Engine Oil Pressure Sender Circuit Test
	Instrument cluster	A - Instrumentation and Warning System Power and Ground Supply Test
	Gauge unit	C - Engine Oil Pressure Sender Circuit Test
	Circuit	C - Engine Oil Pressure Sender Circuit Test
<b>Fuel level gauge does not operate</b>	Sending unit	D - Fuel Sender Circuit Test
	Instrument cluster	A - Instrumentation and Warning System Power and Ground Supply Test
	Gauge unit	D - Fuel Sender Circuit Test
	Circuit	D - Fuel Sender Circuit Test

## Instrumentation and Warning System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Instrumentation and Warning System Power and Ground Supply Test

Test Point	Good Reading	Possible Cause of Bad Reading
1 Measure voltage at instrument cluster connector CN2 terminal 3.	12 volts If good reading, go to test point 4.	Open in unswitched B+ circuit. Go to next test point.
2 Measure voltage at fuse #16.	12 volts If good reading, repair open in 202A(R) circuit.	Fuse #16, or Open in 101A(R) circuit from unswitched B+.
3 Ignition in Run position. Measure voltage at instrument cluster connector CN2 terminal 2.	12 volts If good reading, go to test point 9.	Open in unswitched B+ circuit. Go to next test point.
4 Measure voltage at fuse #37.	12 volts If good reading, repair open in 203A(R) circuit.	Fuse #37, or Open in unswitched B+ circuit. Go to next test point.
5 Measure voltage at splice C20 (Schematic section 21).	12 volts If good reading, repair open in 160 circuit.	Open in unswitched B+ circuit. Go to next test point.
6 Measure voltage at TMF controller relay connector 255F, terminal A5.	12 volts If good reading, repair open in 162B circuit.	Controller Relay.
7 Measure resistance from instrument cluster connector CN2 terminal 4 to ground.	Less than 1 ohm If good reading, Instrumentation and Warning System power and ground supply circuits okay.	Open in circuit from connector CN2 terminal 4 to ground.

**B - Engine Coolant Temperature Sensor Circuit Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Remove electrical connector J1-6 from engine coolant temperature sensor. Check continuity from J1-6 pin A to splice EC1.	If good reading go to next test point.	Open in circuit.
<b>2</b> Check continuity from Splice EC1 to Connector J1 pin 38.	If good reading go to next test point.	Open in circuit from Electronic Engine Controller.
<b>3</b> Check continuity from J1-6 pin B to Connector J1 pin 15.	If good reading and Engine Coolant Temperature sensor does not work, replace Engine Coolant Temperature sensor.	Open in circuit.



### C - Engine Oil Pressure Sensor Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Remove electrical connector J1-8 from engine oil pressure sensor. Check continuity from J1-8 pin 1 to connector J1 pin 17.	If good reading go to next test point.	Open in circuit.
2 Check continuity from J1-8 pin 2 to Splice EC2	If good reading and Oil Pressure Sensor does not work, replace Oil Pressure Sensor.	Open in circuit.

### D - Fuel Sender Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Ignition in Run position. Remove electrical connector 66 from fuel sender. Measure voltage at connector 66 terminal A.	8 volts If good reading, go to test point 4.	Open in 234(R) circuit from instrument cluster. Go to next test point.
2 Measure voltage at in-line connector 60 terminal 8.	8 volts If good reading, repair open in 234B(R) circuit.	Open in 234(R) circuit from instrument cluster. Go to next test point.
3 Measure voltage at instrument cluster connector CN2 terminal 21.	8 volts If good reading, repair open in 234A(R) circuit.	
4 Measure resistance from fuel sender connector 66 terminal C to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from connector 66 terminal C to ground.
5 Remove electrical connector 61 from instrument cluster. Measure resistance from fuel sender connector 66 terminal B to connector CN1 terminal 22.	Less than 1 ohm If good reading, fuel sender circuits are okay. Replace fuel sender.	Open in 234(Y) circuit from instrument cluster. Go to next test point.
6 Measure resistance from in-line connector 60 terminal 13 to instrument cluster connector CN1 terminal 22.	Less than 1 ohm If good reading, repair open in 236B(Y) circuit.	Open in 236A(Y) circuit.

## **INTERIOR LIGHTING AND HORN SYSTEM**

### **Interior Lighting and Horn System Circuit Operation**

Interior lighting consists of a switchable dome light with door switch, a switchable map light, and a console light which operates in conjunction with the Instrument Cluster lighting.

The dome light can be set to either come on when the door opens or it can be switched on with an integral switch. The power source is unswitched, so the dome light can be operated at any time.

The power supply for the horn is switched. When the key is in the ON position the circuit is energized. To operate the horn, ground is provided by pressing the horn button on the universal switch.

### **Interior Lighting and Horn System Circuit Troubleshooting**

Before troubleshooting the Interior Lighting and Horn system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Transmission in neutral or park.
- C. Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.
- D. Fuses 16, 17, 18 and 19 are good.

## Interior Lighting and Horn System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

## Interior Lighting and Horn System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Horn System Circuit Test

Test Point	Good Reading	Possible Cause of Bad Reading
1 Ignition in Run position. Measure voltage at horn connector 412A.	12 volts If good reading, go to test point 7.	Open in unswitched B+ circuit to horn. Go to next test point.
2 Measure voltage at in-line connector 409 terminal A.	12 volts If good reading, repair open in 722D(R) circuit.	Open in unswitched B+ circuit to horn. Go to next test point.
3 Measure voltage at in-line connector 333 terminal 4.	12 volts If good reading, repair open in 722C(R) circuit.	Open in unswitched B+ circuit to horn. Go to next test point.
4 Measure voltage at in-line connector 10 terminal 80.	12 volts If good reading, repair open in 722B(R) circuit.	Open in unswitched B+ circuit to horn. Go to next test point.
5 Measure voltage at fuse #17.	12 volts If good reading, repair open in 722A(R) circuit.	Fuse #17, or Open in unswitched B+ circuit. Go to next test point.
6 Measure voltage at splice fuse 16.	12 volts If good reading, repair open in J9 circuit.	Open in 101B(R) circuit from unswitched B+.

**A - Horn System Circuit Test**

<b>Test Point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>7</b> While pressing horn switch (on universal switch), measure resistance from horn connector 412B to ground.	Less than 1 ohm If good reading, horn power and ground circuits okay. If horn does not work, replace horn.	Open in switched ground circuit from horn. Go to next test point.
<b>8</b> While pressing horn switch, measure resistance from in-line connector 409 terminal B to ground.	Less than 1 ohm If good reading, repair open in 723D(B) circuit.	Open in switched ground circuit from horn. Go to next test point.
<b>9</b> While pressing horn switch, measure resistance from in-line connector 333 terminal 12 to ground.	Less than 1 ohm If good reading, repair open in 723C(B) circuit.	Open in switched ground circuit from horn. Go to next test point.
<b>10</b> While pressing horn switch, measure resistance from in-line connector 60 terminal 16 to ground.	Less than 1 ohm If good reading, repair open in 723B(B) circuit.	Open in switched ground circuit from horn. Go to next test point.
<b>11</b> While pressing horn switch, measure resistance from in-line connector 51 terminal 9 to ground.	Less than 1 ohm If good reading, repair open in 723(A) circuit.	Open in switched ground circuit from horn. Go to next test point.
<b>12</b> While pressing horn switch, measure resistance from universal switch terminal 220H to ground.	Less than 1 ohm If good reading, repair open in 9A(B) circuit.	Open in switched ground circuit from horn. Go to next test point.
<b>13</b> Measure resistance from universal switch terminal 220J to ground.	Less than 1 ohm If good reading, replace universal switch.	Open in circuit from universal switch terminal 220J to ground.

## B - Dome Lamp and Switch Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Measure voltage at dome lamp connector 102.	12 volts If good reading, go to test point 6.	Open in unswitched B+ circuit. Go to next test point.
<b>2</b> Measure voltage at in-line splice between dome lamp connector 102, and in-line connector 13 terminal V.	12 volts If good reading, repair open in 871C(R) circuit.	Open in unswitched B+ circuit. Go to next test point.
<b>3</b> Measure voltage at in-line connector 13 terminal V.	12 volts If good reading, repair open in 871C(R) circuit.	Open in unswitched B+ circuit. Go to next test point.
<b>4</b> Measure voltage at fuse #19.	12 volts If good reading, repair open in 871A(R) circuit.	Open in unswitched B+ circuit. Go to next test point.
<b>5</b> Measure voltage at fuse #18.	12 volts If good reading, repair open in J1(R) circuit.	Open in 101H(R) circuit from unswitched B+.
<b>6</b> Switch dome lamp to door operation. Measure voltage at connector 101 of switch.	12 volts If good reading, go to next test point.	Bulb, or Dome lamp and switch assembly.
<b>7</b> Remove electrical connector 100 from door switch. Measure voltage at connector 100.	12 volts If good reading, go to next test point.	Open in 715A(V) circuit.
<b>8</b> Open door. Measure resistance to ground at terminal of door switch.	Less than 1 ohm If good reading, go to next test point.	Door switch, or Ground connection of door switch.
<b>9</b> Switch dome lamp to On position. Measure resistance from dome lamp and switch connector 103 to ground.	Less than 1 ohm If good reading, dome lamp and switch circuits okay. If dome lamp does not operate properly, replace dome lamp and switch assembly.	Open in circuit from connector 103 to ground.

### C - Map Light Circuit Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Measure voltage at map light connector 170 terminal A.	12 volts If good reading, go to test point 6.	Open in circuit from unswitched B+. Go to next test point.
<b>2</b> Measure voltage at splice SH3.	12 volts If good reading, repair open in 135G(R) circuit.	Open in circuit from unswitched B+. Go to next test point.
<b>3</b> Measure voltage at in-line connector 91 terminal C.	12 volts If good reading, repair open in 135C(R) circuit.	Open in circuit from unswitched B+. Go to next test point.
<b>4</b> Measure voltage at in-line connector 13 terminal X.	12 volts If good reading, repair open in 135B(R) circuit.	Open in circuit from unswitched B+. Go to next test point.
<b>5</b> Measure voltage at fuse #8.	12 volts If good reading, repair open in 135A(R) circuit.	Fuse #8, or Open in 101L(R) circuit from unswitched B+.
<b>6</b> Measure resistance from map light connector 170 terminal C to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from map light connector 170 terminal 3 to ground.
<b>7</b> Remove electrical connector 170 from map light. With map light in On position, check for continuity between terminals A and C of map light assembly.	Continuity If good reading, map light circuits and assembly okay.	Map light bulb, or Map light switch.

## **POWER MIRROR SYSTEM**

### **Power Mirror Circuit Operation**

Switched power is supplied to the power mirror switch from fuse #24. Power is supplied to the mirror switch connector 130.

Chassis ground is supplied to the mirror switch connector 130.

The mirror switch can be set to control either left or right mirrors. This action changes the contacts within the switch in order to operate either the left or the right mirror. Only one mirror can be operated at a time.

There are two motors in each mirror assembly. Power and ground are supplied to the motors through three wires for each mirror assembly, one wire for each motor and one wire in common, therefore the motors can only be operated in one mode at a time; up only, down only, in only, or out only.

Change in mirror motor direction is accomplished by reversing current flow through the motors.

### **Power Mirror Circuit Troubleshooting**

Before troubleshooting the power mirror system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Check fuse #24.
- C. Transmission in neutral or park.
- D. Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.
- E. Refer to Electrical Schematic.

## Power Mirror System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
<b>Mirrors totally inoperable</b>	No power or ground to switch	A - Power Mirror Switch Power and Ground Supply Test
	Mirror Switch	B - Power Mirror Switch Test
	Circuit to mirrors	C - First Circuit Test and D - Second Circuit Test
<b>Left mirror inoperable</b>	Mirror Switch	B - Power Mirror Switch Test, test points 1, 2, 7, 8, 9, 10, 15, 16, 17, and 18.
	Mirror Assembly	F - Left Mirror Assembly Test
	Circuit between switch and mirror	C - First Circuit Test, test points 1 thru 3, and D - Second Circuit Test test points 1 thru 3.
<b>Right mirror inoperable</b>	Mirror Switch	B - Power Mirror Switch Test, test points 1 thru 6, and 11 thru 14.
	Mirror Assembly	E - Right Mirror Assembly Test
	Circuit between switch and mirror	C - First Circuit Test, test points 4 thru 6, and D - Second Circuit Test, test points 4 thru 6.
<b>Right mirror, up/down inoperable</b>	Mirror Switch	B - Power Mirror Switch Test, test points 1, 2, 5, 6, 13 and 14.
	Right Mirror assembly	E - Right Mirror Assembly Test, test points 3, 4, 7, and 8.
	Circuit between switch and mirror	C - First Circuit Test, test points 5 and 6, and D - Second Circuit Test, test points 4 and 5.



<b>Symptom</b>	<b>Possible Cause</b>	<b>Reference/Test</b>
<b>Right mirror, in/out inoperable</b>	Mirror Switch	B - Power Mirror Switch Test, test points 1, 2, 3, 4, 11 and 12.
	Mirror Assembly	E - Right Mirror Assembly Test, test points 1, 2, 5 and 6.
	Circuit between switch and mirror	C - First Circuit Test, test points 5 and 6, and D - Second Circuit Test, test points 4 and 5.
<b>Left mirror, up/down inoperable</b>	Mirror Switch	B - Power Mirror Switch Test, test points 1, 2, 9, 10, 17 and 18.
	Mirror Assembly	F - Left Mirror Assembly Test, test points 3, 4, 7 and 8.
	Open circuit between switch and mirror	C - First Circuit Test, test points 2, 3 and 4, and D - Second Circuit Test, test points 2 and 3.
<b>Left mirror, in/out inoperable</b>	Switch Faulty	B - Power Mirror Switch Test, test points 1, 2, 7, 8, 15 and 16.
	Open circuit between switch and mirror	C - First Circuit Test, test points 1 and 2, and D - Second Circuit Test, test points 1 and 2.
	Mirror Assembly	F - Left Mirror Assembly Test, test points 1, 2, 5 and 6.

## Power Mirror System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Power Mirror Switch Power and Ground Supply Test

Test Point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition in Run position. Measure voltage at power mirror switch connector 130 terminal 9.	12 volts If good reading, go to test point 5.	Open in circuit from switched B+. Go to next test point.
<b>2</b> Measure voltage at splice between power mirror switch connector 130 terminal 9 and in-line connector 13 terminal W.	12 volts If good reading, repair open in 870B(O) circuit.	Open in circuit from switched B+. Go to next test point.
<b>3</b> Measure voltage at fuse #24.	12 volts If good reading, repair open in 870D(O) circuit.	Fuse #24, or Open in circuit from switched B+. Go to next test point.
<b>4</b> Measure resistance from power mirror connector 130 terminal 3 to ground.	Less than 1 ohm If good reading, power mirror switch power and ground supply circuits okay.	Open in circuit from power mirror connector 130 terminal 3 to ground.

## B - Power Mirror Switch Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition in Run position. Measure voltage at power mirror switch connector 130 terminal 9.	12 volts If good reading, go to next test point.	Open in circuit from switched B+. Perform A - Power Mirror Switch Power and Ground Supply Test
<b>2</b> Measure resistance from power mirror switch connector 130 terminal 3 to ground.	Less than 1 ohm If good reading, power mirror switch power and ground supply circuits okay.	Open in circuit from power mirror switch connector 130 terminal 3 to ground.
<b>3</b> Set mirror selector to Right mirror. Hold mirror switch in IN position. Measure voltage at power mirror switch connector 130 terminal 10.	12 volts If good reading, go to next test point.	Open in power mirror switch.
<b>4</b> Hold mirror switch in OUT position. Measure voltage at power mirror switch connector 130 terminal 7.	12 volts If good reading, go to next test point.	Open in power mirror switch.
<b>5</b> Hold mirror switch in UP position. Measure voltage at power mirror switch connector 130 terminal 5.	12 volts If good reading, go to next test point.	Open in power mirror switch.
<b>6</b> Hold mirror switch in DOWN position. Measure voltage at power mirror switch connector 130 terminal 7.	12 volts If good reading, go to next test point.	Open in power mirror switch.
<b>7</b> Set mirror selector to Left mirror. Hold mirror switch in IN position. Measure voltage at power mirror switch connector 130 terminal 8.	12 volts If good reading, go to next test point.	Open in power mirror switch.

## B - Power Mirror Switch Test

	Test point	Good Reading	Possible Cause of Bad Reading
8	Hold mirror switch in OUT position. Measure voltage at power mirror switch connector 130 terminal 7.	12 volts If good reading, go to next test point.	Open in power mirror switch.
9	Hold mirror switch in UP position. Measure voltage at power mirror switch connector 130 terminal 8.	12 volts If good reading, go to next test point.	Open in power mirror switch.
10	Hold mirror switch in DOWN position. Measure voltage at power mirror switch connector 130 terminal 7.	12 volts If good reading, go to next test point.	Open in power mirror switch.
11	Set mirror selector to Right mirror. Hold mirror switch in IN position. Measure resistance from power mirror switch connector 130 terminal 7 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.
12	Hold mirror switch in OUT position. Measure resistance from power mirror switch connector 130 terminal 10 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.
13	Hold mirror switch in UP position. Measure resistance from power mirror switch connector 130 terminal 7 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.
14	Hold mirror switch in DOWN position. Measure resistance from power mirror switch connector 130 terminal 5 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.

**B - Power Mirror Switch Test**

Test point	Good Reading	Possible Cause of Bad Reading
<b>15</b> Set mirror switch to control LEFT mirror. Hold mirror switch in IN position. Measure resistance from power mirror switch connector 130 terminal 7 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.
<b>16</b> Hold mirror switch in OUT position. Measure resistance from power mirror switch connector 130 terminal 8 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.
<b>17</b> Hold mirror switch in UP position. Measure resistance from power mirror switch connector 130 terminal 7 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in power mirror switch.
<b>18</b> Hold mirror switch in DOWN position. Measure resistance from power mirror switch connector 130 terminal 4 to ground.	If all tests have been successfully completed, switch is good.	Open in power mirror switch.

**C - First Circuit Test (Mirror Switch Connector 130 to In-line Connector 111**

	<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b>	Remove connector 130 from power mirror switch. Disconnect in-line connector 111M from in-line connector 111F. Set DVOM to test continuity. Check for continuity between connector 111F terminal 1 and connector 130 terminal 8.	Continuity If good reading, go to next test point.	Open in 275A(O) circuit.
<b>2</b>	Check for continuity between connector 111F terminal 2 and connector 130 terminal 7.	Continuity If good reading, go to test point 4.	Open in circuit between connector 111F terminal 2 and connector 130 terminal 7. Go to next test point.
<b>3</b>	Check for continuity between connector 111F terminal 2 and splice C6.	Continuity If good reading, repair open in 58B(O) circuit.	Open in 58B(O) circuit.
<b>4</b>	Check for continuity between connector 111F terminal 3 and connector 130 terminal 4.	Continuity If good reading, go to next test point.	Open in 277A(O) circuit.
<b>5</b>	Check for continuity between connector 111F terminal 4 and connector 130 terminal 10.	Continuity If good reading, go to next test point.	Open in 278A(O) circuit.
<b>6</b>	Check for continuity between connector 111F terminal 5 and connector 130 terminal 7.	Continuity If good reading, go to next test point.	Open in 58(O) circuit.
<b>7</b>	Check for continuity between connector 111F terminal 6 and connector 130 terminal 5.	Continuity If good reading, circuits between connector 130 and in-line connector 111F are okay	Open in 280A(O) circuit.

## D - Second Circuit Test (Mirror Assembly Connectors 112 and 113 to In-line Connector 111)

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Remove connector 112 from left mirror assembly. Disconnect in-line connector 111M from in-line connector 111F. Set DVOM to test continuity. Check for continuity between connector 111M terminal 1 and connector 112 terminal 3.	Continuity If good reading, go to next test point.	Open in 949A(O) circuit.
<b>2</b> Check for continuity between connector 111M terminal 2 and connector 112 terminal 2.	Continuity If good reading, go to next test point.	Open in 950(DG) circuit.
<b>3</b> Check for continuity between connector 111M terminal 3 and connector 112 terminal 1.	Continuity If good reading, circuits between in-line connector 111M and left mirror connector 112 okay. Go to next test point.	Open in 951A(Y) circuit.
<b>4</b> Remove connector 113 from right mirror assembly. Disconnect in-line connector 111M from in-line connector 111F. Set DVOM to test continuity. Check for continuity between connector 111M terminal 4 and connector 113 terminal 3.	Continuity If good reading, go to next test point.	Open in 952A(O) circuit.
<b>5</b> Check for continuity between connector 111M terminal 5 and connector 113 terminal 2.	Continuity If good reading, go to next test point.	Open in 953A(DG) circuit.
<b>6</b> Check for continuity between connector 111M terminal 6 and connector 113 terminal 1.	Continuity If good reading, circuits between in-line connector 111M and right mirror connector 113 okay.	Open in 954A(Y) circuit.

**E - Right Mirror Assembly Test**

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Perform A - Power Mirror Switch Power and Ground Supply Test. Ignition in Run position. Set mirror selector to Right mirror. Hold mirror switch in IN position. Measure voltage at terminal 3 of right mirror connector 113.	12 volts If good reading, go to next test point.	Open circuit between connector 113 and mirror switch. Perform C - First Circuit Test, test point 7, and D - Second Circuit Test, test point 6.
<b>2</b> Hold mirror switch in OUT position. Measure voltage at terminal 2 of right mirror connector 113.	12 volts If good reading, go to next test point.	Open circuit between connector 113 and mirror switch. Perform C - First Circuit Test, test points 2, 3 and 6, and D - Second Circuit Test, test point 5.
<b>3</b> Hold mirror switch in UP position. Measure voltage at terminal 1 of right mirror connector 113.	12 volts If good reading, go to next test point.	Open circuit between connector 113 and mirror switch. Perform C - First Circuit Test, test point 5, and D - Second Circuit Test, test point 4.
<b>4</b> Hold Mirror switch in DOWN position. Measure voltage at terminal 2 of right mirror connector 113.	12 volts If good reading, go to next test point.	Open in power mirror switch.
<b>5</b> Ignition Off. Set DVOM to measure continuity. Hold mirror switch in IN position. Check for continuity from right mirror connector 113 terminal 2 to ground.	Continuity If good reading, go to next test point.	Open in power mirror switch.
<b>6</b> Hold mirror switch in OUT position. Check for continuity from right mirror connector 113 terminal 1 to ground.	Continuity If good reading, go to next test point.	Open in power mirror switch.



### E - Right Mirror Assembly Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>7</b> Hold mirror switch in UP position. Check for continuity from right mirror connector 113 terminal 2 to ground.	Continuity If good reading, go to next test point.	Open in power mirror switch.
<b>8</b> Hold mirror switch in DOWN position. Check for continuity from right mirror connector 113 terminal 3 to ground.	Continuity If good reading, and right mirror does not operate properly, replace right mirror assembly.	Open in power mirror switch.

### F - Left Mirror Assembly Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Perform A - Power Mirror Switch Power and Ground Supply Test. Ignition in Run position. Set mirror selector to Left mirror. Hold mirror switch in IN position. Measure voltage at terminal 3 of right mirror connector 112.	12 volts If good reading, go to next test point.	Open circuit between connector 112 and mirror switch. Perform C - First Circuit Test, test point 1, and D - Second Circuit Test, test point 1.
<b>2</b> Hold mirror switch in OUT position. Measure voltage at terminal 2 of right mirror connector 112.	12 volts If good reading, go to next test point.	Open circuit between connector 112 and mirror switch. Perform C - First Circuit Test, test point 2, and D - Second Circuit Test, test point 2.
<b>3</b> Hold mirror switch in UP position. Measure voltage at terminal 1 of right mirror connector 112.	12 volts If good reading, go to next test point.	Open circuit between connector 112 and mirror switch. Perform C - First Circuit Test, test point 4, and D - Second Circuit Test, test point 3.

**F - Left Mirror Assembly Test**

Test point	Good Reading	Possible Cause of Bad Reading
<b>4</b> Hold Mirror switch in DOWN position. Measure voltage at terminal 2 of right mirror connector 112.	12 volts If good reading, go to next test point.	Open in power mirror switch.
<b>5</b> Ignition Off. Set DVOM to measure continuity. Hold mirror switch in IN position. Check for continuity from left mirror connector 112 terminal 2 to ground.	Continuity If good reading, go to next test point.	Open in power mirror switch.
<b>6</b> Hold mirror switch in OUT position. Check for continuity from left mirror connector 112 terminal 3 to ground.	Continuity If good reading, go to next test point.	Open in power mirror switch.
<b>7</b> Hold mirror switch in UP position. Check for continuity from left mirror connector 112 terminal 2 to ground.	Continuity If good reading, go to next test point.	Open in power mirror switch.
<b>8</b> Hold mirror switch in DOWN position. Check for continuity from left mirror connector 112 terminal 1 to ground.	Continuity If good reading, and left mirror does not operate properly, replace left mirror assembly.	Open in power mirror switch.

## **POWER SEAT SYSTEM**

### **Power Seat System Circuit Operation**

The seat system has a power seat height adjustment using an air motor adjustment. Additionally the seat has provision for seat and back cushion heating.

The seat height is adjusted with air pressure controlled with a switch. The seat cushions are heated and controlled by a switch. The switch operates as follows: The seat heaters are OFF with the heater switch in the 0 position. Turn the thumb wheel from the lowest position of "1" to the highest position of "6" to achieve heat control.

Seat adjustment and heating is available whenever the ignition switch is ON.

### **Power Seat System Circuit Troubleshooting**

Before troubleshooting the Seat system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Transmission in neutral or park.
- C. Check all connectors for full installation, loose, corroded, pushed out, or bent terminals.
- D. Check fuses #9 (seat adjustment) and #29 (seat heater).
- E. The ignition is in RUN or ACCESSORY position.
- F. Refer to Electrical Schematic section 67.

## Power Seat System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
<b>Height adjustment not operating</b>	Height adjustment switch	B - Height Adjustment Circuit Test
	Power and ground supply	A - Seat System Power and Ground Supply Test
	Seat air pump compressor	B - Height Adjustment Circuit Test
	Air system leaking	Check air lines for leakage
<b>Seat heater not functioning</b>	Heater switch	D - Heater Switch and Relay Power and Ground Supply Test
<b>Operator presence not indicated</b>	Operator presence switch	C - Operator Presence Switches Circuit Test
	Instrument cluster	C - Operator Presence Switches Circuit Test

## Power Seat System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Seat System Power and Ground Supply Test

Test Point	Good Reading	Possible Cause of Bad Reading
1 Ignition in Run position. Measure voltage at seat connector 133 terminal 1.	12 volts If good reading, go to next test point.	Open in circuit from switched B+. Go to test point 5.
2 Measure voltage at seat connector 133 terminal 2.	12 volts If good reading, go to next test point.	Open in circuit from switched B+. Go to test point 6.
3 Measure voltage at seat connector 133 terminal 5.	12 volts If good reading, go to next test point.	Open in circuit from switched B+. Go to test point 7.
4 Measure voltage at seat connector 133 terminal 7.	12 volts If good reading, go to test point 11.	Open in circuit from switched B+. Go to test point 9.
5 Measure voltage at splice C15.	12 volts If good reading, repair open in 73B(R) circuit.	Open in circuit from switched B+. Go to test point 8.
6 Measure voltage at splice C15.	12 volts If good reading, repair open in 73C circuit.	Open in circuit from switched B+. Go to test point 8.
7 Measure voltage at splice C15.	12 volts If good reading, repair open in 73D(R) circuit.	Open in circuit from switched B+. Go to test point 8.
8 Measure voltage at fuse #9.	12 volts If good reading, repair open in 73A(R) circuit.	Fuse #9, or Open circuit 102F(R) circuit from switched B+.
9 Measure voltage at fuse #29.	12 volts If good reading, repair open in 259A(R) circuit.	Open in circuit from switched B+. Go to next test point.

**A - Seat System Power and Ground Supply Test**

Test Point	Good Reading	Possible Cause of Bad Reading
<b>10</b> Measure resistance from seat connector 133 terminal 3 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from seat connector 133 terminal 3 to ground.
<b>11</b> Measure resistance from seat connector 133 terminal 4 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from seat connector 133 terminal 4 to ground.
<b>12</b> Measure resistance from seat connector 133 terminal 8 to ground.	Less than 1 ohm If good reading, seat system power and ground supplies okay.	Open in circuit from seat connector 133 terminal 8 to ground.

**B - Height Adjustment Circuit Test**

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition in Run position. Press height adjustment switch.	Seat height adjustment air compressor runs. If compressor runs, but seat does not adjust, check for air line leakage.	Open in seat height adjustment circuits. Go to next test point.
<b>2</b> Separate electrical connector 133F and 133M. Engage seat height adjust switch and check for continuity from connector 133F terminal 1 to 2.	Continuity Go to next test point.	Seat adjust switch, Seat air pump compressor, or Related circuits within seat assembly.
<b>3</b> Engage seat height adjust switch and check for continuity from connector 133F terminal 1 to 4.	Continuity Go to next test point.	Seat adjust switch, Seat air pump compressor, or Related circuits within seat assembly.
<b>4</b> Engage seat height adjust switch and check for continuity from connector 133F terminal 2 to 3.	Continuity Go to next test point.	Seat adjust switch, Seat air pump compressor, or Related circuits within seat assembly.
<b>5</b> Engage seat height adjust switch and check for continuity from connector 133F terminal 2 to 4.	Continuity Go to next test point.	Seat adjust switch, Seat air pump compressor, or Related circuits within seat assembly.

**B - Height Adjustment Circuit Test**

Test point	Good Reading	Possible Cause of Bad Reading
<b>6</b> Check seat height adjustment power and grounds. Perform A - Seat System Power and Ground Supply Test, test points 1, 2, 10, and 11.	If power and ground supplies okay, seat height adjust switch and air pump compressor circuits have continuity, but height adjustment does not operate, replace seat air pump compressor.	Open in seat power and ground supply circuits.

**C - Operator Presence Switches Circuit Test**

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Separate electrical connector 133F and 133M. While sitting in operator seat, check for continuity between connector 133F terminals 5 and 6.	Continuity If good reading, go to next test point.	Open in operator presence switches and/or circuits within seat assembly.
<b>2</b> Check for continuity between connector 133M terminals 5 and 6 with operator seat empty.	Open circuit If good reading, go to next test point.	Short in operator presence switches and/or circuits within seat assembly.
<b>3</b> Check operator presence switches power supply. Perform A - Seat System Power and Ground Supply Test, test point 3.	If power supply circuits okay, go to next test point.	Open in circuit from switched B+.
<b>4</b> Remove electrical connector CN1 from instrument cluster. Check for continuity from connector CN1 terminal 2 to connector 133 terminal 6.	Continuity If good reading, operator presence switches and circuits okay. Replace instrument cluster	Open in 303A(T) circuit.

**D - Heater Switch and Relay Power and Ground Supply Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Ignition in Run position. Measure voltage at seat connector 133 terminal 7.	12 volts If good reading, go to test point 4.	Open in circuit from switched B+. Go to next test point.
<b>2</b> Measure voltage at fuse #29.	12 volts If good reading, repair open in 259A(R) circuit.	Open in circuit from switched B+. Go to next test point.
<b>3</b> Measure voltage at splice C21.	12 volts If good reading, replace fuse #29, or repair open in 102J(R) circuit.	Open in 102B(R) circuit from switched B+.
<b>4</b> Measure resistance from seat connector 133 terminal 8 to ground.	Less than 1 ohm If good reading, heater switch and relay power and ground supplies okay.	Open in circuit from seat connector 133 terminal 8 to ground.



## STARTING SYSTEM

### Starting System Circuit Operation

Unswitched battery power, B+ is supplied through fuse #7 to the ignition switch connector 161. When the key is turned to the START position current is supplied to the FNRP Module connector 219. If the transmission is in neutral or park current flows to the buss box starter relay, and onto the intermediate starter relay which energizes the starter relay.

### Starter Motor Circuit Troubleshooting

Before troubleshooting the starting system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Check fuse #7.
- C. Transmission in neutral or park.

### Starting System Symptom Chart

**NOTE:** *The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.*

**IMPORTANT:** *DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.*



**WARNING:** *Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.*

Symptom	Possible Cause	Reference/Test
<b>Engine does not crank when key is turned to start</b>	Fuse #7	A - Ignition Switch Power Supply Test, test point 1
	Ignition switch	A - Ignition Switch Power Supply Test, and B - Ignition Switch Test, test points 1 and 2.
	FNRP Module	C - FNRP Module test.
		Refer to Transmission Section of Service Manual and check Neutral Safety switch adjustment.
	Starter relay	D - Starter Relay Test
	Intermediate starter relay	E - Intermediate Starter Relay Test
	Starter motor	F - Starter Motor Test
<b>Click is heard when key is turned but engine does not crank</b>	Starter motor	F - Starter Motor Test
	Starter relay	D - Starter Relay Test
	Intermediate starter relay	E - Intermediate Starter Relay Test

Symptom	Possible Cause	Reference/Test
<b>Engine cranks slowly</b>	Starter motor	F - Starter Motor Test, test points 3, 4 and 5.
	Engine mechanical problem	Refer to Engine Section in Service Manual.
<b>Starter motor continues to operate when key is released from START to RUN position</b>	Ignition switch.	B - Ignition Switch Test, and confirm that switch turns off when key is released.
	Starter relay	D - Starter Relay Test, test point 6, and confirm that relay turns off when key is released.
	Intermediate starter relay	E - Intermediate Starter Relay Test, and confirm that relay turns off when the key is released.
	Starter solenoid	F - Starter Motor Test test point 2 and confirm that 12 volts are not present at terminal 79 when key is released. If starter continues to run when 12 volts are removed, replace starter.

## Starting System Diagnostic Tests

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Ignition Switch Power Supply Test

Test Point	Good Reading	Possible Cause of Bad Reading
1 Measure voltage at ignition switch connector 161 terminal 1.	12 volts If good reading, ignition switch power supply okay.	Open in circuit from unswitched B+. Go to next test point.
2 Measure voltage at fuse #7.	12 volts If good reading, repair open in 107A(R) circuit.	Fuse #7, or Open in 101C(R) circuit from unswitched B+.

### B - Ignition Switch Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Remove electrical connector 161 from ignition switch. While holding ignition switch in Start position, check for continuity from connector 161 terminal 1 to terminal 2.	Continuity If good reading, go to next test point.	Ignition switch.
2 While holding ignition switch in Start position, check for continuity from connector 161 terminal 1 to terminal 5.	Continuity If good reading, go to next test point.	Ignition switch.
3 Ignition switch in Run position. Check for continuity from connector 161 terminal 1 to terminal 5.	Continuity If good reading, go to next test point.	Ignition switch.

**B - Ignition Switch Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>4</b> Ignition switch in Run position. Check for continuity from connector 161 terminal 1 to terminal 6.	Continuity If good reading, go to next test point.	Ignition switch.
<b>5</b> Ignition switch in Accessory position. Check for continuity from connector 161 terminal 1 to terminal 6.	Continuity If good reading, go to next test point.	Ignition switch.
<b>6</b> Ignition switch in Off position. Check for continuity from connector 161 terminal 1 to terminals 2, 3, 4, 5, 6.	No continuity If good reading, ignition switch operating properly.	Ignition switch.

**C - FNRP Module Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Ignition switch in Run position. Measure voltage at FNRP module connector 219 terminal 1.	12 volts If good reading, go to test point 4.	Open in B+ circuit from ignition switch. Go to next test point.
<b>2</b> Measure voltage at in-line connector 51 terminal 1.	12 volts If good reading, repair open in 1(A) circuit.	Open in B+ circuit from ignition switch. Go to next test point.
<b>3</b> Measure voltage at ignition switch connector 161 terminal 2.	12 volts If good reading, repair open in 623A(W) circuit.	Open in B+ circuit from ignition switch. Perform A - Ignition Switch Power Supply Test, and B - Ignition Switch Test
<b>4</b> Transmission control lever in Park. Measure voltage at FNRP module connector 219 terminal 2.	12 volts If good reading, go to next test point.	Park/neutral position switch, or FNRP module

### C - FNRP Module Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>5</b> Transmission control lever in Neutral. Measure voltage at FNRP module connector 219 terminal 2.	12 volts If good reading, FNRP module okay.	Park/neutral position switch, or FNRP module

**NOTE:** Before performing the starter relay test procedure - replace the starter relay with a known good relay. If tractor start troubleshooting is complete. If does not start continue with starter relay test.

### D - Starter Relay Test

Test point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Ignition switch in Start position. Remove the starter relay. Measure voltage at starter relay terminal 1.	12 volts If good reading, go to next test point.	Open in B+ circuit from FNRP module. Perform C - FNRP Module Test
<b>2</b> Measure voltage at starter relay terminal 3.	12 volts If good reading, go to test point 4.	Open in unswitched B+ circuit. Go to next test point.
<b>3</b> Measure voltage at ignition switch connector 161 terminal 1.	12 volts If good reading, repair open in 89C(R) circuit.	Open in unswitched B+ circuit. Perform A - Ignition Switch Power Supply Test, test point 2.
<b>4</b> Measure resistance from starter relay terminal 2 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from starter relay terminal 2 to ground.

## E - Intermediate Starter Relay Test

Test Point	Good Reading	Possible Cause of Bad Reading
1 Ignition switch in Start position. Measure voltage at intermediate starter relay connector 82.	12 volts If good reading, go to test point 5.	Open in B+ circuit from starter relay. Go to next test point.
2 Disconnect connector 108(grey) from the buss box. Measure voltage at pin E on buss box connector 108.	12 volts If good reading, repair open in 622A(W) circuit.	Open in B+ circuit from starter relay. Perform D Starter Relay Test.
3 Measure voltage at intermediate starter relay connector 78.	12 volts If good reading, go to test point 7.	Open in B+ circuit from battery. Go to next test point.
4 Measure voltage at starter motor connector 81.	12 volts If good reading, repair open in 620A(R) circuit.	Open in B+ circuit from battery to starter motor connector 81.
5 Measure resistance from intermediate starting relay connector 83 to ground.	Less than 1 ohm If good reading, go to next test point.	Open in circuit from intermediate starting relay connector 83 to ground.
6 Ignition switch in start position. Measure voltage at intermediate starter relay connector 84.	12 volts If good reading, intermediate starter relay is operating properly.	Intermediate starter relay.

## F - Starter Motor Test

Test Point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Measure voltage at terminal 81 of starter motor.	12 volts If good reading, go to next test point.	Open circuit between starter terminal 81 and battery positive terminal. <b>Caution:</b> <i>When performing continuity test on this circuit, ensure that the cable is disconnected from the battery positive terminal. Failure to do so can result in damage to the test meter.</i>
<b>2</b> Ignition switch in Start position. Measure voltage at starter terminal 79.	12 volts If good reading, go to test point 4.	Open in B+ circuit from starter relay. Go to next test point.
<b>3</b> Ignition switch in Start position. Measure voltage at intermediate starter relay terminal 84.	12 volts If good reading, repair open in 625A(W) circuit.	Open in B+ circuit. Perform E - Intermediate Starter Relay Test.
<b>4</b> Measure resistance from starter motor case to ground.	Less than 1 ohm If good reading, go to next test point.	Check contact surface of starter motor with engine. Ensure starter motor is mounted securely. Check ground strap between engine and chassis.
<b>5</b> Set DVOM to read voltage. Attach positive lead to battery positive terminal. Attach negative lead to terminal 81 of starter motor. Turn key to START position. Less than 0.4 volts should show on voltmeter.	If less than 0.4 volts shown, and starter motor does not operate, replace starter motor.	More than 0.4 volts showing on voltmeter, replace cable between battery positive terminal and starter terminal 81.

## **WIPER/WASHER SYSTEM**

### **Wiper/Washer System Circuit Operation**

The wiper/washer system consists of two separate systems, front and rear.

Each system has a two speed motor and a separate washer motor and reservoir.

The two systems are energized by switched power.

### **Wiper/Washer System Circuit Troubleshooting**

Before troubleshooting the Wiper/Washer system make sure that the following operating conditions are met:

- A. The batteries are fully charged and all connections are clean and tight.
- B. Transmission in neutral or park.
- C. Check all connectors for full installation, loose, corroded or pushed out terminals.



## Wiper/Washer System Symptom Chart

**NOTE:** The batteries must be fully charged and all connections clean and tight. Use a multimeter (DVOM) for these tests. For battery testing and service, see the battery section in the service manual.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

Symptom	Possible Cause	Reference/Test
<b>Front wiper motor is inoperative</b>	Power/Ground Supply	Diagnostic test A.
	Wiper Switch	Diagnostic test C.
	Wiper Motor	Diagnostic test D.
<b>Front wiper motor does not park, stops when switch is turned off</b>	Wiper Motor	Test point E-12.
	Wiper Switch	Test point E-10.
<b>Front wiper motor, low speed only</b>	Wiper Motor	Test point E-6.
	Wiper switch	Test point E-4.
<b>Front wiper motor, high speed only</b>	Wiper Motor	Test point E-9.
	Wiper switch	Test point E-7.
<b>Front washer inoperative</b>	Washer Switch	Test point F-1.
	Washer Motor	Test point F-3
	Washer Fluid Supply	Check reservoir and fluid lines.
<b>Rear wiper motor is inoperative</b>	Power/Ground Supply	Diagnostic test B.
	Wiper Switch	Diagnostic test D.
	Wiper Motor	Diagnostic test G.
<b>Rear wiper motor does not park, stops when switch is turned off</b>	Wiper Motor	Test point G-8.
	Wiper Switch	Test point G-6.
<b>Rear washer inoperative</b>	Washer Switch	H-1.
	Washer Motor	H-3.
	Washer Fluid Supply	Check reservoir and fluid lines.

## Wiper/Washer System Diagnostic Tests

### NOTE:

- The batteries must be fully charged and all connections clean and tight.
- Use a multimeter (DVOM) for these tests.
- Check fuse 52 and circuit breaker 51.
- Check Power Distribution section if fuse and circuit breaker are good.
- For battery testing and service, see the battery section in the service manual.
- Check all listed connectors for loose, damaged corroded or pushed out terminals.

**IMPORTANT:** DO NOT use a self-powered test light for any of these tests. Use of a self-powered test light can cause damage to components in this system.



**WARNING:** Before performing any of the electrical tests, be sure all operating controls are in neutral or park lock position. This will eliminate accidental movement of the machine or start-up of power driven equipment.

### A - Front Wiper System Power and Ground Supply Test

Test Point	Good Reading	Possible Cause of Bad Reading
<b>1</b> Access connector 127 on front wiper switch. Ignition ON. Check for 12 volts at cavity 6.	Wiper switch power supply good, go to test point 4.	Go to next test point.
<b>2</b> Check for 12 volts at inline connector 13, cavity P.	Go to next test point. Check inline splice if sent here by test point 1, bad reading.	Open circuit 831C (R). Check inline splice C31 and circuit 831A (O).
<b>3</b> Check for 12 volts at front wiper motor connector 115, cavity C.	Front wiper motor power supply good. Go to next test point.	Open circuit 831B (O)
<b>4</b> Check for chassis ground at front wiper motor connector 116, cavity A.	Ground circuit OK.	Go to next test point.

### B - Rear Wiper System Power and Ground Supply Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Access connector 122 on rear wiper switch. Ignition ON. Check for 12 volts at cavity 3 and 6.	Rear wiper switch power supply good. Go to next test point.	Go to next test point.
2 Check for 12 volts at inline connector 13, cavity K.	Go to next test point. Check inline splice if sent here by test point -1, bad reading.	Check inline splice C38 and check circuit 841C (O) for open between splice and fuse 52.
3 Check for 12 volts at rear wiper motor connector 98, cavity C.	Rear wiper motor power supply good. Go to next test point.	Open circuit 841B (O).
4 Check for continuity to chassis ground at rear wiper motor connector 99, cavity A.	Ground circuit OK.	Go to next test point.

### C - Front Wiper/Washer Switch Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Key ON. Select low speed on front wiper switch. Does front wiper motor operate at low speed?	Go to next test point.	Go to test point E-4.
2 Select high speed on front wiper switch. Does front wiper motor operate at high speed?	Go to next test point	Go to test point E-7.
3 Operate front washer switch. Does front washer motor operate?	Front wiper/washer switch good.	Go to test point F-1.

**D - Rear Wiper/Washer Switch Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Key ON. Select low speed on rear wiper switch. Does rear wiper motor operate at low speed?	Go to next test point.	Go to test point G-3.
<b>2</b> Turn rear wiper switch OFF. Does rear wiper PARK?	Go to next test point.	Go to test point G-9.
<b>3</b> Operate rear washer switch. Does rear washer motor operate?	Rear wiper/washer switch good.	Go to test point H-1.

**E - Front Wiper Motor Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Key ON. Select low speed on front wiper switch. Does front wiper motor operate at low speed?	Go to next test point.	Go to test point E-4.
<b>2</b> Select high speed on front wiper switch. Does front wiper operate at high speed?	Go to next test point	Go to test point E-7.
<b>3</b> Turn front wiper switch OFF. Do wipers PARK.	Wiper motor good.	Go to test point E-10.
<b>4</b> Access front wiper switch connector 127. Check for 12 volts at cavity 3.	Go to next test point.	Confirm switch power supply, test point A-1. If power supply is good, replace switch.
<b>5</b> Check for 12 volts at inline connector 13, cavity R.	Go to next test point.	Open circuit 834A (O).
<b>6</b> Check for 12 volts at front wiper motor connector 115, cavity B.	Confirm front wiper motor ground, test point A-4. If ground is good, replace front wiper motor.	Open circuit 833B (O).

**E - Front Wiper Motor Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>7</b> Check for 12 volts at front wiper switch connector 127, cavity 4.	Go to next test point.	Confirm switch power supply, test point A-1. If power supply is good, replace switch.
<b>8</b> Check for 12 volts at inline connector 13, cavity S.	Go to next test point.	Open circuit 832A (O).
<b>9</b> Check for 12 volts at front wiper motor connector 115, cavity A.	Confirm front wiper motor ground, test point A-4. If ground is good, replace front wiper motor.	Open circuit 832B (O).
<b>10</b> Wiper switch in OFF position. Check for 12 volts at front wiper switch connector 127, cavity 5.	Go to next test point	Confirm switch power supply, test point A-1. If power supply is good, replace switch.
<b>11</b> Check for 12 volts at inline connector 13, cavity N.	Go to next test point.	Open circuit 830A (O).
<b>12</b> Check for 12 volts at front wiper motor connector 115, cavity A.	Confirm front wiper motor ground, test point A-4. If ground is good, replace front wiper motor.	Open circuit 832B (O).

**F - Front Washer Motor Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Operate front washer switch. Check for 12 volts at front wiper/washer switch connector 127, cavity 2.	Go to next test point.	Confirm switch power supply, test point A-1. If power supply is good, replace switch.
<b>2</b> Check for 12 volts at inline connector 10F, cavity 81.	Go to next test step.	Open circuit 836A (O).
<b>3</b> Check for 12 volts at inline connector 333M, cavity 16.	Go to next test step.	Open circuit 836B (O).
<b>4</b> Check for 12 volts at front washer motor connector 212, cavity B.	Go to next test point.	Open circuit 836D (O).

## F - Front Washer Motor Test

Test point	Good Reading	Possible Cause of Bad Reading
5 Disconnect front washer motor connector 212. Check for chassis ground at cavity A.	Replace front washer motor.	Open circuit to chassis ground 600H (O).

## G - Rear Wiper Motor Test

Test point	Good Reading	Possible Cause of Bad Reading
1 Key ON. Operate rear wiper switch. Does front wiper motor operate?	Go to next test point.	Go to test point G-3.
2 Turn rear wiper switch OFF. Does rear wiper PARK.	Wiper motor good.	Go to test point G-6.
3 Access rear wiper switch connector 122. Check for 12 volts at cavity 2.	Go to next test point.	Confirm switch power supply, test point B-1. If power supply is good, replace switch.
4 Check for 12 volts at inline connector 13, cavity L.	Go to next test point.	Open circuit 843C (O).
5 Check for 12 volts at rear wiper motor connector 98, cavity B.	Confirm rear wiper motor ground, test point B-4. If ground is good, replace rear wiper motor.	Open circuit 843B (O).
6 Check for 12 volts at rear wiper switch connector 122, cavity 3.	Go to next test point.	Confirm switch power supply, test point B-1. If power supply is good, replace switch.
7 Check for 12 volts at inline connector 13, cavity J.	Go to next test point.	Open circuit 844C (O).
8 Check for 12 volts at rear wiper motor connector 98, cavity D.	Confirm rear wiper motor ground, test point B-4. If ground is good, replace rear wiper motor.	Open circuit 844B (O).

**H - Rear Washer Motor Test**

<b>Test point</b>	<b>Good Reading</b>	<b>Possible Cause of Bad Reading</b>
<b>1</b> Check for 12 volts at rear wiper/washer switch connector 122, cavity 3 & 6.	Go to next test point.	Confirm switch power supply, test point B-1. If power supply is good, replace switch.
<b>2</b> Check for 12 volts at inline connector 10, cavity 82.	Go to next test step.	Open circuit 845A (O).
<b>3</b> Check for 12 volts at rear washer motor connector 213, cavity B.	Go to next test point.	Open circuit 845C (O).
<b>4</b> Check for 12 volts at connector 333, cavity 17.	Go to next test point.	Open circuit 845B (O).
<b>5</b> Disconnect rear washer motor connector 213. Check for chassis ground at cavity A.	Replace rear washer motor.	Open circuit to chassis ground 600G (O).

# **Section 55**

## **Chapter 2**

### **INSTRUMENTATION CONTROLLER FAULT CODES**



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## FAULT CODE INST 1015

### Seat Switch Stuck Closed

**Cause:**

The switch is located in the seat cushion. The seat switch closes when the seat is sat in and opens when the operator gets up. If the switch is closed for over 24 engine hours, this fault code will be recorded.

**Possible failure mode:**

1. Seat switch stuck closed.
2. Seat switch wiring circuit problems.

**Solution:**

Check the seat switch function.

Check the wiring from the instrumentation controller to the seat switch.

1. Check the seat switch function with the service tool. The seat switch status can be monitored through the monitor screen of the service tool.

Click the button 'CHANGE PARAMETER SELECTIONS.'

When the 'PARAMETER LIST' screen shows up, select 'SEAT OPERATOR PRESENT SW' and add it to the 'VIEW LIST.'

Now you can monitor the function of the seat switch.

Sit down and then stand up a few times.

The seat switch should close when the seat is sat in and open when the operator gets up.

If the status on the screen changes with the operators position, the seat switch is functioning OK. The fault code might be recorded for intermittent seat problems.

If the status on the screen does not change with the operator's position, there is a problem with the seat switch or their wiring.

Go to the next Step.

2. Check the seat switch function

A. Disconnect the seat switch at the connector C133 (located behind seat).

B. Probe between pin 5 and pin 6 of connector C133. Seat switch must close when seat is sat in and opened when operator gets off the seat.

If the seat switch does not function correctly, check for the following:

A. Seat switch not located correctly in seat.

B. Failed seat switch.

C. If the seat switch does function correctly, go to the next Step.

3. Check the wiring from the instrumentation controller to the seat switch connector C133  
There should be continuity from cavity 23 of connector C61 to cavity 6 of connector C133.  
There should be 12 VDC power supply at the cavity 5 of connector C133.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 67 on the schematic poster.*

## FAULT CODE INST 3010

### PTO Shaft Speed Sensor Failure

**Cause:**

The Data Bus signaled that the PTO shaft speed data is in error or not available from the AUX/HITCH/PTO controller. The instrumentation controller receives the signal from the AUX/HITCH/PTO controller.

**Possible failure modes:**

1. The PTO shaft speed sensor failed in the AUX/HITCH/PTO controller (in most cases).
2. Software execution error in the AUX/HITCH/PTO controller (small chance).

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/HITCH/PTO controller in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 to 80 volts peak to peak centered around chassis ground. Frequency range is from zero to 3 200 Hz worst case.

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/HITCH/PTO controller and its output is proportional to PTO clutch output speed, but is scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use, i.e. 1-3/4 inch 1000 RPM, 1-3/8 inch 1000 RPM or 1-3/8 inch 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 to 80 volts peak to peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

**Solution:**

The PTO shaft speed sensor is hard wired to the AUX/HITCH/PTO controller. If the PTO shaft speed sensor fails in the AUX/HITCH/PTO controller, fault code 163, 164, 165 and 178 may exist.

1. Check for fault code 163, 164, 165 and 178 from the AUX/HITCH/PTO controller. If any exists, follow the corresponding corrective action.
2. Check the function of the AUX/HITCH/PTO controller.

**NOTE:** See schematic sections 49 and 50 on the schematic poster.

## **FAULT CODE INST 3020**

### **Engine Speed Sensor Failed in Engine Controller**

**Cause:**

The Data Bus signaled that the engine speed data is in error or not available from the engine controller.

**Possible failure modes:**

1. The engine speed sensor failed in the engine controller (most cases).
2. The engine controller is configured in the system where there is no engine controller.
3. Software execution error in the engine controller (small chance).

**Solution:**

This fault code is for tractors equipped with an engine controller. The instrumentation controller receives the engine speed signal from the engine controller through the Data Bus.

1. Make sure the engine is running properly.
2. Check that the instrumentation controller is configured correctly.
3. Check for engine fault codes. If any exists, follow the corresponding corrective action. See the engine service manual for diagnosing procedures.

## **FAULT CODE INST 3022**

### **Engine Overspeed**

**Cause:**

The data bus signaled that the engine speed data indicates that the engine RPM exceeded a preset limit.

**Possible failure modes:**

1. The engine speed has exceeded a preset limit.

**Solution:**

The instrument cluster has received the engine speed signal from the engine controller through the data bus.

1. Take precautions to avoid overspeed the engine. Select a lower gear when traveling down inclines, especially when pulling a heavy load.

## **FAULT CODE INST 5010**

### **Engine Oil Pressure Sensor Failed in Engine Controller**

**Cause:**

The Data Bus signaled that the engine oil pressure information is in error or not available from engine controller.

**Possible failure modes:**

1. Engine oil pressure sensor failed in engine controller (most cases).
2. The engine controller is configured in the system when there is no engine controller.
3. Software execution error in the engine controller (small chance).

**Solution:**

This fault code is for tractors equipped with an engine controller. The instrumentation controller receives the oil pressure signal from the engine controller through the Data Bus.

1. Make sure the engine is running properly.
2. Check that the instrumentation controller is configured correctly.
3. Check for engine fault codes. If any exists, follow the corresponding corrective action. See the engine service manual for diagnosing procedures.

## FAULT CODE INST 5011

### Engine Oil Pressure Sensor Signal Too Low

**Cause:**

The engine oil pressure sensor signal voltage is out of range low (the signal was below 0.25 volts for 1 second).

**Possible failure modes:**

1. Engine oil pressure sensor failed.
2. Engine oil pressure sensor wiring harness problems (open circuit, short to ground).
3. Instrument controller failure.

**Solution**

Check the engine oil pressure sensor resistance and the wiring from the instrumentation controller to the engine oil pressure sensor.

1. Validate the pressure sensor power supply.  
Open up the tractor hood and locate the engine oil pressure sensor.  
Disconnect connector C216 from the engine oil pressure sensor.  
Clean the connection. Clean the mating pin and connector. Inspect pin A, B, and C in the connector.  
Measure the voltage at the supply input, pin B. It must be 5 volts.  
If it is as specified, go to the next Step.  
If not, then check for 5 volts out of the instrument controller pin 18 at connector 61.  
If there is not 5 volts at the controller, then pull pin 18 terminal out to determine if 5 volts is present on the controller pin when pin 18 wire is not connected.

**NOTE:** *Use the correct tool to remove pins from connectors.*

2. Check the sensor ground.  
Measure the continuity between pin A of connector C216 to the chassis ground.  
If there is good continuity (less than 1 ohm), go to the next step.  
If there is not good continuity, go to step 4.
3. Check the function of the engine oil pressure sensor.  
Validate that the sensor output voltage is greater than 0.25 volts at pin C of connector C216.  
If not, then replace the engine oil pressure sensor.  
If yes, then validate that output voltage is present at the instrument controller input pin 27 at connector 61. If there is no voltage at the controller, then locate and repair an open circuit in the wire harness signal line.
4. Check the wiring from the engine oil pressure sensor connector C216 to the connector C061 at the instrument controller.  
There should be good continuity between pin A of C216 and the clean ground.  
There should be good continuity between pin B of C216 and pin 18 of C061.  
There should be good continuity between pin C of C216 and pin 27 of C061.  
If there is any open circuit, check the continuity from C216 to C061 to locate the problem.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

## FAULT CODE INST 10031

### Controller Memory Error

**Cause:**

Controller memory error - loss of valid engine hours EEPROM checksum.

**Possible failure modes:**

Memory defect or intermittent controller.

**Solution:**

1. When the valid engine hours are lost in the controller memory (EEPROM checksum), the controller will reset engine hour meter to 50000.0 hours to highlight the failure. It will continue counting the hours from that point.
2. Make sure the controller has a good connection (CN-2) to the battery and is properly grounded. Shut down the tractor and restart.
3. Calibrate the instrumentation controller.
4. If the same fault appears again, replace the controller.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.

## FAULT CODE INST 10032

### Controller Memory Error

**Cause:**

Controller failure: vehicle configuration information lost.

**Possible failure modes:**

Memory defect or intermittent controller

**Solution:**

1. Make sure the controller has a good connection (CN-2) to the battery and is properly grounded.
2. Calibrate the instrumentation controller. Clear the fault code. Shut down the tractor and restart
3. If the same fault code appears again, change the controller.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.

## FAULT CODE INST 10033

### Controller Memory Error

**Cause:**

Controller failure: customer configuration information lost. This is triggered once when either the tire or the English/Metric setting is detected or lost.

**Possible failure modes:**

Memory defect or intermittent controller.

**Solution:**

1. Set English/metric setting to proper mode and set the tire radius accordingly.
2. Make sure the controller has a good connection (CN-2) to the battery and is properly grounded.
3. Calibrate the instrumentation controller. Clear the fault code. Shut down the tractor and restart.
4. If the same fault code appears again, change the controller.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.



## FAULT CODE INST 10034

### Controller Memory Error

**Cause:**

Controller memory error: loss of valid fuel table information.

**Possible failure modes:**

1. Updated software without loading new fuel table.
2. Memory defect or intermittent controller.

**Solution:**

Use the service tool fuel update screen to load a new fuel table into the instrumentation controller. Clear the fault codes.

**NOTE:** *Updating software to a later version requires loading a new fuel table.*

Clear fault code. Shut down the tractor and restart. If the same fault appears again, make sure the controller has a good connection (CN-2) to the battery and is properly grounded.

Clear the fault code. Shut down the tractor and restart. If problem persists, replace the controller.

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

## FAULT CODE INST 10035

### Controller Memory Error - Loss Of Valid Radar Configuration Information

**Cause:**

Controller memory error: loss of valid radar configuration information.

**Possible failure modes:**

1. Intermittent power supply or ground to controller.
2. Controller memory defect.

**Solution:**

Verify power and ground to the controller. Perform radar calibration per the operators manual.

1. Make sure the controller has a good connection (CN-2) to the battery and is properly grounded.
2. Perform the radar calibration for the instrumentation controller per the operators manual.
3. Clear the fault code. Turn the key switch OFF, then ON. If the same fault code appears again, replace the instrumentation controller.

## FAULT CODE INST 10036

### Controller Memory Error - Loss of Valid Timer Information

**Cause:**

Controller memory error: Loss of area, distance and timer information.

**Possible failure mode:**

1. Intermittent power supply or ground to controller.
2. Controller memory defect.

**Solution:**

Verify power and ground to the controller. Reset area, distance and timer values.

1. Make sure the controller has a good connection (CN-2) to the battery and is properly grounded.
2. Reset area, distance and timer values (see the operators manual instructions).
3. Clear the fault code. Turn the key switch OFF, then ON. If the same fault code appears again, replace the instrumentation controller.

**NOTE:** *See schematic sections 24 through 26 of the poster schematic.*

## **FAULT CODE INST 10037**

### **Controller Memory Error - Loss of Valid Implement Width Information**

**Cause:**

Controller memory error: Loss of implement width information.

**Possible failure mode:**

1. Intermittent controller - power supply or ground.
2. Controller memory defect.

**Solution:**

Verify power and ground to the controller. Adjust the implement width.

1. Make sure the controller has a good connection (CN-2) and the battery is properly grounded.
2. Adjust the implement width (see the operators manual for instructions).
3. Clear the fault code. Turn the key to OFF then to ON. If the same fault code appears again replace the instrument cluster.

**NOTE:** See *schematic sections 24 through 26 of the poster schematic.*

## **FAULT CODE INST 10038**

### **Controller Memory Error - Loss of Valid Remote Timer Information**

**Cause:**

Controller memory error: Loss of remote hydraulic timer values.

**Possible failure mode:**

1. Intermittent controller - power supply or ground.
2. Controller memory defect.
3. Remote hydraulic timer value out of range.

**Solution:**

Verify power and ground to the controller. Adjust the remote hydraulic timer values.

1. Make sure the controller has a good connection (CN-2) and the battery is properly grounded.
2. Adjust the remote hydraulic timer values (see the operators manual for instructions). Make sure timers are within a valid range as defined in the operator manual.
3. Clear the fault code. Turn the key to OFF then to ON. If the same fault code appears again replace the instrument cluster.

**NOTE:** See *schematic sections 24 through 26 of the poster schematic.*

## FAULT CODE INST 11011

### Fuel Level Sensor Signal Too Low

**Cause:**

Fuel level sensor signal voltage out of range low (The signal was below 0.125 volts for 1 second).

**Possible failure mode:**

1. Fuel level sensor failure.
2. Fuel level sensor wiring harness problems.
3. Instrument controller failure.

**Solution:**

Check the fuel sensor resistance and the wiring from the instrumentation controller to the fuel level sensor.

1. Test the resistance of the fuel level sensor: Locate the fuel level sensor on the top of the fuel tank.  
Disconnect connector C066 from the fuel level sensor. Clean the connection. Clean the mating pin and connector. Inspect pin A,B, and C in the connector.  
Clean the connection. Clean the mating pin and the connector.  
Validate that the sensor is getting 8 volts at its power supply input at pin A.  
If there is 8 volts, go to step 2.  
If not, then check for 8 volts out of the instrument controller pin 21 at connector CN-2.  
If there is not 8 volts at the controller, pull pin 21 terminal out to determine if 8 volts is present on the controller pin when pin wire 21 is not connected.

**NOTE:** *Use the correct tool to remove pins from connectors.*

If 8 volts is present, then go to step 4 and check for shorts to ground in the harness.

If there is not 8 volts, then replace the instrument controller.

2. Check the sensor ground.  
Measure the continuity between pin C of connector C066 and the chassis ground. If there is good continuity (less than 1 ohm), go to the next step.  
If there is not good continuity, go to step 4.
3. Check the function of the fuel level sensor.  
Validate that the sensor output voltage is greater than 0.125 volts at pin B of connector C066.  
The power supply to the fuel sensor is 8VDC from connector CN-2 cavity 21 of the instrument controller. When the fuel tank is empty, the fuel level signal from pin B should be around 0.25 V. When the fuel tank is full, the fuel level signal from pin B should be around 4.50 V. A straightforward way of testing the fuel sender is to put the sender into a tall oil container and watch the voltage change when the sender is at different depths.  
If the signal is out of range, replace the fuel level sender.  
If the signal is within range, validate that the voltage signal is present at the instrument controller input pin 22 at connector CN-1.  
If no voltage is present at the controller, locate and repair an open circuit in the wire harness signal line.
4. Check the wiring from the fuel level sensor connector C066 to both connectors CN-1 and CN-2 at the instrument controller. There should be 8 VDC power at supply pin A of C066 when the tractor key is in the ON position. There should be good continuity between pin C of C066 and the clean ground.  
There should be good continuity between pin B of connector C066 and pin 22 of connector CN-1.  
There should be good continuity between pin A of connector C066 and pin 21 of connector CN-2. If there is any open circuit, check the continuity from connector C066 to C060 to CN-1 and CN-2 at controller to locate the problem.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

## FAULT CODE INST 12011

### Communication Lost With Armrest Controller

**Cause:**

Communication lost between the instrumentation controller and the armrest controller.

**Possible failure modes:**

1. Bad connection between the instrumentation controller and the armrest controller.
2. Controller failure

**Solution:**

Make sure both the armrest controller and the instrument controller function properly. Check the data bus connections.

1. Check the function of the Armrest controller.
  - A. Make sure the connector C137 is plugged in to the armrest controller.
  - B. Check the LED lamp on the armrest controller.
    - LED lamp on - failed controller, replace the controller.
    - LED lamp flashing - controller is OK.
    - LED lamp off - no power to the controller, check the power supply and its fuse.

**NOTE:** *The LED lamp for the armrest controller is located on the controller circuit board. It can be seen by looking through the opening next to connector C137 from the rear of the armrest.*

2. Check the function of the Instrument controller.
  - A. If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse and the ground to the controller. Make sure the connectors CN-1 and CN-2 to the instrumentation controller are plugged in.
  - B. If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is most likely the instrument controller has failed. Replace the instrument controller.
  - C. If the display is normal, go to number 3.
3. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.

4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

- A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.
  - At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.
  - At cavity B, the green wire, it should read from 2.2 to 2.5 volts.If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
- B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.
  - Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.
  - With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.
    - At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.
    - At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.
  - If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *When there is a bad connection along the Data Bus wiring, this fault code will be accompanied by multiple fault codes such as TRANS 12011 and 12031, INST 12011 and 12031.*

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18.*

## FAULT CODE INST 12043

### Communication Lost With Data Bus and all Other Controllers

**Cause:**

The instrumentation controller has found that it cannot communicate with the Data Bus.

**Possible failure modes:**

1. Data Bus is not powered.
2. Data Bus is shorted.
3. Passive terminator failed.

**Solution:**

Make sure the instrumentation controller is properly connected with the Data Bus.

Check the Data Bus function.

1. Check the function of the instrument controller.
  - A. If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse and the ground to the controller. Make sure the connectors CN-1 and CN-2 to the instrumentation controller are plugged in.
  - B. If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is most likely the instrument controller has failed. Replace the instrument controller.
  - C. If the display is normal, go to number 2.
2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.  
At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.  
Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.
4. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
5. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.

- A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *When there is a bad connection along the Data Bus wiring, this fault code will be accompanied by multiple fault codes such as TRANS 12011 and 12031, INST 12011 and 12031.*

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18.*

## FAULT CODE INST 12051

### Communication Lost With Aux/Hitch/PTO Controller

**Cause:**

Communication lost between the instrumentation controller and the Aux/Hitch/PTO controller.

**Possible failure modes:**

1. Bad connection between the instrumentation and Aux/Hitch/PTO controller.
2. Controller failure.

**Solution:**

Make sure both the Aux/Hitch/PTO controller and the instrumentation controller are functioning properly.  
Check the Data Bus connections.

1. Check the function of the Aux/Hitch/PTO controller.  
Make sure all connectors C053, C054, C055, C056, C057 and C058 are plugged in to the Aux/Hitch/PTO controller.
2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the function of the instrument controller.
  - A. If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse and the ground to the controller. Make sure the connectors CN-1 and CN-2 to the instrumentation controller are plugged in.
  - B. If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is most likely the instrument controller has failed. Replace the instrument controller.
  - C. If the display is normal, go to number 3.
4. Check the Tractor Data Bus at the can bus resistor terminators.  
The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.
  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.  
At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.  
Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.
5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.



- A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *When there is a bad connection along the Data Bus wiring, this fault code will be accompanied by multiple fault codes such as TRANS 12011 and 12031, INST 12011 and 12031.*

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18.*

## FAULT CODE INST 12071

### Communication Lost With Transmission Controller

**Cause:**

Communication is lost between the instrumentation controller and the transmission controller.

**Possible failure mode:**

1. Bad connection between instrumentation controller and transmission controller.
2. Controller failure.

**Solution:**

Make sure both the transmission controller and the instrumentation controller are functioning properly.  
Check the Data Bus connections.

1. Check the function of the transmission controller.
  - A. Make sure all the connectors C350, C351, C353 and C355 are plugged in to the transmission controller.
2. Check the function of the instrument controller.
  - A. If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse and the ground to the controller. Make sure the connectors CN-1 and CN-2 to the instrumentation controller are plugged in.
  - B. If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is most likely the instrument controller has failed. Replace the instrument controller.
  - C. If the display is normal, go to number 3.
3. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.  
At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.  
Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.
5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.

- A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *When there is a bad connection along the Data Bus wiring, this fault code will be accompanied by multiple fault codes such as TRANS 12011 and 12031, INST 12011 and 12031.*

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18.*

## FAULT CODE INST 12091

### Communication Lost With Engine Controller

**Cause:**

Communication lost between the instrumentation controller and the engine controller.

**Possible failure modes:**

1. Bad connection between the instrumentation controller and the engine controller.
2. Controller failure.

**Solution:**

Make sure both the engine controller and the instrumentation controller are functioning properly.

Check the Data Bus connections.

1. Check the function of the engine controller.
  - A. Make sure the connector to the engine controller is plugged in and the Data Bus connectors are all properly connected.
  - B. If the engine controller is correctly connected with the Data Bus, then the fuel lift pump will buzz when the key switch is turned to the ON position. If the fuel lift pump does not make noise with the key on, replace the engine controller.

**NOTE:** *Refer to the engine controller troubleshooting procedures.*

2. Check the function of the instrument controller.
  - A. If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse and the ground to the controller. Make sure the connectors CN-1 and CN-2 to the instrumentation controller are plugged in.
  - B. If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is most likely the instrument controller has failed. Replace the instrument controller.
  - C. If the display is normal, go to number 3.
3. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.

4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

- A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.  
At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
- B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.  
Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *When there is a bad connection along the Data Bus wiring, this fault code will be accompanied by multiple fault codes such as TRANS 12011 and 12031, INST 12011 and 12031.*

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18.*

## FAULT CODE INST 12111

### Communication Lost With ATC Controller

**Cause:**

The instrumentation controller has found that it cannot communicate with the ATC Controller.

**Possible failure modes:**

1. Data Bus is not powered.
2. Data Bus is shorted.
3. Passive terminator failed.
4. Cab pressure blower relay failed.

**Solution:**

Replace the cab pressure blower relay with a known good relay. Replace the relay if fault code can now be erased.

Make sure the instrumentation controller is properly connected with the Data Bus.

Check the Data Bus function.

1. Check the function of the instrument controller.
  - A. If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse and the ground to the controller. Make sure the connectors CN-1 and CN-2 to the instrumentation controller are plugged in.
  - B. If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is most likely the instrument controller has failed. Replace the instrument controller.
  - C. If the display is normal, go to number 2.
2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.

Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.

With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.

At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

4. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
5. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *When there is a bad connection along the Data Bus wiring, this fault code will be accompanied by multiple fault codes such as TRANS 12011 and 12031, INST 12011 and 12031.*

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18.*

## **FAULT CODE INST 13010**

### **Engine Coolant Temperature Sensor Failed in Engine Controller**

**Cause:**

The Data Bus signaled that engine coolant temperature data is in error or not available from the engine controller.

**Possible failure modes:**

1. Engine coolant temperature sensor failed in the engine controller.
2. The engine controller is configured into the instrumentation controller when there is no engine controller.
3. Software execution error in the engine controller.

**Solution:**

This fault code is for the tractors equipped with an engine controller. The instrumentation controller received the coolant temperature signal from the engine controller though the Data Bus.

1. Make sure the engine is running properly.
2. Recalibrate the instrumentation cluster if there is no engine controller but the system was calibrated as with the engine controller.
3. Refer to the engine diagnosing procedures for coolant temperature error troubleshooting.

Fault codes ENG 32, 33, 34, 35, 36, 109, and 119 are coolant temperature related.



**FAULT CODE INST 13011****Engine Coolant Temperature Sensor Signal Too Low****Cause:**

Engine coolant temperature sensor voltage out of range low.

**Possible failure modes:**

1. Engine coolant temperature sensor failed.
2. Engine coolant temperature sensor wiring harness problems (short to ground).
3. Instrument controller failure.

**Solution:**

Check the engine coolant temperature sensor resistance, the instrumentation controller and the wiring to the engine coolant temperature sensor.

1. Test the resistance of the engine coolant temperature sensor.  
Open up the tractor hood and locate the engine coolant temperature sensor.  
Disconnect connector C215 from the engine coolant temperature sensor.  
Inspect the connector and clean the connection.  
Measure the sensor resistance between the connection and the chassis ground as shown in the table below.

<u>Temp Deg F</u>	<u>Ohms</u>
0	24K
10	18K
50	5.5K
70	3.3K
90	2K
110	1.3K
130	835

If the resistance is not as specified, replace the engine coolant temperature sensor.

If it is as specified, go to the next Step.

2. Check the wiring from the engine coolant temperature sensor to connector C061 at the instrumentation controller.

The power supply at the engine coolant temperature sensor connector should be about 5 VDC when the tractor key is in the 'ON' position.

There should be good continuity from the engine coolant temperature sensor connector C215A to the cavity 5 of C060 and then to the cavity 7 of C061.

Check for an open circuit or short to ground.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**FAULT CODE INST 13012****Engine Coolant Temperature Sensor Signal Too High****Cause:**

Engine coolant temperature sensor voltage out of range high.

**Possible failure modes:**

1. Engine coolant temperature sensor failed.
2. Engine coolant temperature sensor wiring harness problems (open circuit, short to power).
3. Instrument controller failure.

**Solution:**

Check the engine coolant temperature sensor resistance, the instrumentation controller and the wiring to the engine coolant temperature sensor.

1. Test the resistance of the engine coolant temperature sensor.  
 Open up the tractor hood and locate the engine coolant temperature sensor.  
 Disconnect connector C215 from the engine coolant temperature sensor.  
 Inspect the connector. Clean the connection.  
 Measure the sensor resistance between the connection and the chassis ground as shown in the table below.

<u>Temp Deg F</u>	<u>Ohms</u>
0	24K
10	18K
50	5.5K
70	3.3K
90	2K
110	1.3K
130	835

If the resistance is not as specified, replace the engine coolant temperature sensor.

If it is as specified, go to the next Step.

2. Check the wiring from the engine coolant temperature sensor to connector C061 at the instrumentation controller.

The power supply at the engine coolant temperature sensor connector should be about 5 VDC when the tractor key is in the 'RUN' position.

There should be good continuity from the engine coolant temperature sensor connector C215A to the cavity 5 of C060 and then to the cavity 7 of C061.

Check for an open circuit and shortage to power.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**FAULT CODE INST 13021****Transmission Oil Temperature Sensor Signal Too Low****Cause:**

Transmission oil temperature sensor voltage out of range low.

**Possible failure modes:**

1. Transmission oil temperature sensor failed.
2. Transmission oil temperature sensor wiring harness problems (short to ground).
3. Instrument controller failure.

**Solution:**

Check the transmission oil temperature sensor resistance, the instrumentation controller and the wiring from the instrumentation controller to the transmission oil temperature sensor.

1. Test the resistance of the transmission oil temperature sensor  
 Locate the transmission oil temperature sensor at the transmission oil filter.  
 Disconnect connector C089 from the transmission oil temperature sensor.  
 Inspect the connector. Clean the connection.  
 Measure the sensor resistance between the connection and the chassis ground as shown in the table below.

<u>Temp Deg F</u>	<u>Ohms</u>
0	24K
10	18K
50	5.5K
70	3.3K
90	2K
110	1.3K
130	835

If the resistance is not as specified, replace the transmission oil temperature sensor.

If it is as specified, go to the next Step.

2. Check the wiring from the transmission oil temperature sensor C89 pin 1 to connector C60 pin 22 to connector CN-1 pin 24 at the instrumentation controller.  
 The power supply at the transmission oil temperature sensor connector should be about 5 VDC when the tractor key is in the 'ON' position.  
 There should be good continuity from the transmission oil temperature sensor connector to the cavity 22 of C060 and then to the cavity 24 of CN-1.  
 Check for an open circuit or short to the ground.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.

**FAULT CODE INST 13022****Transmission Oil Temperature Sensor Signal Too High****Cause:**

Transmission oil temperature sensor voltage out of range high.

**Possible failure modes:**

1. Transmission oil temperature sensor failed.
2. Transmission oil temperature sensor wiring harness problems (open circuit, short to power).
3. Instrument controller failure.

**Solution:**

Check the transmission oil temperature sensor resistance, the instrumentation controller and the wiring from the instrumentation controller to the transmission oil temperature sensor.

1. Test the resistance of the transmission oil temperature sensor.  
 Locate the transmission oil temperature sensor at the transmission oil filter.  
 Disconnect connector C089 from the transmission oil temperature sensor.  
 Inspect the connector. Clean the connection.  
 Measure the sensor resistance between the connection and the chassis ground as shown in the table below.

<u>Temp Deg F</u>	<u>Ohms</u>
0	24K
10	18K
50	5.5K
70	3.3K
90	2K
110	1.3K
130	835

If the resistance is not as specified, replace the transmission oil temperature sensor.

If it is as specified, go to the next Step.

2. Check the wiring from the transmission oil temperature sensor C89 pin 1 to connector C60 pin 22 to connector CN-1 pin 24 at the instrumentation controller.  
 The power supply at the transmission oil temperature sensor connector should be about 5 VDC when the tractor key is in the 'ON' position.  
 There should be good continuity from the transmission oil temperature sensor connector to the cavity 22 of C060 and then to the cavity 24 of CN-1.  
 Check for an open circuit or short to the ground.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.

## **FAULT CODE INST 13040**

### **Air Intake Temperature Sensor Failed in Engine Controller**

**Cause:**

The Data Bus signaled that the air to air intake temperature data is in error or not available from the engine controller.

**Possible failure modes:**

1. Air to air intake sensor failed in the engine controller.
2. The engine controller is configured in the instrumentation controller when there is no engine controller.
3. Software execution error in the engine controller.

**Solution:**

This fault code is for the tractors equipped with an engine controller. The instrumentation controller received the air to air intake temperature signal from the engine controller through Data Bus.

1. Make sure the engine is running properly.
2. Recalibrate the instrumentation controller if there is no engine controller but the system was calibrated as with the engine controller.
3. Refer to engine diagnosing procedures for air to air intake temperature fault troubleshooting.

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

**FAULT CODE INST 13051****Air To Air Intake Temperature Sensor Signal Too Low****Cause:**

Air to air intake temperature sensor voltage out of range low.

**Possible failure modes:**

1. Air to air intake oil temperature sensor failed.
2. Air to air intake oil temperature sensor wiring harness problems (short to ground).
3. Instrument controller failure.

**Solution:**

Check the air to air intake temperature sensor resistance, the instrumentation controller and the wiring from the instrumentation controller to the air to air intake temperature sensor.

1. Test the resistance of the air to air intake temperature sensor.  
 Open the tractor hood and locate the air to air intake temperature sensor.  
 Disconnect connector C075 from the air to air intake temperature sensor.  
 Inspect pin A and B in the connector. Clean the connection. Clean the mating pin and the connector.  
 Use the table below and measure the sensor resistance between pin A and pin B.

<u>Temp Deg C</u>	<u>Ohms</u>
0	32650
5	25390
10	19900
15	15710
20	12940
25	1000
30	8057

If the resistance is not as specified, replace the air to air intake temperature sensor.

If it is as specified, go to the next Step.

2. Check the wiring from the air intake temperature sensor to connector C061 at the instrumentation controller.  
 The power supply at the pin A of the air to air intake temperature sensor connector should be about 5 VDC when the tractor key is in the 'ON' position.  
 There should be good continuity from pin A of C075 to pin 8 of connector C334 to cavity 26 of connector C060 and then to cavity 17 of connector C061.  
 There should be good continuity between pin B of C075 and the clean ground.  
 Check for open circuit and shortage to ground.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**FAULT CODE INST 13052****Air To Air Intake Temperature Sensor Signal Too High****Cause:**

Air to air intake temperature sensor voltage out of range high.

**Possible failure modes:**

1. Air to air intake oil temperature sensor failed.
2. Air to air intake oil temperature sensor wiring harness problems (open circuit, short to power).
3. .Instrument controller failure.

**Solution:**

Check the air to air intake temperature sensor resistance, the instrumentation controller and the wiring from the instrument controller to the air to air intake temperature sensor.

1. Test the resistance of the air to air intake temperature sensor.  
Open the tractor hood and locate the air to air intake temperature sensor.  
Disconnect connector C075 from the air to air intake temperature sensor.  
Inspect pin A and B in the connector. Clean the connection. Clean the mating pin and the connector.  
Use the table below and measure the sensor resistance between pin A and pin B.

Temp Deg C	Ohms
0	32650
5	25390
10	19900
15	15710
20	12940
25	1000
30	8057

If the resistance is not as specified, replace the air to air intake temperature sensor.

If it is as specified, go to the next Step.

2. Check the wiring from the air intake temperature sensor to connector C061 at the instrumentation controller.  
The power supply at the pin A of the air to air intake temperature sensor connector should be about 5 VDC when the tractor key is in the 'ON' position.  
There should be good continuity from pin A of C075 to pin 8 of connector C334 to cavity 26 of connector C060 and then to cavity 17 of connector C061.  
There should be good continuity between pin B of C075 and the clean ground.  
Check for open circuit and shortage to ground.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

## **FAULT CODE INST 53001**

### **Standard Instrumentation Configuration Is Incorrect**

**Cause:**

This fault code is recorded if any controller is detected on the Data Bus but was not set to exist in the instrument controller configuration menu.

**Possible failure mode:**

1. A controller is added to the Data Bus but the instrumentation controller is not recalibrated.
2. The standard instrumentation is calibrated without selecting all the controllers on the Data Bus.

**Solution:**

Repeat controller configuration for the instrument controller. Validate that all the correct controllers are set to exist. If desired, use the AUTO menu selection. It will automatically set the controller configuration in the instrument controller based on Data Bus information.

## **FAULT CODE INST 53005**

### **Engine shutdown activated**

**Cause:**

This fault code is recorded if the engine shutdown is activated

**Possible failure mode:**

1. Engine shutdown was activated.

**Solution:**

See operator manual for more information regarding engine shutdown feature.

## **FAULT CODE INST 65535**

### **Memory Not Cleared From The Factory**

**Cause:**

The instrumentation controller memory has not been cleared from the factory.

**Solution:**

This is a "non fault" fault. Clear the fault code from the controller.





# **Section 55**

## **Chapter 3**

**AUX / HITCH / PTO FAULT CODES**

**TRACTOR MULTI FUNCTION (TMF) CONTROLLER**

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## AUX/HITCH/PTO FAULT CODE 2

### Hitch Raise Solenoid Shorted To 12 Volts

**Cause:**

The hitch raise solenoid or its wiring is shorted to 12 volts.

**Possible failure modes:**

1. Wiring from the hitch controller to the hitch raise solenoid shorted to 12 volts.
2. Hitch raise solenoid failure.

**Solution:**

Check the hitch raise solenoid resistance and the continuity from the hitch controller to the hitch raise solenoid.

1. Test the hitch raise solenoid resistance at the hitch controller connectors C058 and C053.

Remove the controller cover from the rear of the tractor.

Disconnect connectors C058 and C053 from the hitch controller.

Inspect C058, pin 4 and C053, pin 5. Clean the connections.

Clean the mating pin and connector.

Test continuity between pin 4 and pin 5. The resistance should be:

Approximately 5.1 ohms at - 40 C (-40 F).

Approximately 6.9 ohms at 25 C (77 F).

Approximately 9.5 ohm at 100 C (212 F).

If the hitch raise solenoid resistance is not in the range, go to step 2.

If it is as specified, start the engine and test the hitch again.

If fault code is recorded again, check the function of the hitch controller.

If not, problem fixed.

2. Test the hitch raise solenoid resistance at the hitch raise solenoid connector (C151).

Test continuity between pin 1 and pin 2. The resistance should be:

Approximately 5.1 ohms at - 40 C (-40 F).

Approximately 6.9 ohms at 25 C (77 F).

Approximately 9.5 ohm at 100 C (212 F).

If the hitch raise solenoid resistance is not in the range, replace the solenoid.

If it is as specified, wiring problem. Go to step 3.

3. Check the wiring harness from connector C058 and C053 to C151 for shortage to 12 volts.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 4

### Hitch Raise Solenoid Failed Open Or Shorted To Ground

**Cause:**

The hitch raise solenoid or its wiring has failed open or is shorted to ground.

**Possible failure modes:**

1. Wiring from the hitch controller to the hitch raise solenoid has open circuit or short to ground.
2. Hitch raise solenoid failure.

**Solution:**

Check the hitch raise solenoid resistance and the continuity from the hitch controller to the hitch raise solenoid.

1. Test the hitch raise solenoid resistance at the hitch controller connectors C058 and C053.  
Remove the controller cover from the rear of the tractor.  
Disconnect connectors C058 and C053 from the hitch controller.  
Inspect C058, pin 4 and C053, pin 5. Clean the connections.  
Clean the mating pin and connector.  
Test continuity between pin 4 and pin 5. The resistance should be:  
Approximately 5.1 ohms at - 40 C (-40 F).  
Approximately 6.9 ohms at 25 C (77 F).  
Approximately 9.5 ohm at 100 C (212 F).  
If the hitch raise solenoid resistance is not in the range, go to step 2.  
If it is as specified, start the engine and test the hitch again.  
If fault code is recorded again, check the function of the hitch controller.  
If not, problem fixed.
2. Test the hitch raise solenoid resistance at the hitch raise solenoid connector (C151).  
Test continuity between pin 1 and pin 2. The resistance should be:  
Approximately 5.1 ohms at - 40 C (-40 F).  
Approximately 6.9 ohms at 25 C (77 F).  
Approximately 9.5 ohm at 100 C (212 F).  
If the hitch raise solenoid resistance is not in the range, replace the solenoid.  
If it is as specified, wiring problem. Go to step 3.
3. Check the wiring harness from connector C058 and C053 to C151 for open circuit or short to ground.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 5

### Hitch Lower Solenoid Shorted To 12 Volts

**Cause:**

The hitch lower solenoid or its wiring is shorted to 12 volts.

**Possible failure modes:**

1. Wiring from the hitch controller to the hitch lower solenoid shorted to 12 volts.
2. Hitch lower solenoid failure.

**Solution:**

Check the hitch lower solenoid resistance and the continuity from the hitch controller to the hitch lower solenoid.

1. Test the hitch lower solenoid resistance at the hitch controller connectors C058 and C053.

Remove the controller cover from the rear of the tractor.

Disconnect connectors C058 and C053 from the hitch controller.

Inspect C058, pin 5 and C053, pin 12. Clean the connections.

Clean the mating pin and connector.

Test continuity between pin 5 and pin 12. The resistance should be:

Approximately 5.1 ohms at - 40 C (-40 F).

Approximately 6.9 ohms at 25 C (77 F).

Approximately 9.5 ohm at 100 C (212 F).

If the hitch lower solenoid resistance is not in the range, go to step 2.

If it is as specified, start the engine and test the hitch again.

If fault code is recorded again, check the function of the hitch controller.

If not, problem fixed.

2. Test the hitch lower solenoid resistance at the hitch lower solenoid connector (C151).

Test continuity between pin 1 and pin 2. The resistance should be:

Approximately 5.1 ohms at - 40 C (-40 F).

Approximately 6.9 ohms at 25 C (77 F).

Approximately 9.5 ohm at 100 C (212 F).

If the hitch lower solenoid resistance is not in the range, replace the solenoid.

If it is as specified, wiring problem. Go to step 3.

3. Check the wiring harness from connector C058 and C053 to C151 for shortage to 12 volts.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 7

### Hitch Raise/Lower Solenoids Circuit Failed Open, Or Short To Ground

**Possible failure mode:**

1. Wiring problem from the hitch controller to the solenoids.
2. Both raise and lower solenoids failed.

**Solution:**

The chance for both raise and lower solenoids to fail at the same time is rare. If fault code hitch 4 exists, check the single solenoid resistance and its wiring harness. If no other code exists, check the hitch valve wiring.

1. Check for fault code 4. If it exists, follow its corresponding diagnosing procedures.
2. If fault code 4 does not show up. Check the wiring harness from connector C058 and C053 to C151 for an open circuit or short to ground.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *If the problem is intermittent, it may be caused by temperature change on a progressively deteriorating controller. Some shortages are intermittent at initial stage.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 11

### AUX/Hitch/PTO Controller is Disconnected from Can Bus

**Cause:**

AUX/Hitch/PTO controller has found that it cannot communicate with the Tractor Data Bus.

**Possible failure modes:**

1. Tractor Data Bus does not have power or ground.
2. Tractor Data Bus is shorted to power or ground.
3. Resistor Terminator failed.
4. AUX/Hitch/PTO controller failed.

**Solution:**

Make sure the AUX/Hitch/PTO controller and Tractor Data Bus are functioning properly.

1. Check the connection to the AUX/Hitch/PTO controller.
  - A. Make sure connector C053 is firmly connected to the AUX/Hitch/PTO controller (right center connector).
  - B. Make sure the AUX/Hitch/PTO controller has a good connection to the TDB. With the key switch in the ON position and connector C053 disconnected, measure the voltage between the TDB high and low wires and clean ground. TDB high (cavity 15) should measure from 2.5 to 2.8 volts. TDB low (cavity 16) should measure from 2.2 to 2.5 volts.
    - a) If both voltages are within specification and no other controllers show communication fault codes (except the AUX/Hitch/PTO controller) then clear the fault code. If the fault code returns, then replace the controller.
    - b) If both voltages are zero, go to Step 2.
    - c) If the voltages are low or high, go to Step 3.

**NOTE:** Check the Tractor Data Bus wiring from Splice CHA2 to connector C335 and onto connector C053 at AUX/Hitch/PTO Controller for damage, etc. before testing the entire data bus. Gently pull on the TDB high and low wires in cavities 15 and 16 to ensure that the terminals are fully seated and wires are not broken.

2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed. See step 4.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.

Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.

With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.

At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

4. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
5. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *Also see the Tractor Data Bus schematic foldout on the schematic poster.*

**NOTE:** *See schematic sections 24 through 26 and sections 55 through 58 on the schematic poster.*

**NOTE:** *See schematic section 51 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 12

### Communication Lost With The Armrest Controller

**Cause:**

AUX/Hitch/PTO controller is not receiving or recognizing information from the armrest controller.

**Possible failure modes:**

1. Bad connection between AUX/Hitch/PTO controller and the armrest controller.
2. Controller failure.

**Solution:**

Make sure both the armrest controller and the AUX/Hitch/PTO controller are functioning OK.

Check the Data Bus connections.

1. Check the function of the AUX/Hitch/PTO controller.
  - a) Make sure the connectors to the AUX/Hitch/PTO controller are plugged in.
2. Check the function of the armrest controller.
  - a) Make sure the connector C137 to the armrest controller is plugged in.
  - b) Check the LED light on the armrest controller.

LED light on - failed controller, replace the controller.

LED light flashing - controller is OK.

LED off - no power to controller, check power supply and its fuse.

**NOTE:** *The LED light for the armrest controller is located on the controller circuit board. It can be seen by looking through the space besides connector C137 from the rear of the armrest. In bright conditions cover the back of the armrest to block out light.*

3. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.

Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.

With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.

At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.
5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.

- A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.

**NOTE:** Also see the Data Bus schematic foldouts 12 through 18 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 14

### 5 Volt Reference is Above the Upper Voltage Limit

**Cause:**

The 5 volt reference voltage is monitored and is consistently greater than 5.8 volts.

**Possible failure mode:**

- 1. Short circuit to 8 or 12 volt power source.

**Solution:**

- 1. Turn the key switch ON. Disconnect connector C055 (center left) on the AUX/Hitch/PTO controller. Use a multimeter to check the voltage from pin 23 on the controller to ground.
  - A. It should read approximately 5 volts. If the reading is good go to step 2.
  - B. If the reading is above 5.8 volts replace the controller.
- 2. Connect C055 back onto the AUX/Hitch/PTO controller. Locate connector C150 (6 pin) at the rear of the tractor, near the AUX/Hitch/PTO connector. Remove the plug if the connector is not in use. Use a multimeter to check the voltage from pin 2 on the controller to ground.
  - A. It should read approximately 5 volts. If the reading is good erase fault code. If the fault code returns it may be a intermittent short in harness between connectors C150 and C055.
  - B. If the reading is above 5.8 volts there is a short to power somewhere between connector C150 and connector C055 at the AUX/Hitch/PTO controller. Locate and repair the short.

## AUX/HITCH/PTO FAULT CODE 15

### 5 Volt Reference is Below the Lower Voltage Limit

**Cause:**

The 5 volt reference voltage is monitored and is consistently less than 4.2 volts.

**Possible failure mode:**

1. Short circuit to ground or an open circuit.
2. No power or ground to AUX/Hitch/PTO controller. Other low voltage fault codes will be recorded.

**Solution:**

1. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
2. Turn the key switch ON. Disconnect connector C055 (center left) on the AUX/Hitch/PTO controller. Use a multimeter to check the voltage from pin 23 on the controller to ground.
  - A. It should read approximately 5 volts. If the reading is good go to step 2.
  - B. If the reading is below 4.2 volts replace the controller.
3. Locate connector C150 (6 pin) at the rear of the tractor, near the AUX/Hitch/PTO connector. Remove the plug if the connector is not in use. Use a multimeter to check for continuity between the harness connector C055 pin 23 to connector C150 pin 2.
  - A. If there is continuity continue with step 3.
  - B. If there is no continuity locate the open circuit and repair.
4. Connect C055 back onto the AUX/Hitch/PTO controller. Use a multimeter to check the voltage from connector C150 pin 2 to ground.
  - A. It should read approximately 5 volts. If the reading is good erase fault code. If the fault code returns it may be a intermittent short to ground, or poor connection between connectors C150 and C055.
  - B. If the reading is below 4.2 volts there is a short to ground, or broken wire somewhere between connector C150 and connector C055 at the AUX/Hitch/PTO controller. Locate and repair the short.



## AUX/HITCH/PTO FAULT CODE 17

### Hitch Position Command Potentiometer Failure

**Cause:**

The Data Bus signaled that the hitch position command potentiometer has failed.  
The hitch controller received the signal from the armrest controller.

**Possible failure modes:**

1. The hitch position command potentiometer failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The hitch position command potentiometer is hard wired to the armrest controller. If the hitch position command potentiometer fails in the armrest controller, the fault code ARM 69 should exist.

1. Check for fault code ARM 69 at the armrest controller. If ARM 69 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** *See schematic section 47 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 18

### Rockshaft Position Potentiometer Is Outside Normal Operating Range

**Cause:**

The hitch rockshaft position potentiometer signal difference between the fully lowered and fully raised position is not within specifications.

**Possible failure modes:**

1. Rock shaft potentiometer failed.
2. Wiring harness damage.
3. Potentiometer's linkage problem.
4. Mechanical interference.

**Solution:**

Make sure there is no mechanical interference in the hitch linkage.

Check for rock shaft potentiometer failure and linkage problems.

1. Check hitch linkage for mechanical interference. Make sure there is no external object that may cause the hitch to be out of range.
2. Check for the linkage problem on the rockshaft potentiometer.
  - a) Check the linkage from the rockshaft to the potentiometer. Make sure it is not loose, damaged, or improperly installed.
  - b) Adjust rockshaft position potentiometer to  $0.80 + 0.10$  volts when hitch is fully lowered.
  - c) Tighten set screw on rockshaft potentiometer.
3. Test the function of the rockshaft potentiometer.

Signal output from 0 to 5 VDC (1/24 volts per degree) at pin B when pin A is connected to power supply and pin C is grounded.

Disconnect the rockshaft potentiometer at C155.

The resistance is about 4 kohm measured across pins A and C.

The resistance increase with clockwise rotation from 0 to about 4 kohm measured across pin B and C.

Turn potentiometer along the full working range, the multimeter reading must be smooth and continuous.
4. Test the wiring harness of the rock shaft potentiometer.
  - a) Disconnect connectors C056, C057 and C058 from the AUX/Hitch/PTO controller. The resistance between C056 pin 18 and C058 pin 2 should be around 4 kohm. The resistance between C057 pin 2 and either C058 pin 2, or C056 pin 18 should change from 0 to 4 kohm as the pot shaft changes position.
  - b) Test the continuities between the following connectors:

C056 pin 18 to C155 pin A

C057 pin 2 to C155 pin B

C058 pin 2 to C155 pin C

The three wires should all have good continuity.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 19

### Upper Limit Potentiometer Failure

**Cause:**

The Data Bus signaled that the upper limit potentiometer has failed.  
The hitch controller received the signal from the armrest controller.

**Possible failure modes:**

1. The upper limit potentiometer failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The upper limit potentiometer is hard wired to the armrest controller. If the upper limit potentiometer fails in the armrest controller, the fault code ARM 149 should exist.

1. Check for fault code ARM 149 at the armrest controller. If ARM 149 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 21

### Load Command Potentiometer Failure

**Cause:**

The Data Bus signaled that the load command potentiometer has failed.  
The hitch controller received the signal from the armrest controller.

**Possible failure modes:**

1. Load command potentiometer in armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The load command potentiometer is hard wired to the armrest controller. If the load command potentiometer fails in the armrest controller, the fault code ARM 79 should exist.

1. Check for fault code ARM 79 at the armrest controller. If ARM 79 exists, follow the corresponding corrective action.
2. Check the function of the armrest controller.

**NOTE:** See schematic section 45 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 22

### Single Draft Pin Sensor Failed When Configured For One Draft Pin Sensor

**Cause:**

The hitch controller has detected a problem with the draft pin signal.

**Possible failure modes:**

1. Draft pin failed.
2. Wiring problem from the hitch controller to the draft pin.

If the problem is intermittent the draft function is disabled until the next engine start up.

**Solution:**

The most effective way of troubleshooting is to use a Y harness to measure the pin signal. The draft pin signal can also be monitored with the service tool. Another way is to check the pin function or the pin wiring directly.

1. Use a Y harness:  
Plug in the Y harness at the draft pin connector. Cavity A is the ground, Cavity B is the draft pin signal, and Cavity C is the power supply (+8 VDC).
  - a) Check the power supply at Cavity C. If the +8 VDC does not present, check the wiring from draft pin to Pin 1 of C059.
  - b) Check the function of the draft pin.  
Replace the pin in any of the following cases:  
No signal output.  
Signal not within 2.95 to 3.05 when there is no load.  
The output does not change with the load change.
2. Use the service tool:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the HITCH DRAFT PIN-RIGHT-VOLTAGE and then ADD. You will be able to monitor the draft pin signal status on the screen.  
The voltage should be 2.95 to 3.05 when there is no load.  
The voltage should change with the load change in the range of 2.3 to 5.3 VDC at -60 KN to 160 KN.
3. Check the function of the draft pin.
  - a) If a spare draft pin is available, unplug the pin connector. Plug in the new pin, clear the fault codes, start the tractor, and enable hitch. Lower and raise the hitch a few times.  
If the fault code is not recorded, the draft pin failed.  
If the fault code is recorded again, check the wiring.
4. Check the wiring from the hitch controller to the draft pin.
  - a) Disconnect the pin connector. At the controller side, check the power supply across Cavity C and A. It should be 8 volts.
  - b) Check the continuity from draft pin connector to C057 and ground wire to C053.
  - c) At the draft pin side, measure the continuity of the pin circuit. The resistance should be 180 kohm across A and C and 18 kohm across B and C.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *The resistances at the draft pin side are for reference only. Incorrect resistance means bad pin but some bad pins may have correct resistances.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 23

### Both Draft Pins Failed

**Cause:**

Both draft pins failed when tractor is configured for two draft pins.

**Possible failure modes:**

1. Draft pin failure.
2. Wiring problem.

If the problem is intermittent, the draft function is disabled until the next engine start up.

**Solution:**

The chance for both draft pins to fail at the same time is rare. If fault code hitch 30 or hitch 31 exists, check the single pin function or its wiring. If none of the codes exists, check the power supply or the ground to the two pins.

1. Check for the single pin fault code hitch 30 or hitch 31. If any exists, follow its corresponding diagnosing procedures.
2. If none of hitch 30 or hitch 31 exists, check the power supply or the ground to the two pins.
  - a) Check the power supply at either left pin connector or right pin connector. There should be +8 volts at cavity C of C153 or cavity C of C154.  
If not, check the continuity from connector C057 pin 25 to the cavity C of the right draft pin connector and from connector C057 pin 31 to the cavity C of the left draft pin connector
  - b) Check the ground to the two pins. There should be continuity between cavity A of either left pin connector or right pin connector and the cavity 23 of C053.  
If not, check the wiring in between.
3. If none of above, check the function of the hitch controller.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 at the rear of this section.*

## AUX/HITCH/PTO FAULT CODE 24

### Communication Lost With The Instrument Controller

**Cause:**

The AUX/Hitch/PTO controller is not receiving or recognizing information from the instrumentation controller.

**Possible failure codes:**

1. Bad connection between AUX/Hitch/PTO controller and the instrument controller.
2. Controller failure.

**Solution:**

Make sure both the instrument controller and the AUX/Hitch/PTO controller functioning OK.

Check the Data Bus connections.

1. Check the function of the AUX/Hitch/PTO controller.
  - a) Make sure the connectors to the AUX/Hitch/PTO controller are plugged in.
2. Check the function of the instrument controller.
  - a) If there is no display and no back light on the tractor instrumentation, it is more likely that there is no power to controller. Check power supply, its fuse, and the ground to the controller. Make sure the connectors CN-1 and CN-2 are properly connected at instrument controller.
  - b) If there is a display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication is lost with the instrument controller, it is likely that the instrument controller has failed. Replace the controller.
  - c) If nothing can be found wrong with the instrument controller, go to step 3.
3. Check the power supply to the Data Bus.

The power supply to the Data Bus is from the switched power through Fuse #42.

  - a) Make sure Fuse #42 is not burned out.
  - b) Turn the tractor Key 'ON'. Check the power supply at Fuse #42. There should be 12 volts. If not, check the power supply from the switched power.
4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed. See step 5.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.

Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.

With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.

At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed. See step 5.
5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.

- A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 25

### Hitch Up/Down Switch Failure

**Cause:**

The Data Bus signaled that the hitch up/down switch has failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. The hitch up/down switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The hitch up/down switch is hard wired to the armrest controller. If the hitch up/down switch fails in the armrest controller, the fault code ARM 1049 should exist.

1. Check for fault code ARM 1049 at the armrest controller. If ARM 1049 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** *See schematic section 46 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 26

### Up/Down Fender Switch Failure

**Cause:**

Hitch UP/DOWN fender switch failure.

**Possible failure modes:**

1. Both switches are pushed together.
2. Switch was pushed before engine start up.
3. Switch was pushed while tractor was moving.
4. Switch Up was pushed when the hitch is against the upper limit setting.
5. Switch Down was pushed when the hitch is against the lower limit setting.

**Solution:**

Fault code should not be there any more when the fender switch is released. If the code is still there, test the fender switch function and its wiring.

1. Make sure the hitch remote switch is not pressed. Check for mechanical interference which may cause the switch be pressed. Shut down the tractor and start it again. Check the fault code in the hitch controller.  
If the fault code is gone, the problem is fixed.  
If the fault code appears again, go to the next step.
2. Test the function of the fender switch.  
Disconnect the fender switch connector. Check the continuities between the cavities.  
There should be no continuity between any two cavities when the switch is not pressed.  
There should be continuity between cavity A and B when the down switch is pressed.  
There should be continuity between cavity C and B when the up switch is pressed.  
For tractor with fender extension, check the two switches on the fender too.
3. If none of above, test the wiring from the AUX/Hitch/PTO controller C053 and C057 to the fender switches.  
The three wires should have good continuity from end to end, and no shortage between wires.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 28

### Travel Range Potentiometer Failure

**Cause:**

The Data Bus signaled that the travel range potentiometer has failed.  
The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. The travel range potentiometer failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The travel range potentiometer is hard wired to the armrest controller. If the travel range potentiometer fails in the armrest controller, the fault code ARM 169 should exist.

1. Check for fault code ARM 169 at the armrest controller. If ARM 169 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 29

### Drop Rate Command Potentiometer Failure

**Cause:**

The Data Bus signaled that the drop rate command potentiometer has failed.  
The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. The drop rate command potentiometer failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The drop rate command potentiometer is hard wired to the armrest controller. If the drop rate command potentiometer fails in the armrest controller, the fault code ARM 159 should exist.

1. Check for fault code ARM 159 at the armrest controller. If ARM 159 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 30

### Right Draft Pin Voltage is Outside The Normal Operating Range

**Cause:**

During calibration, the 'No Load' offset voltage is out of range for right draft pin.

The draft control requires that the 'No load' voltage is 3.00 +/- 0.05 volts to ensure the draft quality.

The hitch controller will check it during calibration.

**Possible failure modes:**

1. Right draft pin failed.
2. Wiring problem from the hitch controller to the right hand draft pin.

**Solution:**

The 'No Load' offset point can be permanently shifted if the draft pin is installed backwards and overloaded. The pin signal can be checked by using a Y harness or using the monitoring screen of the service tool.

If the signal exists but just slightly beyond the range (say in the range 2.3 - 3.7 volts), the wiring is OK, but pin failed. If there is no signal or signal is far beyond the range, it can either be pin failure or wiring problems.

1. Use a Y harness:  
Plug in the Y harness at the pin connector(C153). cavity A is the ground, cavity B is the draft pin signal, and cavity C is the power supply (+8 VDC).
  - a) Check the power supply at cavity C. If the +8 VDC is not present check the wiring from C153 to Pin 1 of C059.
  - b) Check the function of the right draft pin.  
Replace the pin in any of the following cases:  
No signal output.  
Signal not within 2.95 to 3.05 when there is no load.  
The output does not change with the load change.
2. Use the service tool:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the HITCH DRAFT PIN-RIGHT-VOLTAGE and then ADD. You will be able to monitor the right draft pin signal status on the screen.  
The voltage should be 2.95 to 3.05 when there is no load.  
The voltage should change with the load change in the range of 2.3 to 5.3 VDC at -60 KN to 160 KN.
3. Check the function of the draft pin.
  - a) If a spare draft pin is available, unplug the right pin connector. Plug in the new pin, clear the fault codes, start the tractor, and enable hitch. Lower and raise the hitch a few times.  
If the fault code is not recorded, the draft pin failed.  
If the fault code is recorded again, check the wiring.
  - b) If there is neither fault code hitch 4029 nor hitch 4039, that means the left draft pin is working. Use the left pin as the test pin and repeat the above test.
4. Check the wiring from the hitch controller to the right hand draft pin.
  - a) Disconnect the pin connector. At the controller side, check the power supply across cavity C and A. It should be 8 volts.
  - b) Check the continuity from C153 to C059.
  - c) At the draft pin side, measure the continuity of the pin circuit. The resistance should be 180 kohm across A and C and 18 kohm across B and C.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** The resistances at the draft pin side are for reference only. Incorrect resistance means bad pin but some bad pins may have correct resistances.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 31

### Left Draft Pin No Load Offset Voltage Outside Normal Range

See 58

#### Cause:

During calibration, the 'No Load' offset voltage is outside normal range for left draft pin.  
The draft control requires that the 'No load' voltage is 3.00 +/- 0.05 volts to ensure the draft quality.  
The hitch controller will check it during calibration.

#### Possible failure modes:

1. Left draft pin failed.
2. Wiring problem from the hitch controller to the left hand draft pin.

#### Solution:

The 'No Load' offset point can be permanently shifted if the draft pin is installed backward and overloaded. The pin signal can be checked by using a Y harness or using the monitoring screen of the service tool.

If the signal exists but just slightly beyond the range (say in the range 2.3 - 3.7 volts), the wiring is OK, but pin has failed.

If there is no signal or signal is far beyond the range, it can either be pin failure or wiring problems.

1. Use a Y harness:  
Plug in the Y harness at the pin connector(C154). Cavity A is the ground, cavity B is the draft pin signal, and cavity C is the power supply (+8 VDC).
  - a) Check the power supply at cavity C. If the +8 VDC is not present, check the wiring from C154 to Pin 1 of C059.
  - b) Check the function of the left draft pin.  
Replace the pin in any of the following cases:  
No signal output.  
Signal not within 2.95 to 3.05 when there is no load.  
The output does not change with the load change.
2. Use the service tool:  
Go to the Monitor screen, click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the HITCH DRAFT PIN-LEFT-VOLTAGE and then ADD. You will be able to monitor the left draft pin signal status on the screen.  
The voltage should be 2.95 to 3.05 when there is no load.  
The voltage should change with the load change in the range of 2.3 to 5.3 VDC at -60 KN to 160 KN.
3. Check the function of the draft pin.
  - a) If a spare draft pin is available, unplug the pin connector(C154). Plug in the new pin, clear the fault codes, start the tractor, and enable hitch. Lower and raise the hitch a few times.  
If the fault code is not recorded, the draft pin failed.  
If the fault code is recorded again, check the wiring.
  - b) If there is neither fault code hitch 4019 nor hitch 4039, that means the right draft pin is working. Use the right pin as the test pin and repeat the above test.
4. Check the wiring from the hitch controller to the left hand draft pin.
  - a) Disconnect the pin connector(C154). At the controller side, check the power supply across cavity C and A. It should be 8 volts.
  - b) Check the continuity from C154 to C059.

c) At the draft pin side, measure the continuity of the pin circuit. The resistance should be 180 kohm across A and C and 18 kohm across B and C.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *The resistances at the draft pin side are for reference only. Incorrect resistance means a bad pin but some bad pins may have correct resistances.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 32

### Ground Speed Failure, Value Received From Data Bus Indicates Failure Condition

**Cause:**

The Data Bus signaled that the transmission speed sensor has failed.

The AUX/Hitch/PTO controller received the signal from the instrumentation controller.

**Possible failure mode:**

1. The transmission speed sensor failed (in most cases).
2. Software execution error in instrumentation controller (small chance).

**Solution:**

The speed sensor is hard wired to the instrumentation controller. The instrumentation controller sends the wheel (transmission) speed signal to the AUX/Hitch/PTO controller by way of the Data Bus.

1. If the service tool is connected to the tractor, do the following:  
Go to the Monitor screen, click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Select the INST GROUND SPEED - WHEEL and then ADD.  
You will be able to monitor the wheel speed sensor signal on the screen.  
Drive the tractor and watch the signal change when the tractor speed changes.  
If there is no wheel speed signal, go to step 2.  
If there is wheel speed signal, compare it to the speed display on the instrumentation cluster.  
If the speed signal looks fine on service tool but not on the instrumentation cluster, it is more likely a problem with the instrumentation cluster.  
If both signals seem fine, check the function of the AUX/Hitch/PTO controller.
2. Test the resistance of the transmission speed sensor:  
Locate the transmission speed sensor on top of the transmission.  
Disconnect connector C069 from the sensor.  
Inspect the connector. Clean the connection.  
Measure the sensor resistance between pin A and Pin B.  
The resistance should be around 3 k ohms at 20 degree Celsius.  
If the resistance is not in the specified range, replace the transmission speed sensor.  
If it is as specified, go to next step.
3. Check the wiring from the transmission speed sensor to connector C060 and then to connector CN-2 at the instrumentation controller.  
There should be a 5 VDC power supply from pin 12 of CN-2 to pin A of connector C069 when the tractor key is in the 'RUN' position.  
There should be good continuity from pin B of connector C069 to the clean ground.  
Check for open circuit and wiring shortage.

**NOTE:** Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.

4. If none of above, check the function of the instrumentation controller and the AUX/Hitch/PTO controller.

**NOTE:** Also see the Data Bus schematic foldout on the schematic poster.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 33

### Slip Set Switch Failure

**Cause:**

The Data Bus signaled that the slip set switch has failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. The slip set switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The slip set switch is hard wired to the armrest controller. If the slip set switch fails in the armrest controller, the fault code ARM 1059 should exist.

1. Check for fault code ARM 1059 at the armrest controller. If ARM 1059 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** See schematic section 44 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 34

### Slip Select Switch Failure

**Cause:**

The Data Bus signaled that the slip select switch has failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. The slip select switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The slip select switch is hard wired to the armrest controller. If the slip select switch fails in the armrest controller, the fault code ARM 1059 should exist.

1. Check for fault code ARM 1059 at the armrest controller. If ARM 1059 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** See schematic section 44 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 35

### Percent Slip Error

#### Cause:

The percent wheel slip is determined by the difference between the wheel speed and the ground speed. The AUX/Hitch/PTO controller receives the information from the instrumentation controller through the Data Bus.

#### Possible failure modes:

1. Wheel slip sensing (radar gun, wheel speed sensor) failed (in most cases).
2. Percent slip calculation failed in instrumentation controller (small chance).

#### Solution:

The wheel speed sensor and the radar gun (for the ground speed) are hard wired to instrumentation controller. If the problem is with the wheel speed sender, then the AUX/Hitch/PTO fault code 32 and 87 should appear.

If there is no AUX/Hitch/PTO fault code 32 and 87, the problem is more likely with the radar gun. There is also a small chance of instrumentation controller malfunction.

1. Check the wiring of radar gun.
  - Disconnect connector C068 at the radar.
  - The power supply at pin C of connector C068 should be 12 Volts when the tractor key is in the 'RUN' position.
  - There should be good continuity from pin A of connector C068 to the clean ground.
  - Check for open circuit and wiring shortage.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the radar.
  - The signal is from Pin B of the Radar and connected to the pin 13 of the instrument cluster connector CN-1 through Pin 25 of connector C060. The radar will detect the speed of any thing moving in front of it. So a quick hand moving in front of the radar will be an easy way to test the frequency change of the radar signal. Special tools (such as oscilloscope) is needed to check the frequency.
  - If the radar does not work as expected, replace the radar in the following procedures:
    - a. Disconnect the radar wiring.
    - b. Remove the radar from the vehicle.
    - c. Install the new radar.
    - d. Reconnect the wiring and check the function of the new radar.
3. If there is not problem with the radar and its wiring, check the function of the instrumentation controller and the hitch controller.

**NOTE:** *See schematic sections 24, 25 and 26 on the schematic poster.*

## **AUX/HITCH/PTO FAULT CODE 37**

### **The ARU reports EDC Transport Lock is Faulty or Not Available**

**Cause:**

The armrest controller reports to the AUX/Hitch/PTO controller that the Electronic Draft Control transport lock is faulty or unavailable. The transport lock function control is built into the hitch drop rate control potentiometer.

**Possible failure modes:**

1. The hitch drop rate control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The hitch drop rate control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

Most likely AUX/Hitch/PTO fault code 29 and ARM 159 have also been recorded. See ARM 159 troubleshooting.

## **AUX/HITCH/PTO FAULT CODE 41**

### **The ARU Specified Tractor Without Draft Control, But detected Draft Pins**

**Cause:**

During calibration, the hitch controller is calibrated as position control only due to armrest being calibrated as position only even though draft pins were detected.  
Hitch is electrically disabled.

**Solution:**

Check the armrest calibration and correct if necessary. Calibrate the hitch controller again if draft is desired.



## **AUX/HITCH/PTO FAULT CODE 42**

### **Engine Speed Too Low For Hitch Lower Calibration**

**Cause:**

For hitch lower calibration, the engine speed has to be above 1500 RPM. If the engine speed is lower than 1500 RPM during hitch lower calibration, this fault code is recorded.

**Solution:**

1. Be sure the engine speed is above 1500 RPM and recalibrate the hitch.

## **AUX/HITCH/PTO FAULT CODE 43**

### **Hitch Is Calibrated As Position Only**

**Cause:**

During calibration, hitch controller calibrated as position only. The armrest controller is calibrated for draft.

**Solution:**

The armrest calibration and the hitch calibration should match each other for draft or position control. Check the armrest calibration and correct if necessary. Calibrate the hitch controller again if draft is desired.

## **AUX/HITCH/PTO FAULT CODE 44**

### **Calibration Aborted Due To Tractor Moving**

**Cause:**

During calibration, the calibration aborted due to tractor moving.

**Possible failure modes:**

1. Tractor moved during the calibration (in most cases).
2. Tractor speed sensor failure (small chance).

**Solution:**

Make sure the tractor does not move during the calibration.

If the tractor did not move, check the wheel speed sensor.

Refer to fault code hitch 32 for details of wheel speed sensor troubleshooting.

**NOTE:** *In rare cases, external electromagnetic interference may introduce signals and affect the hitch calibration process. If it is suspected to be such a case, try to avoid high electromagnetic interference devices such as welding machine, high voltage transformer, Radio broadcast tower, etc.*

## **AUX/HITCH/PTO FAULT CODE 45**

### **Electronic Draft Control Calibration Aborted Due To Low Engine speed error**

**Cause:**

Hitch calibration attempted when the engine is not running or engine speed signal failed.

**Solution:**

Make sure the engine is running normal during the hitch calibration. If the engine is running properly, check the engine alternator RPM signal from the instrumentation cluster. Refer to fault code INST 3020 for detail on engine speed signal troubleshooting.

## AUX/HITCH/PTO FAULT CODE 47

### PWM Raise Threshold Is Too High During Calibration

**Cause:**

During calibration, PWM threshold to start hitch raising is above the limit (55%).

**Possible failure modes:**

1. Raise solenoid coil resistance is too high.
2. Wire harness or connector problem between hitch raise solenoid and hitch controller.
3. Battery voltage is very low.
4. Hitch valve raise portion is stuck closed.

**Solution:**

Make sure the calibration procedure is correct. Then do the following for troubleshooting.

1. Make sure the battery voltage and the alternator output voltage is above 9.8 volts DC.  
Refer to fault code AUX/Hitch/PTO 65 for battery voltage troubleshooting procedures.
2. Test the hitch raise solenoid coil (C151) and its wiring for high resistance or openings.  
Refer to fault code AUX/Hitch/PTO 4 troubleshooting procedures for details.
3. Make sure there is proper hydraulic pressure to the hitch valve.  
Check for valve failure (solenoid spool or the valve main spool stuck closed).  
Repair or replace the spools or the valve according to the problem.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 48

### PWM Raise Threshold Is Too Low During Calibration

**Cause:**

During calibration, PWM threshold to start hitch raising is below the limit (6%).

**Possible failure modes:**

1. Raise solenoid coil resistance is too low.
2. Battery voltage is very high.
3. Valve failure.

**Solution:**

Make sure the calibration procedure is correct. Then do the following for troubleshooting.

1. Test battery voltage and the alternator output voltage (must be less than 14.7 volts DC).
2. Test raise solenoid coil (C151) for low resistance. The resistance should be 6.4 to 6.8 ohms.  
Refer to fault code AUX/Hitch/PTO 4 troubleshooting procedures for details.
3. Make sure there is proper hydraulic pressure to the hitch valve.  
Check for valve failure (center spring broken, spool too loose).  
Repair or replace the spools or the valve according to the problem.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 50

### Hitch Pot Signal Not Within Expected Range For Maximum Hitch Position

**Cause:**

During calibration full raise current out of range.

**Possible failure modes:**

1. Raise solenoid coil resistance is too low.
2. Battery voltage is very high.

**Solution:**

Make sure the calibration procedure is correct. Then do the following for troubleshooting.

1. Test battery voltage and the alternator output voltage (must be less than 14.7 volts DC).
2. Test raise solenoid coil (C151) and its wiring for shortage. The resistance should be 6.4 to 6.8 ohms.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 51

### Hitch Lower Valve Threshold Is Too High During Calibration

**Cause:**

During calibration, PWM threshold to start hitch lower is above the limit (55%).

**Possible failure modes:**

1. Lower solenoid coil resistance is too high.
2. Wire harness or connector problem between hitch lower solenoid and hitch controller.
3. Battery voltage is very low.
4. Hitch valve lower portion is stuck closed.

**Solution:**

Make sure the calibration procedure is correct. Then do the following for troubleshooting.

1. Make sure the battery voltage and the alternator output voltage is above 9.8 volts DC.  
Refer to fault code AUX/Hitch/PTO 65 for battery voltage troubleshooting procedures.
2. Test the hitch lower solenoid coil (C152) and its wiring for high resistance or openings.  
Refer to fault code AUX/Hitch/PTO 5 troubleshooting procedures for details.
3. Make sure there is proper hydraulic pressure to the hitch valve.  
Check for valve failure (solenoid spool or the valve main spool stuck closed).  
Repair or replace the spools or the valve according to the problem.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 52

### Hitch Lower Valve Threshold Is Too Low During Calibration

**Cause:**

During calibration, PWM threshold to start hitch lower is below the limit (6%).

**Possible failure modes:**

1. Lower solenoid coil resistance is too low.
2. Battery voltage is very high.
3. Valve failure.

**Solution:**

Make sure the calibration procedure is correct. Then do the following for troubleshooting.

1. Test battery voltage and the alternator output voltage (must be less than 14.7 volts DC).
2. Test lower solenoid coil (C152) and its wiring for low resistance.  
Refer to fault code AUX/Hitch/PTO 5 troubleshooting procedures for details.
3. Make sure there is proper hydraulic pressure to the hitch valve.  
Check for valve failure (center spring broken, spool too loose).  
Repair or replace the spools or the valve according to the problem.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 53

### The Time Allowed For Calibration Has Expired

**Cause:**

During calibration the time allowed for calibration has expired.

**Possible failure modes:**

Operator did not acknowledge (within 6 minutes) when hitch is fully lowered during calibration procedure.

**Solution:**

1. Recalibrate the hitch.

## AUX/HITCH/PTO FAULT CODE 54

### Hitch Position Is Not At Minimum

**Cause:**

During calibration, the hitch rockshaft position potentiometer signal at the fully lowered position is not within specifications.

**Possible failure modes:**

1. Mechanical interference prevents hitch from moving fully down.
2. Rock shaft potentiometer failed.
3. Wiring harness damage.
4. Potentiometer's linkage problem.

**Solution:**

Make sure there is no mechanical interference in the hitch linkage.

Check for rock shaft potentiometer failure and linkage problems.

1. Check hitch linkage for mechanical interference. Make sure there is no external object that may prevent the hitch from full down travel.
2. Check for the linkage problem of the rockshaft potentiometer.
  - a) Check the linkage from the rockshaft to the potentiometer. Make sure it is not loose, damaged, or improper installed.
  - b) Adjust rockshaft position potentiometer to 0.80 +/- 0.10 volts when hitch is fully lowered.
  - c) Tighten set screw on rockshaft potentiometer.
3. Test the function of the rockshaft potentiometer.

Signal output from 0 to 5 VDC (1/24 volts per degree) at pin B when pin A is connected to power supply and pin C is grounded.

Disconnect the rockshaft potentiometer at C155.

The resistance is about 4 kohm measured across pins A and C.

The resistance increase with clockwise rotation from 0 to about 4 kohm measured across pin B and C.

Turn potentiometer along the full working range, the multimeter reading must be smooth and continuous.
4. Test the wiring harness of the rock shaft potentiometer.
  - a) Disconnect connectors C056, C057 and C058 from the AUX/Hitch/PTO controller. The resistance between C056 pin 18 and C058 pin 2 should be around 4 kohm. The resistance between C057 pin 2 and either C058 pin 2, or C056 pin 18 should change from 0 to 4 kohm as the pot shaft changes position.
  - b) Test the continuities between the following connectors:

C056 pin 18 to C155 pin A

C057 pin 2 to C155 pin B

C058 pin 2 to C155 pin C

The three wires should all have good continuity.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 55

### Range Of The Hitch Position Is Not Within Specification

**Cause:**

During calibration, the hitch rockshaft position potentiometer signal difference between the fully lowered and fully raised position is not within specifications.

**Possible failure modes:**

1. Rock shaft potentiometer failed.
2. Wiring harness damage.
3. Potentiometer's shaft loose from the lever.
4. Mechanical interference.

**Solution:**

Make sure there is no mechanical interference in the hitch linkage.

Check for rock shaft potentiometer failure and linkage problems.

1. Check hitch linkage for mechanical interference. Make sure there is no external object that may cause the hitch out of range.
2. Check for the linkage problem of the rockshaft potentiometer.
  - a) Check the linkage from the rockshaft to the potentiometer. Make sure it is not loose, damaged, or improper installed.
  - b) Adjust rockshaft position potentiometer to 0.80 +/- 0.10 volts when hitch is fully lowered.
  - c) Tighten set screw on rockshaft potentiometer.
3. Test the function of the rockshaft potentiometer.

Signal output from 0 to 5 VDC (1/24 volts per degree) at pin B when pin A is connected to power supply and pin C is grounded.

Disconnect the rockshaft potentiometer at C155.

The resistance is about 4 kohm measured across pins A and C.

The resistance increase with clockwise rotation from 0 to about 4 kohm measured across pin B and C.

Turn potentiometer along the full working range, the multimeter reading must be smooth and continuous.
4. Test the wiring harness of the rock shaft potentiometer.
  - a) Disconnect connectors C056, C057 and C058 from the AUX/Hitch/PTO controller. The resistance between C056 pin 18 and C058 pin 2 should be around 4 kohm. The resistance between C057 pin 2 and either C058 pin 2, or C056 pin 18 should change from 0 to 4 kohm as the pot shaft changes position.
  - b) Test the continuities between the following connectors:

C056 pin 18 to C155 pin A

C057 pin 2 to C155 pin B

C058 pin 2 to C155 pin C

The three wires should all have good continuity.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 56

### Ratio Of Position Command To Rockshaft Range Is Not Within Specification

**Cause:**

During calibration, the ratio of rockshaft position range to position command potentiometer range is not within specifications.

**Possible failure modes:**

1. Rockshaft potentiometer has failed.
2. Rockshaft potentiometers shaft is loose from the lever.
3. Position command potentiometer failed at the arm controller.
4. Position command potentiometers shaft is loose from the lever.

**Solution:**

Make sure there is no mechanical interference in the hitch linkage.

Check for rockshaft potentiometer failure and hitch linkage problems.

Check for the position command potentiometer function and linkage problems.

1. Check hitch linkage for mechanical interference. Make sure there is no external object that may cause the hitch out of range.
2. Check for the linkage problem of the rockshaft potentiometer.
  - a) Check the linkage from the rockshaft to the potentiometer. Make sure it is not loose, damaged, or improper installed.
  - b) Adjust rockshaft position potentiometer to 0.80 +/- 0.10 volts when hitch is fully lowered.
  - c) Tighten set screw on rockshaft potentiometer.
3. Test the function of the rockshaft potentiometer.

Signal output from 0 to 5 VDC (1/24 volts per degree) at pin B when pin A is connected to power supply and pin C is grounded.

Disconnect the rockshaft potentiometer at C155.

The resistance is about 4 kohm measured across pins A and C.

The resistance increase with clockwise rotation from 0 to about 4 kohm measured across pin B and C.

Turn potentiometer along the full working range, the multimeter reading must be smooth and continuous.
4. Test the wiring harness of the rock shaft potentiometer.
  - a) Disconnect connectors C056, C057 and C058 from the AUX/Hitch/PTO controller. The resistance between C056 pin 18 and C058 pin 2 should be around 4 kohm. The resistance between C057 pin 2 and either C058 pin 2, or C056 pin 18 should change from 0 to 4 kohm as the pot shaft changes position.
  - b) Test the continuities between the following connectors:

C056 pin 18 to C155 pin A

C057 pin 2 to C155 pin B

C058 pin 2 to C155 pin C

The three wires should all have good continuity.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

5. Check for position command potentiometer problem at the arm controller.

Refer to fault code ARM 69 for potentiometer information, routing information, and diagnosing procedures.

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 57

### Right Draft Pin No Load Offset Voltage Out Of Range

**Cause:**

During calibration, the 'No Load' offset voltage is out of range for right draft pin.  
The draft control requires that the 'No load' voltage is 3.00 +/- 0.05 volts to ensure the draft quality.  
The AUX/Hitch/PTO controller will check it during calibration.

**Possible failure modes:**

1. Right draft pin failed.
2. Wiring problem from the AUX/Hitch/PTO controller to the right hand draft pin.

**Solution:**

The 'No Load' offset point can be permanently shifted if the draft pin is installed backwards and overloaded. The pin signal can be checked by using a Y harness or using the monitoring screen of the service tool.  
If the signal exists but just slightly beyond the range (say in the range 2.3 - 3.7 volts), the wiring is OK, but pin failed.  
If there is no signal or signal is far beyond the range, it can either be pin failure or wiring problems.

1. Use a Y harness:  
Plug in the Y harness at the pin connector(C153). cavity A is the ground, cavity B is the draft pin signal, and cavity C is the power supply (+8 VDC).
  - a) Check the power supply at cavity C. If the +8 VDC is not present check the wiring from C153 to Pin 25 of C057.
  - b) Check the function of the right draft pin.  
Replace the pin in any of the following cases:  
No signal output.  
Signal not within 2.95 to 3.05 when there is no load.  
The output does not change with the load change.
2. Use the service tool:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the HITCH DRAFT PIN-RIGHT-VOLTAGE and then ADD. You will be able to monitor the right draft pin signal status on the screen.  
The voltage should be 2.95 to 3.05 when there is no load.  
The voltage should change with the load change in the range of 2.3 to 5.3 VDC at -60 KN to 160 KN.
3. Check the function of the draft pin.
  - a) If a spare draft pin is available, unplug the right pin connector. Plug in the new pin, clear the fault codes, start the tractor, and enable hitch. Lower and raise the hitch a few times.  
If the fault code is not recorded, the draft pin failed.  
If the fault code is recorded again, check the wiring.
  - b) If there is no fault code AUX/Hitch/PTO 23, that means the left draft pin is working. Use the left pin as the test pin and repeat the above test.
4. Check the wiring from the AUX/Hitch/PTO controller to the right hand draft pin.
  - a) Disconnect the pin connector. At the controller side, check the power supply across cavity C and A. It should be 8 volts.
  - b) Check the continuity from C153 to C057 and C053.
  - c) At the draft pin side, measure the continuity of the pin circuit. The resistance should be 180 kohm across A and C and 18 kohm across B and C.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** The resistances at the draft pin side are for reference only. Incorrect resistance means bad pin but some bad pins may have correct resistances.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.



## AUX/HITCH/PTO FAULT CODE 58

### Left Draft Pin No Load Offset Voltage Outside Normal Range

**Cause:**

During calibration, the 'No Load' offset voltage is outside normal range for left draft pin. The draft control requires that the 'No load' voltage is 3.00 +/- 0.05 volts to ensure the draft quality. The AUX/Hitch/PTO controller will check it during calibration.

**Possible failure modes:**

1. Left draft pin failed.
2. Wiring problem from the AUX/Hitch/PTO controller to the left hand draft pin.

**Solution:**

The 'No Load' offset point can be permanently shifted if the draft pin is installed backward and overloaded. The pin signal can be checked by using a Y harness or using the monitoring screen of the service tool.

If the signal exists but just slightly beyond the range (say in the range 2.3 - 3.7 volts), the wiring is OK, but pin has failed.

If there is no signal or signal is far beyond the range, it can either be pin failure or wiring problems.

1. Use a Y harness:  
Plug in the Y harness at the pin connector(C154). Cavity A is the ground, cavity B is the draft pin signal, and cavity C is the power supply (+8 VDC).
  - a) Check the power supply at cavity C. If the +8 VDC is not present, check the wiring from C154 to Pin 31 of C057.
  - b) Check the function of the left draft pin.  
Replace the pin in any of the following cases:  
No signal output.  
Signal not within 2.95 to 3.05 when there is no load.  
The output does not change with the load change.
2. Use the service tool:  
Go to the Monitor screen, click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the HITCH DRAFT PIN-LEFT-VOLTAGE and then ADD. You will be able to monitor the left draft pin signal status on the screen.  
The voltage should be 2.95 to 3.05 when there is no load.  
The voltage should change with the load change in the range of 2.3 to 5.3 VDC at -60 KN to 160 KN.
3. Check the function of the draft pin.
  - a) If a spare draft pin is available, unplug the pin connector (C154). Plug in the new pin, clear the fault codes, start the tractor, and enable hitch. Lower and raise the hitch a few times.  
If the fault code is not recorded, the draft pin failed.  
If the fault code is recorded again, check the wiring.
  - b) If there is no fault code AUX/Hitch/PTO 23, that means the right draft pin is working. Use the right pin as the test pin and repeat the above test.
4. Check the wiring from the AUX/Hitch/PTO controller to the left hand draft pin.
  - a) Disconnect the pin connector (C154). At the controller side, check the power supply across cavity C and A. It should be 8 volts.
  - b) Check the continuity from C154 to C057 and C053.
  - c) At the draft pin side, measure the continuity of the pin circuit. The resistance should be 180 kohm across A and C and 18 kohm across B and C.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** The resistances at the draft pin side are for reference only. Incorrect resistance means a bad pin but some bad pins may have correct resistances.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 59

### 'No Load' Offset Voltage Out Of Range For Both Draft Pins

**Cause:**

During calibration, the 'No Load' offset voltage is out of normal range for both draft pins.

**Possible failure mode:**

1. Draft pin failure.
2. Wiring problem.

**Solution:**

The chance for both draft pins to fail at the same time is rare. If fault code AUX/Hitch/PTO 57 or AUX/Hitch/PTO 58 exists, check the single pin function or its wiring. If none of the codes exists, check the power supply or the ground to the two pins.

1. Check for the single pin fault code AUX/Hitch/PTO 57 or AUX/Hitch/PTO 58. If any exists, follow its corresponding diagnosing procedures.
2. If neither AUX/Hitch/PTO 57 or AUX/Hitch/PTO 58 exists, check the power supply or the ground to the two pins.
  - a) Check the power supply at either left pin connector or right pin connector. There should be +8 volts at cavity C of C153 or cavity C of C154.  
If not, check the continuity from cavity 25 of C057 to the cavity C of right draft pin connector and from cavity 31 of C057 to the cavity C of left draft pin connector.
  - b) Check the ground to the two pins. There should be continuity between cavity A on both the left pin connector and right pin connector and cavity 23 of C053.  
If not, check the wiring in between.
3. If none of above, check the function of the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 60

### The Selected Pin Is Connected To The Left Side Rather Than The Right Side

**Cause:**

During calibration, draft with one pin was selected.

If one pin draft is selected, the draft pin should be installed on the right side of the tractor.

This fault code is logged if the pin is detected on the left side rather than the right side.

**Solution:**

Make sure the right hand draft pin connector is connected and wired correctly.

Recalibrate hitch if the draft must be with 2 pins.

1. Verify that the connector to the right hand draft pin is connected and wired correctly if draft with one pin is required.
2. Check the right hand draft pin connection along its wiring. Make sure there is no bent pin, loose connection, and damaged wires.
3. Calibrate the hitch again if the intent was for draft with 2 pins.

**NOTE:** *See schematic sections 51 and 52 on the schematic poster.*

## **AUX/HITCH/PTO FAULT CODE 61**

### **AUX/Hitch/PTO Controller Requires Calibration**

**Cause:**

The AUX/Hitch/PTO controller requires calibration. New controller requires calibration, or current software does not match with NVM.

**Solution:**

1. Recalibrate the AUX/Hitch/PTO controller.

## **AUX/HITCH/PTO FAULT CODE 62**

### **No Communication With PMU Controller**

**Cause:**

The AUX/Hitch/PTO controller is not receiving or recognizing information from the Performance Monitor Unit controller which is part of the Instrumentation controller.

**Possible failure codes:**

1. Bad connection between AUX/Hitch/PTO controller and the instrument controller.
2. Controller failure.

**Solution:**

Fault code 24 may accompany this fault code. Follow the troubleshooting for fault code 24.

## **AUX/HITCH/PTO FAULT CODE 63**

### **8 Volt Reference is Above 8.8 Volts**

**Cause:**

The 8 volt reference voltage is monitored and is consistently greater than 8.8 volts.

**Possible failure mode:**

1. Short circuit to 12 volt power source.

**Solution:**

1. Turn the key switch ON. Disconnect connector C057 on the AUX/Hitch/PTO controller. Use a multimeter to check the voltage from pin 25 and pin 31 on the controller to ground.
  - A. It should read approximately 8 volts at both pins. If the reading is good go to step 2.
  - B. If the reading is above 8.8 volts replace the controller.
2. Connect C057 back onto the AUX/Hitch/PTO controller. Locate connector C153 at the right hand draft pin. Disconnect C153 from the harness. Use a multimeter to check the voltage from pin C on the harness to ground.
  - A. The reading should be approximately 8 volts. If the reading is good continue with step 3.
  - B. If the reading is above 8.8 volts there is a short to power somewhere between connector C153 and connector C057 at the AUX/Hitch/PTO controller. Locate and repair the short.
3. Locate connector C154 at the left hand draft pin. Disconnect C154 from the harness. Use a multimeter to check the voltage from pin C on the harness to ground.
  - A. The reading should be approximately 8 volts. If the reading is good the problem may be intermittent.
  - B. If the reading is above 8.8 volts there is a short to power somewhere between connector C154 and connector C057 at the AUX/Hitch/PTO controller. Locate and repair the short.

## AUX/HITCH/PTO FAULT CODE 64

### 8 Volt Reference is Below 7.2 Volts

**Cause:**

The 8 volt reference voltage is monitored and is consistently less than 7.2 volts.

**Possible failure mode:**

1. Open circuit or short to ground.

**Solution:**

1. Turn the key switch ON. Disconnect connector C057 on the AUX/Hitch/PTO controller. Use a multimeter to check the voltage from pin 25 and pin 31 on the controller to ground.
  - A. It should read approximately 8 volts at both pins. If the reading is good go to step 2.
  - B. If the reading is below 7.2 volts replace the controller.
2. Connect C057 back onto the AUX/Hitch/PTO controller. Locate connector C153 at the right hand draft pin. Disconnect C153 from the harness. Use a multimeter to check the voltage from pin C on the harness to ground.
  - A. The reading should be approximately 8 volts. If the reading is good continue with step 3.
  - B. If the reading is below 7.2 volts there is an open or short to ground somewhere between connector C153 and connector C057 at the AUX/Hitch/PTO controller. Locate and repair the open, or short to ground.
3. Locate connector C154 at the left hand draft pin. Disconnect C154 from the harness. Use a multimeter to check the voltage from pin C on the harness to ground.
  - A. The reading should be approximately 8 volts. If the reading is good the problem may be intermittent.
  - B. If the reading is below 7.2 volts there is an open or short to ground somewhere between connector C154 and connector C057 at the AUX/Hitch/PTO controller. Locate and repair the open, or short to ground.

## AUX/HITCH/PTO FAULT CODE 65

### 12VH Voltage Supply is Below 8 Volts

**Possible failure mode:**

1. Battery voltage is too low.
2. Alternator regulator malfunction.
3. The controller has a bad connection to power or is not grounded properly.

**Solution:**

Check for battery voltage, fuse #38, alternator regulator output, and the controller connection to power and ground.

1. Check for AUX/Hitch/PTO fault codes 66, 98 and 99. These are all fault codes for low voltage supply. If they exist, it is most likely that the battery voltage is low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is OK, check system voltage at cavity 20 of connector C053 at AUX/Hitch/PTO controller. Check for bad connection and improper ground at cavity 19 of connector C053 at AUX/Hitch/PTO controller. Check for shortage to the ground along the power supply to the controller.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running. The voltage should be above 14 volts at C077 - B+.
5. If none of above, check the function of the AUX/Hitch/PTO controller.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 66

### 12VF Voltage Supply is Below 8 Volts

**Possible failure mode:**

1. Battery voltage is too low.
2. Alternator regulator malfunction.
3. The controller has a bad connection to power or is not grounded properly.

**Solution:**

Check for battery voltage, fuse #36, alternator regulator output, and the controller connection to power and ground.

1. Check for AUX/Hitch/PTO fault codes 65, 98 and 99. These are all fault codes for low voltage supply. If they exist, it is most likely that the battery voltage is low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is OK, check system voltage at cavity 1, 2 and 3 of connector C053 at AUX/Hitch/PTO controller.  
Check for bad connection and improper ground at cavity 19 of connector C053 at AUX/Hitch/PTO controller.  
Check for shortage to the ground along the power supply to the controller.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running.  
The voltage should be above 14 volts at C077 - B+.
5. If none of above, check the function of the AUX/Hitch/PTO controller.

**NOTE:** See schematic sections 51 and 52 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 80

### MFD Software Fault Condition

**Cause:**

The AUX/Hitch/PTO controller has flagged a MFD software fault condition.

**Solution:**

Calibrate the AUX/Hitch/PTO controller again. If the same fault code is logged after calibration, change the controller. Calibrate the AUX/Hitch/PTO controller again.

## AUX/HITCH/PTO FAULT CODE 81

### MFD Solenoid High Side Driver is Commanded On But No current Was Sensed

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C160.

Disconnect connector C160.

Inspect pin 1 and pin 2 in the connector. Clean the connection.

Clean the mating pin and connector.

Visually inspect the harness between C160 and C054 at the AUX/Hitch/PTO controller.

Check for continuity to ground from C160 harness end pin 2. If no continuity repair ground connection.

If no damage and continuity to ground is good, measure across pin 1 and pin 2 at the MFD valve side.

The resistance should be in the range of 6 to 13 ohms.

If the resistance is higher than 13 ohms, there is an open circuit in the solenoid coil.

If the resistance is less than 6 ohms, there is a shortage in the solenoid coil.

In either case, replace the solenoid on MFD valve.

If the resistance is within the specified range, replace or repair the harness between C160 and C054 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.

Connect all connections. Make sure the controller has proper power and ground connection.

Turn the MFD valve ON, there should be about 12 volts at C054 pin 8.

If not, replace the AUX/Hitch/PTO controller.

**NOTE:** *See schematic section 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 82

### Diff Lock Solenoid High Side Driver is Commanded On But No Current Was Sensed

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C158.  
Disconnect connector C158.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C158 and C054 at the AUX/Hitch/PTO controller.  
Check for continuity to ground from C158 harness end pin 2. If no continuity repair ground connection.  
If no damage and continuity to ground is good, measure across pin 1 and pin 2 at the Diff Lock valve side.  
The resistance should be in the range of 6 to 13 ohms.  
If the resistance is higher than 13 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 6 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid on Diff Lock valve.  
If the resistance is within the specified range, replace or repair the harness between C158 and C054 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the Diff Lock valve ON, there should be about 12 volts at C054 pin 9.  
If not, replace the AUX/Hitch/PTO controller.

**NOTE:** *See schematic section 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 83

### Brake Light Relay High Side Driver is Commanded On But No Current Was Sensed

**Possible failure modes:**

1. Brake light relay coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

1. Locate the brake light relay and replace with a known good relay.
  - A. Erase the fault code. If the problem does not return troubleshooting is complete.
  - B. Changing the relay made no difference. Install original relay and continue with step 2.
2. Check the wiring from the AUX/Hitch/PTO controller to the brake light relay. Check for continuity between C054 pin 17 and the brake light relay base pin 1 (F1).
  - A. If no continuity locate and repair open in wire. Check for continuity between C335 pin 16 and C054 pin 17, and from C054 pin 17 to connector C010 pin 14 to isolate the open circuit.
  - B. Good reading, continue with step 3.
3. Check the ground connection at brake light relay base. There should be continuity from relay base pin 2 to chassis ground.
  - A. No continuity, repair open circuit in ground.
  - B. Good reading, continue with step 4.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

4. Check the function of the AUX/Hitch/PTO controller. Ignition key ON.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Depress both brake pedals, there should be about 12 volts at C054 pin 17.  
If not, replace the AUX/Hitch/PTO controller.

**NOTE:** *See schematic section 34, 49 and 50 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 86

### Wheel Slip Sensing Error In The Instrumentation Controller

#### Cause:

The percent slip is decided by the difference between the wheel speed and the ground speed. The AUX/Hitch/PTO controller receives the slip signal information from the instrumentation controller through the Data Bus.

#### Possible failure mode:

1. Wheel slip sensing (radar gun, wheel speed sensor) failed (in most cases).
2. Percent slip calculation failed in instrumentation controller (small chance).

#### RADAR FUNCTION

The radar is connected to the vehicle electrical system through a 4 pin connector.

Pin A: GND

Pin B: SIG,

Pin C: B+

Pin D: Present

Pin A is the radar ground. Which is connected to the vehicle clean ground through SPL-C1.

Pin B is the radar signal. The signal is of square wave form with 'Low' 0.8 VDC or less and 'High' 3.7 VDC minimum. Its frequency is scaled to 44 HZ/mph and proportional to ground speed. The signal is connected to the ICU pin 13 CN-1 through connector C060 Pin 25.

Pin C is the power supply to the radar from Fuse 34 through connector C010 pin 83.

Pin D is the signal from radar to ICU indicating radar is connected to the system. It is connected to the ICU connector CN-1 Pin 1 through connector C060 Pin 28.

#### Solution:

The wheel speed sensor and the radar gun (for the ground speed) are hard wired to instrumentation controller. If the problem is with the wheel speed sender, then fault code AUX/Hitch/PTO 32 and AUX/Hitch/PTO 87 should be recorded.

If there is no AUX/Hitch/PTO 32 and AUX/Hitch/PTO 87, the problem is most likely with the radar gun. There is also a small chance of instrumentation controller malfunction.

1. Check the wiring of radar gun.

Disconnect connector C068 at the radar.

The power supply at pin C of connector C068 should be about 5 VDC when the tractor key is in the 'RUN' position.

There should be good continuity from pin A of connector C068 to the clean ground.

Check for open circuit and wiring shortage.

2. Check the function of the radar.

The signal is from Pin B of the radar and connected to the pin 13, connector CN-1 of the instrument cluster through Pin 25 of connector C060. The radar will detect the speed of any thing moving in front of it. So a quick hand moving in front of the radar will be an easy way to test the frequency change of the radar signal. Special tools (such as oscilloscope) is needed to check the frequency.

If the radar does not work as expected, replace the radar in the following procedures:

- a. Disconnect the radar wiring.
- b. Remove the radar from the vehicle.
- c. Install the new radar.
- d. Reconnect the wiring and check the function of the new radar.

3. If there is no problem with the radar and its wiring, check the function of the instrumentation controller and the AUX/Hitch/PTO controller.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 24,25 and 26 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 87

### Ground Speed Signal Failed In The Instrumentation Controller

**Cause:**

The Data Bus signaled that the transmission speed sensor has failed.

The AUX/Hitch/PTO controller received the signal from the instrumentation controller.

**Possible failure mode:**

1. The transmission speed sensor failed (in most cases).
2. Software execution error in instrumentation controller (small chance).

**WHEEL SPEED SENSOR INFORMATION**

Cavity A: Signal

Cavity B: Ground

Operating Temperature: - 40 degree C to 125 degree C

Resistance: 2700 to 3300 ohms

Inductance: 1.9 to 2.9 H

Output: 30 Hz to 7 kHz Quasi-Sinusoidal

**Solution:**

The speed sensor is hard wired to the instrumentation controller. The instrumentation controller sends the wheel (transmission) speed signal to the hitch controller and the PTO controller via Data Bus.

If the sensor or the instrumentation controller has a problem, both fault code AUX/Hitch/PTO 32 and AUX/Hitch/PTO 87 should appear.

1. If the service tool is connected to the tractor, do the following:
  - Go to the Monitor screen by clicking on the Monitor Icon.
  - Click the CHANGE PARAMETER SELECTIONS Icon.
  - Select the INST GROUND SPEED - WHEEL and then ADD.
  - You will be able to monitor the wheel speed sensor signal on the screen.
  - Drive the tractor and watch the signal change when the tractor speed changes.
  - If there is no wheel speed signal, go to step 2.
  - If there is wheel speed signal, compare it to the speed display on the instrumentation cluster.
  - If the speed signal looks fine on service tool but not on the instrumentation cluster, it is more likely a problem with the instrumentation cluster.
  - If both signals seem fine, check the function of the AUX/Hitch/PTO controller.
2. Test the resistance of the transmission speed sensor:
  - Locate the transmission speed sensor on top of the transmission.
  - Disconnect connector C069 from the sensor.
  - Inspect the connector. Clean the connection.
  - Measure the sensor resistance between pin A and Pin B.
  - The resistance should be around 3 k ohms at 20 degree celsius.
  - If the resistance is not in the specified range, replace the transmission speed sensor.
  - If it is as specified, go to next step.
3. Check the wiring from the transmission speed sensor to connector C060 and then to connectors CN-1 and CN-2 at the instrumentation controller.
  - There should be 5 VDC power supply from pin 12 of CN-1 to pin A of connector C069 when the tractor key is in the 'RUN' position.
  - There should be good continuity from pin B of connector C069 to the clean ground.
  - Check for open circuit and wiring shortage.
4. If none of above, check the function of the instrumentation controller and the AUX/Hitch/PTO controller.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 24, 25 and 26 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 88

### Auto Differential Switch is Faulty

**Cause:**

The Data Bus signaled that the Diff lock switch has failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure mode:**

1. The diff lock switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The Diff lock switch is hard wired to the armrest controller. If the Diff lock switch fails in the armrest controller, fault code ARM 1079 should exist.

1. Check for fault code ARM 1079 at the armrest controller. If ARM 1079 exists, follow the corresponding corrective action.
2. Check the function the armrest controller

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 44 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 89

### Difflock Switch Failure

**Cause:**

The Data Bus signaled that the Diff lock switch has failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure mode:**

1. The Diff lock switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The Diff lock switch is hard wired to the armrest controller. If the difflock switch fails in the armrest controller, fault code ARM 1079 should exist.

1. Check for fault code ARM 1079 at the armrest controller. If ARM 1079 exists, follow the corresponding corrective action.
2. Check the function the armrest controller

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 44 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 90

### Both Differential Lock Auto and On Switches are Active

**Cause:**

The Data Bus signaled that the difflock switches have failed.

The PTO controller received the signal from the armrest controller.

**Possible failure mode:**

1. The Diff lock switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The Diff lock switch is hard wired to the armrest controller. If the Diff lock switch fails in the armrest controller, fault code ARM 1079 should exist.

1. Check for fault code ARM 1079 at the armrest controller. If ARM 1079 exists, follow the corresponding corrective action.
2. Check the function the armrest controller

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 44 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 92

### MFD Switch Failure

**Cause:**

The Data Bus signaled that the MFD switch has failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure mode:**

1. The MFD switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The MFD switch is hard wired to the armrest controller. If the MFD switch fails in the armrest controller, the fault code ARM 1069 should exist.

1. Check for fault code ARM 1069 at the armrest controller. If ARM 1069 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 44 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 93

### Both Auto MFD and MFD On Switches are Active

**Cause:**

The Data Bus signaled that the MFD switches have failed.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure mode:**

1. The MFD switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The MFD switch is hard wired to the armrest controller. If the MFD switch fails in the armrest controller, the fault code ARM 1069 should exist.

1. Check for fault code ARM 1069 at the armrest controller. If ARM 1069 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 44 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 94

### Differential Lockout Software Fault Condition

**Cause:**

The AUX/Hitch/PTO controller has flagged a Diff lock software fault condition.

**Solution:**

Calibrate the AUX/Hitch/PTO controller again. If the same fault code is logged after calibration, change the controller. Calibrate the AUX/Hitch/PTO controller again.

## AUX/HITCH/PTO FAULT CODE 98

### 12VD Voltage Supply is Below 8 Volts

**Possible failure mode:**

1. Battery voltage is too low.
2. Alternator regulator malfunction.
3. The controller has a bad connection to power or is not grounded properly.

**Solution:**

Check for battery voltage, fuse #39, alternator regulator output, and the controller connection to power and ground.

1. Check for AUX/Hitch/PTO fault codes 65, 66 and 99. These are all fault codes for low voltage supply. If they exist, it is most likely that the battery voltage is low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is OK, check system voltage at cavity 8 of connector C053 at AUX/Hitch/PTO controller. Check for bad connection and improper ground at cavity 19 of connector C053 at AUX/Hitch/PTO controller. Check for shortage to the ground along the power supply to the controller.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running. The voltage should be above 14 volts at C077 - B+.
5. If none of above, check the function of the AUX/Hitch/PTO controller.

**NOTE:** See schematic sections 49 and 50 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 99

### 12VT Voltage Supply is Below 8 Volts

**Possible failure mode:**

1. Battery voltage is too low.
2. Alternator regulator malfunction.
3. The controller has a bad connection to power or is not grounded properly.

**Solution:**

Check for battery voltage, fuse #39, alternator regulator output, and the controller connection to power and ground.

1. Check for AUX/Hitch/PTO fault codes 65, 66 and 98. These are all fault codes for low voltage supply. If they exist, it is most likely that the battery voltage is low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is OK, check system voltage at cavity 25 and 34 of connector C054 at AUX/Hitch/PTO controller. Check for bad connection and improper ground at cavity 19 of connector C053 at AUX/Hitch/PTO controller. Check for shortage to the ground along the power supply to the controller.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running. The voltage should be above 14 volts at C077 - B+.
5. If none of above, check the function of the AUX/Hitch/PTO controller.

**NOTE:** See schematic sections 49 and 50 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 106

### The AUX/Hitch/PTO Controller Has Received The Electro Hydraulic #5 Control Extend Switch Data In The Error State

**Cause:**

The Data Bus signaled that AUX 5 extend switch data (the 5th remote hydraulic valve control) is set to the error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 5 extend switch has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 5th remote switch connector J205 plugs into the armrest controller. If the 5th remote switch fails in the armrest controller, the fault code ARM 1029 should exist.

1. Check for fault code ARM 1029 at the armrest controller. If ARM 1029 exists, follow the corresponding corrective action.
2. Check the function the armrest controller through the Electronic Service Tool.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 5 REMOTE SWITCH and then ADD. Next click EXIT. You will now be able to monitor the 5 REMOTE SWITCH status on the screen.

**NOTE:** See schematic sections 44 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 107

### The AUX/Hitch/PTO Controller Has Received The Electro Hydraulic #5 Control Retract Switch Data In The Error State

**Cause:**

The Data Bus signaled that AUX 5 extend switch data (the 5th remote hydraulic valve control) is set to the error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 5 extend switch has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 5th remote switch connector J205 plugs into the armrest controller. If the 5th remote switch fails in the armrest controller, the fault code ARM 1029 should exist.

1. Check for fault code ARM 1029 at the armrest controller. If ARM 1029 exists, follow the corresponding corrective action.
2. Check the function the armrest controller through the Electronic Service Tool.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 5 REMOTE SWITCH and then ADD. Next click EXIT. You will now be able to monitor the 5 REMOTE SWITCH status on the screen.

**NOTE:** See schematic sections 44 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 108

### Electro Hydraulic Remote #1 Lever Position Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 1 lever potentiometer (the 1st remote hydraulic valve control) is set to the error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 1 lever potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 1st remote lever position control pot, connector J201 plugs into the armrest controller. If the 1st remote control pot fails in the armrest controller, the fault code ARM 29 should exist.

1. Check for fault code ARM 29 at the armrest controller. If ARM 29 exists, follow the corresponding corrective action.
2. Check the function the armrest controller through the Electronic Service Tool.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 1 REMOTE CONTROL LEVER and then ADD. Next click EXIT. You will now be able to monitor the 1 REMOTE CONTROL LEVER status on the screen.

**NOTE:** See schematic sections 45 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 109

### Electro Hydraulic Remote #2 Lever Position Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 2 lever potentiometer (the 2nd remote hydraulic valve control) is set to the error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 2 lever potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 2nd remote lever position control pot, connector J202 plugs into the armrest controller. If the 2nd remote control pot fails in the armrest controller, the fault code ARM 39 should exist.

1. Check for fault code ARM 39 at the armrest controller. If ARM 39 exists, follow the corresponding corrective action.
2. Check the function the armrest controller through the Electronic Service Tool.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 2 REMOTE CONTROL LEVER and then ADD. Next click EXIT. You will now be able to monitor the 2 REMOTE CONTROL LEVER status on the screen.

**NOTE:** See schematic sections 45 on the schematic poster.



## AUX/HITCH/PTO FAULT CODE 110

### Electro Hydraulic Remote #3 Lever Position Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 3 lever potentiometer (the 3rd remote hydraulic valve control) is set to the error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 3 lever potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 3rd remote lever position control pot, connector J203 plugs into the armrest controller. If the 3rd remote control pot fails in the armrest controller, the fault code ARM 49 should exist.

1. Check for fault code ARM 49 at the armrest controller. If ARM 49 exists, follow the corresponding corrective action.
2. Check the function the armrest controller through the Electronic Service Tool.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 3 REMOTE CONTROL LEVER and then ADD. Next click EXIT. You will now be able to monitor the 3 REMOTE CONTROL LEVER status on the screen.

**NOTE:** See schematic sections 45 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 111

### Electro Hydraulic Remote #4 Lever Position Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 4 lever potentiometer (the 4th remote hydraulic valve control) is set to the error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 4 lever potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 4th remote lever position control pot, connector J204 plugs into the armrest controller. If the 4th remote control pot fails in the armrest controller, the fault code ARM 59 should exist.

1. Check for fault code ARM 59 at the armrest controller. If ARM 59 exists, follow the corresponding corrective action.
2. Check the function the armrest controller through the Electronic Service Tool.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 4 REMOTE CONTROL LEVER and then ADD. Next click EXIT. You will now be able to monitor the 4 REMOTE CONTROL LEVER status on the screen.

**NOTE:** See schematic sections 45 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 112

### Electro Hydraulic Remote #1 Lever Flow Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 1 flow limit potentiometer (the 1st variable flow control) is set to error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 1 flow limit potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 1st variable flow control is on the secondary control panel of the armrest controller. If the 1st variable flow control fails in the armrest controller, the fault code ARM 89 should exist.

1. Check for fault code ARM 89 at the armrest controller. If ARM 89 exists, test the function of the 1st variable flow control.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 1 FLOW CONTROL and then ADD. Next click EXIT. You will now be able to monitor the 1st variable flow control status on the screen.  
Turn the flow control up and down, and watch the status change from 0 to 100%.  
If the status display matches the pot changes, the flow control is working OK.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the potentiometer changes, inspect the potentiometer.  
The flow control potentiometer is an integrated part of the second panel of the armrest console. If it is suspected that the potentiometer failed, replace the panel.
2. If ARM 89 does not exist or the 1st variable flow control is working OK, check the function of the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 113

### Electro Hydraulic Remote #2 Lever Flow Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 2 flow limit potentiometer (the 2nd variable flow control) is set to error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 2 flow limit potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 2nd variable flow control is on the secondary control panel of the armrest controller. If the 2nd variable flow control fails in the armrest controller, the fault code ARM 99 should exist.

1. Check for fault code ARM 99 at the armrest controller. If ARM 99 exists, test the function of the 2nd variable flow control.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 2 FLOW CONTROL and then ADD. Next click EXIT. You will now be able to monitor the 2nd variable flow control status on the screen.  
Turn the flow control up and down, and watch the status change from 0 to 100%.  
If the status display matches the pot changes, the flow control is working OK.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the potentiometer changes, inspect the potentiometer.  
The flow control potentiometer is an integrated part of the second panel of the armrest console. If it is suspected that the potentiometer failed, replace the panel.
2. If ARM 99 does not exist or the 2nd variable flow control is working OK, check the function of the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 114

### Electro Hydraulic Remote #3 Lever Flow Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 3 flow limit potentiometer (the 3rd variable flow control) is set to error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 3 flow limit potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 3rd variable flow control is on the secondary control panel of the armrest controller. If the 3rd variable flow control fails in the armrest controller, the fault code ARM 109 should exist.

1. Check for fault code ARM 109 at the armrest controller. If ARM 109 exists, test the function of the 3rd variable flow control.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 3 FLOW CONTROL and then ADD. Next click EXIT. You will now be able to monitor the 3rd variable flow control status on the screen.  
Turn the flow control up and down, and watch the status change from 0 to 100%.  
If the status display matches the pot changes, the flow control is working OK.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the potentiometer changes, inspect the potentiometer.  
The flow control potentiometer is an integrated part of the second panel of the armrest console. If it is suspected that the potentiometer failed, replace the panel.
2. If ARM 109 does not exist or the 3rd variable flow control is working OK, check the function of the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 115

### Electro Hydraulic Remote #4 Lever Flow Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 4 flow limit potentiometer (the 4th variable flow control) is set to error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 4 flow limit potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 4th variable flow control is on the secondary control panel of the armrest controller. If the 4th variable flow control fails in the armrest controller, the fault code ARM 119 should exist.

1. Check for fault code ARM 119 at the armrest controller. If ARM 119 exists, test the function of the 4th variable flow control.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 4 FLOW CONTROL and then ADD. Next click EXIT. You will now be able to monitor the 4th variable flow control status on the screen.  
Turn the flow control up and down, and watch the status change from 0 to 100%.  
If the status display matches the pot changes, the flow control is working OK.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the potentiometer changes, inspect the potentiometer.  
The flow control potentiometer is an integrated part of the second panel of the armrest console. If it is suspected that the potentiometer failed, replace the panel.
2. If ARM 119 does not exist or the 4th variable flow control is working OK, check the function of the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 116

### Electro Hydraulic Remote #5 Lever Flow Control Pot Data Is Set To The Error State

**Cause:**

The Data Bus signaled that AUX 5 flow limit potentiometer (the 5th variable flow control) is set to error state. The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. AUX 5 flow limit potentiometer has failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

**Solution:**

The 5th variable flow control is on the secondary control panel of the armrest controller. If the 5th variable flow control fails in the armrest controller, the fault code ARM 129 should exist.

1. Check for fault code ARM 129 at the armrest controller. If ARM 129 exists, test the function of the 5th variable flow control.  
Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the ARMREST AUX REMOTE 5 FLOW CONTROL and then ADD. Next click EXIT. You will now be able to monitor the 5th variable flow control status on the screen.  
Turn the flow control up and down, and watch the status change from 0 to 100%.  
If the status display matches the pot changes, the flow control is working OK.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the potentiometer changes, inspect the potentiometer.  
The flow control potentiometer is an integrated part of the second panel of the armrest console. If it is suspected that the potentiometer failed, replace the panel.
2. If ARM 129 does not exist or the 5th variable flow control is working OK, check the function of the armrest controller.

**NOTE:** See schematic sections 47 and 48 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 120

### Electro Hydraulic Remote Top Link Switch Is Stuck On

**Cause:**

The Data Bus signaled that the top link switches remain closed (ON).

**Possible failure mode:**

1. A Top link switch failed (in most cases).
2. Software execution error in the AUX/Hitch/PTO controller (small chance).

**Solution:**

The top link switch is hard wired to the AUX/Hitch/PTO controller.

1. Disconnect the harness connectors C399 and C401 at top link switches on fenders. Check the switch function. There should be no continuity between pins 1, 2 or 3. Depress switch to extend, there should be continuity between pins 1 and 2 only. Depress switch to retract, there should be continuity between pins 2 and 3 only.
  - A. Switch contacts closed at all times, replace switch.
  - B. Switch tests out okay. Erase fault code and retry.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 53 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 123

### Current Sensed When The Aux #1 Driver Is Off, Retract /Lower Coil Shorted to 12 Volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C053 pin 10 and C058 pin 1 to the remote valve connector C340 pins 1 and 2.

There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C053 pin 10 or C058 pin 1 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 124

### Aux #1 Driver is On And No Current Is Sensed, Retract /Lower Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C340.  
Disconnect connector C340.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C340 and C053 and C058 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C340 and C053 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 1st remote valve on, there should be about 12 volts at C053 pin 10 and low voltage at C058 pin 1.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 125

### Current Sensed When The Aux #1 Driver Is Off, Extend /Raise Coil Shorted to 12 Volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C053 pin 4 and C058 pin 1 to the remote valve connector C140 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C053 pin 4 or C058 pin 1 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 126

### Aux #1 Driver is On And No Current Is Sensed, Extend /Raise Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C140.  
Disconnect connector C140.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C140 and C053 and C058 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C140 and C053 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 1st remote valve on, there should be about 12 volts at C053 pin 4 and low voltage at C058 pin 1.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 127

### Current Sensed When The Aux #2 Driver Is Off, Retract /Lower Coil Shorted to 12 volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C053 pin 11 and C058 pin 3 to the remote valve connector C341 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C053 pin 11 or C058 pin 3 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 128

### Aux #2 Driver is On And No Current Is Sensed, Retract /Lower Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C341.  
Disconnect connector C341.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C341 and C053 and C058 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C341 and C053 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 2nd remote valve on, there should be about 12 volts at C053 pin 11 and low voltage at C058 pin 3.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 129

### Current Sensed When The Aux #2 Driver Is Off, Extend /Raise Coil Shorted to 12 volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C054 pin 6 and C058 pin 3 to the remote valve connector C141 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C054 pin 6 or C058 pin 3 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 130

### Aux #2 Driver is On And No Current Is Sensed, Extend /Raise Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C141.  
Disconnect connector C141.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C141 and C054 and C058 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C141 and C054 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 2nd remote valve on, there should be about 12 volts at C054 pin 6 and low voltage at C058 pin 3.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 131

### Current Sensed When The Aux #3 Driver Is Off, Retract /Lower Coil Shorted to 12 Volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C053 pin 6 and C058 pin 6 to the remote valve connector C342 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C053 pin 6 or C058 pin 6 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 132

### Aux #3 Driver is On And No Current Is Sensed, Retract /Lower Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C342.  
Disconnect connector C342.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C342 and C053 and C058 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C342 and C053 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 3rd remote valve on, there should be about 12 volts at C053 pin 6 and low voltage at C058 pin 6.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 133

### Current Sensed When The Aux #3 Driver Is Off, Extend /Raise Coil Shorted to 12 Volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C054 pin 5 and C058 pin 6 to the remote valve connector C142 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C054 pin 5 or C058 pin 6 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 134

### Aux #3 Driver is On And No Current Is Sensed, Extend /Raise Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C142.  
Disconnect connector C142.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C142 and C054 and C058 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C142 and C054 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 3rd remote valve on, there should be about 12 volts at C054 pin 5 and low voltage at C058 pin 6.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 135

### Current Sensed When The Aux #4 Driver Is Off, Retract /Lower Coil Shorted to 12 volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connector C054 pin 13 and 18 to the remote valve connector C343 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connector C054 pin 13 or pin 18 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 136

### Aux #4 Driver is On And No Current Is Sensed, Retract /Lower Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C343.  
Disconnect connector C343.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C343 and C054 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C343 and C054 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 4th remote valve on, there should be about 12 volts at C054 pin 13 and low voltage at C054 pin 18.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 137

### Current Sensed When The Aux #4 Driver Is Off, Extend /Raise Coil Shorted to 12 volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connectors C053 pin 7 and C054 pin 18 to the remote valve connector C143 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C053 pin 7 or C054 pin 18 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 138

### Aux #4 Driver is On And No Current Is Sensed, Extend /Raise Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C143.  
Disconnect connector C143.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C143 and C053 and C054 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C143 and C053 and C054 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 4th remote valve on, there should be about 12 volts at C053 pin 7 and low voltage at C054 pin 18.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 139

### Current Sensed When The Aux #5 Driver Is Off, Retract /Lower Coil Shorted to 12 volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connector C054 pin 4 and pin 7 to the remote valve connector C344 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connector C054 pin 4 or pin 7 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 140

### Aux #5 Driver is On And No Current Is Sensed, Retract /Lower Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C344.  
Disconnect connector C344.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C344 and C054 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C344 and C054 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 5th remote valve on, there should be about 12 volts at C054 pin 7 and low voltage at C054 pin 4.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 141

### Current Sensed When The Aux #5 Driver Is Off, Extend /Raise Coil Shorted to 12 Volts

**Cause:**

When the lever for this remote section is in Neutral, the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

Check the wiring from the remote hydraulic controller to the remote valve.

Check the function of the remote hydraulic controller.

1. Check the wiring harness from the AUX/Hitch/PTO controller connector C054 pin 4 and pin 15 to the remote valve connector C144 pins 1 and 2.  
There should be no shortage to 12 volt power at any pin location.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 V is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 V is traced to the controller connectors C054 pin 4 or C054 pin 15 when the lever is in Neutral.

**NOTE:** *See schematic section 54 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 142

### Aux #5 Driver is On And No Current Is Sensed, Extend /Raise Coil Open Or Shorted to Ground

**Possible failure modes:**

1. Valve solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the valve solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the valve solenoid.

1. Test the resistance of the valve solenoid at the valve connector C144.  
Disconnect connector C144.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between C144 and C054 at the AUX/Hitch/PTO controller.  
If no damage, measure across pin 1 and pin 2 at the remote valve side.  
The resistance should be in the range of 4 to 8 ohms.  
If the resistance is higher than 10 ohms, there is an open circuit in the solenoid coil.  
If the resistance is less than 3 ohms, there is a shortage in the solenoid coil.  
In either case, replace the solenoid in the 1st remote valve.  
If the resistance is within the specified range, replace or repair the harness between C144 and C054 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the 5th remote valve on, there should be about 12 volts at C054 pin 15 and low voltage at C054 pin 4.  
If not, replace the remote hydraulic controller.

**NOTE:** *See schematic section 54 on the schematic poster.*

## **AUX/HITCH/PTO FAULT CODE 147**

### **Out Of Range Error High On The #1 Feedback**

**Cause:**

The #1 section feedback voltage is greater than 4.5 volts. The AUX/Hitch/PTO controller generated this fault code.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller back to scraper controls, or implement. Check for damage, chaffed wires that could result in a short circuit to power.
2. Disconnect AUX/Hitch/PTO controller C057. Ignition switch ON, check the 5 volt reference voltage at C057 pin 16. The voltage should read from 4.75 to 5.25 volts.

## **AUX/HITCH/PTO FAULT CODE 148**

### **Out Of Range Error Low On The #1 Feedback**

**Cause:**

The #1 section feedback voltage is less than .5 volts

**Possible failure modes:**

1. Damaged wiring resulting short to ground or open circuit.
2. Controller internal failure.

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller back to scraper controls, or implement. Check for damaged, chaffed wires or broken wire that could result in a short circuit to ground, or cause open circuit.
2. Disconnect AUX/Hitch/PTO controller C057. Ignition switch ON, check the 5 volt reference voltage at C057 pin 16. The voltage should read from 4.75 to 5.25 volts.
  - A. If there is no reference voltage check power and ground to controller. Replace AUX/Hitch/PTO controller.

## **AUX/HITCH/PTO FAULT CODE 149**

### **Out Of Range Error High On The #2 Feedback**

**Cause:**

The #2 section feedback voltage is greater than 4.5 volts

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller back to scraper controls, or implement. Check for damage, chaffed wires that could result in a short circuit to power.
2. Disconnect AUX/Hitch/PTO controller C057. Ignition switch ON, check the 5 volt reference voltage at C057 pin 16. The voltage should read from 4.75 to 5.25 volts.

## **AUX/HITCH/PTO FAULT CODE 150**

### **Out Of Range Error Low On The #2 Feedback**

**Cause:**

The #2 section feedback voltage is less than .5 volts

**Possible failure modes:**

1. Damaged wiring resulting short to ground or open circuit.
2. Controller internal failure.

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller back to scraper controls, or implement. Check for damaged, chaffed wires or broken wire that could result in a short circuit to ground, or cause open circuit.
2. Disconnect AUX/Hitch/PTO controller C057. Ignition switch ON, check the 5 volt reference voltage at C057 pin 16. The voltage should read from 4.75 to 5.25 volts.
  - A. If there is no reference voltage check power and ground to controller. Replace AUX/Hitch/PTO controller.

## AUX/HITCH/PTO FAULT CODE 151

### No Data Transmission From ETC Is Received

**Cause:**

AUX/Hitch/PTO controller is not receiving data from Electronic Transmission Controller.

**Possible failure modes:**

1. Tractor Data Bus does not have power or ground.
2. Tractor Data Bus is shorted to power or ground.
3. Resistor Terminator failed.
4. transmission controller failed.

**Solution:**

Make sure the transmission controller and Tractor Data Bus are functioning properly.

1. Check the connections to the transmission controller.
  - A. Make sure all connectors C350, C351, C353 and C355 are all properly connected to the transmission controller.
  - B. Make sure the transmission controller has a good connection to the TDB. With the key switch in the ON position and connector C350 disconnected, measure the voltage between the TDB high and low wires and clean ground. TDB high (cavity 15) should measure from 2.5 to 2.8 volts. TDB low (cavity 16) should measure from 2.2 to 2.5 volts.
    - a) If both voltages are within specification and no other controllers show communication fault codes (except the transmission controller) then clear the fault code. If the fault code returns, then replace the controller.
    - b) If both voltages are zero, go to Step 2.
    - c) If the voltages are low or high, go to Step 3.

**NOTE:** Check the Tractor Data Bus wiring from Splice CHA2 to connector C335 and onto connector C350 at Trans Controller for damage, etc. before testing the entire data bus. Gently pull on the TDB high and low wires in cavities 15 and 16 to ensure that the terminals are fully seated and wires are not broken.

2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed. See step 4.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.

Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.

With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.

At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

4. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18 in schematic poster.*

## AUX/HITCH/PTO FAULT CODE 152

### EHR Top Link Switch Short

**Cause:**

The Data Bus signaled that the top link switches remain closed (ON). The top link switch is hard wired to the AUX/Hitch/PTO controller.

**Possible failure mode:**

1. Operator depressed both retract and extend switch at same time.
2. Failed switch.

**Solution:**

1. If both retract and extend were depressed at same time, erase fault code and continue operation. If not continue with step 2.
2. Disconnect the harness connectors C399 and C401 at top link switches on fenders. Check the switch function. There should be no continuity between pins 1, 2 or 3. Depress switch to extend, there should be continuity between pins 1 and 2 only. Depress switch to retract, there should be continuity between pins 2 and 3 only.
  - A. Switch contacts closed at all times, replace switch.
  - B. Switch tests out okay. Erase fault code and retry.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 53 in schematic poster.*

## AUX/HITCH/PTO FAULT CODE 153

### EHR Top Link Switch Conflict

**Cause:**

The Data Bus signaled that the top link switches conflict. The top link switch is hard wired to the AUX/Hitch/PTO controller.

**Possible failure mode:**

1. Operator depressed top link switch in cab, second person depressed opposite fender switch.
2. Failed switch.

**Solution:**

1. Operate top link from either cab, or remote fender switch. Erase fault code and continue operation. If not continue with step 2.
2. Disconnect the harness connectors C399 and C401 at top link switches on fenders. Check the switch function. There should be no continuity between pins 1, 2 or 3. Depress switch to extend, there should be continuity between pins 1 and 2 only. Depress switch to retract, there should be continuity between pins 2 and 3 only.
  - A. Switch contacts closed at all times, replace switch.
  - B. Switch tests out okay. Erase fault code and retry.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic section 53 in schematic poster.*

## AUX/HITCH/PTO FAULT CODE 154

### PTO Switch Interlock

**Cause:**

The Data Bus signaled that the PTO switch in cab and the PTO fender switch were both activated within 2 seconds. The PTO switches are hard wired to the AUX/Hitch/PTO controller.

**Possible failure mode:**

1. Operator activated PTO switch in cab, second person activated PTO fender switch.
2. Failed switch.

**Solution:**

1. Operate PTO from either cab, or remote fender switch. Erase fault code and continue operation. If not continue with step 2.
2. Check PTO switches for proper function.
  - A. Left and right remote PTO switches are normally closed.
  - B. Cab PTO control switch normally open.

## AUX/HITCH/PTO FAULT CODE 155

### Auto PTO Switch Data Is Set To The Error State

**Cause:**

The Data Bus signaled that Auto PTO switch data is set to error state.  
The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. Bad Auto PTO switch.
2. Software execution error in the armrest controller (small chance).

**Solution:**

1. Erase fault code. Reprogram Auto PTO function and continue operation. Continue with next step if needed.
2. Connect the service tool to the tractor Data Bus, do the following:
  - Go to the Monitor screen by click the Monitor Icon.
  - Click the CHANGE PARAMETER SELECTIONS Icon.
  - Click the AUTO PTO SWITCH and then ADD. Next click EXIT. You will now be able to monitor the AUTO PTO SWITCH status on the screen.
3. If service tool is not available check Auto PTO switch for proper function. Remove armrest and test switch.



## **AUX/HITCH/PTO FAULT CODE 156**

### **Auto PTO Switch Stuck On Condition**

**Cause:**

The Data Bus signaled that Auto PTO switch is stuck ON.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. Bad Auto PTO switch.
2. Software execution error in the armrest controller (small chance).

**Solution:**

3. Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the AUTO PTO SWITCH and then ADD. Next click EXIT. You will now be able to monitor the AUTO PTO SWITCH status on the screen.
4. If service tool is not available check Auto PTO switch for proper function. Remove armrest and test switch.

## **AUX/HITCH/PTO FAULT CODE 157**

### **PTO Remote Fender Switch Short**

**Cause:**

The Data Bus signaled that PTO remote fender switch short. The PTO remote switches are hard wired to the AUX/Hitch/PTO controller.

**Possible failure modes:**

1. Bad remote PTO switch.
2. Software execution error in the armrest controller (small chance).

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller connector C057 back to remote fender switches. Check for damage, chaffed wires that could result in a short circuit to power.
2. Disconnect AUX/Hitch/PTO controller connector C057. Ignition switch ON, check for power at connector C057 pin 12 to ground. The voltage should read approximately 12 volts. Depressing either the left or right remote fender switch should drop reading to 0 volts.
3. Next check for power at connector C057 pin 11 to ground. The voltage should read 0 volts. Depressing either the left or right remote fender switch should raise the reading to 12 volts.
4. If readings are okay erase fault code and continue operation. If 12 volts is present when not expected locate source of short circuit.

## AUX/HITCH/PTO FAULT CODE 158

### PTO Remote Fender Switch Open

**Cause:**

The Data Bus signaled that a PTO remote fender switch is stuck open. The PTO remote switches are hard wired to the AUX/Hitch/PTO controller.

**NOTE:** *AUX/Hitch/PTO fault code 159 may also be recorded.*

**Possible failure modes:**

1. Bad remote PTO switch.
2. Software execution error in the armrest controller (small chance).

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller connector C057 back to remote fender switches. Check for damage, chaffed wires that could result in an open circuit.
2. Disconnect AUX/Hitch/PTO controller connector C057. Ignition switch ON, check for power at connector C057 pin 12 to ground. The voltage should read approximately 12 volts. If 12 volts is not present check both remote PTO fender switches. Both switches are normally closed. Replace the switch that is open.

## AUX/HITCH/PTO FAULT CODE 159

### PTO Remote Fender Switch Stuck On

**Cause:**

The Data Bus signaled that a PTO remote fender switch is stuck on. The PTO remote switches are hard wired to the AUX/Hitch/PTO controller.

**NOTE:** *AUX/Hitch/PTO fault code 158 may also be recorded.*

**Possible failure modes:**

1. Bad remote PTO switch.
2. Software execution error in the armrest controller (small chance).

**Solution:**

1. Check the wiring from the AUX/Hitch/PTO controller connector C057 back to remote fender switches. Check for damage, chaffed wires that could result in an open circuit.
2. Disconnect AUX/Hitch/PTO controller connector C057. Ignition switch ON, check for power at connector C057 pin 11 to ground. The voltage should read approximately 0 volts. If 12 volts is present check both remote PTO fender switches. Both switches are normally closed. Replace the switch that is open.

## AUX/HITCH/PTO FAULT CODE 160

### PTO Clutch Is Slipping Excessively For The Duration Of 5 Seconds Or Longer

**Cause:**

The PTO controller monitors the PTO clutch input and output speed. This fault code is recorded when the difference of the input and output is beyond the limit.

**Possible failure mode:**

1. PTO load too heavy.
2. PTO clutch pressure too low.
3. PTO speed sensor or its wiring harness failure.
4. Incorrect engine RPM signal from the alternator.

**Solution:**

Make sure there is no PTO clutch slippage caused by either a heavy implement load or PTO clutch internal problem.

Test the PTO speed sensor and its wiring harness.

1. Turn off tractor engine. Check the implement connected to the PTO. Make sure the load is proper.
2. Check the PTO clutch pressure and PTO valve. Check for sticking solenoid, sticking valve spool, leaking clutch seal, burned clutch pad, or broken PTO shaft.
3. Check the alternator and the engine RPM signal from the alternator.  
The PTO clutch input speed is the engine RPM signal from the alternator.
  - a. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
  - b. Check for worn alternator belt.
  - c. Check the engine RPM signal wiring. There should be good continuity between cavity 33 of AUX/Hitch/PTO controller connector C057 and the terminal W of the alternator.
  - d. Check the engine RPM signal at terminal W of the alternator.
  - e. Go to the monitor screen of the service tool. Select parameter PTO ENGINE SPEED FREQUENCY. This is the PTO clutch input speed.
4. Check the wiring harness to the PTO shaft speed sensor.  
Check the continuity from Pin 20 of connector C058 to Pin A of connector C145.  
Check the continuity from Pin B of connector C145 to the chassis ground.
5. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 49, 50 and 19 and 27 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 161

### PTO RPM Is Too High

**Cause:**

The PTO controller monitors the PTO clutch input and output speed. This fault code is recorded when the PTO controller has detected a PTO speed that is 20% higher than expected for more than 2 seconds.

**Possible failure modes:**

1. PTO load is driving the PTO.
2. Wrong signal from the shaft speed sensor.
3. Incorrect alternator installed.

**PTO SHAFT SPEED SIGNAL**

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

**Solution:**

Make sure the PTO shaft is not driven by the load such as in the down hill situation.  
Test the PTO speed sensor and its wiring harness.

1. Check the PTO operation is correct and the external load is not driving the shaft.
2. Check the wiring harness to the PTO shaft speed sensor.  
Check the continuity from Pin 20 of connector C058 to Pin A of connector C145.  
Check the continuity from Pin B of connector C145 to the chassis ground.
3. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.
4. Check the alternator and the engine RPM signal from the alternator.  
The PTO clutch input speed is the engine RPM signal from the alternator.
  - a. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
  - b. Check for worn alternator belt.
  - c. Check the engine RPM signal wiring. There should be good continuity between cavity 33 of AUX/Hitch/PTO controller connector C057 and the terminal W of the alternator.
  - d. Check the engine RPM signal at terminal W of the alternator.
  - e. Go to the monitor screen of the service tool. Select parameter PTO ENGINE SPEED FREQUENCY. This is the PTO clutch input speed.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 49 and 50 on the schematic poster.

## **AUX/HITCH/PTO FAULT CODE 162**

### **Engine Speed Is Too Low For The PTO To Be In The On State**

**Cause:**

The engine speed is at 0 RPM and the PTO is in the On state.

**Possible failure mode:**

1. The engine has either stalled out, or has been shutdown.

**Solution:**

Determine the cause of the engine shutdown. Restart engine and erase fault code. Continue PTO operations.

## AUX/HITCH/PTO FAULT CODE 163

### PTO Is Commanded Off But The PTO Speed Is Greater Than Zero

#### Cause

The PTO controller monitors the PTO clutch output speed. This fault code is recorded if the PTO controller has detected PTO shaft rotation when PTO is turned off for 45 seconds.

#### Possible failure mode:

1. The PTO brake not functioning.
2. The clutch is not really turned off.
3. Implement attached to tractor had caused the PTO to turn.
4. PTO speed sensor or its wiring harness failure.

#### PTO SHAFT SPEED SIGNAL

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/Hitch/PTO control module. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

#### PTO SHAFT SIZE SPEED SIGNAL

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/Hitch/PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

#### Solution:

Make sure the Implement attached to tractor is not causing the PTO to turn. If the PTO is still turning when it is turned off, check for PTO solenoid and PTO clutch problem. If it is not turning, test the PTO speed sensor and its wiring harness.

1. Turn off tractor engine. Check the implement connected to the PTO. Make sure it is not causing the PTO to turn.
2. If the PTO is still turning when it is turned off, check PTO clutch brake function, also check PTO valve for sticking solenoid, sticking valve spool.
3. If the PTO shaft stops turning after it turned off and the fault code is still recorded, go to step 4 and 5.
4. Check the wiring harness to the PTO shaft speed sensor.  
Check the continuity from Pin 20 of connector C058 to Pin A of connector C145.  
Check the continuity from Pin B of connector C145 to the chassis ground.
5. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 164

### The Software Has Not Detected PTO Shaft Speed For 3.6 Seconds Since The PTO Initial Fill Valve Was Commanded

**Cause:**

The PTO controller monitors the PTO clutch output speed. This fault code is triggered if the PTO controller does not detect PTO shaft rotation after engagement.

**Possible failure mode:**

1. PTO shaft locked up by the implement.
2. PTO solenoid is not energized or spool stuck in the OFF position.
3. PTO clutch pressure too low.
4. PTO speed sensor or its wiring harness failure.

**PTO SHAFT SPEED SIGNAL**

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/Hitch/PTO control module. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/Hitch/PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

**Solution:**

Make sure the PTO clutch is not locked up by heavy implement load. If it is still not turning without heavy implement load, check for PTO solenoid and PTO clutch problem. If it is turning, test the PTO speed sensor and its wiring harness.

1. Turn off tractor engine. Check the implement connected to the PTO. Make sure the load is proper.
2. If the PTO shaft does not turn even without any implement load, check for sticking solenoid, sticking valve spool, leaking clutch seal, burned clutch pad, or broken PTO shaft.
3. If the PTO shaft turns or it turns for 5 seconds when it is turned on and then stops, go to step 4 and 5.
4. Check the wiring harness to the PTO shaft speed sensor.  
Check the continuity from Pin 20 of connector C058 to Pin A of connector C145,  
Check the continuity from Pin B of connector C145 to the chassis ground.
5. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 165

### PTO Speed Is Detected When The PTO Is In The Off State Without Engine RPM

**Cause:**

The PTO controller monitors the PTO clutch output speed. This fault code is recorded if the PTO controller has detected PTO shaft rotation when engine is off.

**Possible failure mode:**

1. Implement attached to tractor caused the PTO to turn.
2. PTO speed sensor or its wiring harness failure.

**PTO SHAFT SPEED SIGNAL**

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/Hitch/PTO control module. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/Hitch/PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

**Solution:**

Make sure the implement attached to tractor is not causing the PTO to turn. Test the PTO speed sensor and its wiring harness.

1. Make sure the implement attached to tractor is not causing the PTO to turn.
2. Restart the tractor after PTO switch moved to OFF position. Turn PTO on and off to check the shaft spinning.
3. Monitor the engine speed and PTO speed either at Instrument cluster or using the service tool. If there is no engine speed display when the engine is running, go to step 4. If there is PTO speed display when the engine is not running, go to step 5 and 6.
4. Check the engine RPM signal.
  - a) Check the engine RPM signal wiring. There should be good continuity between cavity 33 of AUX/Hitch/PTO controller connection C057 and the terminal W of the alternator.
  - b) Check the engine RPM signal at terminal W of the alternator.
5. Check the wiring harness to the PTO shaft speed sensor.

Check the continuity from Pin 20 of connector C058 to Pin A of connector C145.

Check the continuity from Pin B of connector C145 to the chassis ground.
6. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 49 and 50 on the schematic poster.*



## AUX/HITCH/PTO FAULT CODE 166

### PTO Driver Is On And No Current Is Sensed

**Possible failure modes:**

1. PTO solenoid coil failed.
2. Damaged wiring.
3. Loose connector or bent pin.
4. Controller internal failure.

**Solution:**

Check the PTO solenoid resistance and the wiring from the AUX/Hitch/PTO controller to the PTO solenoid.

1. Test the resistance of the PTO solenoid at the valve connector C159.  
Disconnect connector C159.  
Inspect pin 1 and pin 2 in the connector. Clean the connection.  
Clean the mating pin and connector.  
Visually inspect the harness between connector C159 and C053 pin 13 at the AUX/Hitch/PTO controller.  
Next visually inspect the harness between connector C159 and C058 pin 7 at the AUX/Hitch/PTO controller.  
Use a multimeter to check the continuity between connector C053 pin 13 and connector C159 pin 1.  
Next use a multimeter to check the continuity between connector C058 pin 7 and connector C159 pin 2.

If no damage and continuity checks are good, measure across pin 1 and pin 2 at the PTO solenoid.

The resistance should be in the range of 6 to 13 ohms.

If the resistance is higher than 13 ohms, there is an open circuit in the solenoid coil.

If the resistance is less than 6 ohms, there is a shortage in the solenoid coil.

In either case, replace the solenoid on PTO solenoid.

If the resistance is within the specified range, replace or repair the harness between C159 and C053 and C058 at the AUX/Hitch/PTO controller.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

2. Check the function of the AUX/Hitch/PTO controller.  
Connect all connections. Make sure the controller has proper power and ground connection.  
Turn the PTO ON, there should be about 12 volts at C053 pin 13.  
If not, replace the AUX/Hitch/PTO controller.

**NOTE:** *See schematic section 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 167

### Current Sensed When PTO Driver Is Off

**Cause:**

When the PTO switch is OFF the controller should provide no voltage to the solenoid. If the controller senses voltage on the circuit, this fault code is recorded.

**Possible failure modes:**

1. Damaged wiring resulting short to power.
2. Controller internal failure.

**Solution:**

1. Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the PTO SWITCH and then ADD. Next click EXIT. You will now be able to monitor the PTO SWITCH status on the screen. If the switch checks out okay continue with the next step.
2. Check remote PTO switch function. Both switches are normally closed.
3. Check the wiring harness from the AUX/Hitch/PTO controller connector C053 pin 13 to ground.  
There should be no shortage to 12 volt power at this location with the PTO switch in OFF position.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

4. In any of the following two conditions, replace the controller.
  - a. No shortage to 12 volts is found in the circuit and there is no 12 V at any of the pins or cavities,
  - b. The 12 volts is traced to the controller connectors C053 pin 13 or C058 pin 7 when the PTO switch is OFF.

**NOTE:** *See schematic section 49 and 50 on the schematic poster.*

## **AUX/HITCH/PTO FAULT CODE 168**

### **PTO Off Switch Data Is Set To The Error State**

**Cause:**

The Data Bus signaled that PTO switch data is set to error state.

The AUX/Hitch/PTO controller received the signal from the armrest controller.

**Possible failure modes:**

1. Bad PTO switch.
2. Software execution error in the armrest controller (small chance).

**Solution:**

1. Erase fault code. Continue PTO function and continue operation. Continue with next step if needed.
2. Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the PTO SWITCH and then ADD. Next click EXIT. You will now be able to monitor the AUTO PTO SWITCH status on the screen.
3. If service tool is not available check PTO switch for proper function. Remove armrest and test switch.

## AUX/HITCH/PTO FAULT CODE 169

### Both PTO On And Off Switches Are Simultaneously Off, One of the PTO Switches Is Shorted To Ground

**Cause:**

The PTO switches in armrest are both simultaneously off, one switch may be shorted to ground or a wire maybe open. The PTO switch in armrest is hard wired to AUX/Hitch/PTO controller.

**Possible failure mode:**

1. The PTO on/off switch failed in the armrest controller (in most cases).
2. PTO switch wiring failure between the AUX/Hitch/PTO controller and the armrest controller (fair chance).
3. Software execution error in the armrest controller (small chance).

**Background:**

The PTO off/on switch is hard wired to the armrest controller and the AUX/Hitch/PTO controller.

**Solution:**

The PTO on/off switch is hard wired in the armrest controller and is hard wired to the AUX/Hitch/PTO controller.

1. Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the PTO SWITCH and then ADD. Next click EXIT. You will now be able to monitor the PTO SWITCH status on the screen.  
Turn the switch on and off, and watch the status change.  
If the status display matches the switch changes, the switch is working OK. If not, continue the test procedures.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the switch changes, test the switch and its wiring. See step 2.
2. Check for continuity from main harness connector C137 pin 7 harness end to AUX/Hitch/PTO controller connector C057 pin 30. If there is no continuity check for damage to harness. Check for continuity from both C137 and C057 to connector C010 pin 29. Continuity from C137 to C010 would indicate the cab harness portion is good.
3. If none of the above or the problem is intermittent, the switch may be contaminated internally or the wiring may have started to deteriorate.

**NOTE:** See schematic sections 47, 49 and 50 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 170

### Both PTO On And Off Switches Are Simultaneously On, One of the PTO Switches Is Shorted To 12 Volts

**Cause:**

The PTO switches in armrest are both simultaneously on, one switch may be shorted to 12 volts. The PTO switch in armrest is hard wired to AUX/Hitch/PTO controller.

**Possible failure mode:**

1. The PTO on/off switch failed in the armrest controller (in most cases).
2. PTO switch wiring shorted to power between the AUX/Hitch/PTO controller and the armrest controller (fair chance).
3. Software execution error in the armrest controller (small chance).

**Background:**

The PTO off/on switch is hard wired to the armrest controller and the AUX/Hitch/PTO controller.

**Solution:**

The PTO on/off switch is hard wired in the armrest controller and is hard wired to the AUX/Hitch/PTO controller.

1. Connect the service tool to the tractor Data Bus, do the following:  
Go to the Monitor screen by click the Monitor Icon.  
Click the CHANGE PARAMETER SELECTIONS Icon.  
Click the PTO SWITCH and then ADD. Next click EXIT. You will now be able to monitor the PTO SWITCH status on the screen.  
Turn the switch on and off, and watch the status change.  
If the status display matches the switch changes, the switch is working OK. If not, continue the test procedures.  
If the service tool is not connected to the tractor Data Bus or the status display does not match the switch changes, test the switch and its wiring. See step 2.
2. Check for a short to power in main harness at connector C137 pin 7 to ground. If 12 volts is present disconnect connector C010. If the 12 volts disappears the short is between connector C010 and the AUX/Hitch/PTO controller connector C057 pin 30. If the 12 volt reading persists the short is in cab harness between connector C010 and C157.

**NOTE:** See schematic sections 47, 49 and 50 on the schematic poster.

## AUX/HITCH/PTO FAULT CODE 171

### PTO Software Fault Condition Detected

**Cause:**

The AUX/Hitch/PTO controller has flagged a PTO software fault condition.

**Solution:**

Calibrate the AUX/Hitch/PTO controller again. If the same fault code is logged after calibration, change the controller. Calibrate the AUX/Hitch/PTO controller again.

## AUX/HITCH/PTO FAULT CODE 172

### PTO Solenoid Circuit Shorted To B+ When PTO Is In Off State

**Cause:**

The AUX/Hitch/PTO controller has detected B+ power at PTO solenoid, when PTO is in OFF state.

**Possible failure mode:**

1. The PTO clutch solenoid coil shorted to power.
2. PTO clutch solenoid wiring shorted to power.

**Solution:**

Disconnect the PTO valve solenoid connector C159. Ignition key in On position.

1. Check the wiring harness end pin 1 to ground. There should be no voltage at this location with the PTO switch in OFF position
2. Check the wiring harness end pin 2 to ground. There should be no voltage at this location with the PTO switch in OFF position.
3. If B+ power is recorded at either pin inspect the harness back to AUX/Hitch/PTO controller for source of short to power. If no short is located continue with next step.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

Disconnect the connector C053 and C058 at the AUX/Hitch/PTO controller.

4. Check the AUX/Hitch/PTO controller connector C053 pin 13 to ground. There should be no B+ power at this location with the PTO switch in OFF position
5. Check the AUX/Hitch/PTO controller connector C058 pin 7 to ground.  
There should be no B+ power at this location with the PTO switch in OFF position.
6. If 12 volts is traced to the controller connectors C053 pin 13 or C058 pin 7 when the PTO switch is OFF, replace the AUX/Hitch/PTO controller.
7. If no power is recorded at AUX/Hitch/PTO connectors continue checking harness wiring from AUX/Hitch/PTO controller to PTO solenoid for short to power.

**NOTE:** *See schematic section 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 173

### PTO Solenoid Circuit Shorted To Ground When PTO Is In Off State

**Cause:**

The AUX/Hitch/PTO controller has detected a short to ground at PTO solenoid, when PTO is in OFF state.

**Possible failure mode:**

1. The PTO clutch solenoid coil shorted to ground
2. PTO clutch solenoid wiring shorted to ground.

**Solution:**

Disconnect the PTO valve solenoid connector C159.

1. Check the wiring harness end pin 1 to ground. There should be no continuity to ground at this location with the PTO switch in OFF position
2. Check the wiring harness end pin 2 to ground. There should be no continuity to ground at this location with the PTO switch in OFF position.
3. If continuity to ground is recorded at either pin inspect the harness back to AUX/Hitch/PTO controller for source of short to ground. If no short is located continue with next step.

**NOTE:** *Always inspect connector ends for damage, bent or dislocated pins when troubleshooting.*

Disconnect the connector C053 and C058 at the AUX/Hitch/PTO controller.

4. Check the AUX/Hitch/PTO controller connector C053 pin 13 to ground. There should be no continuity to ground at this location with the PTO switch in OFF position
5. Check the AUX/Hitch/PTO controller connector C058 pin 7 to ground.  
There should be no continuity to ground at this location with the PTO switch in OFF position.
6. If continuity to ground is traced to the controller connectors C053 pin 13 or C058 pin 7 when the PTO switch is OFF, replace the AUX/Hitch/PTO controller.
7. If continuity to ground is recorded at AUX/Hitch/PTO connectors continue checking harness wiring from AUX/Hitch/PTO controller to PTO solenoid for short to ground.

**NOTE:** *See schematic section 49 and 50 on the schematic poster.*

## **AUX/HITCH/PTO FAULT CODE 174**

### **Current Flowing In The Sense Resistor When The High Side Was Off**

**Cause:**

The sense resistor is an internal component in the AUX/Hitch/PTO controller. There should be no current flow in the sense resistor when the high side is off.

**Possible failure modes:**

1. Bad AUX/Hitch/PTO controller.

**Solution:**

Replace AUX/Hitch/PTO controller.



## AUX/HITCH/PTO FAULT CODE 175

### PTO Clutch Did Not Lock Up After 6 Seconds Of Clutch Motion

#### Cause:

The AUX/Hitch/PTO controller monitors the PTO clutch input and output speed. This fault code is recorded when the PTO does not reach lock up speed within 6 seconds of being turned on.

#### Possible failure modes:

1. PTO load too heavy.
2. PTO clutch pressure too low.
3. PTO solenoid is not energized.
4. PTO speed sensor and its wiring harness failure.
5. Incorrect alternator installed.

#### PTO SHAFT SPEED SIGNAL

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/Hitch/PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

#### PTO SHAFT SIZE SPEED SIGNAL

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/Hitch/PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

#### PTO CLUTCH SLIPPAGE

The PTO clutch slippage limit is set as the follow:

PTO clutch slip > +/-15 % for 5 seconds

#### Solution:

Make sure there is no PTO clutch slippage caused by either heavy implement load or PTO clutch internal problem. Test the PTO speed sensor and its wiring harness.

Test the alternator and the engine RPM signal from the alternator.

1. Turn off tractor engine. Check the implement connected to the PTO. Make sure the load is proper and the PTO shaft is not locked up by the implement.
2. If there is visible PTO shaft slippage with or without implement load, check the PTO clutch pressure and PTO valve. Check for sticking solenoid, sticking valve spool, leaking clutch seal, burned clutch pad, or broken PTO shaft.
3. Check the alternator and the engine RPM signal from the alternator.  
The PTO clutch input speed is the engine RPM signal from the alternator.
  - a. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
  - b. Check for worn alternator belt.
  - c. Check the engine RPM signal wiring. There should be good continuity between cavity 33 of AUX/Hitch/PTO controller connector C057 and the terminal W of the alternator.
  - d. Check the engine RPM signal at terminal W of the alternator.
  - e. Go to the monitor screen of the service tool. Select parameter PTO ENGINE SPEED FREQUENCY. This is the PTO clutch input speed.
4. If the PTO shaft turns or it turns for 5 seconds when it is turn on and then stops, go to step 5 and 6.

5. Check the wiring harness to the PTO shaft speed sensor.

Check the continuity from Pin 20 of connector C058 to Pin A of connector C145.

Check the continuity from Pin B of connector C145 to the chassis ground.

6. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 49 and 50 on the schematic poster.*

## **AUX/HITCH/PTO FAULT CODE 178**

### **PTO Speed Sensor Has Been Changed**

**Cause:**

The PTO speed sensor has been changed.

**Possible failure modes:**

1. PTO clutch frequency is less than the PTO shaft size frequency.

**Solution:**

Calibrate the PTO speed configuration.

## AUX/HITCH/PTO FAULT CODE 179

### PTO Is Configured As A Two Speed And No Shaft Size Frequency Was Detected When The PTO Was Switched On

**Cause:**

The module is receiving no frequency from the shaft size sensor when configured as a two speed PTO tractor.

**Possible failure mode:**

1. The PTO system is equipped with only shaft speed sensor but configures as two speed system.
2. PTO shaft size sensor is not well connected or failed.
3. Wiring problem between AUX/Hitch/PTO controller and the PTO shaft size sensor.

**PTO SHAFT SPEED SIGNAL**

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/Hitch/PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/Hitch/PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use. i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

**Solution:**

Make sure the tractor has the PTO dual speed (shaft size) sensor installed and properly connected.

Check the wiring from the AUX/Hitch/PTO controller to the shaft size sensor.

Test the function of the sensor.

1. Make sure the tractor has the PTO dual speed (shaft size) sensor installed and properly connected. If not, either reconfigure as a single speed sensor PTO system or add the shaft size sensor to the tractor.
2. Check the wiring harness to the PTO dual speed (shaft size) sensor.  
Check the continuity from Pin 21 of connector C054 to Pin A of connector C336.  
Check the continuity from Pin B of connector C336 to the chassis ground.
3. Check the function of the shaft size sensor. It should have resistance of about 3 K ohms.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

**NOTE:** *See schematic sections 49 and 50 on the schematic poster.*

## AUX/HITCH/PTO FAULT CODE 180

### PTO Is Configured As A Single Speed And Shaft Size Frequency Was Detected When The PTO Was Switched On, Shaft Size Frequency Input Is Only Used For Two Speed PTO

**Cause:**

The module is receiving frequency from the shaft size sensor when configured as a single speed PTO tractor.

**Possible failure mode:**

1. The PTO system is equipped with shaft size frequency but configures as single speed system.
2. PTO shaft size sensor is not well connected or failed.

**PTO SHAFT SPEED SIGNAL**

The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the AUX/Hitch/PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

**PTO SHAFT SIZE SPEED SIGNAL**

The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the AUX/Hitch/PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use. i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

**Solution:**

The tractor is equipped with dual speed PTO system. Reconfigure/calibrate the system as a two speed PTO system.

**NOTE:** See schematic sections 49 and 50 on the schematic poster.

# **Section 55**

## **Chapter 4**

**TRANSMISSION CONTROLLER FAULT CODES**  
**(INCLUDES SUSPENDED AXLE)**

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## FAULT CODE TRANS 11

### Master Clutch Potentiometer Open Circuit or Short to Ground

#### Cause:

The transmission controller has detected that the clutch (inching) pedal potentiometer signal is out of range low.

#### Possible failure mode:

1. The pedal position potentiometer failure.
2. Wire harness of the inching pedal potentiometer failed open or shorted to ground.

#### Solution:

The clutch (inching) pedal position potentiometer is mounted on side of the inching pedal and wired to the transmission controller.

1. Check the pedal position potentiometer and its wiring through the TRANS VIEW / VIEW PEDAL screen or the service tool.  
The clutch pedal position can be viewed in the instrumentation cluster display through the TRANS VIEW/VIEW PEDAL screen.  
It can also be viewed in the monitor screen of the service tool.  
If correct, the position display should be 100% when the clutch pedal is fully up and 0% when the pedal is fully depressed.  
The number should smoothly drop as the clutch pedal is depressed.  
Watch the display while slowly cycling the inching pedal.  
If the number change follows the pedal movement smoothly, the potentiometer and its wiring are working OK.  
If the numbers are hard to control or do not fall in sequential order, replace the pedal position potentiometer.  
If numbers on display are locked up and will not change when clutch pedal is cycled, check the pedal position potentiometer and its wiring.

**NOTE:** *There could be an intermittent problem and the tractor may still run, so check for loose connections.*

2. Test the pedal position potentiometer and its wiring.  
Remove the rear controller cover.  
Disconnect connector C351 and C350.  
Measure the resistance at the harness side.  
The resistance between pin 1 and pin 17 of C351 must increase smoothly as clutch pedal is depressed.  
The resistance between pin 1 of C351 and pin 23 of C350 must decrease smoothly as clutch pedal is depressed.  
If the potentiometer does not work as specified above, repeat same testing procedures at connector C010 and C052.  
If the potentiometer does not work as specified above at C052, replace the potentiometer. Otherwise check the wiring back to the controller.  
If the potentiometer is working as specified the problem may be intermittent.

## FAULT CODE TRANS 12

### Master Clutch Potentiometer Short to 12 Volts or Short to 5 Vreff

#### Cause:

The transmission controller has detected that the clutch (inching) pedal potentiometer signal is out of range high.

#### Possible failure mode:

1. The pedal position potentiometer failed.
2. The wire harness of the inching pedal potentiometer is shorted to power.

#### Solution:

The clutch (inching) pedal position potentiometer is mounted on the side of the inching pedal and wired to the transmission controller.

1. Check the pedal position potentiometer and its wiring through the TRANS VIEW / VIEW PEDAL screen or the service tool.  
The clutch pedal position can be viewed in the instrumentation cluster display through the TRANS VIEW/VIEW PEDAL screen.  
It can also be viewed in the monitor screen of the service tool.  
If correct, the position display should be 100% when the clutch pedal is fully up and 0% when the pedal is fully depressed.  
The number should smoothly drop as the clutch pedal is depressed.  
Watch the display while slowly cycling the inching pedal.  
If the number change follows the pedal movement smoothly, the potentiometer and its wiring are working OK.  
If the numbers are hard to control or do not fall in sequential order, replace the pedal position potentiometer.  
If numbers on display are locked up and will not change when clutch pedal is cycled, check the pedal position potentiometer and its wiring.

**NOTE:** *There could be an intermittent problem and the tractor may still run, so check for loose connections.*

2. Test the pedal position potentiometer and wiring.  
Remove the rear controller cover.  
Disconnect connector C351.  
Measure the resistance at the harness side between pin 1 and pin 17 of connector C351. The resistance must increase smoothly as the clutch pedal is depressed.  
If the potentiometer does not work as specified above, repeat the test procedure at connector C010 and at connector C052.  
If the potentiometer does not work as specified after checking at connectors C010 and C052 replace the potentiometer.  
If the potentiometer works as specified, go to next step.
3. Check the voltage at pin 1 of connector C351.  
Release the secondary lock on connector C351 and remove pin 1 from the connector. Plug connector C351 back into the controller. Turn the ignition key to the ON position. Measure the voltage at pin 1 of C351 against ground. The voltage should change between 0 and 5 volts as the clutch pedal is depressed or released.  
The fault code is recorded if the voltage exceeds 5 volts.  
If the measured voltage does go higher than 5 volts, locate the short within the harness.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*

## **FAULT CODE TRANS 24**

### **The Transmission Clutches Are Not Calibrated**

**Cause:**

Transmission clutches have not been calibrated

**Solution:**

Clear the fault codes and perform the calibration procedure.

If the fault code still appears after the calibration procedure is completed replace the Transmission controller.

## FAULT CODE TRANS 37

### BOC switch open circuit or Neutral relay stuck open

#### Cause:

Fault code 37 is recorded when the clutch pedal position is above 30%, shuttle lever is in Forward or Reverse, and the controller does not detect +12V from bottom of clutch relay.

#### Possible failure mode:

1. Neutral relay failure
2. Bottom of clutch switch failed open
3. No power supply to the Neutral Relay
4. Wiring or connections to the Neutral relay or BOC switch failed

#### Solution:

1. The power supply to the Neutral relay (relay #6) and Park brake relay (relay #5) is from fuse #43. If fault code 52 comes with this fault code and the Park Brake will not release when shifted to Forward or Reverse, check fuse #43.  
If fuse #43 is not blown, check wiring between the fuse and the relays.
2. If this fault code comes without fault code 52, replace the relay with a known good relay. If the fault goes away, it was a relay failure. Otherwise go to next step.
3. Unplug the Neutral relay. Turn tractor Key on. Check power and ground to the Neutral relay.  
There should be constant 12 V to cavity 3. If the 12 V is not present, check from the cavity back to fuse #43.  
There should be constant 12 V to cavity 1 when the clutch pedal position is above 30% and the shuttle lever is in Forward OR Reverse. The 12 V should disappear when the clutch pedal position is fully depressed or the shuttle lever is in Neutral OR Park. If the 12 V is not present, go to step 4.  
There should continuity between cavity 2 and ground. If not, check the wiring from cavity 2 to the ground.  
If above checks are all ok, check the continuity between cavity 5 and pin 25 or pin 34 of connector 355. If there is no continuity, check the wiring in between.
4. Check the BOC switch and its wiring.  
The BOC switch is located under the steering column. Disconnect connector C50. Measure continuity between Pin A and B on the switch. With inching pedal up, there should be continuity. With inching pedal down, there should be no continuity. If the switch works OK, check the wiring between the BOC switch and the cavity 1 of neutral relay.  
Pay attention to loose wire or loose terminal to the relay seat.  
If there is not a new relay ready available, swap the Neutral relay with other relays for the checks.

## **FAULT CODE TRANS**

### **38 Shuttled to reverse when no wheel speed signal**

#### **Cause:**

This fault code will be recorded when the operator attempts to shuttle to reverse from 13 gear forward or higher and there is Fault code 77 (no transmission output RPM signal).

#### **Solution:**

Correct the no transmission output RPM signal fault following the trouble-shooting procedures for fault code 77. Otherwise, shift to forward or cycle the shuttle lever. Reverse will be available 10 seconds after the last time that the shuttle lever was in forward without the clutch pedal down.

## FAULT CODE TRANS 47

### Clutch Position Sensor Not Agree With BOC Switch

#### Cause:

The position sensor of the inching clutch pedal does not agree with the bottom of clutch (BOC) switch.

#### Possible failure mode:

1. Mechanical misadjusted inching pedal, its position potentiometer, or BOC switch.
2. Bottom of clutch switch, its relay, or their wiring failure.
3. Inching pedal position potentiometer or its wiring failure.

#### Solution:

Check the inching pedal, its position potentiometer, and the BOC switch assembly. Make sure the mechanical installation is proper and tight.

The clutch (inching) pedal position potentiometer is mounted on side of the inching pedal. The bottom of clutch switch is mounted on top of the inching pedal. Both are wired to the transmission controller. The transmission controller monitors the on/off status of the bottom of clutch switch and the position of the inching pedal. When the inching clutch pedal is fully depressed, the BOC switch should be off. When inching pedal is above a certain height, the BOC switch should be on. If the position of the inching clutch pedal and the status of the bottom of clutch switch does not work as specified above, this fault code will be generated.

1. Monitor and test the function of the pedal position potentiometer and the bottom of clutch switch.  
The position of the inching clutch pedal and the status of the bottom of clutch switch can be monitored through the TRANS VIEW of the instrumentation cluster or the monitor screen of the service tool.  
The position display should be 100% when the clutch is fully up and 0% when the pedal is fully depressed.  
The number should smoothly drop as the clutch pedal is depressed.  
The bottom of clutch switch will only be displayed as on if the transmission control relay and neutral relay have pulled in and the inching clutch is in the bottom of clutch position.  
Enter TRANS VIEW or the monitor screen. Watch the display while slowly cycle the inching pedal.  
If the position display of the inching pedal does not work as specified, go to step 2.  
If the status display of the bottom of clutch switch does not work as specified, go to step 5.
2. Test the function of the pedal position potentiometer.  
In the TRANS VIEW or the monitor screen:  
If the number change follows the pedal movement smoothly but does not reach the 0%, the potentiometer and its wiring are working OK.  
If the numbers are hard to control or do not fall in sequential order, replace the pedal position potentiometer.  
If numbers on display are locked up and will not change when clutch pedal is cycled, go to step 3 and 4.
3. Test the pedal position potentiometer and its wiring.  
Remove the rear controller cover.  
Disconnect connector C010.  
Measure the resistance at the potentiometer side.  
The resistance between pin 38 and pin 39 must be around 4 K ohms.  
The resistance must increase smoothly between pin 40 and pin 39 as clutch pedal in depressed.  
The resistance must decrease smoothly between pin 40 and pin 39 as clutch pedal in released.  
If the potentiometer works as specified above, go to step 5.  
If the potentiometer does not work as specified above, repeat same testing procedures at connector C052.  
If the potentiometer still does not work as specified above, replace the potentiometer. Otherwise check the wiring.
4. Test the transmission controller and the wiring.  
Test the controller side at C010.  
The power supply voltage from the controller at pin 38 should be around 8 VDC.

There should be continuity from pin 40 to chassis ground (resistance less than 3 ohms).

If it does work as specified, replace the transmission controller.

5. Test the function of bottom of clutch switch, its relay and the wiring.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.*



## **FAULT CODE TRANS 48**

### **BOC switch or Neutral relay short circuit**

#### **Cause:**

Fault code 48 is recorded when the clutch pedal position is below 5%, shuttle lever is in Forward OR Reverse, and the controller detected +12V from bottom of clutch relay.

#### **Possible failure mode:**

1. Neutral relay stuck closed
2. Bottom of clutch switch stuck closed
3. Wiring shorted to power.

#### **Solution:**

1. Replace the Neutral relay (relay #6) with a known good relay. If the fault goes away, it was a relay failure. Otherwise go to next step.
2. Unplug the Neutral relay. Turn tractor Key on.  
There should be constant 12 V to cavity 1 when the clutch pedal position is above 30% and the shuttle lever is in Forward OR Reverse. The 12 V should disappear when the clutch pedal position is fully depressed or the shuttle lever is in Neutral OR Park. If the 12 V is constant, go to step 3.  
Otherwise, check shortage to power in the wiring between cavity 5 and pin 25 or pin 34 of connector 355.
3. Check the BOC switch and its wiring.  
The BOC switch is located under the steering column. Disconnect connector C50. Measure continuity between Pin A and B on the switch. With inching pedal up, there should be continuity. With inching pedal down, there should be no continuity. If the switch works OK, check shortage to power in the wiring between the BOC switch and the cavity 1 of neutral relay.  
Pay attention to loose wire or loose terminal to the relay seat.  
If there is not a new relay ready available, swap the Neutral relay with other relays for the checks.

## **FAULT CODE TRANS 49**

### **Auto Guidance Isolation Valve Driver Fault**

#### **Cause:**

The high side driver has detected an open circuit, or is in thermal shutdown (short circuit).

#### **Possible failure mode:**

1. Bad auto guidance solenoid.
2. Damaged wiring to auto guidance solenoid.

#### **Solution:**

1. Disconnect the auto guidance solenoid valve connector C074. Use a multimeter to check the resistance of the coil. A good reading is 5 to 10 ohms. If the reading is out of range replace the coil. If the coil reading is okay continue with step 2.
2. Check the wiring harness for an open circuit. Check from pin 2 on harness end of connector C074 to chassis ground for continuity. If no continuity locate and repair open ground wire. Continuity okay, continue with step 3.
3. Disconnect transmission controller connector C0355 (at rear of cab). Check for continuity from harness end of C355 pin 17 to pin 1 of C074. If no continuity, repair the open circuit.
4. If solenoid is okay and wiring is good, double check all electrical connectors and for damage to harness that may cause intermittent fault.

## FAULT COE TRANS 50

### Park Brake is powered off when in park

#### Cause:

The park brake is spring applied. It is hydraulically disengaged when 12 V is applied to the Park solenoid. Fault code 50 is recorded when the transmission controller turned the power off to the Park relay (in Park position) but sensed 12 v at the Park Brake coil.

#### Possible failure mode:

1. Park relay stuck closed or shorted internally
2. Wiring shorted to power.

#### Solution:

1. Replace the Park relay (relay #5) with a known good relay. If the fault goes away, it was a relay failure. Otherwise go to next step.
2. Unplug the Park relay. Turn tractor off but Key on.  
There should be 12 V to cavity 1 of the relay seat when Tractor is not in Park. The 12 V should disappear when the Tractor is in Park. If the 12 V presents when in Park, check shortage to power in the wiring between cavity 1 of park relay seat and cavity 4 of connector 350.  
If the 12 V comes and goes as expected, go to step 3.
3. Check cavity 5 of Park relay seat.  
Turn tractor off but Key on  
There should be no 12 V at the cavity. If there is, check for short to power between this cavity and the park Brake solenoids.  
Depress the two brake pedals all way down. If the 12 V disappears, the shortage to power is between the park solenoid and the Bottom of Brake switches. Otherwise, the shortage to power is between the relay seat and the Bottom of Brake switches.

**NOTE:** Pay attention to damaged harness, pinched wire, or loose terminal to the relay seat.  
If there is not a new relay ready available, swap the Park relay with other relays for the checks.

## FAULT CODE TRANS 51

### FNRP pod indicates forward OR reverse is on when Park is on

#### Cause:

If Park switch is off (indicating tractor is in Park) and either Forward or Reverse switch are in ON position (indicating tractor is in Forward or Reverse) at the same time, this fault code will be generated.

#### Possible failure modes:

1. The transmission control (FNRP) pot failure
2. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### Solution:

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon lit on display when in park and in neutral, either the Forward switch failed closed or its wiring shorted to power.

If Reverse icon lit on display when in park and in neutral, either the Reverse switch failed closed or its wiring shorted to power.

If the 'P' icon remains ON steady when the Forward or Reverse is selected, either the Park switch failed open or its wiring shorted to ground.

2. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 6 (Forward) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Forward position and about 2500 - 3000 Ohms when in other positions. If not, the Forward switch failed.

Measure between Pin 5 (Reverse) and Pin 8, there should be about 500 - 600 Ohms when in Reverse position and about 2500 - 3000 Ohms when in other positions. If not, the Reverse switch failed.

Measure between Pin 4 (Park) and Pin 3, there should be no continuity in Park position and there should be continuity in other positions. If not, the Park switch failed.

**NOTE:** *Park switch off indicates tractor is in Park. Park switch on indicates tractor is not in Park.*

If any above switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

3. Check the wiring from connector C051 to the transmission controller.

Check the wiring from connector C051 to connector C351 on the transmission controller.

Follow the wiring schematics. Conduct continuity checking (in a similar way to the way specified in step 2) between pins at each connectors.

**NOTE:** *Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires*

## FAULT CODE TRANS 52

### Park Brake is stuck on when commanded off

#### Cause:

The park brake is spring applied. It is hydraulically disengaged when 12 V is applied to the Park solenoid. Fault code 52 is recorded when the transmission controller turned the power on to the Park relay (Tractor shifted out of Park and powered off the Park brake) but sensed no power at the Park Brake coil.

#### Possible failure mode:

1. Park relay stuck open or failed internally
2. No power supply to the Park Relay
3. Wiring or connection to the Park relay has open circuit.

#### Solution:

1. The power supply to the Park brake relay (relay #5) and the Neutral relay (relay #6) is from fuse #43. If fault code 52 comes with fault code 37 and the Park Brake will not release when shifted to Forward or Reverse, check fuse #43.  
If fuse #43 is not blown, check wiring between the fuse and the relays.
2. If this fault code comes without fault code 37, replace the Park relay (relay #5) with a known good relay. If the fault goes away, it was a relay failure. Otherwise go to next step.
3. Unplug the Park relay. Turn tractor off but Key on.  
There should be constant 12 V to cavity 3 of the relay seat. If the 12 V is not present, check from the cavity back to fuse #43.  
There should be 12 V to cavity 1 of the relay seat when Tractor is not in Park. The 12 V should disappear when the Tractor is in Park. If the 12 V is not present when tractor is not in Park, check open circuit in the wiring between cavity 1 of park relay seat and cavity 4 of connector 350.  
There should continuity between cavity 2 and ground. If not, check the wiring from cavity 2 to the ground.  
If above checks are all ok, go to next step.
4. Check cavity 5 of Park relay seat.  
Turn tractor off.  
Check resistance between cavity 5 of Park relay seat and the ground. It should be around 5 to 10 Ohms. Depress the two brake pedals all way down, the resistance should go to unlimited.  
If the resistance is unreasonably high in both conditions, there is an open circuit in the wiring between cavity 5 of Park relay seat and the park solenoid (Make sure the two Bottom of Brake switches are plugged in).  
If the resistance is as expected, check for open circuit between the Bottom of Brake switches and pin 28 of connector 351.

**NOTE:** Pay attention to damaged harness, pinched wire, or loose terminal to the relay seat.  
If there is not a new relay ready available, swap the Park relay with other relays for the checks.

## FAULT CODE TRANS 53

### 5 Volt Reference Voltage Too High

#### Cause:

The transmission controller provides 5 volts to the FNRP pod and the Master clutch pedal pot through pin 16 and pin 17 of connector C351. The controller monitors the voltage at the two pins. If the voltage is higher than 5.8 volts, this fault code will be recorded.

#### Possible failure modes:

1. Wiring harness shorted to power externally.
2. Internal problem with the transmission controller.

#### Solution:

Since the 5 volts is provided to the FNRP pod and the Master clutch pedal pot, relative symptoms or faults codes will show up if the wire harness is shorted to power externally.

1. Troubleshooting by checking fault codes.

If fault codes 67 and 69 come with this fault code, there is a good chance the wiring from the transmission controller to the FNRP pod is shorted to power.

If fault codes 12 comes with this fault code, there is a good chance the wiring from the transmission controller to Master clutch pedal pot is shorted to power.

2. Troubleshooting by viewing the Instrumentation display.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon stays lit up on display when not in Forward and Reverse icon stays lit up on display when not in Reverse, there is a good chance the wiring from the transmission controller to the FNRP pod is shorted to power.

Turn Key 'ON' and get into Trans View to watch the Master clutch pedal position display.

If the Master clutch pedal position stays high on display when Master clutch pedal is depressed, there is a good chance the wiring from the transmission controller to Master clutch pedal pot is shorted to power

3. Troubleshooting by checking pin connection.

Take pin 17 out of connector C351 and clear all Trans fault codes. (See the procedure for pin removal and erasing fault codes in front of this section.)

Turn the Key 'Off' for a few seconds. Then turn Key 'ON' and check the fault code again. If this fault code comes again, there is a good chance the wiring from the transmission controller to the FNRP pod is shorted to power.

Take pin 16 out of connector C351 and clear all Trans fault codes. Turn the Key 'Off' for a few seconds. Then turn Key 'On' and check the fault code again. If this fault code comes again, there is a good chance the wiring from the transmission controller to Master clutch pedal pot is shorted to power.

4. Check the wiring from the transmission controller to the FNRP pod and the Master clutch pedal pot.

If the wiring shortage to the power is suspected in the FNRP pod circuit,

Check the wiring between Pin 8 of connector C051 and pin 16 of connector C351 for shortage to power.

Check the wiring between Pin 6 of connector C051 and pin 13 of connector C351 for shortage to power.

Check the wiring between Pin 5 of connector C051 and pin 12 of connector C351 for shortage to power.

If the wiring shortage to the power is suspected in the Master clutch pedal pot circuit, Check the wiring between Pin 1 and pin 17 of connector C351 for shortage to power.

5. Check for Internal problem with the transmission controller.

If no problem can be found in steps 1 to 4, clear all the Trans fault codes. Disconnect connector 351, turn Key On, and check for fault 53 again.

If fault code 53 appears again, it is an internal problem with the transmission controller.

If fault code 53 does not appear any more, the problem must still be external. Repeat step 1 to 4.

**NOTE:** *Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires*

## FAULT CODE TRANS 54

### 5 volt reference voltage too low

#### Cause:

The transmission controller provides 5 volt to the FNRP pod and the Master clutch pedal pot through pin 16 and pin 17 of connector C351. The controller monitors the voltage at the two pins. If the voltage is lower than 4.2 volts, this fault code will be recorded.

#### Possible failure modes:

1. Wiring harness has shortage to ground.
2. Internal problem with the transmission controller.

#### Solution:

Since the 5 volt is provided to the FNRP pod and the Master clutch pedal pot, relative symptoms or faults codes will show up if the wire harness has shortage to ground.

1. Troubleshooting by checking fault codes.

If fault codes 66 and 68 come with this fault code, there is a good chance the wiring from the transmission controller to the FNRP pod has shortage to ground.

If fault codes 11 comes with this fault code, there is a good chance the wiring from the transmission controller to Master clutch pedal pot has shortage to ground.

2. Troubleshooting by viewing the Instrumentation display.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon does not light up on display when in Forward and Reverse icon does not light up on display when in Reverse, there is a good chance the wiring from the transmission controller to the FNRP pod has shortage to ground.

Turn Key 'ON' and get into Trans View to watch the Master clutch pedal position display.

If the Master clutch pedal position stays low on display when Master clutch pedal is not depressed, there is a good chance the wiring from the transmission controller to Master clutch pedal pot has shortage to ground.

3. Troubleshooting by checking pin connection.(See the procedure for pin removal and erasing fault codes in front of this section.)

Take pin 16 out of connector C351 and clear all Trans fault codes. Turn the Key 'Off' for a few seconds. Then turn Key 'On' and check the fault code again. If this fault code does not come again, there is a good chance the wiring from the transmission controller to the FNRP pod has shortage to ground.

Take pin 17 out of connector C351 and clear all Trans fault codes. Turn the Key 'Off' for a few seconds. Then turn Key 'On' and check the fault code again. If this fault code does not come again, there is a good chance the wiring from the transmission controller to Master clutch pedal pot has shortage to ground.

4. Check the wiring from the transmission controller to the FNRP pod and the Master clutch pedal pot.

If the wiring problem is suspected in the FNRP pod circuit,

Check the wiring between Pin 8 of connector C051 and pin 16 of connector C351 for shortage to ground.

Check the wiring between Pin 6 of connector C051 and pin 13 of connector C351 for shortage to ground.

Check the wiring between Pin 5 of connector C051 and pin 12 of connector C351 for shortage to ground.

If the wiring problem is suspected in the Master clutch pedal pot circuit, Check the wiring between Pin 1 and pin 17 of connector C351 for shortage to ground.

5. Check for Internal problem with the transmission controller.

If no problem can be found in steps 1 to 4, clear all the Trans fault codes. Disconnect connector 351, turn Key On, and check for fault 54 again.



If fault code 54 appears again, it is an internal problem with the transmission controller.

If fault code 54 does not appear any more, the problem must still be external. Repeat step 1 to 4.

**NOTE:** *Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires*

## FAULT CODE TRANS 59

### FNRP pod in illogical state (two position on at same time)

#### Cause:

If FNRP pot indicates two of the three positions (Neutral, Forward, and Reverse) are in ON position at the same time, the transmission controller will record this fault code.

#### Possible failure modes:

1. The transmission control (FNRP) pot failure
2. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### Solution:

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon lit on display when in park and in neutral, either the Forward switch failed closed or its wiring shorted to power.

If Reverse icon lit on display when in park and in neutral, either the Reverse switch failed closed or its wiring shorted to power.

If Neutral icon remains ON steady when the Forward or Reverse is selected, either the Neutral switch failed open or its wiring shorted to ground.

2. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 6 (Forward) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Forward position and about 2500 - 3000 Ohms when in other positions. If not, the Forward switch failed.

Measure between Pin 5 (Reverse) and Pin 8, there should be about 500 - 600 Ohms when in Reverse position and about 2500 - 3000 Ohms when in other positions. If not, the Reverse switch fails open.

Measure between Pin 7 (not Neutral) and Pin 3, there should be no continuity in Park or Neutral position and there should be continuity in Forward or Reverse positions. If not, the Neutral switch failed.

**NOTE:** *Neutral switch off indicates tractor is in Neutral. Neutral switch on indicates tractor is not in Park.*

If any above switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

3. Check the wiring from connector C051 to the transmission controller.

Check the wiring from connector C051 to connector C351 on the transmission controller.

Follow the wiring schematics. Conduct continuity checking (in a similar way to the way specified in step 2) between pins at each connectors.

**NOTE:** *Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires*

## FAULT CODE TRANS 60

### FNRP pod in illogical state (in no position)

#### Cause:

If FNRP pot indicates not in neutral, not in forward, and not in reverse for 2.5 seconds, the transmission controller will record this fault code.

#### Possible failure modes:

For NH8: 1. The FNR lever may be stuck in between positions.

For MU8: 1. The operator may be holding the lever up for too long.

2. The transmission control (FNRP) pot failure

3. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### Solution:

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Make sure the operator is not holding the lever up for too long.

2. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon does not lit up on display when in Forward, either the Forward switch failed open or its wiring shorted to ground.

If Reverse icon does not lit up on display when in Reverse, either the Reverse switch failed open or its wiring shorted to ground.

If Neutral icon does not lit up steady when in Neutral or Park, either the Neutral switch failed closed or its wiring shorted to power.

3. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 6 (Forward) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Forward position and about 2500 - 3000 Ohms when in other positions. If not, the Forward switch failed.

Measure between Pin 5 (Reverse) and Pin 8, there should be about 500 - 600 Ohms when in Reverse position and about 2500 - 3000 Ohms when in other positions. If not, the Reverse switch fails open.

Measure between Pin 7 (not Neutral) and Pin 3, there should be no continuity in Park or Neutral position and there should be continuity in Forward or Reverse positions. If not, the Neutral switch failed.

**NOTE:** *Neutral switch off indicates tractor is in Neutral. Neutral switch on indicates tractor is not in Park.*

If any above switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

4. Check the wiring from connector C051 to the transmission controller.

Check the wiring from connector C051 to connector C351 on the transmission controller.

Follow the wiring schematics. Conduct continuity checking (in a similar way to the way specified in step 2) between pins at each connectors.

**NOTE:** *Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires*

## **FAULT CODE TRANS 66**

### **FNRP Pod Forward switch is shorted to ground or open circuit**

#### **Cause:**

If the Forward signal voltage from FNRP pot is detected too low, the transmission controller will record this fault code.

#### **Possible failure modes:**

1. The transmission control (FNRP) pot failure
2. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### **Solution:**

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon does not lit up on display when in Forward, either the Forward switch failed open or its wiring shorted to ground.

2. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 6 (Forward) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Forward position and about 2500 - 3000 Ohms when in other positions. If not, the Forward switch failed.

If the Forward switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

3. Check the wiring from connector C051 to the transmission controller.

If fault code 66 comes with fault code 68, there is a higher chance the failure is in the 5 V supply circuit.

Check the wiring between Pin 8 of connector C051 and pin 16 of connector C351 for open circuit.

If fault code 66 comes without fault code 68, there is a higher chance the failure is in the Forward circuit. Check the wiring between Pin 6 of connector C051 and pin 13 of connector C351 for open circuit.

**NOTE:** *Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires*

## FAULT CODE TRANS 67

### FNRP Pod Forward switch is shorted to power

#### Cause:

If the Forward signal voltage from FNRP pot is detected too high, the transmission controller will record this fault code.

#### Possible failure modes:

1. The transmission control (FNRP) pot failure
2. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### Solution:

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If Forward icon stays lit up on display when not in Forward, either the Forward switch shorted internally or its wiring shorted to power.

2. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 6 (Forward) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Forward position and about 2500 - 3000 Ohms when in other positions. If not, the Forward switch failed.

If the Forward switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

3. Check the wiring from connector C051 to the transmission controller.

If fault code 67 comes with fault code 69, there is a higher chance the failure is in the 5 V supply circuit.

Check the wiring between Pin 8 of connector C051 and pin 16 of connector C351 for shortage to power.

If fault code 67 comes without fault code 69, there is a higher chance the failure is in the Forward circuit. Check the wiring between Pin 6 of connector C051 and pin 13 of connector C351 for shortage to power.

**NOTE:** Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires

## FAULT CODE TRANS 68

### FNRP Pod Reverse switch is shorted to ground or open circuit

#### Cause:

If the Reverse signal voltage from FNRP pot is detected too low, the transmission controller will record this fault code.

#### Possible failure modes:

1. The transmission control (FNRP) pot failure
2. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### Solution:

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If the Reverse icon does not lit up on display when in Reverse, either the Reverse switch failed open or its wiring shorted to ground.

2. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 5 (Reverse) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Reverse position and about 2500 - 3000 Ohms when in other positions. If not, the Reverse switch fails open.

If the Reverse switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

3. Check the wiring from connector C051 to the transmission controller.

If fault code 66 comes with fault code 68, there is a higher chance the failure is in the 5 V supply circuit.

Check the wiring between Pin 8 of connector C051 and pin 16 of connector C351 for open circuit.

If fault code 68 comes without fault code 66, there is a higher chance the failure is in the Reverse circuit. Check the wiring between Pin 5 of connector C051 and pin 12 of connector C351 for open circuit.

**NOTE:** Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires

## FAULT CODE TRANS 69

### FNRP Pod Reverse switch is shorted to power

#### Cause:

If the Reverse signal voltage from FNRP pot is detected too high, the transmission controller will record this fault code.

#### Possible failure modes:

1. The transmission control (FNRP) pot failure
2. Wiring harness problem from the transmission control (FNRP) pot to the transmission controller.

#### Solution:

The transmission control (FNRP) pod is directly wired to the transmission controller. The transmission controller monitors the shuttle shifting and displays the shuttle position on the instrumentation cluster.

1. Troubleshooting by viewing the shuttle position display.

In some cases, problems can be detected by viewing the display while shifting the transmission control (FNRP) lever.

Turn Key 'ON' and watch the shuttle position display.

If Reverse icon stays lit up on display when not in Reverse, either the Reverse switch shorted internally or its wiring shorted to power.

2. Troubleshooting by checking FNRP switch function.

Disconnect the cover panel under the steering column. Locate connector C051. Measure continuities on the transmission control (FNRP) pot side.

Measure between Pin 5 (Reverse) and Pin 8 (5 Vref), there should be about 500 - 600 Ohms when in Reverse position and about 2500 - 3000 Ohms when in other positions. If not, the Reverse switch fails open.

If the Reverse switch failure is detected, replace the transmission control (FNRP) pot.

If no switch failure is detected, go to next step.

3. Check the wiring from connector C051 to the transmission controller.

If fault code 67 comes with fault code 69, there is a higher chance the failure is in the 5 V supply circuit.

Check the wiring between Pin 8 of connector C051 and pin 16 of connector C351 for shortage to power.

If fault code 69 comes without fault code 67, there is a higher chance the failure is in the Reverse circuit. Check the wiring between Pin 5 of connector C051 and pin 12 of connector C351 for shortage to power.

**NOTE:** Pay attention to bent pin, loose pin, wire damage, and any possible shortage between pins and wires

## **FAULT CODE TRANS 70**

### **Battery voltage is too low for clutch solenoid operation**

#### **Cause:**

The transmission controller monitors the power supply. If the voltage drops to 9 volts, this fault code will be recorded and transmission will shift to neutral.

#### **Possible failure modes:**

1. Battery voltage low.
2. Alternator regulator malfunction.
3. The controller has a bad connection to power or is not grounded properly.

#### **Solution:**

Check for battery voltage, alternator regulator output, and the controller connection to power and ground.

1. Check for fault codes ARM 8011 and AUX/Hitch/PTO 65, 66, 98 and 99. These are all fault codes for battery voltage low. If most exist, it is more likely that the battery voltage low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is Ok, check system voltage at pin 14 of connector C350.  
Check for bad connection and improper ground at cavity 19, 23, 25, and 26 of the same connector.  
Check for shortage to the ground along the power supply to the controller.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running.  
The voltage should be above 14 volts at C077 - B+.

## **FAULT CODE TRANS 72**

### **Hot Transmission Oil Temperature**

#### **Cause:**

The transmission oil temperature above 122 degree C for 2 seconds.

#### **Possible failure modes:**

1. Air flow through radiator/oil coolers is blocked.
2. Low coolant level.

#### **Solution:**

Clear debris from radiator/oil cooler intake. Check and correct cooling system coolant level.



## **FAULT CODE TRANS 73**

### **Software is Out of Calibration Mode And Park Brake Request is Still Active.**

#### **Cause:**

Transmission clutches are at maximum pressure and the park brake is ON.

#### **Possible failure modes:**

1. Software issue.
2. Controller failed.

#### **Solution:**

Download latest software version for transmission controller.

## **FAULT CODE TRANS 74**

### **The Park Brake is Commanded ON and Gear is Engaged, But There is No Park Brake Request From Calibration.**

#### **Cause:**

Transmission clutches are at maximum pressure and the park brake is ON.

#### **Possible failure modes:**

1. Software issue.
2. Controller failed.

#### **Solution:**

Download latest software version for transmission controller.

## FAULT CODE TRANS 77

### No signal from wheel speed sensor

#### Cause:

If the transmission controller detected the wheel speed sensor signal is too weak or does not exist, this fault code will be recorded.

#### Possible failure modes:

1. Wheel speed sensor problem.
2. Wiring harness problem between the wheel speed sensor and the transmission controller.

#### Solution:

The wheel speed sensor is hard wired to both the transmission controller and the instrumentation controller. The wheel speed is displayed on the ICU when Radar is not present.

1. Troubleshooting by viewing the Instrumentation display

Disconnect Radar if Radar is equipped. The wheel speed from the wheel speed sensor will be displayed when tractor is running.

Drive the tractor at different gears and watch the wheel speed.

If the speed display is normal, the wheel speed sensor is fine. The problem is more likely in the wiring connection from the sensor to the transmission controller.

If the wheel speed display stays at 0 when tractor is moving, go to next step.

2. Test the resistance of the transmission speed sensor:

Locate the transmission speed sensor on top of the transmission.

Disconnect connector C069 from the sensor.

Inspect the connector. Clean the connection.

Measure the sensor resistance between pin A and pin B.

The resistance should be around 3 k ohms.

If the resistance is much higher than 3K, the sensor coil may be damaged internally.

If the resistance is close to 0, there must be a shortage inside the sensor.

In either case, replace the transmission speed sensor.

If the resistance is close to 3k ohms, go to next step.

3. Check the wiring from the wheel speed sensor to the transmission controller.

Check continuity between pin A of connector C069 and pin 34 of connector 351.

Check continuity between pin B of connector C069 and the clean ground.

If there is no good continuity in either case, check for open circuit and wiring shortage.

**NOTE:** Pay attention to wiring damage, loose connectors, and bent pins.

4. Check the function of the wheel speed sensor

Take pin 34 out of connector 351 with all other part of harness connected, the signal from the wheel speed sensor can be checked.

The signal from the wheel speed sensor is in sinusoidal form. The sensor has to be properly installed onto transmission (turn all way in) to give enough signal.

With the key ON, but tractor not moving, the signal will show around 2.5 V DC and almost 0 V AC.

When tractor is moving, the DC voltage will remain the same and the AC voltage will jump to several volts (depending on loads in the harness). The AC voltage will increase as tractor speed goes up.

If the wheel speed sensor functions normal, check connections from the sensor to the controller.

If the wheel speed sensor does not functions normal, replace the sensor.

## **FAULT CODE TRANS 78**

### **Transmission regulated pressure accumulator is discharged**

#### **Cause:**

The transmission controller monitors the regulated system pressure. If the pressure drops below normal range during shifts, this fault code will be recorded.

#### **Possible failure modes:**

1. Transmission regulated pressure accumulator is discharged (most likely).
2. Extensive internal clutch leaks (Rare case).

#### **Solution:**

The transmission regulated pressure accumulator plays a big role in Powershift.

If the shift quality for all shifts is noticeably deteriorated, it is a good indication that the transmission regulated pressure accumulator is discharged.

If the accumulator is fully charged but the fault code still appears, there may be extensive internal clutch leaks.

## FAULT CODE TRANS 79

### Engine RPM from the alternator is measured too high

#### Cause:

If the transmission controller detected the engine speed exceeds 3000 RPM, this fault code will be recorded.

#### Possible failure modes:

1. Tractor was in over-speed condition, such as run down hill with load.
2. Faulty signal.

#### Solution:

The engine speed signal is from the W terminal of the alternator. The RPM is displayed on the ICU.

This fault code is most likely being recorded when tractor was in over-speed condition, such as runs down hill with heavy load. In such case, fault code 80 may be recorded too.

If it is sure the tractor has not been in over-speed condition or the fault code is active in normal conditions, go to the following steps.

1. Make sure the alternator is the specified model and its engine RPM signal matches the specified model. Make sure the belt and pulley are properly installed.

2. Troubleshooting by viewing the Instrumentation display

The engine speed is displayed when tractor is running.

Drive the tractor at different engine throttle and watch the speed.

If the speed display is normal, the speed signal is fine. The problem is more likely in the wiring connection from the alternator to the transmission controller. Go to step 4.

If the engine speed display is higher than it should be, go to next steps.

3. Disconnect the wire connection at the W terminal of the alternator. Clear all trans faults. Run the tractor and check trans faults again.

If fault code 79 appears again, There is good chance the higher than normal signal is coming from other signal sources. Go to step 4.

Otherwise, check the signal at W terminal of the alternator.

4. Check the wiring from the alternator to the transmission controller.

Check from W terminal of the alternator to pin 33 of connector 351.

Pay attention to connection crossing among wheel speed sensor circuit, engine RPM signal circuit, and PTO speed signal circuit.

Looking for wiring shortage, loose connectors, and bent pins.

5. Check the signal at W terminal of the alternator.

The signal is in half-wave rectified sinusoidal output (close to square wave) form.

The signal will show around 7 V DC (will increase as engine speed goes up) and 0 to 14 V AC.

At 1000 engine RPM, the AC signal will have around 290 Hz Frequency.

At 2000 engine RPM, the AC signal will have around 580 Hz Frequency.

If the engine speed signal is normal, check connections from the alternator to the controller.

If the engine speed signal is not normal, replace the alternator.

## FAULT CODE TRANS 80

### wheel speed sensor is measured too high

#### Cause:

If the transmission controller detected the transmission output RPM (wheel speed sensor signal) is too high for the desired gear, this fault code will be recorded.

#### Possible failure modes:

1. Tractor was in over-speed condition, such as run down hill with load.
2. Wheel speed sensor problem.
3. Wiring harness problem between the wheel speed sensor and the transmission controller.

#### Solution:

The wheel speed sensor is hard wired to both the transmission controller and the instrumentation controller. The wheel speed is displayed on the ICU when Radar is not present.

This fault code is most likely being recorded when tractor was in over-speed condition, such as runs down hill with heavy load. In such case, fault code 79 may be recorded too.

If it is sure the tractor has not been in over-speed condition or the fault code is active in normal condition, go to the following steps.

1. Troubleshooting by viewing the Instrumentation display  
Disconnect Radar if equipped. The wheel speed from the wheel speed sensor will be displayed when tractor is running.  
Drive the tractor at different gears and watch the wheel speed.  
If the speed display is normal, the wheel speed sensor is fine. The problem is more likely in the wiring connection from the sensor to the transmission controller.  
If the wheel speed display is higher than it should be, go to next steps.
2. Test the resistance of the transmission speed sensor:  
Locate the transmission speed sensor on top of the transmission.  
Disconnect connector C069 from the sensor.  
Inspect the connector. Clean the connection.  
Measure the sensor resistance between pin A and pin B.  
The resistance should be around 3 k ohms.  
If the resistance is much higher than 3K, the sensor coil may be damaged internally.  
If the resistance is close to 0, there must be a shortage inside the sensor.  
In either case, replace the transmission speed sensor.  
If the resistance is close to 3k ohms, go to next step.
3. Check the wiring from the wheel speed sensor to the transmission controller.  
There is good chance the higher than normal signal is coming from other signal sources.  
Check from pin A of connector C069 to pin 34 of connector 351 and from pin B of connector C069 to the clean ground.  
Pay more attention to connections crossing along wheel speed sensor circuit, engine RPM signal circuit, and PTO speed signal circuit.  
Looking for wiring shortage, loose connectors, and bent pins.
4. Check the function of the wheel speed sensor

Take pin 34 out of connector 351 with all other part of harness connected, the signal from the wheel speed sensor can be checked.

The signal from the wheel speed sensor is in sinusoidal form. The sensor has to be properly installed onto transmission (turn all way in) to give enough signal.

With key ON, but tractor not moving, the signal will show around 2.5 V DC and almost 0 V AC.

With tractor moving, the DC voltage will remain the same and the AC voltage will jump to several volts (depending on loads in the harness). The AC voltage will increase as tractor speed goes up.

If the wheel speed sensor functions normal, check connections from the sensor to the controller.

If the wheel speed sensor does not functions normal, replace the sensor.

## FAULT CODE TRANS 81

### transmission clutches are slipping

#### Cause:

If the transmission controller detected the output speed is too low for gear selected, this fault code will be recorded.

#### Possible failure mode:

1. Failed transmission speed sensor.
2. Solenoid mechanically not being turned ON (sticking).
3. Low hydraulic system pressure.
4. Leaking transmission clutch.
5. Failed master clutch.
6. Failed shaft in transmission.

#### Solution:

The transmission controller compares the engine speed against the final drive speed. This ratio will change as different gears are selected. If this fault code only appears in certain gears a clutch may be starting to fail.

1. Check for fault code 77, 79, and 80.  
Make sure there not fault indication for the engine speed and the transmission output (final drive) speed
2. Check for fault code 147.  
Make sure the regulated system pressure is within the specified range.
3. Check for fault code 50 and 52.  
Make sure the park brake is released.
4. If none of above fault code are recorded, check and verify that the transmission clutches are slipping.
  - A. Clear the fault code. Engage different gears until the fault code shows up.
  - B. Check whether the tractor speed is normal in the gears which create the fault code. Pay attention to abnormal noise and sluggish gear engagement.  
If It is suspected that the transmission slips in certain gears, go to step 5.  
If there is no sign of clutch slippage, either engine speed signal or transmission speed signal may be invalid. Go to step 6 and 7.
5. Troubleshoot the clutch slippage.
  - A. Select different gears to identify the slipping clutch. Refer to the powershift valve clutch engagement table for clutches engaged in each gear. See section 6000 in this manual.
  - B. If a slipping clutch is identified, test its solenoid and the valve.  
Make sure the solenoid will mechanically engage when it is turned ON.  
Make sure there is no sticking spool in the valve.
  - C. If none of above, check for transmission internal failure such as failed clutch or broken shaft.
6. Test the transmission speed sensing (refer to the troubleshooting procedure for fault 80)  
Test the resistance of the transmission speed sensor:

Locate the transmission speed sensor on top of the transmission.

Disconnect connector C069 from the sensor.

Inspect the connector. Clean the connection.

Measure the sensor resistance between pin A and Pin B.

The resistance should be around 3 k ohms at 20 degree Celsius.

If the resistance is not in the specified range, replace the transmission speed sensor.

**NOTE:** *There are cases where the resistance of the sensor is within the specified range but its signal may not be right. To verify the validity of the speed signal is a complicated process. If it is suspected that the signal may be wrong, replace the transmission speed sensor*

7. Test engine speed sensing (refer to the troubleshooting procedure for fault 79)

If the tractor has engine controller, refer to engine diagnosing procedures for troubleshooting.

If the tractor does not have engine controller, do the following:

- A. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
- B. Check for worn alternator belt.
- C. Check the Engine RPM signal wiring.
- D. Check the Engine RPM signal at terminal W of the alternator.



## **FAULT CODE TRANS 82**

### **Creep Clutch is not calibrated**

#### **Cause:**

Creep Clutch is not calibrated

#### **Solution:**

Clear the fault codes and calibrate the Creep Clutch.

## **FAULT CODE TRANS 83**

### **Governor is off line CAN Bus**

#### **Cause:**

Transmission controller has lost communication with engine controller.

#### **Solution:**

Check the engine and transmission controller connectors. Make sure the connectors are properly connected and that there are no broken wires or loose pins. Check the harness wiring for any visible damage.

## FAULT CODE TRANS 103

### Odd Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The odd clutch solenoid coil failed open.
2. Odd clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the odd clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C350 and C353 from the transmission controller. Measure the resistance between cavity 9 of connector C350 and cavity 8 of connector C353 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the odd clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 9 of connector C350 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the odd clutch solenoid and the transmission controller.  
Measure the resistance between cavity 8 of connector C353 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the odd clutch solenoid and the transmission controller.  
If the harness is okay check the odd clutch solenoid.
4. Lift the cab. Disconnect the odd clutch solenoid connector (C029).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the odd clutch solenoid coil is failed open. Replace the odd clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 9 of connector C350 and cavity 8 of connector C353.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 104

### Even Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The even clutch solenoid coil failed open.
2. Even clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the even clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C350 and C353 from the transmission controller. Measure the resistance between cavity 10 of connector C350 and cavity 1 of connector C353 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the even clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 10 of connector C350 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the even clutch solenoid and the transmission controller.  
Measure the resistance between cavity 1 of connector C353 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the even clutch solenoid and the transmission controller.  
If the harness is okay check the even clutch solenoid.
4. Lift the cab. Disconnect the even clutch solenoid connector (C030).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the even clutch solenoid coil is failed open. Replace the even clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 10 of connector C350 and cavity 1 of connector C353.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 105

### C1-2 Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The C1-2 clutch solenoid coil failed open.
2. C1-2 clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the C1-2 clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C350 and C353 from the transmission controller. Measure the resistance between cavity 6 of connector C350 and cavity 6 of connector C353 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the C1-2 clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 6 of connector C350 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the C1-2 clutch solenoid and the transmission controller.  
Measure the resistance between cavity 6 of connector C353 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the C1-2 clutch solenoid and the transmission controller.  
If the harness is okay check the C1-2 clutch solenoid.
4. Lift the cab. Disconnect the C1-2 clutch solenoid connector (C031).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the C1-2 clutch solenoid coil is failed open. Replace the C1-2 clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 6 of connector C350 and cavity 6 of connector C353.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 106

### C3-4 Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The C3-4 clutch solenoid coil failed open.
2. C3-4 clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the C3-4 clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C350 and C353 from the transmission controller. Measure the resistance between cavity 7 of connector C350 and cavity 13 of connector C353 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the C3-4 clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 7 of connector C350 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the C3-4 clutch solenoid and the transmission controller.  
Measure the resistance between cavity 13 of connector C353 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the C3-4 clutch solenoid and the transmission controller.  
If the harness is okay check the C3-4 clutch solenoid.
4. Lift the cab. Disconnect the C3-4 clutch solenoid connector (C032).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the C3-4 clutch solenoid coil is failed open. Replace the C3-4 clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 7 of connector C350 and cavity 13 of connector C353.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 107

### C5-6 Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The C5-6 clutch solenoid coil failed open.
2. C5-6 clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the C5-6 clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C355 from the transmission controller. Measure the resistance between cavity 13 and cavity 1 of connector C355 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the C5-6 clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 13 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the C5-6 clutch solenoid and the transmission controller.  
Measure the resistance between cavity 1 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the C5-6 clutch solenoid and the transmission controller.  
If the harness is okay check the C5-6 clutch solenoid.
4. Lift the cab. Disconnect the C5-6 clutch solenoid connector (C033).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the C5-6 clutch solenoid coil is failed open. Replace the C5-6 clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 13 and cavity 1 of connector C355.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 108

### Master Clutch Solenoid Circuit Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The master clutch solenoid coil failed open.
2. Master clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the master clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C350 and C353 from the transmission controller. Measure the resistance between cavity 5 of connector C350 and cavity 4 of connector C353 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the master clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 5 of connector C350 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the master clutch solenoid and the transmission controller.  
Measure the resistance between cavity 4 of connector C353 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the master clutch solenoid and the transmission controller.  
If the harness is okay check the master clutch solenoid.
4. Lift the cab. Disconnect the master clutch solenoid connector (C035).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the master clutch solenoid coil is failed open. Replace the master clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 5 of connector C350 and cavity 4 of connector C353.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 109

### Low clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The low clutch solenoid coil failed open.
2. Low clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the low clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C355 from the transmission controller. Measure the resistance between cavity 14 and cavity 18 of connector C355 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the low clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 14 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the low clutch solenoid and the transmission controller.  
Measure the resistance between cavity 18 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the low clutch solenoid and the transmission controller.  
If the harness is okay check the low clutch solenoid.
4. Lift the cab. Disconnect the low clutch solenoid connector (C036).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the low clutch solenoid coil is failed open. Replace the low clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 14 and cavity 18 of connector C355.  
Check for loose, bent, or any damaged pins.



## FAULT CODE TRANS 110

### Mid Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The mid clutch solenoid coil failed open.
2. Mid clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the mid clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C355 from the transmission controller. Measure the resistance between cavity 6 and cavity 10 of connector C355 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the mid clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 6 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the mid clutch solenoid and the transmission controller.  
Measure the resistance between cavity 10 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the mid clutch solenoid and the transmission controller.  
If the harness is okay check the mid clutch solenoid.
4. Lift the cab. Disconnect the mid clutch solenoid connector (C037).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the mid clutch solenoid coil is failed open. Replace the mid clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 6 and cavity 10 of connector C355.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 111

### High Clutch Solenoid Or Its Wiring Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The high clutch solenoid coil failed open.
2. High clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the high clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C355 from the transmission controller. Measure the resistance between cavity 16 and cavity 4 of connector C355 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the high clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 16 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the high clutch solenoid and the transmission controller.  
Measure the resistance between cavity 4 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the high clutch solenoid and the transmission controller.  
If the harness is okay check the high clutch solenoid.
4. Lift the cab. Disconnect the high clutch solenoid connector (C038).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the high clutch solenoid coil is failed open. Replace the high clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 16 and cavity 4 of connector C355.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 112

### Reverse Clutch Solenoid Circuit Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The reverse clutch solenoid coil failed open.
2. Reverse clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the reverse clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C355 from the transmission controller. Measure the resistance between cavity 5 and cavity 2 of connector C355 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the reverse clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 5 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the reverse clutch solenoid and the transmission controller.  
Measure the resistance between cavity 2 of connector C355 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the reverse clutch solenoid and the transmission controller.  
If the harness is okay check the reverse clutch solenoid.
4. Lift the cab. Disconnect the reverse clutch solenoid connector (C034).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the reverse clutch solenoid coil is failed open. Replace the reverse clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 5 and cavity 2 of connector C355.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 113

### Creeper Clutch Solenoid Circuit Failed Open Or Shorted To Ground

#### Possible failure mode:

1. The creeper clutch solenoid coil failed open.
2. Creeper clutch solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the creeper clutch solenoid circuit. If the current draw is lower than a limit, it means the circuit is open or shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check the wiring harness for damage.
2. Disconnect connector C350 and C353 from the transmission controller. Measure the resistance between cavity 11 of connector C350 and cavity 3 of connector C353 on the wiring harness side. The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit. Check the harness first for the open. If the harness is okay, check the creeper clutch solenoid for the open.  
If the resistance is around 10 ohms, go to next step.
3. Measure the resistance between cavity 11 of connector C350 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the creeper clutch solenoid and the transmission controller.  
Measure the resistance between cavity 3 of connector C353 and the chassis ground. If the resistance is less than a few ohms, there is a short from the wire to ground. Check the wire for damage between the creeper clutch solenoid and the transmission controller.  
If the harness is okay check the creeper clutch solenoid.
4. Lift the cab. Disconnect the creeper clutch solenoid connector (C039).  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the creeper clutch solenoid coil is failed open. Replace the creeper clutch solenoid.  
If the resistance is as specified above, check to see if the coil is internally shorted to solenoid case.
5. If no problem is found in above test, check both male and female pins in the cavity 11 of connector C350 and cavity 3 of connector C353.  
Check for loose, bent, or any damaged pins.

## FAULT CODE TRANS 114

### Even Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned Even clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The Even clutch solenoid coil shorted to power.
2. Even clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the even clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C353 from the transmission controller.  
Measure the resistance between cavity 10 of connector C350 and cavity 1 of connector C353 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 10 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between even clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 1 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between even clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 10 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between even clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 1 of connector C353 and cavity 20 of connector C350.  
There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between even clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 10 from connector 350 and remove wire/pin 1 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 10 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 1 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 115

### Odd Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned odd clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The odd clutch solenoid coil shorted to power.
2. Odd clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the odd clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C353 from the transmission controller.  
Measure the resistance between cavity 9 of connector C350 and cavity 8 of connector C353 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 9 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between odd clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 8 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between odd clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 9 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between odd clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 8 of connector C353 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between odd clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 9 from connector 350 and remove wire/pin 8 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 9 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 8 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 116

### C1-2 Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned C1-2 clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The C1-2 clutch solenoid coil shorted to power.
2. C1-2 clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the C1-2 clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C353 from the transmission controller.  
Measure the resistance between cavity 6 of connector C350 and cavity 6 of connector C353 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 6 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C1-2 clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 6 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C1-2 clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 6 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C1-2 clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 6 of connector C353 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C1-2 clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 6 from connector 350 and remove wire/pin 6 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 6 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 6 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 117

### C3-4 Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned C3-4 clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The C3-4 clutch solenoid coil shorted to power.
2. C3-4 clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the C3-4 clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C353 from the transmission controller.  
Measure the resistance between cavity 7 of connector C350 and cavity 13 of connector C353 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 7 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C3-4 clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 13 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C3-4 clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 7 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C3-4 clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 13 of connector C353 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C3-4 clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 7 from connector 350 and remove wire/pin 13 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 7 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 13 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.



## FAULT CODE TRANS 118

### C5-6 Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned C5-6 clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The C5-6 clutch solenoid coil shorted to power.
2. C5-6 clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the C5-6 clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C355 from the transmission controller.  
Measure the resistance between cavity 13 of connector C353 and cavity 1 of connector C355 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 13 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C5-6 clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 1 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C5-6 clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 13 of connector C353 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C5-6 clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 1 of connector C355 and cavity 20 of connector C350.  
There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between C5-6 clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 13 and wire/pin 1 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 13 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 1 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 119

### Master Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned master clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The master clutch solenoid coil shorted to power.
2. Master clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the master clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C353 from the transmission controller.  
Measure the resistance between cavity 5 of connector C350 and cavity 4 of connector C353 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 5 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between master clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 4 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between master clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 5 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between master clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 4 of connector C353 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between master clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 5 from connector 350 and remove wire/pin 4 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 5 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 4 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 120

### Low Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned low clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The low clutch solenoid coil shorted to power.
2. Low clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the low clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C355 from the transmission controller.  
Measure the resistance between cavity 14 of connector C355 and cavity 18 of connector C355 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 14 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between low clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 18 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between low clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 14 of connector C355 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between low clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 18 of connector C355 and cavity 20 of connector C350.  
There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between low clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 14 and wire/pin 18 from connector 355. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 14 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 18 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 121

### Mid Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned mid clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The mid clutch solenoid coil shorted to power.
2. Mid clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the mid clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C355 from the transmission controller.  
Measure the resistance between cavity 6 of connector C355 and cavity 10 of connector C355 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 6 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between mid clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 10 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between mid clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 6 of connector C355 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between mid clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 10 of connector C355 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between mid clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 6 and wire/pin 10 from connector 355. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 6 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 10 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 122

### High Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned high clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The high clutch solenoid coil shorted to power.
2. High clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the high clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C355 from the transmission controller.  
Measure the resistance between cavity 16 of connector C355 and cavity 4 of connector C355 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 16 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between high clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 4 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between high clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 16 of connector C355 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between high clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 4 of connector C355 and cavity 20 of connector C350.  
There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between high clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 16 and wire/pin 4 from connector 355. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 16 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 4 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 123

### Reverse Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned reverse clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The reverse clutch solenoid coil shorted to power.
2. Reverse clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the reverse clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C355 from the transmission controller.  
Measure the resistance between cavity 5 of connector C355 and cavity 2 of connector C355 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 5 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between reverse clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 2 of connector C355 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between reverse clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 5 of connector C355 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between reverse clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 2 of connector C355 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between reverse clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 5 and wire/pin 2 from connector 355. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 5 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 2 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## FAULT CODE TRANS 124

### Creeper Clutch Solenoid Coil Shorted Or Its Wiring Shorted To Power

#### Cause:

The transmission controller has turned creeper clutch solenoid OFF but sensed current in the circuit.

#### Possible failure mode:

1. The creeper clutch solenoid coil shorted to power.
2. Creeper clutch solenoid wiring shorted to power.

#### Solution:

The transmission controller measures the current from the creeper clutch solenoid circuit. If the current is higher than a set limit, it means the circuit is shorted to power.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoids under the cab. Check for abnormal routing and wire damage.
2. Disconnect connector C350 and C353 from the transmission controller.  
Measure the resistance between cavity 11 of connector C350 and cavity 3 of connector C353 at the wiring harness side.  
The resistance should be around 10 ohms.
3. Measure the resistance between cavity 11 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between creeper clutch solenoid wiring and fuse #44.
4. Next measure the resistance between cavity 3 of connector C353 and cavity 1 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between creeper clutch solenoid wiring and fuse #44.
5. Measure the resistance between cavity 11 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between creeper clutch solenoid and cavity 5 of Neutral Relay.
6. Next measure the resistance between cavity 3 of connector C353 and cavity 20 of connector C350. There should be no continuity. If the resistance is less than a few ohms, there is a shortage from the wire to the power. Check for wire damage between creeper clutch solenoid and cavity 5 of Neutral Relay.
7. If no problem could be found in the above checks continue with item 8.
8. Remove wire/pin 11 from connector 350 and remove wire/pin 3 from connector 353. See the instructions near the beginning of this section for the proper procedure. Once the wires/pins are removed reconnect the connectors back to the transmission controller.
9. Place the transmission control lever in Park position. Start the engine and raise the inching pedal.
10. Check for voltage from pin 11 to the ground. The voltage should be 0 volts. Operate tractor functions such as PTO, MFD, Diff Lock, AC, lights etc., to locate the source of shortage. It may be necessary to drive the tractor and shift gears up and down while checking for voltage. If under any condition voltage is present, pursue troubleshooting for a short circuit accordingly.
11. Repeat the procedure from above checking for shortage from pin 3 to ground.
12. When the check is completed return the wire/pin to the proper cavity in each connector. See the instructions near the beginning of this section for the proper procedure.

## **FAULT CODE TRANS 125**

### **Odd Clutch is not calibrated**

**Cause:**

Odd Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the Odd Clutch.

If the fault code still appears after the Odd clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 126**

### **Even Clutch is not calibrated**

**Cause:**

Even Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the Even Clutch.

If the fault code still appears after the Even clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 127**

### **C1-2 Clutch is not calibrated**

**Cause:**

C1-2 Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the C1-2 Clutch.

If the fault code still appears after the C1-2 clutch is properly calibrated, please contact TSG.



## **FAULT CODE TRANS 128**

### **C3-4 Clutch is not calibrated**

**Cause:**

C3-4 Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the C3-4 Clutch.

If the fault code still appears after the C3-4 clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 129**

### **C5-6 Clutch is not calibrated**

**Cause:**

C5-6 Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the C5-6 Clutch.

If the fault code still appears after the C5-6 clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 130**

### **Low Range Clutch is not calibrated**

**Cause:**

Low Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the Low Clutch.

If the fault code still appears after the Low clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 131**

### **Mid Range Clutch is not calibrated**

**Cause:**

Mid Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the Mid Clutch.

If the fault code still appears after the Mid clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 132**

### **High Range Clutch is not calibrated**

**Cause:**

High Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the High Clutch.

If the fault code still appears after the High clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 133**

### **Reverse Clutch is not calibrated**

**Cause:**

Reverse Clutch is not calibrated

**Solution:**

Clear the fault codes and calibrate the Reverse Clutch.

If the fault code still appears after the Reverse clutch is properly calibrated, please contact TSG.

## **FAULT CODE TRANS 134**

### **Master Clutch is not calibrated**

#### **Cause:**

Master Clutch is not calibrated

#### **Solution:**

Clear the fault codes and calibrate the Master Clutch.

If the fault code still appears after the Master clutch is properly calibrated, please contact TSG.

## FAULT CODE TRANS 135

### Communication lost with the armrest controller

#### Cause:

Communication lost between transmission controller and armrest controller.

#### Possible Failure modes:

1. Bad Can Bus connection between the transmission controller and armrest controller.
2. Controller failure.

#### Solution:

Make sure both the transmission controller and armrest controller are functioning OK.

Check the Data Bus connections.

1. Check the function of the Armrest controller:
  - A. Make sure the connector C137 to the Armrest controller is plugged in
  - B. Check the LED light on the Armrest controller  
LED light on - failed controller, replace the controller.  
LED light flashing - controller is OK  
LED off - no power to controller, check power supply and its fuse.

**NOTE:** *The LED light for the Armrest controller is located on the controller circuit board. It can be seen by looking through the opening next to connector C137 from the rear of the Armrest.*

2. Check the function of the transmission controller:

Make sure there is no other fault code or symptom indicating transmission controller malfunctioning.
3. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.  
At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
  - B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.  
Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.

At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18 on the schematic poster.*

## FAULT CODE TRANS 136

### Communication lost with the instrumentation controller

#### Cause:

Communication lost between transmission controller and instrumentation controller.

#### Possible Failure modes:

1. Bad Can Bus connection between the transmission controller and instrumentation controller.
2. Controller failure.

#### Solution:

Make sure both the transmission controller and instrumentation controller are functioning OK.  
Check the Data Bus connections.

1. Check the function of the transmission controller:

Make sure there is no other fault code or symptom indicating transmission controller malfunctioning.

2. Check the function of the Instrument controller:

- A. If there is no display and no back light on the tractor instrumentation, it is more likely that there is no power to controller. Check power supply, its fuse, and the ground to the controller. Make sure the connector (C061) to the Instrument controller is plugged in.
- B. If there is display on the tractor instrumentation but the display is erratic, such as totally strange symbols, and other controllers claim communication lost with the Instrument controller, it is more like the Instrument controller failed. Replace the controller.
- C. If nothing wrong can be found with the Instrument controller, go to step 3.

3. Check the power supply to the Tractor Data Bus.

- A. Check fuse #42.
- B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.

4. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

- A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.  
At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed.
- B. Check from the can bus resistor terminator in the AUX/Hitch/PTO controller.  
Reconnect the engine end resistor terminator and disconnect the AUX/Hitch/PTO controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The AUX/Hitch/PTO controller resistor terminator has most likely failed. Test the AUX/Hitch/PTO resistor terminator and replace if it has failed.

5. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at AUX/Hitch/PTO controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
6. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.
  - B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**NOTE:** *Also see the Data Bus schematic foldouts 13 through 18 on the schematic poster.*

## FAULT CODE TRANS 137

### Front Suspension upper lock solenoid circuit shorted or open circuit

#### Cause:

The transmission controller monitors the upper lock solenoid circuit. If the transmission controller detected open circuit or too much current draw in circuit, this fault code will be recorded.

#### Possible failure mode:

1. The upper lock solenoid coil failed.
2. The upper lock solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the upper lock solenoid circuit. If the current draw is lower than a limit, it means the circuit is open. If the current draw is higher than a limit, it means the circuit is shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoid. Check for proper routing and wire damage.

2. Disconnect connector C350 and C353 from the transmission controller.

Measure the resistance between cavity 13 of connector C350 and cavity 7 of connector C353 at the wiring harness side.

The resistance should be around 5.6 ohms.

If the resistance is dramatically higher than specified, there is an open in the circuit.

If the resistance is close to 0, there is a shortage in the circuit.

If the resistance is as specified, go to the next step.

3. Measure the resistance from cavity 13 of connector C350 or cavity 7 of connector C353 to the chassis ground.

If the resistance is less than a few ohms, there is a shortage from the wire to the ground. Check for wire shortage in the harness.

If the above checks are all OK, check the upper lock solenoid.

4. Check upper lock solenoid.

Disconnect the upper lock solenoid at connector C186.

Measure the resistance between pin 1 and pin 2 of the solenoid.

The resistance should be around 5.6 ohms.

If the resistance is dramatically higher than specified, the upper lock solenoid coil failed open.

If the resistance is close to 0, there is an internal shortage.

In either case, replace the upper lock solenoid.

5. If no problem is found in above test, check both male and female pins in the cavity 13 of connector C350 and cavity 7 of connector C353.

Check for no loose pin, bent pin, or any damage.

**NOTE:** See the Data Bus schematic section 43 on the schematic poster.



## FAULT CODE TRANS 138

### Front Suspension Raise solenoid circuit shorted or open circuit

#### Cause:

The transmission controller monitors the Raise solenoid circuit. If the transmission controller detected open circuit or too much current draw in circuit, this fault code will be recorded.

#### Possible failure mode:

1. The Raise solenoid coil failed.
2. The Raise solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the Raise solenoid circuit.

If the current draw is lower than a limit, it means the circuit is open.

If the current draw is higher than a limit, it means the circuit is shorted to ground.

If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoid. Check for proper routing and wire damage.

2. Disconnect connector C355 from the transmission controller.

Measure the resistance between cavity 8 of connector C355 and the chassis ground at the wiring harness side.

The resistance should be around 10 ohms.

If the resistance is dramatically higher than specified, there is an open in the circuit.

If the resistance is close to 0, there is a shortage in the circuit.

Check the harness. If the harness is OK, check the Raise solenoid.

3. Check the Raise solenoid.

Disconnect the Raise solenoid at connector C183.

Measure the resistance between pin 1 and pin 2 of the solenoid.

The resistance should be around 10 ohms.

If the resistance is dramatically higher than specified, the Raise solenoid coil failed open.

If the resistance is close to 0, there is an internal shortage.

In either case, replace the Raise solenoid.

4. If no problem is found in above test, check both male and female pins in the cavity 8 of connector C355. Check for no loose pin, bent pin, or any damage.

**NOTE:** See the Data Bus schematic section 43 on the schematic poster.

## FAULT CODE TRANS 139

### Front Suspension Lower solenoid circuit shorted or open circuit

#### Cause:

The transmission controller monitors the Lower solenoid circuit. If the transmission controller detected open circuit or too much current draw in circuit, this fault code will be recorded.

#### Possible failure mode:

1. The Lower solenoid coil failed.
2. The Lower solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the Lower solenoid circuit.

If the current draw is lower than a limit, it means the circuit is open.

If the current draw is higher than a limit, it means the circuit is shorted to ground.

If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoid. Check for proper routing and wire damage.
2. Disconnect connector C355 from the transmission controller.  
Measure the resistance between cavity 15 of connector C355 and the chassis ground at the wiring harness side.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit.  
If the resistance is close to 0, there is a shortage in the circuit.  
Check the harness. If the harness is OK, check the Lower solenoid.
3. Check the Lower solenoid.  
Disconnect the Lower solenoid at connector C184.  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 10 ohms.  
If the resistance is dramatically higher than specified, the Lower solenoid coil failed open.  
If the resistance is close to 0, there is an internal shortage.  
In either case, replace the Lower solenoid.
4. If no problem is found in above test, check both male and female pins in the cavity 15 of connector C355.  
Check for no loose pin, bent pin, or any damage.

**NOTE:** See the Data Bus schematic section 43 on the schematic poster.

## FAULT CODE TRANS 140

### front suspension position is above the expected absolute limit

#### Cause:

The transmission controller monitors the front axle potentiometer circuit. If the transmission controller detected the voltage is above 4.74 Volts, this fault code will be recorded.

#### Possible failure mode:

1. The front suspension position is above the absolute limit.
2. The front axle position sensor failed.
3. The front axle position sensor wiring shorted to power.

#### Solution:

1. Check if the front suspension position has been above the absolute limit.  
The front axle position should always be kept within the expected range to make sure the suspension works. Make sure the tractor is properly ballasted and the implement is not too heavy for the tractor.
2. Check the installation of the front axle position sensor.  
Make sure the front axle position sensor is properly installed. There is no mechanical damage or blockage preventing its linkage work properly.  
If the sensor installation is proper and the front axle position has never really been above the range, go to next steps to check for electrical problems.
3. Check the front axle position sensor.  
The front axle position sensor voltage can be monitored on the Instrument controller.  
Enter program mode on ICU. Go to Fsus under Trans.  
The front axle position sensor voltage will be displayed in both CAL and Manual mode.  
The voltage should change smoothly from less than 1 volts to close to 5 volts when the front axle moves from the lowest to the highest.  
If the voltage changes as expected, the position sensing is working fine. It is more likely the front axle was above the limit for mechanical reasons.  
Otherwise, go to next step.
4. Check the front axle position sensor wiring.  
Measure at the connector C193 on the harness side.  
There should be good continuity between pin 1 and the vehicle ground.  
There should be good continuity between pin 3 of connector C193 and pin 2 of connector C353.  
Turn the tractor key On, there should be battery voltage (around 12 volts) at pin 2 and no volts at pin 3 and pin1.  
If the measurement is as expected, replace the front axle position sensor.  
Otherwise, check for wire shortage and damages.

**NOTE:** Pay attention to wiring damage, loose connectors, and bent pins.

**NOTE:** See the Data Bus schematic section 43 on the schematic poster.

## FAULT CODE TRANS 141

### front suspension position is below the expected absolute limit

#### Cause:

The transmission controller monitors the front axle potentiometer circuit. If the transmission controller detected the voltage is below 0.74 Volts, this fault code will be recorded.

#### Possible failure mode:

1. The front suspension position is below the absolute limit.
2. The front axle position sensor failed.
3. The front axle position sensor wiring shorted to ground.

#### Solution:

1. Check if the front suspension position has been below the absolute limit.  
The front axle position should always be kept within the expected range to make sure the suspension works. Make sure the tractor is properly ballasted and the front weight is proper for the tractor.
2. Check the installation of the front axle position sensor.  
Make sure the front axle position sensor is properly installed. There is no mechanical damage or blockage preventing its linkage work properly.  
If the sensor installation is proper and the front axle position has never really been below the range, go to next steps to check for electrical problems.
3. Check the front axle position sensor.  
The front axle position sensor voltage can be monitored on the Instrument controller.  
Enter program mode on ICU. Go to Fsus under Trans.  
The front axle position sensor voltage will be displayed in both CAL and Manual mode.  
The voltage should change smoothly from less than 1 volts to close to 5 volts when the front axle moves from the lowest to the highest.  
If the voltage changes as expected, the position sensing is working fine. It is more likely the front axle was above the limit for mechanical reasons.  
Otherwise, go to next step.
4. Check the front axle position sensor wiring.  
Measure at the connector C193 on the harness side.  
There should be good continuity between pin 1 and the vehicle ground.  
There should be no continuity between pin 3 and the vehicle ground.  
There should be good continuity between pin 3 of connector C193 and pin 2 of connector C353.  
Turn the tractor key On, there should be battery voltage (around 12 volts) at pin 2 and no volts at pin 3 and pin1.  
If the measurement is as expected, replace the front axle position sensor.  
Otherwise, check for wire shortage and damages.

**NOTE:** Pay attention to wiring damage, loose connectors, and bent pins.

**NOTE:** See the Data Bus schematic section 43 on the schematic poster.

## **FAULT CODE TRANS 142**

### **Front suspension travel range has not been calibrated**

#### **Cause:**

Front suspension travel range is not calibrated

#### **Solution:**

Clear the fault codes and calibrate the front suspension travel range.

## **FAULT CODE TRANS 143**

### **Front suspension position is above the upper suspension range**

#### **Cause:**

The transmission controller monitors the front axle potentiometer circuit. If the transmission controller detected the voltage is 0.62 Volts above the mid calibrated point for 30 seconds, this fault code will be recorded.

#### **Solution:**

1. Check if the front suspension position has been above the upper range for too long.  
When the front axle suspension is turned on, the system should bring the axle within the range quickly.  
Make sure the tractor is properly ballasted and the implement is not too heavy for the tractor.  
Check the installation of the front axle position sensor.  
Make sure the front axle position sensor is properly installed. There is no mechanical damage or blockage preventing the suspension back to the mid point.  
If the above checks are all OK, go to next steps.
2. Check for electrical problems.  
Check for fault codes involving Raise, Lower, Upper lock, and Lower lock solenoid failures.  
Make sure all solenoids have been connected and electronically function OK.
3. Check for hydraulic problems.  
Check the hydraulic system.  
Make sure all circuits are well connected, the accumulators are properly charged, the pressure and flow are within the range.

## **FAULT CODE TRANS 144**

### **Front suspension position is below the lower suspension range**

#### **Cause:**

The transmission controller monitors the front axle potentiometer circuit. If the transmission controller detected the voltage is 0.62 Volts below the mid calibrated point for 30 seconds, this fault code will be recorded.

#### **Solution:**

1. Check if the front suspension position has been below the lower range for too long.  
When the front axle suspension is turned on, the system should bring the axle within the range quickly.  
Make sure the tractor is properly ballasted and the front weight is proper for the tractor.  
Check the installation of the front axle position sensor.  
Make sure the front axle position sensor is properly installed. There is no mechanical damage or blockage preventing the suspension back to the mid point.  
If the above checks are all OK, go to next steps.
2. Check for electrical problems.  
Check for fault codes involving Raise, Lower, Upper lock, and Lower lock solenoid failures.  
Make sure all solenoids have been connected and electronically function OK.
3. Check for hydraulic problems.  
Check the hydraulic system.  
Make sure all circuits are well connected, the accumulators are properly charged, the pressure and flow are within the range.

## FAULT CODE TRANS 145

### Front Suspension lower lock solenoid circuit shorted or open circuit

#### Cause:

The transmission controller monitors the lower lock solenoid circuit. If the transmission controller detected open circuit or too much current draw in circuit, this fault code will be recorded.

#### Possible failure mode:

1. The lower lock solenoid coil failed.
2. The lower lock solenoid wiring failed open or shorted to ground.

#### Solution:

The transmission controller measures the current draw from the lower lock solenoid circuit. If the current draw is lower than a limit, it means the circuit is open. If the current draw is higher than a limit, it means the circuit is shorted to ground. If the problem is temperature sensitive, the solenoid coil may be starting to fail.

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the solenoid. Check for abnormal routing and wire damage.
2. Disconnect connector C355 from the transmission controller.  
Measure the resistance between cavity 3 and cavity 15 of connector C355 at the wiring harness side.  
The resistance should be around 5.6 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit.  
If the resistance is close to 0, there is a shortage in the circuit.  
If the resistance is as specified, go to the next step.
3. Measure the resistance from cavity 3 or cavity 15 of connector C355 to the chassis ground.  
If the resistance is less than a few ohms, there is a shortage from the wire to the ground. Check for wire shortage in the harness.  
If the above checks are all OK, check the lower lock solenoid.
4. Check lower lock solenoid.  
Disconnect the lower lock solenoid at connector C187.  
Measure the resistance between pin 1 and pin 2 of the solenoid.  
The resistance should be around 5.6 ohms.  
If the resistance is dramatically higher than specified, the lower lock solenoid coil failed open.  
If the resistance is close to 0, there is an internal shortage.  
In either case, replace the lower lock solenoid.
5. If no problem is found in above test, check both male and female pins in the cavity 3 and cavity 15 of connector C355.  
Check for no loose pin, bent pin, or any damage.

**NOTE:** See the Data Bus schematic section 43 on the schematic poster.

## FAULT CODE TRANS 147

### Regulated system pressure below 290 PSI

#### Cause:

The transmission controller monitors the regulated system pressure. If the pressure drops below 290 PSI, this fault code will be recorded.

#### Possible failure modes:

1. Transmission regulated pressure dropped.
2. Pressure sensor or its circuit has problem.

#### Solution:

1. Check the transmission regulated pressure. See section 8001.

If the regulated pressure is low, following the hydraulic troubleshooting procedures.

If the regulated pressure is within the specified range but the fault code still appears, check the system pressure sensor and its circuit.

2. Troubleshooting by viewing the Instrumentation display.

The regulated system pressure can be viewed in the instrumentation cluster display.

Use the TRANS view to view the pressure.

- A. With the tractor in PARK, slowly move the throttle lever from low idle to high idle and then from high idle to low idle. The pressure should be 70 to 200 kPa (10 to 30 PSI) higher in high idle than in low idle.  
If the pressure follows the change of the throttle, it is more likely a hydraulic problem.  
If the pressure does not follow the change of the throttle, it is more likely the sensor or its wiring problem.
- B. Make sure that it is safe for the tractor to move during testing. Shift through gears.  
At each shift, the pressure should have a sudden drop to fill the clutch. Once the tractor is engaged, the pressure should come back to normal.  
If the pressure shows the sudden drop, it is more likely a hydraulic problem.  
If the pressure does not show the sudden drop, it is more likely the sensor or its wiring problem.

**NOTE:** *The engaging of the transmission may cause sudden movement of the tractor. Execute extreme caution when engaging the tractor to avoid any personal damage. Do the test only when the tractor can be moved safely.*

3. Troubleshooting of hydraulic problem.

- A. Adjust the regulated system pressure.  
If the pressure is too low or beyond adjustment, check the pressure regulating valve and other parts. Look for external and internal leaks.
- B. Make sure that it is safe for the tractor to move during testing. Shift through gears.  
At each shift, the pressure should have a sudden drop to fill the clutch. Once the tractor is engaged, the pressure should come back to normal.  
If the sudden drop is dramatic and pressure recovery is very slow when a gear is engaged, it is very likely that the clutch for that gear is leaking.  
Such as:  
If the clutch for 1-2 is leaking, the dramatic sudden drop and the slow pressure recovery should happen when engaging the following gears: 1, 2, 7, 8, 13, and 14.  
If the clutch for Odd is leaking, the dramatic sudden drop and the slow pressure recovery should happen when engaging the following gears: 1, 3, 5, 7, 9, etc.  
If the clutch for Mid is leaking, the dramatic sudden drop and the slow pressure recovery should happen when engaging the Mid gears: 6 to 7 and 13 to 12.



The engaging of the transmission may cause sudden movement of the tractor. Execute extreme caution when engaging the tractor to avoid personal damage. Do the test only when the tractor can be moved safely.

4. Troubleshooting the system pressure sensor and its circuit.

Clear fault codes. Disconnect the sensor at connector C044.

Shorting pin C to pin A at the harness side and run the tractor. This fault code should not reappear.

Shorting pin C to pin B at the harness side and run the tractor. This fault code should reappear.

If above situations are true, replace the pressure sensor. Otherwise, check the wiring

Make sure the 5 V power supply is available from the controller at Pin A of C044.

Make sure there is good continuity between Pin C of C044 and Pin 11 of C351.

Make sure there is good continuity between Pin B of C044 and the clean ground.

**NOTE:** *Pay attention to wiring damage, loose connectors, and bent pins.*

## FAULT CODE TRANS 148

### Backup alarm circuit shorted or open

#### Cause:

The transmission controller monitors the backup alarm circuit. If the transmission controller detected open circuit or too much current draw in the backup alarm circuit, this fault code will be recorded.

#### Possible failure mode:

1. The backup alarm failed.
2. The backup alarm wiring failed open or shorted to ground.

#### Solution:

1. Remove the controller cover from the rear of the tractor. Visually inspect the wiring harness from the transmission controller towards the backup alarm. Check for abnormal routing and wire damage.
2. Disconnect connector C355 from the transmission controller.  
Measure the resistance between cavity 9 of connector C355 and the ground at the wiring harness side.  
The resistance should be around 2 to 5 ohms.  
If the resistance is dramatically higher than specified, there is an open in the circuit.  
If the resistance is close to 0, there is a shortage to the ground.  
Check the harness. If the harness is OK, check the backup alarm.
3. Check the backup alarm.  
Disconnect the backup alarm at either connector C338 or C337.  
Measure the resistance between pin 1 and pin 2 of backup alarm.  
The resistance should be around 2 to 5 ohms.  
If the resistance is dramatically higher than specified, the backup alarm is failed open.  
If the resistance is close to 0, there is an internal shortage.  
In either case, replace the backup alarm.
4. If no problem is found in above test, check both male and female pins in the cavity 9 of connector C355.  
Check for no loose pin, bent pin, or any damage.



# **Section 55**

## **Chapter 5**

### **ARMREST CONTROLLER FAULT CODES**

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## FAULT CODE ARM 19

### The Throttle Lever Potentiometer Failure

**Cause:**

The throttle potentiometer has failed.

(This fault code is for the tractors with electronically controlled engines only).

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The throttle lever potentiometer is hard wired to the armrest controller.

1. The lever position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.
2. Open the armrest controller housing and disconnect connector J208.
2. Check the wiring harness from the throttle control potentiometer to the armrest controller.
  - a) Check for the continuity between pin 1 and pin C, pin 2 and pin E, pin 3 and pin D. There should be good continuity.
  - b) Check for wiring damage, loose connector, or bent pin.
3. Disconnect the throttle potentiometer at J208 and test its parameters:
  - a) Measure the continuity between pin 1 (or pin C) and pin 3 (or pin D). The resistance should be 2.5 k ohms.
  - b) Measure between pin 2 (pin E) and pin 1 (pin C) when moving the throttle from high to low idle. The resistance should change continuously from below 500 ohms to about 2 k ohms.
4. Check the power supply and the ground:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 1 or pin C. It should be approximately 8 volts.
  - c) Check continuity between pin D (or pin 3) and the clean ground cavity 11 of C137. There should be good continuity (less than 1 Ohm).
5. If any problem is found in above tests, change the part with problems.  
If no problem is found in above tests, reconnect the potentiometer to the controller and check the function again. If the throttle function is still not working well and the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 46,47 and 48 on schematic poster.

## FAULT CODE ARM 29

### The 1st Remote Hydraulic Control Lever Potentiometer Failure

**Cause:**

The 1st remote valve lever potentiometer has failed.

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The 1st remote hydraulic control lever potentiometer (AUX 1 lever) is hard wired to the armrest controller. The lever position information is broadcast over the Data Bus. The remote hydraulic lever potentiometer function should be checked out with the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J201 for the AUX 1 lever.
2. Test the 1st remote hydraulic control lever potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 3 (orange wire) and pin 5 (black wire). The resistance should be about 4 k ohms.
  - b) Measure between pin 4 (green wire) and pin 5 when moving the remote control lever from retract to extend. The resistance should change continuously and smoothly.If there is any problem with the pot function, replace the remote control.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 2 (red wire). It should be approximately 12 volts.
  - c) Test the potentiometer power supply from the armrest controller at pin 3 (orange wire). It should be approximately 8 volts.If no problem is found in above tests, go to the next step.
4. Connect the potentiometer from the 2nd or 3rd remote control lever (J202 or J203) to the J201 in the controller. Move the 2nd or 3rd lever forward and backward and monitor the lever position in the monitor screen of the service tool.

If the lever functions OK now, replace the 1st remote hydraulic control.

If the lever still does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** *You can directly use the test procedure in Step 4 to troubleshoot. Connect the potentiometer from the 2nd and 3rd remote control lever (J202 or J203) to the J201 in the controller. Move the 2nd or 3rd lever forward and backward and monitor the lever position in the monitor screen. If the lever functions are OK now, replace the 1st remote hydraulic control. If the lever still does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the 1st remote control lever (J201) to the J202 in the controller. Move the 1st lever forward and backward and monitor the lever position in the monitor screen. If the lever still does not function well and the fault code can be recorded again, replace the 1st remote hydraulic control. If the lever functions OK now, replace the armrest controller.*

**NOTE:** *See schematic section 45 on schematic poster.*



## FAULT CODE ARM 39

### The 2nd Remote Hydraulic Control Lever Potentiometer Failure

**Cause:**

The 2nd remote valve lever potentiometer has failed.

**Possible failure modes:**

1. Potentiometer failed shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The 2nd remote hydraulic control lever potentiometer (AUX 2 lever) is hard wired to the armrest controller. The lever position information is broadcast over the Data Bus. The remote hydraulic lever potentiometer function should be checked out with the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J202 for the AUX 2 lever.
2. Test the 2nd remote hydraulic control lever potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 3 (orange wire) and pin 5 (black wire). The resistance should be about 4 k ohms.
  - b) Measure between pin 4 (green wire) and pin 5 when moving the remote control lever from retract to extend. The resistance should change continuously and smoothly.If there is any problem with the potentiometer function, replace the remote control.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 2 (red wire). It should be approximately 12 volts.
  - c) Test the potentiometer power supply from the armrest controller at pin 3 (orange wire). It should be approximately 8 volts.If no problem is found in above tests, go to the next step.
4. Connect the potentiometer from the 1st or 3rd remote control lever (J201 or J203) to the J202 in the controller. Move the 1st or 3rd lever forward and backward and monitor the lever position in the monitor screen of the service tool.

If the lever functions OK now, replace the 2nd remote hydraulic control.

If the lever still does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** *You can directly use the test procedure in step 4 to troubleshoot: Connect the potentiometer from the 1st or 3rd remote control lever (J201 or J203) to the J202 in the controller. Move the 1st or 3rd lever forward and backward and monitor the lever position in the monitor screen. If the lever functions OK now, replace the 2nd remote hydraulic control. If the lever still does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the 2nd remote control lever (J202) to the J201 or J203 in the controller. Move the 2nd lever forward and backward and monitor the lever position in the monitor screen. If the lever still does not function well and the fault code can be recorded again, replace the 2nd remote hydraulic control. If the lever functions OK now, replace the armrest controller.*

**NOTE:** *See schematic section 45 on schematic poster.*

## FAULT CODE ARM 49

### The 3rd Remote Hydraulic Control Lever Potentiometer Failure

**Cause:**

The 3rd remote valve lever potentiometer has failed.

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The 3rd remote hydraulic control lever potentiometer (AUX 3 lever) is hard wired to the armrest controller. The lever position information is broadcast over the Data Bus. The remote hydraulic lever potentiometer function should be checked out with the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J203 for the AUX 3 lever.
2. Test the 3rd remote hydraulic control lever potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 3 (orange wire) and pin 5 (black wire). The resistance should be about 4 k ohms.
  - b) Measure between pin 4 (green wire) and pin 5 when moving the remote control lever from retract to extend. The resistance should change continuously and smoothly.If there is any problem with the potentiometer function, replace the remote control.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 2 (red wire). It should be approximately 12 volts.
  - c) Test the potentiometer power supply from the armrest controller at pin 3 (orange wire). It should be approximately 8 volts.If no problem is found in above tests, go to the next step.
4. Connect the potentiometer from the 2nd or 4th remote control lever (J202 or J204) to the J203 in the controller. Move the 2nd or 4th lever forward and backward and monitor the lever position in the monitor screen of the service tool.

If the lever functions OK now, replace the 3rd remote hydraulic control.

If the lever still does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** *You can directly use the test procedure in step 4 to troubleshoot: Connect the potentiometer from the 2nd or 4th remote control lever (J202 or J204) to the J203 in the controller. Move the 2nd or 4th lever forward and backward and monitor the lever position in the monitor screen. If the lever functions OK now, replace the 3rd remote hydraulic control. If the lever still does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the 3rd remote control lever (J203) to the J202 or J204 in the controller. Move the 3rd lever forward and backward and monitor the lever position in the monitor screen. If the lever still does not function well and the fault code can be recorded again, replace the 3rd remote hydraulic control. If the lever functions OK now, replace the armrest controller.*

**NOTE:** *See schematic section 45 on schematic poster.*

## FAULT CODE ARM 59

### The 4th Remote Hydraulic Control Lever Potentiometer Failure

**Cause:**

The 4th remote valve lever potentiometer has failed.

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The 4th remote hydraulic control lever potentiometer (AUX 4 lever) is hard wired to the armrest controller. The lever position information is broadcast over the Data Bus. The remote hydraulic lever potentiometer function should be checked out with the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J204 for the AUX 4 lever.
2. Test the 4th remote hydraulic control lever potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 3 (orange wire) and pin 5 (black wire). The resistance should be about 4 k ohms.
  - b) Measure between pin 4 (green wire) and pin 5 when moving the remote control lever from retract to extend. The resistance should change continuously and smoothly.If there is any problem with the potentiometer function, replace the remote control.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 2 (red wire). It should be approximately 12 volts.
  - c) Test the potentiometer power supply from the armrest controller at pin 3 (orange wire). It should be approximately 8 volts.If no problem is found in above tests, go to the next step.
4. Connect the potentiometer from the 2nd or 3rd remote control lever (J202 or J203) to the J204 in the controller. Move the 2nd or 3rd lever forward and backward and monitor the lever position in the monitor screen of the service tool.

If the lever functions OK now, replace the 4th remote hydraulic control.

If the lever still does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** You can directly use the test procedure in step 4 to troubleshoot: Connect the potentiometer from the 2nd or 3rd remote control lever (J202 or J203) to the J204 in the controller. Move the 2nd or 3rd lever forward and backward and monitor the lever position in the monitor screen. If the lever functions OK now, replace the 4th remote hydraulic control. If the lever still does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the 4th remote control lever (J204) to the J203 in the controller. Move the 4th lever forward and backward and monitor the lever position in the monitor screen. If the lever still does not function well and the fault code can be recorded again, replace the 4th remote hydraulic control. If the lever functions OK now, replace the armrest controller.

**NOTE:** See schematic section 45 on schematic poster.

## FAULT CODE ARM 69

### Hitch Position Control Lever Potentiometer Failure

**Cause:**

Hitch position potentiometer has failed.

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The hitch position control lever potentiometer is hard wired to the armrest controller. The lever position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J206 for hitch position control.
2. Test the parameters of the hitch position control lever potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 1 and pin 3. The resistance should be about 1 k ohms.
  - b) Measure between pin 2 and pin 3 when moving the control lever up and down. The resistance should change continuously and smoothly.If there is any problem with the potentiometer function, replace the hitch position control.

3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 1. It should be approximately 8 volts.If no problem is found in above tests, go to the next step.

4. Connect the potentiometer from the hitch load control or 5th remote flow control (J205 or J207) to the J206 in the controller. Turn control knob back and forth and monitor the hitch position control in the monitor screen of the service tool.

If the potentiometer functions OK now, replace the hitch position control.

If the lever still does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** *You can directly use the test procedure in step 4 to troubleshoot: Connect the potentiometer from the hitch load control or 5th remote flow control (J205 or J207) to the J206 in the controller. Turn control knob back and forth and monitor the hitch position control in the monitor screen. If the potentiometer functions OK now, replace the hitch position control. If the lever still does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the hitch position control lever (J206) to the J205 or J207 in the controller. Move the hitch position lever up and down and monitor the hitch load control or 5th remote flow control in the monitor screen. If the lever still does not function well and the fault code can be recorded again, replace the hitch position control. If the lever functions OK now, replace the armrest controller.*

**NOTE:** *See schematic section 45 on schematic poster.*

## FAULT CODE ARM 79

### Hitch Load Control Potentiometer Failure

**Cause:**

Hitch load potentiometer has failed.

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The hitch load control potentiometer is hard wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J205 for hitch load control.
2. Test the hitch load control potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 1 and pin 3. The resistance should be about 1 k ohms.
  - b) Measure between pin 2 and pin 3 when moving the control knob back and forth. The resistance should change continuously and smoothly.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 1. It should be approximately 8 volts.If no problem is found in above tests, go to next step.
4. Connect the potentiometer from the hitch position control or 5th remote flow control (J206 or J207) to the J205 in the controller. Turn control lever or knob back and forth and monitor the hitch load control in the monitor screen of the service tool.

If the potentiometer functions OK now, replace the hitch load control.

If the lever or potentiometer does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** *You can directly use the test procedure in step 4 to troubleshoot: Connect the potentiometer from the hitch position control or 5th remote flow control (J206 or J207) to the J205 in the controller. Turn control lever or knob back and forth and monitor the hitch load control in the monitor screen. If the lever or potentiometer functions OK now, replace the hitch load control. If the lever or potentiometer does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the hitch load control lever (J205) to the J206 or J207 in the controller. Move the knob back and forth and monitor the hitch position control or 5th remote flow control in the monitor screen. If the potentiometer still does not function well and the fault code can be recorded again, replace the hitch load control. If the potentiometer functions OK now, replace the armrest controller.*

**NOTE:** *See schematic section 45 on schematic poster.*

## FAULT CODE ARM 89

### The 1st Remote Hydraulic Flow Control Failure

**Cause:**

The 1st remote valve flow potentiometer has failed.

**Possible failure modes:**

1. The remote hydraulic flow control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller has a fault, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is difficult but possible to test the flow control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 3 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel (panel with hitch or panel without hitch).
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check for fault code again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 99

### The 2nd Remote Hydraulic Flow Control Failure

**Cause:**

The 2nd remote valve flow potentiometer has failed.

**Possible failure modes:**

1. The remote hydraulic flow control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The 2nd remote hydraulic flow control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller has a fault, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the flow control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 4 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel (panel with hitch or panel without hitch).
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check for fault codes again. If no fault code is recorded, the problem is fixed. If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 109

### The 3rd Remote Hydraulic Flow Control Failure

**Cause:**

The 3rd remote valve flow potentiometer has failed.

**Possible failure modes:**

1. The remote hydraulic flow control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The 3rd remote hydraulic flow control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller has a fault, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the flow control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 5 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel (panel with hitch or panel without hitch).
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check for fault codes again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.



## FAULT CODE ARM 119

### The 4th Remote Hydraulic Flow Control Failure

**Cause:**

The 4th remote valve flow potentiometer has failed.

**Possible failure modes:**

1. The remote hydraulic flow control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The 4th remote hydraulic flow control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller has a fault, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the flow control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 6 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel (panel with hitch or panel without hitch).
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check for fault codes again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 129

### The 5th Remote Hydraulic Flow Control Potentiometer Failure

**Cause:**

The 5th remote valve flow potentiometer has failed.

**Possible failure modes:**

1. Potentiometer shorted or open.
2. External wiring damage.
3. Loose connector, bent or partially inserted pin.
4. Controller failure.

**Solution:**

The 5th remote hydraulic flow control potentiometer (AUX 5 FLOW) is hard wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

1. Open the armrest controller housing and disconnect connector J207 for AUX 5 FLOW.
2. Test the AUX 5 FLOW control potentiometer and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a) Measure the continuity between pin 1 and pin 3. The resistance should be about 1 k ohms.
  - b) Measure between pin 2 and pin 3 when moving the control knob back and forth. The resistance should change continuously and smoothly.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply from the armrest controller at pin 1. It should be approximately 8 volts.If no problem is found in above tests, go to the next step.
4. Connect the potentiometer from the hitch position control or hitch load control (J206 or J205) to the J207 in the controller. Turn control lever or knob back and forth and monitor the 5th remote flow control in the monitor screen of the service tool.

If the lever or potentiometer functions OK now, replace the 5th remote flow control.

If the lever or potentiometer does not function well and the fault code can be recorded again, replace the armrest controller.

**NOTE:** *You can directly use the test procedure in step 4 to troubleshoot: Connect the potentiometer from the hitch position control or hitch load control (J206 or J205) to the J207 in the controller. Turn control lever or knob back and forth and monitor the 5th remote flow control in the monitor screen. If the lever or pot functions OK now, replace the 5th remote flow control. If the lever or potentiometer does not function well and the fault code can be recorded again, replace the armrest controller, or connect the potentiometer from the 5th remote flow control lever (J207) to the J206 or J205 in the controller. Move the knob back and forth and monitor the hitch position control or hitch load control in the monitor screen. If the potentiometer still does not function well and the fault code can be recorded again, replace the 5th remote flow control. If the potentiometer functions OK now, replace the armrest controller.*

**NOTE:** *See schematic section 45 on schematic poster.*

## FAULT CODE ARM 139

### The Remote Hydraulic Timer Control Failure

**Cause:**

The remote valve timer potentiometer has failed.

**Possible failure modes:**

1. The remote hydraulic timer control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The remote hydraulic timer control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller is bad, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the timer control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 7 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel (panel with hitch or panel without hitch).
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check for fault codes again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 149

### The Hitch Upper Limit Control Failure

**Cause:**

Hitch upper limit potentiometer has failed.

**Possible failure modes:**

1. The hitch upper limit control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The hitch upper limit control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller is bad, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the hitch upper limit control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 8 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check the fault code again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 159

### The Hitch Drop Rate Control Failure

**Cause:**

Hitch drop rate potentiometer has failed.

**Possible failure modes:**

1. The hitch drop rate control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The hitch drop rate control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller has a fault, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the hitch drop rate control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 9 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check the fault code again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 169

### The Hitch Travel Control Failure

**Cause:**

Hitch travel potentiometer has failed.

**Possible failure modes:**

1. The hitch travel control potentiometer failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The hitch travel control potentiometer is mounted on the second panel and wired to the armrest controller. The potentiometer position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

All controls on the second panel are built in as an integrated part with the second panel. If any control fails, the whole second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller is bad, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149, ARM 159, and ARM 169.

If a single fault code is recorded, it is more possible that the potentiometer or its wiring to the armrest controller has failed.

Whether it is a single or multiple fault codes, always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard but possible to test the hitch travel control potentiometer and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the potentiometer:
  - a) Measure the continuity between pin 1 and pin 2 of J2. The resistance should be approximately 2 k ohms.
  - b) Measure between pin 2 and pin 10 when turning the potentiometer, the resistance should change continuously from 0.1 k to about 1.1 k ohms.If the potentiometer or its wiring is bad, replace the second panel.
3. Check the power supply:
  - a) Turn tractor key switch to the ACC position.
  - b) Check the power supply from the armrest controller at pin 1 of J2. It should be approximately 8 volts.If the power supply from the armrest controller is bad, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller. Calibrate the armrest controller and check the fault code again.  
If no fault code is recorded, the problem is fixed.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 1029

### Remote Hydraulic Control Selection Switch 5 Failure

**Cause:**

This fault code is triggered when the extend and retract position are detected to be on at the same time.

**Possible failure modes:**

1. Switch failed.
2. External wiring failure (damaged wires, loose connectors, or bent pins).
3. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector SW205 for AUX 5.
2. Test the remote hydraulic control switch 5 (AUX 5) and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the switch is in EXTEND position, there should be continuity between pin 1 and pin 2 and no continuity between pin 1 and pin 3.
  - b. When the switch is in RETRACT position, there should be continuity between pin 2 and pin 3 and no continuity between pin 1 and pin 3.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 1, pin 2, and pin 3.If the switch is not functioning as specified above, replace the switch.
3. Check controller function:
  - a. Measure the voltage output from the controller at pin 2 of SW205. It should be at 12 VDC.
  - b. Short wire pin 1 to pin 2 to simulate the EXTEND function. Short wire pin 2 to pin 3 to simulate the RETRACT function.Monitor the switch status on the monitor screen of the service tool.  
If the controller does not function properly, replace the armrest controller.

**NOTE:** See schematic section 44 on schematic poster.

## FAULT CODE ARM 1039

### PTO ON/OFF Control Switch Failure

**Cause:**

PTO ON/OFF control switch failure.

**Possible failure modes:**

1. Switch failed.
2. External wiring failure (damaged wires, loose connectors, or bent pins).
3. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector J213 for PTO ON/OFF control.
2. Test the PTO ON/OFF control switch and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the switch is in ON position, there should be continuity between pin 1 and pin 3. No continuity between pin 1 and pin 2.
  - b. When the switch is in OFF position, there should be continuity between pin 1 and pin 2. No continuity between pin 1 and pin 3.

If the switch is not functioning as specified above, replace the switch.

3. Check controller function:
  - a. Measure the voltage output from the controller at pin 1 of J213. It should be at 12 VDC.
  - b. Short wire pin 1 to pin 2 to simulate the OFF function. Short wire pin 1 to pin 3 to simulate the ON function.

Monitor the switch status on the monitor screen of the service tool.

If the controller does not function properly, replace the armrest controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.



## FAULT CODE ARM 1049

### Hitch UP/DOWN Switch Failure

**Cause:**

Hitch up/down switch failure.

**Possible failure modes:**

1. The operator has been holding the switch between Up/Down positions for more than 2 seconds.
2. Switch failed.
3. External wiring failure (damaged wires, loose connectors, or bent pins).
4. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

The ARMREST controller monitors the switch positions. The switch should stay in either up, down or fast drop position. If the switch is not in contact with either position or is in contact with two or more positions at the same time, the controller will record the fault code.

**NOTE:** *When the tractor reaches the end of a row, some operator tends to press or hold the switch before really putting it into position. This may cause the switch not in contact with either the up, down or fast drop position. If this situation lasts for more than two seconds, the controller will record the fault code and the instrument cluster will flash 'ARM Fault'. For safety reasons, the hitch will be disabled. The operator has to cycle the key switch and recapture the hitch to make the system function again. If this is not the case, do the following:*

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector J210 for HITCH UP/DOWN control.
2. Test the HITCH UP/DOWN switch and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the switch is in UP position, there should be continuity between J210 pin 4 and pin 2. No continuity between other pins.
  - b. When the switch is in DOWN position, there should be continuity between J210 pin 1 and pin 2. No continuity between other pins.
  - c. When the switch is in DOWN FAST position, there should be continuity between J210 pin 2 and pin 3. No continuity between other pins.If the switch is not functioning as specified above, replace the switch.
3. Check controller function:
  - a. Measure the voltage output from the controller at pin 2 of J210. It should be at 12 VDC.
  - b. Short wire pin 2 to pin 1 to simulate the DOWN function. Short wire pin 2 to pin 3 to simulate the DOWN FAST function. The switch normal position is the UP position.Monitor the switch status on the monitor screen of the service tool.  
If the controller does not function properly, replace the armrest controller.

**NOTE:** *See schematic section 46 on schematic poster.*

## FAULT CODE ARM 1059

### Slip Limit Switch Failure

**Cause:**

Slip limit switch failure.

**Possible failure modes:**

1. Switch failed.
2. External wiring failure (damaged wires, loose connectors, bent pins).
3. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector SW202 for WHEEL SLIP LIMIT.
2. Test the SLIP LIMIT switch and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the switch is in SLIP SELECT position, there should be continuity between pin 4 and pin 5 and no continuity between pin 4 and pin 6.
  - b. When the switch is in SLIP SET position, there should be continuity between pin 4 and pin 6 and no continuity between pin 4 and pin 5.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 4, pin 5 and pin 6.If the switch is not functioning as specified above, replace the switch.

3. Check controller function:
  - a. Measure the voltage output from the controller at pin 4 of SW202. It should be at 12 VDC.
  - b. Short wire pin 4 to pin 5 to simulate the SLIP SELECT function. Short wire pin 4 to pin 6 to simulate the SLIP SET function.

Monitor the switch status on the monitor screen of the service tool.

If the controller does not function properly, replace the armrest controller.

**NOTE:** See schematic section 44 on schematic poster.

## FAULT CODE ARM 1069

### MFD Switch Failure

**Cause:**

MFD switch failure.

**Possible failure modes:**

1. Switch failed.
2. External wiring failure (damaged wires, loose connectors, or bent pins).
3. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector SW201 for MFD.
2. Test the MFD switch and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the switch is in AUTO position, there should be continuity between pin 1 and pin 2 and no continuity between pin 1 and pin 3.
  - b. When the switch is in ON position, there should be continuity between pin 2 and pin 3 and no continuity between pin 1 and pin 2.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 1, pin 2 and pin 3.If the switch is not functioning as specified above, replace the switch.
3. Check controller function:
  - a. Measure the voltage output from the controller at pin 2 of SW201. It should be at 12 VDC.
  - b. Short wire pin 1 to pin 2 to simulate the AUTO function. Short wire pin 2 to pin 3 to simulate the ON function.Monitor the switch status on the monitor screen of the service tool.  
If the controller does not function properly, replace the armrest controller.

**NOTE:** See schematic section 44 on schematic poster.

## FAULT CODE ARM 1079

### DIFF Lock Switch Failure

**Cause:**

DIFF LOCK switch failure.

**Possible failure modes:**

1. Switch failed.
2. External wiring failure (damaged wires, loose connectors, or bent pins).
3. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector SW203 for DIFF LOCK.
2. Test the DIFF LOCK switch and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the switch is in DIFF LOCK AUTO position, there should be continuity between pin 1 and pin 2 and no continuity between pin 1 and pin 3.
  - b. When the switch is in DIFF LOCK ON position, there should be continuity between pin 2 and pin 3 and no continuity between pin 1 and pin 2.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 1, pin 2 and pin 3.If the switch is not functioning as specified above, replace the switch.
3. Check controller function:
  - a. Measure the voltage output from the controller at pin 2 of SW203. It should be at 12 VDC.
  - b. Short wire pin 1 to pin 2 to simulate the DIFF LOCK AUTO function. Short wire pin 2 to pin 3 to simulate the DIFF LOCK ON function.

Monitor the switch status on the monitor screen of the service tool.

If the controller does not function properly, replace the armrest controller.

**NOTE:** See schematic section 44 on schematic poster.

## FAULT CODE ARM 1089

### Programmable Up/Down Switch Failure

**Cause:**

Programmable up/down switch failure.

**Possible failure modes:**

1. Switch failed.
2. External wiring failure (damaged wires, loose connectors, or bent pins).
3. Armrest controller internal failure (power supply or signal sensing failed).

**Solution:**

Monitor the switch status on the monitor screen of the service tool. Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector J212 for PROGRAMMABLE UP/DOWN SHIFT.
2. Test the PROGRAMMABLE UP/DOWN switch and its wiring. Pay attention for wiring damage, loose connectors, or bent pins.
  - a. When the momentary switch is in the UPSHIFT position, there should be continuity between switch pin 2 and pin 3 and no continuity between pin 1 and pin 2.
  - b. When the momentary switch is in the DOWNSHIFT position, there should be continuity between pin 1 and pin 2 and no continuity between pin 2 and pin 3.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 1, pin 2 and pin 3.If the switch is not functioning as specified above, replace the switch.
3. Check controller function:
  - a. Measure the voltage output from the controller at pin 1 of J212. It should be at 12 VDC.
  - b. Short wire pin 1 to pin 6 to simulate the UPSHIFT function. Short wire pin 1 to pin 5 to simulate the DOWNSHIFT function.Monitor the switch status on the monitor screen of the service tool.  
If the controller does not function properly, replace the armrest controller.

**NOTE:** See schematic section 47 on schematic poster.

## FAULT CODE ARM 1099

### Remote Set Switch Failure

**Possible failure modes:**

1. Remote set switch failed.
2. Bad connection between the armrest controller and the second panel.
3. Armrest controller failure.

**Solution:**

The remote set switch is mounted on the second panel and wired to the armrest controller. The switch position information is broadcast over the Data Bus and can be monitored in the monitor screen of the service tool.

The remote set switch is built in as an integrated part with the second panel. If it fails, the whole second panel must be replaced.

The remote set switch with the power supply and ground is connected to the armrest controller through connector J2.

Always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

It is hard, but possible to test the remote set switch and the wiring circuit.

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the remote set switch function:
  - a. When the switch is in EXTEND LIMIT SET position, there should be continuity between pin 11 and pin 14 and no continuity between pin 12 and pin 14.
  - b. When the switch is in RETRACT LIMIT SET position, there should be continuity between pin 12 and pin 14 and no continuity between pin 11 and pin 14.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 11, pin 12 and pin 14.If the switch is not functioning as specified above, replace the second panel (panel with hitch or panel without hitch).
3. Check controller function:
  - a. Turn tractor key switch to the ACC position.
  - b. Check the power supply from the armrest controller at pin 14 of J2. It should be approximately 12 volts.
  - c. Short wire pin 11 to pin 14 to simulate the EXTEND LIMIT SET function. Short wire pin 12 to pin 14 to simulate the RETRACT LIMIT SET function.Monitor the switch status on the monitor screen of the service tool.  
If the controller does not function properly, replace the armrest controller.
4. If none of above, clean the connectors and reconnect the second panel to the armrest controller.  
Calibrate the armrest controller and check for fault codes again.  
If no fault code is recorded, the fault is fixed.  
If the fault code is recorded again, replace the armrest controller.  
When the switch is in OFF position, there should be no continuity between J2-11, J2-12 and J2-14.  
If the switch does not function as specified, replace the switch.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 1109

### Hand Throttle Idle Validation Switch Failure

**Cause:**

Hand Throttle idle validation switch failure.

**Possible failure modes:**

1. Switch Failed (shorted or open).
2. External wiring damage (shorted or open).
3. Bad connection (loose connector or bent pin).
4. Armrest controller has failed.

**Solution:**

Test the switch function, its wiring, and the function of the armrest controller.

1. Open the armrest controller housing and disconnect connector J208.
2. Check the wiring harness from the throttle control potentiometer to the armrest controller.
  - a) Check for the continuity from pin 4 and pin J, pin 5 to pin K, pin 6 to pin G. There should be good continuity.
  - b) Check for wiring damages, loose connectors, or bent pins.
3. Test the parameters of idle validation switch (the switch is an integrated part of the throttle control potentiometer).
  - a) Push the hand throttle to LOW IDLE position. There should be continuity between pin 5 and pin 6 and no continuity between pin 5 and pin 4.
  - b) Push the hand throttle to HIGH IDLE position. There should be continuity between pin 5 and pin 4 and no continuity between pin 5 and pin 6.
  - c) When the throttle is in the position between LOW IDLE and HIGH IDLE, there should be no continuity between pin 4, pin 5 and pin 6.If the switch does not function as specified in above, replace the throttle control potentiometer.
4. Check the power supply from the controller:
  - a) Turn tractor key switch to the ACC position.
  - b) Test the switch power supply at pin 5 or pin K. It should be approximately 12 volts.
5. If no problem is found in the above tests, connect the potentiometer to the controller and check the function again. If the throttle function is still not working well and the fault code is recorded again, replace the armrest controller.

**NOTE:** See schematic section 46 on schematic poster.

## FAULT CODE ARM 1119

### HTS Record/Play Switch Failure

**Cause:**

Both HTS RECORD and HTS PLAY circuits are detected to be closed at the same time.

**Possible failure modes:**

1. HTS Record/Play switch failed.
2. Bad connection at the armrest controller.
3. Armrest controller failure.

**Solution:**

The HTS Record/Play switch is mounted on the second panel and wired directly to the armrest controller.

**NOTE:** *The HTS Record/Play switch information is broadcast over the Tractor Data Bus. The HTS Record/Play switch can be monitored using the MONITOR window in the service tool and selecting Armrest HTS Record/Play Switch.*

The HTS Record/Play switch on the second panel is an integrated part with the second panel. If any control fails, the second panel must be replaced.

All controls on the second panel share the power supply and ground. All control signals with the power supply and ground are connected to the armrest controller through connector J2.

If the power supply or ground from the armrest controller are not correct, all the controls on the second panel will show fault codes. It means all the following fault codes will be recorded at the same time.

ARM 89, ARM 99, ARM 109, ARM 119, ARM 139, ARM 149 and ARM 159.

Always check the connection between the second panel and the armrest controller first. Make sure there is no damaged wires, loose connections, or bent pins.

To test the HTS Record/Play switch and the wiring circuit:

1. Open the armrest controller housing and disconnect connector J2 of the second panel from the armrest controller.
2. Check the HTS Record/Play switch function:
  - a. When the switch is in HTS RECORD position, there should be continuity between pin 11 and pin 14 and no continuity between pin 12 and pin 14.
  - b. When the switch is in HTS PLAY position, there should be continuity between pin 12 and pin 14 and no continuity between pin 11 and pin 14.
  - c. When the switch is in OFF position, there should be no continuity between any two of pin 11, pin 12 and pin 14.

If the switch is not functioning as specified above, replace the second panel

3. Check controller function:
  - a. Turn key switch to the OFF, and then to the ON position.
  - b. Check the power supply from the armrest controller at pin 14 of J2. It should be approximately 12 volts.
  - c. Short wire pin 11 to pin 14 to simulate the HTS RECORD function. Short wire pin 12 to pin 14 to simulate the HTS PLAY function.

Monitor the switch status on the monitor screen of the service tool.

If the controller does not function properly, replace the armrest controller.

4. If none of above, clean the connectors and reconnect the second panel to the armrest controller.  
Clear the fault code. Cycle the key switch. Depress the HTS Record/Play switch in each direction several times.  
If the fault code is recorded again, replace the armrest controller.

**NOTE:** *See schematic sections 47 and 48 of the poster schematic.*



## FAULT CODE ARM 1129

### Invalid Configuration Implement Depth Control Switch Failure

**Cause:**

The implement depth control switch has failed.

**Possible failure modes:**

1. Implement depth control switch failed.
2. Bad connection between the armrest controller and implement depth control switch.
3. Armrest controller failure.

**Solution:**

The implement depth control switch information is broadcast over the Tractor Data Bus. The implement depth control switch can be monitored using the MONITOR window in the service tool and selecting Armrest implement depth control Switch.

1. If the service tool MONITOR window shows the switch is not working. Open the armrest controller housing and disconnect connector J14 and J15 of the armrest controller.
2. Check the wiring to the implement depth control switch. The momentary switch is normally open for both upper limit set and lower limit set. When each side of the switch is depressed the contacts should close.
3. If the switch is bad, replace the secondary panel.

## FAULT CODE ARM 8011

### Battery Voltage Low

**Cause:**

Battery voltage low.

**Possible failure modes:**

1. Battery voltage lower than 9.8 volts.
2. The controller has a bad connection to power or is not grounded properly.
3. Alternator regulator malfunction.

**Solution:**

Check for battery voltage, alternator regulator output, and the controller connection to power and ground.

1. Check for fault codes Tractor Multi Function Controller TMF 65, 66, 98 and 99 and TRANS 8011. These are all fault codes for battery voltage low. If they exist, it is more likely that the battery voltage low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is within specifications, check system voltage at cavity 12 of connector C137. Check for bad connection and improper ground at cavity 11 of the same connector.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running.
5. If none of above, check the function of the armrest controller.

## FAULT CODE ARM 9011

### Controller Memory Error

**Cause:**

Controller memory error: Loss of hitch position command calibration.

**Possible failure modes:**

Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

Shut down the tractor and restart. Calibrate the hitch menu in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9012

### Controller Memory Error

**Cause:**

Controller memory error: Loss of AUX remote lever calibration.

**Possible failure mode:**

Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

Shut down the tractor and restart. Calibrate the AUX menu in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9013

### Controller Memory Error

**Cause:**

Controller failure: Loss of throttle calibration.

**Possible failure mode:**

Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

Shut down the tractor and restart. Calibrate the throttle menu in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9014

### Controller Memory Error

**Cause:**

Controller failure: Loss of MFD switch configuration.

**Possible failure mode:**

Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

Shut down the tractor and restart. Calibrate the MFD menu in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9015

### Controller Memory Error

**Cause:**

Controller failure: Loss of trans switches configuration.

**Possible failure mode:**

Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

Shut down the tractor and restart. Calibrate the TRANS menu in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9021

### Hitch Position Command Potentiometer Calibration Error

**Cause:**

Hitch position command potentiometer calibration results not acceptable.

**Possible failure mode:**

1. Calibration was done incorrectly.
2. Hitch position command potentiometer or the lever are out of the working range.
3. Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

1. Shut down the tractor and restart. Calibrate the hitch menu in the armrest controller. Make sure the calibration is done with the proper procedures.
2. If the same fault code appears again, check the hitch position command potentiometer and the lever for any defect.  
Refer to Fault Code ARM 69 for diagnosing procedures details.
3. Calibrate the hitch menu in the armrest controller again. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9031

### Hand Throttle Potentiometer Calibration Error

**Cause:**

Hand throttle potentiometer calibration results not acceptable.

**Possible failure mode:**

1. Calibration was done incorrectly.
2. Hand throttle potentiometer or the lever out of the working range.
3. Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

1. Shut down the tractor and restart. Calibrate the throttle menu in the armrest controller. Make sure the calibration is done with the proper procedures.
2. If the same fault code appears again, check the hand throttle potentiometer and the lever for any defect. Refer to Fault Code ARM 19 diagnosing procedures details.
3. Calibrate the throttle menu again in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 9041

### EDC Drop Rate Potentiometer Calibration Error

**Cause:**

EDC drop rate potentiometer calibration results not acceptable.

**Possible failure mode:**

1. Calibration was done incorrectly.
2. EDC drop rate potentiometer is out of the working range.
3. Memory defect or intermittent controller.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

1. Shut down the tractor and restart. Calibrate the EDC drop rate. Make sure the calibration is done with the proper procedures.
2. If the same fault code appears again, use the service tool MONITOR function to check potentiometer.
3. Calibrate the EDC drop rate again in the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** See schematic sections 47 and 48 on schematic poster.

## FAULT CODE ARM 10091

### Controller Internal Failure

**Cause:**

Controller internal failure: +5 V or +8 V regulator is out of range.

**Solution:**

Make sure the controller has a good connection (C137) to the battery and is properly grounded.

Shut down the tractor and restart. Calibrate the armrest controller. If the same fault code appears again, replace the controller.

**NOTE:** *See schematic sections 47 and 48 on schematic poster.*

## FAULT CODE ARM 12013

### Communication Lost With The Data Bus

**Cause:**

The armrest controller has found that it can not communicate with the Data Bus.

**Possible failure mode:**

1. Data Bus is not powered.
2. Data Bus is shorted.
3. Passive terminator failed.

**Solution:**

Make sure the armrest controller is well connected to the Data Bus.

Check the Data Bus function.

1. Check the connection to the armrest controller:
  - a) Make sure connector C137 is firmly plugged in to the armrest controller.
  - b) Make sure the armrest controller has a good connection to the Data Bus.
2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed. See step 4.
  - B. Check from the can bus resistor terminator in the TMF controller.

Reconnect the engine end resistor terminator and disconnect the TMF controller connector C053. With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.  
At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The TMF controller resistor terminator has most likely failed. Test the TMF resistor terminator and replace if it has failed.
4. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at TMF controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
5. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.

- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**IMPORTANT:** *When there is a bad connection along the Data Bus wiring, the fault code will be accompanied by multiple fault codes such as Aux/Hitch/PTO 11, INST 12011, INST 12031 and TRANS 12031.*

**NOTE:** *Also see the Data Bus schematic in poster schematic.*



## FAULT CODE ARM 12081

### HTS Capability Message Not Received

**Cause:**

The armrest controller has found that it cannot communicate with the deluxe ICU (Instrument Cluster).

**Possible failure mode:**

1. Instrument cluster not configured for HTS capability.
2. Data Bus is not powered.
2. Data Bus is shorted.
3. Passive terminator failed.

**Solution:**

Make sure the armrest controller is properly configured. The programmable up shift and programmable down shift values must be set to zero in order enable the HTS feature.

Make sure the armrest controller is well connected to the Data Bus.

Check the Data Bus function.

1. Check the connection to the armrest controller:
  - a) Make sure connector C137 is firmly plugged in to the armrest controller.
  - b) Make sure the armrest controller has a good connection to the Data Bus.
2. Check the power supply to the Tractor Data Bus.
  - A. Check fuse #42.
  - B. Turn the tractor key switch to the ON position. Verify approximately 12 volts power at fuse #42. If no power, check the power supply to the key switch power stud.
3. Check the Tractor Data Bus at the can bus resistor terminators.

The following checks are performed looking into one end of the data bus and checking the resistor terminator at the other end.

  - A. Check from the can bus resistor terminator at the engine. Raise the tractor hood. The resistor terminator is located in harness that leads into Buss box. Disconnect the terminator plug at connector C205. With the key switch in the ON position, measure the voltage on each pin to ground on connector C205.

At cavity A, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity B, the green wire, it should read from 2.2 to 2.5 volts.

If the above checks are ok and all controllers came online, it means that the opposite end resistor terminator and the data bus wiring are functioning correctly. The engine end resistor terminator has most likely failed. Test the engine end resistor terminator and replace if it has failed. See step 4.
  - B. Check from the can bus resistor terminator in the TMF controller.

Reconnect the engine end resistor terminator and disconnect the TMF controller connector C053.  
With the key switch to OFF, then to ON. Measure the voltage between the following cavities at connector C053.

At cavity 15, the yellow wire, it should read from 2.5 to 2.8 volts.  
At cavity 16, the green wire, it should read from 2.2 to 2.5 volts.  
If the above checks are ok and all controllers came online, it means that the engine end resistor terminator and the data bus wiring are functioning correctly. The TMF controller resistor terminator has most likely failed. Test the TMF resistor terminator and replace if it has failed.
4. Use a multimeter to check the resistance on both can bus resistor terminators. The resistance at TMF controller connector C053 from pin 15 to 16 should be 120 ohms. The resistance at the engine end resistor terminator plug pin 1 to 2 should also be 120 ohms.
5. Split the Data Bus by disconnecting connector C333. Turn the key switch to OFF, then to ON.
  - A. If none of the controllers come back on line, the problem is inside the cab. Check the Data bus wiring in the cab for open circuits or shorts to ground. If the problem cannot be found in the wiring, disconnect each controller one at a time to determine if one of the controllers has failed.

- B. If all of the controllers except the engine controller come back online, the problem is the Data Bus external to the cab. Check the Data bus wiring outside of the cab for open circuits or shorts to ground. The Data bus can be split once again at connector C060 to determine which portion of the exterior Data bus wiring has the problem. If the problem cannot be found in the wiring, disconnect the engine controller to determine if it has failed.

**NOTE:** *Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting the Data Bus. One intermittent connection can cause the entire bus to stop communications.*

**IMPORTANT:** *When there is a bad connection along the Data Bus wiring, the fault code will be accompanied by multiple fault codes such as Aux/Hitch/PTO 11, INST 12011, INST 12031 and TRANS 12031.*

**NOTE:** *Also see the Data Bus schematic on poster schematic.*

## **FAULT CODE ARM 65535**

### **Memory Not Cleared From The Factory**

**Cause:**

The armrest controller memory has not been cleared from the factory.

**Solution:**

This is a non fault. Clear the fault code from the controller.



# **Section 55**

## **Chapter 6**

**ELECTRONIC CONTROLLER CONFIGURATION,  
CALIBRATION AND FAULT CODE RETRIEVAL**

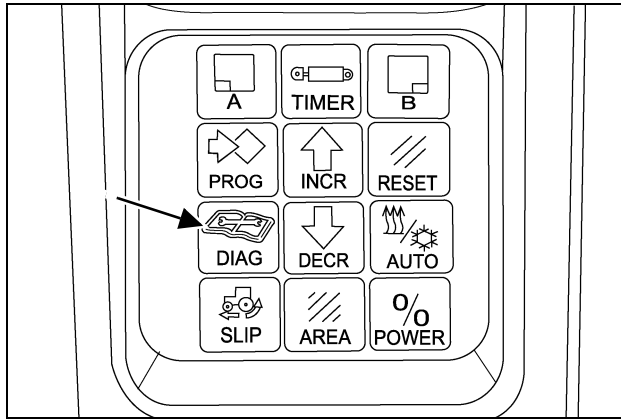
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## FAULT CODE RETRIEVAL

Controllers can be checked for fault codes at any time. Up to 10 fault codes can be stored in each controller.

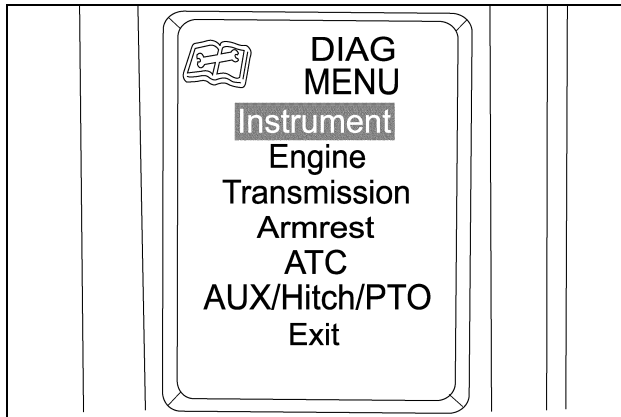
### STEP 1



MD05F003

With the key switch in the **ON** or **RUN** position, press and hold the **DIAG** key on the programmable display key board to enter the controller selection screen. The display will read **DIAG MENU**.

### STEP 2

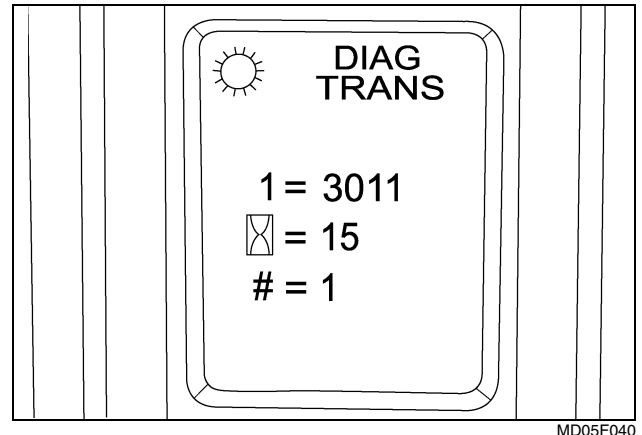


RD06A066

Use the **DECR** key to scroll through the different controllers: **INSTRUMENT** (instrument cluster) - **ENGINE** - **TRANSMISSION** - **ARMREST** - **ATC** (automatic temperature control) and **AUX/HITCH/PTO** (auxiliary remote hydraulics, three point hitch, power take off)

**NOTE:** The Aux/Hitch/PTO controller is also referred to as the Tractor Multi Function (TMF) controller.

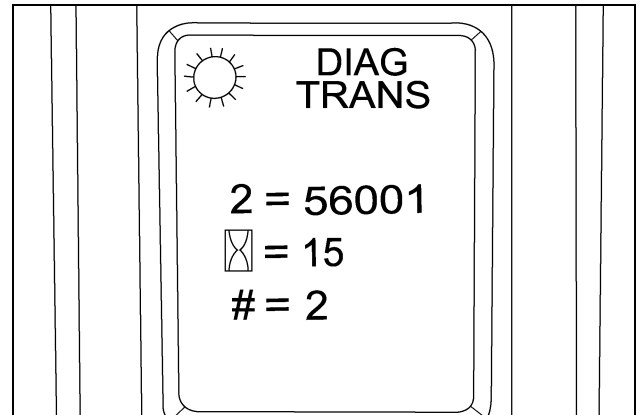
### STEP 3



MD05F040

When the required controller is displayed, press the **PROG** key. If a controller is selected that is not on the Data Bus (does not exist), the display will read **COMM ERR.**

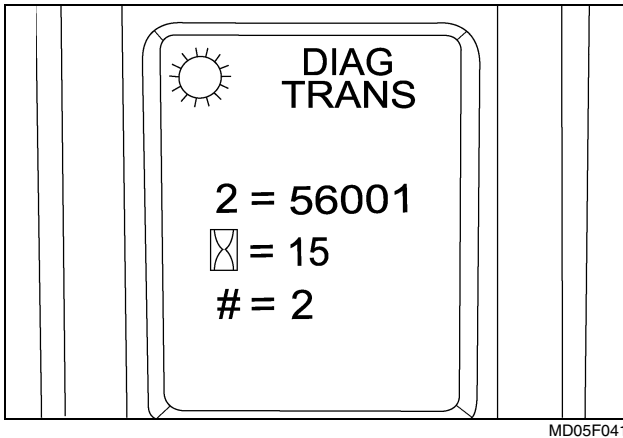
### STEP 4



MD05F041

Use the **INCR** and **DECR** keys to scroll through the 10 possible fault codes. The controller name will be at the top of the display. The fault code and which number that fault is (01 to 10), will be at the bottom of the display.

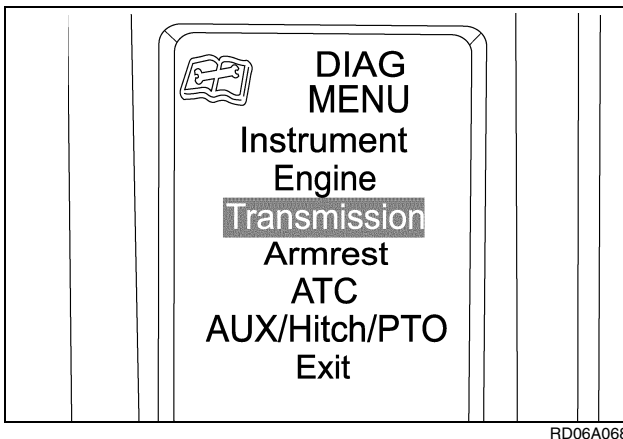
## STEP 5



To erase the fault codes from a controller, press and hold both the **INCR** and **DECR** keys for 10 seconds.

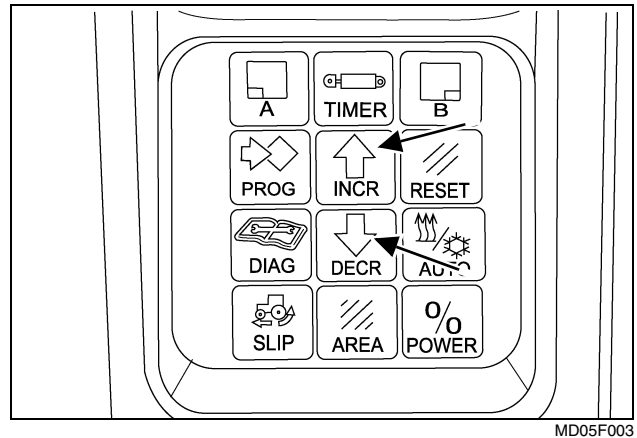
**NOTE:** *All the fault codes for that controller will be erased.*

## STEP 6



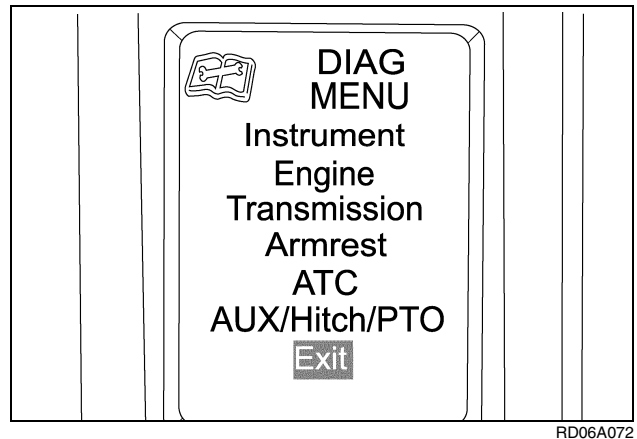
When the fault codes are erased, the display will return to the **DIAG MENU** screen for that controller.

## STEP 7



Another controller can be selected at this time by using the **INCR** and **DECR** keys to scroll through the controller list as in Step 2.

## STEP 8



To exit the select controller screen, scroll until **EXIT** is displayed and press the **PROG** key. This will return you to normal operation.

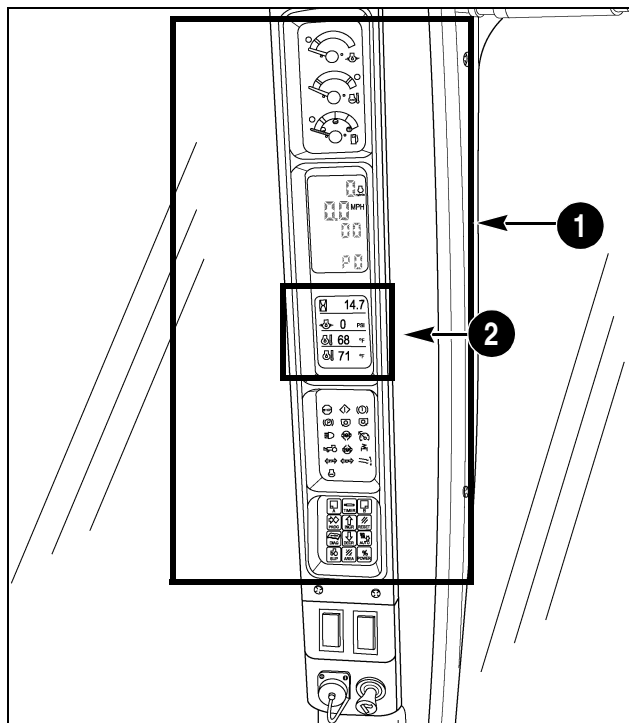
## INSTRUMENTATION PROGRAMMING

### General Information

The standard instrumentation controller must be configured/calibrated before any other controller. Tractor Standard instrumentation programming is performed through three levels. The first level, operation setup permits adjustment of display units and tire radius. The second level, controller configuration permits viewing of the current selection for tractor model (set during third level) and configuration of the electronic controllers that are expected to be on the TDB (Tractor Data Bus). The third level requires the use of the service tool to select the tractor model and fuel tank size.

**IMPORTANT:** All three levels of programming must be performed when moving an instrumentation controller from one tractor to another.

**NOTE:** When replacing the standard instrumentation controller the fuel tank size selection must be selected using the service tool configuration window.



MD05F002

1. STANDARD INSTRUMENTATION

2. PROGRAMMABLE DISPLAY

Configure the instrumentation with the key in the ON position and the engine not running. Be sure the batteries are fully charged. Turn off all accessories during configuration.

### Operation Setup

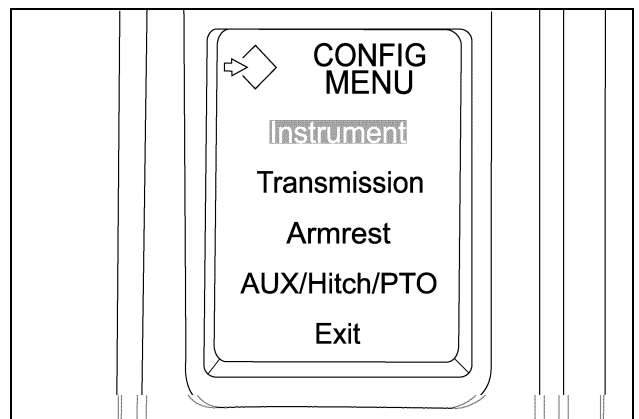
**NOTE:** Configuration can only be entered within the first 10 seconds of turning the key switch to the ON position.

#### STEP 1

Enter operation setup by pressing and holding the PROG key for 3 seconds within the first 10 seconds of turning the key switch to the ON position.

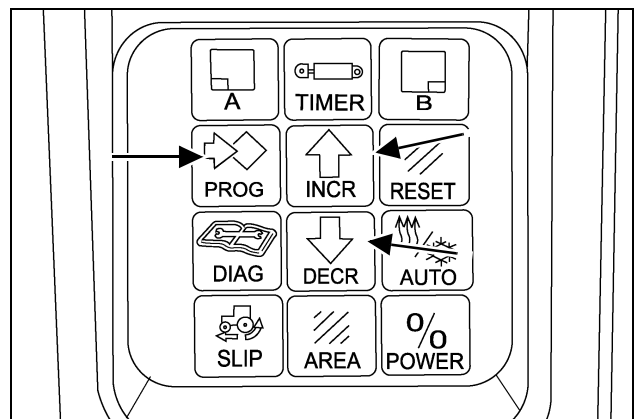
**NOTE:** If any fault codes are recorded, they must be corrected before configuration is possible. See Fault Code Retrieval in this section.

#### STEP 2



RD05G056

The display will read **CONFIG MENU** with all menu items listed. The default highlighted option is **ICU**. Press the **PROG** key.

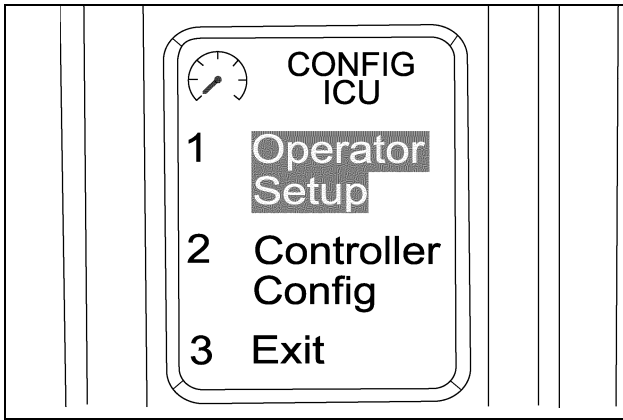


MD05F003

**NOTE:** If another option is highlighted use the **INCR** or **DECR** keys to highlight **ICU**.



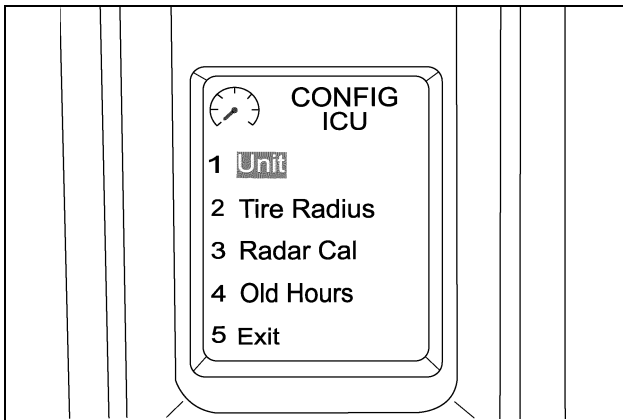
### STEP 3



MD05F005

The display will read **CONFIG ICU** with options, **Operator Setup**, **Controller Config** and **Exit**. The default will highlight **Operator Setup**. Press the **PROG** key.

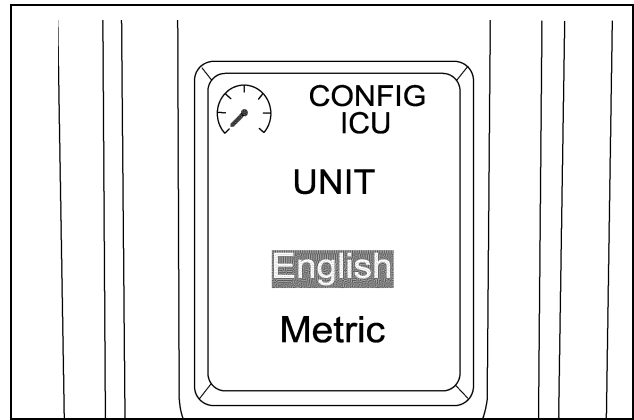
### STEP 4



MD05F006

The display will read **CONFIG ICU** with the operator setup options, **Unit**, **Tire Radius**, **Radar Cal**, **Old Hours** and **Exit**. The default will highlight **Unit**. Press the **PROG** key.

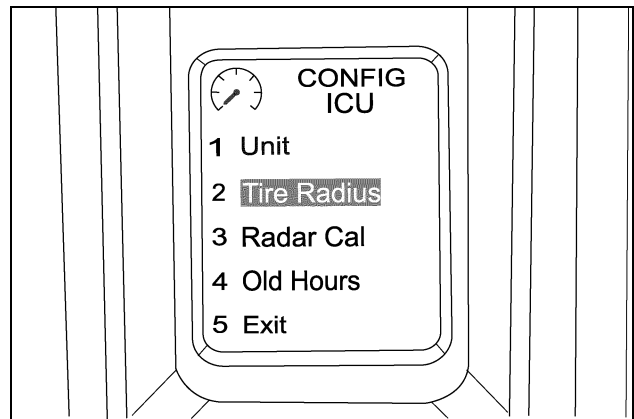
### STEP 5



MD05F007

The display will show under the **UNIT** heading **English** and **Metric**. The last stored heading will be highlighted. The default setting is **English**. Display units can now be selected, either **English** or **Metric**, by using the **INCR** or **DECR** keys. Press the **PROG** key to save your choice. The display will return to the operator setup options.

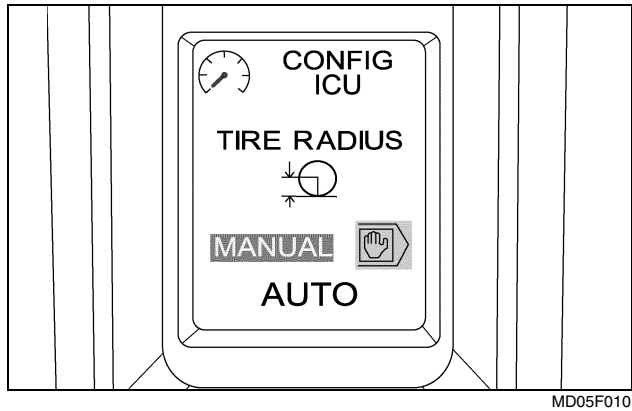
### STEP 6



MD05F009

Use the **INCR** or **DECR** keys to highlight **Tire Radius**. Press the **PROG** key.

## STEP 7

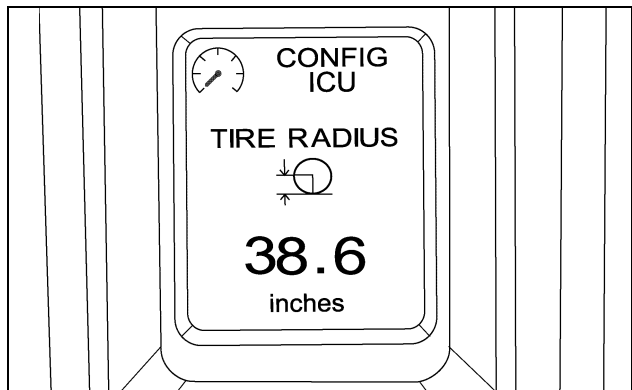


MD05F010

The display will read **TIRE RADIUS** with the radius icon above the **MANUAL** or **AUTO** options. Use the **INCR** and **DECR** keys to select either **MANUAL** or **AUTO** format. Press the **PROG** key to enter the selected format.

If **MANUAL** is selected, proceed to Step 8. If **AUTO** (automatic) is selected, proceed to Step 9.

## STEP 8

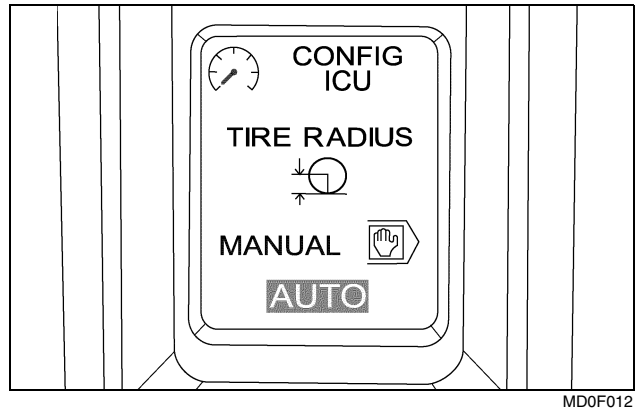


MD05F011

When the **MANUAL** format is selected the display will read **TIRE RADIUS** with the radius icon above the previously saved radius.

1. Use the **INCR** or **DECR** keys to change the radius number by 1 mm (0.1 inch). Pressing and holding the **INCR** or **DECR** keys will rapidly change the radius number.
2. When the correct radius number is reached, press the **PROG** key to save that number.

## STEP 9

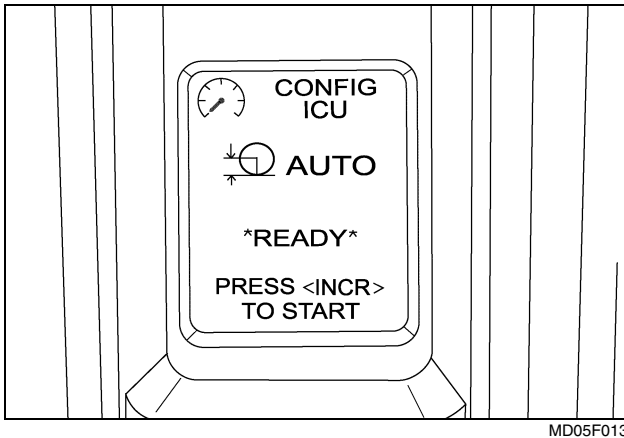


MD0F012

To use the **AUTO** format for determining tire radius the following preparations must be made:

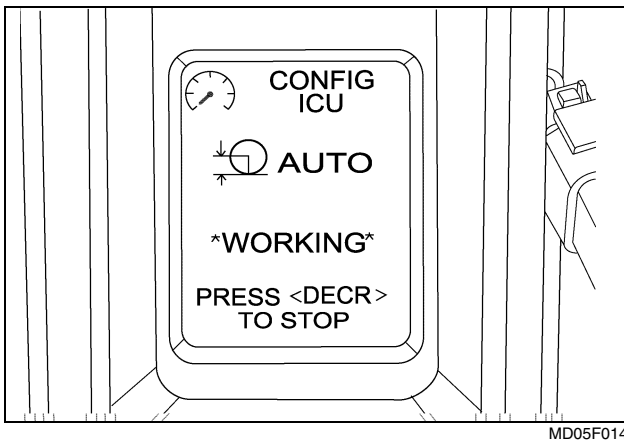
1. Mark a straight-line course of 60 meters (196.86 feet) with a start line and finish line that can be clearly seen from the cab.
2. Position the tractor at an adequate distance from the start line to allow the tractor to achieve and maintain a steady speed faster than 2 MPH (3.22 KPH).
3. Turn the key switch **OFF**. Press and hold the **PROG** key for 3 seconds within the first 10 seconds of starting the engine.
4. The display will read **CONFIG MENU** and a list of options. With the **ICU** highlighted press the **PROG** key.
5. The display will read **CONFIG MENU** followed by **Operator Setup**, **Controller Config** and **Exit**. With **Operator Setup** highlighted press the **PROG** key.
6. The display will show the **CONFIG ICU** options. Use the **INCR** or **DECR** keys to select **Tire Radius** and press the **PROG** key.
7. The display will read **TIRE RADIUS** with the radius icon above the **MANUAL** or **AUTO** options. Use the **INCR** or **DECR** keys to select **AUTO** and press the **PROG** key.

## STEP 10



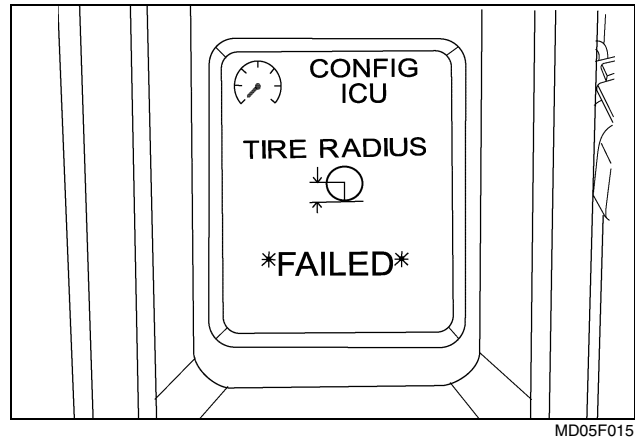
When the **AUTO** format is selected in Step 9 the display will show the radius icon followed by **AUTO**. The next line reads **\*READY\*** and the bottom of the screen reads **PRESS <INCR> TO START**.

## STEP 11



Select a forward gear and engine rpm that will maintain a steady speed above 2 MPH (3.22 KPH), release the clutch and press the **INCR** key when the front wheels touch the start line. The display will read **\*WORKING\*** and **PRESS <DECR> TO STOP**.

## STEP 12



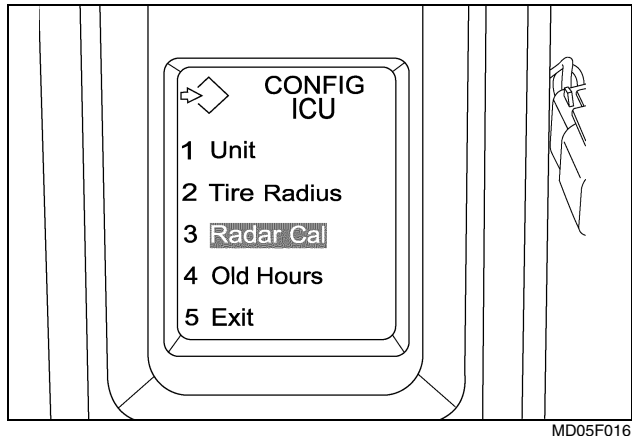
Press the **DECR** key when the front wheels touch the finish line.

If successful the **ICU** will calibrate the tire radius, display and save the new value for 2 seconds before returning to the **CONFIG ICU** options screen.

If unsuccessful, due to unsteady tractor speed or the **INCR** and **DECR** keys were not pressed at the proper time the display will read **\*FAILED\*** for 2 seconds before returning to **CONFIG ICU** options. Repeat Steps 9 through 12.

## Radar Calibration

### STEP 13



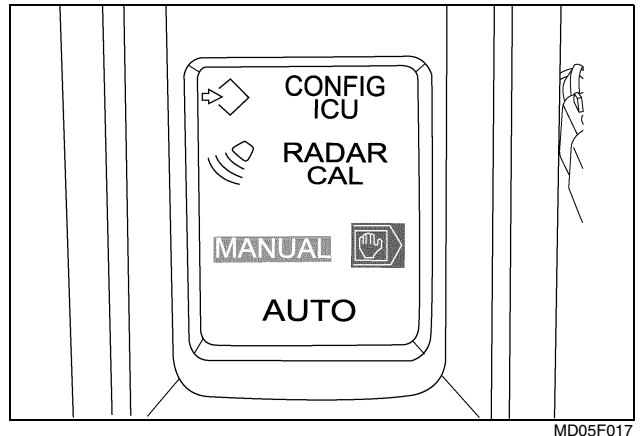
After the **Tire Radius** has been completed the **CONFIG ICU** options screen is displayed.

**NOTE:** If only calibrating the radar, complete Steps 1, 2 and 3 to display the **CONFIG ICU** options.

Use the **INCR** or **DECR** keys to highlight **Radar Cal** and press the **PROG** key.

If the tractor is not equipped with radar the display will read **RADAR NOT PRESENT**.

### STEP 14

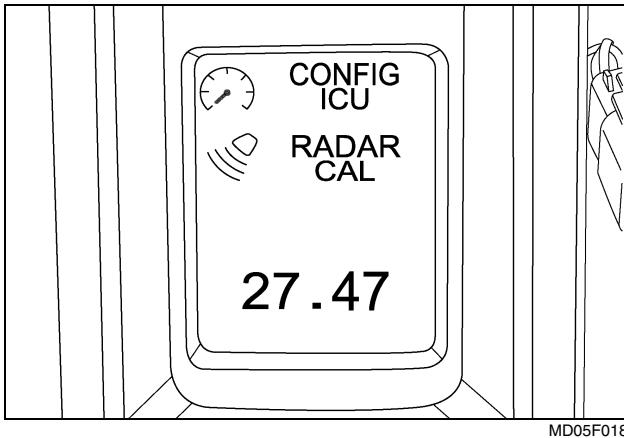


The display will show the radar icon and **RADAR CAL**. The next line shows **MANUAL** with the manual icon and the bottom line shows **AUTO**. Use the **INCR** and **DECR** keys to highlight either **MANUAL** or **AUTO**. Use the **PROG** key to enter the selected format.

If **MANUAL** is selected, proceed to Step 15. If **AUTO** (automatic) is selected, proceed to Step 16.

**NOTE:** It is recommended to use the **AUTO** format. The **MANUAL** format may need to be repeated numerous times before the correct calibration is achieved.

## STEP 15

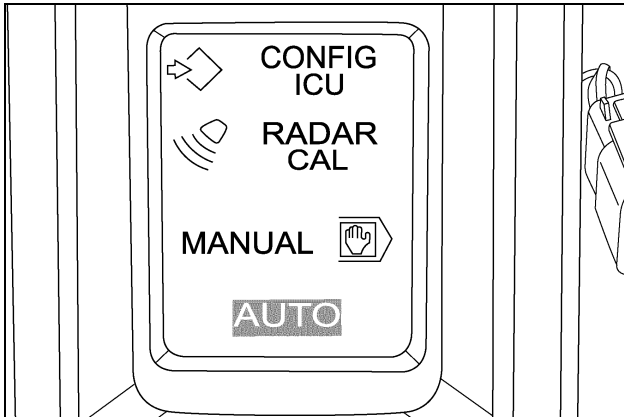


MD05F018

When the **MANUAL** format is selected the display will show the radar icon followed by **RADAR CAL**. The bottom of the display will show the previously saved or default (27.47) calibration number.

1. Use the **INCR** or **DECR** keys to change the number. Decrease the number to increase radar read out speed and reduce the percentage of slip displayed during operation. Increase the number to decrease the read out speed and increase the percentage of slip display.
2. When the corrected calibration number is reached, press the **PROG** key to save that number.

## STEP 16



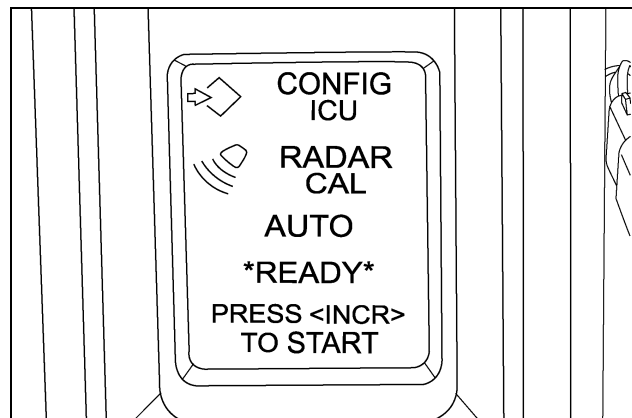
MD05F019

To use the **AUTO** format for determining the radar calibration the following preparations must be made:

1. Mark a straight-line course of 60 meters (196.86 feet) with a start line and finish line that can be clearly seen from the cab.
2. Position the tractor at an adequate distance from the start line to allow the tractor to achieve and maintain a steady speed faster than 2 MPH (3.22 KPH).

3. Turn the key switch OFF. Press and hold the **PROG** key for 3 seconds within the first 10 seconds of starting the engine.
4. The display will read **CONFIG MENU**. With **ICU** highlighted press the **PROG** key.
5. The display will show the **CONFIG ICU** options. Use the **INCR** or **DECR** keys to select **Radar Cal** and press the **PROG** key.
6. The display will show the radar icon followed by **RADAR CAL**. The next line reads **MANUAL** followed by the manual icon and the bottom line reads **AUTO**. Use the **INCR** or **DECR** key to select **AUTO** and press the **PROG** key.

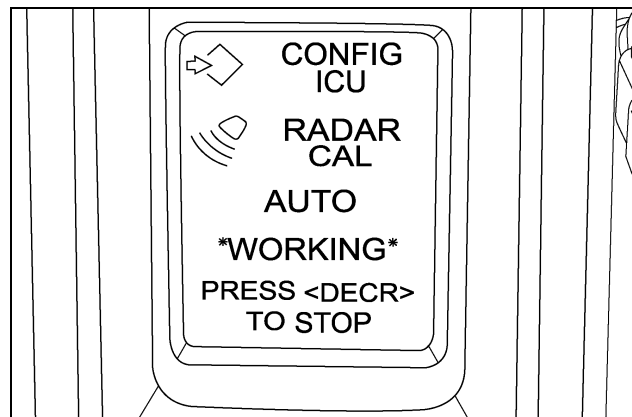
## STEP 17



MD05F020

When the **AUTO** format is selected in Step 16 the display will show the radar icon and **RADAR CAL**. The next line reads **AUTO** and below that **\*READY\***. The bottom of the screen reads **PRESS <INCR> TO START**.

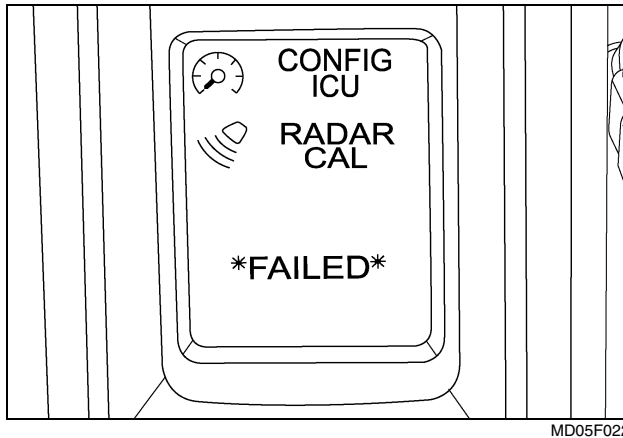
## STEP 18



MD05F021

Select a forward gear and engine rpm that will maintain a steady speed above 2 MPH (3.22 KPA), release the clutch and press the **INCR** key when the front wheels touch the start line. the display will read **\*WORKING\*** and **PRESS <DECR> TO STOP**.

### STEP 19

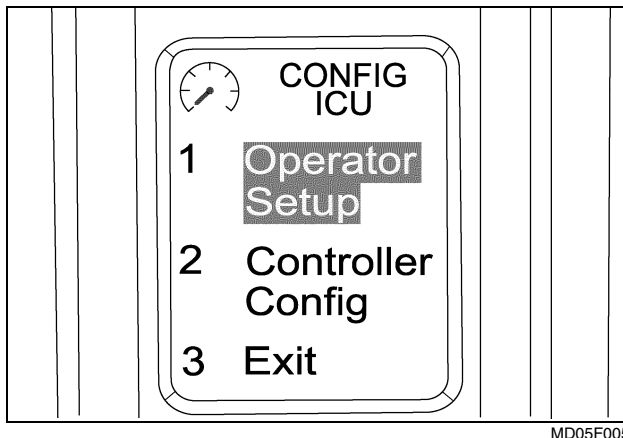


Press the **DECR** key when the front wheels touch the finish line.

If successful, the **ICU** will calculate the new radar calibration and display **\*COMPLETE\***. Press the **PROG** key to save the new value and return to the **CONFIG ICU** options screen.

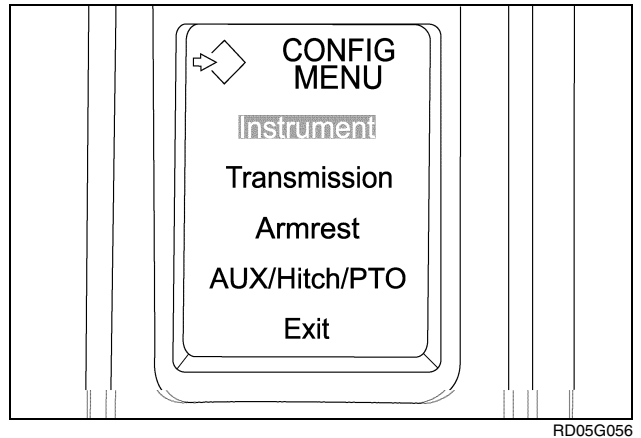
If unsuccessful, due to unsteady tractor speed or the **INCR** and **DECR** keys were not pressed at the proper time, the display will read **\*FAILED\***. Repeat Steps 16 through 19, or press **PROG** to exit the **RADAR CAL**.

### STEP 20



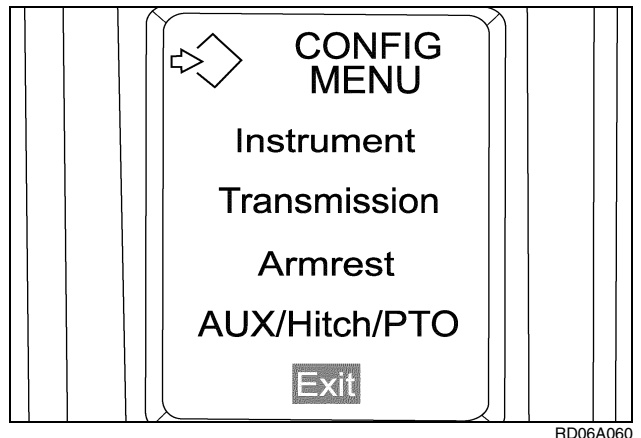
Press the **DECR** key to highlight **EXIT**. Press the **PROG** key.

### STEP 21



The **CONFIG MENU** is displayed.

### STEP 22



Press the **INCR** key to highlight **EXIT**. Press the **PROG** key to exit tractor setup and return to normal operation.

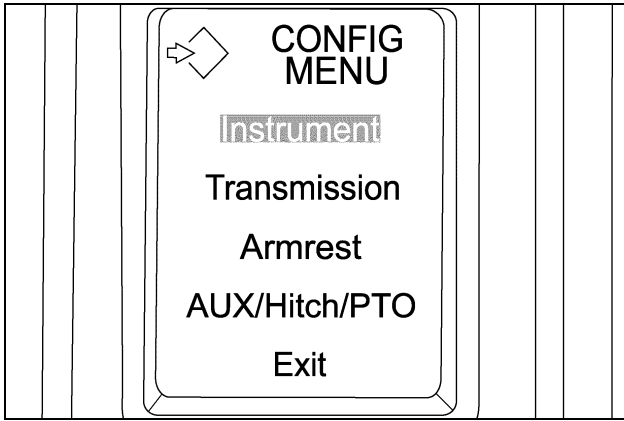
### STEP 23

If the programmable display reads **FAILED** at any time during the calibration process a condition has occurred which caused the calibration process to fail. Press the **PROG** key to exit the calibration.

## Controller Configuration

**NOTE:** Configuration can only be entered within the first 10 seconds of turning the key switch to the ON position.

### STEP 24



RD05G056

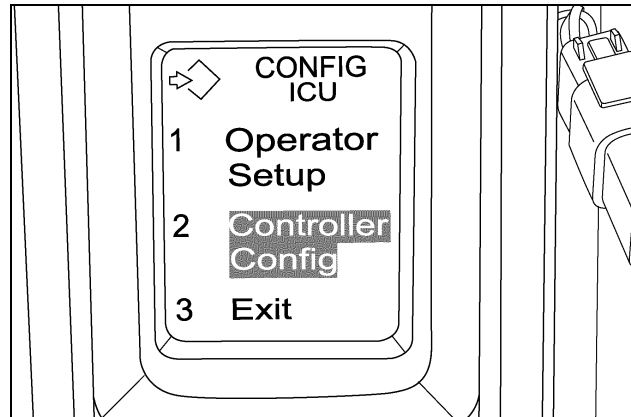
1. Enter the operation setup by pressing and holding the **PROG** key for 3 seconds within the first 10 seconds of turning the key switch to the ON position.

**NOTE:** If any fault codes are recorded, they must be corrected before configuration is possible. See *Fault Code Retrieval* in this section.

2. The display will read **CONFIG MENU**. This is the control selection menu. Pressing the **DECR** key will toggle through the list of controllers. The controllers will appear in this order (if equipped):  
**INSTRUMENT** (Instrument Cluster)  
**TRANSMISSION**  
**ARMREST**  
**AUX/HITCH/PTO**

**NOTE:** The Aux/Hitch/PTO controller is also referred to as the Tractor Multi Function (TMF) controller.

### STEP 25



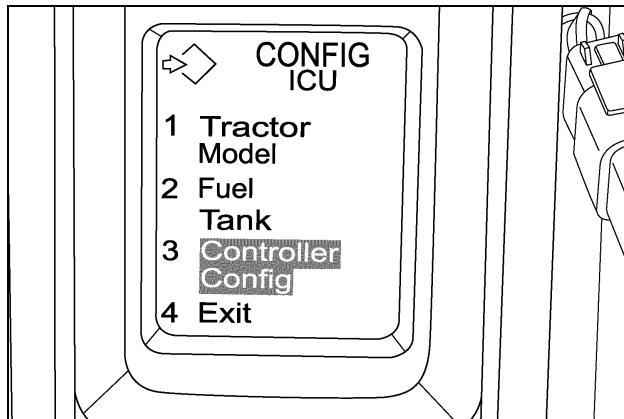
MD05F025

3. Press the **PROG** key with **INSTRUMENT** on the display. The display will read **CONFIG ICU**, 1. **Operator Setup**, 2. **Controller Config**, and 3. **Exit**. (Instrumentation operation setup). Press the **DECR** key to highlight 2. **Controller Config** (Instrumentation controller configuration). Press the **PROG** key to enter the controller configuration menu.

**NOTE:** If the selected controller does not exist or respond to communication, the display will read **COMM ERR** (communication error). The display can be cleared by pressing the **PROG** key.

## Configuration/Calibration Mode

## STEP 26



MD05F026

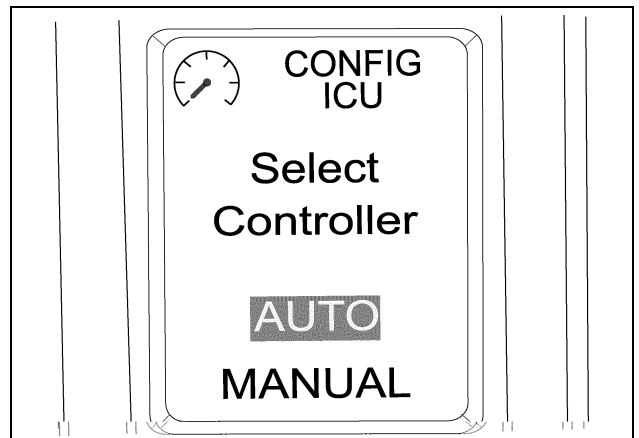
The display will read **CONFIG ICU**, **1. Tractor Model**, **2. Fuel Tank**, **3. Controller Config** and **4. Exit**. Use the **INCR** or **DECR** key to highlight **3. Controller Config** and press the **PROG** key.

**NOTE:** The **1. Tractor Model** or **2. Fuel Tank** do not need to be configured unless the **ICU** has been replaced. Use the **INCR** and **DECR** key to highlight and the **PROG** key to view Tractor Models or fuel Tank.

If the model number is not correct, use the Electronic Service Tool configuration window, tractor model select option to correct the model number.

The display will read **MANUAL** and **AUTO**. Use the **INCR** or **DECR** keys to select (highlight) either **MANUAL** or **AUTO**. The default format is **MANUAL**. If the **MANUAL** format is selected the controller menus must be toggled through and configured into the system manually. If the **AUTO** is selected, the instrumentation controller will check to see which other controllers are present on the tractor through the Data Bus.

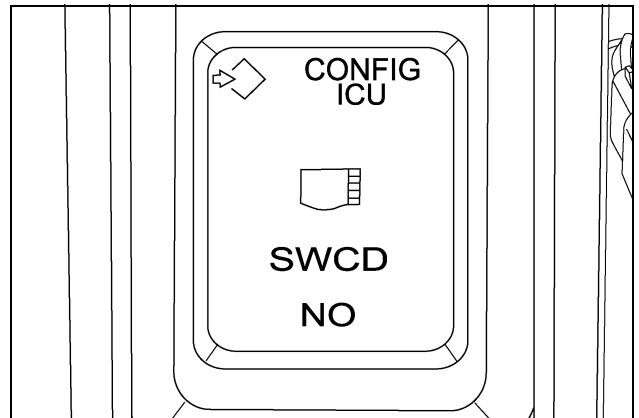
## STEP 27



MD05F174

Select between **MANUAL** or **AUTO** and press the **PROG** key. If **AUTO** was chosen, the system will go to Step 36. If **MANUAL** was chosen, the system will go to the next step.

## STEP 28

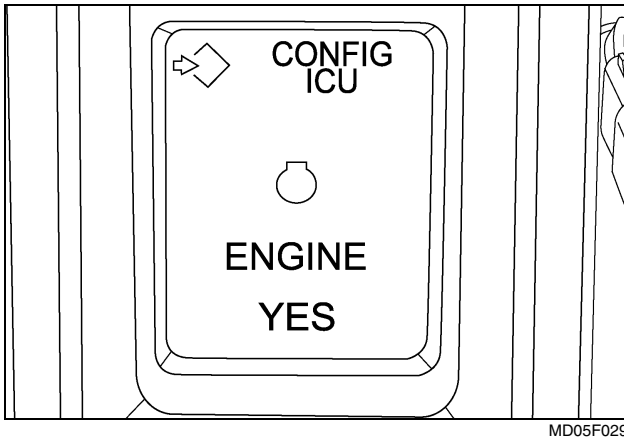


MD05F027

The bottom of the display will read **SWCD** (Color Display not available at this time). Press the **INCR** or **DECR** key to select **NO** and press the **PROG** key. The system will go to the next step.



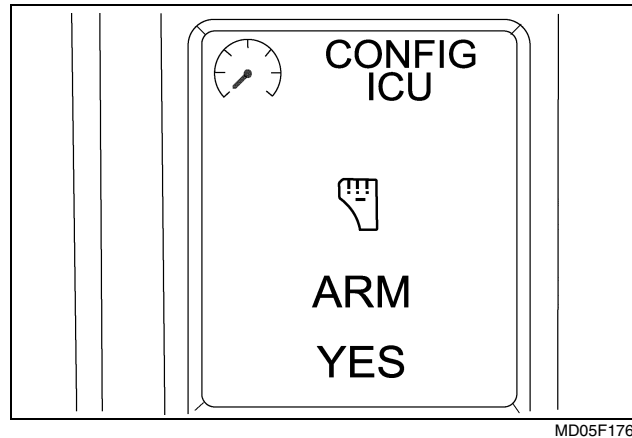
### STEP 29



MD05F029

The bottom of the display will read **ENGINE** (engine controller). Press the **INCR** or **DECR** key to toggle between **YES** and **NO**. Select your choice and press the **PROG** key. The system will go to the next step.

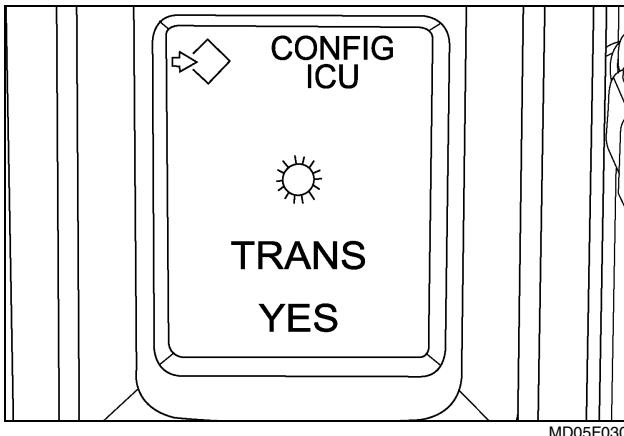
### STEP 31



MD05F176

The bottom of the display will read **ARM** (armrest controller). Press the **INCR** or **DECR** key to select **YES** and press the **PROG** key. The system will go to the next step.

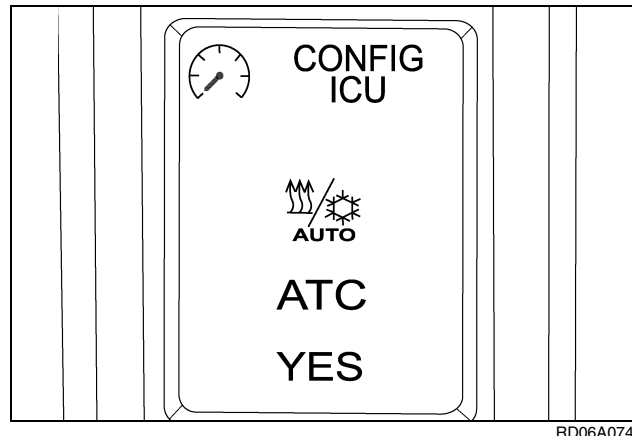
### STEP 30



MD05F030

The bottom of the display will read **TRANS** (transmission controller). Press the **INCR** or **DECR** key to toggle between **YES** and **NO**. Select your choice, press the **PROG** key. The system will go to the next step.

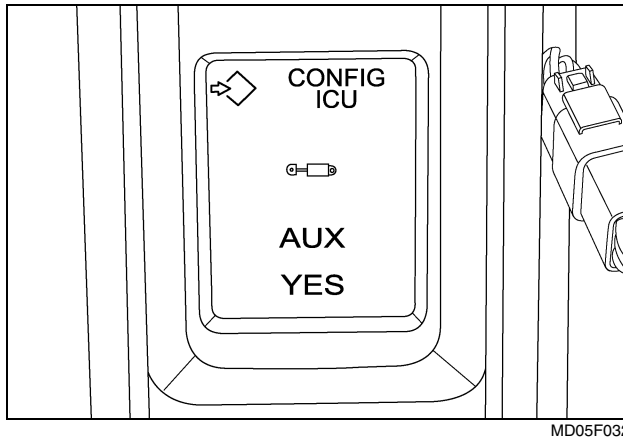
### STEP 32



RD06A074

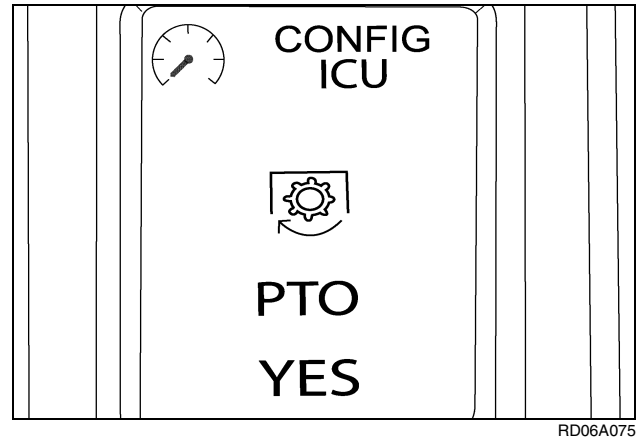
The bottom of the display will read **ATC** (automatic temperature control). Press the **INCR** or **DECR** key to select **YES** or **NO** and press the **PROG** key. The system will go to the next step.

### STEP 33



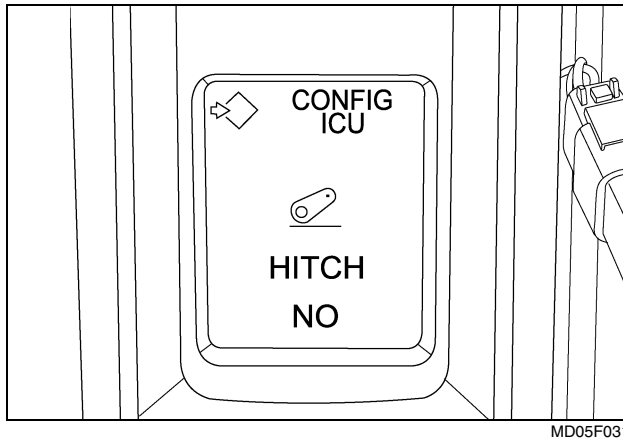
The bottom of the display will read **AUX** (remote hydraulic controller). Press the **INCR** or **DECR** key to toggle between **YES** and **NO**. Select your choice and press the **PROG** key. The system will go to the next step.

### STEP 35



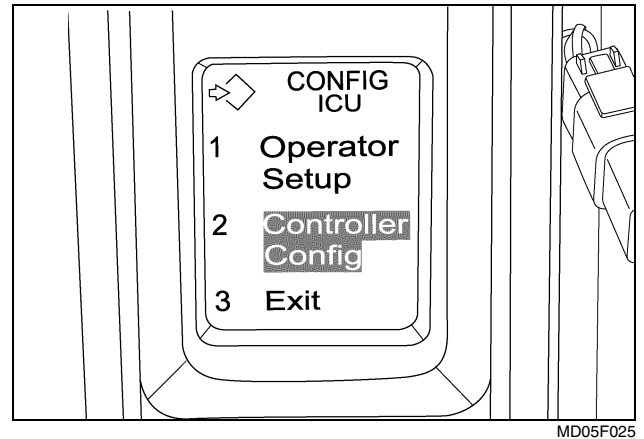
The bottom of the display will read **PTO** (AUX/HITCH/PTO controller). Press the **INCR** or **DECR** key to toggle between **YES** and **NO**. Select your choice and press the **PROG** key. The system will go to the next step.

### STEP 34



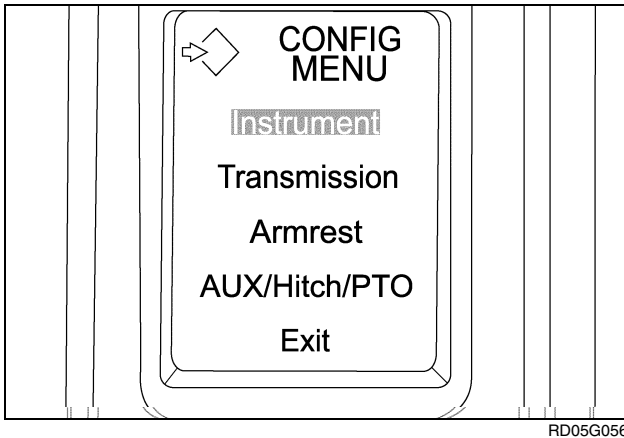
The bottom of the display will read **HITCH** (hitch controller). Press the **INCR** or **DECR** key to toggle between **YES** and **NO**. Select your choice and press the **PROG** key. The system will go to the next step.

### STEP 36



Press the **DECR** key. The display will read **CONFIG ICU**, 1. **Operator Setup**, 2. **Controller Config**, 3. **Exit**. Use the **DECR** key to highlight **Exit**. Press the **PROG** key to exit instrumentation controller configuration.

### STEP 37



The display will read **CONFIG MENU**. Press the **INCR** key. The display will read **Exit**. Press the **PROG** key to return to normal operation.

### STEP 38

Cycle the key switch **OFF**, then **ON**. Check controllers for any fault codes. Erase the fault codes if any exist.

**IMPORTANT:** *The controller must be calibrated when moved from one tractor to another.*

## **INSTRUMENTATION DISPLAY SYMPTOM BASED FAULTS**

### **Instrumentation Display Will Not Illuminate When Key Is Turned On**

### **No Fault Code**

**Meaning:**

The INST controller (display) is not to be powered or has failed.

**Possible failure mode:**

1. Failed cab power relay - engine will run after starting.
2. Failed controller power relay - engine will stop after starting.
3. Failed key switch - engine will stop after starting.
4. Fuse #37 failed or circuit from fuse to controller pin 2 of connector CN2 failed open.
5. Poor ground supply to Display pin 4 of connector CN2.

**Background:**

The key switch activates the cab power relay and the controller relay (#19) when the key is placed in the start and run position. The cab power relay supplies battery power (switched power) to the controller relay (#19). Both relays must be powered for the controllers to be powered.

**NOTE:** *Both the cab power relay and the controller relay (TMF/ICU controller relay #19) must make a clicking sound when the key is turned on.*

**Wiring information:**

Instrumentation controller connector CN2-2<--->Fuse 37<--->255 (Controller relay #19) 255<--->138 (cab power relay)

240<--->unswitched power

**Corrective action:**

**STEP 1 - Cycle key switch - (20 times)**

Turn the front wiper on.

Turn the key switch on and off while monitoring the display and the front wiper, the display and front wiper must turn on and off everytime when the key is cycled.

- OK - The display and front wiper turned on every time when key switch was turned on.
- NOT OK - The wiper turned on but the display did not turn on when the key was turned on. Go to Step 4.
- NOT OK - The display and the wiper did not turn on, go to Step 2.

**STEP 2 - Check power to cab power relay**

The cab power relay is located in the fuse compartment behind the operator seat.

Turn the key on, the relay should make a clicking sound.

- OK - Relay clicks, but wiper did not turn on - Replace relay (failed contacts).
- NOT OK - Relay did not click - Check power supply to relay. Go to Step 3.

**STEP 3 - Check power and ground to the cab power relay**

Check relay ground - correct if needed.

Turn key on.

Check for relay coil power at ring terminal 138 for switched power from the key switch.

- OK - Replace relay
- NOT OK - Failed key switch
  - No power to key switch
  - Failed wire from the key switch to relay

**STEP 4 - Check fuse 37**

With the key switch on the display will not illuminate.

Check fuse 37.

- OK - Go to Step 5.
- NOT OK - Replace fuse, If fuse fails when key is turned on, go to Step 9.

### STEP 5 - Check power at fuse 37

With the key switch on and the display not illuminate.

Remove fuse 37 and check for 12 volts.

- OK - Go to Step 7.
- NOT OK - Go to Step 6.

### STEP 6 - Check controller relay (TMF/ICU controller relay #19)

The controller relay (#19) is located in the fuse compartment behind the operator seat.

Check relay ground supply wire.

Turn key on.

Check for power at Controller relay (#19) base. Remove relay and check for power at C255 terminal 2 and 3.

- OK - Replace relay.
- NOT OK - Failed wire 160 to ignition switch, or wire 102 to ring terminal 138.

### STEP 7 - Check power and ground supply to the instrumentation controller (Instrument Cluster).

Install fuse 37.

Remove the instrumentation controller.

Turn the key on.

Check connector CN2, pin 2 for 12 volts.

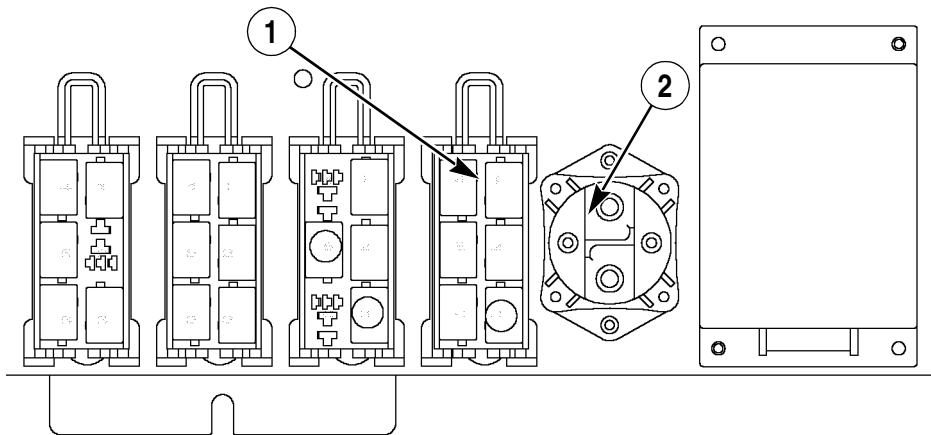
- NOT OK - Replace the wire between fuse 37 and the instrumentation controller connector CN2, pin 2.
- OK - Go to Step 8.

### STEP 8 - Check the ground supply at connector CN2, pin 4

Check the ground supply at connector CN2, pin 4.

- OK - Replace the instrumentation controller.
- NOT OK - Correct grounding problem.

**NOTE:** If the problem is intermittent, one of the relays is starting to fail or has dirty contacts.



RI05G040

**Fuse/relay compartment (behind operator seat)**

1. TMF/ICU RELAY (#19)

2. CAB POWER RELAY

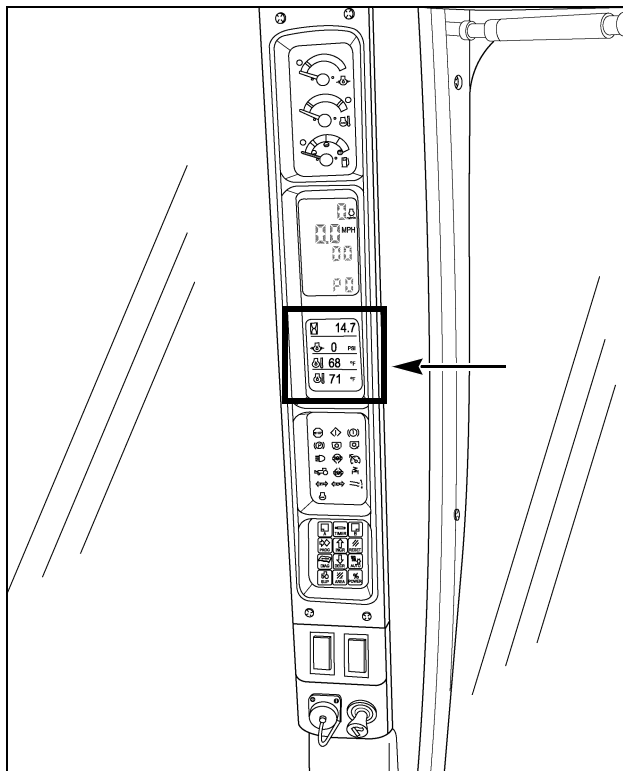
## ARMREST CONTROLLER CONFIGURATION AND CALIBRATION

### General Information

**NOTE:** The standard instrumentation controller must be calibrated before the armrest controller is calibrated.

The armrest controller is located in the right hand armrest of the operators seat. The controller monitors the switches and potentiometers which are located in the armrest and then broadcasts their status over the Tractor Data Bus (TDB). The other controllers on the tractor obtain this information from the TDB.

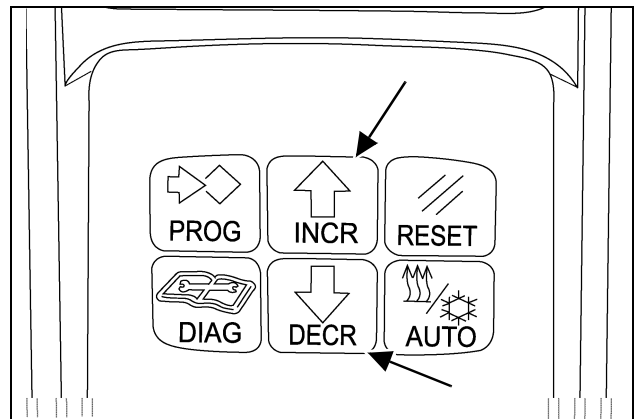
Armrest controller calibration is performed through the programmable display on the standard or performance instrumentation.



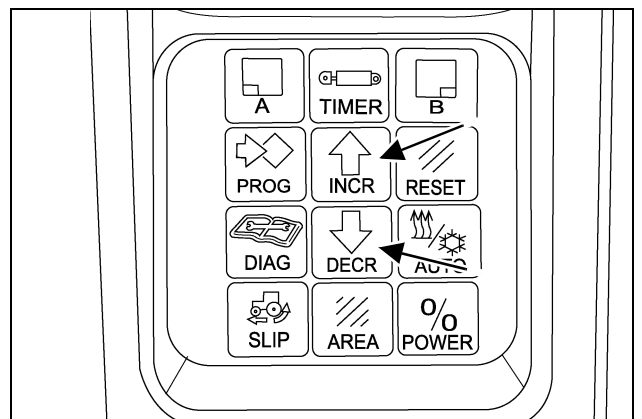
There are a five possible main menus that can be cycled through. Only those menus that the standard instrumentation controller is configured for will appear on the display. The possible menus are:

1. **HITCH** - This menu is for the calibration of the hitch position command potentiometer.
2. **THROTTLE** - This menu calibrates the hand throttle lever potentiometer voltage for high and low idle.
3. **AUX FLOW** - This menu calibrates the flow potentiometers for high and low flow.

4. **AUX LEVER** - (Remote hydraulic valve) This menu is used to tell the controller how many remote hydraulic valves are present on the tractor, and to record the voltage for the extend and retract position for each of the valve control levers.
5. **ARM MFD** - This menu calibrates the flow potentiometers for high and low flow.
6. **ARM TRANS** - This menu calibrates the flow potentiometers for high and low flow.
7. **VIEW** - This menu is used to see what version of software is currently installed.
8. **EXIT** - Used to exit armrest controller calibration.



STANDARD INSTRUMENTATION CLUSTER



PERFORMANCE INSTRUMENTATION CLUSTER

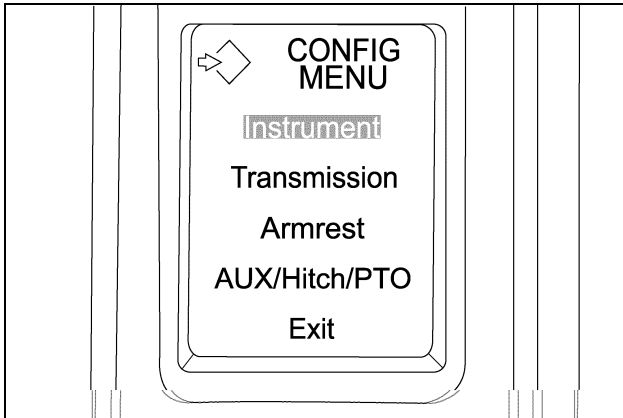
The **INCR** and **DECR** keys are used to toggle between these menus.

## Entering Armrest Calibration

**NOTE:** Programming can only be entered within the first 10 seconds of turning the key switch to the ON position.

To get to the armrest controller calibration main menu, do the following:

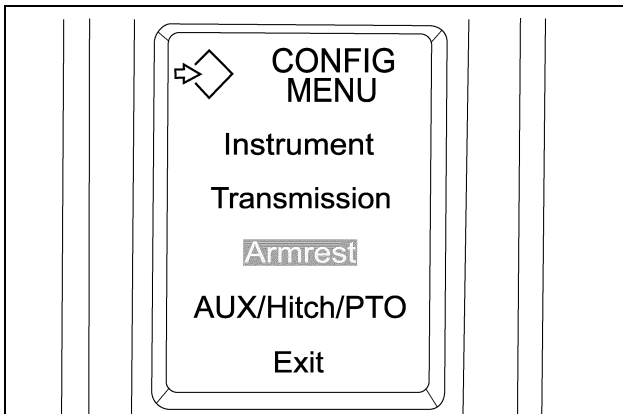
### STEP 1



RD05G056

Turn the keys switch to the **ON** position. Push the program key and hold for two seconds within the first ten seconds of turning on the key switch. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.

### STEP 2



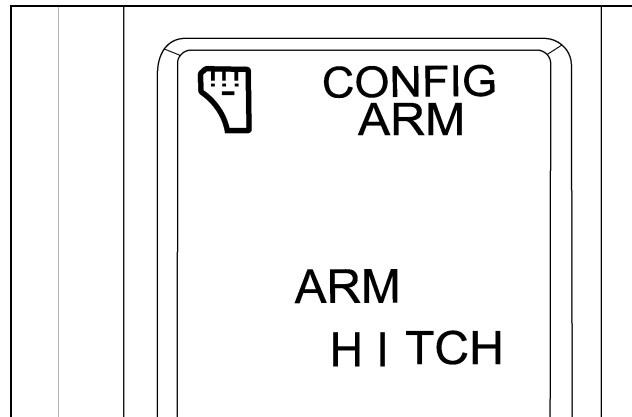
RD06A058

Press the **DECR** key until **ARMREST** is highlighted. Press the **PROG** key to enter the programing menus.

**NOTE:** If not equipped with a hitch, go to Step 7.

## Hitch Menu

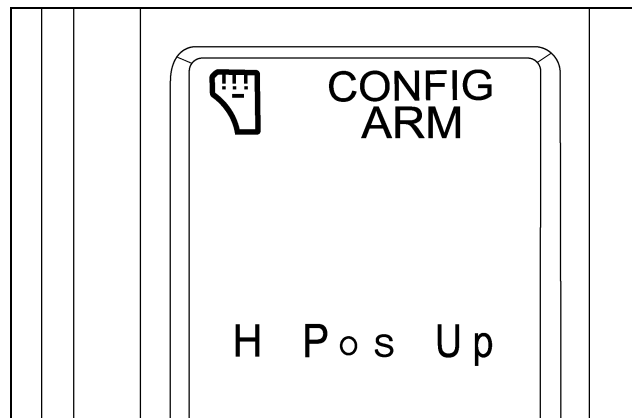
### STEP 3



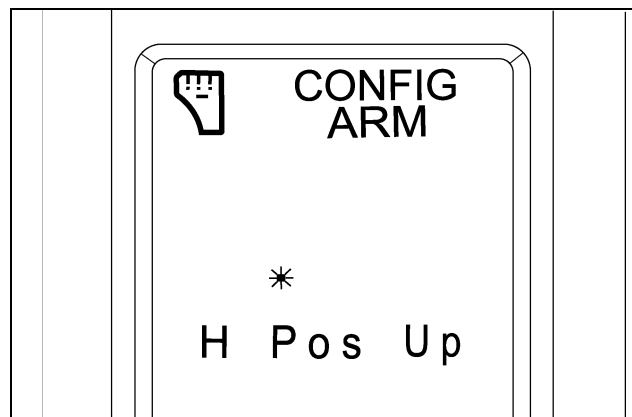
MD05F097

Select the calibration option for the hitch control lever (if equipped). When the display reads **ARM HITCH**, press the **PROG** key.

### STEP 4



MD05F098

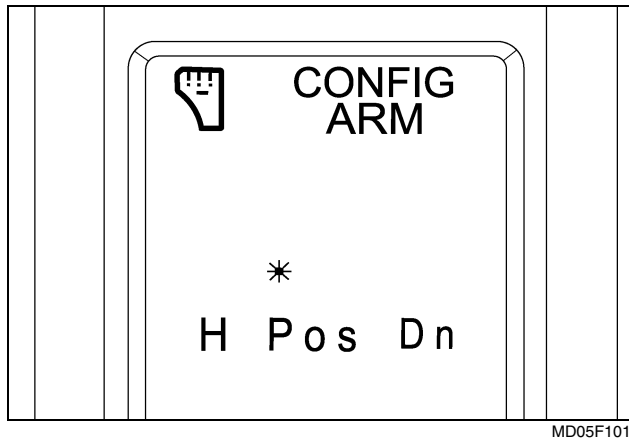
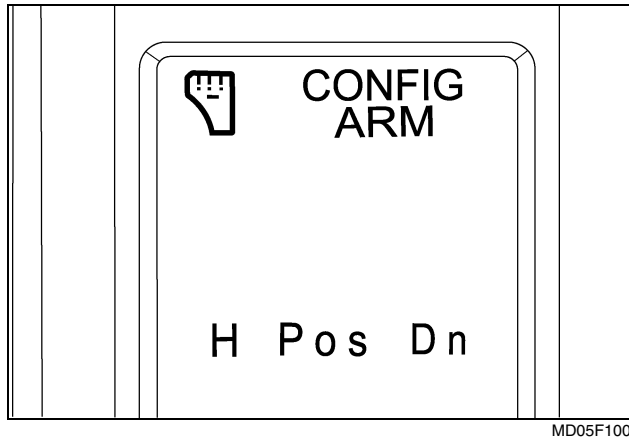


MD05F099

The display will read **H Pos Up**. Move the hitch position lever to the full up position. An asterisk (\*) will appear on the display when the potentiometer is in a valid range. Press the **PROG** key to record the voltage.

**NOTE:** Do not go to the transport lock position.

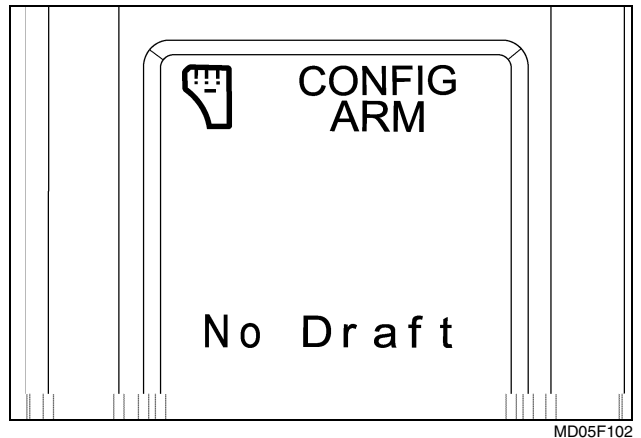
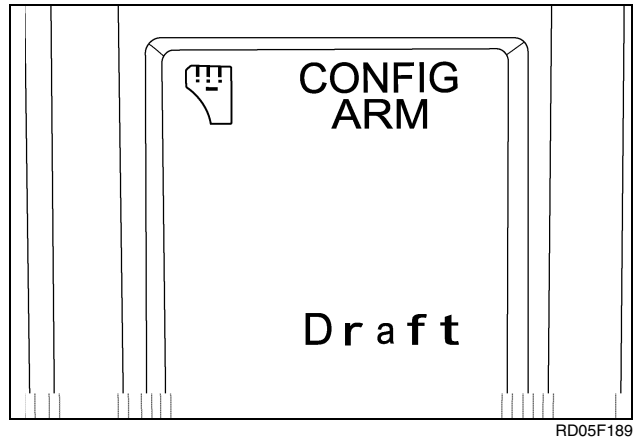
## STEP 5



Press the PROG key. The display will read **H Pos Dn**. Move the hitch position lever to the full down position. An asterisk (\*) will appear in the display when the potentiometer is in a valid range. Press the **PROG** key to record the voltage.

**NOTE:** If either the up or down position was not valid, and the asterisk did not appear in the display, the display will read *cal failed* and this calibration option will abort. A problem will have to be corrected before calibration will be possible.

## STEP 6



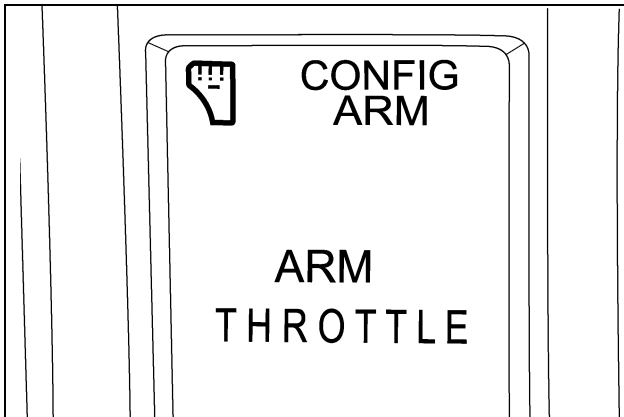
The display will now read **Draft** or **No Draft**. There must be a hitch load command potentiometer in the armrest controller to select **Draft**. Select **No Draft** and the hitch will be configured as a position only hitch. The hitch calibration option is now complete.

Press the **PROG** key. The display will read **ARM HITCH**. To exit the armrest calibration go to Step 23. Press the **DECR** key and go to the next step to continue with armrest calibration.



## Throttle Menu

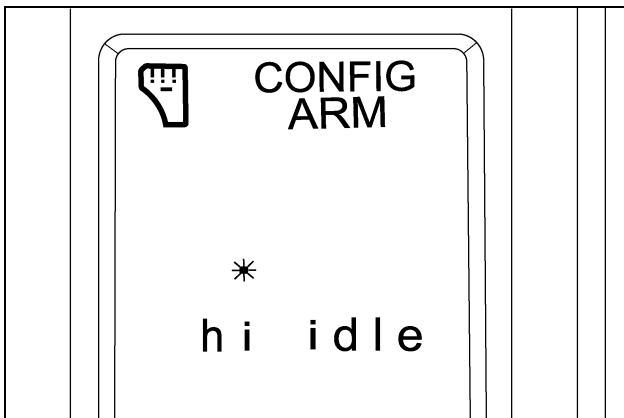
### STEP 7



MD05F103

Select the calibration option for throttle lever. When the display reads **ARM THROTTLE**, press the **PROG** key.

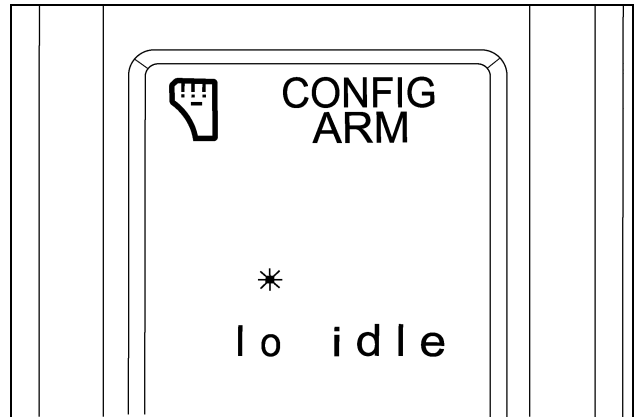
### STEP 8



MD05F104

The display will read **hi idle**. Move the hand throttle lever to the high idle position. An asterisk (\*) will appear on the display when the potentiometer is in a valid range. Press the **PROG** key to record the voltage.

### STEP 9



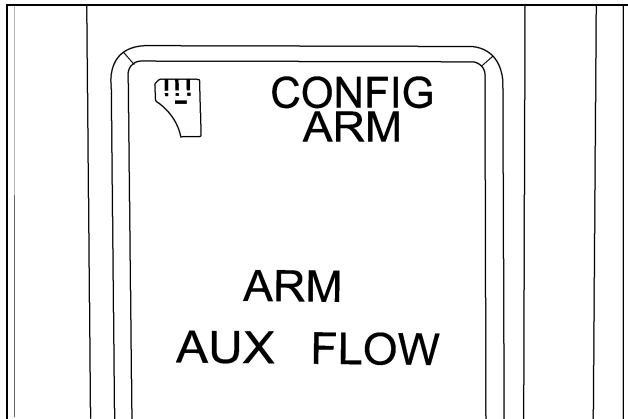
MD05F105

The display will read **lo idle**. Move the throttle lever to the low idle. An asterisk (\*) will appear in the display when the potentiometer is in a valid range. Press the **PROG** key to record the voltage. The display will now read **ARM THROTTLE**. To exit the armrest calibration, go to Step 23. Press the **DECR** key and go to the next step to continue with the armrest calibration.

**NOTE:** If either the high or low idle position was not valid, and the asterisk did not appear in the display, the display will read *cal failed* and this calibration option will abort. The problem will have to be corrected before calibration will be possible.

## Remote Valve Menu

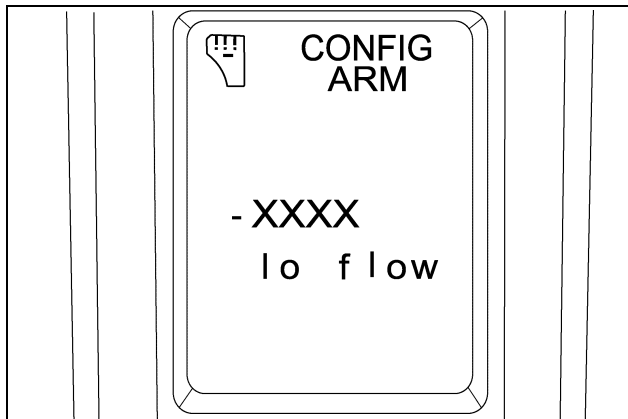
### STEP 10



MD05F106

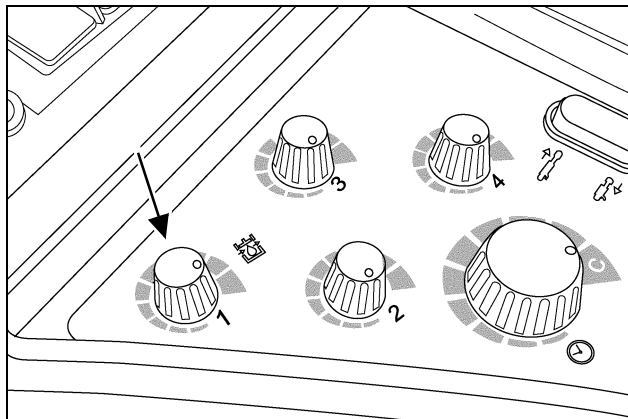
Select the calibration option for the remote hydraulic flow controls. When the display reads **ARM AUX FLOW** press the **PROG** key.

### STEP 11



RD05F145

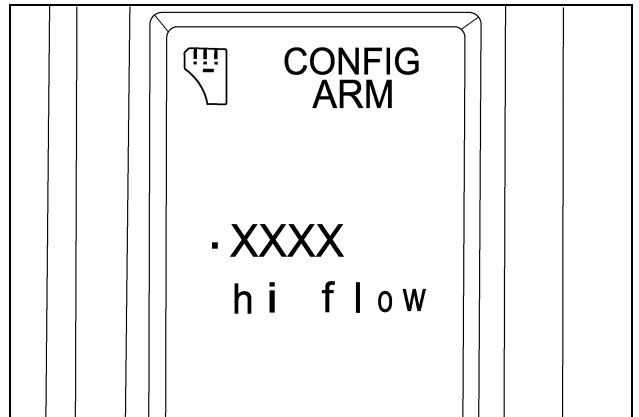
The display will read **-XXXX lo flow**.



MD05F107

Turn the **#1 flow potentiometer** completely counterclockwise until the **1** appears in the first **X** position of the display. Press the **PROG** key.

### STEP 12



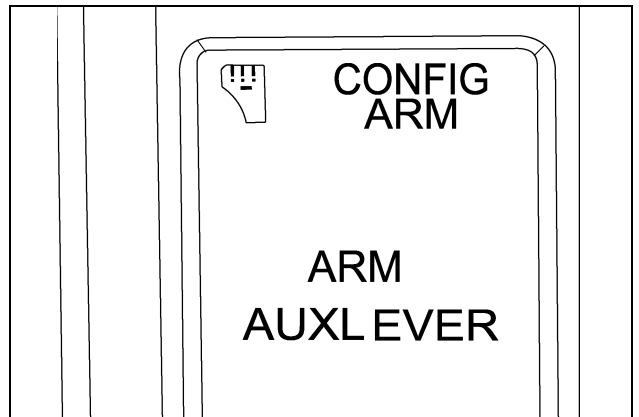
RD05F188.

The display will read **-XXXX hi flow**. Turn the #1 flow potentiometer completely clockwise until the **1** appears in the first - position of the display. Press the **PROG** key.

### STEP 13

The screen reads, **ARM AUX FLOW**. Press the **DECR** key to select **AUX ARM LEVER**.

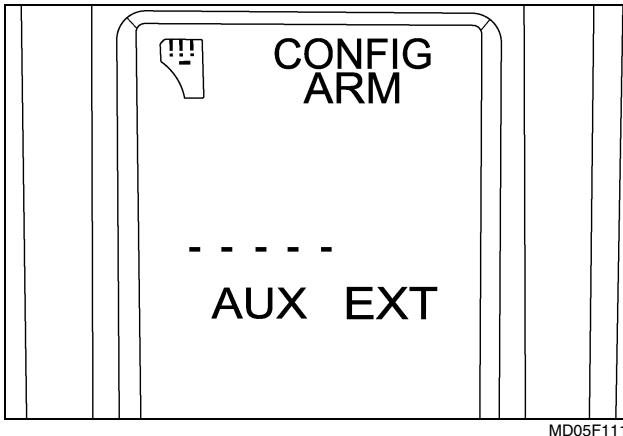
### STEP 14



MD05F110

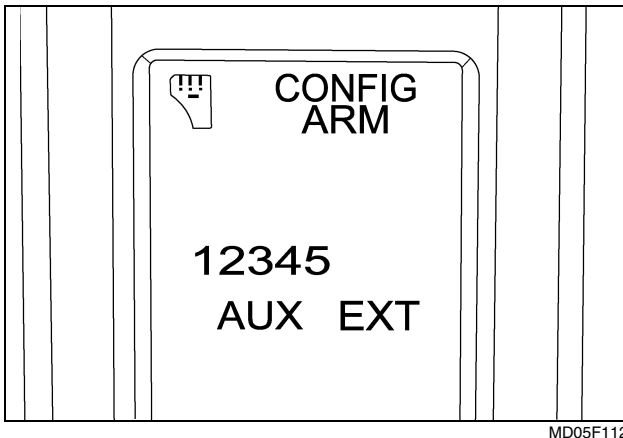
When the display reads **ARM AUX LEVER**, press the **PROG** key.

### STEP 15



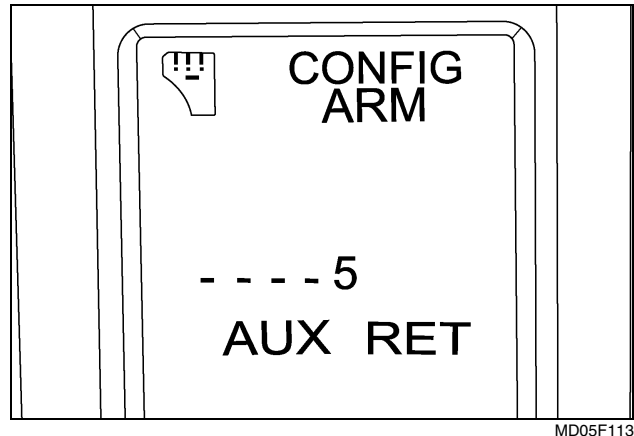
The display will read **AUX EXT** (extend). Move all the remote hydraulic levers to the full extend position (Rearward detent). If equipped with a fifth remote hydraulic section, press and release the fifth remote hydraulic control switch (momentary) in the extend direction (rearward).

### STEP 16



The display will indicate which levers are in the extend position with the number of the remote. A dash (-) indicates that the corresponding lever is not in the extend position. When completed with all the levers, press the **PROG** key. The voltage for all the levers that are in the extend position will be recorded. An **X** will be displayed for any lever that did not have a valid extend voltage recorded.

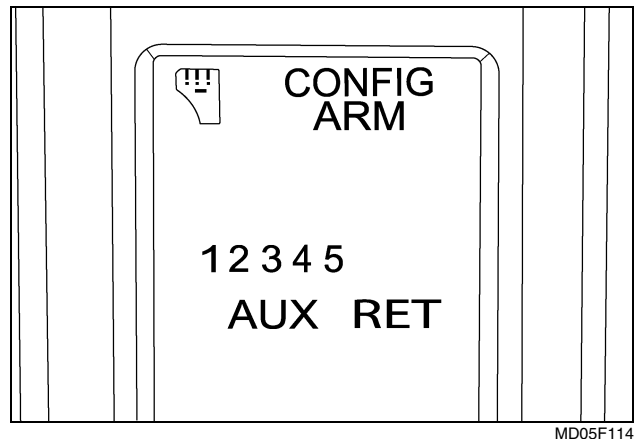
### STEP 17



The display will read **AUX RET** (retract). Move all the remote hydraulic levers to the full retract position (First forward detent).

**NOTE:** Do not move the lever to the float position.

### STEP 18

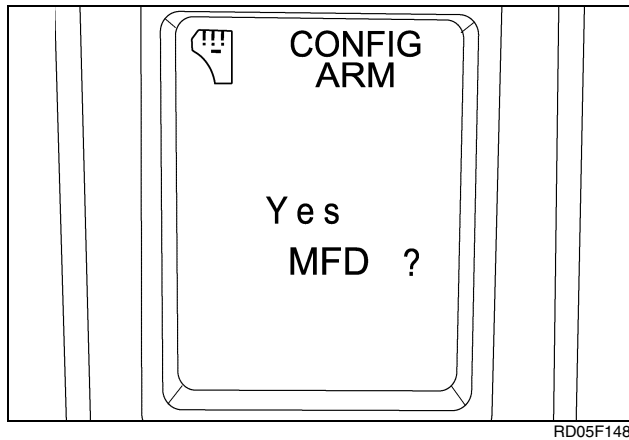
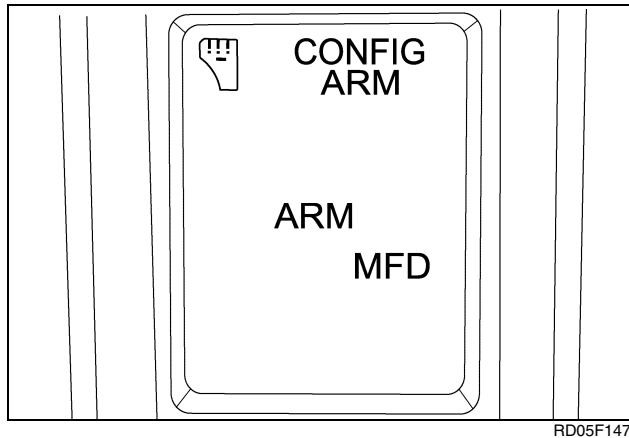


The display will indicate which levers are in the retract position with the number of the remote. If the 5th remote was actuated for the extend position, it need not be actuated again. The number **5** will already appear on the display. A dash (-) indicates that the corresponding lever is not in the retract position. Press the **PROG** key to record the voltage for all the levers in the retract position. An **X** will be displayed for any lever that did not have a valid retract voltage recorded.

The remote lever calibration is now complete. Press **PROG** and the display will now read **ARM AUX LEVER**. To exit the armrest calibration, go to Step 23. Press **DECR** and go to the next step to continue with the armrest calibration.

## ARM MFD

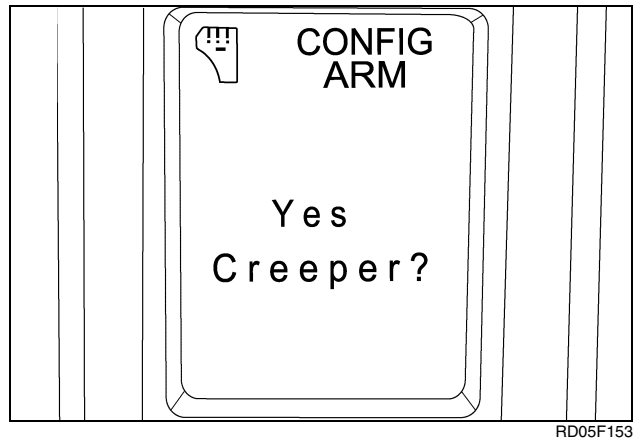
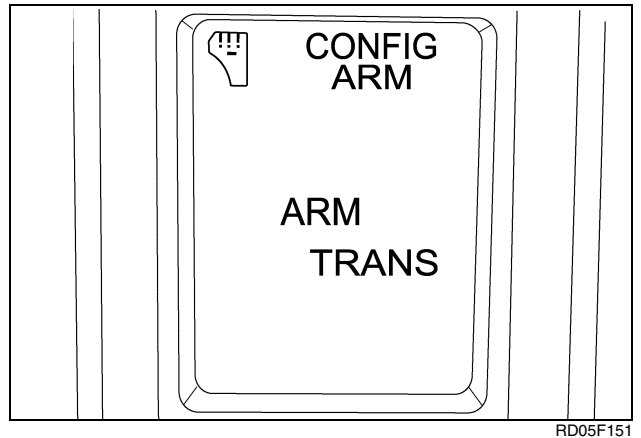
### STEP 19



Select the software view option from the main menu. The display will read **ARM MFD**. Press the **PROG** key. The display will read **YES MFD ?**. Press the **INCR** key to change to **NO MFD ?** if not equipped. Press the **PROG** key to exit the **ARM MFD** menu.

## ARM TRANS

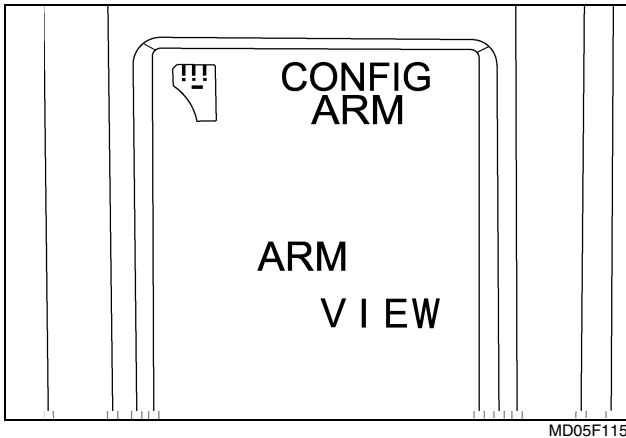
### STEP 20



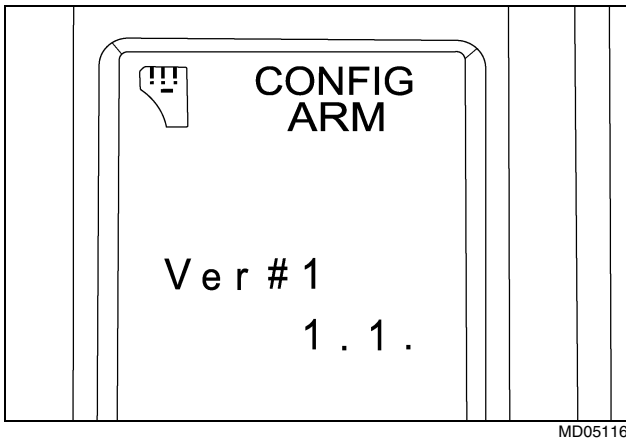
Select the software view option from the main menu. The display will read **ARM TRANS**. Press the **PROG** key. The display will read **YES Creeper ?**. Press the **INCR** key to change to **NO Creeper ?** if not equipped. Press the **PROG** key to exit the **ARM TRANS** menu.

## View Menu

## STEP 21



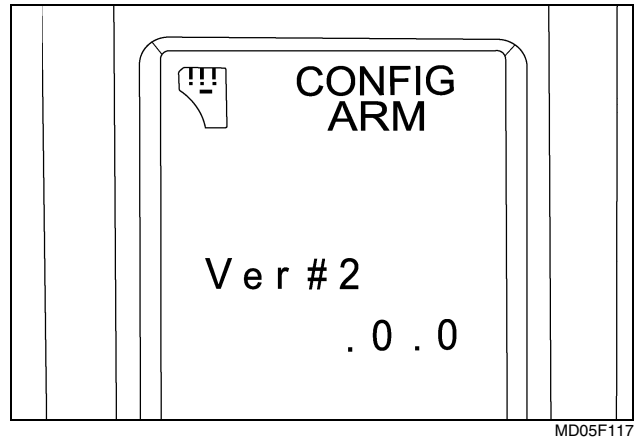
MD05F115



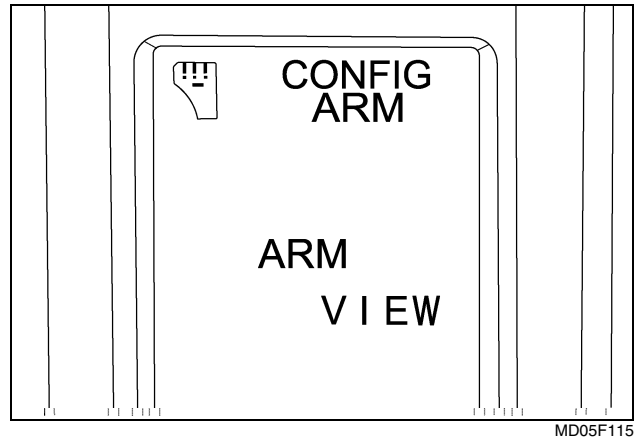
MD05F116

Select the software view option from the main menu. The display will read **ARM VIEW**. Press the **PROG** key. The software is displayed in two parts. The display will read **Ver#1** on the top of and the first part of the software code on the bottom of the display. Press the **PROG** key.

## STEP 22



MD05F117

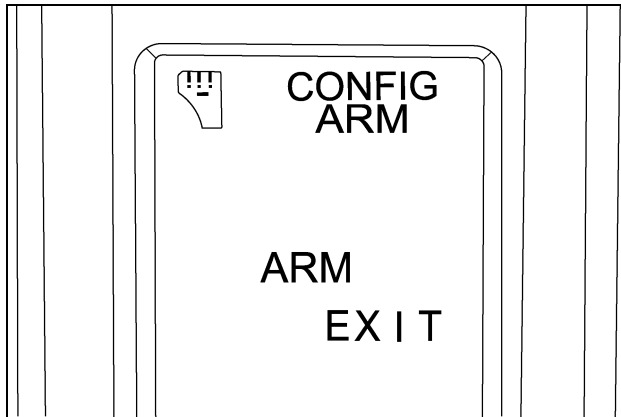


MD05F115

The second part of the software code will now be shown. The display will read **Ver#2** on the top and the software code on the bottom of the display. Press the **PROG** key to exit the view menu. The display will now read **ARM VIEW**.

## Exit Calibration

### STEP 23



MD05F118

Use the **DECR** key to select the **ARM EXIT** menu and press the **PROG** key to exit armrest controller calibration. The display will now read **CONFIG MENU**. Press the **INCR** or **DECR** key until the display reads **EXIT SET MENU**. Press the **PROG** key to return to normal operation.

## TRANSMISSION CONTROLLER CONFIGURATION AND CALIBRATION

### Important General Information

- Before starting the transmission calibration procedure, check the wiring harness and components for damage or loose connections. Replace or repair any damaged part as necessary.
- Before calibrating the transmission controller, be sure the Standard Instrumentation (ICU) and Armrest (ARM) controllers are calibrated.
- Be sure that no persons are in front of or in back of the tractor during calibration.



**WARNING:** *Since the clutch calibration process involves engaging transmission clutches, this procedure should only be performed in open areas, free of obstructions. The tractor may experience a small amount of movement during calibration and the tractor operator should be ready to stop the tractor at any time.*

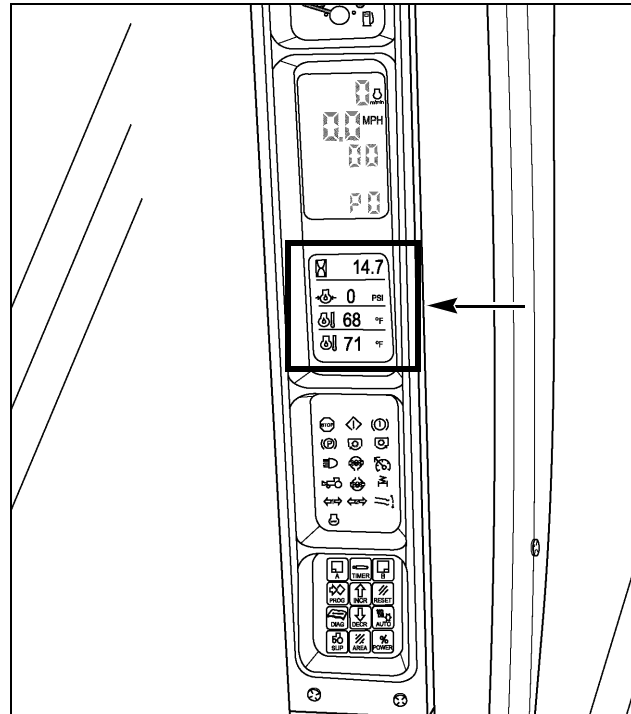
M588

- The transmission oil must be warmed to more than 60°C (140°F).
- The engine speed must be 1200 RPM or higher during calibration.

### When Calibration is Required

After service work has been performed on a transmission valve, master clutch, clutch pedal or the transmission controller calibration is required.

Clutch calibration is performed through the programmable display on the standard instrumentation.



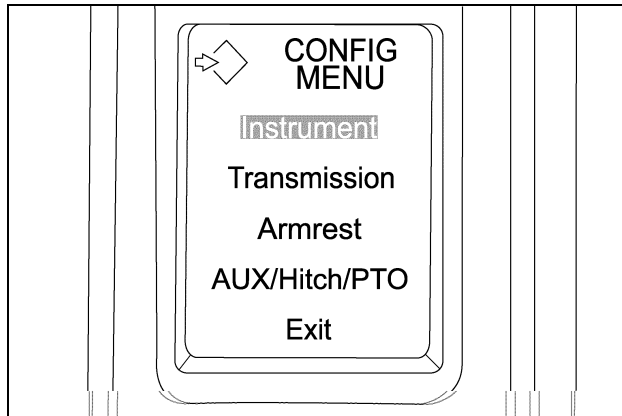
MD05F002

There are 6 main menu options in the transmission configuration/calibration mode:

1. **TRANS VIEW** - This menu displays clutch calibration values (milliamp and temperature). System oil temperature, inching pedal calibration values, software revision numbers, transmission system pressure, and engine load in percent. Normal tractor operation is allowed while this menu is being displayed.
2. **TRANS SETUP** - This menu is used to enter the clutch calibration and to set default gear values for transmission controller.
3. **TRANS ADJUST** - This menu can only be accessed when the Electronic Service Tool (EST) is in use on the tractor. **Do Not Enter this menu.**
4. **TRANS DIAG** - This menu can only be accessed when the Electronic Service Tool (EST) is in use on the tractor. **Do Not Enter this menu.**
5. **TRANS FSUS** - This menu is used to setup for suspended axle, view suspension menus, calibrate, enter demo mode, or manual mode.
6. **TRANS EXIT** - This menu entry will exit the calibration mode for the transmission system.

To access these menus:

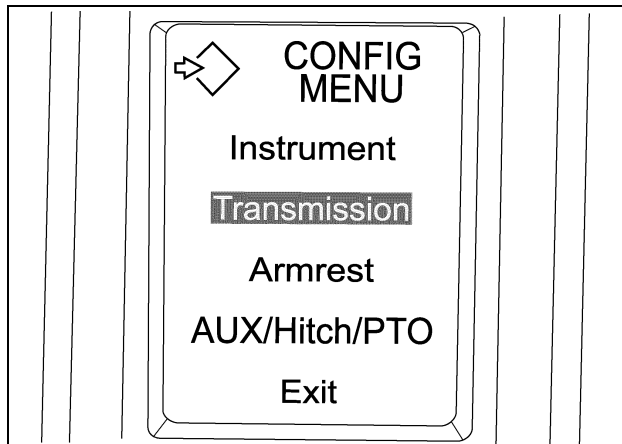
### STEP 1



RD05G056

Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.

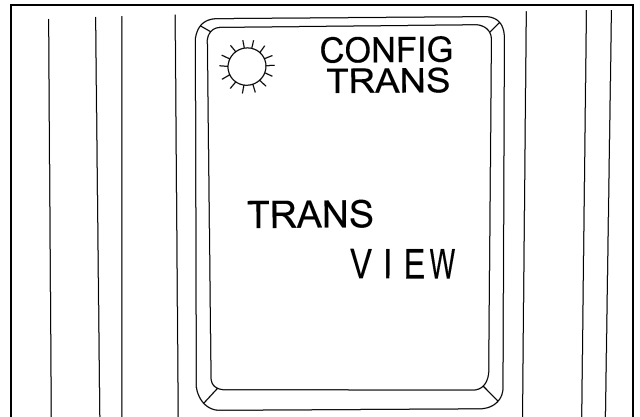
### STEP 2



RD06A057

Push the **DECR** key until the display reads **TRANSMISSION** and press the **PROG** key again.

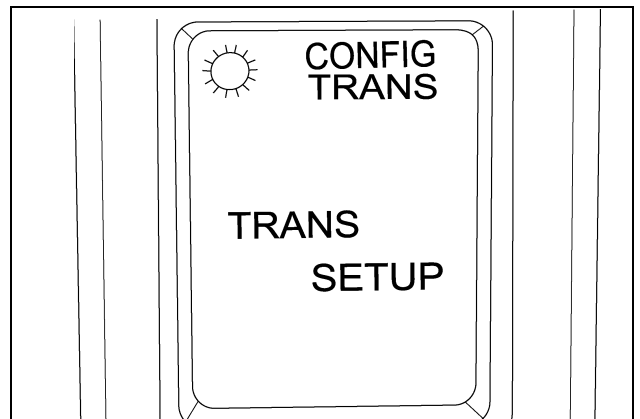
### STEP 3



RD05F104

The display will read **TRANS VIEW**. Press **DECR** key.

### STEP 4

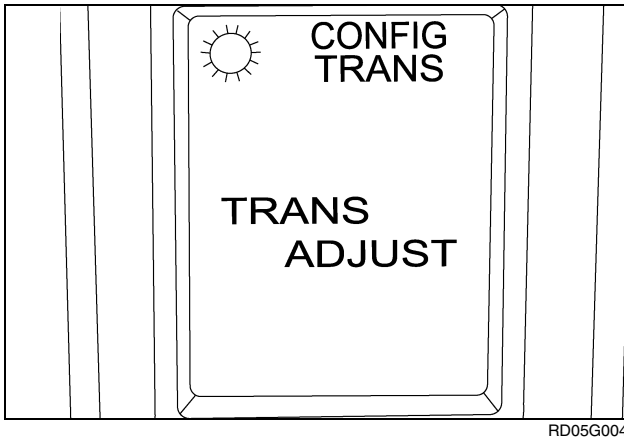


RD05F125

The display will read **TRANS SETUP**. Press **DECR** key.



## STEP 5

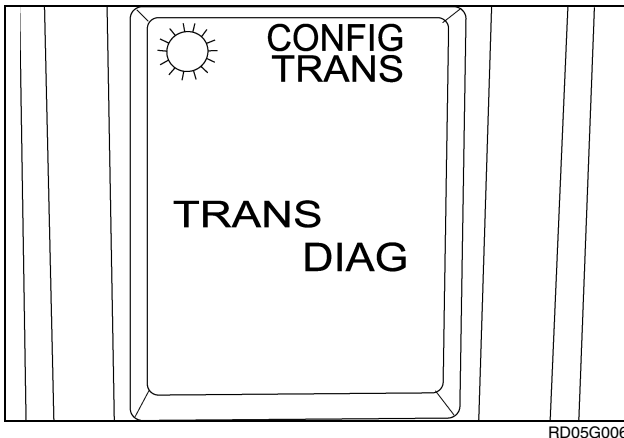


RD05G004

**IMPORTANT:** The **TRANS ADJUST** menu will only appear when the Electronic Service Tool (EST) is in use. Do Not enter this menu. Press the **DECR** key.

The display will read **TRANS ADJUST**. Press the **DECR** key.

## STEP 6

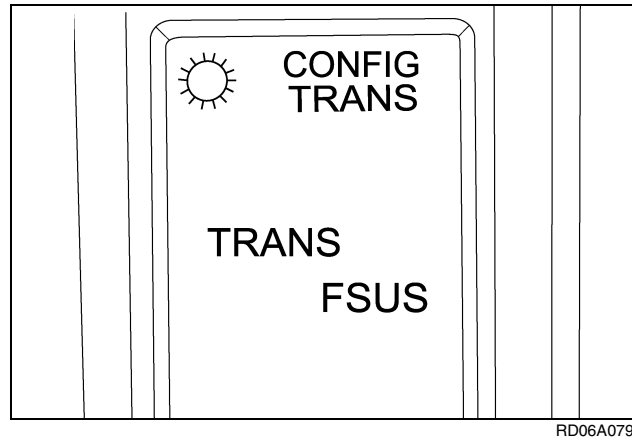


RD05G006

**IMPORTANT:** The **TRANS DIAG** menu will only appear when the Electronic Service Tool (EST) is in use. Do Not enter this menu. Press the **DECR** key.

The display will read **TRANS DIAG**. Press **DECR** key.

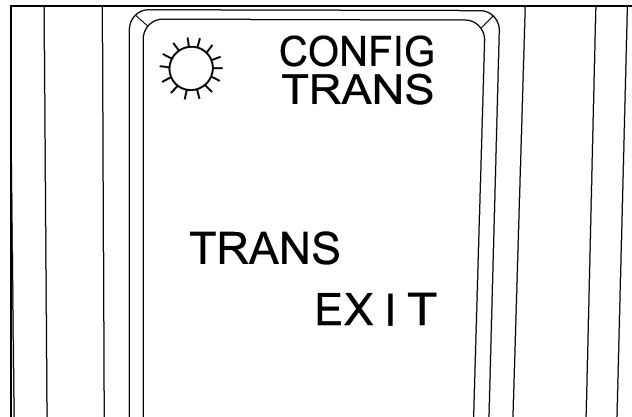
## STEP 7



RD06A079

The next display will be **TRANS FSUS**, but only if equipped with the Suspended Axle Option. Press **DECR** key.

## STEP 8



RD05F134

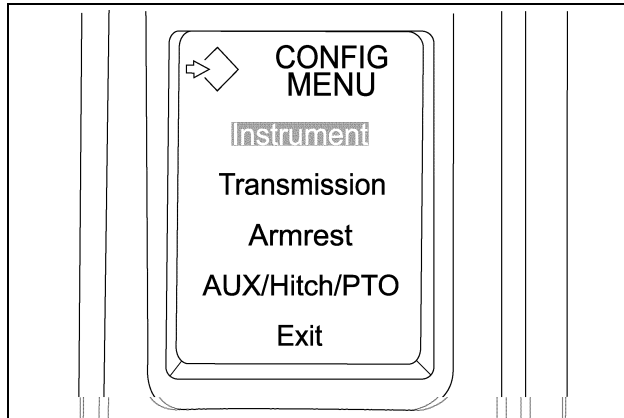
The display will read **TRANS EXIT**. Press the **PROG** key to exit.

## Trans View Mode

**NOTE:** Calibration can only be entered by pressing and holding the **PROG** key within the first 10 seconds of starting the tractor.

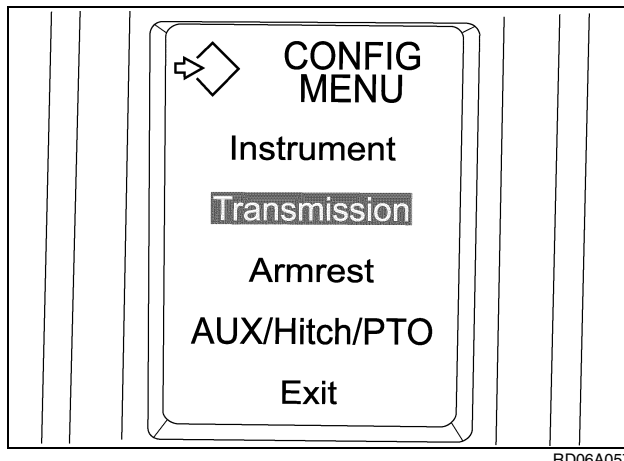
**NOTE:** If any fault codes are recorded, they must be cleared before calibration is possible. Retrieve, record and clear any fault codes. See Fault Code Retrieval in this section.

### STEP 9



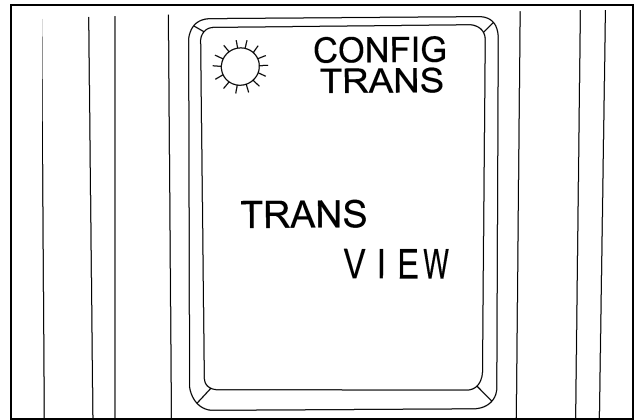
Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.

### STEP 10



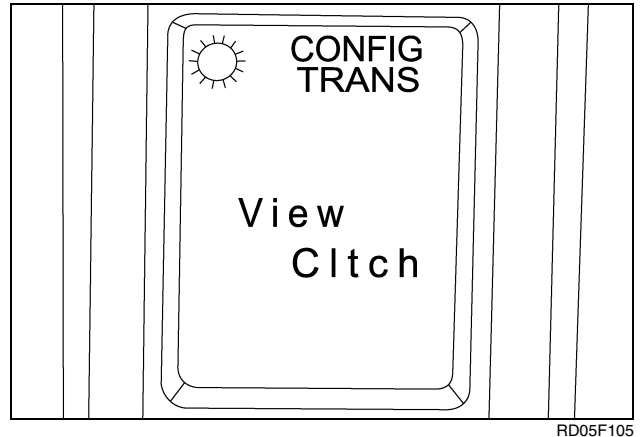
Push the **DECR** key until the display reads **TRANSMISSION** and press the **PROG** key again.

### STEP 11



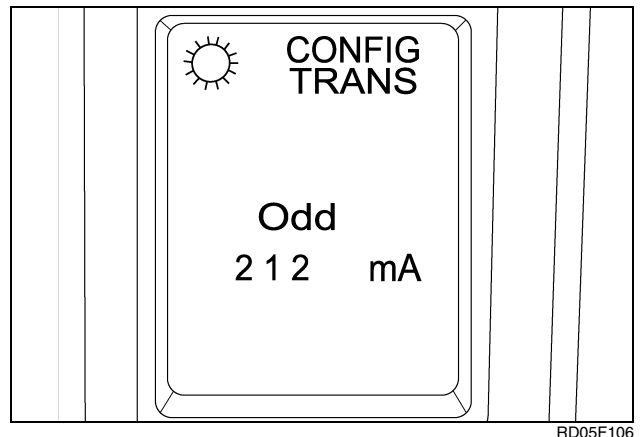
The display will read **TRANS VIEW**. Press the **PROG** key to enter the Transmission View Menus.

### STEP 12



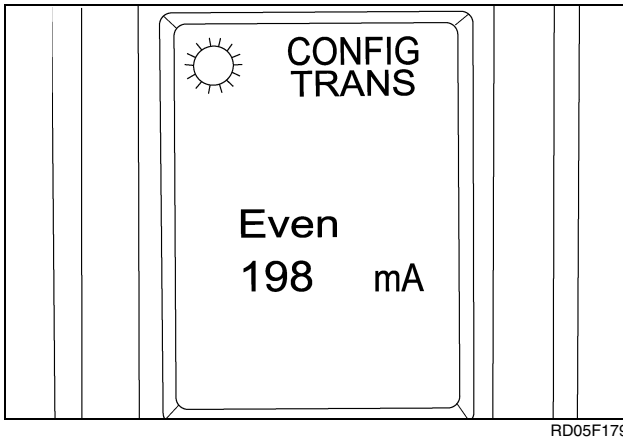
The display will read **VIEW CLTCH**. Push the **PROG** key.

### STEP 13



The display will read **ODD mA**. This displays the calibrated clutch current values in milliamps. The Odd clutch current value is displayed first. Push the **DECR** key.

#### STEP 14

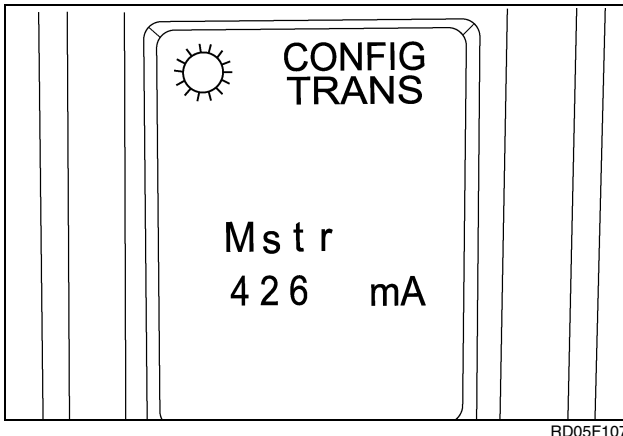


RD05F179

The display will read **EVEN mA**. This displays the calibrated clutch current values in milliamps. Continue pushing the **DECR** key to display the calibrated clutch current values for C/O, C1, C3, C5, LOW, MID, HIGH, REV and MSTR clutch.

**NOTE:** Pushing the **PROG** key at any point will return you to the upper level menu, **VIEW CLTCH**.

#### STEP 15

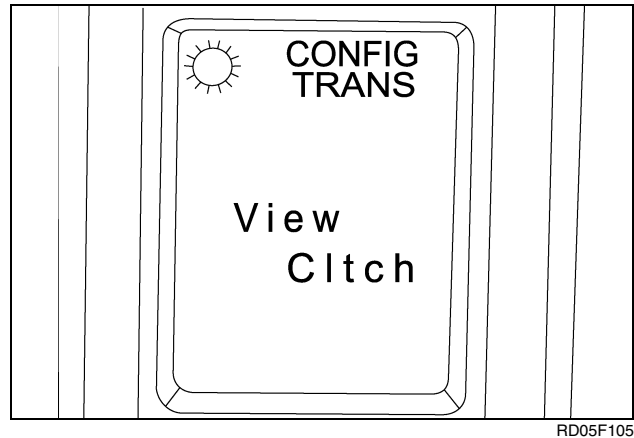


RD05F107

The Master Clutch milliamp reading is the final readout. Push the **PROG** key.

**NOTE:** If you continue to push the **DECR** key the display will start through the menu again starting with the Odd clutch mA reading.

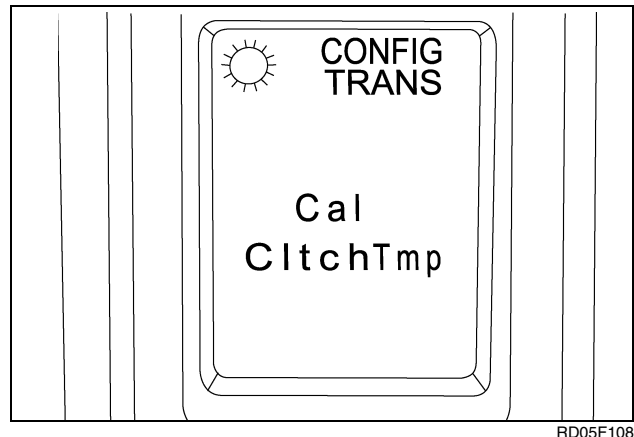
#### STEP 16



RD05F105

The display will return to **VIEW CLTCH**. To display the next Transmission View Menu push the **DECR** key.

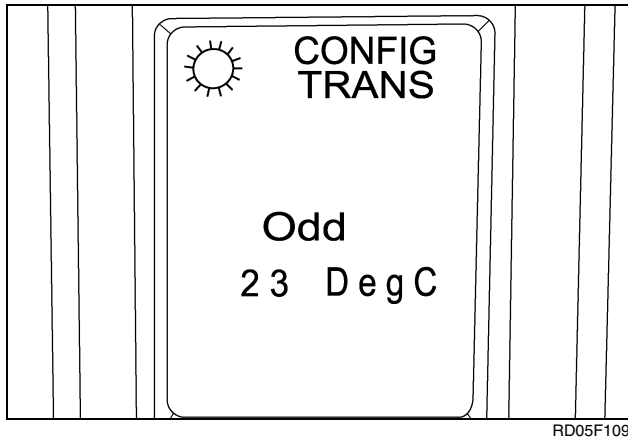
#### STEP 17



RD05F108

The display will read **CAL CLTCHTMP**. The Calibration Clutch Temperature View Menu shows the clutch temp at which the calibration was performed. Push the **PROG** key.

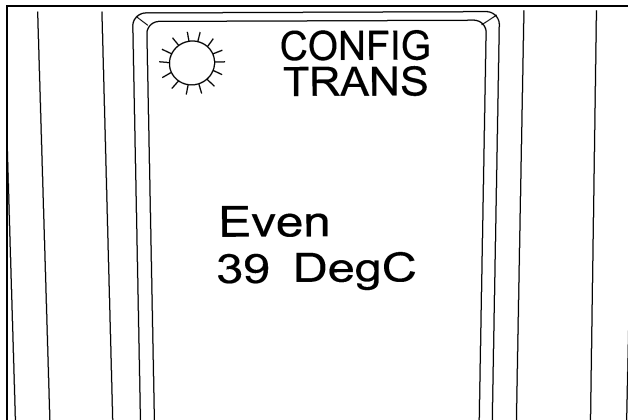
### STEP 18



RD05F109

The display will read **ODD DEGC**. The Calibration Clutch Temperature View Menu shows the clutch temp at which the calibration was performed. Push the **DECR** key.

### STEP 19



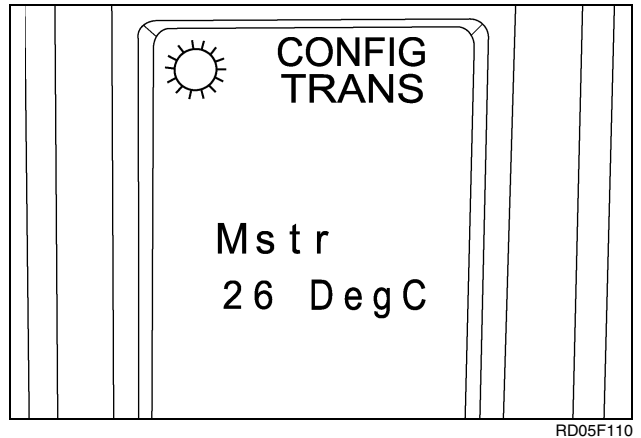
RD05G008

The display will read **EVEN DEGC**. The Calibration Clutch Temperature View Menu shows the clutch temp at which the calibration was performed.

Continue pushing the **DECR** key to display the calibrated clutch temperature values for C/O, C1, C3, C5, LOW, MID, HIGH, REV and MSTR clutch.

**NOTE:** Pushing the **PROG** key at any point will return you to the upper level menu, **CAL CLTCHTMP**.

### STEP 20

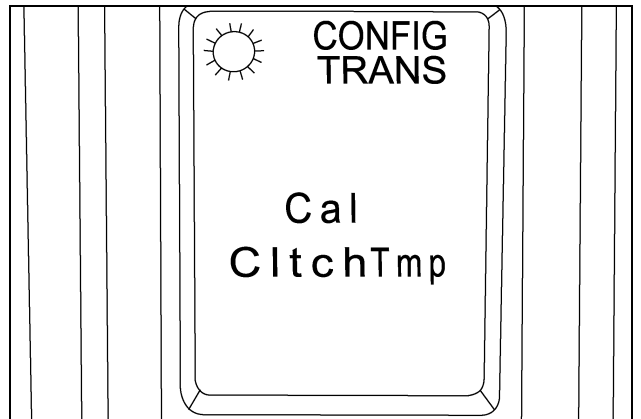


RD05F110

The Master Clutch temperature display reading is the final readout. Push the **PROG** key.

**NOTE:** If you continue to push the **DECR** key the display will start through the menu again starting with the **Odd** clutch temp reading.

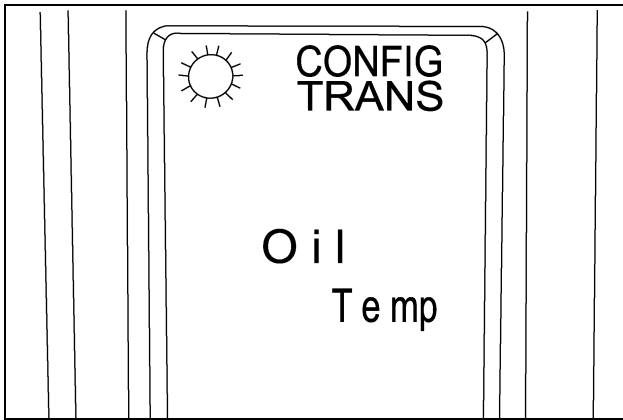
### STEP 21



RD05F108

The display will return to **CAL CLTCHTMP**. To display the next Transmission View Menu push the **DECR** key.

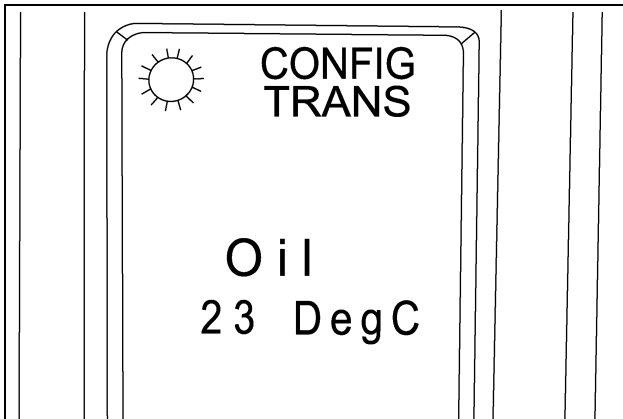
## STEP 22



RD05F111

The display will read **OIL TEMP**. Push the **PROG** key.

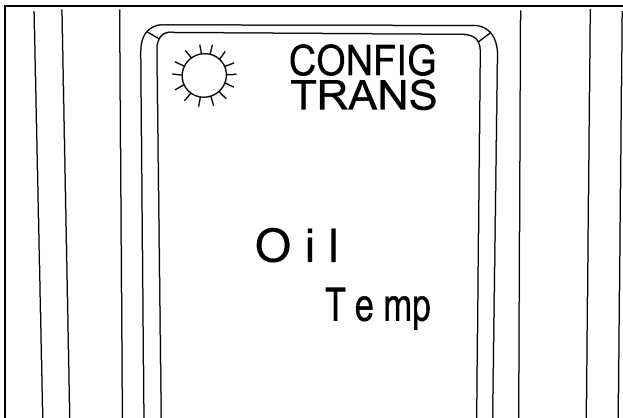
## STEP 23



RD05F112

The display will read **OIL DEGC**. This is the actual transmission oil temperature. Pres the **PROG** key.

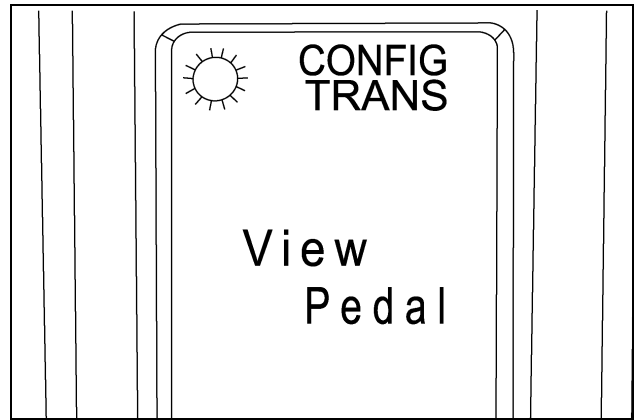
## STEP 24



RD05F111

The display returns to **OIL TEMP** display. To display the next Transmission View Menu push the **DECR** key.

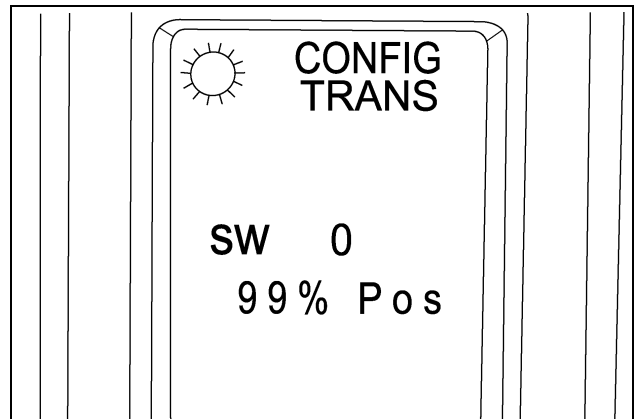
## STEP 25



RD05F113

The display will read **VIEW PEDAL**. The Clutch Pedal View Menu displays the position of the clutch. Push the **PROG** key.

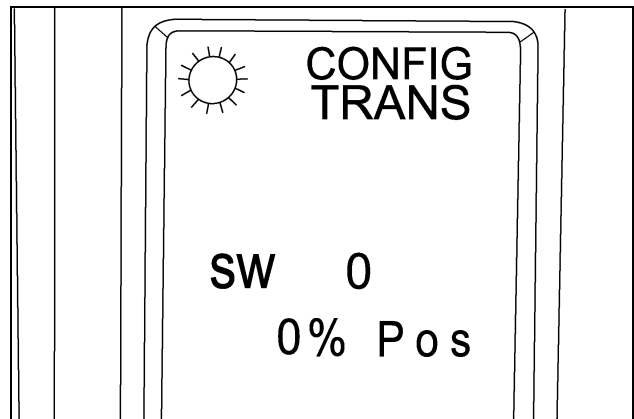
## STEP 26



RD05F114

The current pedal position is displayed, 100% for inching pedal up (top of clutch). Depress the inching pedal to the floor.

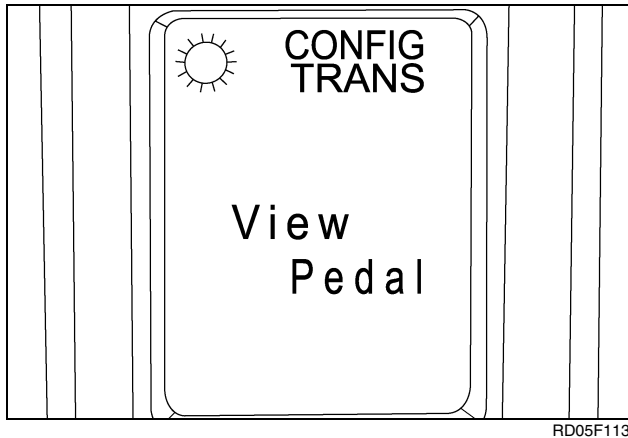
## STEP 27



RD05F115

The display will read 0% for inching pedal to the floor (bottom of clutch). Release pedal and push the **PROG** key.

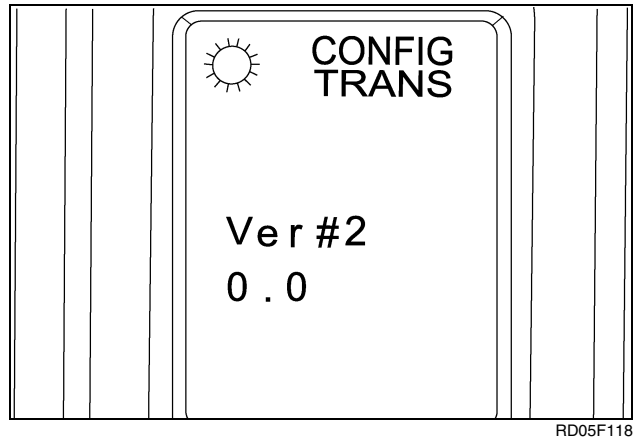
**STEP 28**



RD05F113

The display will again read **VIEW PEDAL**. To display the next Transmission View Menu push the **DECR** key.

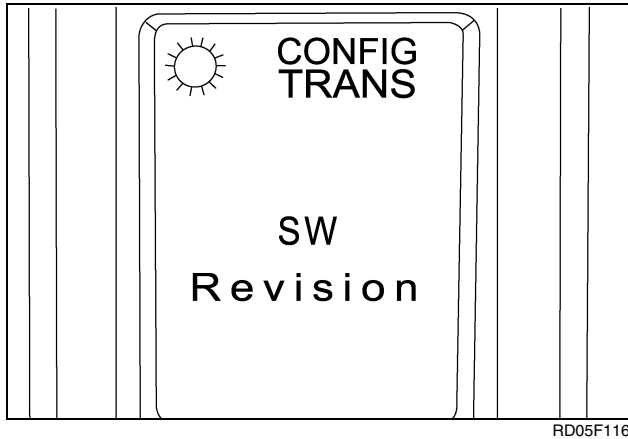
**STEP 31**



RD05F118

The display will read **VER#2**. Version #2 is the engineering software version numbers. Push the **PROG** key.

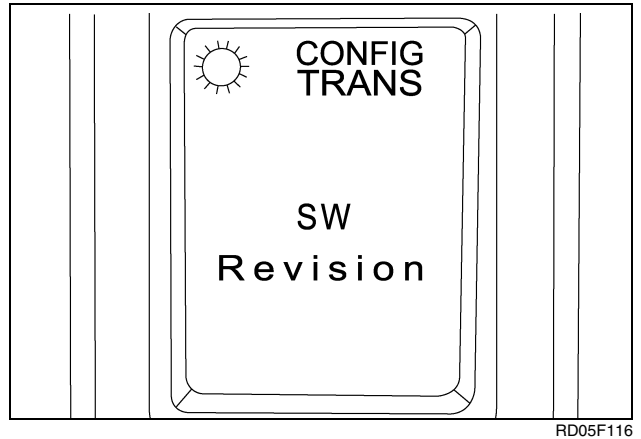
**STEP 29**



RD05F116

The display will read **SW REVISION**. This is the Software Revision View Menu. Push the **PROG** key.

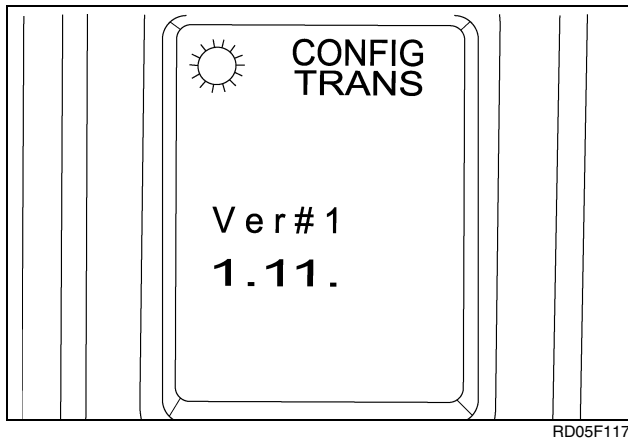
**STEP 32**



RD05F116

The display will again read **SW REVISION**. To display the next Transmission View Menu push the **DECR** key.

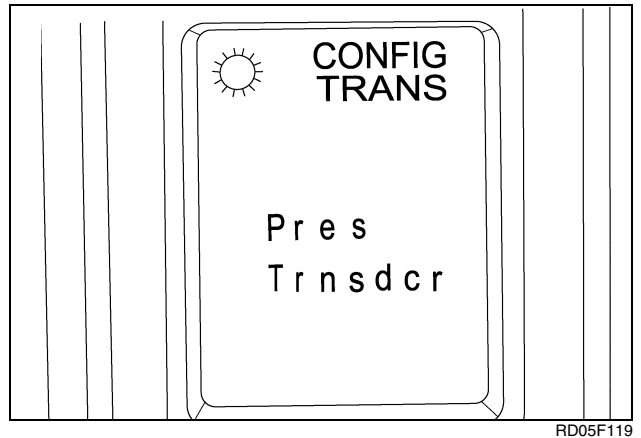
**STEP 30**



RD05F117

The display will read **VER#1**. Version #1 is the major software version number, the lower number (1.11.) is the minor software version number. Push the **DECR** key.

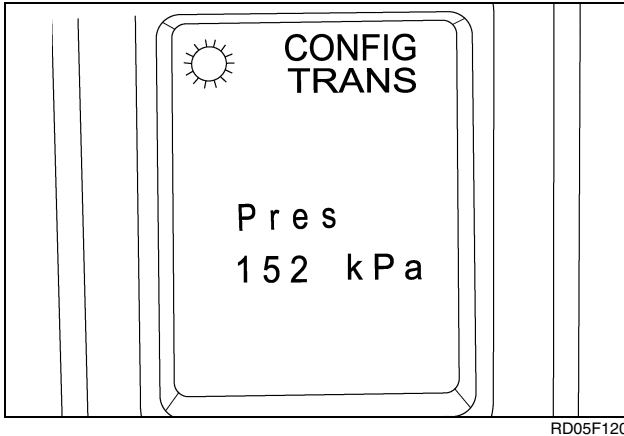
**STEP 33**



RD05F119

The display will read **PRES TRNSDCR**. This menu leads to the transmission system pressure display. Push the **PROG** key.

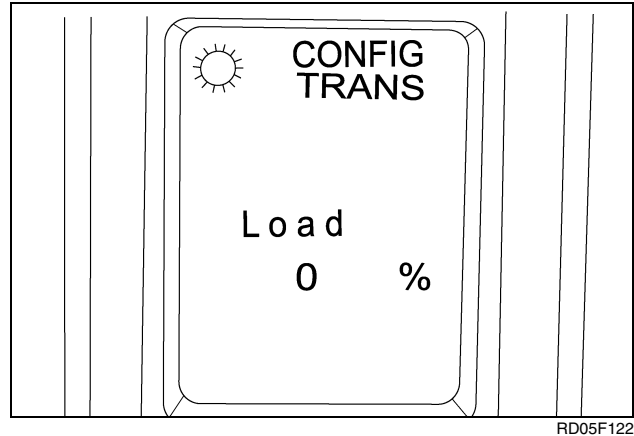
### STEP 34



RD05F120

The display will read **PRES KPA**. This is the Transmission System Pressure. Push the **PROG** key.

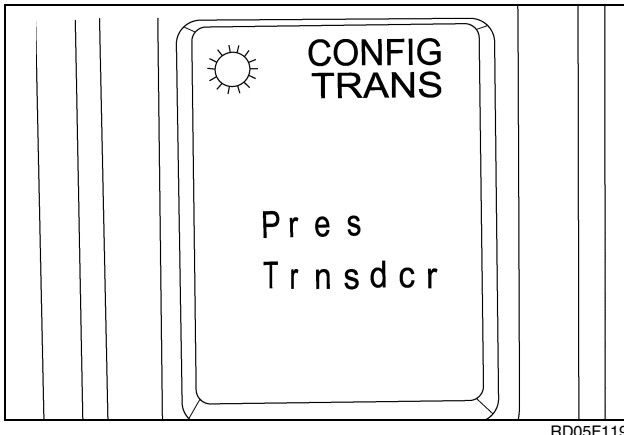
### STEP 37



RD05F122

The display will read **LOAD %**. The engine load is displayed in percentage related to the engine torque. Push the **PROG** key.

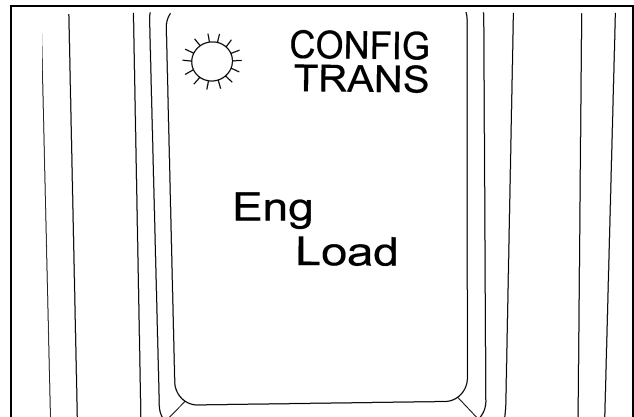
### STEP 35



RD05F119

The display will again read **PRES TRNSDCR**. To display the next Transmission View Menu push the **DECR** key.

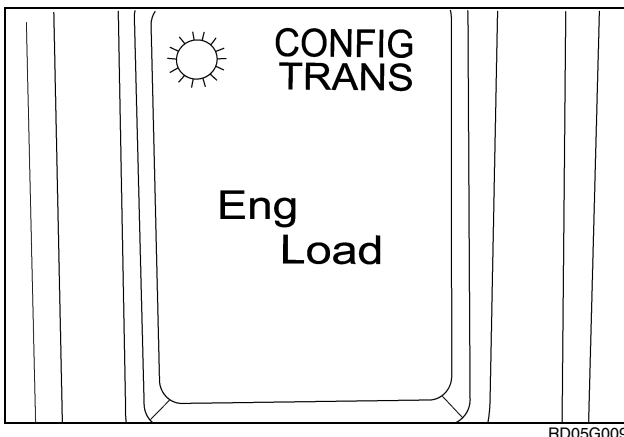
### STEP 38



RD05G009

The display will again read **ENG LOAD**. To display the next Transmission View Menu push the **DECR** key.

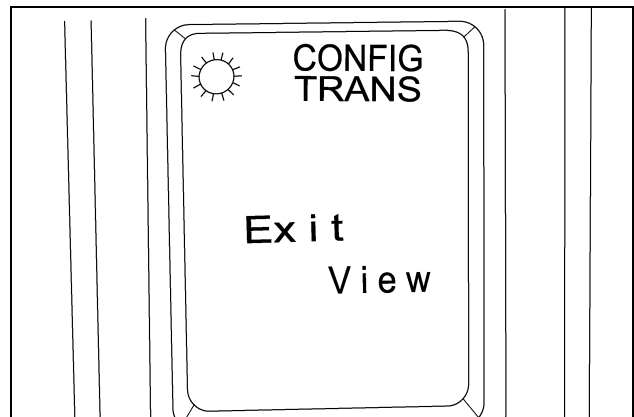
### STEP 36



RD05G009

The display will read **LOAD**. This is the engine load display. Push the **PROG** key.

### STEP 39



RD05F124

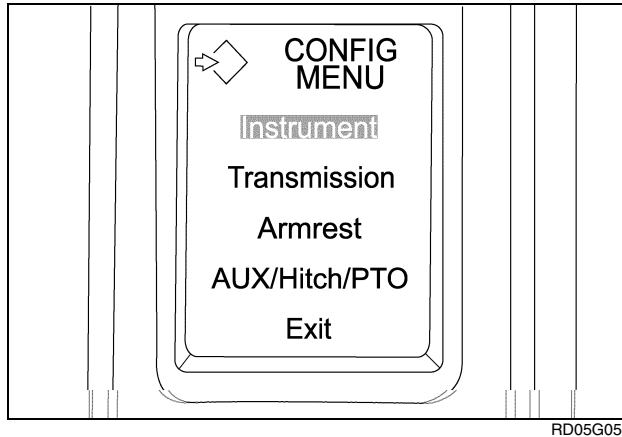
The display will read **EXIT VIEW**. Push the **PROG** key to exit. Press the **DECR** key to return to the first item in menu.

## Trans Setup Mode

**NOTE:** Calibration can only be entered by pressing and holding the **PROG** key within the first 10 seconds of starting the tractor.

**NOTE:** If any fault codes are recorded, they must be cleared before calibration is possible. Retrieve, record and clear any fault codes. See *Fault Code Retrieval* in this section.

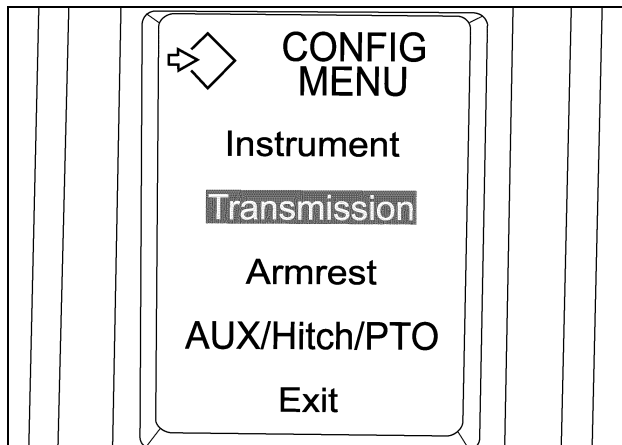
### STEP 40



RD05G056

Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.

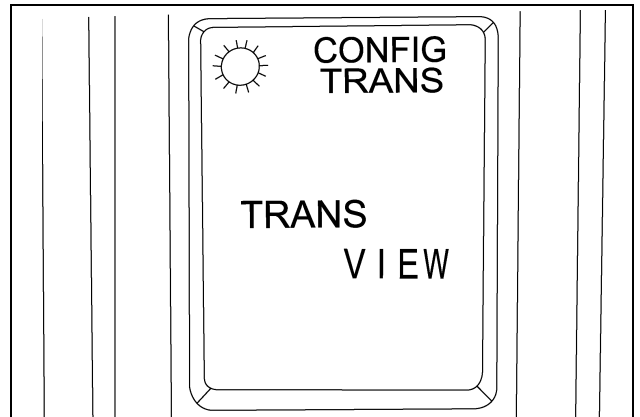
### STEP 41



RD06A057

Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

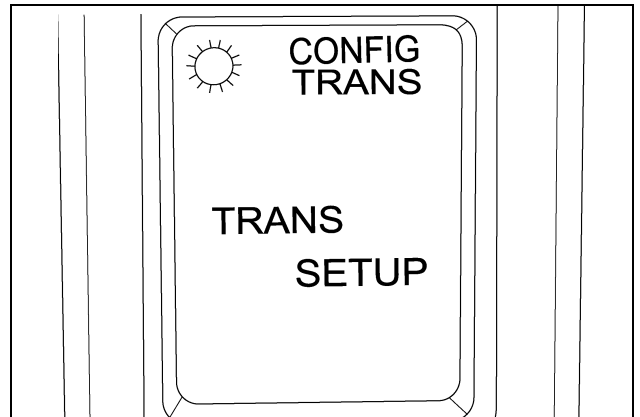
### STEP 42



RD05F104

The display will read **TRANS VIEW**. Press **DECR** key.

### STEP 43

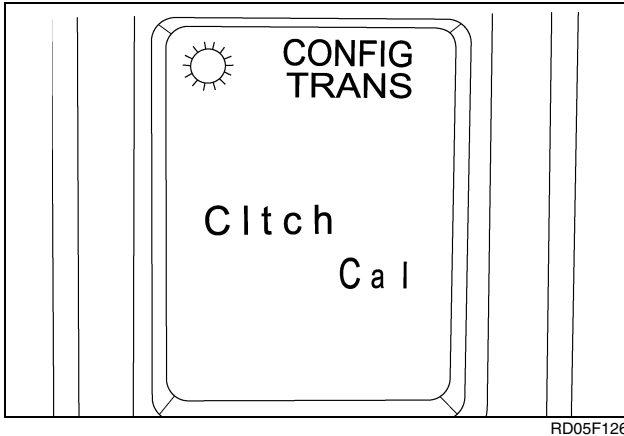


RD05F125

The display will read **TRANS SETUP**. Press **PROG** key.



#### STEP 44



RD05F126

The display will read **CLTCH CAL**. See the Clutch Calibration Procedure. To see the next setup menu press the **DECR** key.

**NOTE:** The display will go directly to Step 48, **GEAR DEFAULT**, unless the Electronic Service Tool (EST) is in use.

#### STEP 45

The display will read **RESET NVM**. To see the next setup menu press the **DECR** key.

**IMPORTANT:** The **RESET NVM** menu will only appear when the Electronic Service Tool (EST) is in use. Do Not enter this menu. Press the **DECR** key.

#### STEP 46

The display will read **SETUP BKUP ALM**. To see the next setup menu press the **DECR** key.

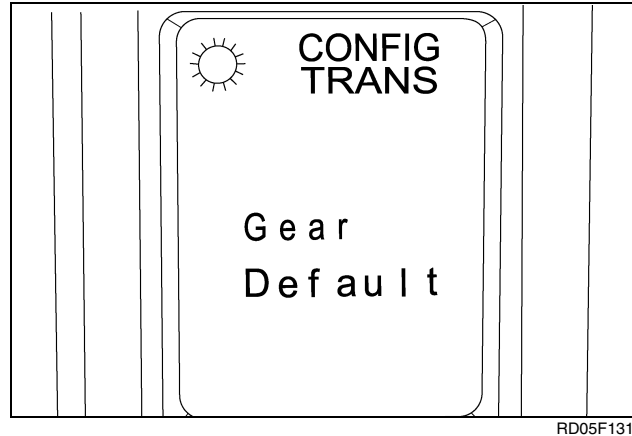
**IMPORTANT:** The **SETUP BKUP ALM** menu will only appear when the Electronic Service Tool (EST) is in use. Do Not enter this menu. Press the **DECR** key.

#### STEP 47

The display will read **SETUP FSUS**. To see the next setup menu press the **DECR** key.

**IMPORTANT:** The **SETUP FSUS** menu will only appear when the Electronic Service Tool (EST) is in use. To see the next setup menu press the **DECR** key.

#### STEP 48



RD05F131

The display will read **GEAR DEFAULT**. See the Gear Default Mode in this section. Press **DECR** key.

#### STEP 49

The display will read **EXIT SETUP**. Press **PROG** key to exit.

## Clutch Calibration Procedure

**NOTE:** Calibration can only be entered by pressing and holding the **PROG** key within the first 10 seconds of starting the tractor.

**NOTE:** If any fault codes are recorded, they must be cleared before calibration is possible. Retrieve, record and clear any fault codes.

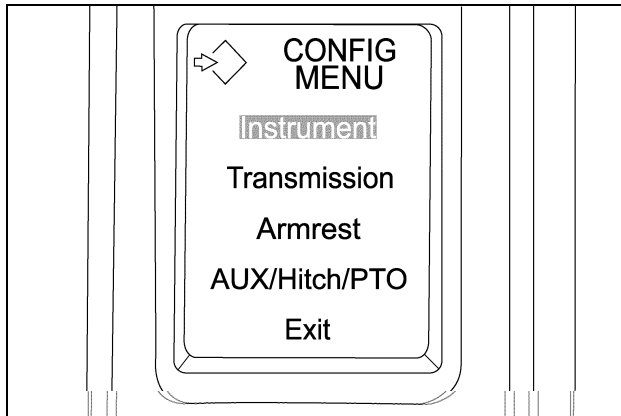


**WARNING:** Since the valve calibration process involves engaging transmission clutches, this procedure should only be performed in open areas, free of obstructions. The tractor may experience a small amount of movement during calibration and the tractor operator should be ready to stop the tractor at any time.

M588

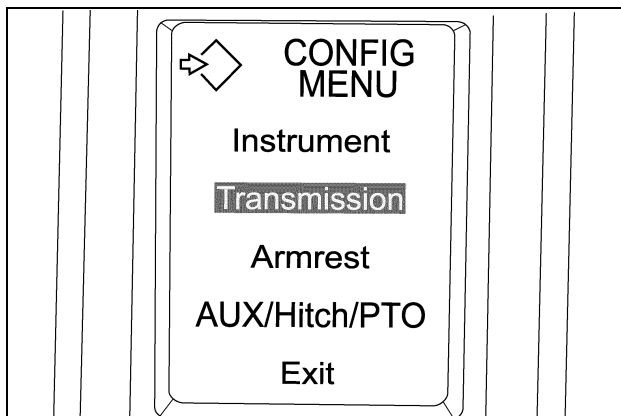
### STEP 50

Start the tractor. The tractor must be running to perform clutch calibration procedure. The transmission oil temperature should be above 60 degrees C (140 degrees F) for the calibration procedure.



RD05G056

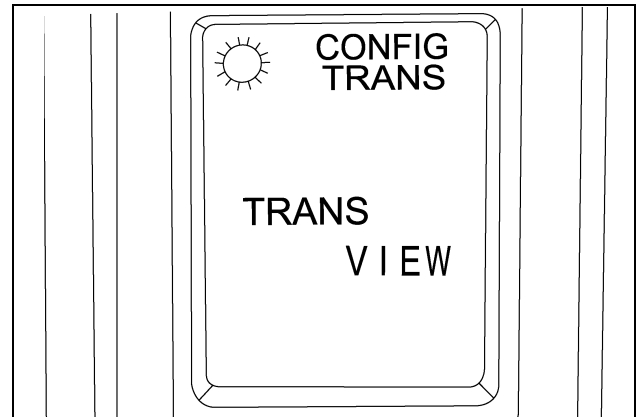
Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.



RD06A057

Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

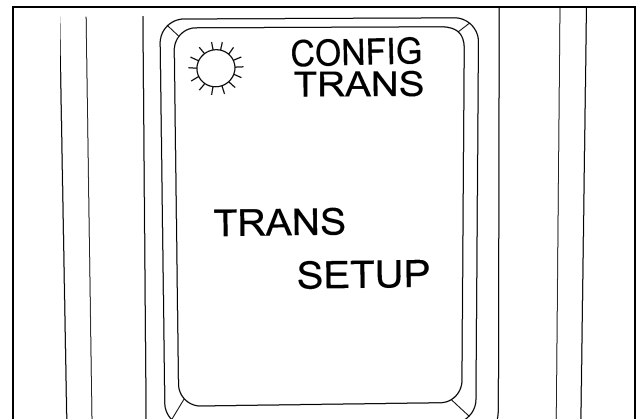
### STEP 51



RD05F104

When the **TRANS VIEW** menu is displayed, push the **DECR** key.

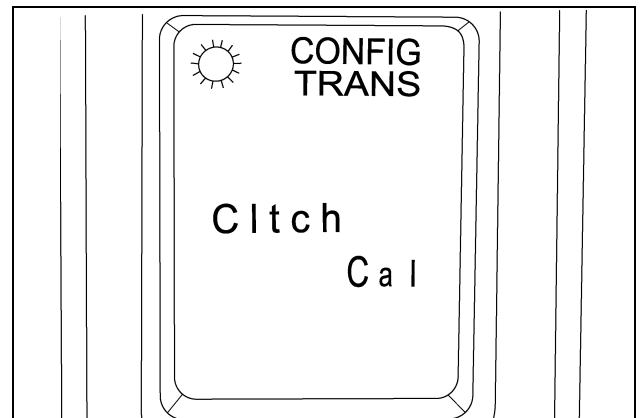
### STEP 52



RD05F125

The display will read **TRANS SETUP**. Press the **PROG** key to enter the Transmission Setup Menus.

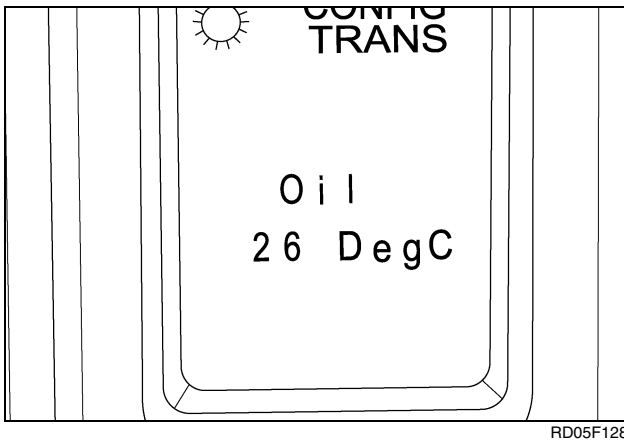
### STEP 53



RD05F126

The display will read **CLTCH CAL**. Push the **PROG** key.

### STEP 54

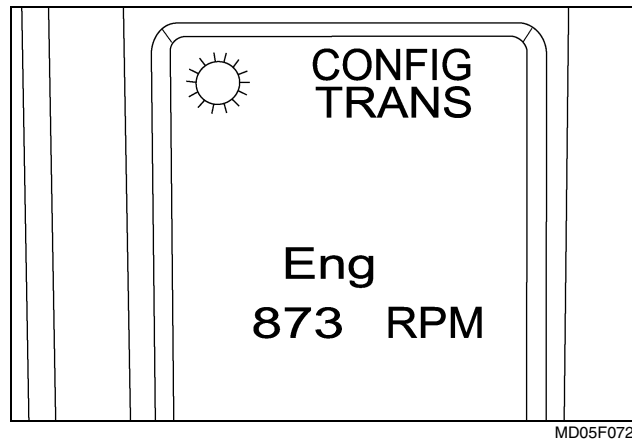


RD05F128

The display will read **OIL DEGC**. The transmission oil temp should be between 60 and 105 degrees C (140 to 221 degrees F). Push the **PROG** key.

**NOTE:** If the temperature was not in range see Step 55. If the transmission oil temperature was in the proper range see Step 56.

### STEP 56

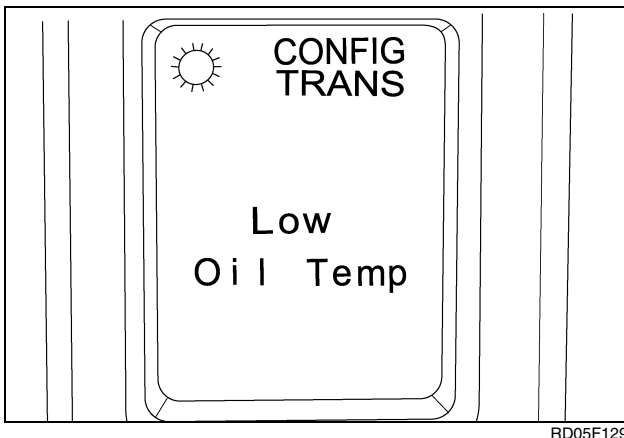


MD05F072

The display will read **ENG RPM**. Increase the engine RPM to 1100 to 1300 RPM. Push the **PROG** key.

**NOTE:** If the program key is pushed when the RPM is not in the proper range The display will read **CAL ABORTED**. Pushing the **PROG** key again will display **CAL EXIT**. To continue the calibration procedure push the **PROG** key.

### STEP 55



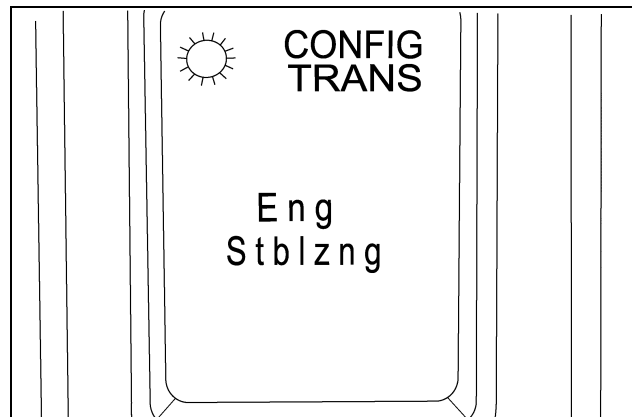
RD05F129

If the transmission oil temp is below 60 degrees C the **LOW OIL TEMP** message will be displayed for 4 seconds. The display will then return to the oil temperature display.

**NOTE:** If the **PROG** key is pressed when **LOW OIL TEMP** is on display the calibration procedure may be continued. Calibration at a lower temperature should only be performed when the recommended temperature range cannot be achieved.

**NOTE:** If the oil temp is above 105 degrees C the display will read **HOT OIL TEMP**, if the oil temp is below 10 degrees C the display will read **COLD OIL TEMP**. The display will return to oil temperature display after 4 seconds.

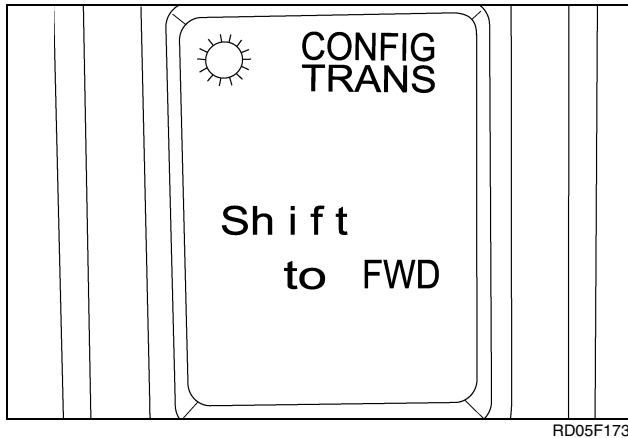
### STEP 57



RD05G016

The display will now read **ENG STBLZNG**. After several seconds the display will change.

### STEP 58



RD05F173

The display will read **SHIFT TO FWD**. Shift the transmission control lever to FWD.



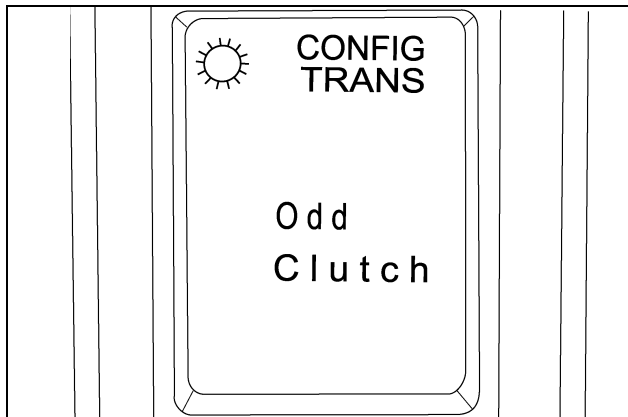
**WARNING:** *Since the valve calibration process involves engaging transmission clutches, this procedure should only be performed in open areas, free of obstructions. The tractor may experience a small amount of movement during calibration and the tractor operator should be ready to stop the tractor at any time.*

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### STEP 59

If the inching pedal is not up, the display will read **PEDAL UP**. Move inching pedal to up position.

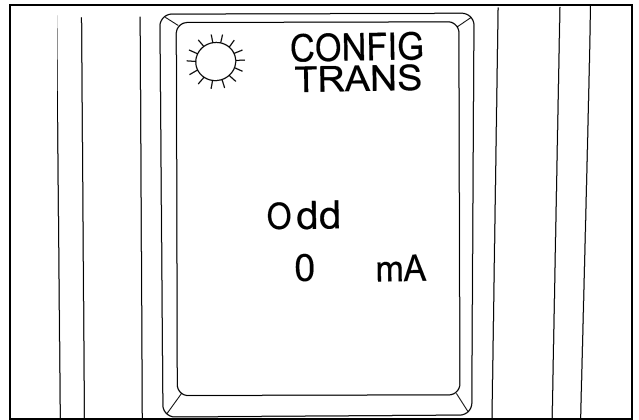
### STEP 60



RD05F174

The display will now read **ODD CLUTCH**. Push the **PROG** key once.

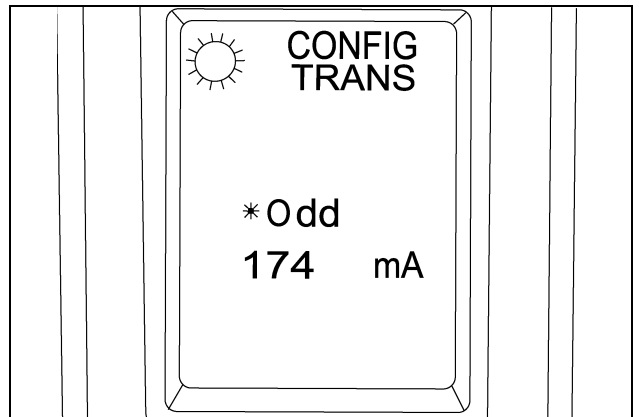
### STEP 61



RD05F182

The display will read **Odd mA**. The tractor transmission controller will automatically run through the Odd clutch calibration procedure.

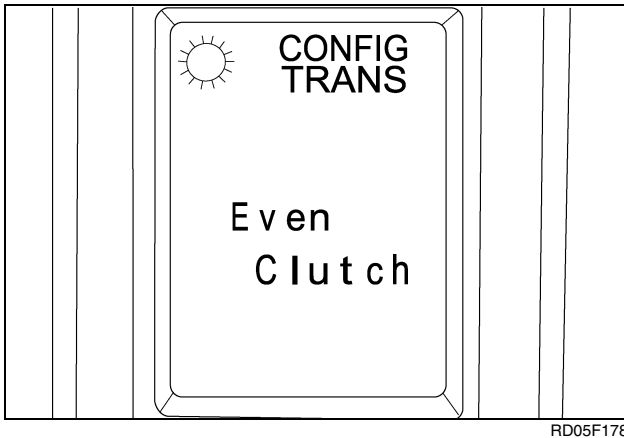
### STEP 62



RD05F175

The display will read **\*ODD mA** when the Odd clutch calibration is completed. Push the **PROG** key.

### STEP 63



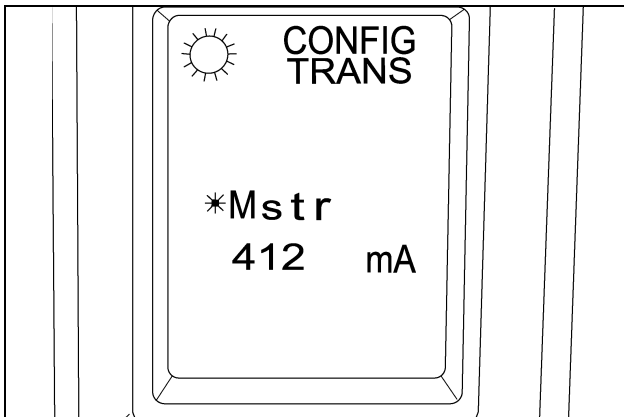
RD05F178

The display will read **EVEN CLUTCH**. Push the **PROG** key and the tractor transmission controller will automatically run through the Even clutch calibration procedure.

The display will read \*EVEN mA when the Even clutch calibration is completed. Push the **PROG** key.

Repeat this procedure to calibrate the C1, C3, C5, LOW, MID, HIGH, REV and MSTR clutch.

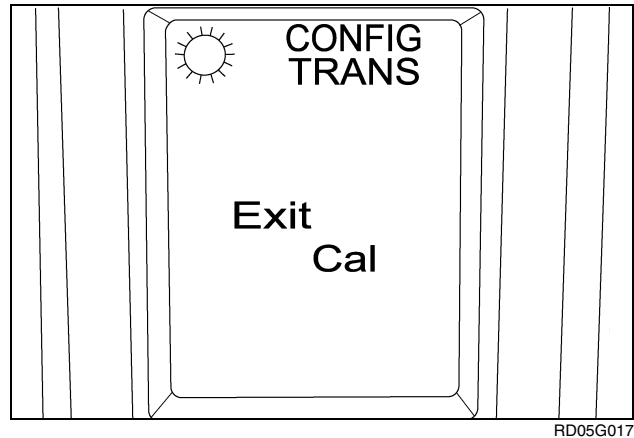
### STEP 64



RD05F186

After performing the calibration procedure on all clutches the display will now read **\*MSTR mA**. Push the **PROG** key once.

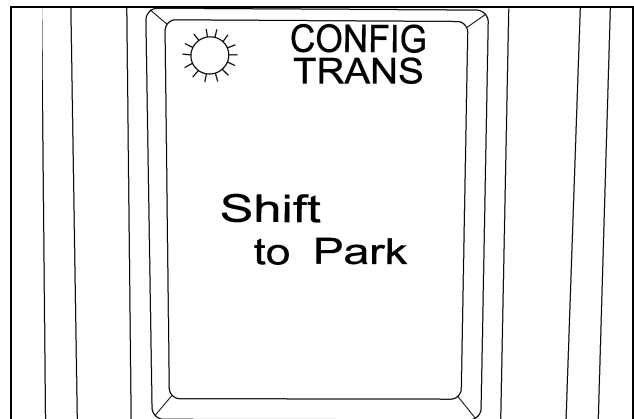
### STEP 65



RD05G017

The display will now read **EXIT CAL**. Push the prog key once.

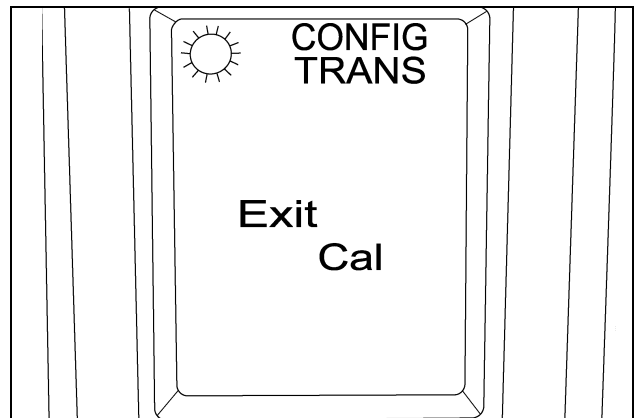
### STEP 66



RD05G018

The display will now read **SHIFT TO PARK**. Shift the transmission control lever into PARK position.

### STEP 67



RD05G017

The display will now read **EXIT CAL** again.

Reduce engine speed to low idle. Turn ignition switch to **OFF** position. The calibration will be saved when the tractor is shutdown.

## Calibration Error Messages

Listed below are calibration error messages that can appear during a calibration failure.

**POT OPEN CKT:** Potentiometer open circuit or disconnected.

**POT HIGH VAL:** Potentiometer is higher than safety value.

**POT SHRT CKT:** Potentiometer short circuit.

**POT LOW VAL:** Potentiometer is lower than safety value.

**SLOW UP MVMNT:** Not moved over a certain time when raising.

**SLOW TO MAX:** Maximum position not reached in time.

**SLOW DN MVMNT:** Not moved over a certain time when lowering.

**SLOW TO MIN:** Minimum position not reached in time.

**NOT CAL:** Front suspension not calibrated.

**TRCTR MOVING:** Tractor moving when calibrating.

## Gear Default Mode

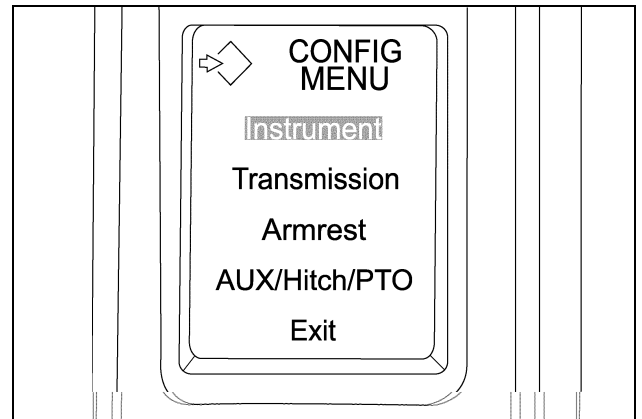
When a tractor is started up and shifted into Forward the default gear is 7th. If shifted into Reverse the default gear is 2nd. Follow this procedure to change the Forward, or Reverse default gear settings.

Forward gear default can be set for 1st through 13th gear. Reverse gear default can be set for 1st through 4th gear.

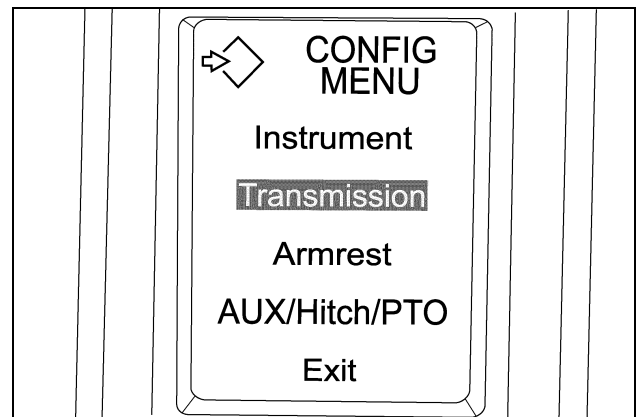
Calibration can only be entered by pressing and holding the **PROG** key within the first 10 seconds of starting the tractor.

**NOTE:** Do not perform this procedure with the Electronic Service Tool in use.

## STEP 68

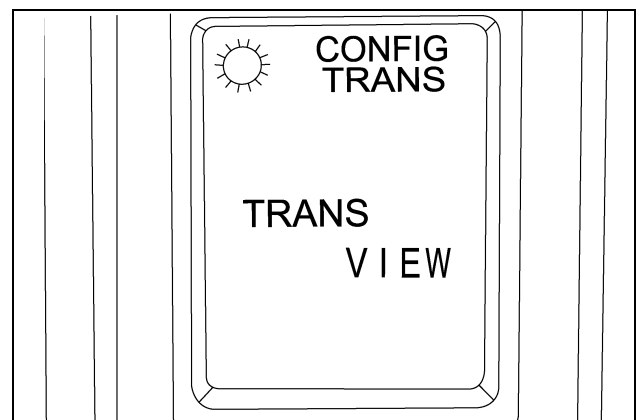


Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.



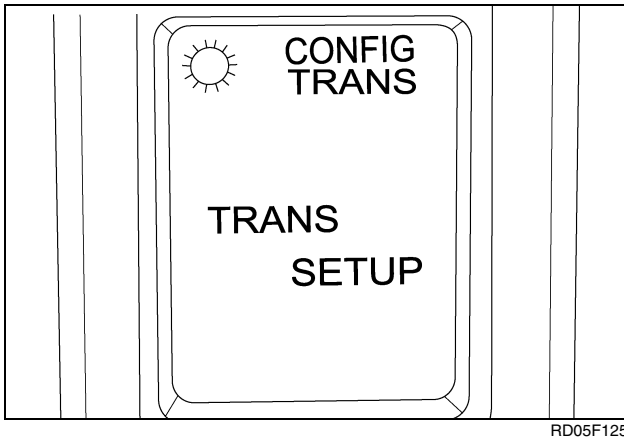
Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

## STEP 69



When the **TRANS VIEW** menu is displayed, push the **DECR** key.

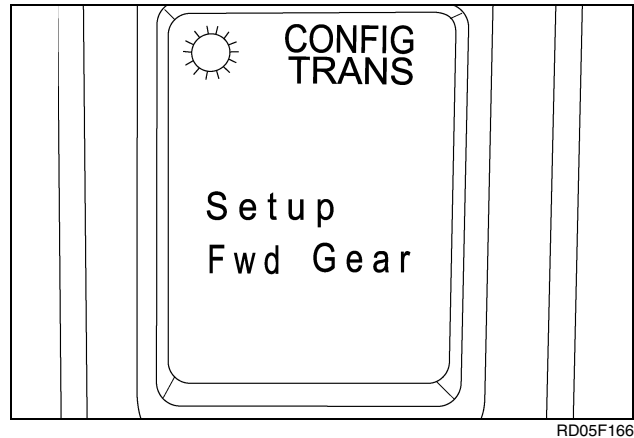
### STEP 70



RD05F125

The display will read **TRANS SETUP**. Press the **PROG** key to enter the Transmission Setup Menus.

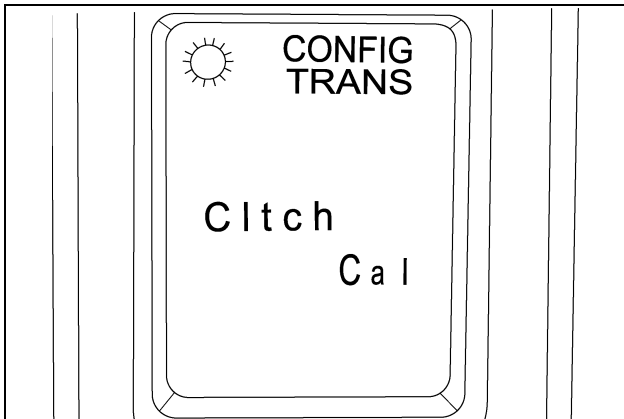
### STEP 73



RD05F166

The display will read **SETUP FWD GEAR**. Push the **PROG** key

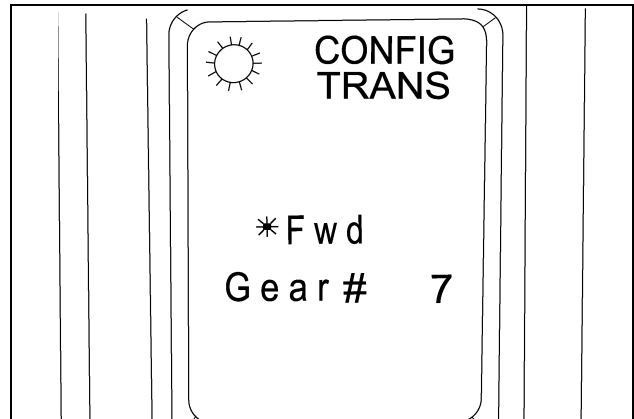
### STEP 71



RD05F126

The display will read **CLTCH CAL**. Push the **DECR** key.

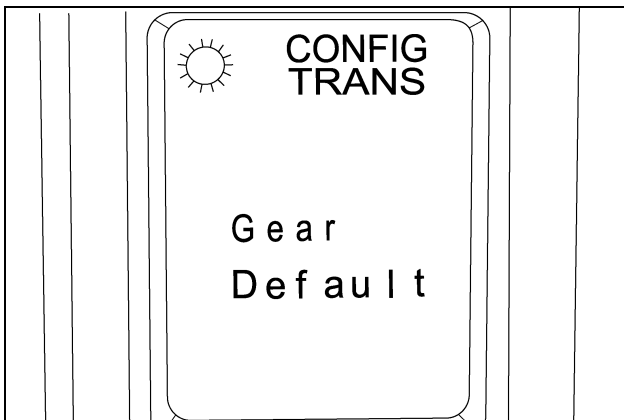
### STEP 74



RD05F167

The display will read **\*FWD GEAR# 7**. Press the **INCR** key to increase the gear number, or press the **DECR** key to decrease the gear number. If no change is desired leave gear number as it is. Press the **PROG** key when desired gear number is set.

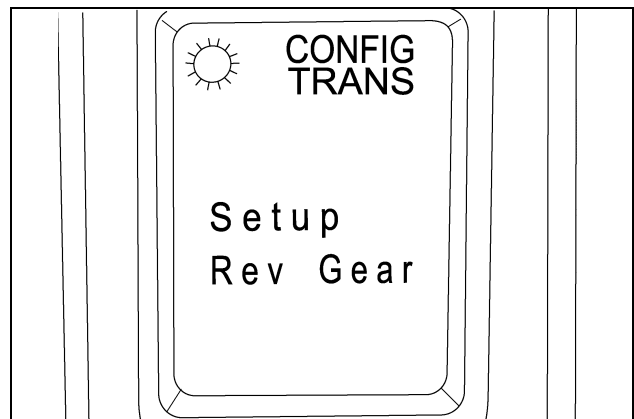
### STEP 72



RD05F131

The display will read **GEAR DEFAULT**. Push the **PROG** key.

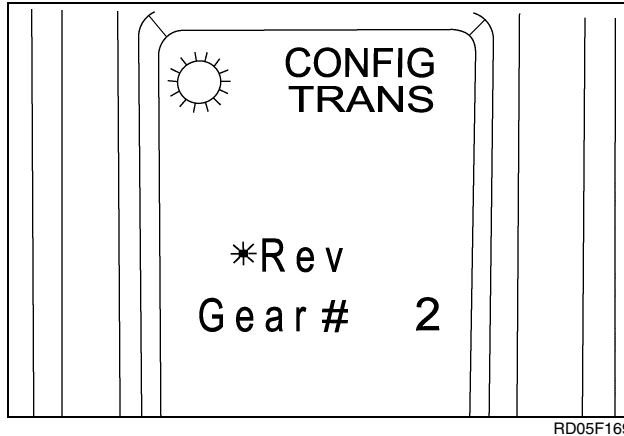
### STEP 75



RD05F168

The display will read **SETUP REV GEAR**. Push the **PROG** key.

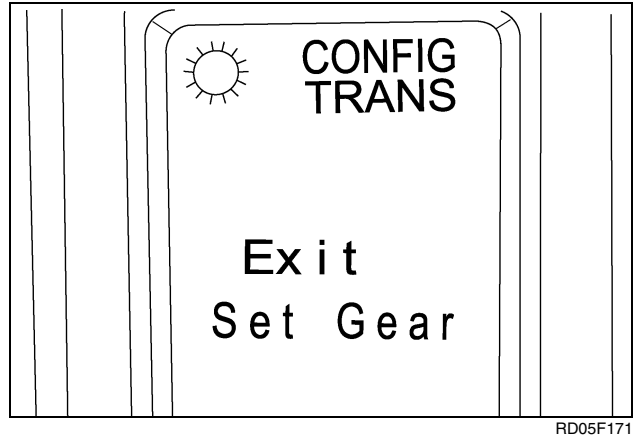
**STEP 76**



RD05F169

The display will read **\*REV GEAR# 2**. Press the **INCR** key to increase the gear number, or press the **DECR** key to decrease the gear number. If no change is desired leave gear number as it is. Press the **PROG** key when desired gear number is set.

**STEP 77**



RD05F171

The display will read **EXIT SET GEAR**. Press the **PROG** key to exit this menu.

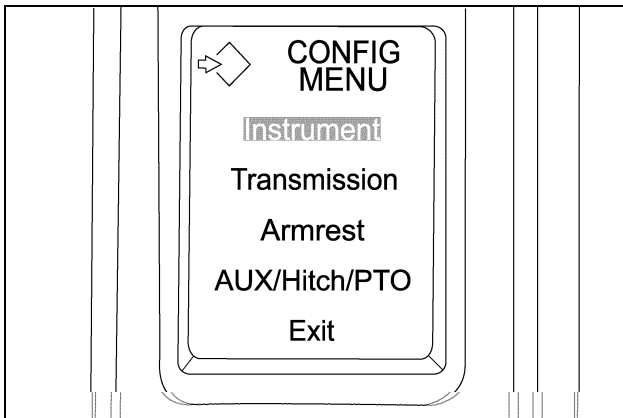


## Front Suspension Installation Menu

This menu allows the user to install, or remove the FSUS (Front Suspension).

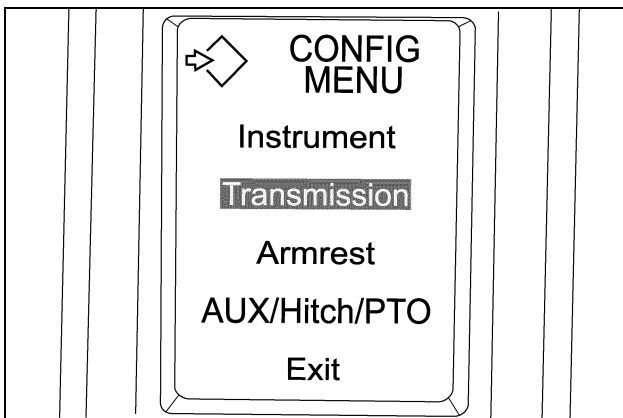
**NOTE:** This menu will only work when the Electronic Service Tool is in use.

### STEP 78



RD05G056

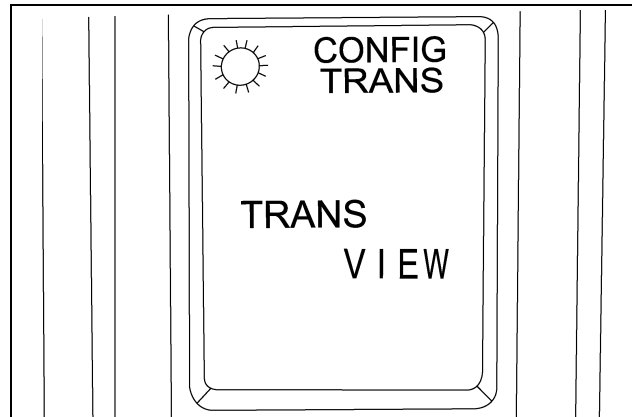
Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.



RD06A057

Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

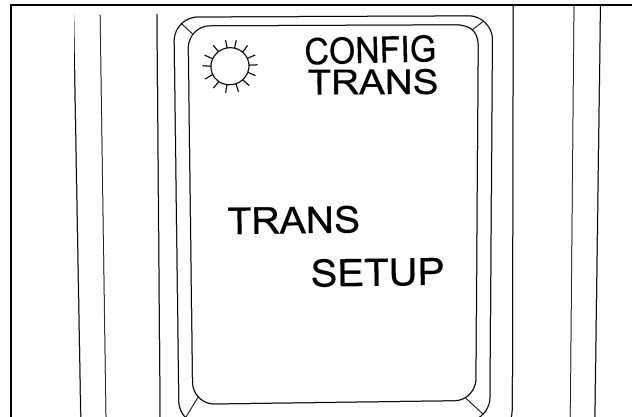
### STEP 79



RD05F104

When the **TRANS VIEW** menu is displayed, push the **DECR** key.

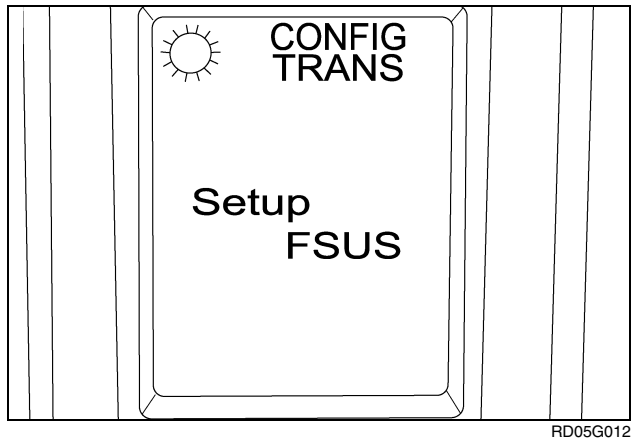
### STEP 80



RD05F125

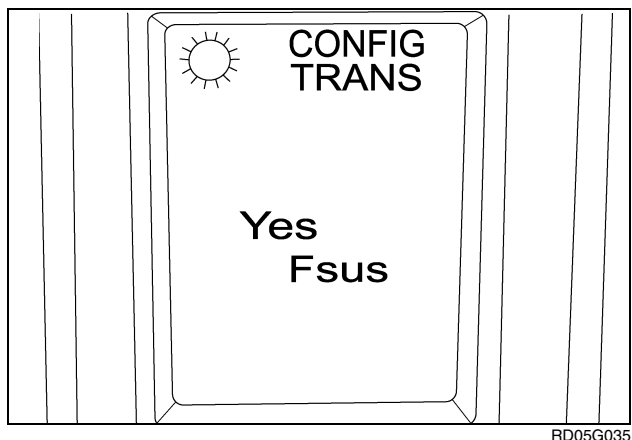
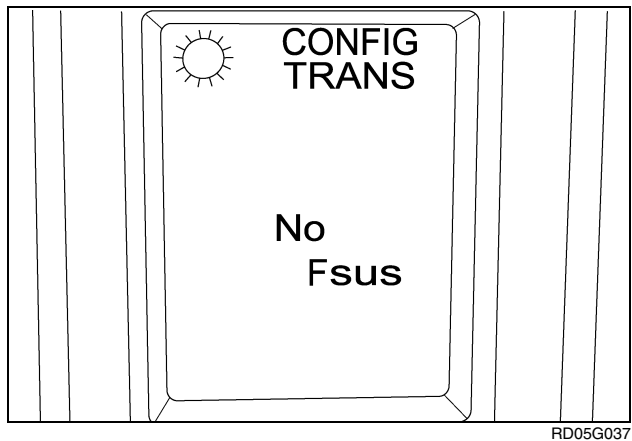
The display will read **TRANS SETUP**. Press The **PROG** key to enter the Transmission Setup Menus.

### STEP 81



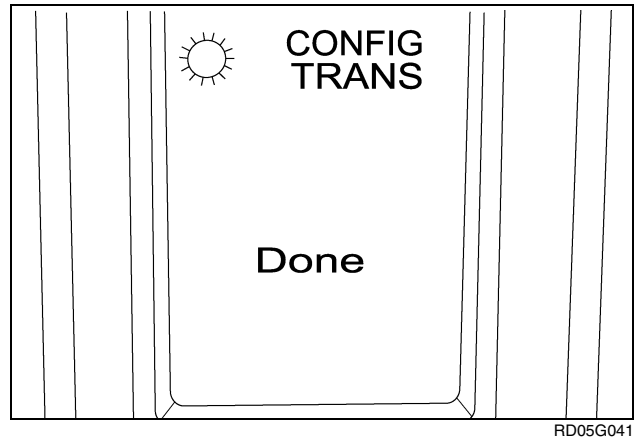
Press the **DECR** key multiple times until **SETUP FSUS** is displayed. Press the **PROG** key to enter the Menu.

### STEP 82



The display will read **NO FSUS**, or **YES FSUS**. To change status press **INCR** or **DECR** key. When the status is correct press **PROG** key.

### STEP 83



The display will read **DONE**. After 1 second the display exits this menu.

## Front Suspension Menus

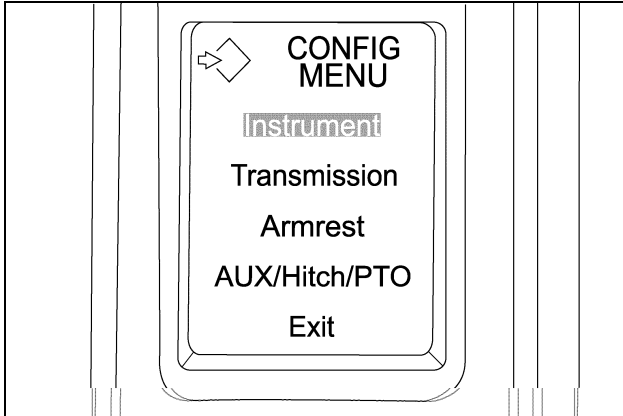
The following menus are available for the Front Suspension.

1. **FSUS CAL** - This menu allows the user to Calibrate the Front Suspended axle.
2. **FSUS DEMO** - This menu can only be accessed when the Electronic Service Tool (EST) is in use on the tractor. It allows the user to switch the Front Suspended Axle ON or OFF especially at speeds greater than 12 KMH.
3. **FSUS MANUAL** - This menu allows the operator to manually operate the Front Suspension. The axle may be raised or lowered when the tractor is stationary.
4. **EXIT FSUS**- This menu entry will exit the Front Suspension Menus.

## Front Suspension Calibration

**NOTE:** This menu will only work when the Electronic Service Tool is in use.

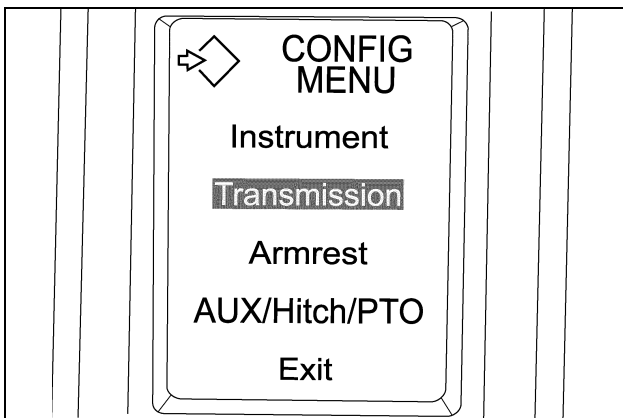
### STEP 84



RD05G056

Start the engine.

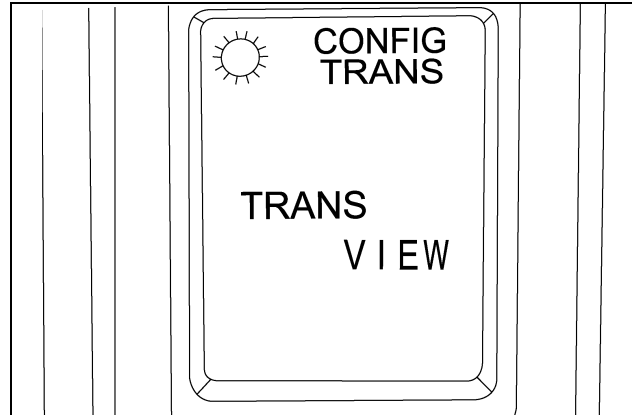
Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.



RD06A057

Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

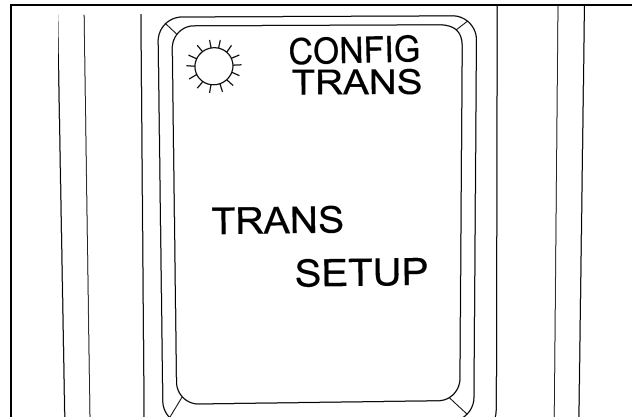
### STEP 85



RD05F104

When the **TRANS VIEW** menu is displayed, push the **DECR** key.

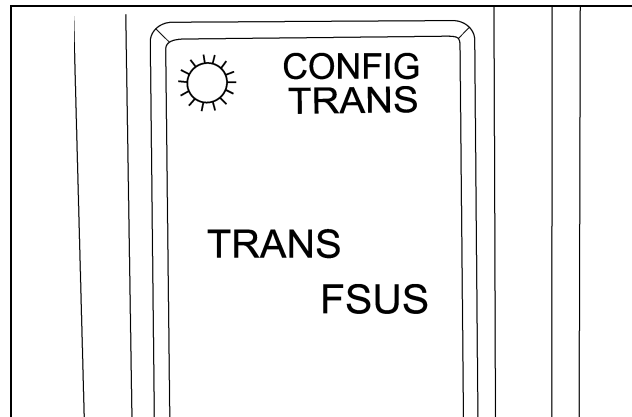
### STEP 86



RD05F125

The display will read **TRANS SETUP**. Press the **DECR** key.

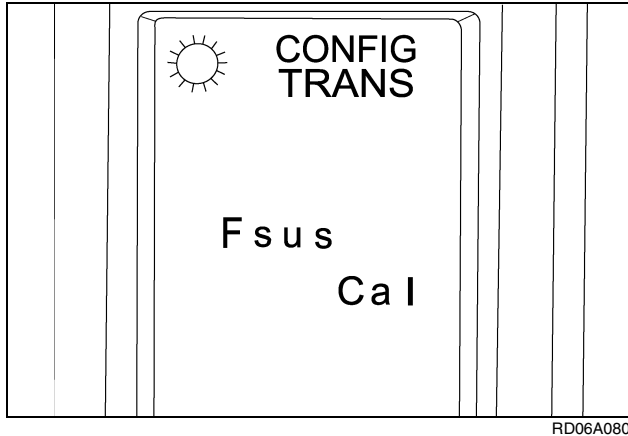
### STEP 87



RD06A079

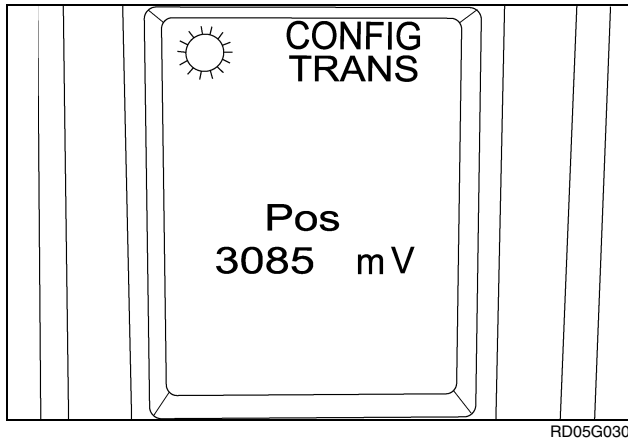
The display will read **TRANS FSUS**. Press the **PROG** key.

### STEP 88



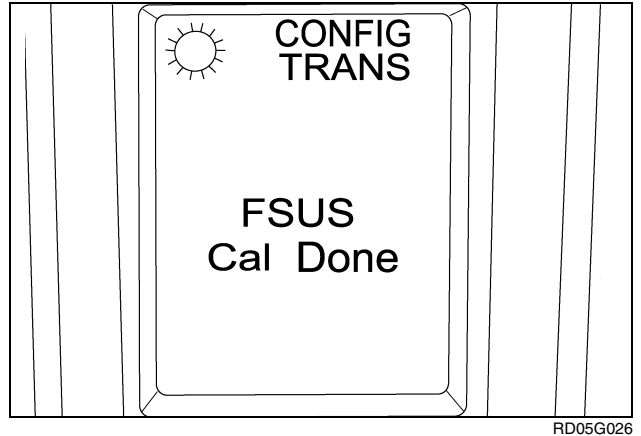
The display reads **FSUS CAL**. Press the **PROG** key to automatically start the calibration process. The Suspended Axle Switch lamp will flash on and off.

### STEP 89



The display numbers (nnnn) will change as the calibration is in progress. This display is the front axle position sensor output voltage.

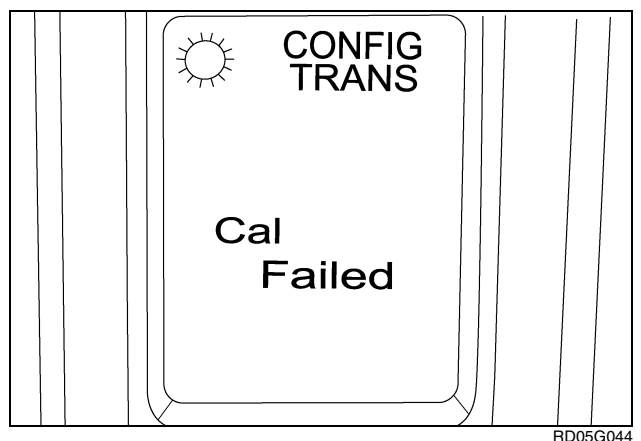
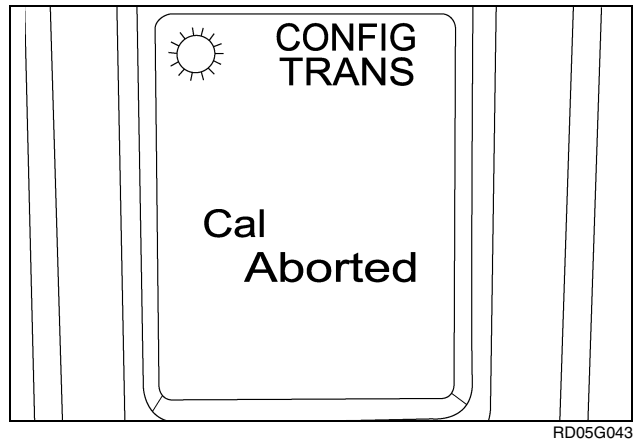
### STEP 90



When the calibration is completed the display will show **FSUS Cal Done**.

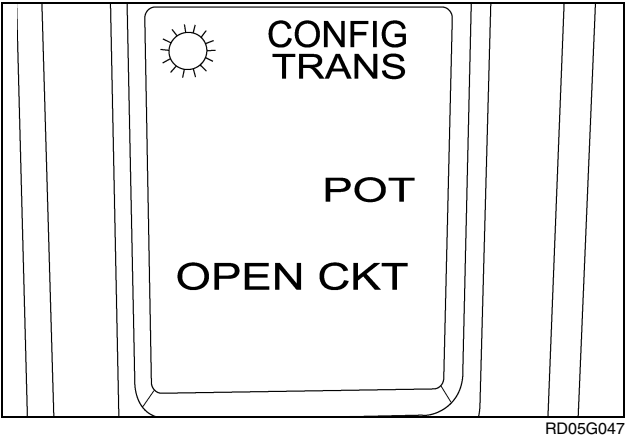
**NOTE:** If the **PROG** key is pressed during the calibration the display will read **CAL ABORTED**.

### STEP 91



If the calibration process fails the display will read **CAL FAILED**. The Suspended Axle Switch lamp will turn off. If the **CAL FAILED** message appears press the **PROG** key to access the Error Message Display.

STEP 92



Error Message Display Example.

Possible Error Messages

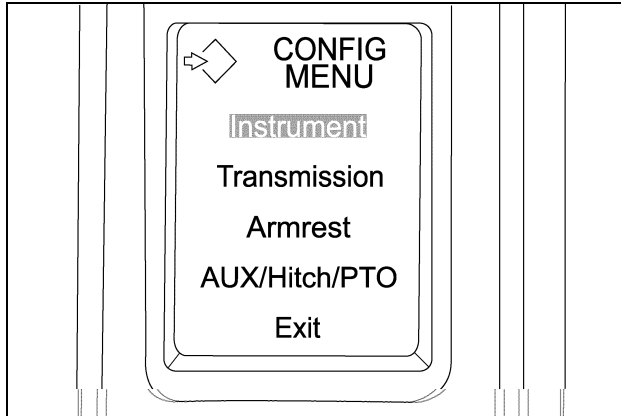
ttt	bbbbbbb
POT	OPEN CKT
POT	HIGH VAL
POT	SHRT CKT
POT	LOW VAL
POT	LOW RNG
SLOW	UP MVMNT
SLOW	TO MAX
SLOW	DN MVMNT
SLOW	TO MIN
NOT	CAL
WHEEL	MOVED

## Front Suspension Demo

The menu is accessed through the Trans Setup Menu.

**NOTE:** This menu will only work when the Electronic Service Tool is in use.

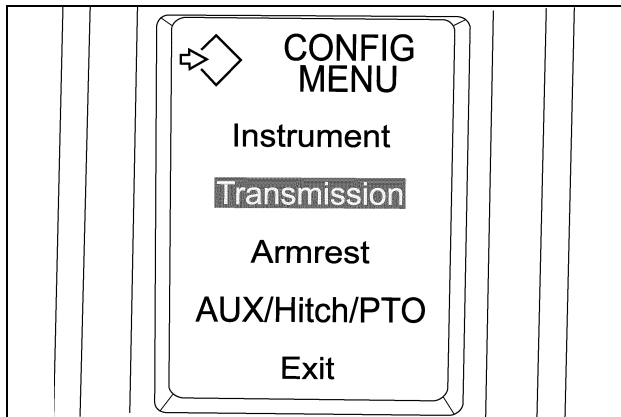
### STEP 93



RD05G056

Start the engine.

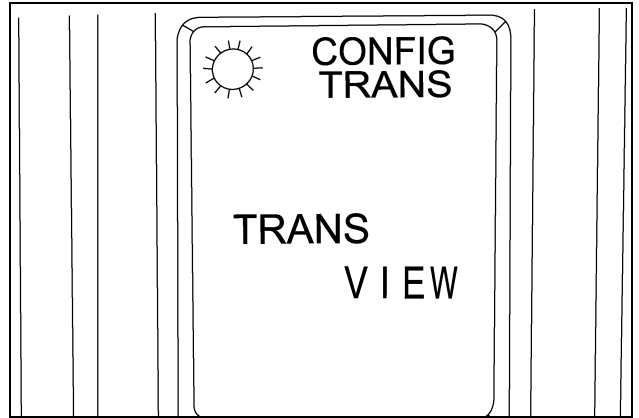
Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.



RD06A057

Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

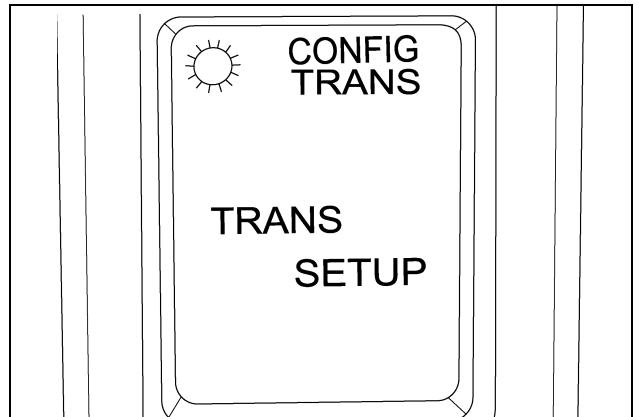
### STEP 94



RD05F104

When the **TRANS VIEW** menu is displayed, push the **DECR** key.

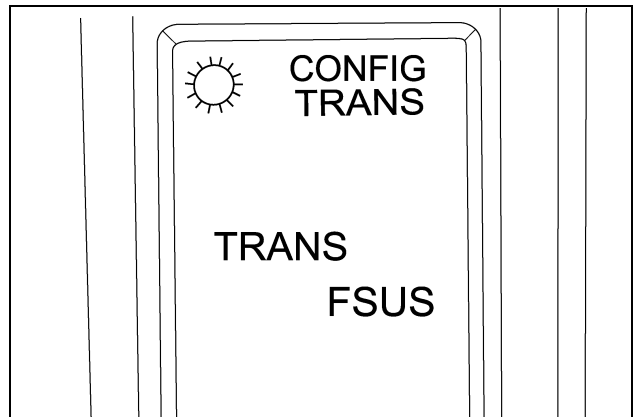
### STEP 95



RD05F125

The display will read **TRANS SETUP**. Press the **DECR** key.

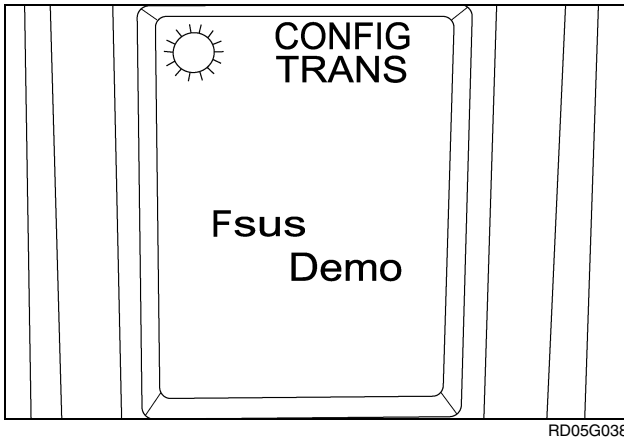
### STEP 96



RD06A079

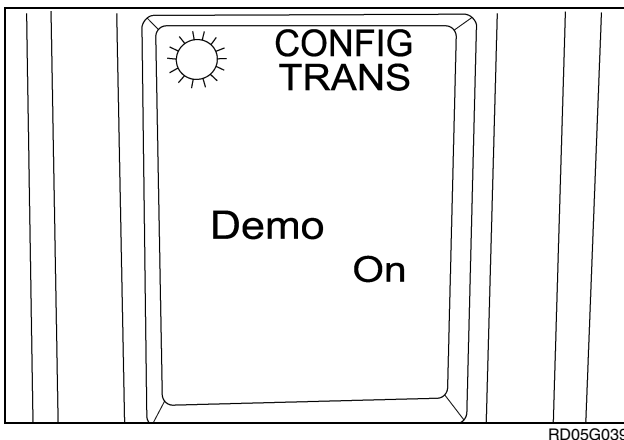
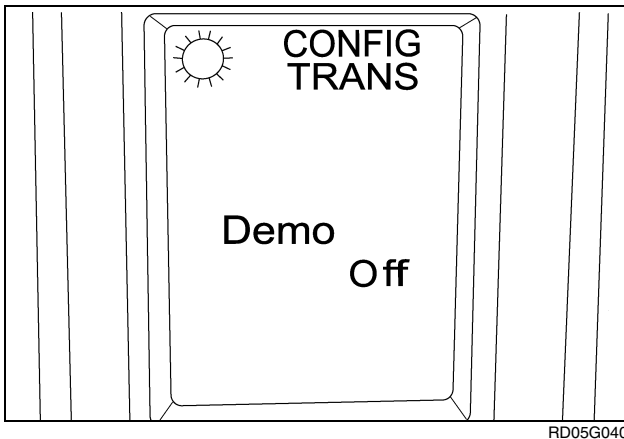
The display will read **TRANS FSUS**. Press the **PROG** key.

## STEP 97



Press the **DECR** key multiple times until **FSUS DEMO** is displayed. Press the **PROG** key.

## STEP 98



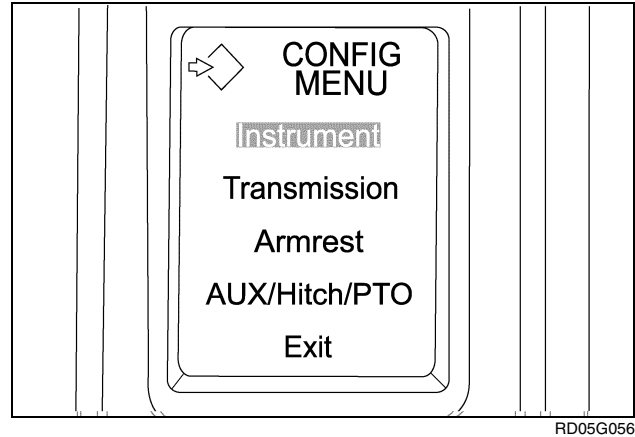
The display will read **DEMO OFF**, or **DEMO ON**. To change status press **INCR** or **DECR** key. When the status is correct press **PROG** key.

The **DEMO** allows the user to switch the Front Suspended Axle ON or OFF especially at speeds greater than 12 KMH.

## Front Suspension Manual Menu

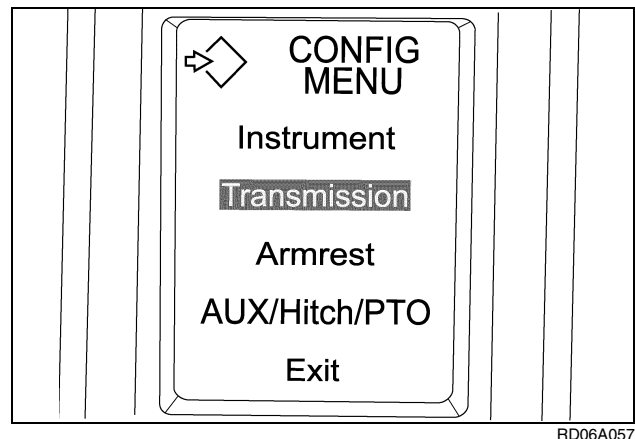
**NOTE:** This menu will only work when the Electronic Service Tool is in use.

## STEP 99



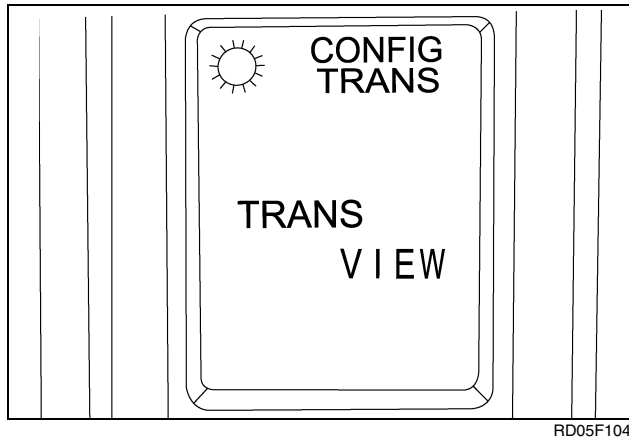
Start the engine.

Push and hold the **PROG** key for two seconds within the first ten seconds after starting the tractor. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.



Push the **DECR** key until the display reads **TRANS** and press the **PROG** key again.

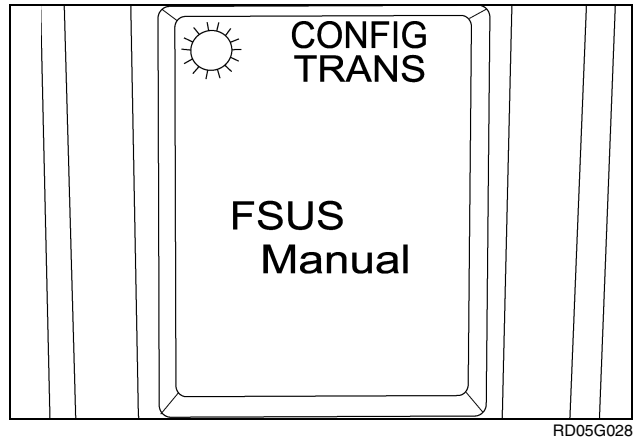
### STEP 100



RD05F104

When the **TRANS VIEW** menu is displayed, push the **DECR** key.

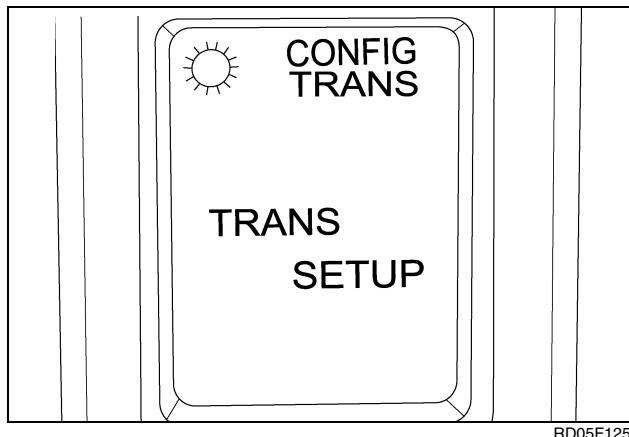
### STEP 103



RD05G028

Push the **DECR** key until the display reads **FSUS Manual** and then press the **PROG** key.

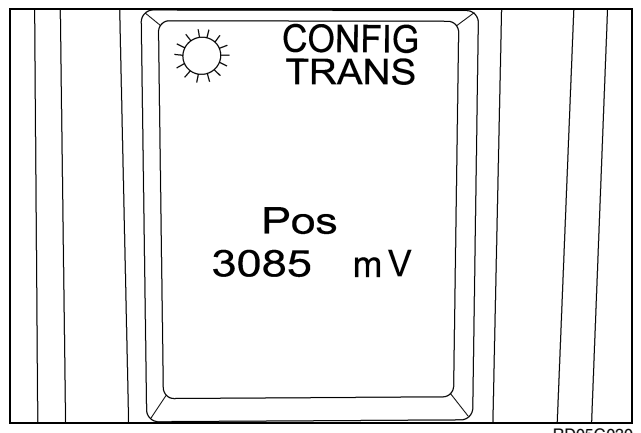
### STEP 101



RD05F125

The display will read **TRANS SETUP**. Press the **DECR** key.

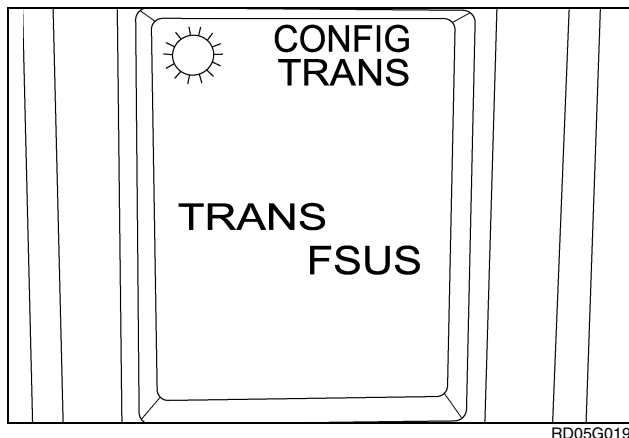
### STEP 104



RD05G030

The display will read **POS nnnn mV**. This display is the front axle position sensor output voltage. Press the **DECR** key.

### STEP 102

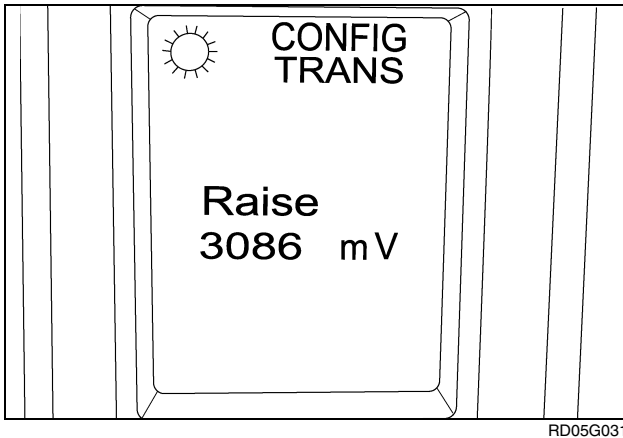


RD05G019

The display will read **TRANS FSUS**. Press the **PROG** key.



### STEP 105

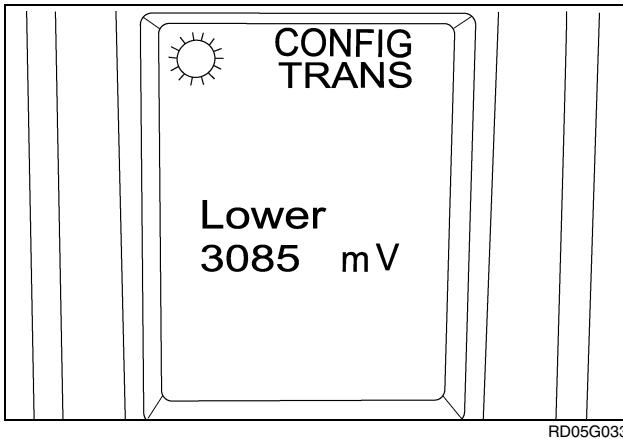


RD05G031

The display will read **RAISE nnnn mV**. Press and hold the Front Suspended Axle switch to raise the suspended axle. Release the switch to stop. Press the **DECR** key again.

**NOTE:** The manual raise feature can be useful for troubleshooting the raise function. Power the raise solenoid ON and OFF and check for 12 volts at raise solenoid.

### STEP 106

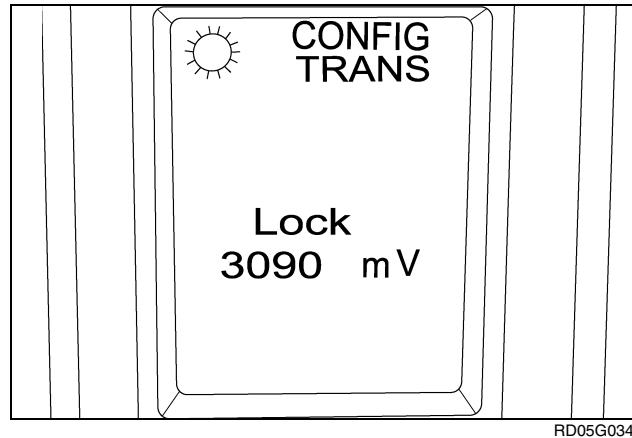


RD05G033

The display will read **LOWER nnnn mV**. Press and hold the Front Suspended Axle switch to lower the suspended axle. Release the switch to stop. Press the **DECR** key again.

**NOTE:** The manual lower feature can be useful for troubleshooting the lower function. Power the lower solenoid ON and OFF and check for 12 volts at lower solenoid.

### STEP 107



RD05G034

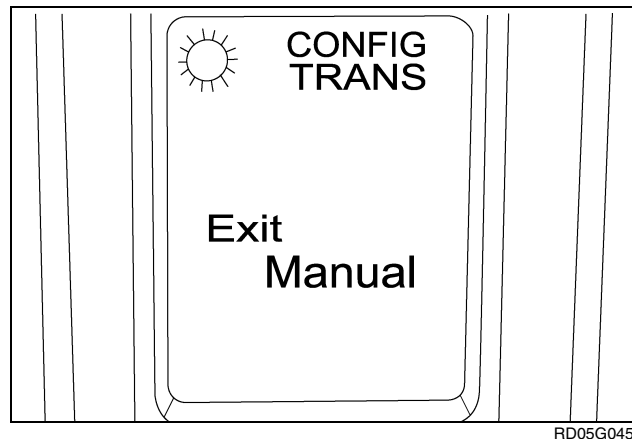
The display will read **LOCK nnnn mV**. Both the upper and lower lock solenoids are now powered ON. Press and hold the Front Suspended Axle switch to power OFF the lock solenoids.

**NOTE:** The manual lock feature can be useful for troubleshooting the lock function. Power the lock solenoids ON and OFF and check for 12 volts at the upper and lower lock solenoids.

To continue manual adjustments press the **INCR** keys to get back to lower and raise screens.

Press the **DECR** key when the display reads **LOCK nnnn mV**.

### STEP 108



RD05G045

The display will read **EXIT MANUAL**. Press **PROG** key to exit menu.

## REMOTE (AUX) SYSTEM CALIBRATION

### Requirements For Calibration

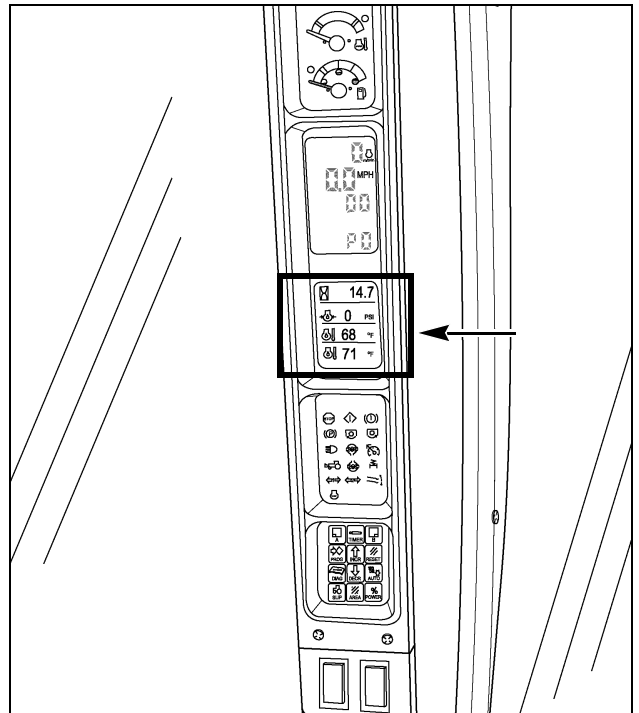
**NOTE:** AUX/HITCH/PTO controller is also referred to as Tractor Multi Function TMF Controller.

**IMPORTANT:** The remote system controller must be calibrated anytime any service work is done on the remote valves or when the controller is changed.

- Before starting the remote hydraulic calibration procedure, check the wiring harness and components for damage or loose connections. Replace or repair any damaged part as necessary.
- Before calibrating the remote hydraulic controller, be sure the Standard Instrumentation (INST) and Armrest (ARM) controllers are calibrated.
- The hydraulic oil must be warmed to 49°C (120°F) or higher.
- Engine speed must be set to 1500 RPM or higher.
- Disconnect any implements before calibration.

### Aux Set Main Menu

Remote hydraulic calibration is performed through the programmable display on the standard instrumentation.



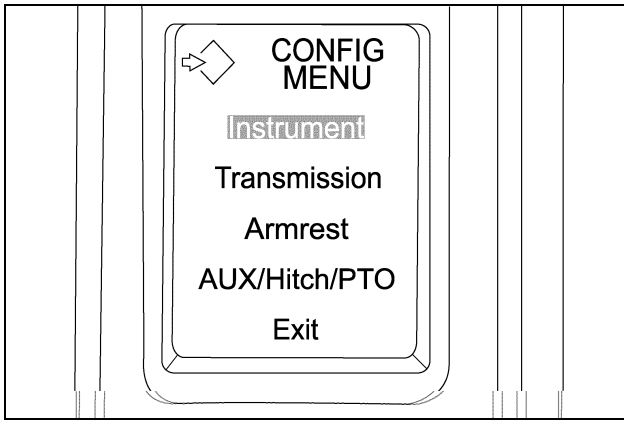
MD05F002

Once the requirements for calibration have been met, remote hydraulics calibration can begin.

**NOTE:** Programming can only be entered within the first 10 seconds of turning the key switch to the ON position or starting the tractor.

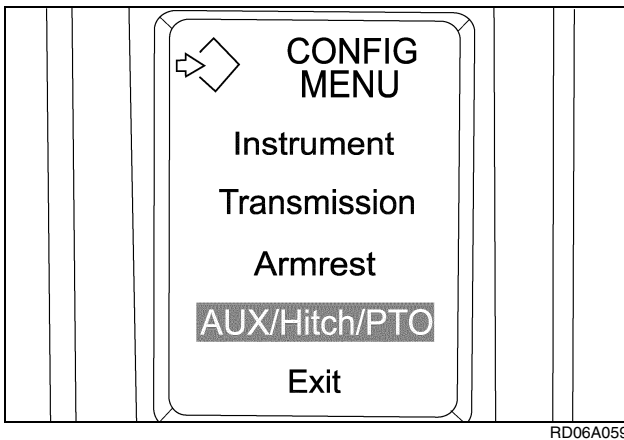
To get to the aux set main menu, do the following:

### STEP 1



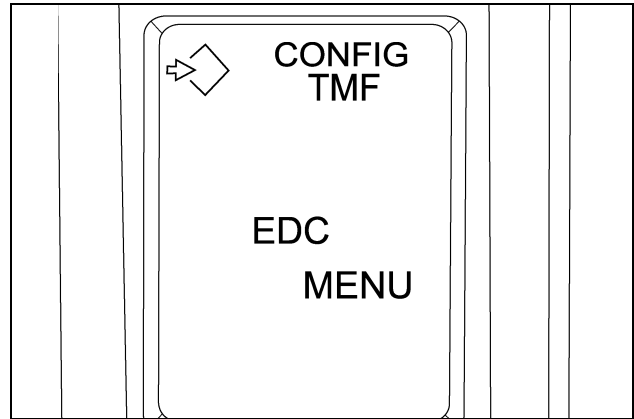
Start the tractor. Push the **PROG** key and hold for two seconds within the first ten seconds. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.

### STEP 2



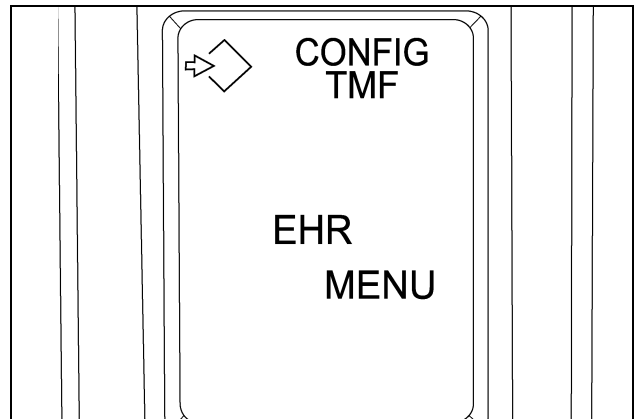
Push the **DECR** key three times. The display should read **AUX/HITCH/PTO**. Push the **PROG** key.

### STEP 3



The display will read **EDC MENU**. Press the **DECR** key twice.

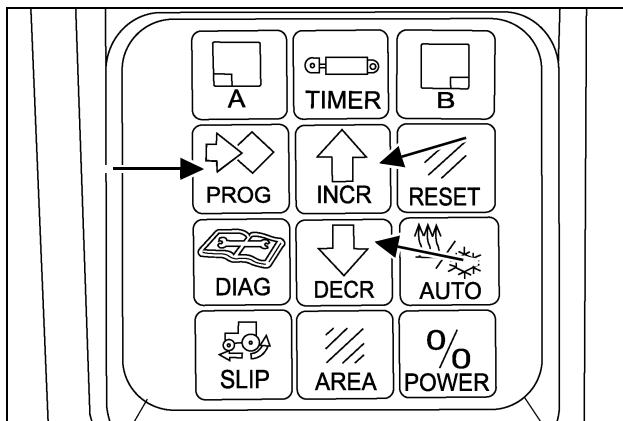
### STEP 4



The display should read **EHR MENU** (Electro Hydraulic Remotes). Press the **PROG** key to enter the main menu.

There are 5 main menu options in the **EHR MENU**:

1. **AUX VIEW** - This menu displays the software revision code and scraper configuration.
2. **AUX ADJUST** - The adjustment menu offers the operator a means of tailoring the flow from a remote section to meet the needs of the job to be done. The extend and retract flows are adjustable independently.
3. **AUX SETUP** - The setup option menu is for the configuration of the implement controls. There is the option of none, one and two. Default is none.
4. **AUX CAL** - The calibration menu allows the control to find the flow thresholds of the valves. Only the valves that are configured in the armrest controller at power up are calibrated.
5. **AUX EXIT** - Used to exit the **AUX**.

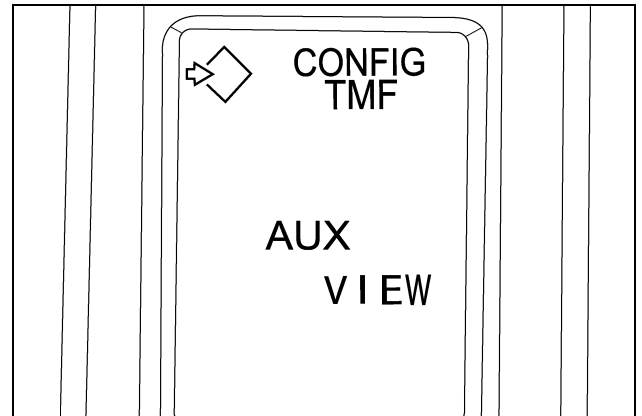


MD05F003

Use the **INCR** or **DECR** key to move through these menus. To enter the menu of your choice, press the **PROG** key.

## Aux View Menu

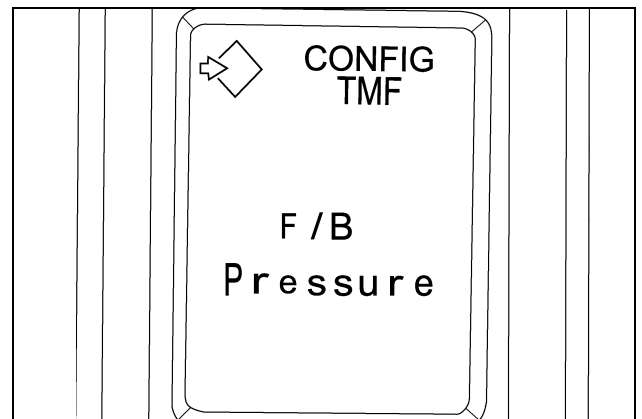
### STEP 1



RD06A099

With **AUX VIEW** on the display, press the **PROG** key.

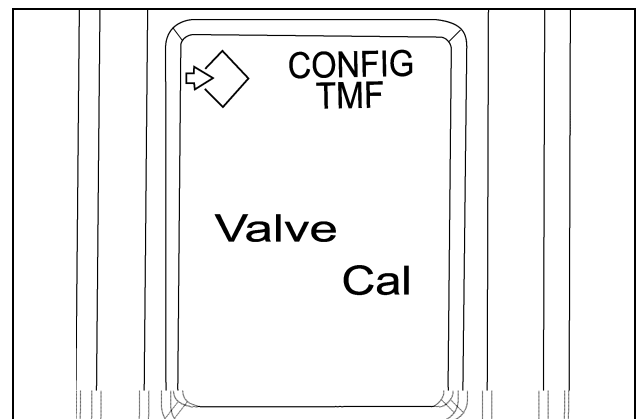
### STEP 2



RD06A100

The **F/B Pressure** (Feedback) screen is on the display, press the **DECR** key

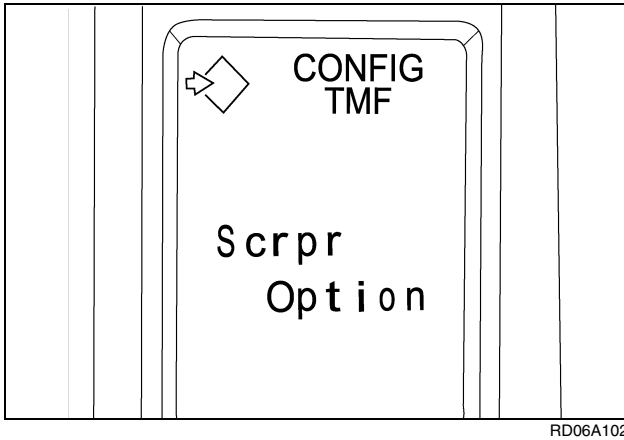
### STEP 3



RD06A101

The **VALVE CAL** screen is on the display. Used to view calibration values. Press the **DECR** key.

#### STEP 4

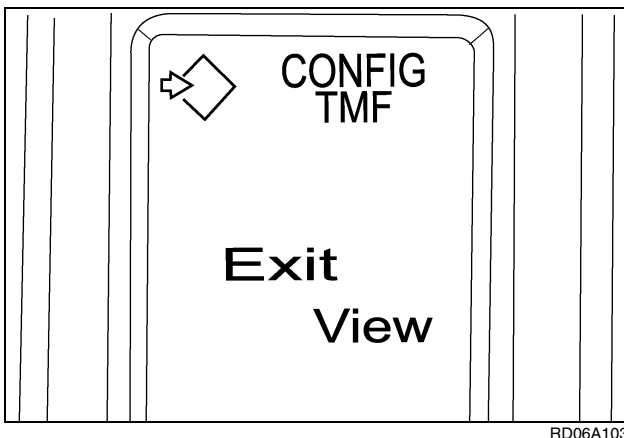


RD06A102

The screen will now read **SCRPR OPTION**. Press the **PROG** key. The display will now show how many scrapers are configured in the system. Press the **DECR** key.

**NOTE:** *Scraper configuration is performed in the **AUX SETUP** menu.*

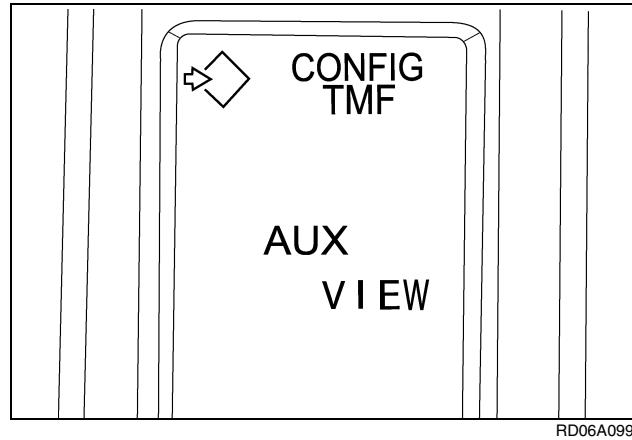
#### STEP 5



RD06A103

The display will now read **EXIT VIEW**. Press the **PROG** key.

#### STEP 6

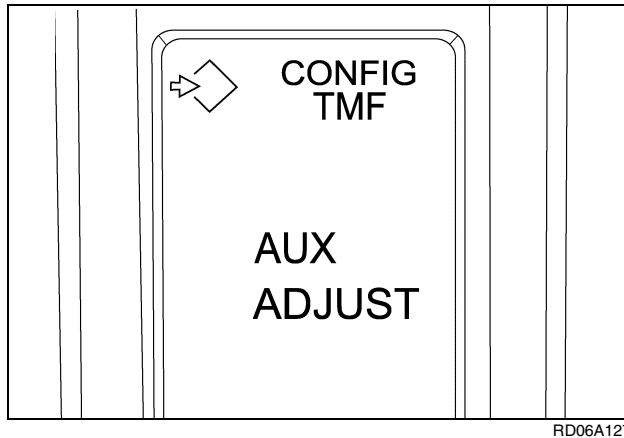


RD06A099

The **AUX VIEW** screen will now be displayed. Press the **DECR** key to display **AUX ADJUST**.

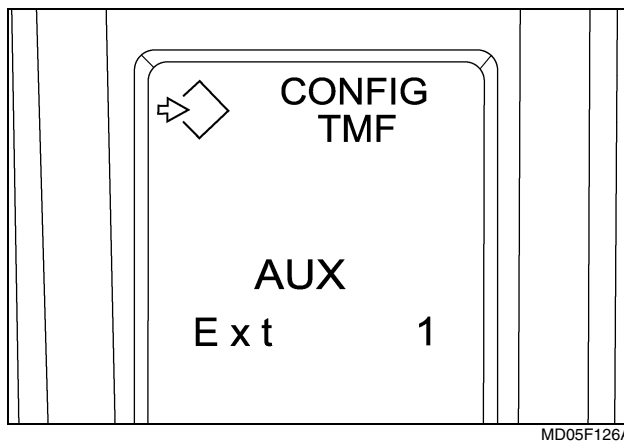
## Aux Adjust Menu

### STEP 7



With **AUX ADJUST** on the display, press the **PROG** key.

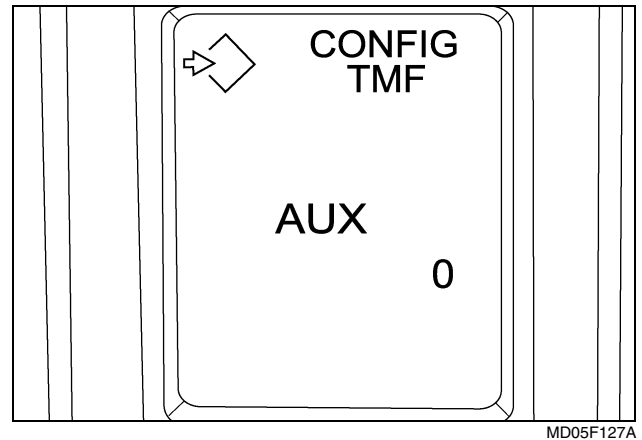
### STEP 8



Press the **INCR** or **DECR** key to select the remote section (1 through 5) and the extend or retract circuit for that section.

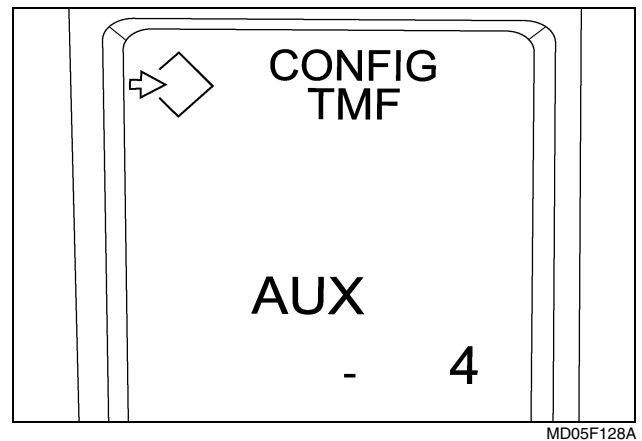
**NOTE:** Only valve sections with a valid lever range and no faults will be broadcast (over the Tractor Data Bus) from the armrest controller will be listed in this menu.

### STEP 9



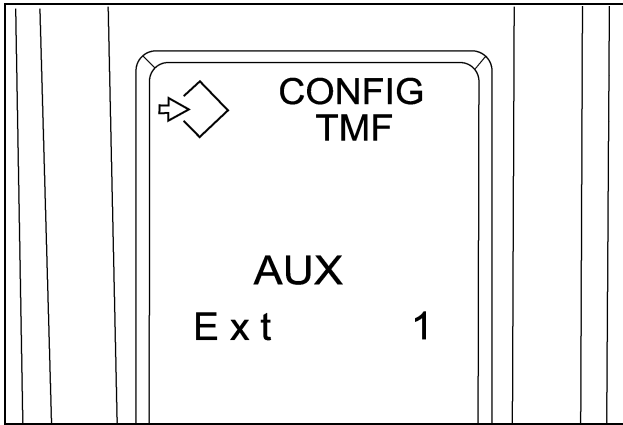
Press the **PROG** key for the section circuit of your choice. The current valve setting, which will be a number between -40 to +40 will be displayed. If the value displayed is increased, the flow curve associated with that valve will be shifted to the left. This results in a higher flow for a given flow potentiometer setting for that flow direction. If the value is decreased, the flow curve associated with that valve will be shifted to the right. This results in a lower flow for a given flow potentiometer setting for that direction. As the displayed value is changed, the shift in the flow curve will take effect immediately. The range of adjustment is -40 to +40, with 0 having no effect on the flow curve.

### STEP 10



Press the **INCR** or **DECR** key to increase or decrease the number. Each time the **INCR** or **DECR** key is pressed, the flow will change 0.2 to 0.6 GPM (0.7 to 2.2 LPM).

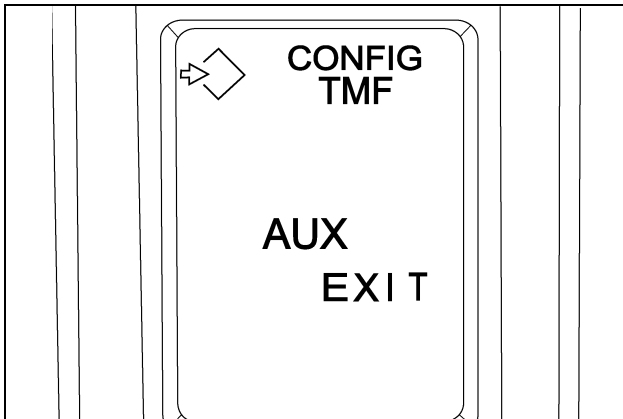
## STEP 11



MD05F126A

Press the **PROG** key to return to the valve section selection menu. Repeat these steps for other valve sections.

## STEP 12



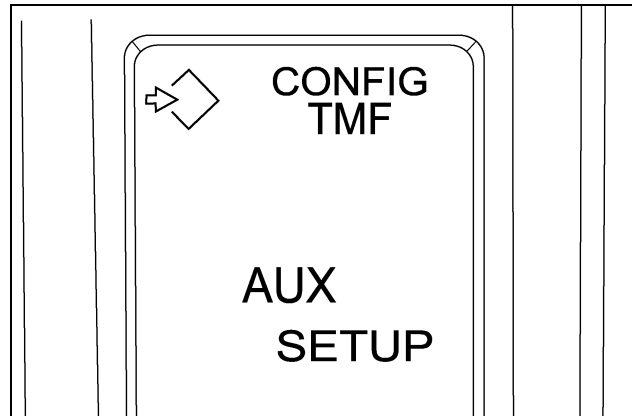
RD06A130

Press the **INCR** or **DECR** key to return to the **EXIT** screen. Press the **PROG** key.

**NOTE:** The **AUX** controller must leave through the **EXIT** screen or the adjustments will not be saved.

## Aux Setup Menu

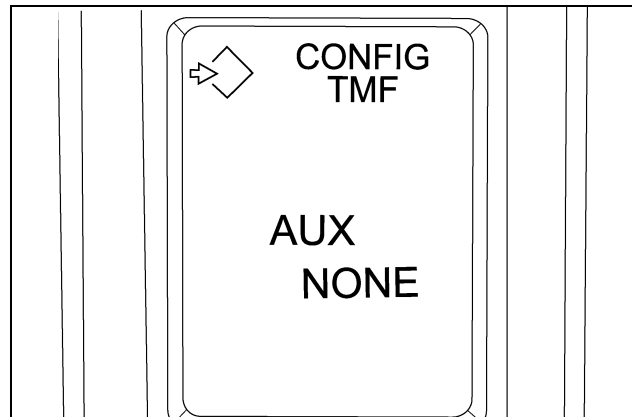
## STEP 13



RD06A128

With **AUX SETUP** on the display, push the **PROG** key.

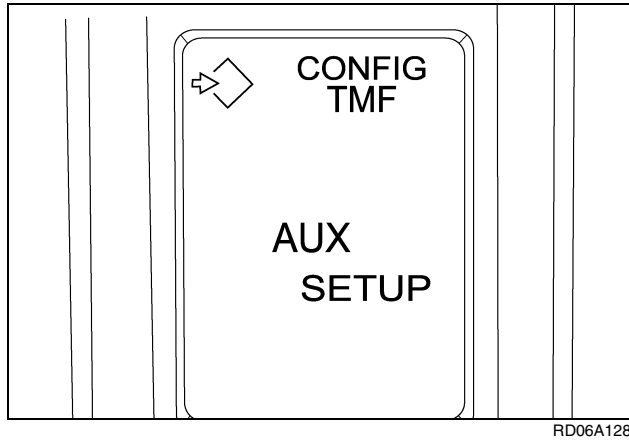
## STEP 14



RD06A170

The display will show the current setup value, either **AUX NONE**, **1SCRAPER**, **2SCRAPER** or **IMP ctl** (**IMP ctl** will display if installed).

Use the **INCR** or **DECR** key to select your option, then push the **PROG** key.

**STEP 15**

RD06A128

The display will return to the **AUX SETUP** screen. Use the **INCR** or **DECR** key to go to the next menu item.

**Aux Cal Menu****Requirements For Calibration**

**IMPORTANT:** *The remote hydraulic controller must be calibrated anytime any service work is done on the remote valves or when the controller is changed.*

- Before starting the remote hydraulic calibration procedure, check the wiring harness and components for damage or loose connections. Replace or repair any damaged part as necessary.
- Before calibrating the remote hydraulic controller, be sure the Standard Instrumentation (INST) and Armrest (ARM) controllers are calibrated.
- The hydraulic oil must be warmed to 49°C (120°F) or higher.
- Engine speed must be set to 1500 RPM or higher.
- Disconnect any implements before calibration.

**Calibration Process**

Before the calibration process starts, the system will perform a pre-calibration check. This check includes:

- Levers and switches for the available valve sections are in the neutral position.
- When equipped with MegaFlow, plug the transducer into the left diagnostic fitting on the remote manifold.
- There are no faults present.
- The feedback signal used for the calibration indicates less than 100 PSI (689 kPa) and is greater than 0.25 volts.

If any of these checks do not pass, the calibration will be exited with a message displayed of the fault. Selection of the **INCR** or **DECR** key will bring the main calibration menu back.

If the checks pass, the present calibration values are set to a default value and the calibration process will begin.

The sequence of calibration is sequential from valve section one through section five of the available sections. The valve order for each section is lower first, then raise. The valve and section that is in process of calibration will be displayed.

**If Equipped with MegaFlow**

For tractors equipped with the MegaFlow option, a pause is provided to allow field technicians to calibrate both remote systems with one pressure transducer.

Once the calibration procedure is in progress for the 1st remote section, move the 3rd remote lever out of neutral. The calibration will pause after the 2nd remote section is calibrated. Move the transducer to the right side diagnostic fitting. Place the 3rd remote lever back into neutral and select continue from the menu. The calibration process will continue.

The valve is commanded to starting current. After three seconds, the pressure reading is verified that it has not changed more than 27 PSI (186 kPa) higher. If the feedback signal is above this, calibration will be stopped. If the value is below this pressure check, the pressure reading is stored for the initial value and used for a relative reference for the remainder of this valve calibration.

Every 200 mS, the commanded current will be incremented until the feedback signal has become greater than 27 PSI (186 kPa) from the initial value recorded. The valve is then commanded to zero current and allowed to settle for three seconds. The feedback is then checked for a value below 18 PSI (124 kPa) from the initial value. A minimum of one second and up to 30 seconds is allowed for this signal to decay. The valve is then commanded at the current just found minus 16 mA. The current is incremented every three seconds until a change of 27 PSI (186 kPa) or greater from the initial value is reached. Again the valve is allowed to settle as above. If the feedback signal does not decay within the time frame allowed, the calibration will exit.

When calibration is completed, the thresholds will be saved and Done will be displayed on the standard instrumentation display. If calibration is stopped, one of the following messages will be displayed:

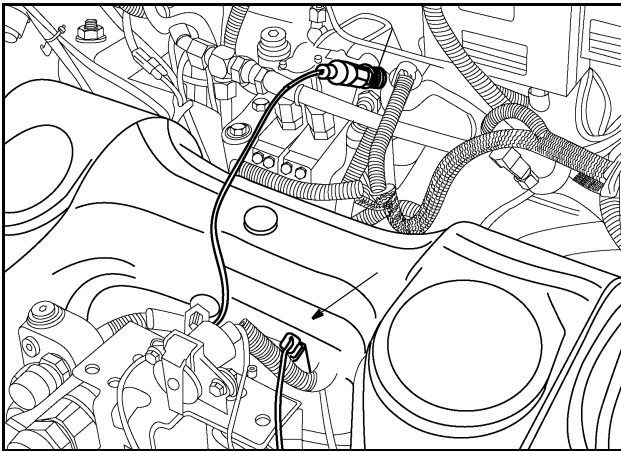


- Enable - lever not in neutral during pre-cal check.
- Quit - During calibration, the lever of valve being calibrated was moved from neutral, INCR, Decr or PROG key was pushed.
- PSI - Feedback signal out of range low or high during pre-cal check.
- Cal Time - Pressure takes too long to drop during settling phase of calibration
- Cal Halt - Anytime a fault is associated with the section is detected.
- Cal Fail - Starting current generates too much pressure or the commanded current has gone through its valid range without finding the threshold.

**NOTE:** Disconnect any implement from the remote hydraulic valves before performing the AUX CAL procedure.

**NOTE:** Before performing the AUX CAL procedure, make sure valve spools are moving freely. With the engine running, cycle each remote hydraulic section to the extend and retract detente position.

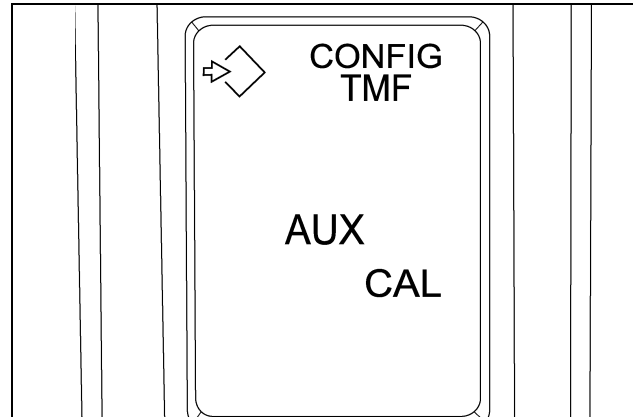
## STEP 16



RD02E096

Connect Remote Hydraulic Calibration Tool CAS 2806 to the implement potentiometer connector (C150M below cab) and the load sensing diagnostic port on the remote valve.

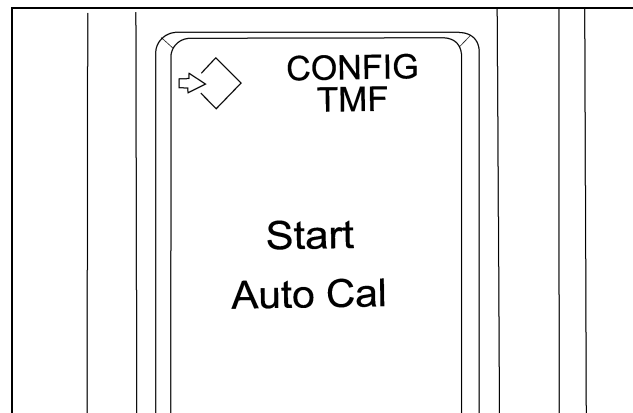
## STEP 17



RD06A129

With **AUX CAL** on the display, Press the **PROG** key.

## STEP 18



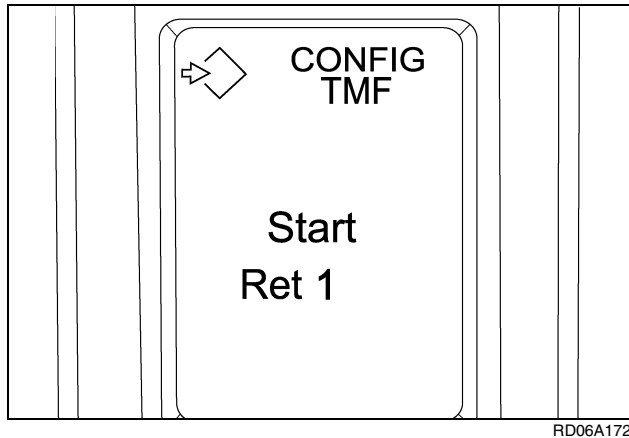
RD06A171

The display will read **Start Auto Cal**. To begin the automatic calibration press the **PROG** key.

**ATTENTION:** If a manual calibration of an individual Aux section is desired, when the display reads **Start Auto Cal** press the **DECR** key. The display will read **Start Man Cal**. This menu will allow you to manually select the Aux (remote) section that you wish to calibrate. Press the **PROG** key.

Press the **INCR** or **DECR** key to select the aux section that you wish to calibrate. Press the **PROG** key to calibrate that section.

## STEP 19



RD06A172

The first portion of calibration procedure is running. If no faults are displayed continue on to Step 21.

## STEP 20

If any of these checks do not pass, the calibration will be exited with a message displayed of the problem.

The top of the display will indicate **RET** or **EXT** along with the Aux section number. The bottom of the display will indicate fault:

**Low Psi** - AUX feedback pressure below expected range

**High Psi** - AUX feedback pressure above expected range

**Psi Fault** - Feedback pressure 1 and 2 outside expected range

**Cal Low** - AUX valve crack point current calibrated out of range low

**Cal High** - AUX valve crack point current calibrated out of range high

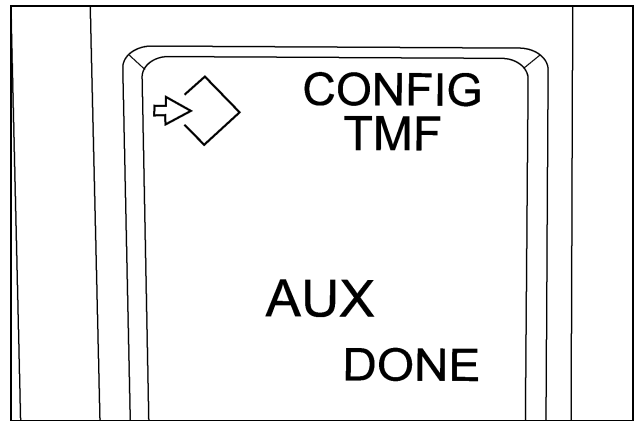
**Fault** - Detected AUX solenoid valve short or open during calibration

**CAN Fault** - ICU not present

**Time Out** - AUX feedback pressure drop was not detected during the calibration period

**Fault AUX k** - Detected AUX solenoid valve short or open prior to calibration

## STEP 21



MD05F177A

The system will go automatically into the calibration process when the pre-calibration is completed. The screen will display each remote valve as it is calibrated and will automatically cycle through all remote valves in numeric order. The calibration process for a five valve remote system will take approximately five minutes. When calibration is completed, the display will read Done. Push the **PROG** key to return to the **AUX Cal** menu. If the calibration process could not be completed, the display will read the reason why. See Calibration Process at the beginning of **Aux Cal** Menu.

## HITCH SYSTEM CALIBRATION

### Setup Process

#### Requirements For Calibration

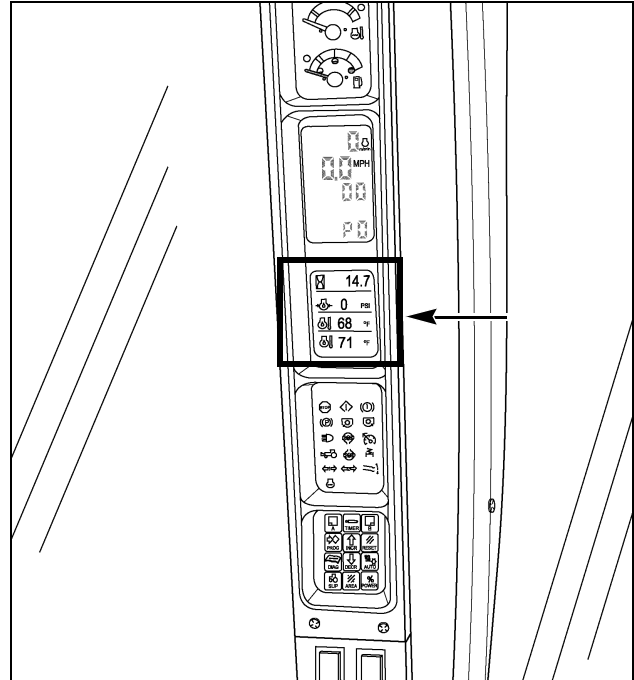
**NOTE:** The standard instrumentation and armrest controllers must be calibrated before the hitch controller can be calibrated.

**NOTE:** AUX/HITCH/PTO controller is also referred to as Tractor Multi Function TMF Controller.

- Before starting the hitch calibration procedure, check the wiring harness and components for damage or loose connections. Replace or repair any damaged part as necessary.
- Be sure that the hitch is free to move all the way between the lift cylinders minimum and maximum limits. Make sure that no interference exists during hitch movement (such as a quick coupler contacting a draw bar). **Be sure there are no persons in the back of the tractor during hitch calibration.**
- Do not calibrate the hitch with the tractor moving.
- The transmission oil must be warmed to more than 38°C (100°F).
- The engine speed must be 1600 RPM or higher during calibration.

### Hitch Setup Main Menu

Hitch setup / calibration is performed from the programmable display on the standard monitor.



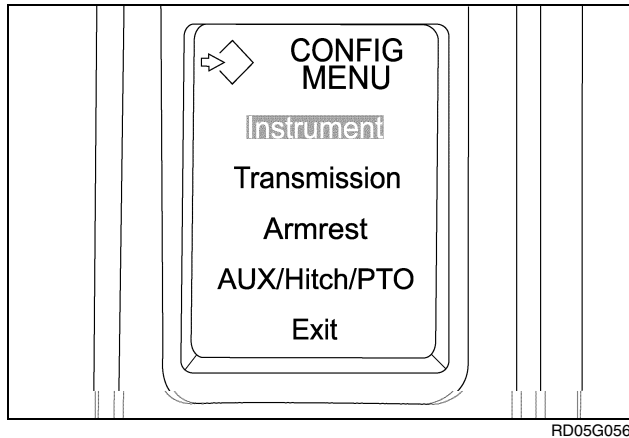
MD05F002

Once the requirements for calibration have been met, hitch calibration can begin.

**NOTE:** Programming can only be entered within the first 10 seconds of turning the key switch to the ON position.

**NOTE:** If any fault codes are recorded, they must be corrected before programming is possible.

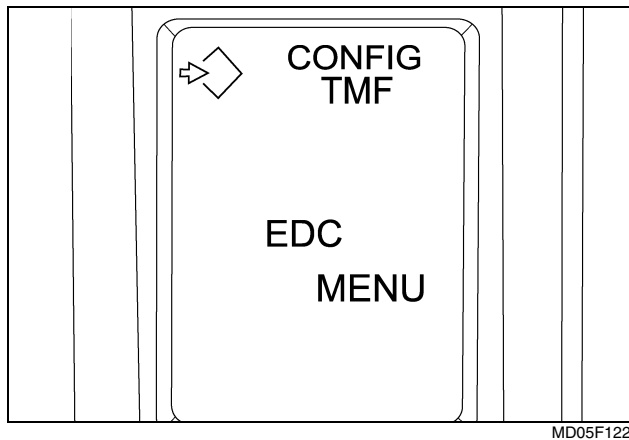
## STEP 1



To get to the hitch setup main menu, do the following:

1. Start the tractor.
2. Push the **PROG** key and hold for two seconds within the first ten seconds after turning on the key switch. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.
3. Push the **DECR** key three times to highlight **AUX/HITCH/PTO**.
4. Push the **PROG** key.

## STEP 2

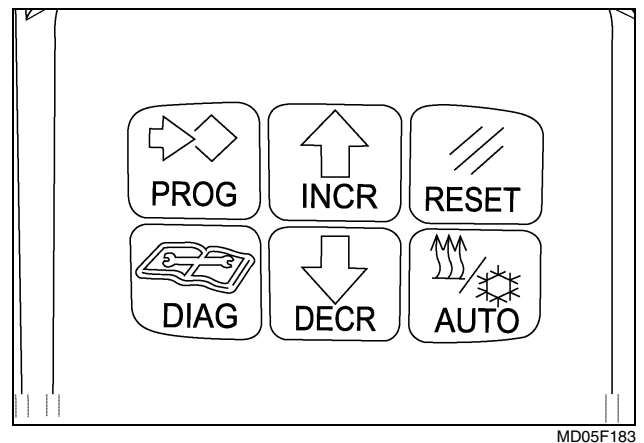


The display will read **EDC MENU** (Electronic Draft Control). Press the **PROG** key to enter the EDC main menu.

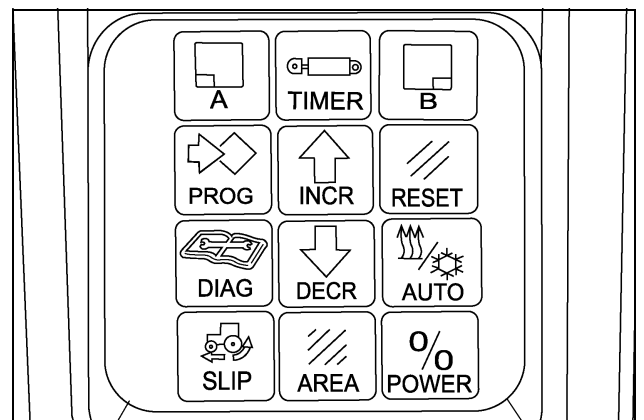
When the Electronic Draft Control (EDC) main menu is entered, the setup options include the following:

1. **HITCH CAL** - Capability to calibrate the hitch system.
  - A. Calibration of systems configuration.
  - B. Calibration of systems parameters
2. **HITCH SETTINGS** - Capability to set user settings of certain parameters.
3. **HITCH VIEW** - Capability to view information about the controller.
4. **HITCH NVM**- Allows the user to see stored calibration values.
5. **HITCH EXIT** - Used to exit the hitch menus.

The **HITCH CAL** will be the first option upon entry into the setup main menu. Press the **INCR** or **DECR** key to move through the main menu which includes **HITCH CAL**, **HITCH SETTINGS**, **HITCH VIEW** and **HITCH EXIT**. To enter the submenu of your choice, press **PROG**.



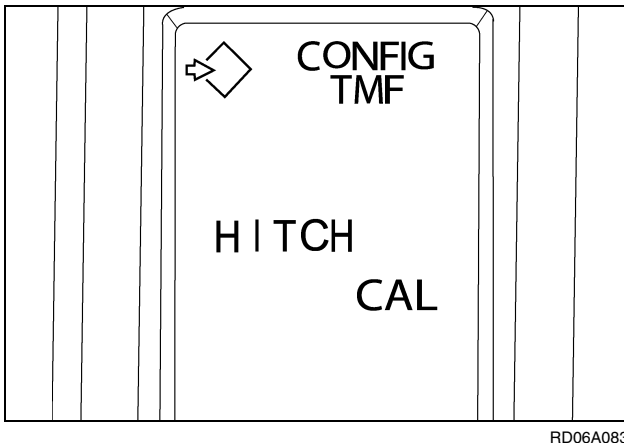
STANDARD INSTRUMENTATION CLUSTER



PERFORMANCE INSTRUMENTATION CLUSTER

## Hitch Calibration Menu

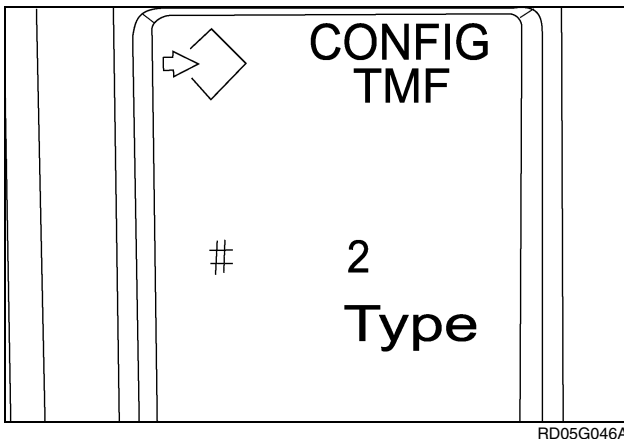
**NOTE:** If any fault codes are recorded, they must be corrected before programming is possible.



The **Hitch Cal** menu allows the user to calibrate the system parameters. These parameters include the tractor type, position feedback potentiometer and valve thresholds.

### STEP 3

The lower line of the display will have the word **Type**. The tractor type must be entered in the top line of the display. If the tractor has been previously calibrated, the top line will have that calibration number. If the controller has not been calibrated, the display will default to the number 1.



1. Use the **INCR** or **DECR** keys to scroll through the cylinder sizes to find the size that applies to your tractor.

1 = Two 88.9 mm (3.5 inch) ID cylinders.

2 = One 88.9 mm (3.5 inch) and One 95.2 mm (3.75 inch) ID cylinders.

3 = Two 95.2 mm (3.75 inch) ID cylinders.

4 = One 92.5 mm (3.75 inch) and One 104.8 (4.125 inch) ID cylinders.

2. When the correct cylinder size is found, press the **PROG** key to enter the selection.

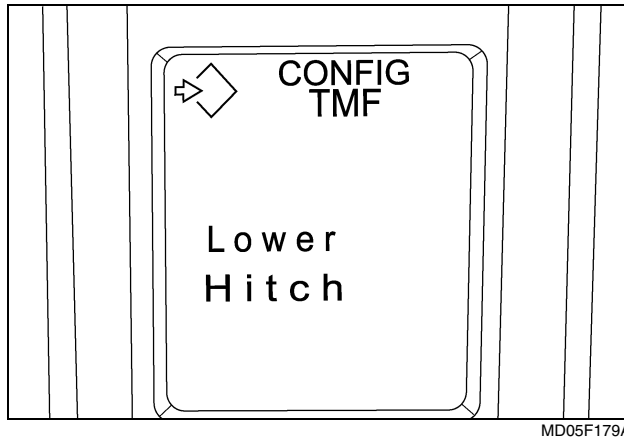
### STEP 4

At this step, the controller is looking for the number of draft pins in the system.

1. If the hitch controller detects two draft pins, and the armrest controller is calibrated for draft, the hitch controller will assume there are two draft pins and go to Step 5.
2. If the armrest controller is calibrated for position only, the controller will assume there are no draft pins and go to Step 5.
3. If neither item 1 or 2 are true, the lower line of the display will read "Pins". This means that the number of draft pins must be programmed into the controller.
4. If the hitch controller has been previously calibrated, the top line will have that calibration number. If the controller has never been calibrated, the top line of the display will read "0".
5. Use the **INCR** or **DECR** keys to scroll through the number of draft pins.
6. When the correct number of draft pins is displayed on the upper line of the display, press the **PROG** key to select that number of draft pins. The system will go to Step 5 after the selection has been made

**NOTE:** If a failure is detected, the system will go to Step 12.

## STEP 5



The display will now read **Lower Hitch**. It will allow you to lower the hitch. Be sure the engine is at 1600 RPM minimum.

1. To lower the hitch, press and hold the **PROG** key until the hitch lowers completely. The hitch will lower as long as the PROG key is depressed. While the hitch is lowering, the display will change to **Hitch Lower ON**.
2. When the **PROG** button is released, the system will go to Step 6.
3. To abort calibration, press either the **INCR** or **DECR** key. The system will go to Step 11.

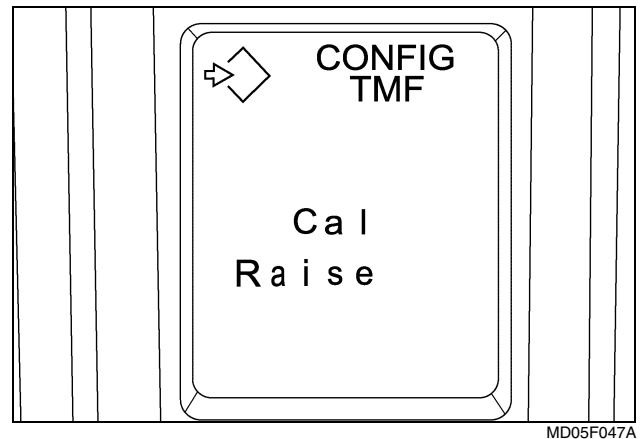
**NOTE:** If a failure is detected, the system will go to Step 12.

## STEP 6

The display will now read **Cal Raise**. This will allow you to calibrate the raise threshold of the hitch valve.

1. To calibrate the raise portion of the hitch valve, press the **PROG** key. The controller will start the raise calibration. Whenever current is applied to the coil, the display will change to **xxx Raise mA**, where "xxx" is the current value in mA.

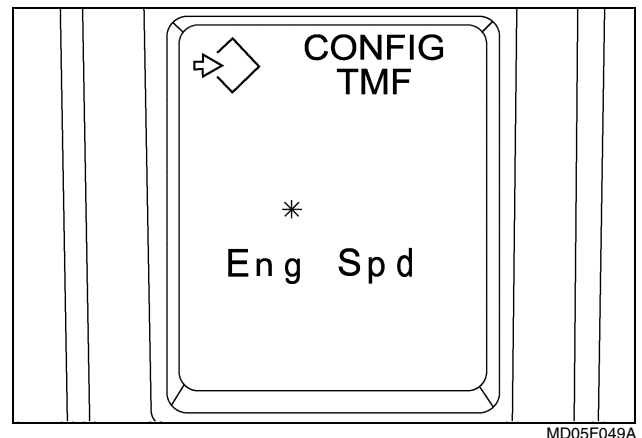
**NOTE:** Once the controller has found the raise threshold of the valve the hitch will raise.



2. When the controller has found the raise threshold of the valve, the hitch will move to the maximum raised position. The system will then go to Step 5.
3. To abort calibration, press either the **INCR** or **DECR** key. The system will go to Step 11.

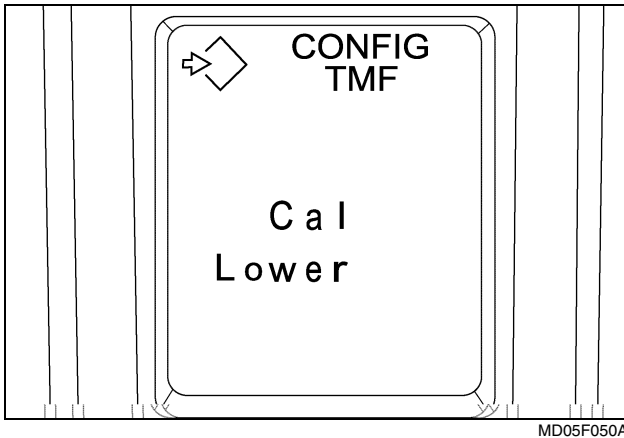
**NOTE:** If a failure is detected, the system will go to Step 12.

## STEP 7



The display will read **ENG SPD**. If the engine RPM is at or above 1600 RPM, there will be an asterisk (\*) on the display. If there is no asterisk, increase engine speed until the asterisk appears. Then press the **PROG** key.

**NOTE:** If the program key is pressed without an asterisk on the display, **Cal Fail** will appear on the display and calibration cannot continue.

**STEP 8**

The display will now read **Cal Lower**. This will allow you to calibrate the lower threshold of the hitch valve.

1. To calibrate the lower portion of the hitch valve, press the **PROG** key. The controller will start the lower calibration. Whenever current is applied to the coil, the display will change to **xxx L mA**, where "xxx" is the current value in mA.
2. The hitch will move down for approximately 0.8 seconds as soon as the **PROG** key is released. The hitch will then stop while the hitch valve finds its lower threshold. Then the hitch will move down to the lower limit.

**NOTE:** Calibration may take a few minutes. To abort calibration, press either the **INCR** or **DECR** key. The system will go to Step 11.

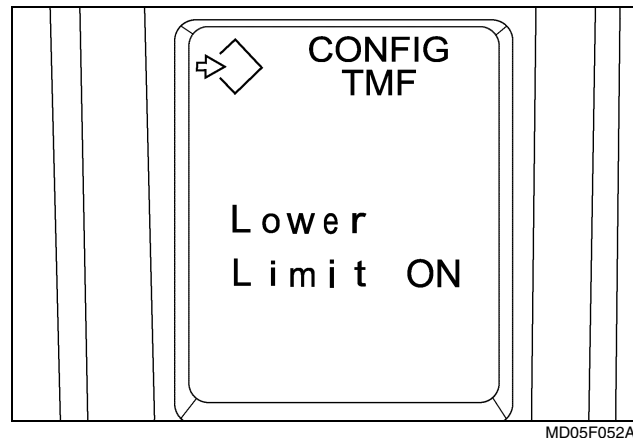
**NOTE:** Be sure the engine is at 1600 RPM minimum.

**NOTE:** If a failure is detected, the system will go to Step 10.

**STEP 9**

The display will now read **Lower Limit ON**. The system wants you to acknowledge that the hitch has reached the lower limit.

1. Push the "**PROG**" key to acknowledge that the hitch is at the lower limit. The system will then go to Step 10.

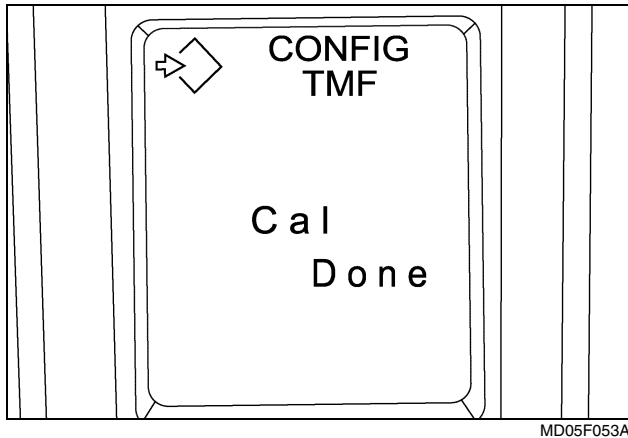


2. To abort calibration, press either the **INCR** or **DECR** key. The system will go to Step 11.

**NOTE:** If the **PROG** key is not pressed within 6 minutes, the calibration will fail and the system will go to Step 12.

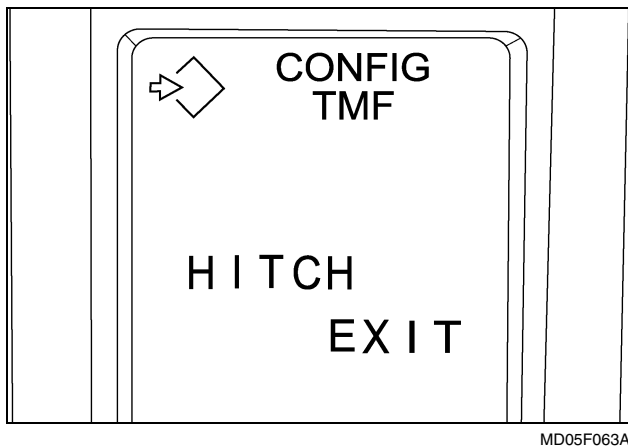
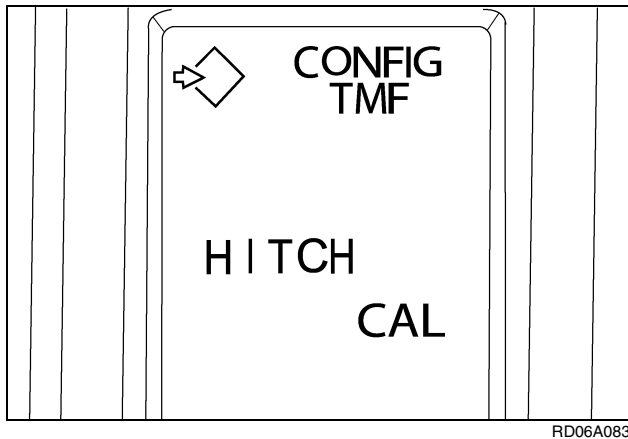
**NOTE:** If a failure is detected, the system will go to Step 12.

## STEP 10



The display will now read **Cal Done**. This indicates that hitch calibration has been successfully completed.

1. Press the **PROG** key to return to the hitch main menu.



2. **HITCH CAL** will be on the display. Press the **INCR** key to go to **HITCH EXIT** menu. Press the **PROG** key to exit calibration.

## STEP 11

If the display reads **Cal Aborted**. This means that the calibration process was aborted at some point.

1. Press the **PROG** key to return to the main menu.
2. There are several things that can cause the calibration to be aborted.
  - A. The tractor starts moving.
  - B. No engine speed.
  - C. The operator aborted calibration.

## STEP 12

If the display reads **Cal Fail**, it means that a failure has occurred during the calibration process. The controller will now be in the halt mode.

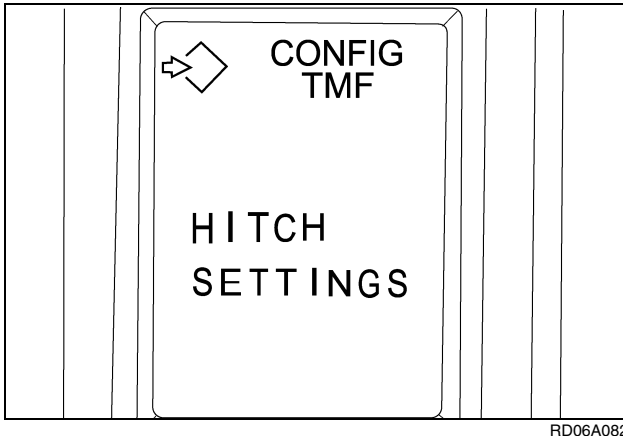
1. Press the **PROG** key to go back to the main menu.

**NOTE:** Entry into hitch calibration will not be allowed until the key switch has been cycled OFF, then ON.



## Hitch Setting Menu

Go to the Hitch Setting menu as shown under Hitch Setup Main Menu. The Hitch Setting Menu allows you to set certain performance parameters.



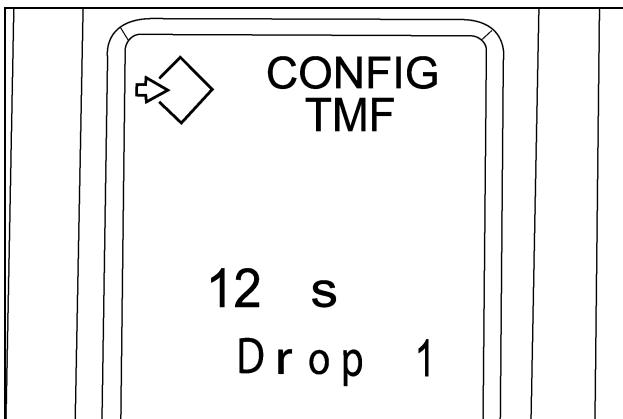
RD06A082

**NOTE:** Each parameter has a default setting that would be preferred under normal operating conditions.

Press **PROG** key.

### STEP 13

The lower line of the display will read **Drop 1**. This will allow you to set the slowest drop rate of the hitch. The three choices are **12**, **16** and **20** second. The default setting is 12 seconds.

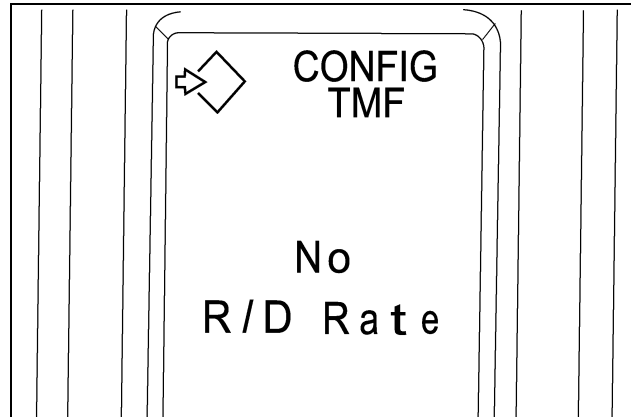


RD06A084

1. Press the **INCR** or **DECR** key to scroll through the selections.
2. Press the **PROG** key to select your choice of drop rate. The system will go to the next step.

### STEP 14

The lower line of the display will read **R/D Rate** (raise/drop rate). The top line of the display will show the present user setting for this (either yes or no). If **Yes** is selected, the system will use the drop rate setting to set the raise rate. If **No** is selected, the hitch will raise to the rate specified in Step 12. The default setting for this step is **No**.

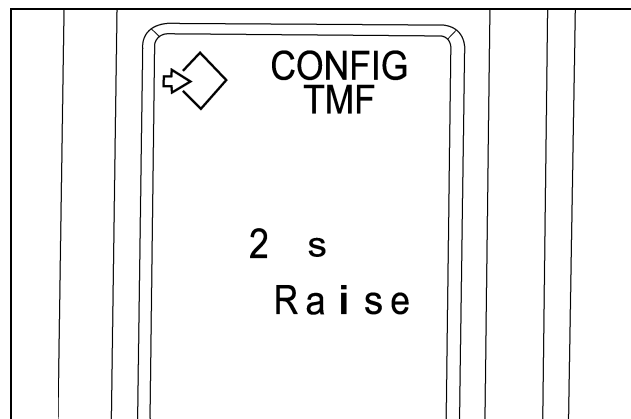


MD05F056

1. Press the **INCR** or **DECR** key to toggle between **Yes** and **No**.
2. Press the **PROG** key to select your choice. If **Yes** is selected, the system will go to Step 13. If **No** is selected, the system will go to Step 12.

### STEP 15

The lower line of the display will read **Raise**. This will allow you to choose the approximate desired time to fully raise the hitch. There are five choices for this: **2**, **4**, **6**, **8**, and **10** seconds. The default time is 2 seconds.

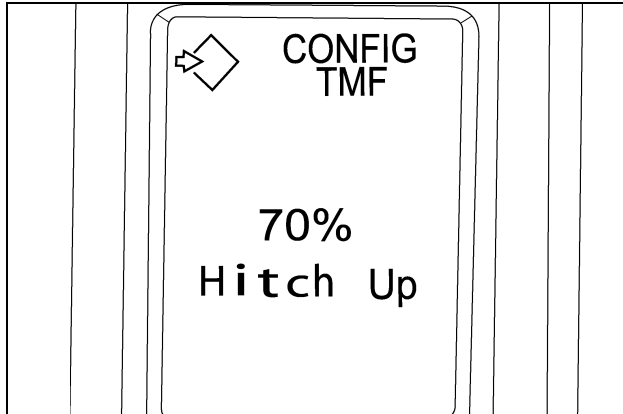


RD06A086

1. Press the **INCR** or **DECR** key to change the selection.
2. Press the **PROG** key to choose your selection. The system will go to Step 13 when your choice is made.

**STEP 16**

The lower line of the display will now read **Hitch Up**. This will allow you to choose the desired percentage of hitch travel that will be used to determine if the hitch is up for the Auto MFD and Auto Dif Lock functions. There are four choices: **60%**, **70%**, **80%** and **90%**. The default is 70%.

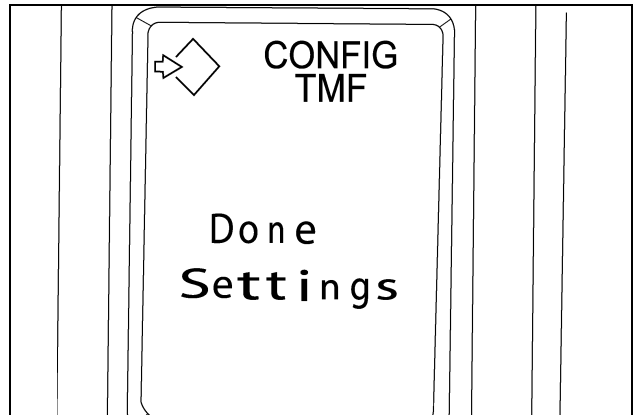


MD05F058

1. Press the **INCR** or **DECR** key to change the selection.
2. To select a percentage, press the **PROG** key. The system will go to step 14.

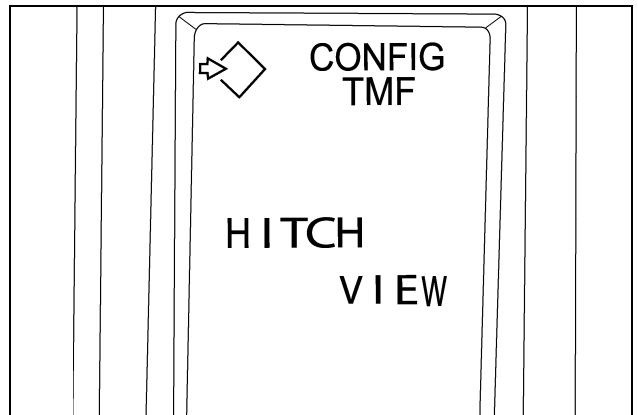
**STEP 17**

The display will now read **Done Settings**. This indicates that the user settings have been successfully programed.



RD06A088

1. Press the **PROG** key to return to **HITCH SETTINGS**, the main menu.



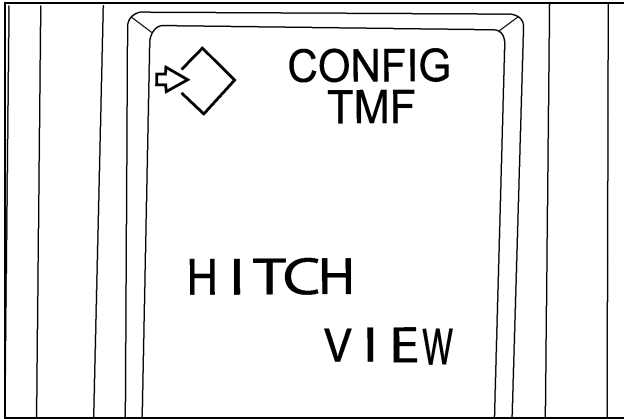
RD06A089

2. Press the **DECR** key to go to the **HITCH VIEW** menu.

## Hitch View Menu

The **Hitch View** Menu allows the user to see different parameters of the system. It is used to monitor the hitch system for diagnostic purpose. The tractor should be running.

### STEP 18



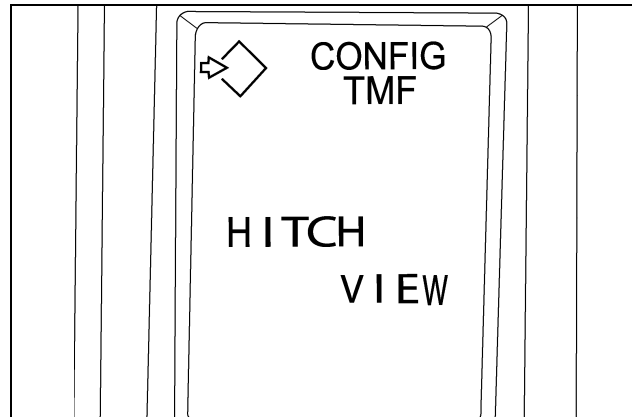
RD06A089

Press the **PROG** key with **HITCH VIEW** on the display. Press the **INCR** or **DECR** key to scroll through the menu.

Hitch view menu:

1. **RAISE mA**
2. **LOWER mA**
3. **PWMR** - Pulse width modulation count raise
4. **PWML** - Pulse width modulation count lower
5. **R DRAFT** - Software count right load pin
6. **L DRAFT** - Software count left load pin
7. **POS** - Hitch feedback position measured in millivolts

### STEP 19

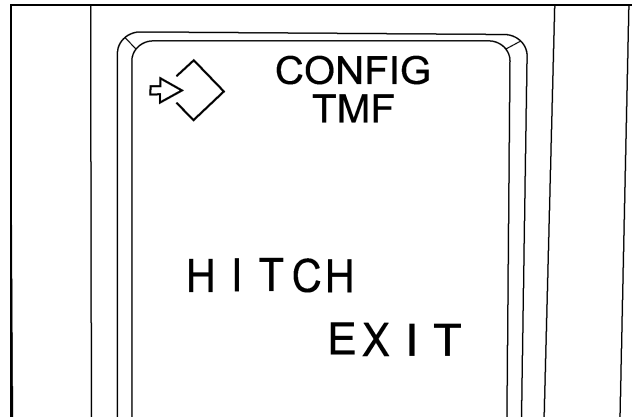


RD06A089

Press the **PROG** key. The display will now read **HITCH VIEW**.

Press **DECR** key to go to **HITCH NVM**, or to **HITCH EXIT**.

### STEP 20



MD05F063A

Press the **PROG** key to exit the hitch menus

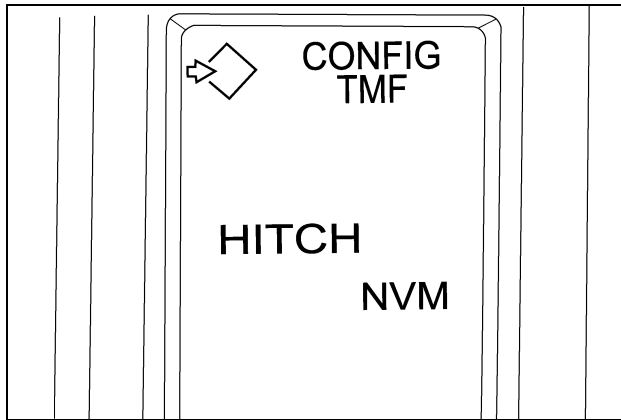
### STEP 21

Cycle the key switch **OFF**, then **ON**. Check to see if there are any fault codes. Erase any fault codes if they exist.

## Hitch NVM Menu

The **Hitch NVM** Menu allows the user to see the calibration values that are stored.

### STEP 22



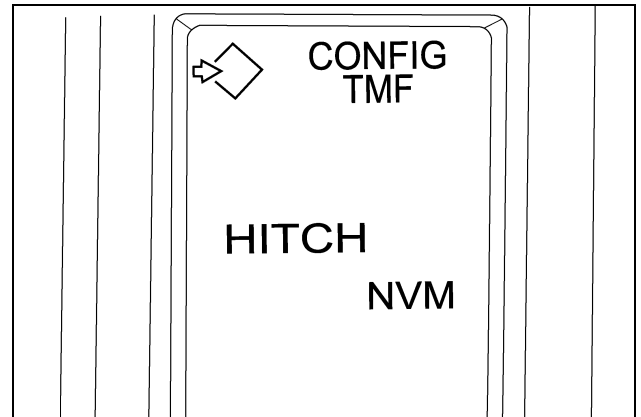
RD06A091

Press the **PROG** key with **HITCH NVM** on the display. Press the **INCR** or **DECR** key to scroll through the menu.

Hitch NVM menu:

1. **PWMLT** - Pulse Width Modulation threshold for lower valve
2. **PWMRT** - Pulse Width Modulation threshold for raise valve
3. **POS MIN**- Count # of voltage reading when hitch is at minimum
4. **r offset**- Count # of no load voltage reading on right load pin
5. **l offset**- Count # of no load voltage reading on left load pin
6. **aaa1** - Count # used to map position command range and the hitch position range
7. **posrange**- Count #indicating the full hitch position travel
8. **Type** - Indicates tractor family series and model

### STEP 23

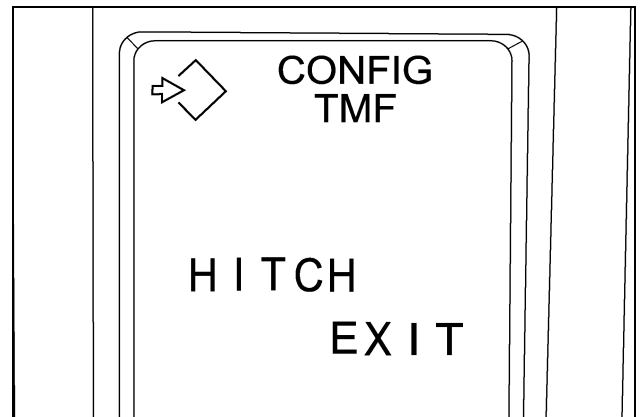


RD06A091

Press the **PROG** key. The display will now read **HITCH NVM**.

Press **DECR** key to go to **HITCH EXIT**.

### STEP 24



MD05F063A

Press the **PROG** key to exit the hitch menus

### STEP 25

Cycle the key switch **OFF**, then **ON**. Check to see if there are any fault codes. Erase any fault codes if they exist.

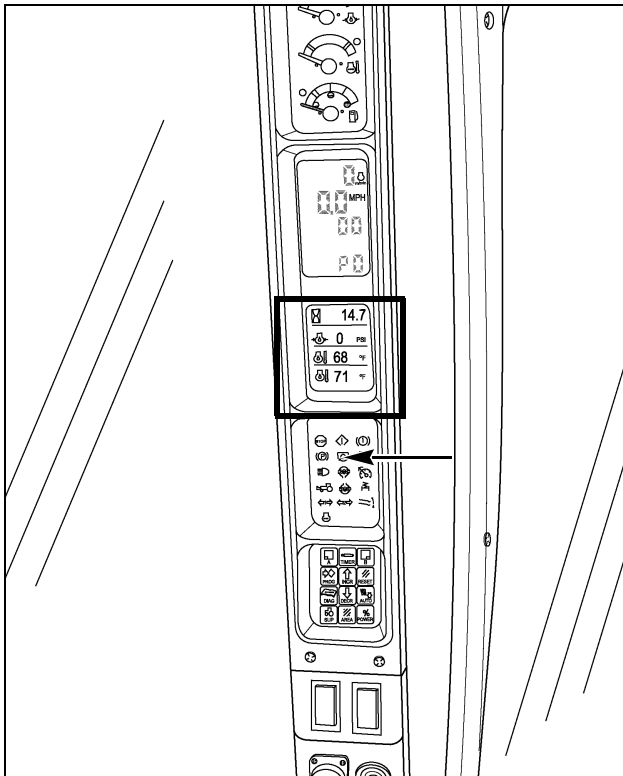
## PTO SYSTEM CONFIGURATION

### General Information

**NOTE:** The standard instrumentation and armrest controllers must be calibrated before the AUX/HITCH/PTO controller can be configured.

**NOTE:** AUX/HITCH/PTO controller is also referred to as Tractor Multi Function TMF Controller.

The AUX/HITCH/PTO controller configuration is performed through the programmable display on the standard instrumentation.

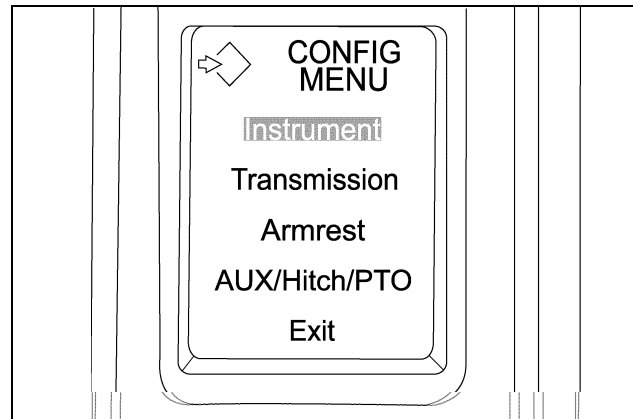


MD05F002

### PTO Main Menu

**NOTE:** Controller programming can only be entered within the first 10 seconds of turning the key switch to the on or run position.

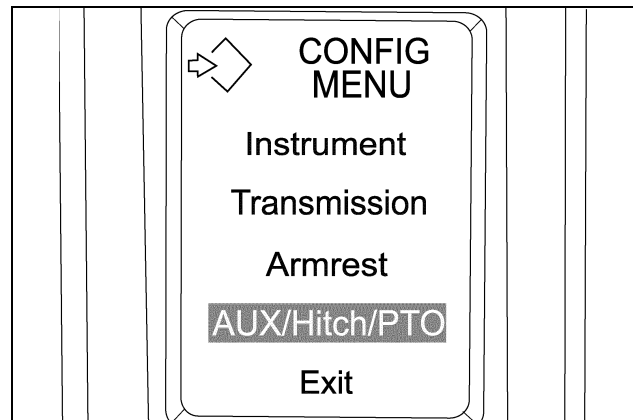
#### STEP 1



RD05G056

Turn the key switch to the ON position. Push the **PROG** key and hold for two seconds within the first ten seconds of turning on the key switch. A short beep will indicate that the program mode has been accessed and the display will read **CONFIG MENU**.

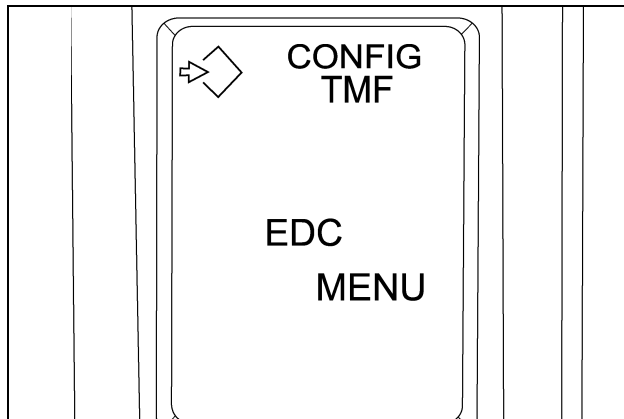
#### STEP 2



RD06A059

Press the **DECR** key until the display reads **AUX/HITCH/PTO**. Press the **PROG** key.

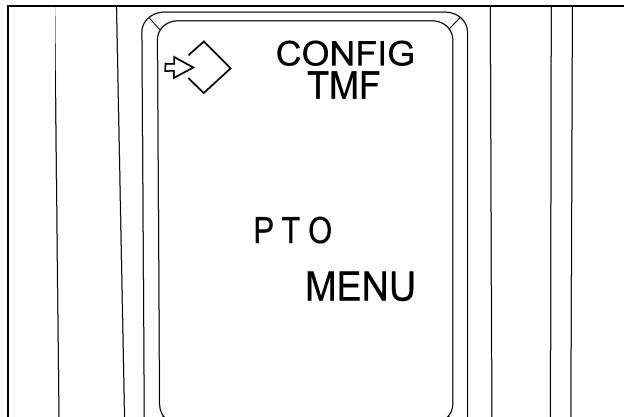
### STEP 3



RD06A061

The display will read **EDC MENU**. Press the **DECR** key.

### STEP 4



RD06A062

The display should read **PTO MENU**. Press the **PROG** key to enter the main menu for the PTO system.

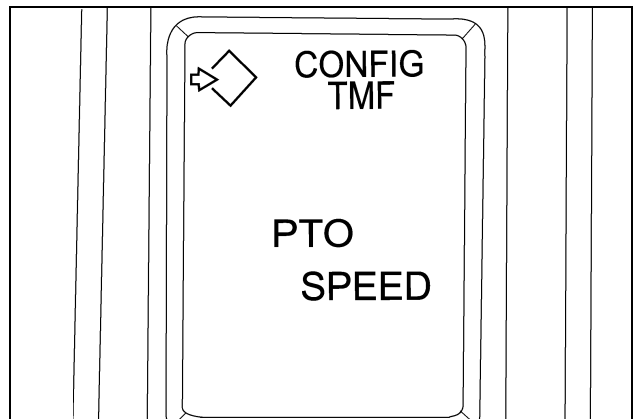
There are three operations under the main PTO menu.

1. **PTO SPEED** - Selects either a one or two speed PTO.
2. **PTO VIEW** - Allows the operator to view PTO software version and the ratio between the engine speed and the PTO shaft speed.
3. **PTO RESET** - Reset PTO Cal current
4. **PTO EXIT** - Returns to the main menu.

The **INCR** and **DECR** keys are used to toggle between these menus.

## PTO Speed Menu

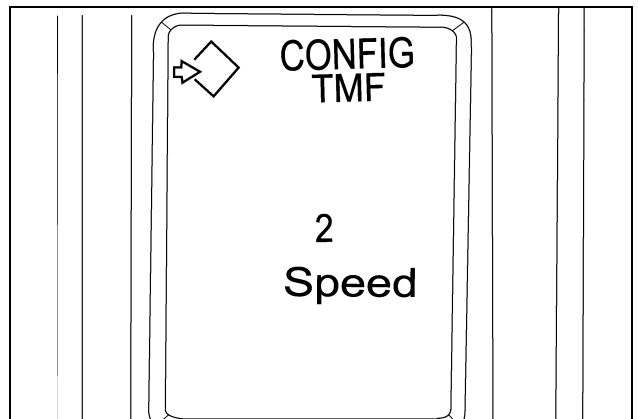
### STEP 5



RD06A111

The display will read **PTO SPEED**. Press the **PROG** key again. Use the **INCR** or **DECR** key to toggle between 1 and 2 and choose the number that applies to the number of PTO speeds that the tractor has.

### STEP 6

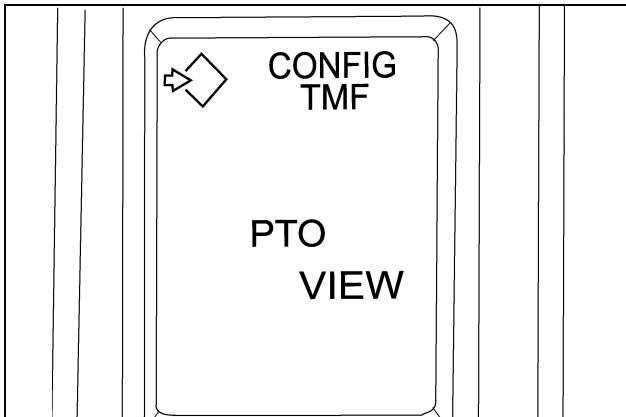


RD05F137

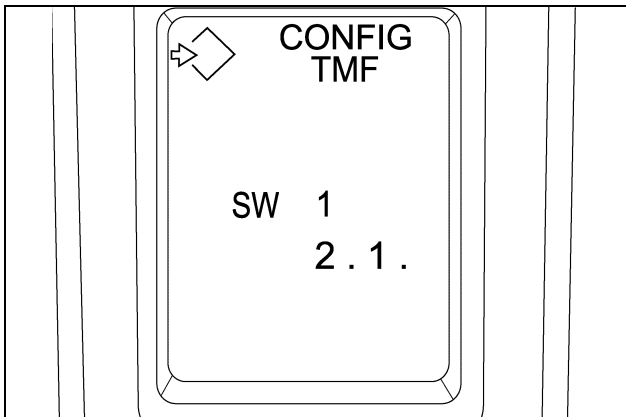
Press the **PROG** key to record your choice. The display will read (1) or (2) SPEED.

## View Menu

### STEP 7



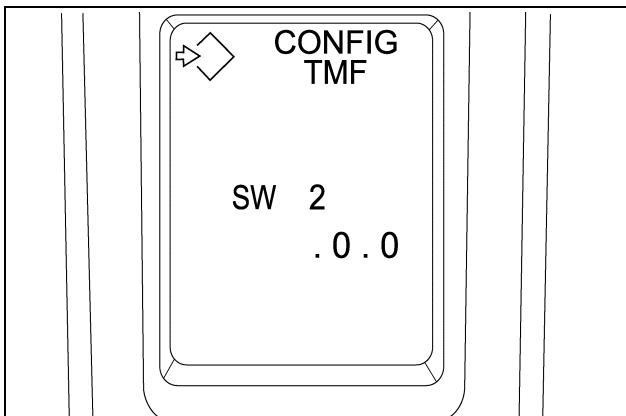
RD06A112



RD05F139A

Press the **DECR** key. The menu will read **PTO VIEW**. Press the **PROG** key. The display will read **SW 1**. This is the first part of the software version number.

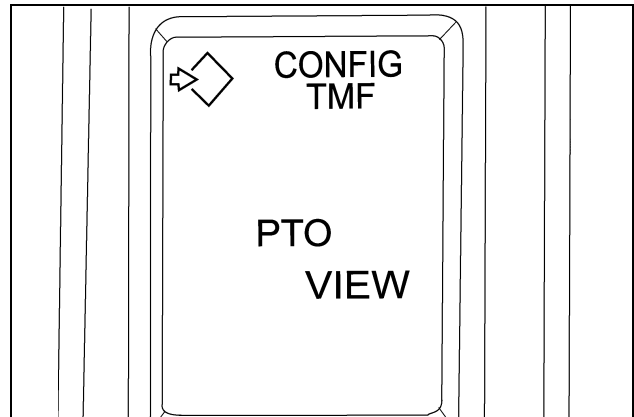
### STEP 8



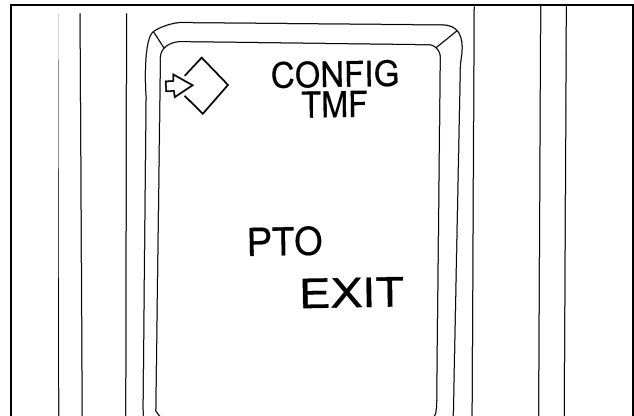
RD05F140A

Press the **PROG** key. The display will read **SW 2**. This is the second part of the software version number.

### STEP 9



RD06A112



RD06A114

Press the **PROG** key. The display will read **PTO VIEW**. Press The **DECR** key and the display will read **PTO EXIT**. Pressing the **PROG** key will exit from PTO configuration.

# **Section 90**

## **Chapter 1**

### **PEDAL AND PEDAL SWITCH ADJUSTMENTS**

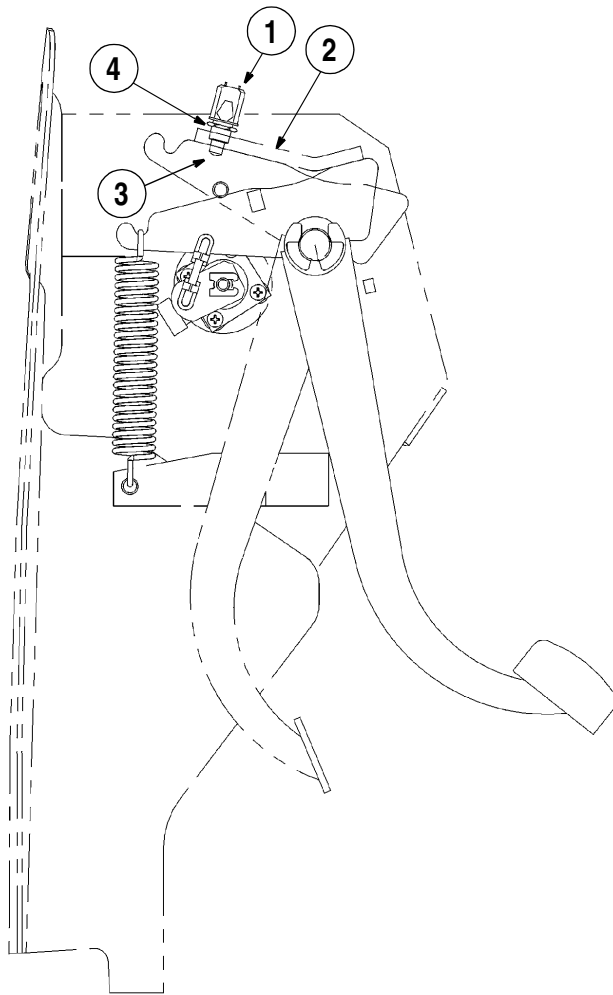


**TABLE OF CONTENTS**

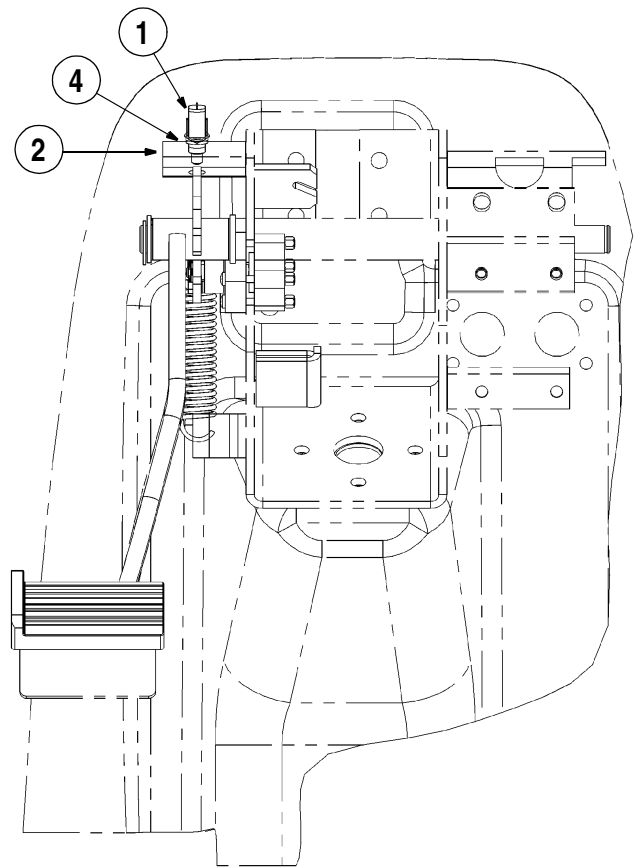
INCHING PEDAL SWITCH ADJUSTMENT ..... 90-1-3

BRAKE PEDAL ADJUSTMENTS ..... 90-1-4

## INCHING PEDAL SWITCH ADJUSTMENT



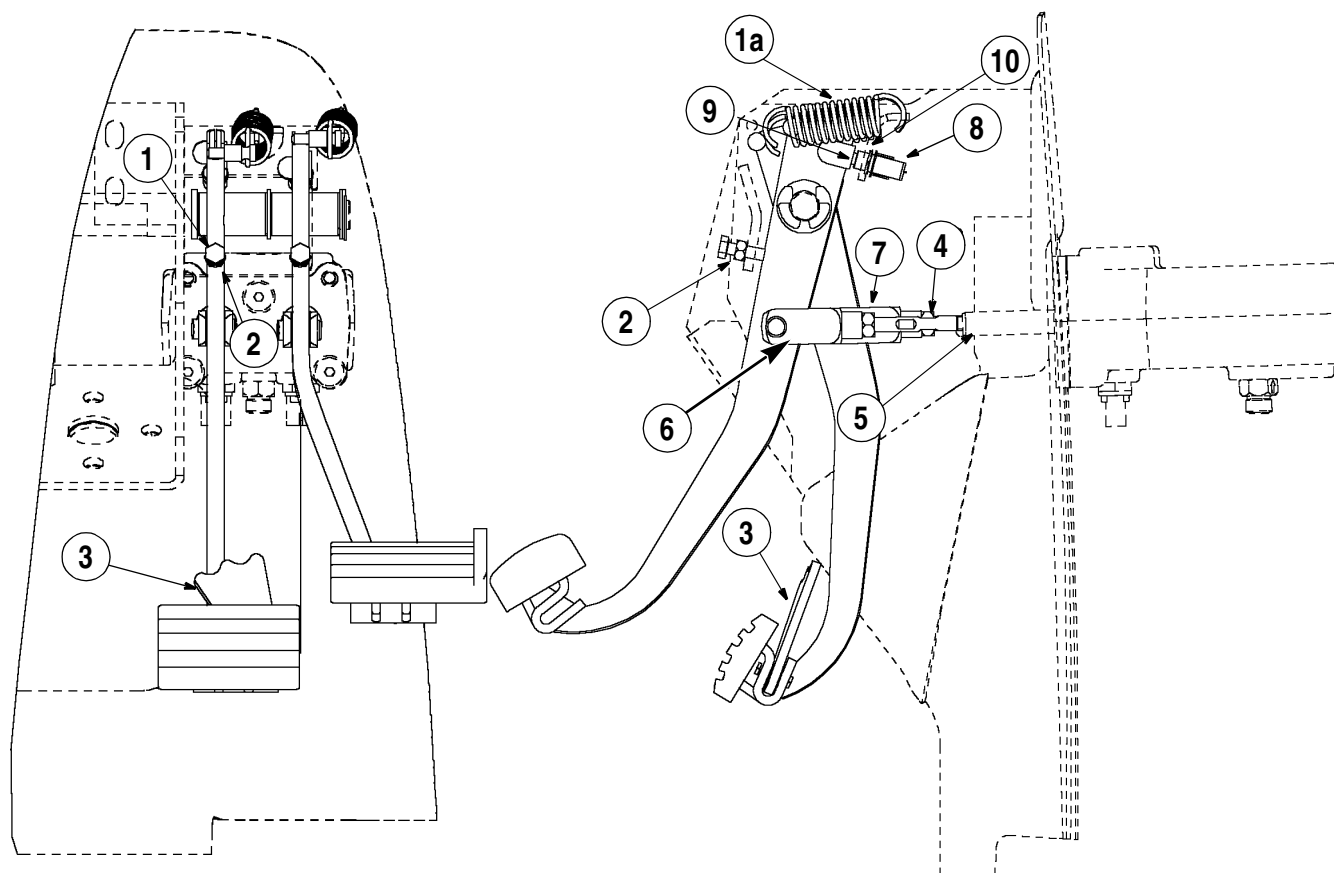
RT97K033



RT97K034

- A. Install the switch (1) into the mounting bracket (2).
- B. Turn the switch into the bracket until the tip of the switch plunger (3) is even with the mounting bracket.
- C. Turn the switch an additional 2.3 turns so that the switch plunger protrudes from the bracket approximately 4.0 mm.
- D. Tighten the switch locking nuts (4) to secure the switch in position. Connect the switch to the wire harness.
- E. Turn the key switch to the ON position. Enter the TRANS VIEW menu in the display. Go to the inching pedal potentiometer position menu to observe the pedal position.
- F. Shift the tractor out of park. Slowly cycle the inching pedal while watching the display. The display should read 100% when fully up and smoothly go down to 0% when fully depressed.
- G. The switch should turn OFF and ON (make a click noise) between 5 and 15% clutch travel as shown on the display.
- H. If the switch does not activate between this range, loosen the lock nut (4) and turn the switch (1) as required until the switch will activate between 7 and 14% of pedal travel as shown on the display. Tighten the lock nut.

## BRAKE PEDAL ADJUSTMENTS



RI02K092

RI02K093

### Brake Pedal Stop Adjustments

- A. Use the stop adjusting screw (1) to adjust the left brake pedal to the same height as the clutch pedal. Tighten the lock nut (2) when done.
- B. Adjust the right brake pedal to the same height as the left pedal. Be sure that the brake pedal lock (3) will engage the right pedal easily. Tighten the lock nut when done.

**NOTE:** Be sure that there is no free play in the pedal springs (1a) after adjustment is complete. If there is, turn the adjustment screw enough to remove any looseness in the spring.

### Brake Link Rod Adjustment

- C. Adjust the length of the left brake link rod (4) so that it just touches the bottom of the brake valve poppet sleeve(5) when the brake pedal is fully extended. Tighten the clevis(6) lock nuts (7) when done. Repeat for the right brake.

### Brake Light Switch Adjustment

- D. Adjust the left brake light switch (8) until the switch plunger (9) just touches the left pedal. Turn the switch in an additional 1 to 1 1/4 turns. Tighten the lock nut (10). Repeat the procedure for the right brake pedal switch.

# **Section 90**

## **Chapter 2**

### **CAB RAISE / REMOVAL AND INSTALLATION**

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SPECIAL TORQUES ..... 90-2-3

SPECIAL TOOLS ..... 90-2-3

CAB RAISE PROCEDURE ..... 90-2-4

CAB LOWERING PROCEDURE ..... 90-2-7

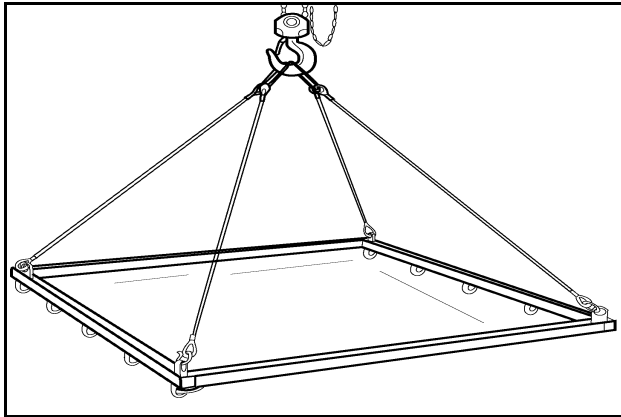
CAB REMOVAL ..... 90-2-10

CAB INSTALLATION ..... 90-2-17

## SPECIAL TORQUES

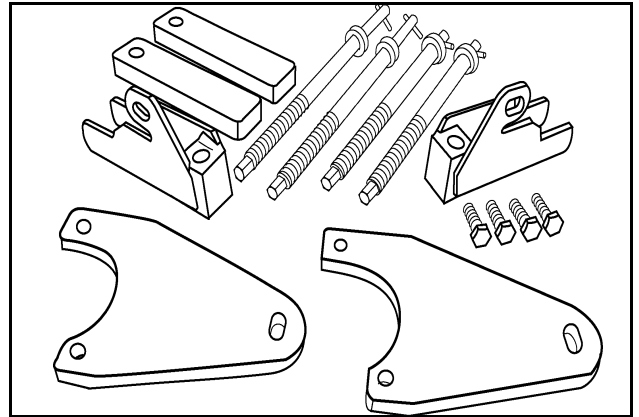
Cab Mounting Bolt to Threaded Flat Plate .....	47 to 61 Nm (35 to 45 lb. ft.)
Cab Mounting Bolt Nut .....	190 to 244 Nm (140 to 180 lb. ft.)

## SPECIAL TOOLS



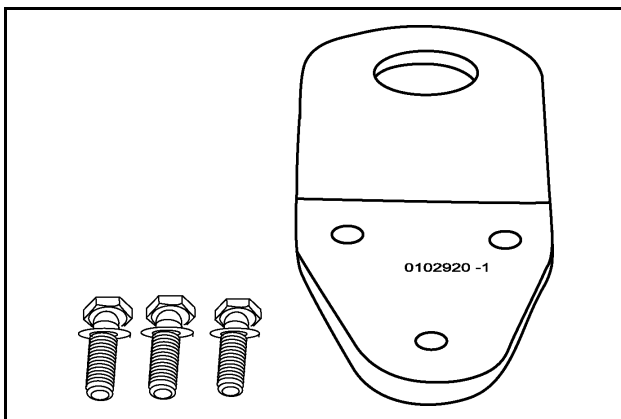
38-8R2

Cab Lift Tool CAS2531



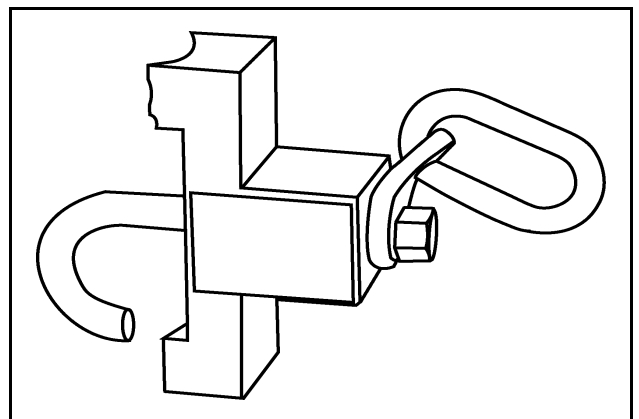
RD02E109

Cab Raising Bracket Kit CAS2577



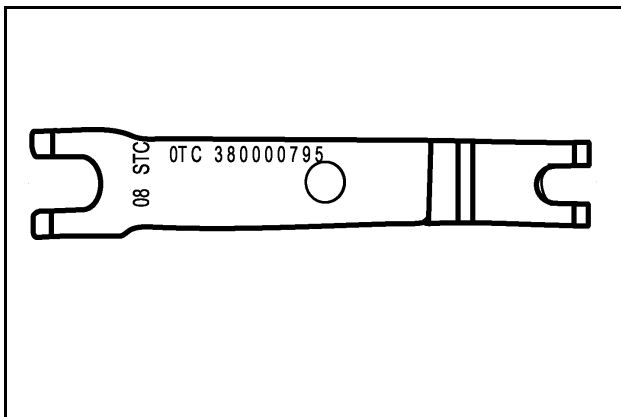
RD02E108

Front Cab Lifting Bracket CAS2529-1  
(Part Of CAS2529 Kit)



Q4

Rear Cab Lifting Bracket CAS2529-2  
(Part Of CAS2529 Kit)

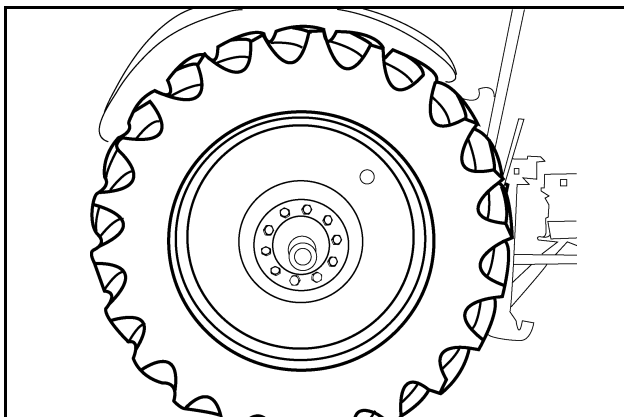


RD03C059

Steering Line Quick Disconnect Tool 380000795

## CAB RAISE PROCEDURE

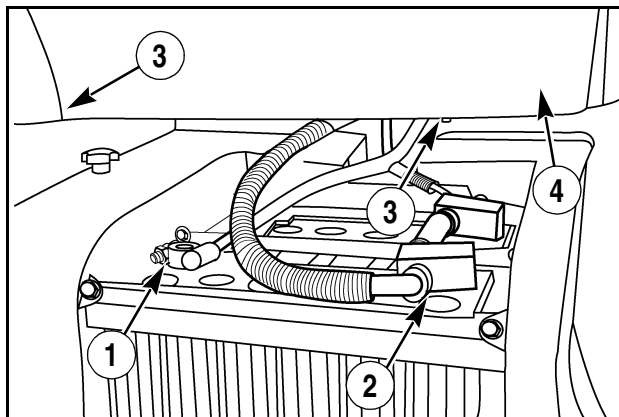
### STEP 1



RD02C070

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Place blocks in front of and behind the rear wheels. Start the engine and fully raise the rear hitch. Turn off the engine and remove the key.

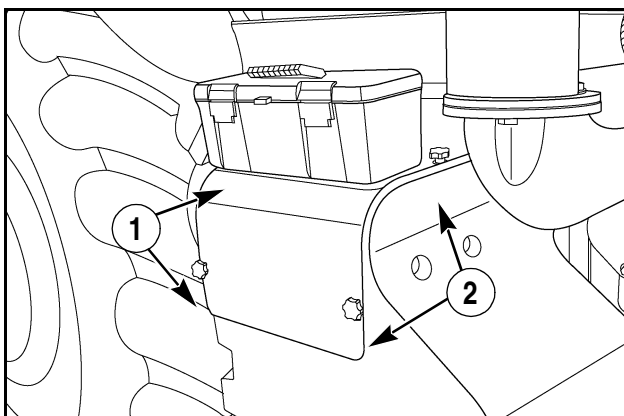
### STEP 3



RD02E069

Disconnect the negative (-) battery cable (1), first. Disconnect the positive (+) battery cable (2). Remove the three screws (3) securing the right front cab panel (4). Remove the two screws securing the left front cab panel. Remove both panels from the tractor.

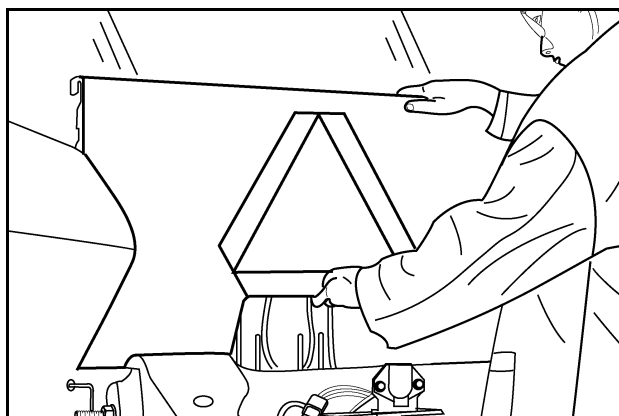
### STEP 2



RD05K002

Loosen the two left thumbscrews (1), remove the two right thumbscrews (2) and remove the toolbox and battery cover.

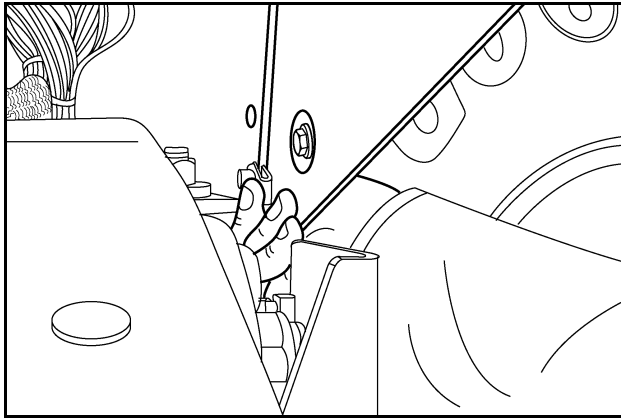
### STEP 4



76-33

Open the rear window. Remove the two bolts securing the rear cab panel to the cab. Remove the panel.

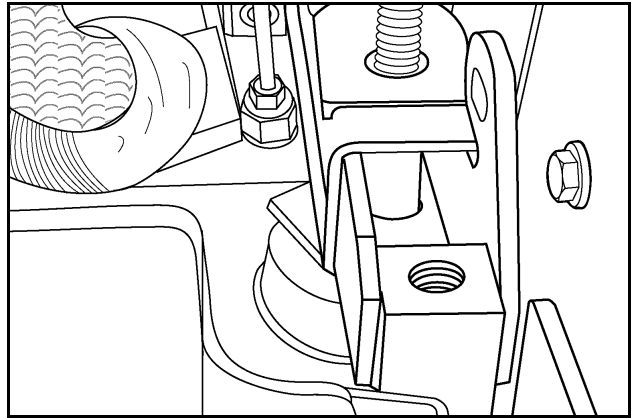
### STEP 5



77-2

If equipped with rear fenders, remove the lower fender retaining bolt and spring nut from the right rear fender.

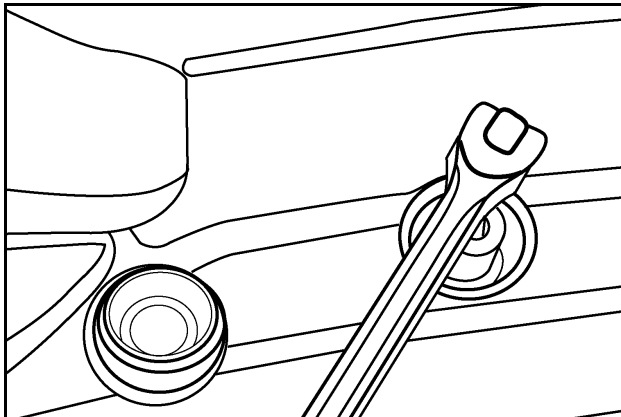
### STEP 7



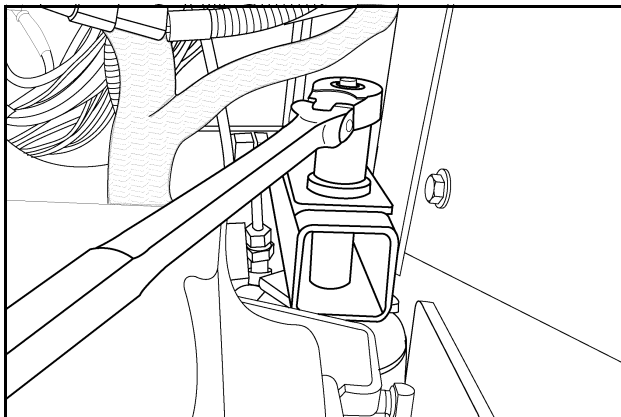
RD02F103

Install the right rear cab raising bracket CAS2577-1 (from CAS2577 Cab Raising Bracket Kit) into the right rear cab support tube.

### STEP 6



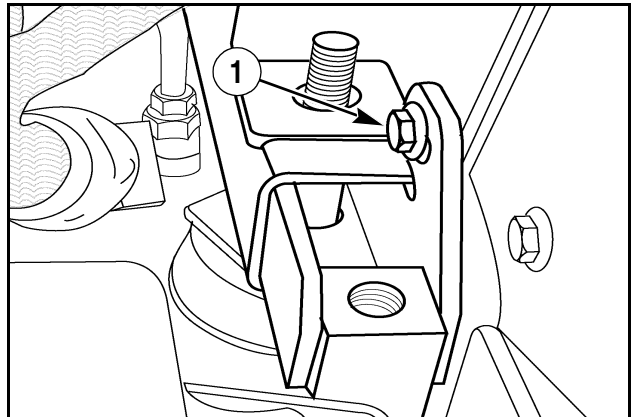
RD02C143



RD02F105

Remove the cab floor plugs. Remove the nuts and washers from the front cab mounts. Remove the rear cab mount nuts and washers.

### STEP 8

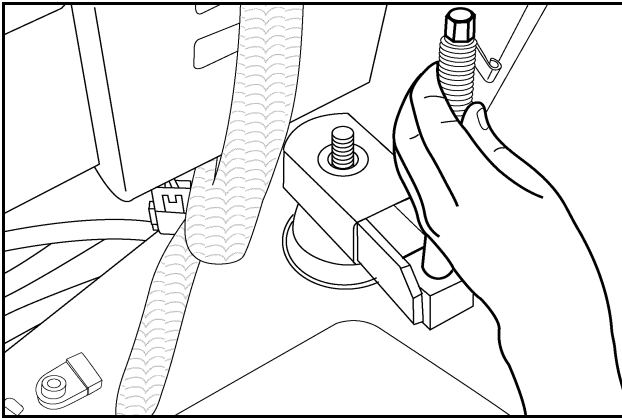


RD02F104

Install a bolt (1), and a washer from the cab raising bracket kit through the slot in the raising bracket and the hole in the cab side panel. Install a washer and a nut on the bolt threads and loosely tighten.

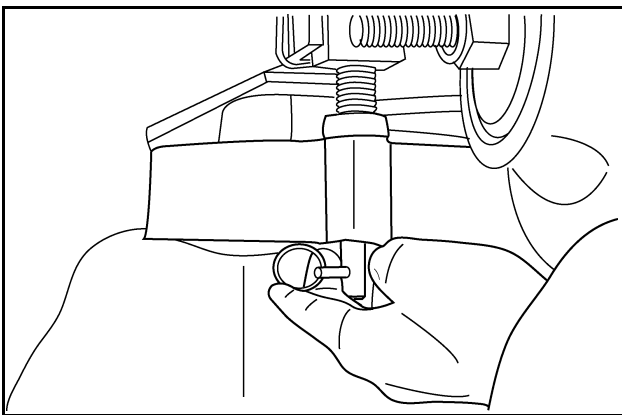


## STEP 9



Place one of the load bearings from CAS2577 under the rear cab raising bracket. Insert one of the longer threaded rods from the kit through the rear cab raising bracket, the load bearing, and the through hole in the cab support bracket. Thread the rod through the raising bracket until the threads contact the load bearing.

## STEP 10



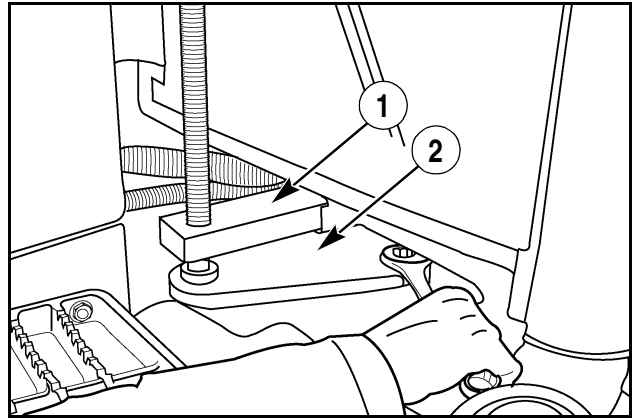
Insert the locking pin through the bottom of the threaded rod. Tighten the nut on the bolt through the raising bracket and the cab side panel.

**NOTE:** For photographic purposes, the locking pin shown is on the left rear side of the cab.

## STEP 11

Install the left rear cab raising bracket CAS2577-2 into the left rear cab support tube. Repeat Steps 7 through 9 on the left rear side of the cab.

## STEP 12



Install the upper cab raising bracket (1) from CAS2577 Cab Raising Bracket Kit into the left front cab support tube. Install CAS2577-3 lower raising plate (2) on the front cab mounting bracket, using two of the bolts from the kit. Place a load bearing on top of the lower raising plate and insert one of the shorter threaded rods through the upper raising bracket. Thread the rod through the raising bracket until the threads contact the load bearing. Insert the locking pin through the bottom of the threaded rod. Repeat this procedure on the opposite side of the cab.

**NOTE:** For easier installation of the right hand lower raising plate (2), raise the front left side up a few inches.

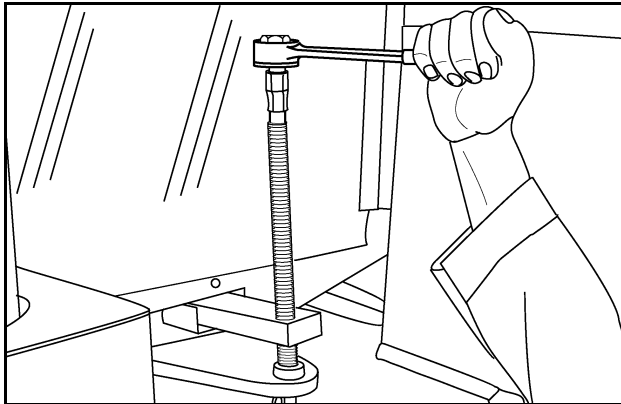
## STEP 13

Turn in the four threaded rods on the cab raising brackets in equal amounts to evenly lift the cab.

**NOTE:** Monitor all lines when raising or lowering the cab to prevent breakage or bending of lines.

## CAB LOWERING PROCEDURE

### STEP 14

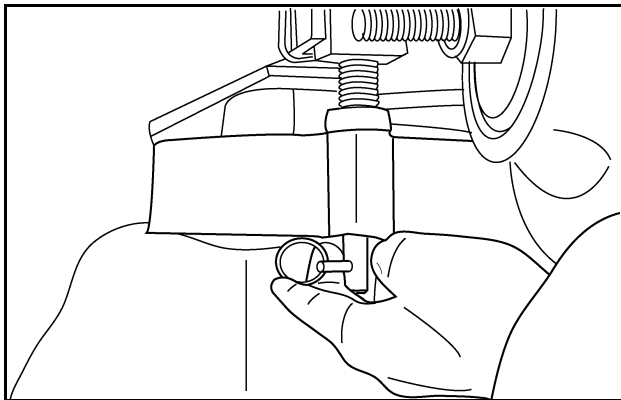


75-13

Turn out the four threaded rods on the cab raising brackets in equal amounts to evenly lower the cab. Make sure the sleeves on the cab mounting bolts align with the holes in the cab support tubes. Begin lowering the tractor cab. Check for pinched cables, lines, or hoses. Fully lower the cab.

**NOTE:** The cab must be evenly lowered. The cab bolt mounting sleeves can bind in the cab support tube holes, so the cab cannot be lowered.

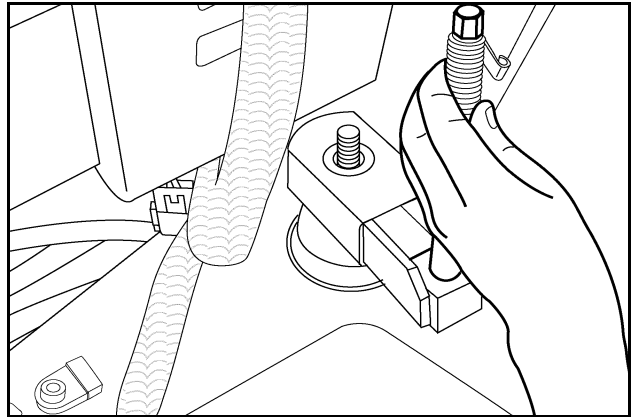
### STEP 15



77-36X

Remove the locking pin from the bottom of the threaded rod on the rear cab raising tool.

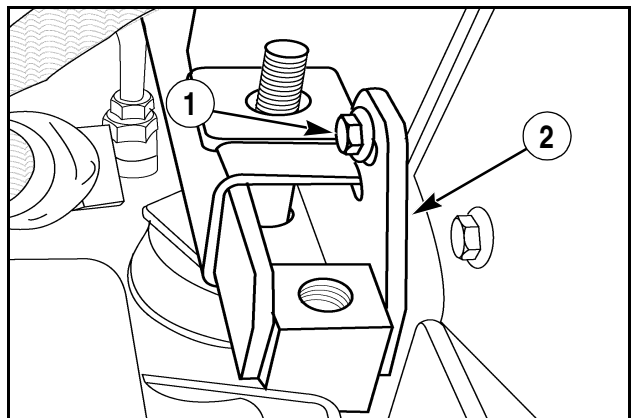
### STEP 16



77-23

Remove the threaded rod from the raising bracket. Remove the load bearing.

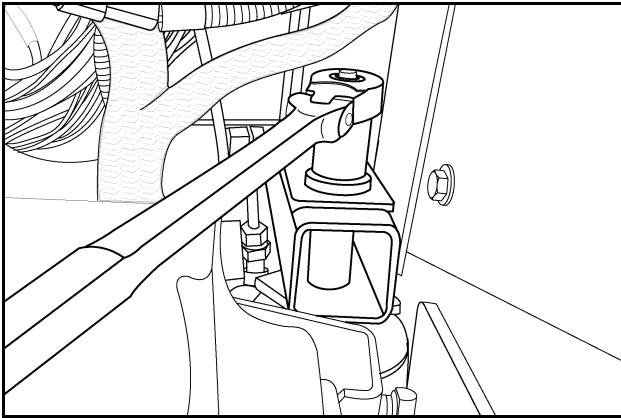
### STEP 17



RD02F104

Remove the bolt (1), nut, and the two washers from the cab side panel and the slot in the right rear raising bracket. Remove CAS2577-1 right rear raising bracket (2). Set the preload on the cab isomounts to a torque of 47 to 61 Nm (35 to 45 lb. ft.) by holding the square plate and tightening the bolt.

### STEP 18

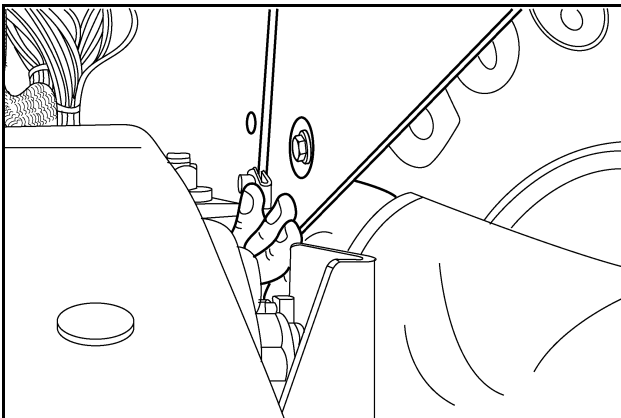


Install a new nut and the rear cab mount washer. Tighten the nut to a torque of 190 to 244 Nm (140 to 180 lb. ft.). Have an assistant hold the head of the bolt under the cab, if necessary.

### STEP 19

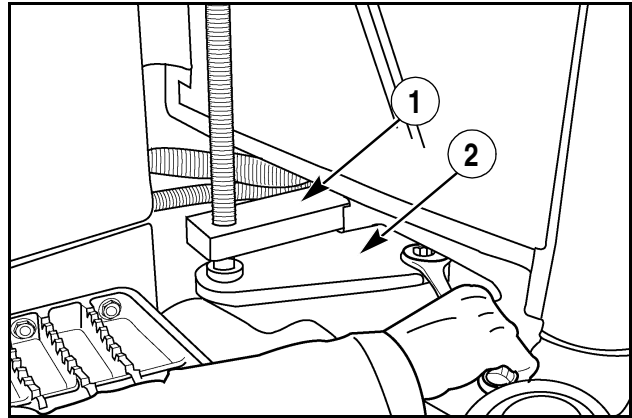
Repeat the procedures from Step 15 through Step 18 on the left rear side of the cab to remove CAS2577-2 cab raising bracket.

### STEP 20



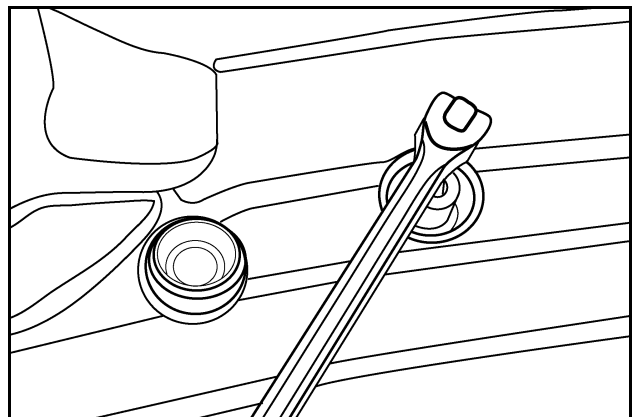
If equipped with rear fenders, install the lower fender retaining bolt and spring nut on the right rear fender.

### STEP 21



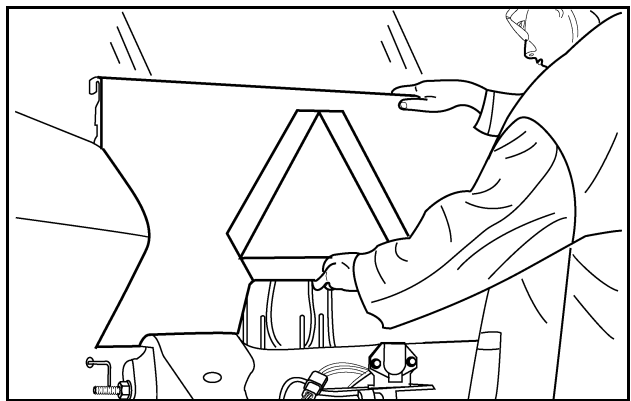
Remove the locking pin from bottom of the threaded rod on the front cab raising tool. Remove the threaded rod from the front cab upper raising bracket (1) and remove the bracket. Remove the load bearing. Detach CAS2577-3 lower raising plate (2) by removing the two bolts. Repeat this procedure on the opposite side of the cab.

### STEP 22



Set the preload on the front cab isomounts to a torque of 47 to 61 Nm (35 to 45 lb. ft.) by holding the square plate and tightening the bolt. Have an assistant hold the head of the bolt, if necessary. Install the front cab mount washer and a new nut. Tighten the nut to a torque of 190 to 244 Nm (140 to 180 lb. ft.) on both sides of the cab. Install the cab floor plug.

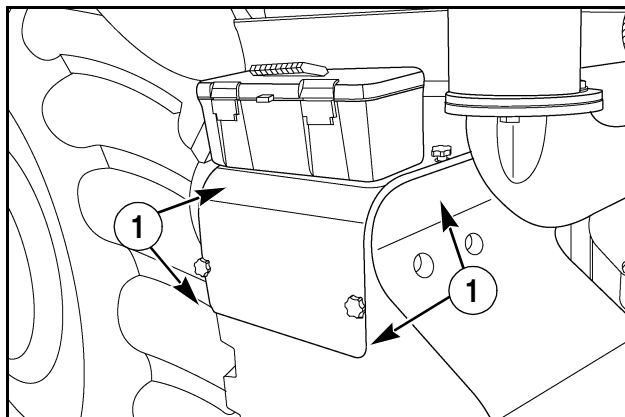
### STEP 23



76-33

Open the rear window. Install the two bolts securing the rear cab panel to the cab.

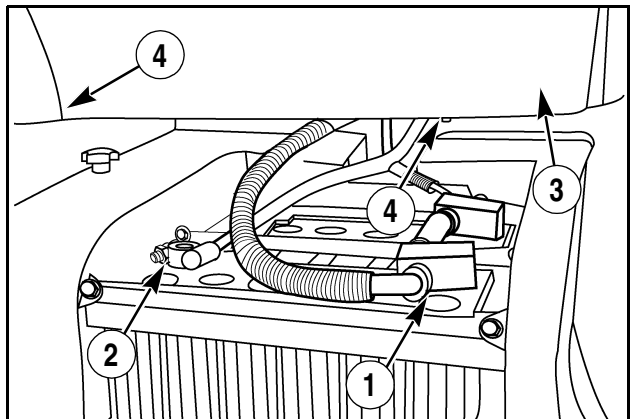
### STEP 25



RD05K002

Install the battery cover and tool box. Tighten the thumbscrews.

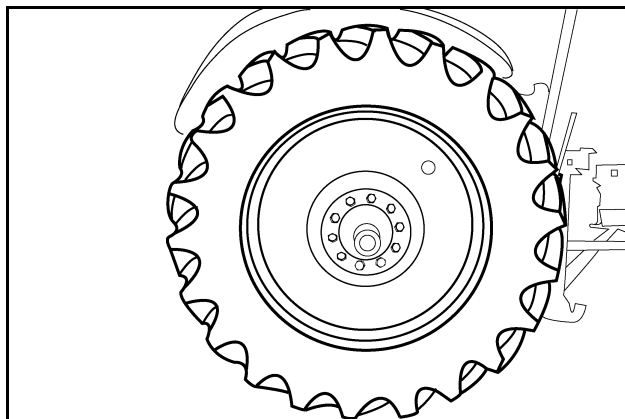
### STEP 24



RD02E069

Install the right panel (3). Install the three mounting screws (4) and tighten. Install the left panel and tighten the mounting screws. Install the positive (+) battery cable (1), first. Install the negative (-) battery cable (2).

### STEP 26

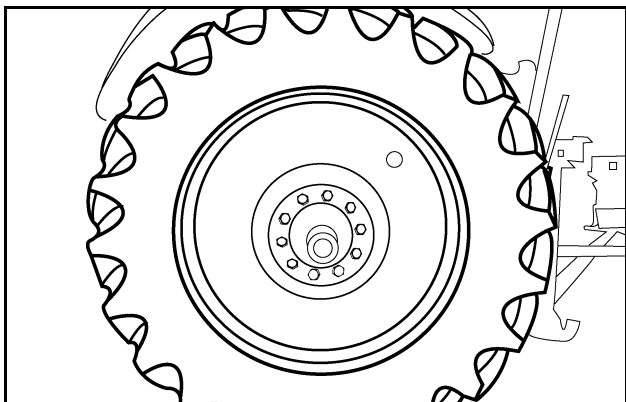


RD02C070

Make sure the transmission shift lever is in PARK. Start the engine and lower the rear hitch. Turn the engine off and remove the key. Remove the wheel blocks.

## CAB REMOVAL

### STEP 27

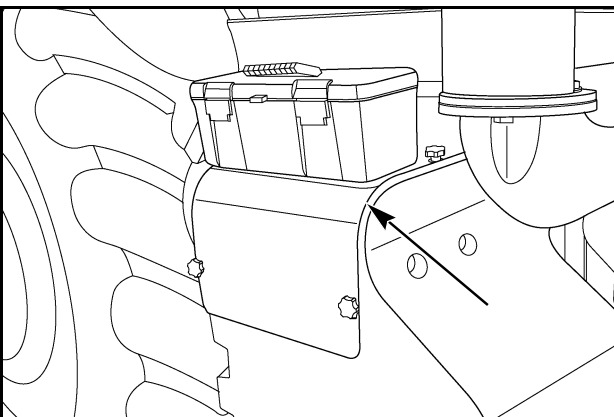


RD02C070

Park the tractor on a hard, level surface. Put the transmission shift lever in PARK. Turn off the engine and remove the key. Place blocks in front of and behind the front wheels. Drain the radiator on a cold engine. Refer to the Operator's Manual for cooling system capacity. Properly support the tractor and remove the rear wheels, if necessary.

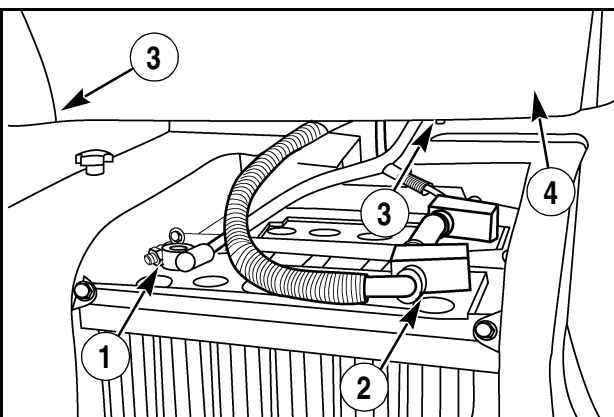
**NOTE:** It is not necessary to remove the rear wheels, but may be required to gain enough clearance at the tractor chassis and the top of the lift.

### STEP 28



RD05K002

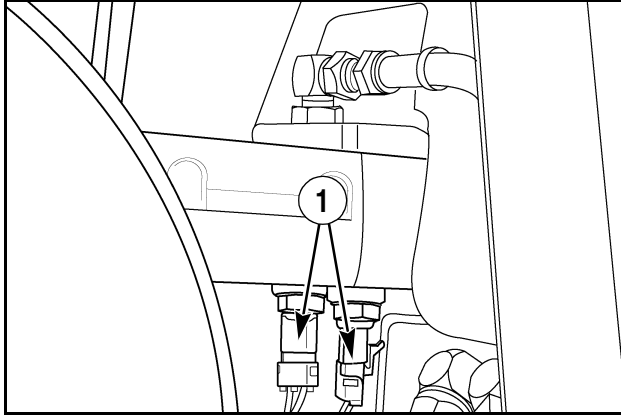
### STEP 29



RD02E069

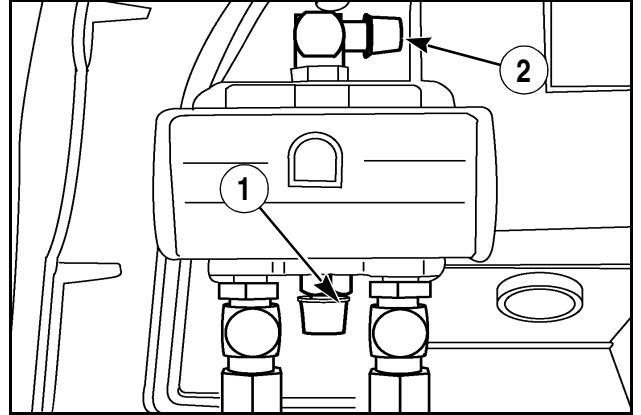
Disconnect the negative (-) battery cable (1), first. Disconnect the positive (+) battery cable (2). Remove the three screws (3) securing the right front cab panel (4). Remove the two screws securing the left front cab panel. Remove both panels from the tractor.

### STEP 30



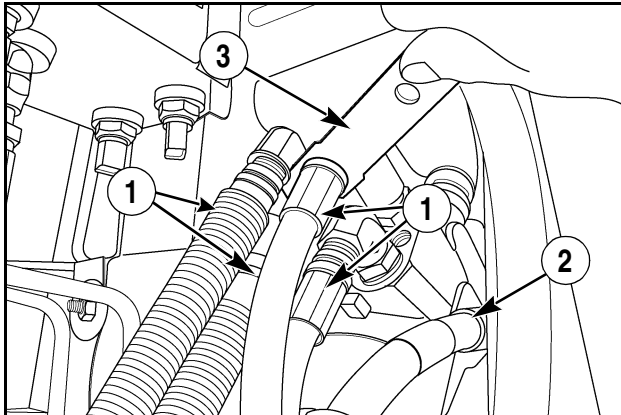
Identify, tag, and remove the wiring harnesses on the two brake light switches (1) on the brake valve.

### STEP 32



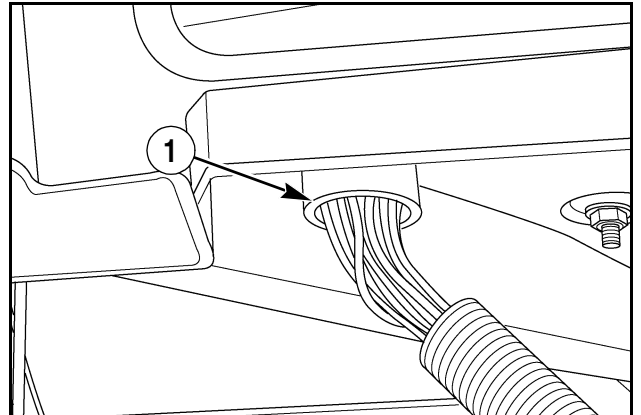
Identify, tag, and remove the brake valve supply (1) and return line to sump (2). Cap the lines and open fittings.

### STEP 31



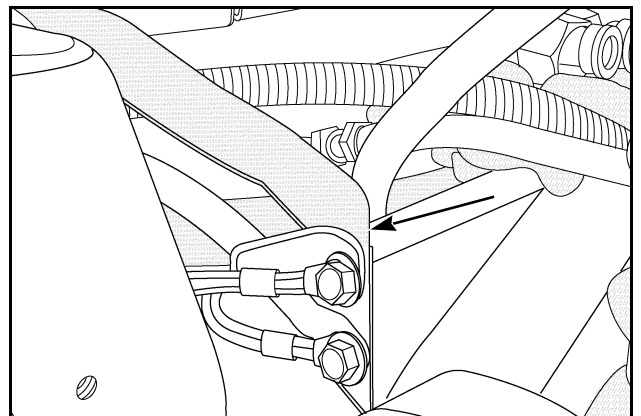
Identify, tag, and remove the four hydraulic hoses (1) and the steering sensing line (2) from the steering hand pump. Cap the lines and open fittings. If your tractor is equipped with quick disconnect fittings, use Special Tool 380000795 (3) to disconnect the lines.

### STEP 33



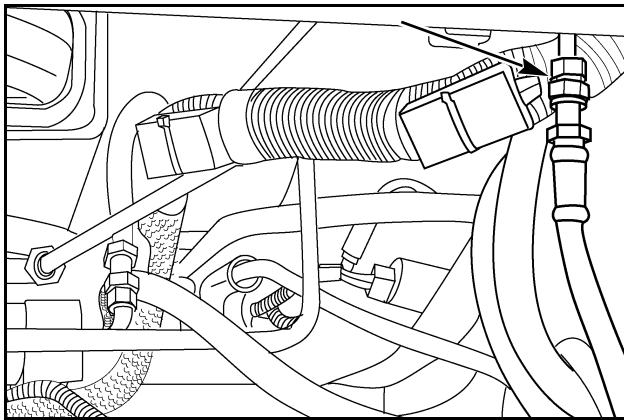
Remove the cab connector (1) at the right hand front side of the cab.

### STEP 34



Disconnect the cab ground strap.

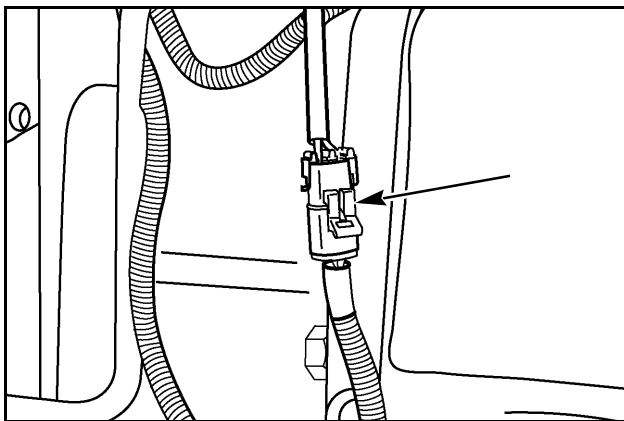
### STEP 35



RD02C121

Remove the supply line to the left and right rear brake.

### STEP 36

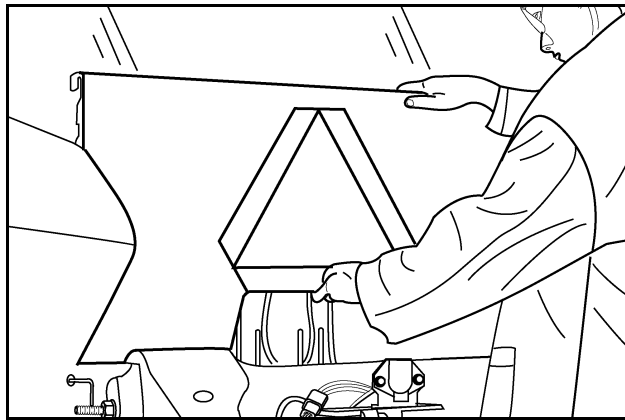


RD02C124

Remove the electrical connector from the cab pressurization blower.

**NOTE:** Fuel tank removed for photographic purposes.

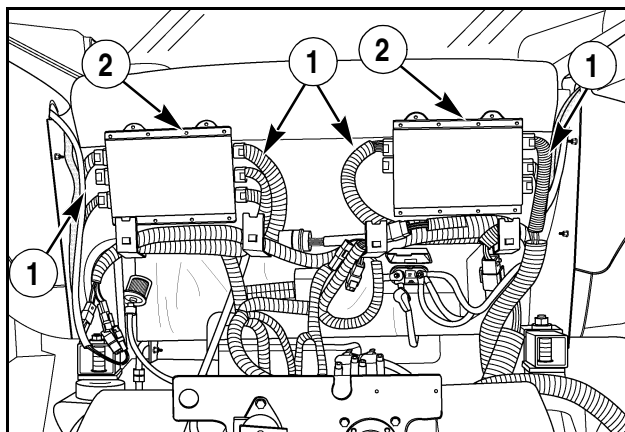
### STEP 37



76-33

Open the rear window. Remove the two bolts securing the rear cab panel to the cab. Remove the panel.

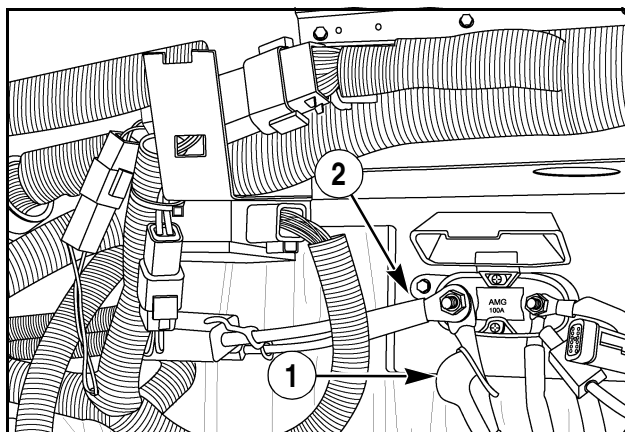
### STEP 38



RD05M054

Tag and remove all connectors (1) from the controllers (2).

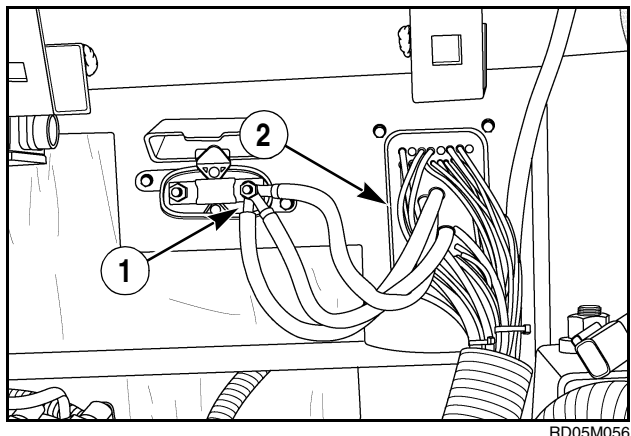
### STEP 39



RD05M055

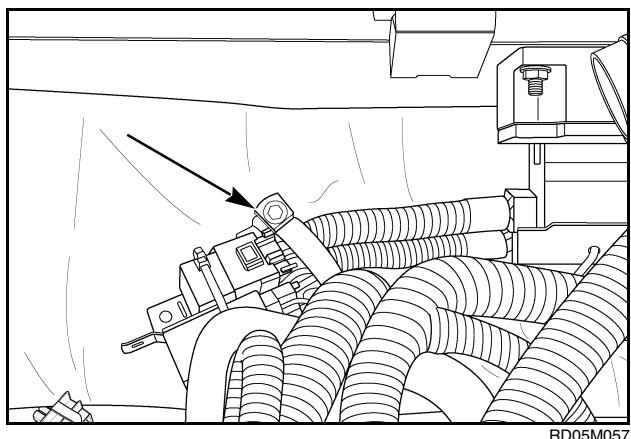
Remove the cab power supply cable (1) and ISO 11783 (2) (if equipped) at the right rear of the cab.

### STEP 40



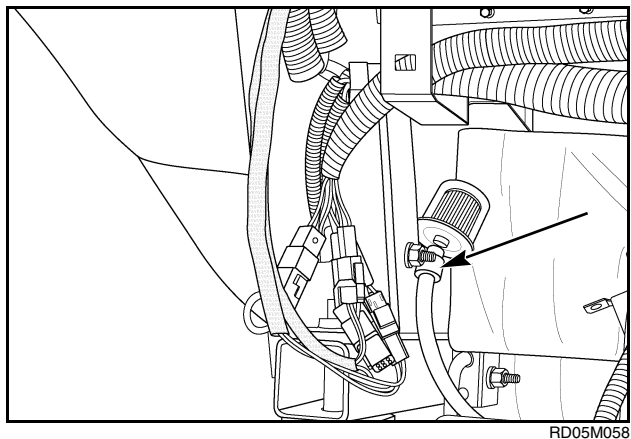
Disconnect the power cables (1) and remove the cab connector (2).

### STEP 41



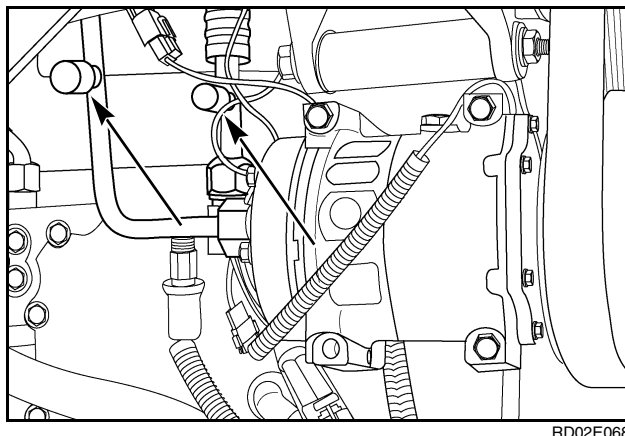
Remove the ISO 11783 harness clamp (if equipped) at the rear of the cab.

### STEP 42



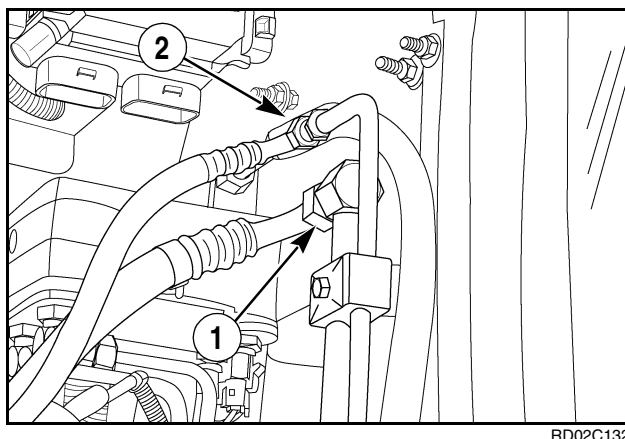
Remove the fuel tank vent filter clamp.

### STEP 43



Refer to the Air Conditioning Component Service section in this manual and evacuate the freon from the air-conditioning system at the capped line fittings (arrows) attached to the rear of the air conditioning compressor.

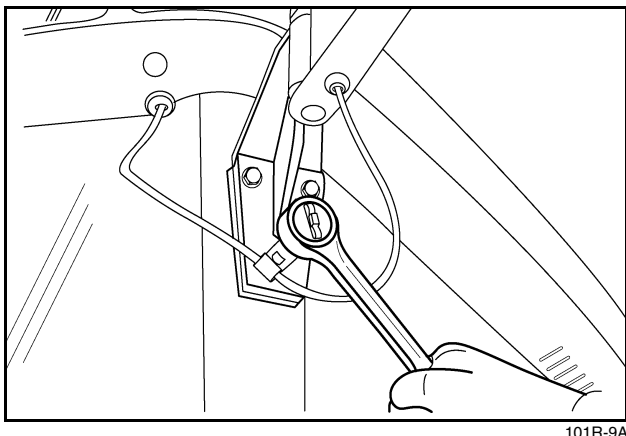
### STEP 44



Once the A/C system has been evacuated, disconnect the A/C lines at the cab firewall. Discard the O-rings.



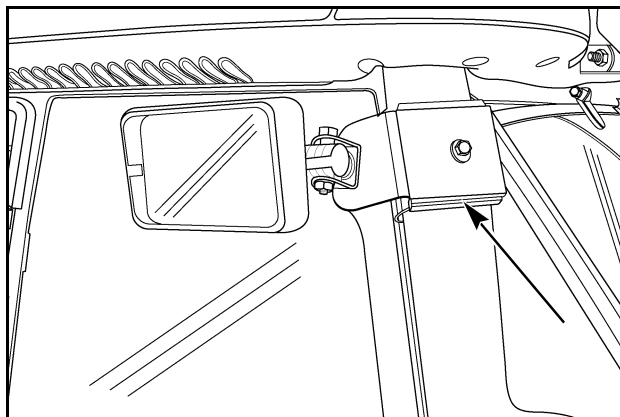
### STEP 45



101R-9A

Remove the three mirror retaining bolts and the electrical plug, if equipped. Remove the mirrors.

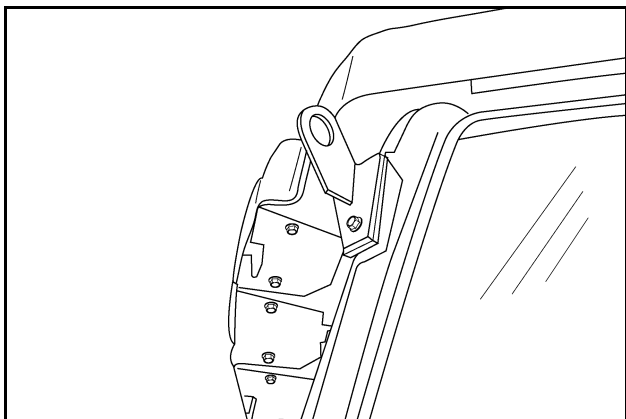
### STEP 48



RD05M051

Remove the right and left side mount light (if equipped).

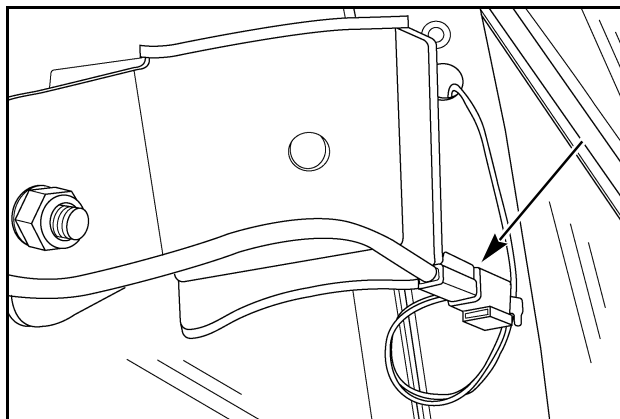
### STEP 46



RD02C139

Install CAS2529-1 front cab lifting brackets.

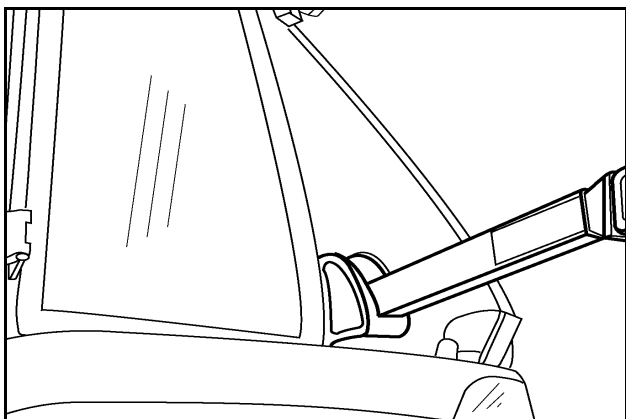
### STEP 49



RD05M052

Disconnect the right and left side light harness (if equipped).

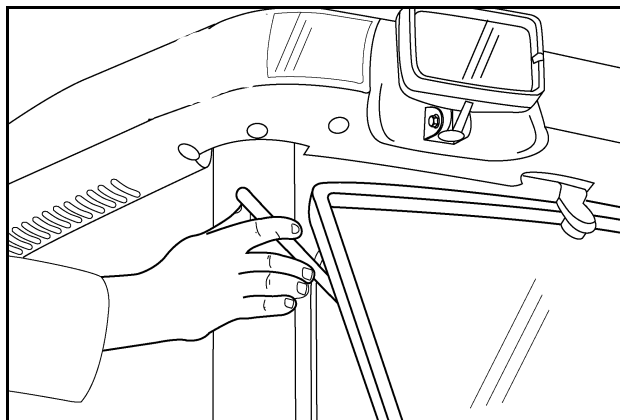
### STEP 47



RD02E104

Loosen the lower bolt, remove the upper bolt, and swing the tractor rear warning marker lights down. Finger tighten the upper bolt.

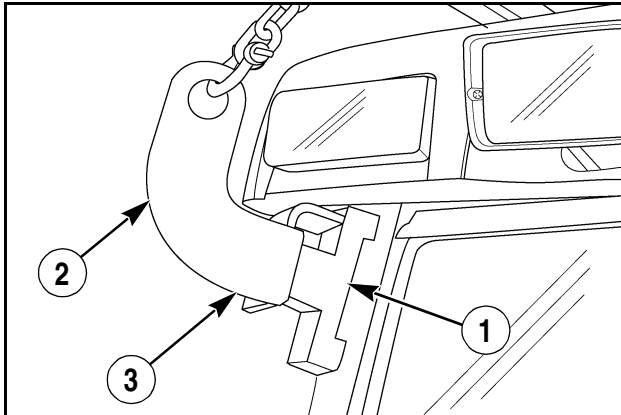
### STEP 50



RD02E094

Remove the plastic plug (if required) from the cab rear window post and insert the J-hook from CAS2529-2 rear cab lifting bracket in the hole. The hooked end faces downward. The rear window must be open in order to insert the J-hook.

### STEP 51



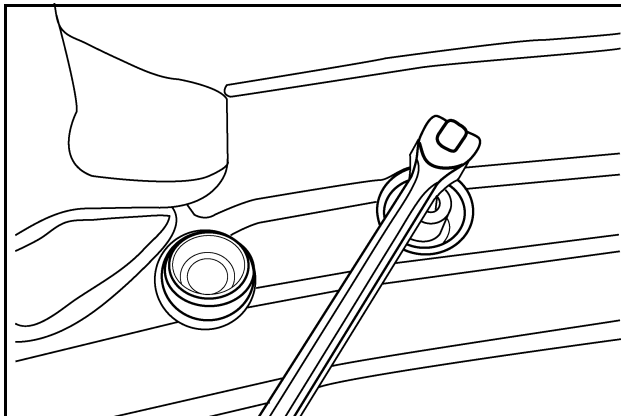
RD02E274

Install the rear lifting bracket (1) and extension arm (2). Install the mounting nut (3) (not shown). Make sure the mounting bracket (1) is fully seated on the ROPS post. Tighten the nut. Repeat this step and the previous step on the opposite side of the cab.

**NOTE:** If side mounted lights were removed, use care not to pinch the wire harness when installing the J-hook and lifting bracket.

**NOTE:** Do not lift the cab until all electrical cables, hydraulic lines, and mechanical parts needed for cab removal have been tagged and disconnected.

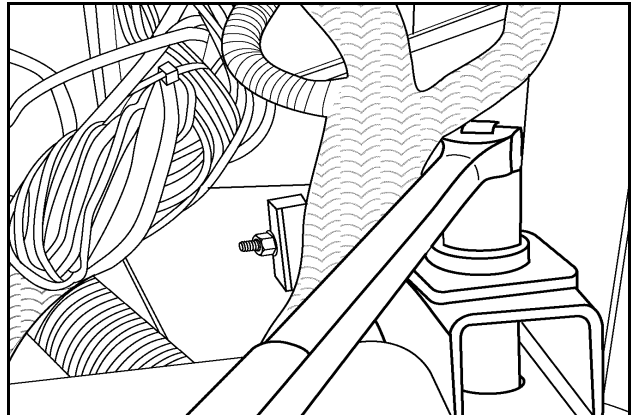
### STEP 52



RD02C143

Remove the cab floor plug. Remove the nut and washer from the front cab mount bolt. Have an assistant hold the head of the bolt under the cab. Repeat this operation on the opposite side of the cab.

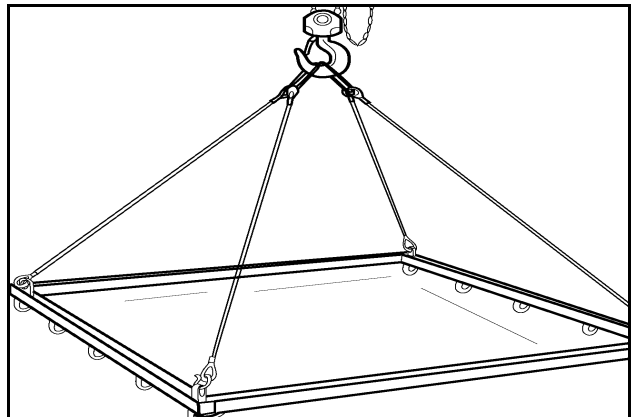
### STEP 53



RD02F026

Remove the rear cab mount nut and washer on both sides of the cab.

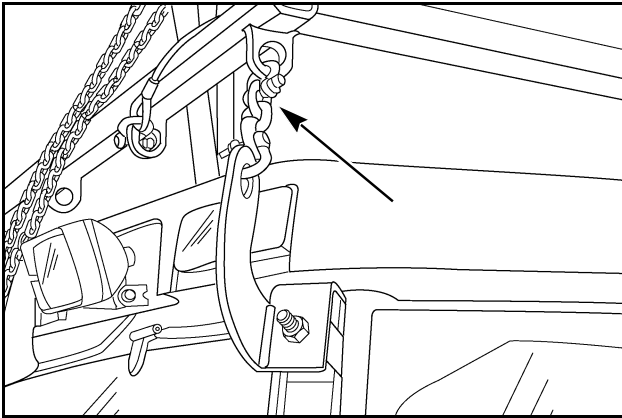
### STEP 54



38-8R2

Attach a lift hook to the cab lift tool CAS2531.

## STEP 55

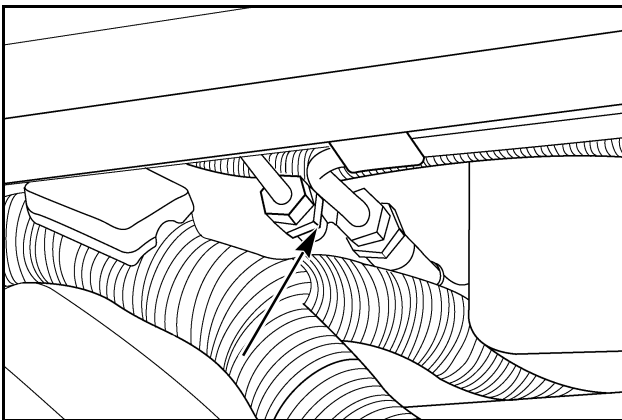


RD02E272

Install CAS2531 cab lifting tool on the cab brackets. Make sure the chains do not bind against the roof or cab lenses. Lift the cab only high enough to gain access to the heater hoses and hydraulic trailer lines (if equipped).

**IMPORTANT:** *When working under the suspended cab, place supports between the cab rails and the cab mounting supports. Lower the cab onto the supports.*

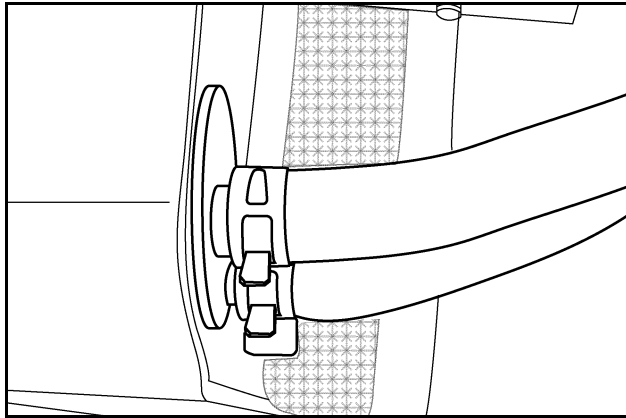
## STEP 56



RD02C155

If equipped, remove the hydraulic trailer brake supply lines. These lines are located below the cab at the right rear.

## STEP 57



RD02E067

Remove the heater hoses at the cab HVAC box.

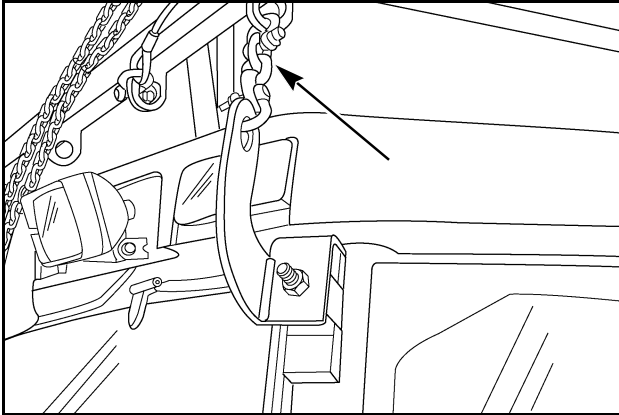
## STEP 58

Continue to lift the cab and remove from the tractor chassis. Carefully lower the cab onto supports placed under the cab rails.

**NOTE:** *Make sure the supports are high enough so the cab pressurization blower clears the ground.*

## CAB INSTALLATION

### STEP 59

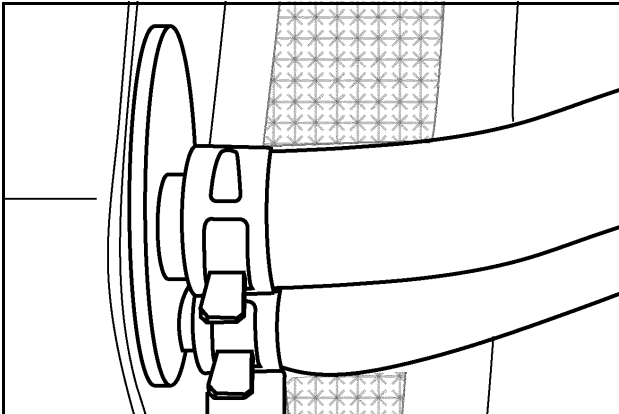


RD02E272

Make sure the chains attached to cab lift tool CAS2531 do not bind against the roof or cab lenses. Raise the cab just high enough to clear all chassis components and move into place. Lower it so that it is slightly above the chassis. Properly support the cab.

**IMPORTANT:** When working under the suspended cab, place supports between the cab rails and the cab mounting supports. Lower the cab onto the supports.

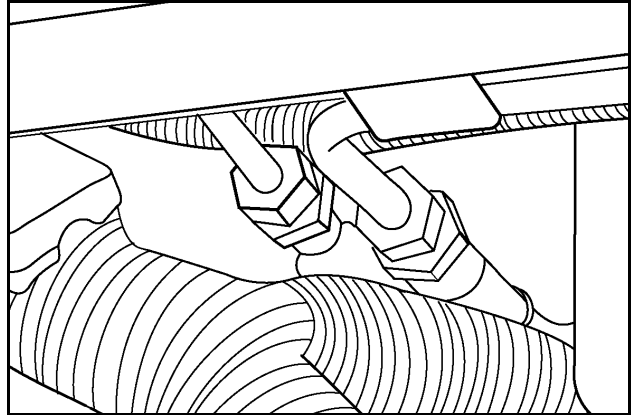
### STEP 60



RD02E067

Install the heater hoses at the cab HVAC box, located under the right hand side of the cab.

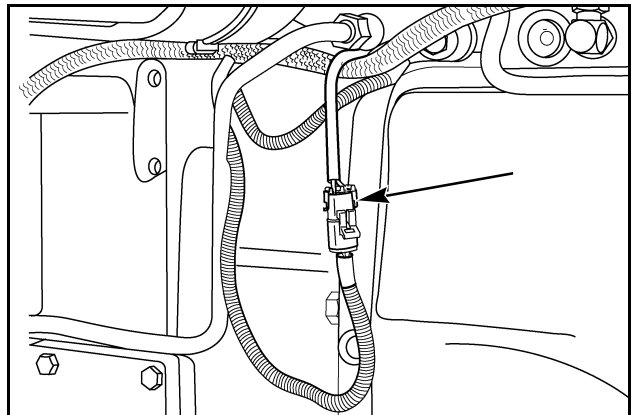
### STEP 61



RD02C155

Lower the cab until the hydraulic trailer brake supply lines (if equipped) can be installed at the right rear side of the tractor. Tighten the trailer brake supply lines.

### STEP 62

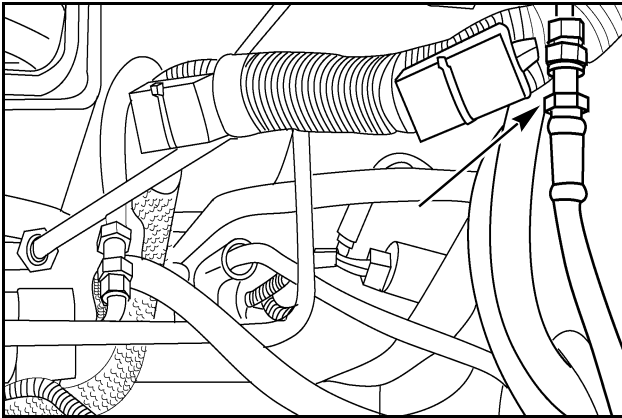


RD02C124

Install the electrical connector from the cab pressurization blower.

**NOTE:** Fuel tank removed for photographic purposes.

### STEP 63



RD02C121

Install the supply line to the left and right rear brake.

Continue to lower the cab onto the tractor chassis, aligning the cab mount bolts with the holes in the cab frame. Check for pinched cables, lines, or hoses. Remove any tension on the cab lifting equipment.

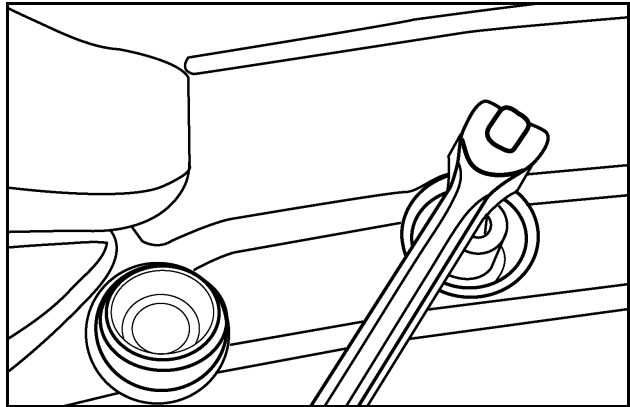
### STEP 64



RD02F026

Set the preload on the rear cab isomounts to a torque of 47 to 61 Nm (35 to 45 lb. ft.) by holding the square plate and tightening the bolt. Install the rear cab mount washer and nut. Tighten the nut to a torque of 190 to 244 Nm (140 to 180 lb. ft.) on both sides of the cab. Have an assistant hold the bolt, if necessary.

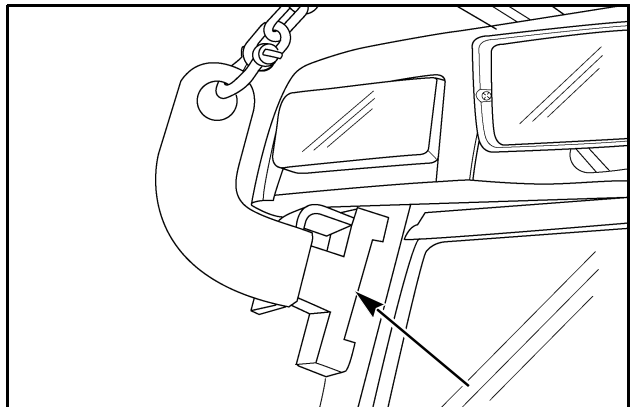
### STEP 65



RD02C143

Set the preload on the front cab isomounts using the procedure in the previous step. Install the front cab mount washer and nut. Tighten the nut to a torque of 190 to 244 Nm (140 to 180 lb. ft.) on both sides of the cab.

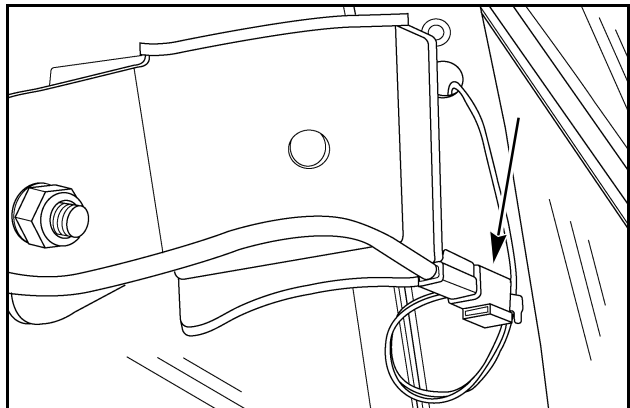
### STEP 66



RD02E274

Remove the cab lifting tool and rear cab lifting brackets. Install the plastic plugs in the cab rear window posts if required.

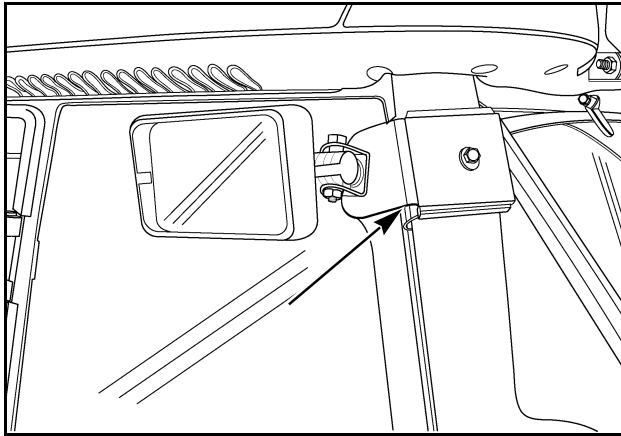
### STEP 67



RD05M052

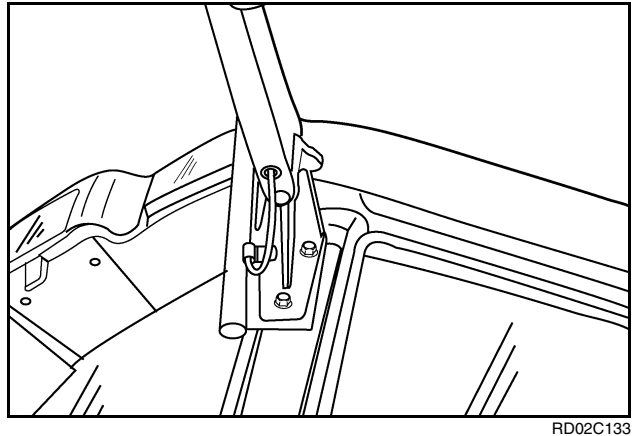
If equipped, connect the wire harness for the right and left side mounted field lights.

### STEP 68



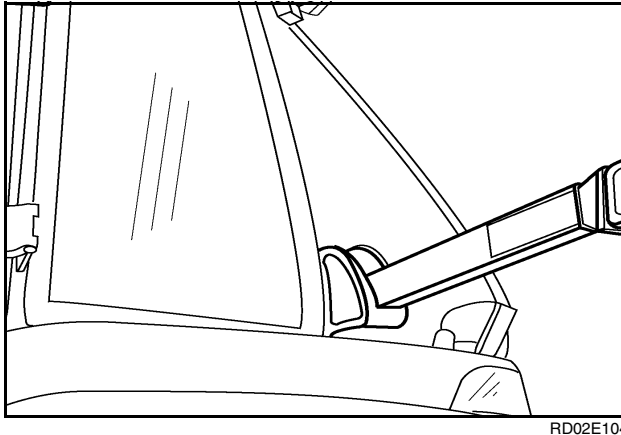
If equipped, install the right and left side mounted field lights.

### STEP 71



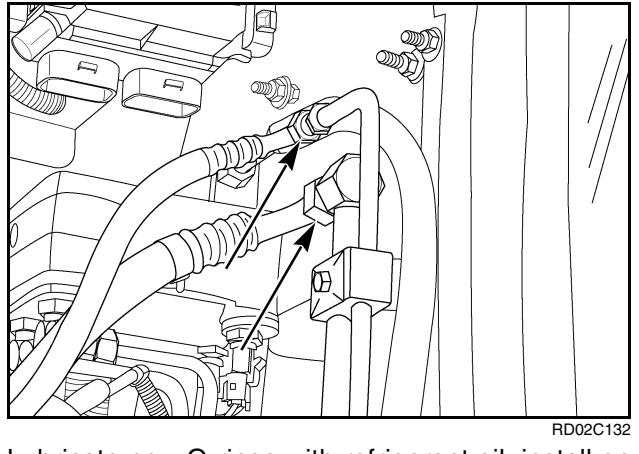
Install the mirrors and the three mirror retaining bolts. Connect the electrical plug if equipped.

### STEP 69



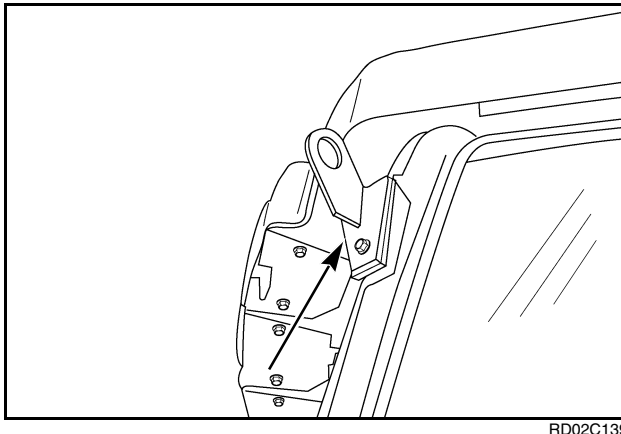
Remove the upper bolt and swing the tractor rear warning lights up. Tighten the upper and lower bolts.

### STEP 72



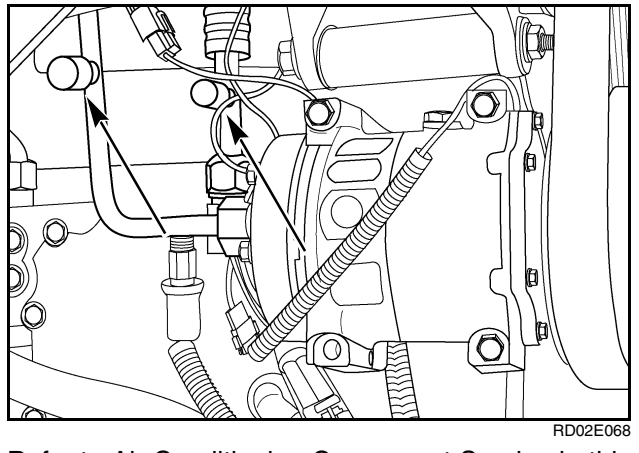
Lubricate new O-rings with refrigerant oil, install on the A/C fittings at the firewall and tighten.

### STEP 70



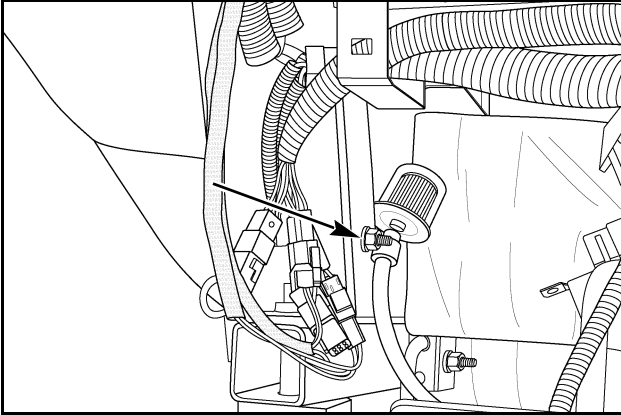
Remove front lifting bracket.

### STEP 73



Refer to Air Conditioning Component Service in this manual Recharge the air-conditioning system with freon at the capped line fittings (arrows) attached to the rear of the air conditioning compressor.

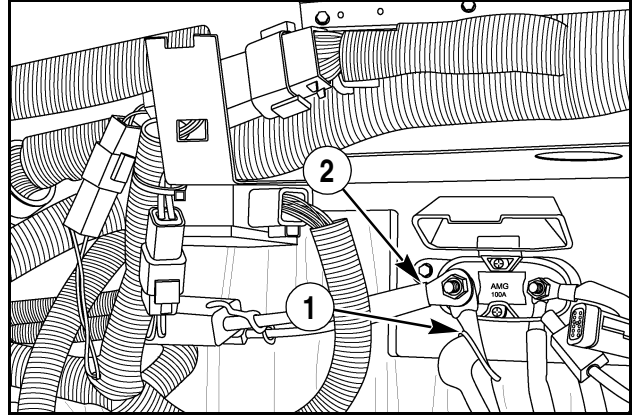
### STEP 74



RD05M058

Install the fuel vent mounting clamp.

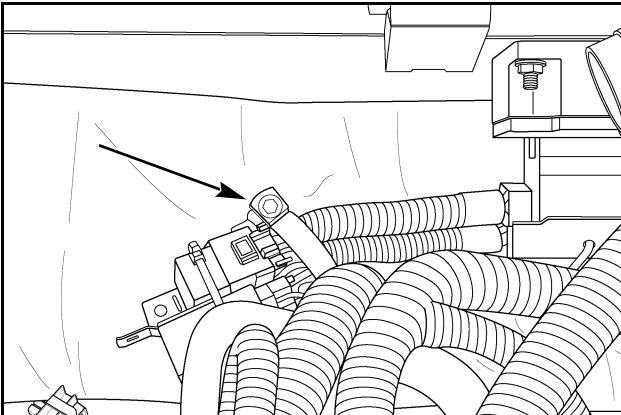
### STEP 77



RD05M055

Connect the cab power supply cable (1) and the ISO 11783 power cables (2) (if equipped).

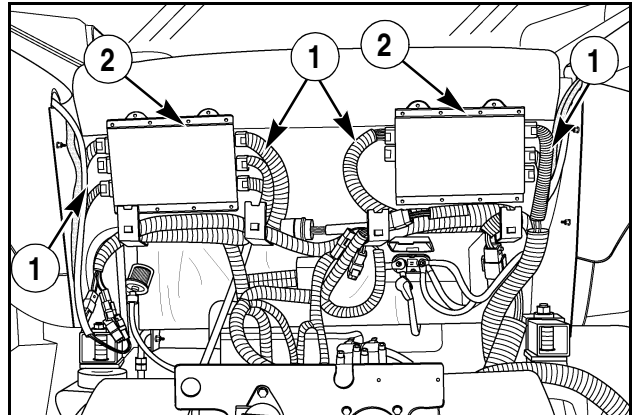
### STEP 75



RD05M057

Install the ISO 11783 harness clamp (if equipped)

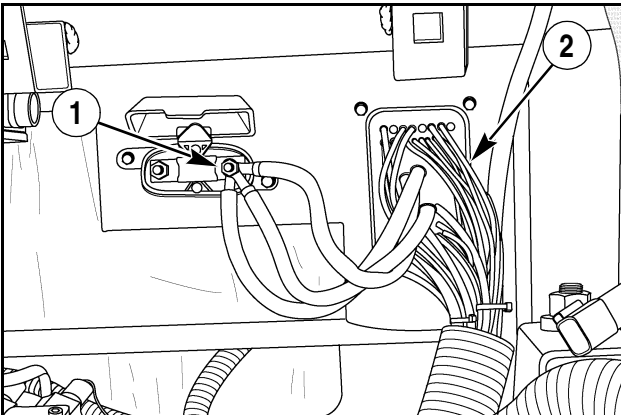
### STEP 78



RD05M054

Connect the wire harnesses (1) to the controllers (2).

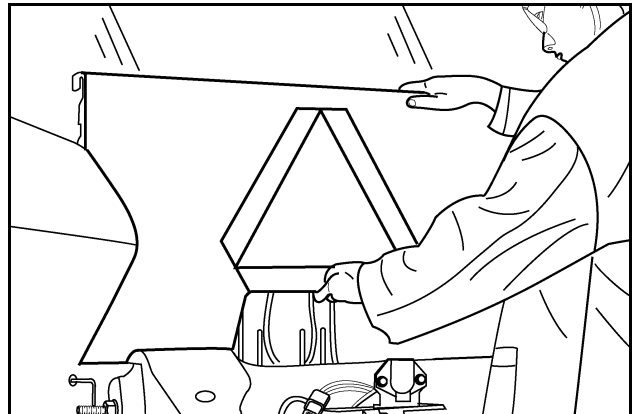
### STEP 76



RD05M056

Install the cab power cables (1) and the wire connector (2) at the right rear of the cab.

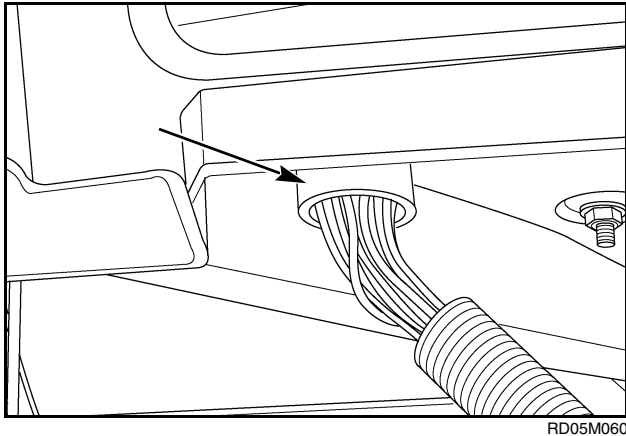
### STEP 79



76-33

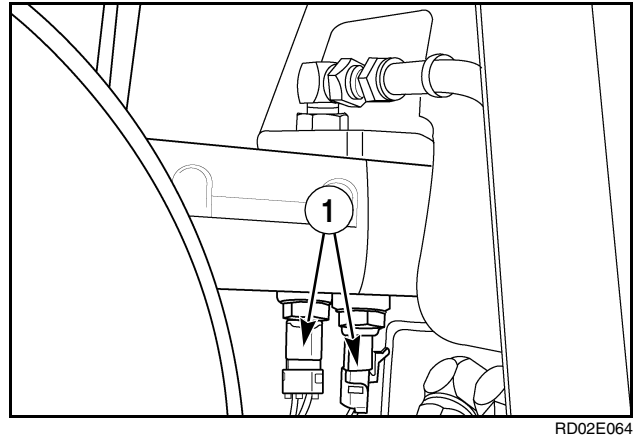
Install the two bolts securing the rear cab panel to the cab.

### STEP 80



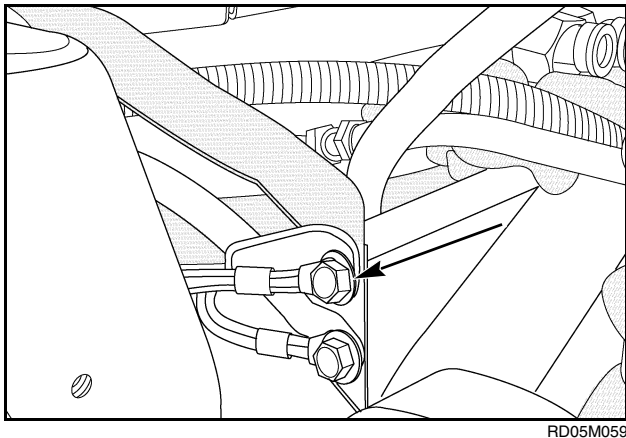
Install the cab connector at the right hand front side of the cab.

### STEP 83



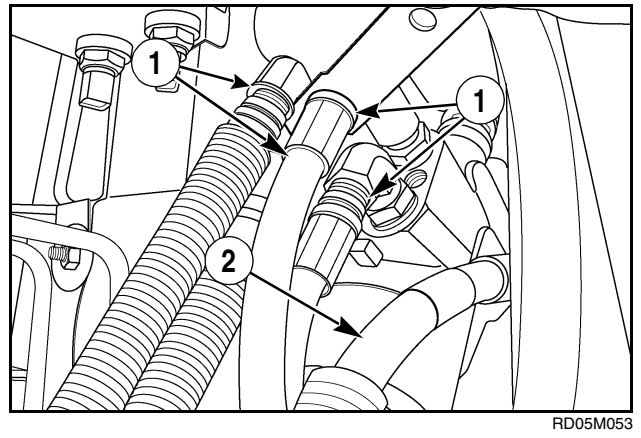
Use the identification tags to install the wiring harnesses on the two brake light switches (1).

### STEP 81



Connect the cab ground strap.

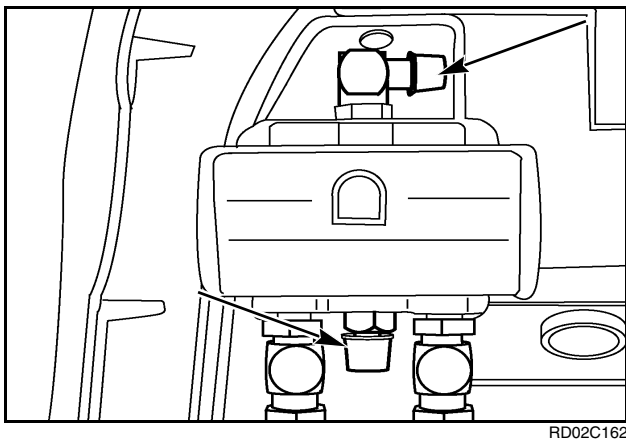
### STEP 84



Use the identification tags to install the four hydraulic hoses (1) and the steering sensing line (2) to the steering hand pump.

**NOTE:** After each is installed, firmly pull back on the hose to make sure it is fully seated.

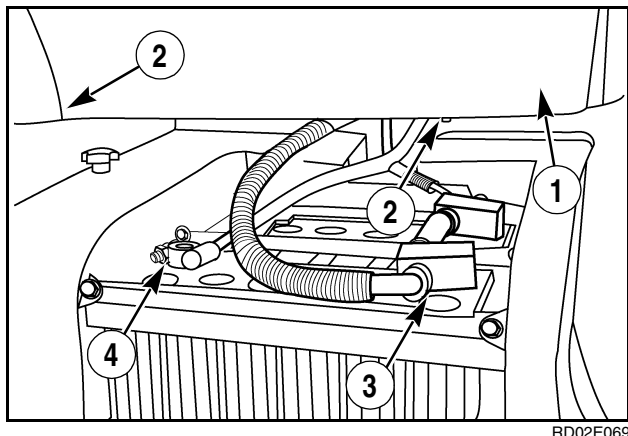
### STEP 82



Use the identification tags to install the return and supply line on the brake valve.

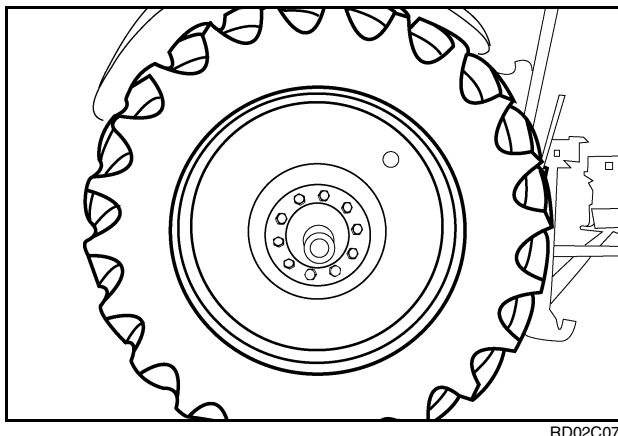


## STEP 85



Install the right panel (1). Install the three mounting screws (2) and tighten. Install the left panel and tighten the mounting screws. Install the positive (+) battery cable (3), first. Install the negative (-) battery cable (4).

## STEP 86



Install the rear wheels, if removed. Apply antiseize to the wheel hub bolts and tighten in a crossing pattern to a torque of 530 to 570 Nm (390 to 420 lb. ft.). Remove the rear axle supports, if the rear wheels were removed. Fill the cooling system. Refer to the Operators Manual for cooling system capacity. Check the hydraulic fluid level. Add fluid as needed. Remove the front axle wheel blocks.