

450DLC Excavator Repair

TECHNICAL MANUAL 450DLC Excavator Repair

TM2362 25JUN08 (ENGLISH)

For complete service information also see:

450DLC Excavator Operation and Tests . . .	TM2361
Undercarriage Appraisal Manual	SP326
450DLC Operator's Manual	OMT221101

**Worldwide Construction
And Forestry Division**
LITHO IN U.S.A.

Introduction

Foreword

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.



This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Technical manuals are divided in two parts: repair and operation and tests. Repair sections tell how to repair the components. Operation and tests sections help you identify the majority of routine failures quickly.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, service parts kits, specifications, wear tolerances, and torque values.

Technical Manuals are concise guides for specific machines. They are on-the-job guides containing only the vital information needed for diagnosis, analysis, testing, and repair.

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes.

DX, TMIFC -19-29SEP98-1/1

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Section 00 General Information

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Recognize Safety Information

This is the safety alert symbol. When this symbol is noticed on the machine or in this manual, be alert for the potential of personal injury.

Follow the precautions and safe operating practices highlighted by this symbol.

A signal word — DANGER, WARNING, or CAUTION — is used with the safety alert symbol. DANGER identifies the most serious hazards.

On the machine, DANGER signs are red in color, WARNING signs are orange, and CAUTION signs are yellow. DANGER and WARNING signs are located near specific hazards. General precautions are on CAUTION labels.



T1133555 -UN-28AUG00

T1133588 -19-28AUG00

TX03679.00016CC -19-03JAN07-1/1

Follow Safety Instructions

Read the safety messages in this manual and on the machine. Follow these warnings and instructions carefully. Review them frequently.

Be sure all operators of this machine understand every safety message. Replace operator's manual and safety labels immediately if missing or damaged.



T1133556 -UN-24AUG00

TX03679.00016F9 -19-03JAN07-1/1

Operate Only If Qualified

Do not operate this machine unless the operator's manual has been read carefully, and you have been qualified by supervised training and instruction.

Operator should be familiar with the job site and surroundings before operating. Try all controls and

machine functions with the machine in an open area before starting to work.

Know and observe all safety rules that may apply to every work situation and work site.

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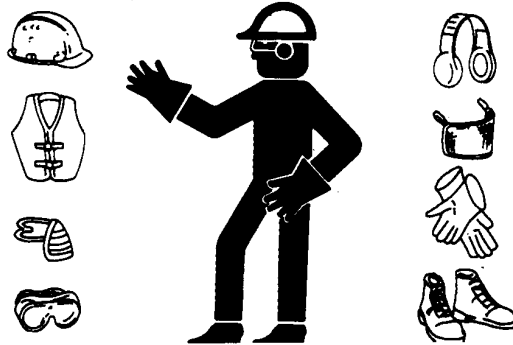
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Wear Protective Equipment

Guard against injury from flying pieces of metal or debris; wear goggles or safety glasses.

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear suitable hearing protection such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



TS206 -UN-23AUG88

TX03679,00016D0 -19-03JAN07-1/1

Avoid Unauthorized Machine Modifications

Modifications of this machine, or addition of unapproved products or attachments, may affect machine stability or reliability, and may create a hazard for the operator or others near the machine.

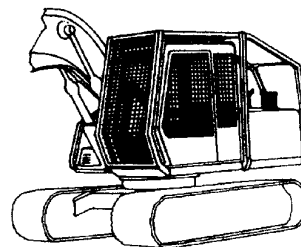
Always contact an authorized dealer before making machine modifications that change the intended use, weight or balance of the machine, or that alter machine controls, performance or reliability.

TX03679,00016B7 -19-30OCT00-1/1

Add Cab Guarding for Special Uses

Special work situations or machine attachments may create an environment with falling or flying objects. Working near an overhead bank, doing demolition work, using a hydraulic hammer, or working in a wooded area, for example, may require added guarding to protect the operator.

FOPS (falling object protective structures) and special screens or guarding should be installed when falling or flying objects may enter or damage the machine. Contact your authorized dealer for information on devices intended to provide protection in special work situations.



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TX03679,00016CE -19-03JAN07-1/1

Inspect Machine

Inspect machine carefully each day by walking around it before starting.

Keep all guards and shields in good condition and properly installed. Fix damage and replace worn or broken parts immediately. Pay special attention to hydraulic hoses and electrical wiring.



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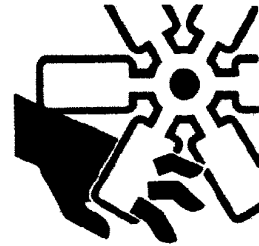
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Stay Clear of Moving Parts

Entanglements in moving parts can cause serious injury.

Stop engine before examining, adjusting or maintaining any part of machine with moving parts.

Keep guards and shields in place. Replace any guard or shield that has been removed for access as soon as service or repair is complete.



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Avoid High-Pressure Oils

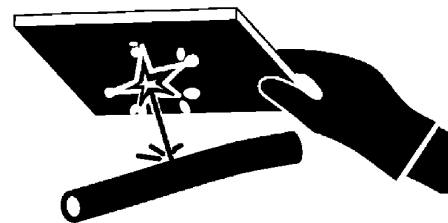
This machine uses a high-pressure hydraulic system. Escaping oil under pressure can penetrate the skin causing serious injury.

Never search for leaks with your hands. Protect hands. Use a piece of cardboard to find location of escaping oil. Stop engine and relieve pressure before disconnecting lines or working on hydraulic system.

If hydraulic oil penetrates your skin, see a doctor immediately. Injected oil must be removed surgically within hours or gangrene may result. Contact a knowledgeable medical source or the Deere & Company Medical Department in Moline, Illinois, U.S.A.



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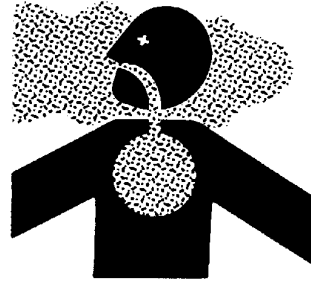
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Beware of Exhaust Fumes

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in an enclosed space, provide adequate ventilation. Use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring outside air into the area.



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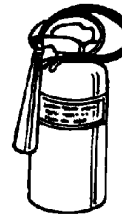
Prevent Fires

Handle Fuel Safely: Store flammable fluids away from fire hazards. Never refuel machine while smoking or when near sparks or flame.

Clean Machine Regularly: Keep trash, debris, grease and oil from accumulating in engine compartment, around fuel lines, hydraulic lines, exhaust components, and electrical wiring. Never store oily rags or flammable materials inside a machine compartment.

Maintain Hoses and Wiring: Replace hydraulic hoses immediately if they begin to leak, and clean up any oil spills. Examine electrical wiring and connectors frequently for damage.

Keep A Fire Extinguisher Available: Always keep a multipurpose fire extinguisher on or near the machine. Know how to use extinguisher properly.



T133552 -UN-14SEP00

T133553 -UN-07SEP00

T133554 -UN-07SEP00

TX03679,00016F5 -19-14APR08-1/1

Prevent Battery Explosions

Battery gas can explode. Keep sparks, lighted matches, and open flame away from the top of battery.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



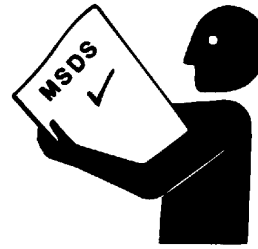
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Handle Chemical Products Safely

Exposure to hazardous chemicals can cause serious injury. Under certain conditions, lubricants, coolants, paints and adhesives used with this machine may be hazardous.

If uncertain about safe handling or use of these chemical products, contact your authorized dealer for a Material Safety Data Sheet (MSDS). The MSDS describes physical and health hazards, safe use procedures, and emergency response techniques for chemical substances. Follow MSDS recommendations to handle chemical products safely.



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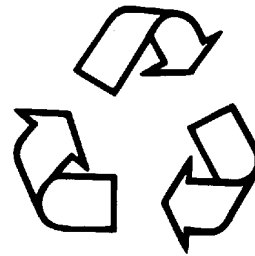
Dispose of Waste Properly

Improper disposal of waste can threaten the environment. Fuel, oils, coolants, filters and batteries used with this machine may be harmful if not disposed of properly.

Never pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants can damage the atmosphere. Government regulations may require using a certified service center to recover and recycle used refrigerants.

If uncertain about the safe disposal of waste, contact your local environmental or recycling center or your authorized dealer for more information.



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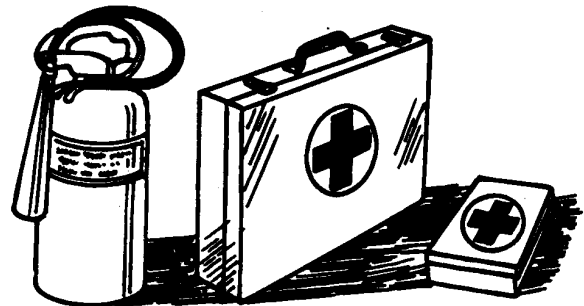
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Prepare for Emergencies

Be prepared if an emergency occurs or a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



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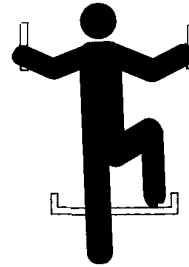
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Use Steps and Handholds Correctly

Prevent falls by facing the machine when getting on and off. Maintain 3-point contact with steps and handrails. Never use machine controls as handholds.

Use extra care when mud, snow, or moisture present slippery conditions. Keep steps clean and free of grease or oil. Never jump when exiting machine. Never mount or dismount a moving machine.



T133468 -UN-30AUG00

TX03679,00016F2 -19-15MAR07-1/1

Start Only From Operator's Seat

Avoid unexpected machine movement. Start engine only while sitting in operator's seat. Ensure all controls and working tools are in proper position for a parked machine.

Never attempt to start engine from the ground. Do not attempt to start engine by shorting across the starter solenoid terminals.



T133715 -UN-07SEP00

TX03679,0001799 -19-03JAN07-1/1

Use and Maintain Seat Belt

Use seat belt when operating machine. Remember to fasten seat belt when loading and unloading from trucks and during other uses.

Examine seat belt frequently. Be sure webbing is not cut or torn. Replace seat belt immediately if any part is damaged or does not function properly.

The complete seat belt assembly should be replaced every 3 years, regardless of appearance.



**USE
SEAT
BELT**

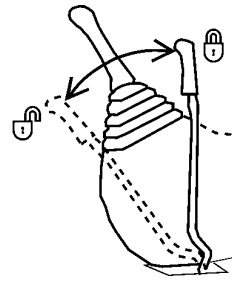
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Prevent Unintended Machine Movement

Be careful not to accidentally actuate control levers when co-workers are present. Pull pilot control shutoff lever to locked position during work interruptions. Pull pilot control shutoff lever to locked position and stop engine before allowing anyone to approach machine.

Always lower work equipment to the ground and pull pilot control shutoff lever to locked position before standing up or leaving the operator's seat. Stop engine before exiting.



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Avoid Work Site Hazards

Avoid contact with gas lines, buried cables and water lines. Call utility line location services to identify all underground utilities before you dig.

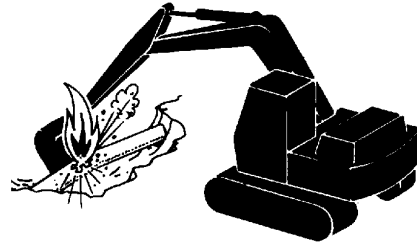
Prepare work site properly. Avoid operating near structures or objects that could fall onto the machine. Clear away debris that could move unexpectedly if run over.

Avoid boom or arm contact with overhead obstacles or overhead electrical lines. Never move any part of machine or load closer than 3 m (10 ft) plus twice the line insulator length to overhead wires.

Keep bystanders clear at all times. Keep bystanders away from raised booms, attachments, and unsupported loads. Avoid swinging or raising booms, attachments, or loads over or near personnel. Use barricades or a signal person to keep vehicles and pedestrians away. Use a signal person if moving machine in congested areas or where visibility is restricted. Always keep signal person in view. Coordinate hand signals before starting machine.

Operate only on solid footing with strength sufficient to support machine. When working close to an excavation, position travel motors away from the hole.

Reduce machine speed when operating with tool on or near ground when obstacles may be hidden (e.g., during snow removal or clearing mud, dirt, etc). At high speeds, hitting obstacles (rocks, uneven concrete or manholes) can cause a sudden stop. Always wear your seat belt.



T134986 -UN-31OCT00



T133650 -UN-27SEP00



T133549 -UN-24AUG00

TX03679,0001748 -19-16APR08-1/1

Keep Riders Off Machine

Only allow operator on machine.

Riders are subject to injury. They may fall from machine, be caught between machine parts, or be struck by foreign objects.

Riders may obstruct operator's view or impair his ability to operate machine safely.



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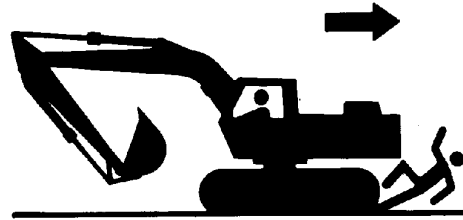
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Avoid Backover Accidents

Before moving machine, be sure all persons are clear of both travel and swing paths. Turn around and look directly for best visibility. Use mirrors to assist in checking all around machine. Keep windows and mirrors clean, adjusted, and in good repair.

Be certain travel alarm is working properly.

Use a signal person when backing if view is obstructed or when in close quarters. Keep signal person in view at all times. Use prearranged hand signals to communicate.



T1133548 -UN-24AUG00

TX03679.00016F3 -19-03JAN07-1/1

Avoid Machine Tip Over

Use seat belt at all times.

Do not jump if the machine tips. You will be unlikely to jump clear and the machine may crush you.

Load and unload from trucks or trailers carefully. Be sure truck is wide enough and on a firm level surface. Use loading ramps. Properly attach ramps to truck bed. Avoid trucks with steel beds because tracks slip more easily on steel.

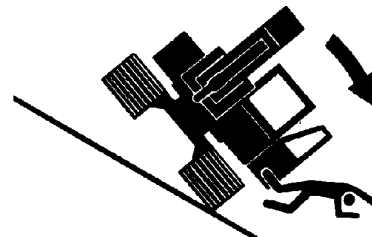
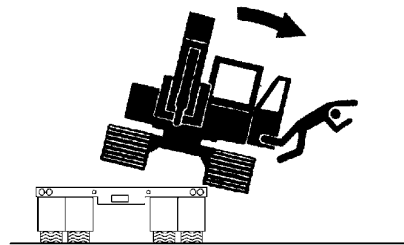
Be careful on slopes. Use extra care on soft, rocky or frozen ground. Machine may slip sideways in these conditions. When traveling up or down slopes, keep the bucket on uphill side and just above ground level.

Be careful with heavy loads. Using oversize buckets or lifting heavy objects reduces machine stability. Extending a heavy load or swinging it over side of undercarriage may cause machine to tip.

Ensure solid footing. Use extra care when operating near banks or excavations that may cave-in and cause machine to tip or fall.



**USE
SEAT
BELT**



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T1133545 -UN-15SEP00

T1133803 -UN-27SEP00

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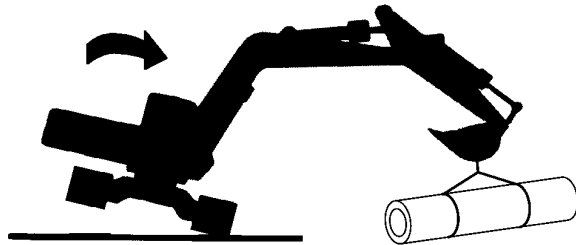
Use Special Care When Lifting Objects

Never use this machine to lift people.

Never lift a load above another person. Keep bystanders clear of all areas where a load might fall if it breaks free. Do not leave the seat when there is a raised load.

Do not exceed lift capacity limits posted on machine and in this manual. Extending heavy loads too far or swinging over undercarriage side may cause machine to tip over.

Use proper rigging to attach and stabilize loads. Be sure slings or chains have adequate capacity and are in good condition. Use tether lines to guide loads and prearranged hand signals to communicate with co-workers.



T133839 -UN-27SEP00

TX03679,00016E1 -19-03JAN07-1/1

Add and Operate Attachments Safely

Always verify compatibility of attachments by contacting your authorized dealer. Adding unapproved attachments may affect machine stability or reliability, and may create a hazard for others near the machine.

Ensure that a qualified person is involved in attachment installation. Add guards to machine if operator protection is required or recommended. Verify

that all connections are secure and attachment responds properly to controls.

Carefully read attachment manual and follow all instructions and warnings. In an area free of bystanders and obstructions, carefully operate attachment to learn its characteristics and range of motion.

TX03679,00016F0 -19-24JAN07-1/1

Park and Prepare for Service Safely

Warn others of service work. Always park and prepare your machine for service or repair properly.

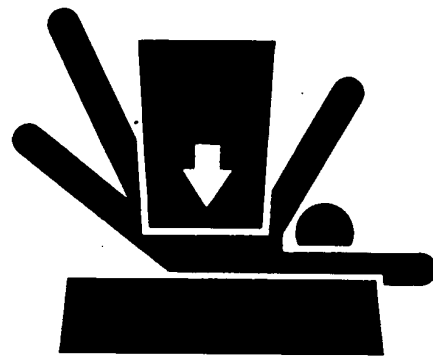
- Park machine on a level surface and lower equipment to the ground.
- Place pilot control shutoff lever in “lock” position. Stop engine and remove key.
- Attach a “Do Not Operate” tag in an obvious place in the operator’s station.



Securely support machine or equipment before working under it.

- Do not support machine with boom, arm, or other hydraulically actuated attachments.
- Do not support machine with cinder blocks or wooden pieces that may crumble or crush.
- Do not support machine with a single jack or other devices that may slip out of place.

Understand service procedures before beginning repairs. Keep service area clean and dry. Use two people whenever the engine must be running for service work.



T133332 -19-14DEC01

TS229 -JUN-23AUG88

TX03679,00016E9 -19-24JAN07-1/1

Service Cooling System Safely

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



TS281 -JUN-23AUG88

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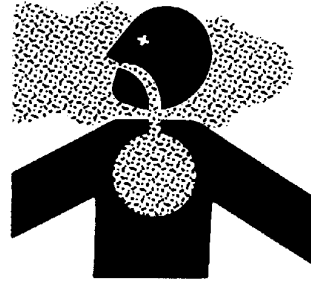
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Remove Paint Before Welding or Heating

Hazardous fumes can be generated when paint is heated by welding or using a torch. Dust from sanding or grinding paint can also be hazardous.

Remove paint to at least 76 mm (3 in.) from area to be heated. Wear an approved respirator when sanding or grinding paint. If a solvent or paint stripper is used, wash area with soap and water. Remove solvent or paint stripper containers from work area, and allow fumes to disperse at least 15 minutes before welding or heating.

Work outside or in a well-ventilated area. Dispose of waste, paint, and solvents properly.



T133546 -UN-24AUG00

TX03679,0001732 -19-29AUG07-1/1

Make Welding Repairs Safely

IMPORTANT: Disable electrical power before welding. Turn off main battery switch or disconnect positive battery cable. Separate harness connectors to engine and vehicle microprocessors.

Avoid welding or heating near pressurized fluid lines. Flammable spray may result and cause severe burns if pressurized lines fail as a result of heating. Do not let heat go beyond work area to nearby pressurized lines.

Remove paint properly. Do not inhale paint dust or fumes. Use a qualified welding technician for structural repairs. Make sure there is good ventilation. Wear eye protection and protective equipment when welding.



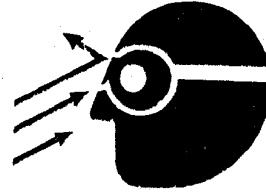
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Drive Metal Pins Safely

Always wear protective goggles or safety glasses and other protective equipment before striking hardened parts. Hammering hardened metal parts such as pins and bucket teeth may dislodge chips at high velocity.

Use a soft hammer or a brass bar between hammer and object to prevent chipping.



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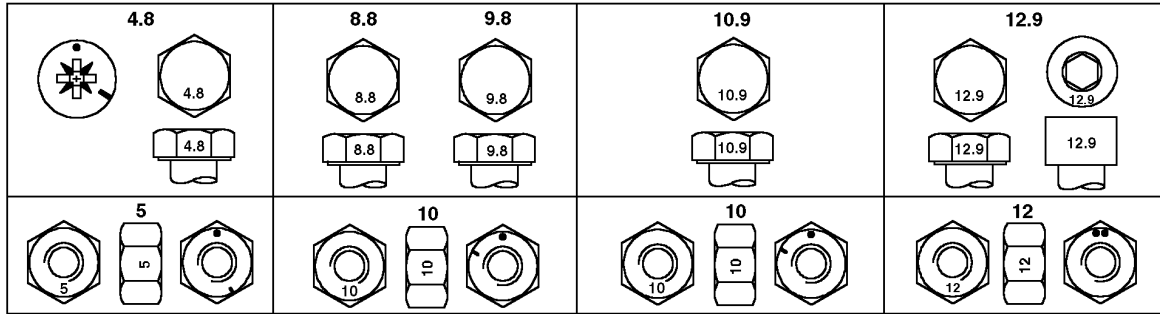
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Safety

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Metric Bolt and Cap Screw Torque Values



Top—Property Class and Head Markings; Bottom—Property Class and Nut Markings

METRIC BOLT AND CAP SCREW TORQUE VALUES—Tolerance is $\pm 10\%$ unless otherwise specified								
Thread Size	Class 4.8		Class 8.8 or 9.8		Class 10.9		Class 12.9	
	Lubricated ^a N•m (lb-ft)	Dry ^b N•m (lb-ft)	Lubricated ^a N•m (lb-ft)	Dry ^b N•m (lb-ft)	Lubricated ^a N•m (lb-ft)	Dry ^b N•m (lb-ft)	Lubricated ^a N•m (lb-ft)	Dry ^b N•m (lb-ft)
M6	4.7 (3.5)	6 (4.4)	9 (6.6)	11.5 (8.5)	13 (9.5)	16.5 (12.2)	15.5 (11.5)	19.5 (14.5)
M8	11.5 (8.5)	14.5 (10.7)	22 (16)	28 (20.5)	32 (23.5)	40 (29.5)	37 (27.5)	47 (35)
M10	23 (17)	29 (21)	43 (32)	55 (40)	63 (46)	80 (59)	75 (55)	95 (70)
M12	40 (29.5)	50 (37)	75 (55)	95 (70)	110 (80)	140 (105)	130 (95)	165 (120)
M14	63 (46)	80 (59)	120 (88)	150 (110)	175 (130)	220 (165)	205 (150)	260 (190)
M16	100 (74)	125 (92)	190 (140)	240 (175)	275 (200)	350 (255)	320 (235)	400 (300)
M18	135 (100)	170 (125)	265 (195)	330 (245)	375 (275)	475 (350)	440 (325)	560 (410)
M20	190 (140)	245 (180)	375 (275)	475 (350)	530 (390)	675 (500)	625 (460)	790 (580)
M22	265 (195)	330 (245)	510 (375)	650 (480)	725 (535)	920 (680)	850 (625)	1080 (800)
M24	330 (245)	425 (315)	650 (480)	820 (600)	920 (680)	1150 (850)	1080 (800)	1350 (1000)
M27	490 (360)	625 (460)	950 (700)	1200 (885)	1350 (1000)	1700 (1250)	1580 (1160)	2000 (1475)
M30	660 (490)	850 (625)	1290 (950)	1630 (1200)	1850 (1350)	2300 (1700)	2140 (1580)	2700 (2000)
M33	900 (665)	1150 (850)	1750 (1300)	2200 (1625)	2500 (1850)	3150 (2325)	2900 (2150)	3700 (2730)
M36	1150 (850)	1450 (1075)	2250 (1650)	2850 (2100)	3200 (2350)	4050 (3000)	3750 (2770)	4750 (3500)

^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.
^b "Dry" means plain or zinc plated without any lubrication.



CAUTION: Use only metric tools on metric hardware. Other tools may not fit properly. Tool may slip and cause injury.

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

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Additional Metric Cap Screw Torque Values

! **CAUTION: Use only metric tools on metric hardware. Other tools may not fit properly. They may slip and cause injury.**

Check tightness of cap screws periodically. Torque values listed are for general use only. Do not use these values if a different torque value or tightening procedure is listed for a specific application.

T6873AA



T6873AA -UN-18OCT88

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

T6873AB



T6873AB -UN-18OCT88

Make sure fastener threads are clean and you properly start thread engagement. This will prevent them from failing when tightening.

Tighten cap screws having lock nuts to approximately 50 percent of amount shown in chart.

T6873AC



T6873AC -UN-18OCT88

Continued on next page

04T,90,M170 -19-29SEP99-1/2

Torque Values

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3

METRIC CAP SCREW TORQUE VALUES^a						
Nominal Dia	T-Bolt		H-Bolt		M-Bolt	
	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
8	29	21	20	15	10	7
10	63	46	45	33	20	15
12	108	80	88	65	34	25
14	176	130	137	101	54	40
16	265	195	206	152	78	58
18	392	289	294	217	118	87
20	539	398	392	289	167	125
22	735	542	539	398	216	159
24	931	687	686	506	274	202
27	1372	1012	1029	759	392	289
30	1911	1410	1421	1049	539	398
33	2548	1890	1911	1410	735	542
36	3136	2314	2401	1772	931	687

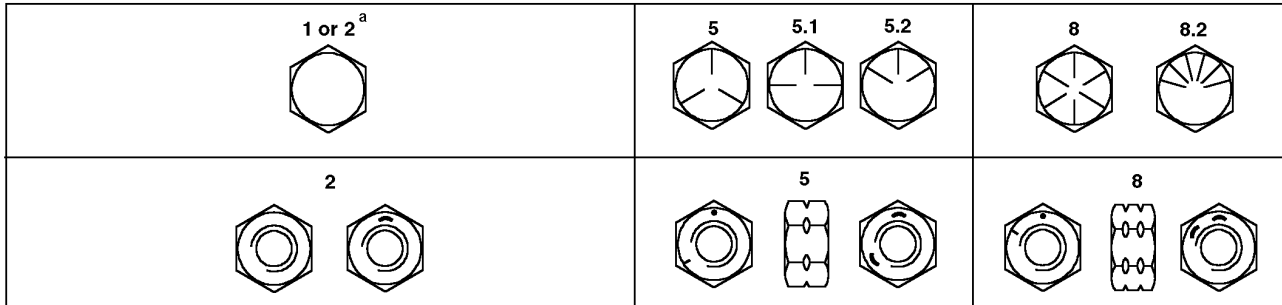
^aTorque tolerance is ±10%.

04T.90.M170 -19-29SEP99-2/2

Torque Values

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Unified Inch Bolt and Cap Screw Torque Values



Top—SAE Grade and Head Markings; Bottom—SAE Grade and Nut Markings

TOR01A -JUN-27SEP99

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES—Tolerance is $\pm 10\%$ unless otherwise specified								
Thread Size	Grade 1 (No Mark)		Grade 2 ^a (No Mark)		Grade 5, 5.1 or 5.2		Grade 8 or 8.2	
	Lubricated ^b N•m (lb-ft)	Dry ^c N•m (lb-ft)	Lubricated ^b N•m (lb-ft)	Dry ^c N•m (lb-ft)	Lubricated ^b N•m (lb-ft)	Dry ^c N•m (lb-ft)	Lubricated ^b N•m (lb-ft)	Dry ^c N•m (lb-ft)
1/4	3.8 (2.8)	4.7 (3.5)	6 (4.4)	7.5 (5.5)	9.5 (7)	12 (9)	13.5 (10)	17 (12.5)
5/16	7.7 (5.7)	9.8 (7.2)	12 (9)	15.5 (11.5)	19.5 (14.5)	25 (18.5)	28 (20.5)	35 (26)
3/8	13.5 (10)	17.5 (13)	22 (16)	27.5 (20)	35 (26)	44 (32.5)	49 (36)	63 (46)
7/16	22 (16)	28 (20.5)	35 (26)	44 (32.5)	56 (41)	70 (52)	80 (59)	100 (74)
1/2	34 (25)	42 (31)	53 (39)	67 (49)	85 (63)	110 (80)	120 (88)	155 (115)
9/16	48 (35.5)	60 (45)	76 (56)	95 (70)	125 (92)	155 (115)	175 (130)	220 (165)
5/8	67 (49)	85 (63)	105 (77)	135 (100)	170 (125)	215 (160)	240 (175)	305 (225)
3/4	120 (88)	150 (110)	190 (140)	240 (175)	300 (220)	380 (280)	425 (315)	540 (400)
7/8	190 (140)	240 (175)	190 (140)	240 (175)	490 (360)	615 (455)	690 (510)	870 (640)
1	285 (210)	360 (265)	285 (210)	360 (265)	730 (540)	920 (680)	1030 (760)	1300 (960)
1-1/8	400 (300)	510 (375)	400 (300)	510 (375)	910 (670)	1150 (850)	1450 (1075)	1850 (1350)
1-1/4	570 (420)	725 (535)	570 (420)	725 (535)	1280 (945)	1630 (1200)	2050 (1500)	2600 (1920)
1-3/8	750 (550)	950 (700)	750 (550)	950 (700)	1700 (1250)	2140 (1580)	2700 (2000)	3400 (2500)
1-1/2	990 (730)	1250 (930)	990 (730)	1250 (930)	2250 (1650)	2850 (2100)	3600 (2650)	4550 (3350)

^a Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

^b "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.

^c "Dry" means plain or zinc plated without any lubrication.

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

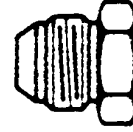
Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Service Recommendations for 37° Flare and 30° Cone Seat Connectors

1. Inspect flare and flare seat. They must be free of dirt or obvious defects.
2. Defects in tube flare cannot be repaired. Overtightening a defective flared fitting will not stop leaks.
3. Align tube with fitting before attempting to start nut.
4. Lubricate male threads with hydraulic fluid or petroleum jelly.
5. Index angle fittings and tighten by hand.
6. Tighten fitting or nut to torque value shown on torque chart. Do not allow hoses to twist when tightening fittings.



T6234AC -JUN-18OCT88

STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART		
Thread Size	N•m	lb-ft
3/8 - 24 UNF	8	6
7/16 - 20 UNF	12	9
1/2 - 20 UNF	16	12
9/16 - 18 UNF	24	18
3/4 - 16 UNF	46	34
7/8 - 14 UNF	62	46
1-1/16 - 12 UN	102	75
1-3/16 - 12 UN	122	90
1-5/16 - 12 UN	142	105
1-5/8 - 12	190	140
1-7/8 - 12 UN	217	160

NOTE: Torque tolerance is $\pm 10\%$.

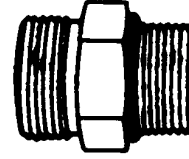
T82,BHMA,EL -19-29SEP99-1/1

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Service Recommendations for O-Ring Boss Fittings

Straight Fitting

1. Inspect O-ring boss seat for dirt or defects.
2. Lubricate O-ring with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.



T6243AE -JUN-18OCT88

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04T,90,K66 -19-29SEP99-1/2

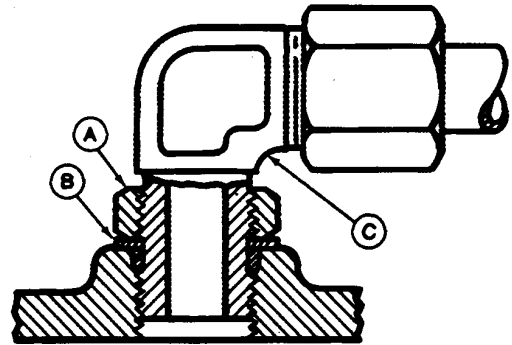
Torque Values

Angle Fitting

1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.
2. Turn fitting into threaded boss until back-up washer contacts face of boss.
3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).

NOTE: Do not allow hoses to twist when tightening fittings.

4. Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.



T6620AB -JUN-18OCT88

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STRAIGHT FITTING OR SPECIAL NUT TORQUE CHART

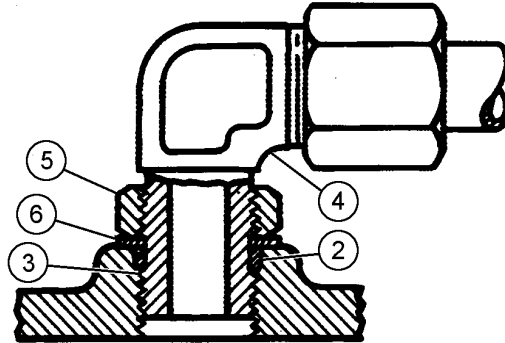
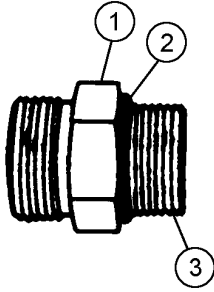
Thread Size	N•m	lb-ft
3/8-24 UNF	8	6
7/16-20 UNF	12	9
1/2-20 UNF	16	12
9/16-18 UNF	24	18
3/4-16 UNF	46	34
7/8-14 UNF	62	46
1-1/16-12 UN	102	75
1-3/16-12 UN	122	90
1-5/16-12 UN	142	105
1-5/8-12 UN	190	140
1-7/8-12 UN	217	160

NOTE: Torque tolerance is $\pm 10\%$.

04T,90,K66 -19-29SEP99-2/2

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O-Ring Boss Fittings In Aluminum Housing Service Recommendations—Excavators



T196315

O-Ring Boss Straight and Adjustable Fittings

1—Straight Fitting
2—O-Ring

3—Stud End
4—Adjustable Fitting

5—Hex Nut

6—Backup Washer

T196315 -UN-17NOV03

O-RING BOSS STRAIGHT OR ADJUSTABLE FITTING STUD END NUT WITH METRIC THREAD IN ALUMINUM HOUSING TORQUE VALUES—Tolerance is $\pm 10\%$ unless otherwise specified

Thread Size mm	Hex Nut Size mm	Nm (lb-ft)
M12 x 1.5	17	39 (29)
M14 x 1.5	19	39 (29)
M16 x 1.5	22	55 (41)
M22 x 1.5	27	75 (55)
M27 x 2	32	110 (81)
M30 x 2	36	141 (104)
M33 x 2	41	165 (122)
M38 x 2	46	165 (122)
M42 x 2	50	275 (203)

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OUT3035,0000353 -19-14JAN04-1/2

Torque Values

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O-RING BOSS STRAIGHT OR ADJUSTABLE FITTING STUD END NUT WITH INCH THREAD IN ALUMINUM HOUSING TORQUE VALUES—Tolerance is $\pm 10\%$ unless otherwise specified

Thread Size in.	Nm (lb-ft)
1/8	—
1/4	28 (20)
3/8	39 (29)
1/2	75 (55)
3/4	126 (93)
1	165 (122)
1-1/8	—
1-1/4	259 (191)
1-3/8	—
1-1/2	330 (243)
1-3/4	—
2	—

O-RING BOSS PLUG STUD END WITH INCH THREAD IN ALUMINUM HOUSING TORQUE VALUES—Tolerance is $\pm 10\%$ unless otherwise specified

Thread Size in.	Nm (lb-ft)
1/8	7.8 (5.80)
1/4	11.8 (8.70)
3/8	23 (17)
1/2	39 (29)
3/4	55 (41)
1	86 (64)
1-1/4	126 (93)
1-1/2	157 (116)
2	204 (150)

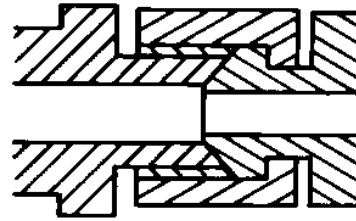
1. Inspect fitting and O-ring boss sealing surfaces and the O-ring. They must be free of dirt, scratches, nicks, or burrs. O-ring must be free of dirt, cuts, cracks, swelling or flatten condition.
2. Back the stud end hex nut (5) off as far as possible. Push backup washer (6) towards the nut to fully expose the turn down section of stud end. Washer must fit turned down section and not be too loose
3. Wrap electrical tape over threads to protect O-ring. Slide O-ring over the tape into turned down section. Remove tape. Apply hydraulic oil to the threads of stud end, turned down section, and O-ring.
4. Turn fitting into the boss by hand until face of nut or backup washer squeezes O-ring into the seat and contacts face of boss. Loosen an adjustable fitting no more than one turn for alignment.
5. Tighten straight fitting or hex nut to the torque value given. Hold body of adjustable fitting using a second wrench when tightening hex nut.

OUT3035,0000353 -19-14JAN04-2/2

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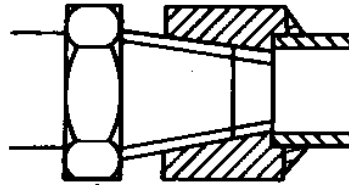
Service Recommendations For Flared Connections—Straight or Tapered Threads

1. Inspect flare and flare seat. They must be free of dirt or obvious defects.
2. Defects in the tube flare cannot be repaired. Overtightening a defective flared fitting will not stop leaks.
3. Align the tube with the fitting before attempting to start the nut.
4. Lubricate the male threads with hydraulic fluid or petroleum jelly.
5. Index angle fittings and tighten by hand.
6. Tighten fitting or nut to torque value shown on the chart. Do not allow hoses to twist when tightening fittings.



T6873AE

Straight Thread



T6873AD

Tapered Thread

TORQUE CHART ^a

Thread Size	Straight Thread ^b		Tapered Thread	
	N•m	lb-ft	N•m	lb-ft
1/8	15	11		
1/4	20	15	45	33
3/8	29	21	69	51
1/2	49	36	93	69
3/4	69	51	176	130
1	157	116	343	253
1-1/2	196	145	539	398
2	255	188	588	434

^aTorque tolerance is $\pm 10\%$.

^bWith seat face.

NOTE: If female thread is cast iron (control valves, brake valves motors, etc.), torque must be reduced approximately 10%.

T6873AE -UN-18OCT88

T6873AD -UN-18OCT88

Service Recommendations For Flat Face O-Ring Seal Fittings

1. Inspect the fitting sealing surfaces and O-ring. They must be free of dirt or defects.
2. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
3. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
4. Tighten fitting or nut to torque value shown on the chart. Do not allow hoses to twist when tightening fittings, use backup wrench on straight hose couplings.

IMPORTANT: Tighten fittings to 150% of listed torque value if indexing is necessary or if fitting is attached to an actuating devise.

Tighten fittings to 50% of listed torque value if used in aluminum housing.

FLAT FACE O-RING SEAL FITTING TORQUE*						
Nomial Tube O.D.		Thread Size	Swivel Nut		Bulkhead Nut	
mm	in.	in.	N•m	lb-ft	N•m	lb-ft
6.35	0.250	9/16-18	16	12	12	9
9.52	0.375	11/16-16	24	18	24	18
12.70	0.500	13/16-16	50	37	46	34
15.88	0.625	1-14	69	51	62	46
19.05	0.750	1 3/16-12	102	75	102	75
22.22	0.875	1 3/16-12	102	75	102	75
25.40	1.000	1 7/16-12	142	105	142	105
31.75	1.250	1 11/16-12	190	140	190	140
38.10	1.500	2-12	217	160	217	160

*Torque tolerance is +15 -20% unless otherwise specified.

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OUO6092,00010A4 -19-02JAN08-1/2

Torque Values

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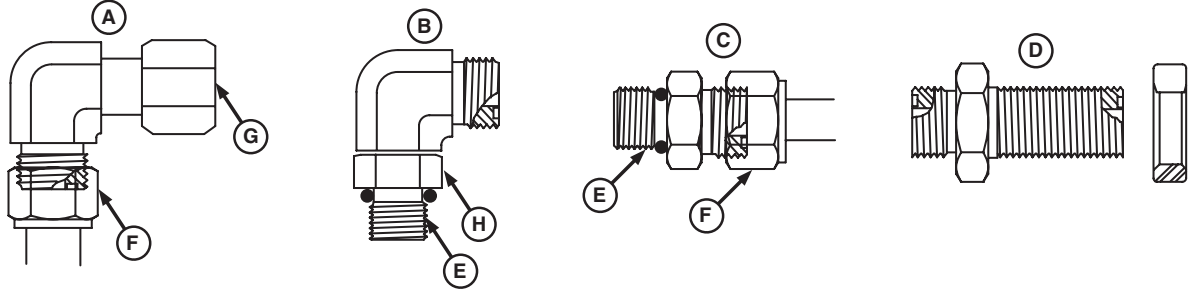
Stud End O-ring Seal Torque for Straight and Adjustable Fittings*

Thread Size	Straight Hex Size	Locknut Hex Size	Straight Fitting or Locknut Toque	
			N•m	lb-ft
Inch	Inch	Inch		
3/8-24	5/8	9/16	12	9
7/16-20	5/8	5/8	21	15
1/2-20	3/4	11/16	26	19
9/16-18	3/4	3/4	34	25
3/4-16	7/8	15/16	73	55
7/8-14	1 1/16	1 1/16	104	76
1 1/16-12	1 1/4	1 3/8	176	130
1 3/16-12	1 3/8	1 1/2	230	170
1 5/16-12	1 1/2	1 5/8	285	210

*Torque tolerance is +15 -20% unless otherwise specified.

OUO6092,00010A4 -19-02JAN08-2/2

O-Ring Face Seal Fittings With SAE Inch Hex Nut And Stud End For High Pressure Service Recommendations



- A—90° Swivel Elbow and Tube Nut
 B—90° Adjustable Stud Elbow
 C—Stud Straight and Tube Nut
 D—Bulkhead Union and Nut
 E—Stud End
 F—Tube Nut
 G—Swivel Nut
 H—Hex Nut

O-RING FACE SEAL FITTINGS WITH SAE INCH HEX NUT AND STUD END FOR HIGH PRESSURE, ABOVE 27 600 kPa (276 bar) (4000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified

Nominal Tube OD or Hose ID			O-Ring Face Seal Hose or Tube Swivel Nut			Bulkhead Nut	
Metric Tube OD	Inch Tube OD or Hose ID		Thread Size	Hex Size	Torque	Hex Size	Torque
mm	Dash Size	mm (in.)	in.	in.	Nm (lb-ft)	in.	Nm (lb-ft)
5	-3	4.78 (0.188)	—	—	—	—	—
6	-4	6.35 (0.250)	9/16-18	11/16	24 (18)	13/16	32 (24)
8	-5	7.92 (0.312)	—	—	—	—	—
10	-6	9.53 (0.375)	11/16-16	13/16	37 (27)	1	42 (31)
12	-8	12.70 (0.500)	13/16-16	15/16	75 (55)	1-1/8	93 (69)
16	-10	15.88 (0.625)	1-14	1-1/8	103 (76)	1-5/16	118 (87)
20	-12	19.05 (0.750)	1-3/16-12	1-3/8	152 (112)	1-1/2	175 (129)
22	-14	22.23 (0.875)	1-3/16-12	—	152 (112)	—	175 (129)
25	-16	25.40 (1.000)	1-7/16-12	1-5/8	214 (158)	1-3/4	247 (182)
32	-20	31.75 (1.250)	1-11/16-12	1-7/8	286 (211)	2	328 (242)
38	-24	38.10 (1.500)	2-12	2-1/4	326 (240)	2-3/8	374 (276)

H70406 -UN-12DEC01

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OUT3035.0000420 -19-14JAN04-1/2

Torque Values

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O-RING STRAIGHT, ADJUSTABLE, AND EXTERNAL HEX PLUG WITH SAE INCH STUD END FOR HIGH PRESSURE, ABOVE 27 600 kPa (276 bar) (4000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified

Thread Size	Straight Hex Size ^a	Adjustable Nut Hex Size	Steel or Gray Iron Torque
in.	in.	in.	Nm (lb-ft)
3/8-24	5/8	9/16	18 (13)
7/16-20	5/8	5/8	24 (18)
1/2-20	3/4	11/16	30 (22)
9/16-18	3/4	3/4	37 (27)
3/4-16	7/8	15/16	75 (55)
7/8-14	1-1/16	1-1/16	103 (76)
1-1/16-12	1-1/4	1-3/8	177 (131)
1-3/16-12	1-3/8	1-1/2	231 (170)
1-5/16-12	1-1/2	1-5/8	270 (199)
1-5/8-12	1-3/4	1-7/8	286 (211)
1-7/8-12	2-1/8	2-1/8	326 (240)

^a *Straight hex size applies to fittings only and may not be the same as the corresponding plug of the same thread size.*

1. Inspect fitting and connector sealing surfaces and the O-rings. They must be free of dirt, scratches, nicks, and burrs. O-ring must be free of dirt, cuts, cracks, swelling or flatten condition.
 2. Back the stud end hex nut off as far as possible. Push backup washer towards the nut to fully expose the turn down section. Washer must fit turned down section and not be too loose
 3. Lubricate O-rings using a thin film of clean hydraulic oil or as needed, petroleum jelly to hold O-ring in place.
- Install O-ring into groove making sure it is seated at the bottom. Excess petroleum jelly will prevent seating of O-ring and cause it to pop out.

To protect an O-ring from threads, wrap electrical tape over the threads. Slide O-ring over the tape into the turned down section. Remove the tape.

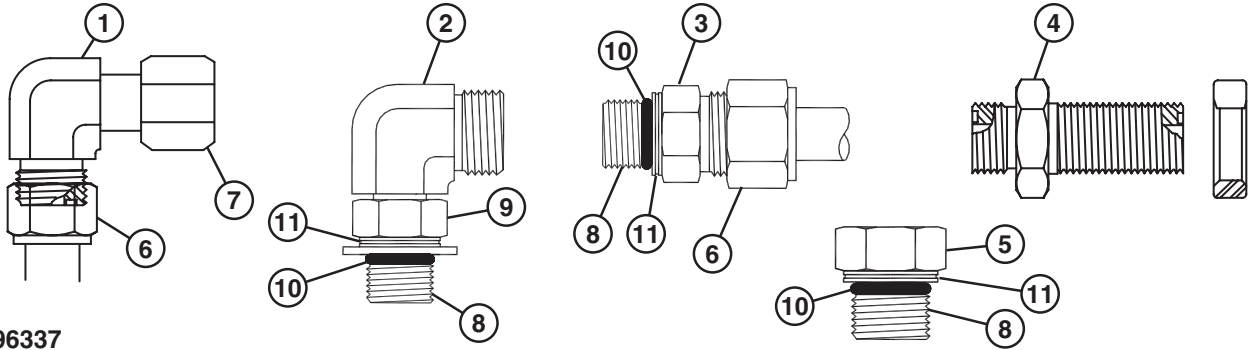
4. Turn fitting into the boss by hand until face of nut or washer squeezes the O-ring into the seat and contacts face of boss. Loosen adjustable fittings no more than one turn for alignment.

Hold connections together while tightening nut to ensure O-ring remains in place.

5. Tighten fitting or nut to torque value shown. Use a second wrench to hold the fitting in position or to keep hose from twisting while tightening nut.

OUT3035,0000420 -19-14JAN04-2/2

O-Ring Face Seal Fittings With Metric Hex Nut And Stud End For Standard Pressure Service Recommendations



T196337

- 1—90° Swivel Elbow
- 2—90° Adjustable Stud Elbow
- 3—Stud Straight
- 4—Bulkhead Union and Nut
- 5—External Hex Stud End Plug
- 6—Tube Nut
- 7—Swivel Nut
- 8—Stud End
- 9—Hex Nut
- 10—O-Ring
- 11—Identification Groove

O-RING FACE SEAL AND FITTINGS WITH METRIC HEX NUT AND STUD END FOR STANDARD PRESSURE, BELOW 27 600 kPa (275.8 bar) (4,000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified							
Nominal Tube OD or Hose ID			O-Ring Face Seal Hose or Tube Swivel Nut			Bulkhead Nut	
Metric Tube OD	Inch Tube OD or Hose ID		Thread Size	Hex Size	Torque	Hex Size	Torque
mm	Dash Size	mm (in.)	in.	mm	Nm (lb-ft)	mm	Nm (lb-ft)
4	-2	3.18 (0.125)	—	—	—	—	—
5	-3	4.78 (0.188)	—	—	—	—	—
6	-4	6.35 (0.250)	9/16-18	17	16 (12)	22	32 (24)
8	-5	7.92 (0.312)	—	—	—	—	—
10	-6	9.53 (0.375)	11/16-16	22	24 (18)	27	42 (31)
12	-8	12.70 (0.500)	13/16-16	24	50 (37)	30	93 (69)
16	-10	15.88 (0.625)	1-14	30	69 (51)	36	118 (87)
20	-12	19.05 (0.750)	1-3/16-12	36	102 (75)	41	175 (129)
22	-14	22.23 (0.875)	1-3/16-12	36	102 (75)	41	175 (129)
25	-16	25.40 (1.000)	1-7/16-12	41	142 (105)	46	247 (182)
28	—	—	—	—	—	—	—
32	-20	31.75 (1.250)	1-11/16-12	50	190 (140)	50	328 (242)
38	-24	38.10 (1.500)	2-12	60	217 (160)	60	374 (276)
50	-32	50.80 (2.000)	—	—	—	—	—

Continued on next page

OUT3035.0000366 -19-14JAN04-1/2

Torque Values

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O-RING STRAIGHT, ADJUSTABLE, AND EXTERNAL HEX PLUG WITH METRIC STUD END FOR STANDARD PRESSURE, BELOW 27 600 kPa (275.8 bar) (4,000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified

Thread Size ^a	Straight Hex Size ^b	Adjustable Nut Hex Size	Steel or Gray Iron Torque	Aluminum or Brass Torque
mm.	mm	mm	Nm (lb-ft)	Nm (lb-ft)
M8 x 1	12	12	8 (6)	5 (4)
M10 x 1	14	14	15 (11)	10 (7)
M12 x 1.5	17	17	25 (18)	17 (12)
M14 x 1.5	19	19	40 (30)	27 (20)
M16 x 1.5	22	22	45 (33)	30 (22)
M18 x 1.5	24	24	50 (37)	33 (25)
M22 x 1.5	27	27	69 (51)	46 (34)
M27 x 2	32	32	100 (74)	67 (49)
M30 x 2	36	36	130 (96)	87 (64)
M33 x 2	41	41	160 (118)	107 (79)
M38 x 2	46	46	176 (130)	117 (87)
M42 x 2	50	50	210 (155)	140 (103)
M48 x 2	55	55	260 (192)	173 (128)
M60 x 2	65	65	315 (232)	210 (155)

^a Stud end threads are identified as metric by an identification groove in the hex nut next to the O-ring.

^b Straight hex size applies to fittings only and may not be the same as the corresponding plug of the same thread size.

1. Inspect fitting and connector sealing surfaces and the O-rings. They must be free of dirt, scratches, nicks, and burrs. O-ring must be free of dirt, cuts, cracks, swelling or flatten condition.
2. Back the stud end hex nut off as far as possible. Push backup washer towards the nut to fully expose the turn down section. Washer must fit turned down section and not be too loose
3. Lubricate O-rings using a thin film of clean hydraulic oil or as needed, petroleum jelly to hold O-ring in place.

Install O-ring into groove making sure it is seated at the bottom. Excess petroleum jelly will prevent seating of O-ring and cause it to pop out.

To protect an O-ring from threads, wrap electrical tape over the threads. Slide O-ring over the tape into the turned down section. Remove the tape.

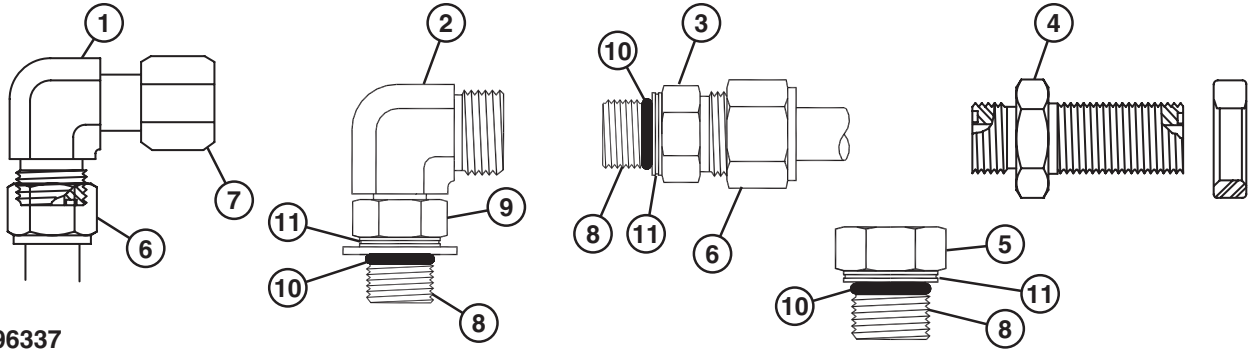
4. Turn fitting into the boss by hand until face of nut or washer squeezes the O-ring into the seat and contacts face of boss. Loosen adjustable fittings no more than one turn for alignment.

Hold connections together while tightening nut to ensure O-ring remains in place.

5. Tighten fitting or nut to torque value shown. Use a second wrench to hold the fitting in position or to keep hose from twisting while tightening nut.

OUT3035,0000366 -19-14JAN04-2/2

O-Ring Face Seal Fittings With Metric Hex Nut And Stud End For High Pressure Service Recommendations



T196337

- 1—90° Swivel Elbow
- 2—90° Adjustable Stud Elbow
- 3—Stud Straight
- 4—Bulkhead Union and Nut
- 5—External Hex Stud End Plug
- 6—Tube Nut
- 7—Swivel Nut
- 8—Stud End
- 9—Hex Nut
- 10—O-Ring
- 11—Identification Groove

O-RING FACE SEAL FITTINGS WITH METRIC HEX NUT AND STUD END FOR HIGH PRESSURE, ABOVE 27 600 kPa (275.8 bar) (4,000 psi), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified

Nominal Tube OD or Hose ID			O-Ring Face Seal Hose or Tube Swivel Nut			Bulkhead Nut	
Metric Tube OD	Inch Tube OD or Hose ID		Thread Size	Hex Size	Torque	Hex Size	Torque
mm	Dash Size	mm (in.)	in.	mm	Nm (lb-ft)	mm	Nm (lb-ft)
4	-2	3.18 (0.125)	—	—	—	—	—
5	-3	4.78 (0.188)	—	—	—	—	—
6	-4	6.35 (0.250)	9/16-18	17	24 (18)	22	32 (24)
8	-5	7.92 (0.312)	—	—	—	—	—
10	-6	9.53 (0.375)	11/16-16	22	37 (27)	27	42 (31)
12	-8	12.70 (0.500)	13/16-16	24	75 (55)	30	93 (69)
16	-10	15.88 (0.625)	1-14	30	103 (76)	36	118 (87)
20	-12	19.05 (0.750)	1-3/16-12	36	152 (112)	41	175 (129)
22	-14	22.23 (0.875)	1-3/16-12	36	152 (112)	41	175 (129)
25	-16	25.40 (1.000)	1-7/16-12	41	214 (158)	46	247 (182)
28	—	—	—	—	—	—	—
32	-20	31.75 (1.250)	1-11/16-12	—	286 (211)	50	328 (242)
38	-24	38.10 (1.500)	2-12	—	326 (240)	60	374 (276)

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OUT3035.0000421 -19-14JAN04-1/2

Torque Values

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O-RING STRAIGHT, ADJUSTABLE, AND EXTERNAL HEX PLUG WITH METRIC STUD END FOR HIGH PRESSURE, ABOVE 27 600 KPA (275.8 BAR) (4,000 PSI), TORQUE VALUES—Tolerance is +15 -20% unless otherwise specified

Thread Size ^a	Straight Hex Size ^b	Adjustable Nut Hex Size	Steel or Gray Iron Torque
mm.	mm	mm	Nm (lb-ft)
M8 x 1	12	12	8 (6)
M10 x 1	14	14	15 (11)
M12 x 1.5	17	17	35 (26)
M14 x 1.5	19	19	45 (33)
M16 x 1.5	22	22	55 (41)
M18 x 1.5	24	24	70 (52)
M22 x 1.5	27	27	100 (74)
M27 x 2	32	32	170 (125)
M30 x 2	36	36	215 (159)
M33 x 2	41	41	260 (192)
M38 x 2	46	46	320 (236)
M42 x 2	50	50	360 (266)
M48 x 2	55	55	420 (310)

^a Stud end threads are identified as metric by an identification groove in the hex nut next to the O-ring.

^b Straight hex size applies to fittings only and may not be the same as the corresponding plug of the same thread size.

1. Inspect fitting and connector sealing surfaces and the O-rings. They must be free of dirt, scratches, nicks, and burrs. O-ring must be free of dirt, cuts, cracks, swelling or flatten condition.
2. Back the stud end hex nut off as far as possible. Push backup washer towards the nut to fully expose the turn down section. Washer must fit turned down section and not be too loose
3. Lubricate O-rings using a thin film of clean hydraulic oil or as needed, petroleum jelly to hold O-ring in place.

Install O-ring into groove making sure it is seated at the bottom. Excess petroleum jelly will prevent seating of O-ring and cause it to pop out.

To protect an O-ring from threads, wrap electrical tape over the threads. Slide O-ring over the tape into the turned down section. Remove the tape.

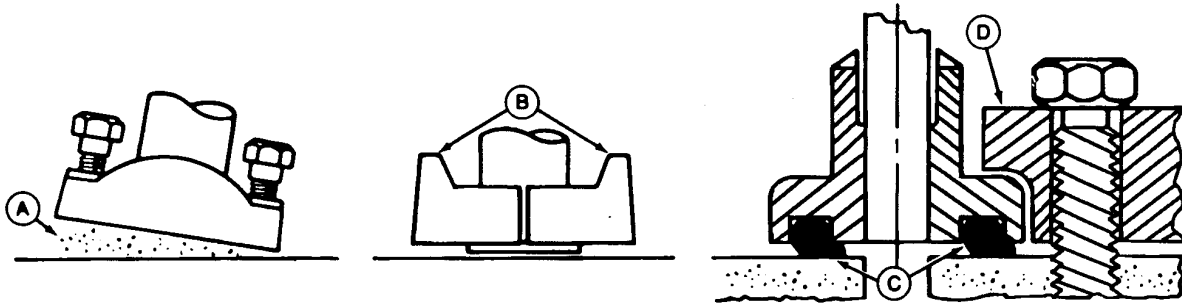
4. Turn fitting into the boss by hand until face of nut or washer squeezes the O-ring into the seat and contacts face of boss. Loosen adjustable fittings no more than one turn for alignment.

Hold connections together while tightening nut to ensure O-ring remains in place.

5. Tighten fitting or nut to torque value shown. Use a second wrench to hold the fitting in position or to keep hose from twisting while tightening nut.

OUT3035,0000421 -19-14JAN04-2/2

Service Recommendations for Metric Series Four Bolt Flange Fitting



A—Sealing Surface

B—Split Flange

C—Pinched O-Ring

D—Single Piece Flange

1. Clean sealing surfaces (A). Inspect. Scratches cause leaks. Roughness causes seal wear. Out-of-flat causes seal extrusion. If defects cannot be polished out, replace component.
2. Install the correct O-ring (and backup washer if required) into groove using petroleum jelly to hold it in place.
3. Split flange: Loosely assemble split flange (B) halves. Make sure split is centrally located and perpendicular to the port. Hand tighten cap screws to hold parts in place. Do not pinch O-ring (C).
4. Single piece flange (D): Place hydraulic line in center of flange and install four cap screws. Flange must be centrally located on port. Hand tighten cap screws to hold flange in place. Do not pinch O-ring.
5. After components are properly positioned and cap screws are hand tightened, tighten one cap screw,

then tighten the diagonally opposite cap screw. Tighten two remaining cap screws. Tighten all cap screws as specified in the chart below.

DO NOT use air wrenches. DO NOT tighten one cap screw fully before tightening the others. DO NOT over tighten.

TORQUE CHART ^a		
Thread ^b	N•m	lb-ft
M6	12	9
M8	30	22
M10	57	42
M12	95	70
M14	157	116
M16	217	160
M18	334	246
M20	421	318

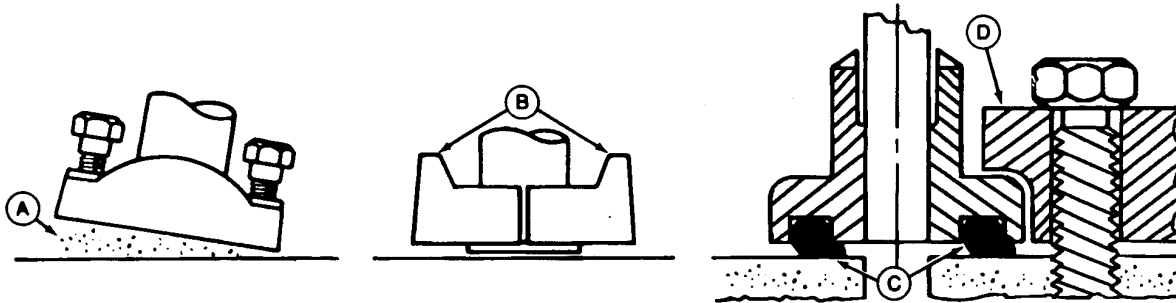
^aTolerance $\pm 10\%$. The torques given are enough for the given size connection with the recommended working pressure. Increasing cap screw torque beyond these amounts will result in flange and cap screw bending and connection failures.

^bMetric standard thread.

T6890BB -JUN-01MARGO

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Service Recommendations For Inch Series Four Bolt Flange Fittings



A—Sealing Surface

B—Split Flange

C—Pinched O-Ring

D—Single Piece Flange

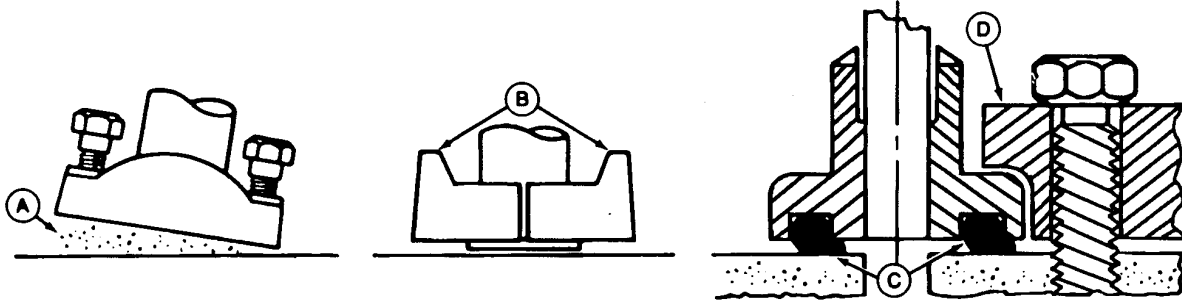
1. Clean sealing surfaces (A). Inspect. Scratches cause leaks. Roughness causes seal wear. Out-of-flat causes seal extrusion. If defects cannot be polished out, replace component.
2. Install O-ring (and backup washer if required) into groove using petroleum jelly to hold it in place.
3. Split flange: Loosely assemble split flange (B) halves. Make sure split is centrally located and perpendicular to port. Hand tighten cap screws to hold parts in place. Do not pinch O-ring (C).
4. Single piece flange (D): Place hydraulic line in center of flange and install cap screws. Flange must be centrally located on port. Hand tighten cap screws to hold flange in place. Do not pinch O-ring.
5. Tighten one cap screw, then tighten the diagonally opposite cap screw. Tighten two remaining cap screws. Tighten all cap screws as specified in the chart below.

DO NOT use air wrenches. DO NOT tighten one cap screw fully before tightening the others. DO NOT over tighten.

TORQUE CHART					
Nominal Flange Size	Cap Screw Size	N•m		lb-ft	
		Min	Max	Min	Max
1/2	5/16-18 UNC	20	31	15	23
3/4	3/8-16 UNC	28	54	21	40
1	3/8-16 UNC	37	54	27	40
1-1/4	7/16-14 UNC	47	85	35	63
1-1/2	1/2-13 UNC	62	131	46	97
2	1/2-13 UNC	73	131	54	97
2-1/2	1/2-13 UNC	107	131	79	97
3	5/8-11 UNC	158	264	117	195
3-1/2	5/8-11 UNC	158	264	117	195
4	5/8-11 UNC	158	264	117	195
5	5/8-11 UNC	158	264	117	195

T6890BB -UN-01MARS0

Inch Series Four Bolt Flange Fitting For High Pressure Service Recommendations



A—Sealing Surface

B—Split Flange

C—Pinched O-Ring

D—Single Piece Flange

INCH SERIES FOUR BOLT FLANGE FITTING FOR 41 400 kPa (414 bar) (6000 psi) PRESSURE SERIES TORQUE VALUES— Tolerance is ± 10% unless otherwise specified		
Nominal Flange Size	Cap Screw Size ^a	Min—Max Torque
in.	in.	Nm (lb-ft) ^b
1/2	5/16-18 UNC	20—31 (15—23)
3/4	3/8-16 UNC	34—54 (25—40)
1	7/16-14 UNC	57—85 (42—63)
1-1/4	1/2-13 UNC	85—131 (63—97)
1-1/2	5/8-11 UNC	159—264 (117—195)
2	3/4-10 UNC	271—468 (200—345)

^a JDM A17D, SAE Grade 5 or better cap screws with plated hardware. Lock washers are permissible but not recommended.

^b Minimum torques given are enough for the given size connection with the recommended working pressure. Torques can be increased to the maximum shown for each cap screw size if desired. Increasing cap screw torque beyond the maximum will result in flange and cap screw bending and connection failures.

1. Clean sealing surfaces (A). Inspect. Scratches, nicks, and burrs cause leaks. Roughness causes O-ring wear. Out-of-flat causes O-ring extrusion. If imperfection cannot be polished out, replace component.

2. Install the O-ring (and backup ring, if used) into groove. Use petroleum jelly to hold it in place.

IMPORTANT: DO NOT use air wrenches. DO NOT tighten one cap screw fully before tightening the others. DO NOT over tighten.

3. Split flange: Loosely assemble split flange (B) halves. Make sure split is centrally located and perpendicular to port. Hand tighten cap screws to hold flange halves and line in place. Do not pinch O-ring (C).

Single piece flange (D): Make sure flange is centrally located on port and line is centered in flange. Install the cap screws. Hand tighten cap screws to hold flange and line in place. Do not pinch O-ring.

4. Tighten one cap screw and then the diagonally opposite cap screw. Tighten the two remaining cap screws. Tighten cap screws within the specified torque values.

Torque Values

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Section 01 Tracks

01

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Track Roller Remove and Install

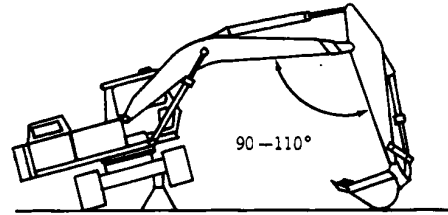
1. Swing upperstructure 90° and lower bucket to raise track off ground. Keep angle between boom and arm 90—110° and position round side of bucket on ground.



CAUTION: Prevent possible injury from unexpected machine movement. Put shop stands under frame to support machine while removing track roller.

2. Put shop stands under machine.

	Specification
Machine—Weight	44 500 kg approximate 98,100 lb approximate



T6876FG -JUN-06DEC88

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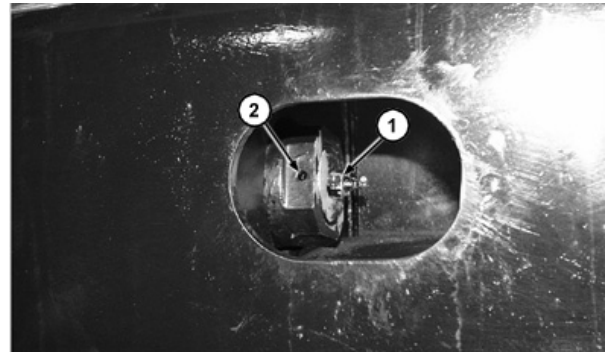
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CAUTION: High pressure grease in track adjuster cylinder. Do not remove grease fitting or nut and valve assembly to release grease.

3. Loosen nut and valve assembly (1) one turn to release grease from track adjuster cylinder through bleed hole (2).

- 1—Nut and Valve Assembly
- 2—Bleed Hole



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Continued on next page

TX17984,0000001 -19-02AUG06-2/3

Track System



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 01
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2
- Remove cap screws (1). Remove roller (2).

Specification

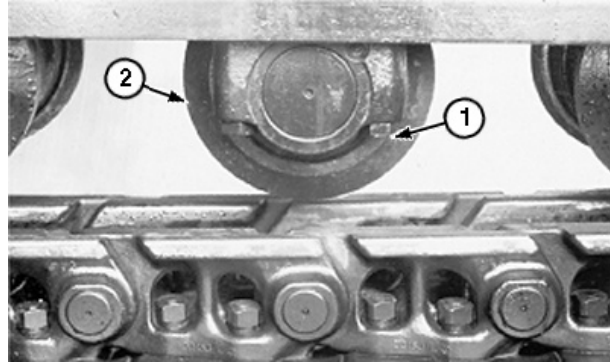
Track Roller—Weight 80 kg approximate
176 lb approximate

- Replace parts as necessary. See 450DLC Track Roller Tread Diameter for component wear measurements.
- Install roller on track link with flat portion of bracket upward.
- Lower excavator enough to allow cap screws (1) to be installed.
- Tighten cap screws.

Specification

Track Roller-to-Frame Cap
Screw—Torque 740 N•m
545 lb-ft

- Check roller oil level by removing plug in bracket. Add oil as necessary. Approximate oil capacity is 500 mL (17 fl oz).
- See Check and Adjust Track Sag. (Operator's Manual.)

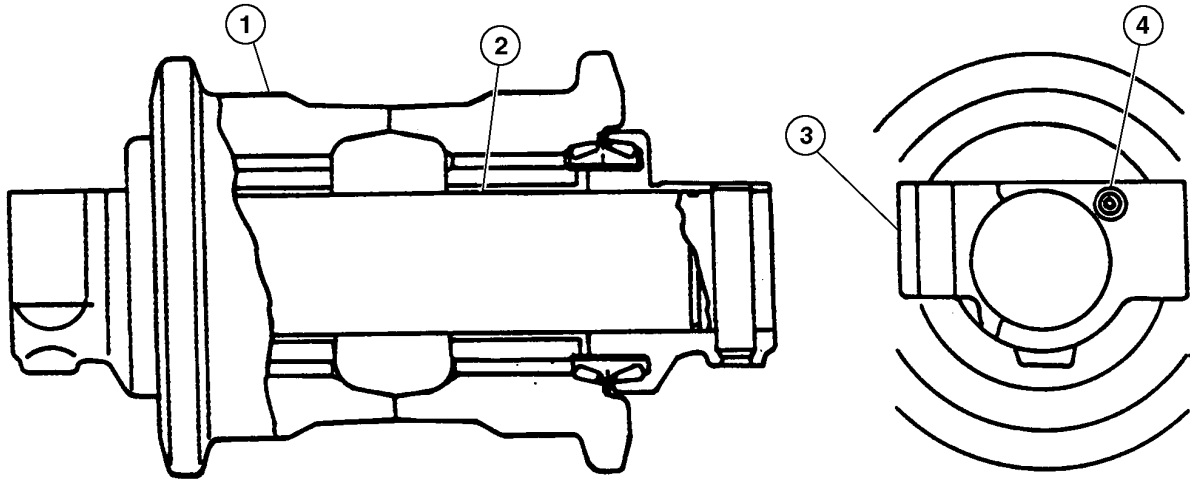


1—Cap Screw (2 used)
2—Track Roller

TX11008326A -UN-24MAY06

TX17984,0000001 -19-02AUG06-3/3

Track Roller Disassemble and Assemble



TX1008198

1—Roller

2—Axle

3—Bracket

4—Plug

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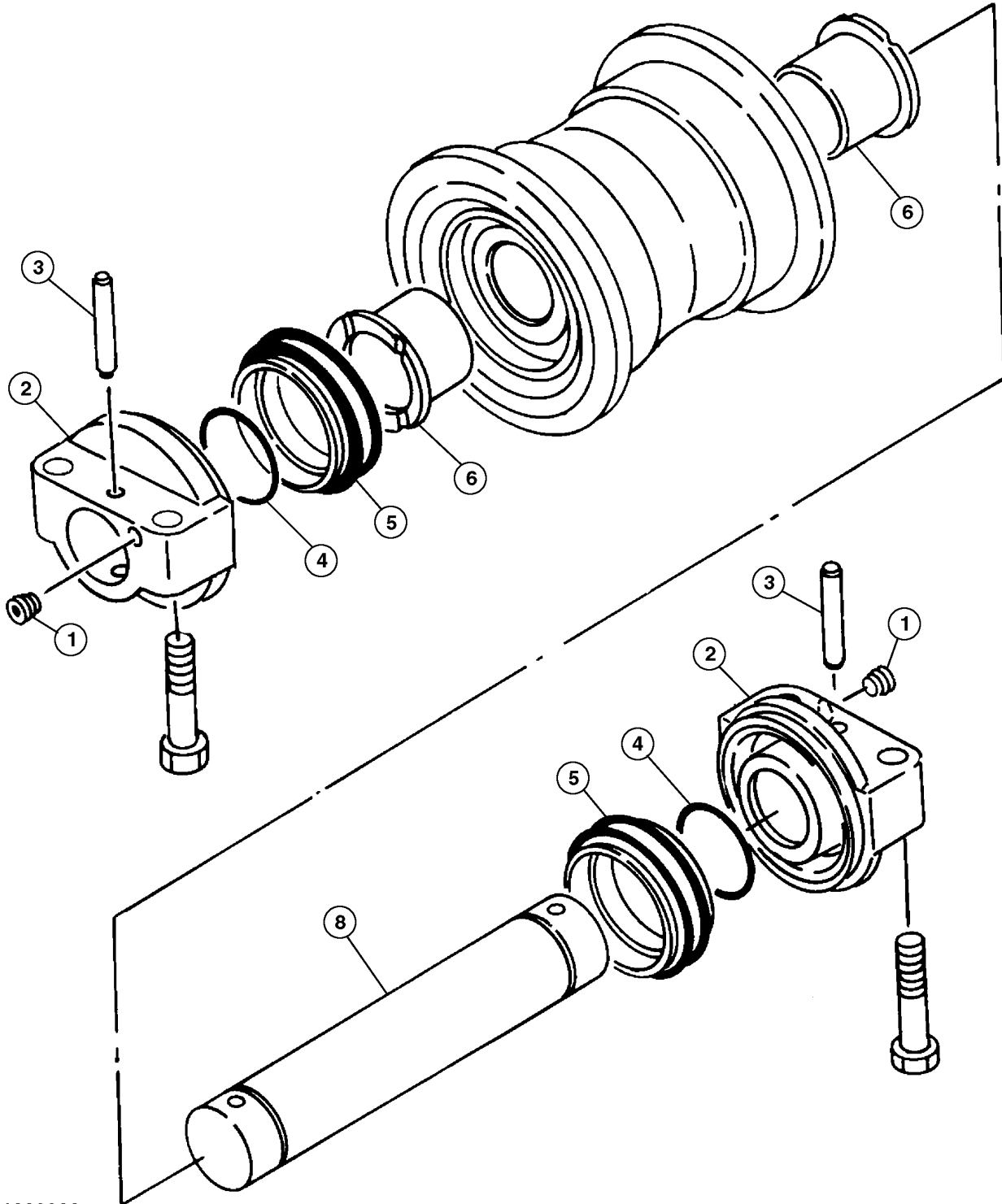
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TX1008198 -UN-24MAY06

Track System

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TX1008200

TX1008200 -JUN-24MAY06

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MD46667.00000AE -19-03AUG06-2/7

Track System

1—Plug (2 used)
2—Bracket (2 used)
3—Pin (2 used)

4—O-Ring (2 used)
5—Metal Face Seals with
O-Rings (2 used)

6—Bushing
7—Roller

8—Shaft

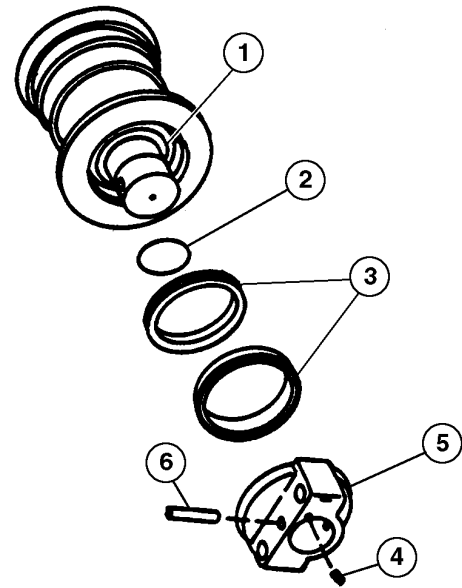
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1. Remove plug (4) to drain oil. Approximate capacity is 500 mL (17 fl oz).
2. Remove pin (6).
3. Remove bracket (5) using a bearing puller attachment and adapters from puller set.

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A used seal must be kept together as a set because of wear patterns on seal ring face.

4. Remove metal face seal (3) from roller and bracket. Keep seal rings together as a matched set with seal ring faces together to protect surfaces.
 5. Inspect seals. Perform Metal Face Seal Inspection. (Group 0130.) For seals that are reused, put a piece of cardboard between seal rings to protect seal face.
 6. Remove axle from roller.
- NOTE: Only remove bushing if replacement is necessary.*
7. Remove bushings (1) using a 2-jaw puller and adapters from puller set.



1—Bushing
2—O-Ring
3—Metal Face Seal
4—Plug
5—Bracket
6—Pin

TX1008201 -JUN-24MAY06

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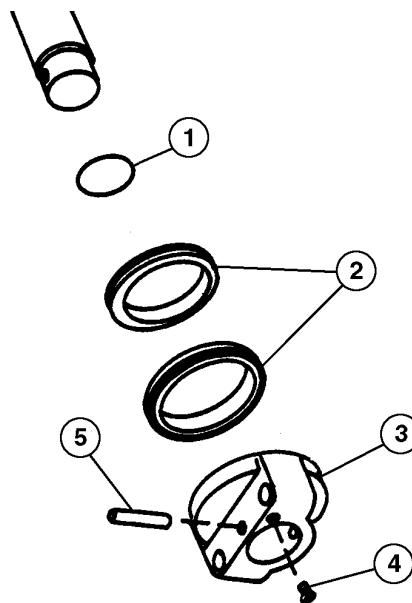
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8. Install O-ring (1) on axle shaft.
9. Apply a thin layer of TY24811 NEVER-SEEZ® Lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (5).
10. Install shaft into bracket (3).
11. Apply a thin layer of TY24811 NEVER-SEEZ® Lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (5).

IMPORTANT: O-rings and seat surfaces for O-rings must be clean, dry, and oil free so O-rings do not slip when roller is turning.

12. Thoroughly clean the O-rings and seat surfaces in roller brackets, and seal rings using volatile, non-petroleum base solvent and lint-free tissues.
13. Install O-ring on seal rings.
14. Install seals in bracket and roller.

Apply equal pressure with fingers at four equally spaced points on seal face. Seal must “pop” down into place so O-ring is tight against seal bore. A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant.
15. Wipe finger prints and foreign material off seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal ring face.
16. Apply cure primer and pipe sealant to threads of plug (4). Install plug.



- 1—O-Ring
- 2—Metal Face Seal
- 3—Bracket
- 4—Plug
- 5—Pin

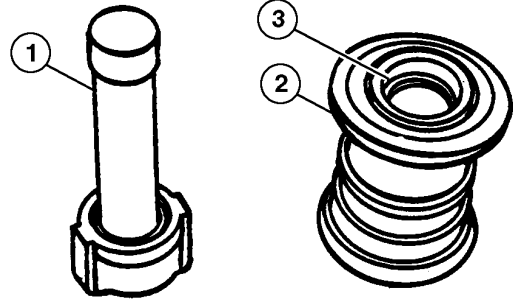
TX1008202 -JUN-24MAY06

Track System

17. Apply a thin film of oil to bushings (3). Install bushings.

18. Install axle shaft (1) with assembled parts to roller (2).

- 1—Axle Shaft
- 2—Roller
- 3—Bushing



Continued on next page

MD46667,00000AE -19-03AUG06-6/7

TX1008203 -UN-24MAY06

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19. Install O-ring (B) on shaft.

IMPORTANT: O-rings and seat surfaces for O-rings must be clean, dry, and oil free so O-rings do not slip when roller is turning.

20. Thoroughly clean the O-rings and seat surfaces in shell, brackets, and seal rings using volatile, non-petroleum base solvent and lint-free tissues.

21. Install O-ring on seal ring.

22. Install O-rings and seal rings as an assembly into bracket and roller.

Apply equal pressure with fingers at four equally spaced points on seal face. Seal must "pop" down into place so O-ring is tight against seal bore.

NOTE: A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant.

23. Clean seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal face.

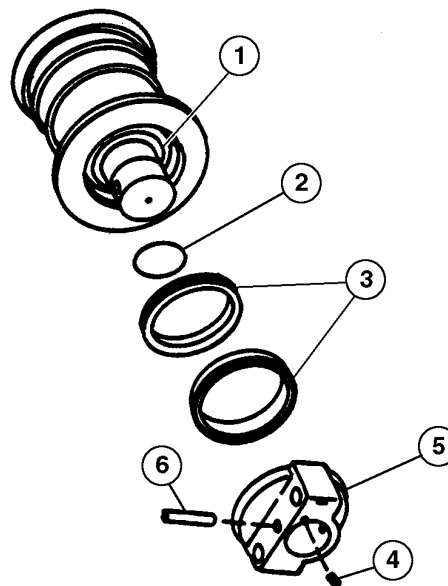
Apply a thin layer of TY24811 NEVER-SEEZ® Lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (5).

24. Install bracket (5).

25. Apply a thin layer of TY24811 NEVER-SEEZ® Lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (5).

26. Add 500 mL (17 fl oz) of Torq-Gard Supreme 30W oil through hole (4).

27. Apply cure primer and pipe sealant to threads of plug (4). Install plug.



- 1—Bushing
- 2—O-Ring
- 3—Metal Face Seal
- 4—Plug
- 5—Bracket
- 6—Pin

TX1008201 -JUN-24MAY06

Track Roller Pressure Test

1. Hold shaft and turn shell of roller several turns to seat metal face seals.
2. Remove the drain plug.

NOTE: Plug, barbed adapter, and connector are from leak detector kit D05361ST.

3. Install parts (1—6).
4. Tighten plug. Slowly pressurize oil cavity to test pressure specification.

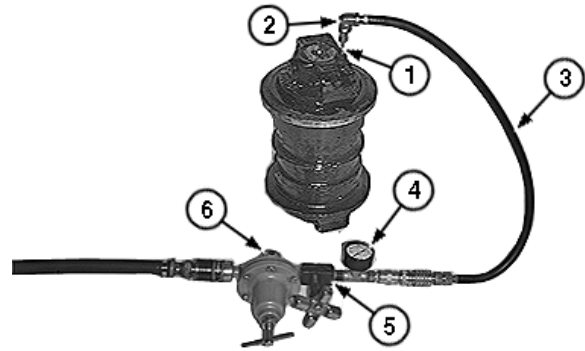
Specification

Track Roller Oil Cavity—Pressure 82—138 kPa
 12—20 psi

5. Close valve. Wait for 30 seconds. Check for oil leaks or pressure decrease.
6. If leakage, disassemble roller and replace parts as necessary. See Track Roller Disassemble and Assemble. (Group 0130.)
7. Apply PM37509 Cure Primer and PM37397 Pipe Sealant to threads of plug. Install and tighten plug to specification.

Specification

Plug—Torque..... 30 N•m
 22 lb-ft



- 1—Plug, Barbed Adapter and Connector
- 2—JT03001 Tee Fitting 7/16-20 M 37° x 7/16-20 F 37° SW x 7/16-20 M 37°
- 3—Hose (2 used)
- 4—Pressure Gauge
- 5—Needle Valve
- 6—Air Pressure Regulator

TX1008204A -UN-24MAY06

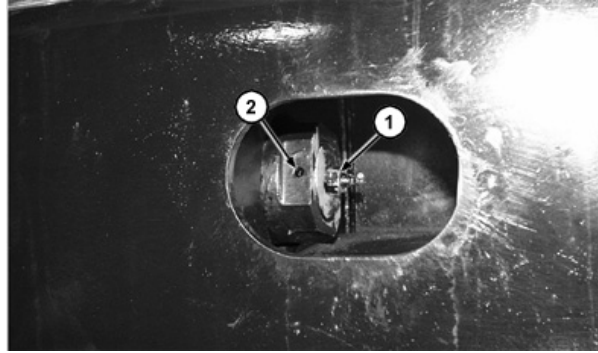
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Track Carrier Roller Remove and Install

! **CAUTION:** High pressure grease in track adjuster cylinder. Do not remove grease fitting or nut and valve assembly to release grease.

1. Loosen nut and valve assembly (1) one turn to release grease from track adjuster cylinder through bleed hole (2).

1—Nut and Valve Assembly
2—Bleed Hole



T138569B -UN-30APR01

MD46667,00000AF -19-02AUG06-1/3

! **CAUTION:** Prevent possible crushing injury from heavy component. Use appropriate lifting device.

2. Raise track link just enough to permit upper roller removal.

Specification

Track Carrier Roller—Weight 39 kg approximate
86 lb approximate



T657DJ -UN-25OCT88

! **CAUTION:** Securely support track, to prevent, accidental lowering of track.

3. Install wooden blocks between track link and frame.

Continued on next page

MD46667,00000AF -19-02AUG06-2/3

Track System

4. Remove cap screws (2) to remove upper roller (1). See 450DLC Track Carrier Roller Tread Diameter for component wear measurements.

5. Install upper roller (1). Tighten cap screws (2).

Specification

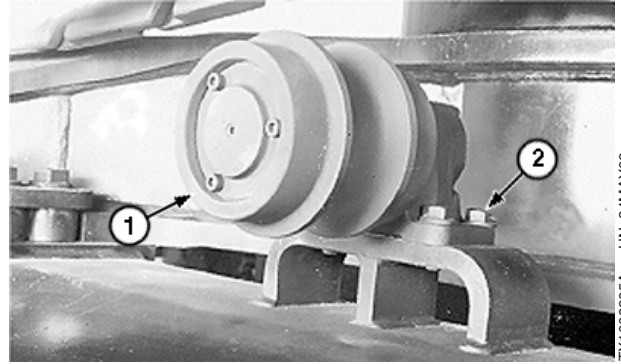
Track Carrier Roller-to-Frame

Cap Screw—Torque 400 N•m
295 lb-ft

6. Check roller oil level by removing plug in cover. Add oil as necessary. (See Track Roller, Front Idler, and Carrier Roller Oil in Operator's Manual.) Approximate oil capacity is 120 mL (4 fl oz).

7. Remove wooden blocks and jack.

8. See Check and Adjust Track Sag. (Operator's Manual.)



1—Upper Roller
2—Cap Screw (4 used)

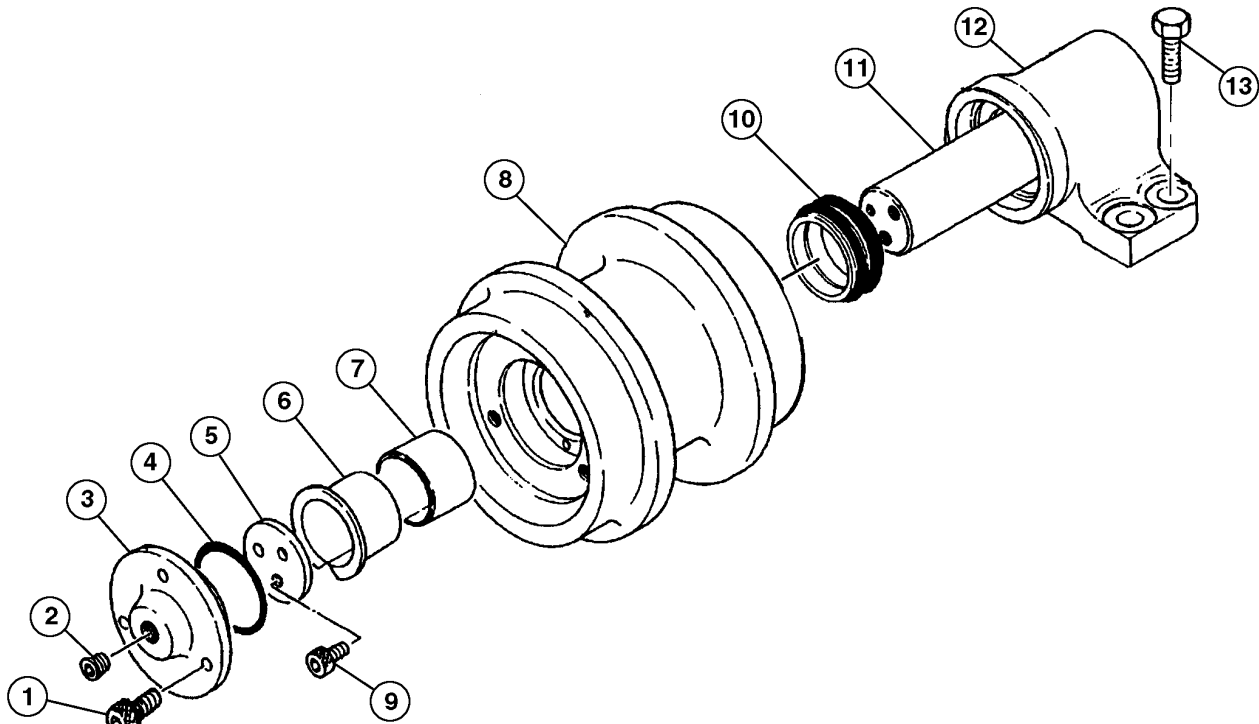
TX1008205A -UN-24MAY06

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MD46667,00000AF -19-02AUG06-3/3

Track Carrier Roller Disassemble and Assemble

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TX1008207

- | | | | |
|----------------------|-----------------|----------------------|-----------------------|
| 1—Cap Screw (3 used) | 5—Thrust Washer | 8—Roller | 11—Axle |
| 2—Plug | 6—Bushing | 9—Cap Screw (3 used) | 12—Bracket |
| 3—Cover | 7—Bushing | 10—Metal Face Seal | 13—Cap Screw (4 used) |
| 4—O-Ring | | | |

1. Remove plug (2) to drain oil.
2. Remove parts (1, 3—5 and 9) to remove roller (8).

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A seal must be kept together as a set because of wear patterns on seal ring face.

3. Remove metal face seal (10) from roller (8) and bracket (12). Keep seal rings together as a matched set with faces together to protect lapped surfaces. See Metal Face Seal Inspection. (Group 0130.)
4. Remove bushings (6 and 7) if replacement is necessary.

5. Replace parts as necessary.
6. Install bushing (6) in roller so flange is tight against shoulder. Install bushing (7).

IMPORTANT: O-rings and seat surfaces must be clean, dry, and oil free so O-rings do not slip when roller is turning.

7. Thoroughly clean the O-rings and seat surfaces in roller, bracket, and seal rings using a volatile, non-petroleum base solvent and lint-free tissues.
8. Install O-ring on seal rings.
9. Install seal rings and O-rings as an assembly into bracket (12) and roller (8).

TX1008207 -JUN-24MAY06

Continued on next page

MD46667,00000B0 -19-02AUG06-1/2

Track System

Apply equal pressure with the fingers at four equally spaced points on seal ring face. Seal must “pop”

into place so O-ring and seal ring is seated squarely in bore.

NOTE: A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant.

10. Clean seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal ring face.
11. Install roller (8) and thrust washer (5). Tighten cap screws (9).

Track Carrier Roller—Specification

Thrust Washer-to-Axle Cap
Screw—Torque 64 N•m
47 lb-ft

12. Install O-ring (4) and cover (3). Tighten cap screws (1).

Track Carrier Roller—Specification

Cover-to-Roller Cap Screw—
Torque..... 64 N•m
47 lb-ft

13. Fill roller with 120 mL (4 fl oz) of clean oil. See Track Roller, Front Idler, and Carrier Roller Oil. (See Operator’s Manual.)
14. Apply cure primer and pipe sealant to threads of plug (2). Install plug.

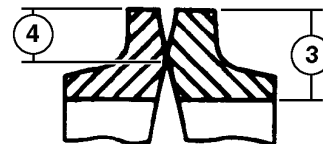
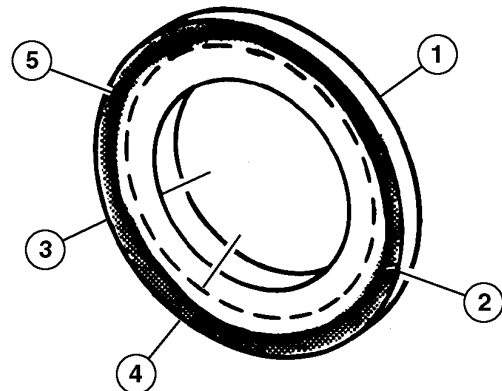
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MD46667,00000B0 -19-02AUG06-2/2

Metal Face Seal Inspection

1. Inspect for the following conditions to determine if seals can be reused:
 - a. The narrow, highly polished sealing area (5) must be in the outer half of seal ring face (4).
 - b. Sealing area must be uniform and concentric with the ID and OD of seal ring (1).
 - c. Sealing area must not be chipped, nicked, or scratched.

- 1—Seal Ring
- 2—Worn Area (shaded area)
- 3—Seal Ring Face
- 4—Outer Half of Seal Ring Face
- 5—Sealing Area (dark line)



TX1008208 -JUN-24MAY06

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MD46667,00000D2 -19-02AUG06-1/3

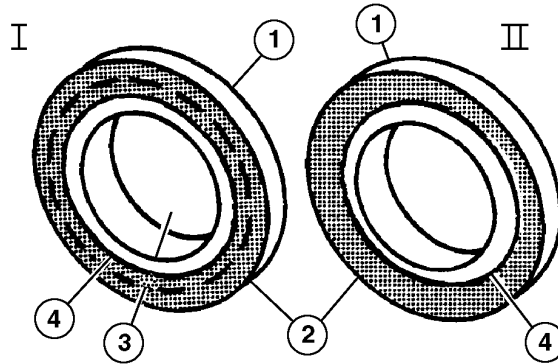
Track System

2. Illustration shows examples of worn seal rings (1).

I—Sealing area (4) is in inner half of seal ring face (3).

II—Sealing area (4) not concentric with ID and OD of seal ring.

- 1—Seal Ring
- 2—Worn area (shaded area)
- 3—Inner Half of Seal Ring Face
- 4—Sealing Area (dark line)



TX1008209 -JUN-31MAY06

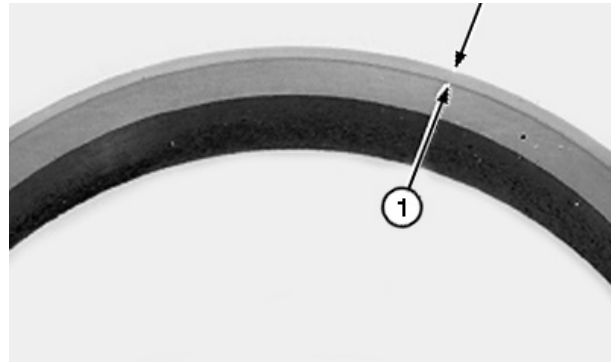
MD46667,0000D2 -19-02AUG06-2/3

3. Clean reusable seals by removing all foreign material from seal rings, except seal face (1), using a scraper or a stiff bristled fiber brush.

4. Wash seal rings and O-rings using a volatile, non-petroleum base solvent to remove all oil. Thoroughly dry parts using a lint-free tissue.

Apply a thin film of oil to seal ring face. Put face of seal rings together and hold using tape.

- 1—Seal Face



TX1008335A -JUN-26MAY06

MD46667,0000D2 -19-02AUG06-3/3

Track Shoe Remove and Install

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

1. Remove nuts, cap screws, and shoe.

Specification	
Track Shoe 600 mm—Weight.....	28 kg 62 lb

Specification	
Track Shoe 750 mm—Weight.....	36 kg 79 lb

Specification	
Track Shoe 900 mm—Weight.....	42 kg 93 lb

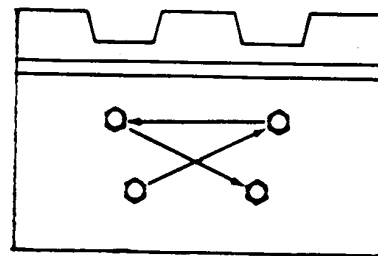
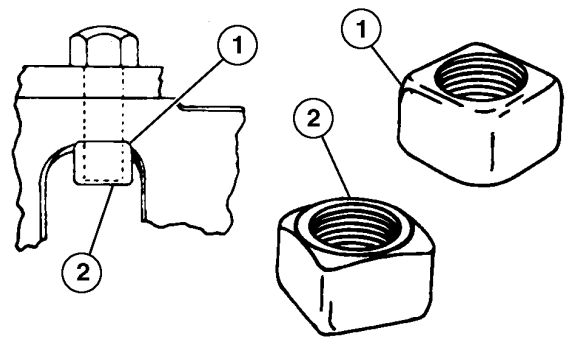
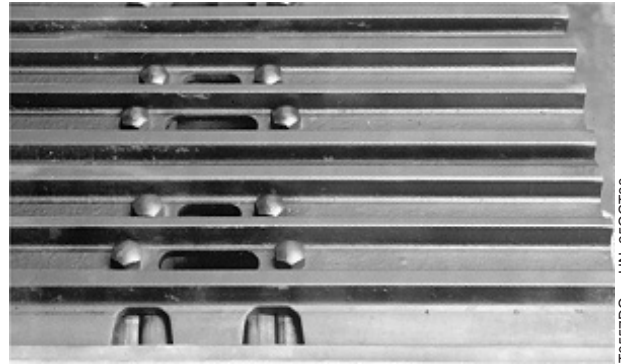
2. Apply a light coat of oil to cap screw threads and install shoe.

3. Install all track shoe nuts with rounded edges (1) against the link and chamfered edges (2) away from the link. Be sure nut is properly positioned in the link so there is full contact between the nut and the link.

4. Starting at any cap screw, tighten cap screws in sequence shown.

Track Shoe—Specification	
Shoe-to-Chain Cap Screw—	
Torque	1400 N•m 1030 lb-ft

- 1—Rounded Edge
- 2—Chamfered Edge



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TX1008211 -UN-24MAY06

T6552AH -UN-23FEB89

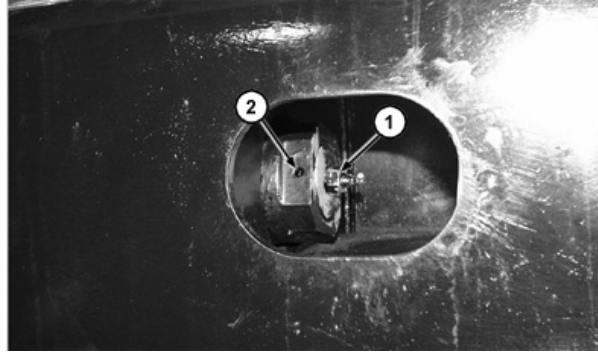
MD46667,00000B2 -19-02AUG06-1/1

Track Chain Remove and Install

! **CAUTION:** High pressure grease in track adjuster cylinder. Do not remove grease fitting or nut and valve assembly to release grease.

1. Loosen nut and valve assembly (1) one turn to release grease from track adjuster cylinder through bleed hole (2).

1—Nut and Valve Assembly
2—Bleed Hole

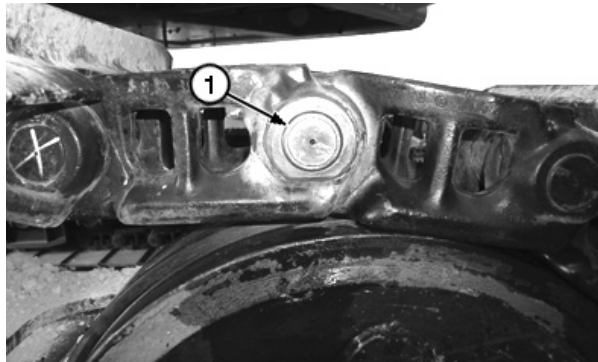


T138569B -JUN-30APR01

MD46667,0000B3 -19-02AUG06-1/4

2. Move track chain so master pin (1) is over front idler.
3. Remove nuts and cap screws to remove shoe on each side of master pin.
4. Put a wooden block in front of idler and under chain so chain does not fall when master pin is removed.
5. Raise excavator just enough so bottom of sprocket clears track chain.

1—Master Pin



TX1009154A -JUN-05JUL06

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MD46667,0000B3 -19-02AUG06-2/4

Track System

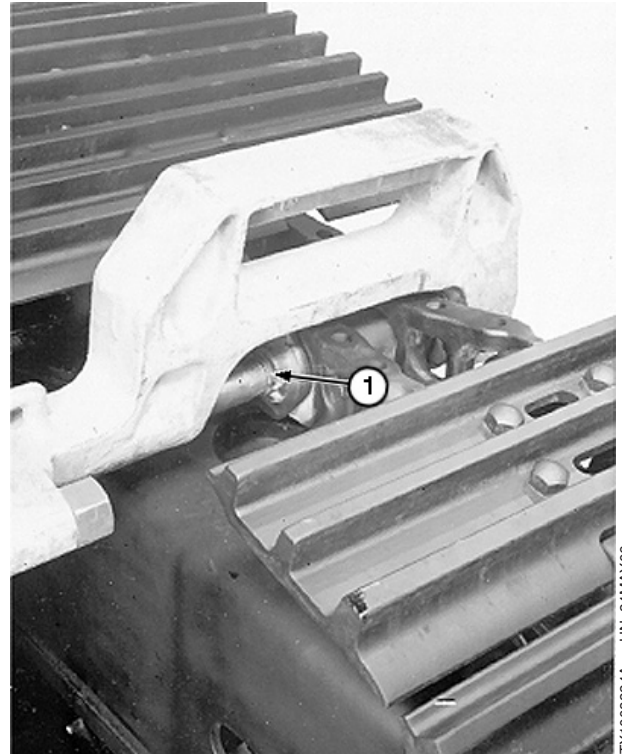
6. Remove master pin (1) using 100 ton track press.
7. Pry apart chain and lower end of track.

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

8. Slowly turn sprocket in reverse direction to remove track chain from excavator.

Specification	
Track Chain 600 mm—Weight.....	2470 kg 5445 lb
Specification	
Track Chain 750 mm—Weight.....	3040 kg 6702 lb
Specification	
Track Chain 900 mm—Weight.....	3380 kg 7452 lb

9. Remove collars from master link counter bores.
10. Inspect parts and repair or replace as necessary.
11. Install track chain so section on ground has pin boss on links towards rear of unit.
12. Install end of chain on sprocket and slowly turn sprocket in forward direction to pull chain across top of frame to front idler.
13. Install collars in counter bores.
14. Pull ends of chain together.
15. Install master pin (1) using 100 ton track press.
16. Lower excavator.
17. Apply a light coat of oil to threads of cap screws.
18. Install shoe on each side of master pin.



1—Master Pin

TX1008324A -JUN-24MAY06

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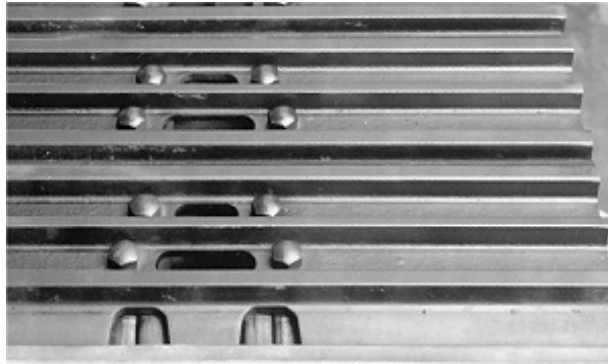
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MD46667,00000B3 -19-02AUG06-3/4

Track System

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19. Install all track shoe nuts with rounded edges (1) against the link and chamfered edges (2) away from the link. Be sure nut is properly positioned in the link so there is full contact between the nut and the link.
20. Starting at any cap screw, tighten cap screws in sequence shown.

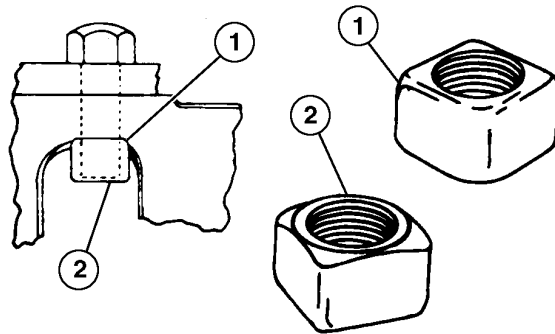


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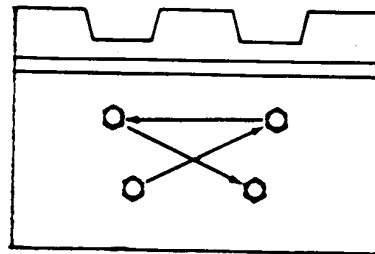
Track Chain—Specification

Shoe-to-Chain Cap Screw—
Torque 1400 N•m
1030 lb-ft

- 1—Rounded Edge
- 2—Chamfered Edge



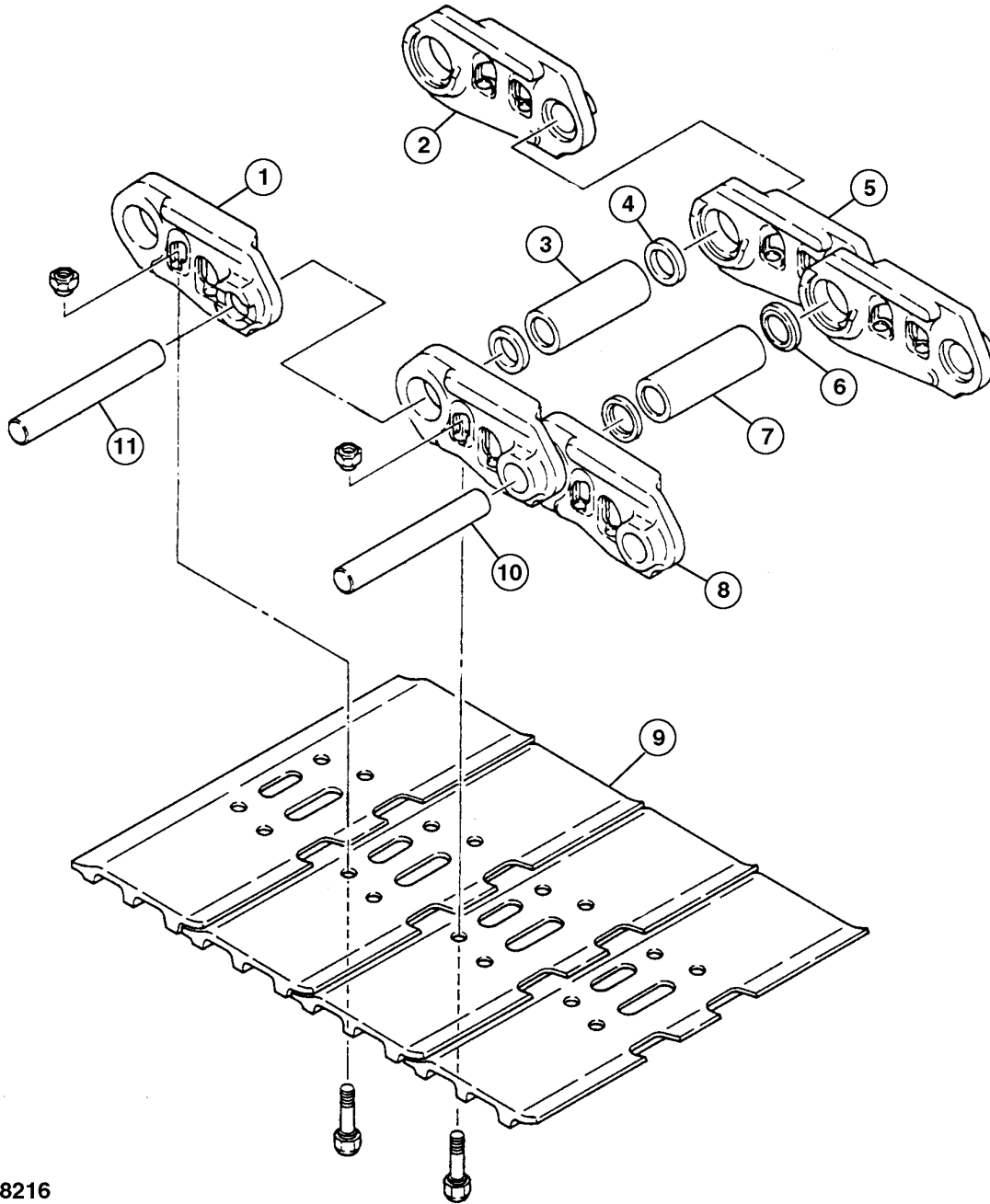
TX1008211 -UN-24MAY06



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MD46667,00000B3 -19-02AUG06-4/4

Track Chain Disassemble and Assemble



TX1008216

- | | | | |
|---------------------------|------------------------------|-----------------------------|------------------|
| 1—Left Master Track Link | 4—Collar (2 used) | 7—Bushing (52 used) | 10—Pin (52 used) |
| 2—Right Master Track Link | 5—Right Track Link (52 used) | 8—Left Track Link (52 used) | 11—Master Pin |
| 3—Master Bushing | 6—Seal (104 used) | 9—Shoe (53 used) | |

1. Remove parts (1—12). Inspect and replace parts as necessary.

Continued on next page

MD46667,00000B4 -19-02AUG06-1/2

Track System

2. Install parts.

Specification

Track Chain Master Pin—OD.....	47.30 mm (1.86 in.) new
	44.30 mm (1.74 in.) limit of use
Track Chain Master Bushing—	
ID	47.90 mm (1.89 in.) new
	59.90 mm (2.36 in.) limit of use
Track Chain Track Pin—OD.....	47.6 mm (1.87 in.) new
	44.6 mm (1.76 in.) limit of use
Track Chain Bushing—ID.....	48.40 mm (1.91 in.) new
	49.43 mm (1.95 in.) limit of use

Limit of use is the maximum allowable wear for turning pins and bushings.

Measure bushing outer diameter at the two worn places using a caliper such as the D17524C1 100 mm Caliper from JT05518A or JT05523 Undercarriage Inspection Service Tool Kit.

NOTE: Access Undercarriage Appraisal Manual SP326 for additional information.

MD46667,00000B4 -19-02AUG06-2/2

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Track Chain Repair to Replace Broken Part

1. Swing upperstructure to side. Lower boom to raise track off the ground.

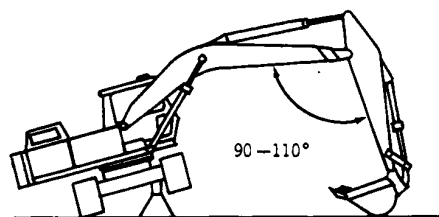
Keep the angle between boom and arm at 90—110° with the round side of bucket on the ground.

⚠ CAUTION: Prevent possible injury from unexpected machine movement. Put blocks or shop stands under machine frame to support machine while measuring track sag.

2. Place blocks or shop stands under the machine to support machine.

Specification

Machine—Weight	46 600 kg approximate
	102,735 lb approximate



T6876FG -UN-06DEC88

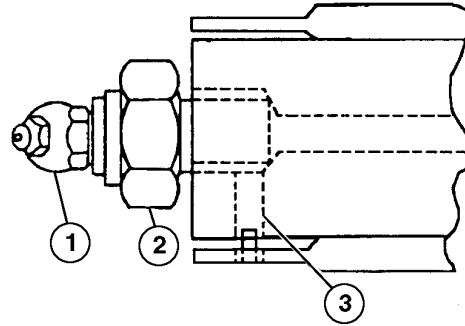
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TX17984,0000009 -19-02AUG06-1/4

⚠ CAUTION: Prevent possible injury from high pressure grease. Do not remove grease fitting (1) from valve (2).

3. Loosen valve (2) one to two turns to release grease through bleed hole (3).

- 1—Grease Fitting
- 2—Valve
- 3—Bleed Hole



TX1008218 -JUN-24MAY06

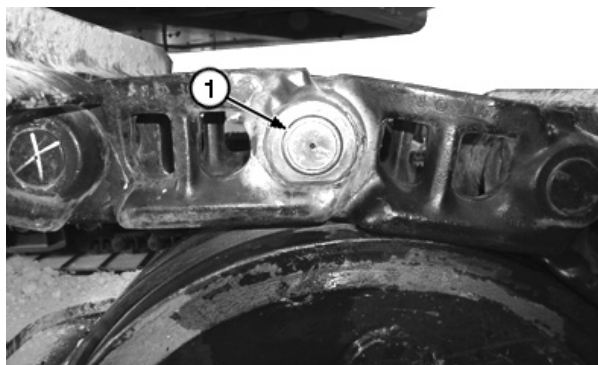
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TX17984,0000009 -19-02AUG06-2/4

NOTE: Disconnect track chain at the end of track frame where the work is to be done.

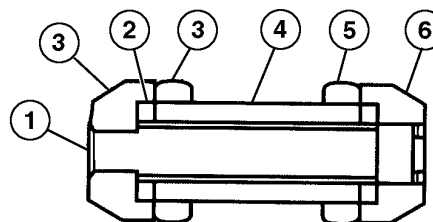
4. Move track chain so master pin (1) is over front idler or sprocket.
5. Remove the track shoe on each side of master pin.
6. If removing chain at idler, put wood blocks in front of idler and under chain so chain does not fall when master pin is removed.
7. Remove master pin using a D01063AA 100-ton Master Pin Pusher Installer or ST 1532 Master Pin Pusher Installer. Remove spacers (2).



TX1009154A -UN-05JUL06

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

8. Remove track chain.



- 1—Master Pin
- 2—Spacer (2 used)
- 3—Link
- 4—Master Bushing
- 5—Link
- 6—Master Link

TX1008223 -UN-18JUL06

Specification

Track With 600 mm (24 in.)	
Shoes—Weight.....	2470 kg approximate 5401 lb approximate
Track With 700 mm (28 in.)	
Shoes—Weight.....	3040 kg approximate 6702 lb approximate
Track with 900 mm (35 in.)	
Shoes—Weight.....	3380 kg approximate 7452 lb approximate

9. Measure track chain link, bushing, and pitch. See 450DLC Track Link Height. (SP326 Undercarriage Appraisal Manual.)

See 450DLC Bushing Outer Diameter. (SP326 Undercarriage Appraisal Manual.)

See 450DLC Track Chain Pitch-215.9 mm (8.5 in.). (SP326 Undercarriage Appraisal Manual.)

10. Repair or replace parts as necessary.
11. Position track chain so section on ground has pin boss on links toward rear of machine.

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Track System

12. Install end of chain on sprocket and slowly turn sprocket in forward direction to pull chain across top of frame to front idler.
13. Pull ends of chain together. Install spacers and master pin using master pin pusher installer.
14. Install track shoe. See Track Shoe Remove and Install. (Group 0130.)
15. Perform Check and Adjust Track Sag. (Operator's Manual.)

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TX17984,0000009 -19-02AUG06-4/4

Sprocket Remove and Install

IMPORTANT: Sprocket must be replaced when the tooth tips become excessively rounded, worn, or chipped to prevent excessive wear to chain. If machine is driven in one direction a majority of the time, wear will be on one side of teeth. To extend service life, change sprockets from one side of machine to the other.

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1. Disconnect track chain. See Track Chain Remove and Install. (Group 0130.)
2. Lift side of machine so sprocket teeth clear chain.

 **CAUTION:** Prevent possible crushing injury from heavy component. Use appropriate lifting device.

3. Remove sprocket cap screws.

Sprocket—Specification

Sprocket—Weight.....	85 kg approximate
	187 lb approximate

4. Attach sprocket to hoist, remove and move to other side of machine or replace.
5. Install sprocket. Apply thread lock and sealer (high strength) to threads of cap screws and tighten.

Sprocket—Specification

Sprocket-to-Gearbox Cap	
Screw—Torque.....	740 N•m
	545 lb-ft

6. Perform Check and Adjust Track Sag. (Operator's Manual.) When installing sprocket.

MD46667,00000B6 -19-02AUG06-1/1

Front Idler Remove and Install

1. Disconnect track chain. See Track Chain Remove and Install. (Group 0130.)
2. Slide front idler (1) forward, using pry bar.

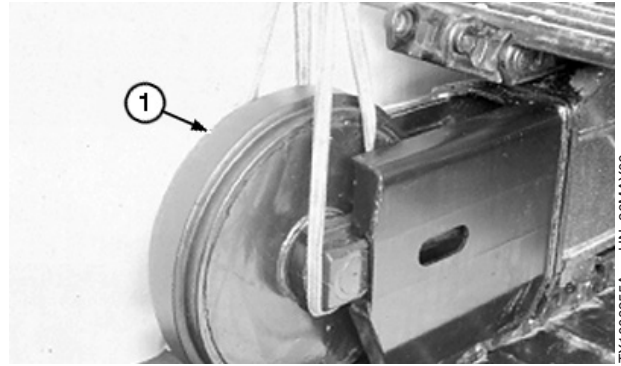
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

3. Attach appropriate lifting device to front idler and remove from frame.

Specification

Front Idler—Weight 281 kg approximate
619 lb approximate

4. Measure front idler wear. See 450DLC Front Idler Flange Height. (SP326 Undercarriage Appraisal Manual.)
5. Repair or replace idler as necessary. See Front Idler Disassemble and Assemble. (Group 0130.)
6. Install front idler.
7. Connect track chain. See Track Chain Remove and Install. (Group 0130.)



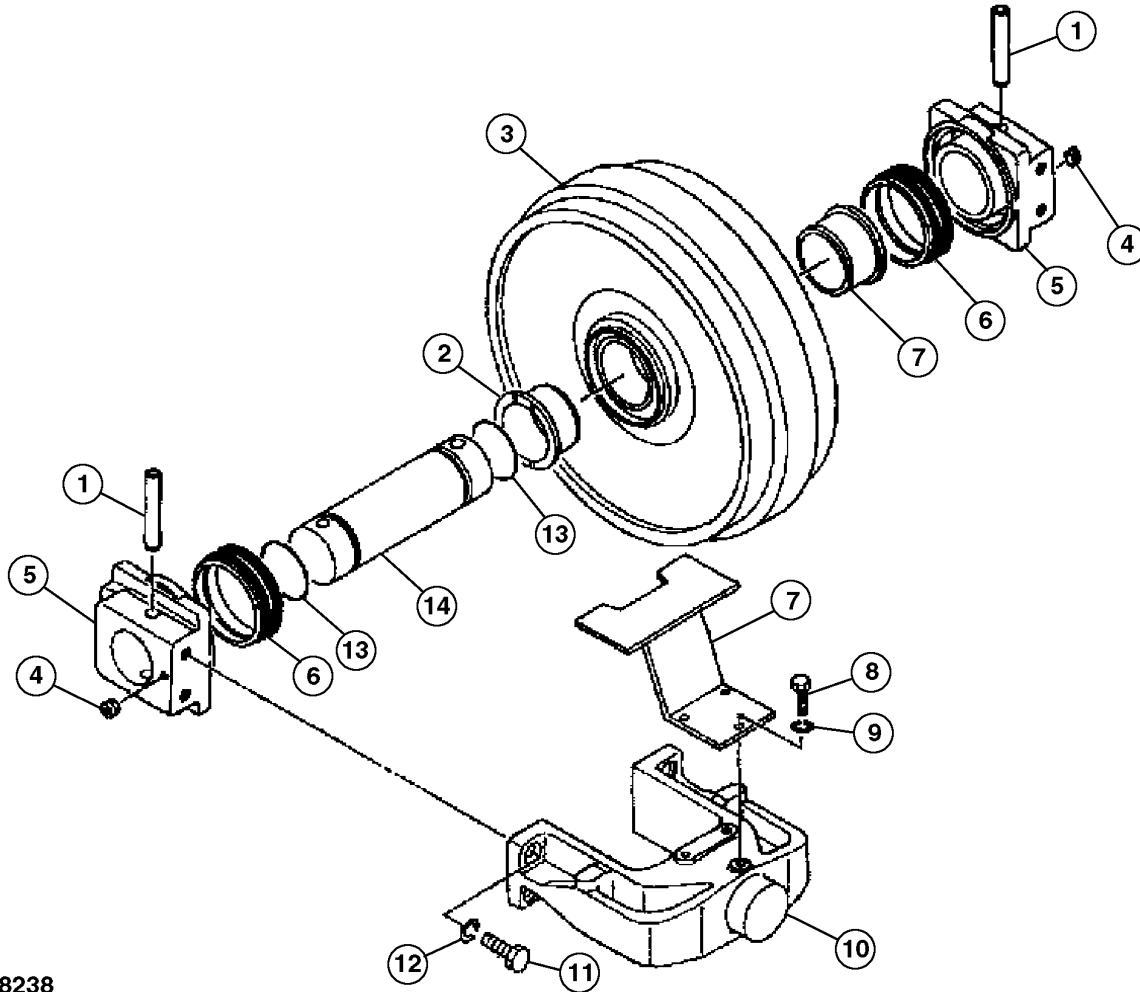
1—Front Idler

TX1008255A -UN-26MAY06

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Front Idler Disassemble and Assemble

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TX1008238

- | | | | |
|--------------------|----------------------------|------------------------|-------------------------|
| 1—Pin (2 used) | 5—Bracket (2 used) | 9—Lock Washer (3 used) | 12—Lock Washer (4 used) |
| 2—Bushing (2 used) | 6—Metal Face Seal (2 used) | 10—Yoke | 13—O-Ring (2 used) |
| 3—Idler | 7—Guard | 11—Cap Screw (4 used) | 14—Axle |
| 4—Plug (2 used) | 8—Cap Screw (3 used) | | |

1. Remove cap screws (8). Remove guard (7).
2. Remove cap screws (11). Remove yoke (10).
3. Remove plug (4) to drain oil. Approximate capacity is 450 mL (15 fl oz).

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MD46667,00000B8 -19-02AUG06-1/7

TX1008238 -UN-24MAY06

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A used seal must be kept together as a set because of wear patterns on seal ring face.

- Remove pins (4) to remove brackets (5), O-rings (3), and metal face seals (2).

Keep seal rings together as a matched set with seal ring faces together to protect surfaces.

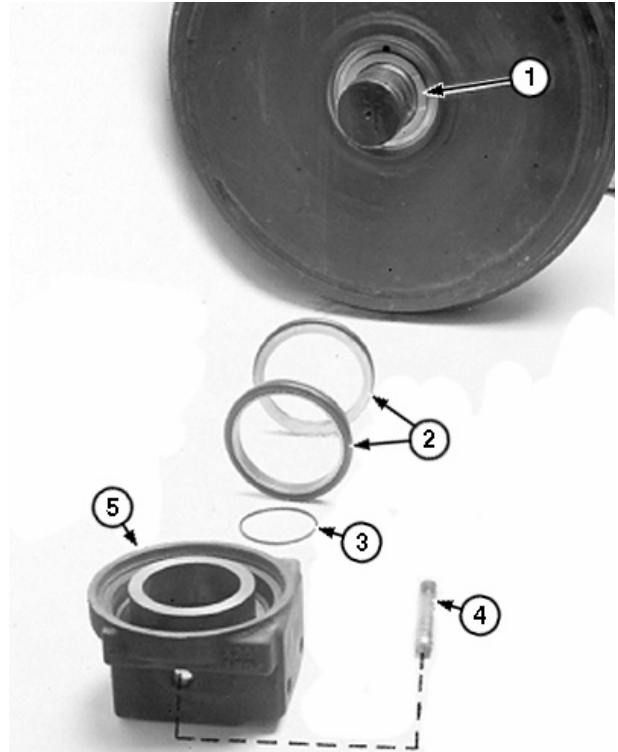
See Metal Face Seal Inspection. (Group 0130.)

CAUTION: Prevent possible injury from heavy component. Use appropriate lifting device.

- Remove axle (1).

	Specification	
Axle— Weight.....		28 kg approximate 62 lb approximate

- 1—Axle
- 2—Metal Face Seal
- 3—O-Ring
- 4—Pin
- 5—Bracket



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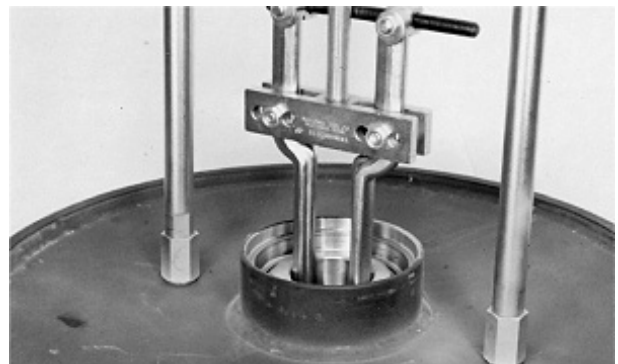
TX1008239A -JUN-24MAY06

MD46667.00000B8 -19-02AUG06-2/7

- Inspect the bushing for scoring or excessive wear. Also inspect the shaft.

NOTE: Only remove bushings if replacement is necessary.

- Remove bushing using a 2-jaw puller and adapters from 17-1/2 and 30-ton puller set.
- Apply a thin film of oil to bushings (1). Install bushings using disks.



T5939AG -JUN-25OCT88

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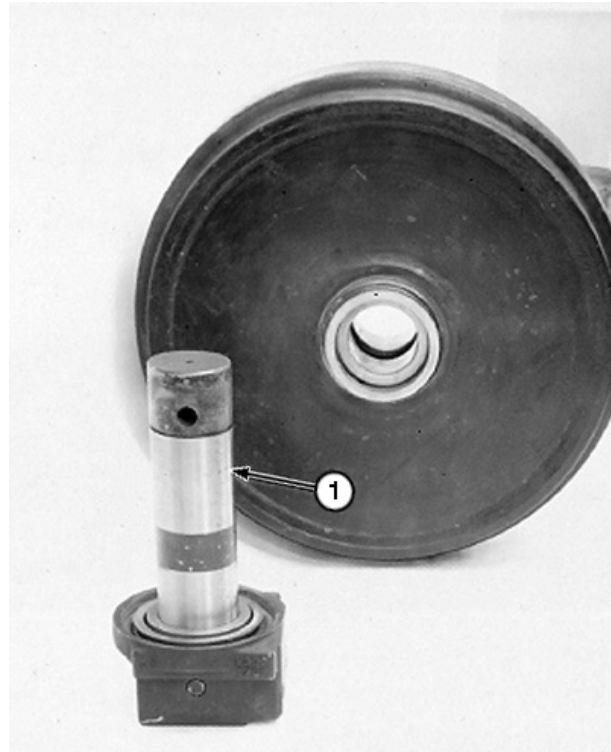
9. Install O-ring on axle (1).
10. Apply a thin layer of TY24811 NEVER-SEEZ® Lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (5).
11. Install axle into bracket.
12. Apply NEVER-SEEZ lubricant or an equivalent to pin (4). Install pin.

IMPORTANT: O-rings and seat surfaces for O-rings must be clean, dry, and oil free so O-rings do not slip when idler is turning.

13. Thoroughly clean the O-rings and seat surfaces in idler, brackets, and seal rings using volatile, non-petroleum base solvent and lint-free tissues.
14. Install O-ring on seal rings.
15. Install seals in bracket and idler.

Apply equal pressure with fingers at four equally spaced points on seal ring face. Seal must “pop” down into place so O-ring is tight against seal bore. A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant. Solvent **MUST NOT** damage the O-rings or leave an oil residue.

16. Wipe finger prints and foreign material off seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal ring face.



TX1008240A -UN-24MAY06

1—Axle

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

17. Install axle and bracket assembly (1).

Specification

Axle and Bracket Assembly—
 Weight..... 98 kg approximate
 216 lb approximate

18. Install O-ring (3) on axle.

19. Apply a thin layer of NEVER-SEEZ lubricant or an equivalent to end of axle from O-ring to end of axle and to bore in bracket (5).

IMPORTANT: O-rings and seat surfaces for O-rings must be clean, dry, and oil free so O-rings do not slip when idler is turning.

20. Thoroughly clean the O-rings and seat surfaces in idler, brackets, and seal rings using volatile, non-petroleum base solvent and lint-free tissues.

21. Install O-ring on seal rings.

22. Install seals (2) in bracket and idler.

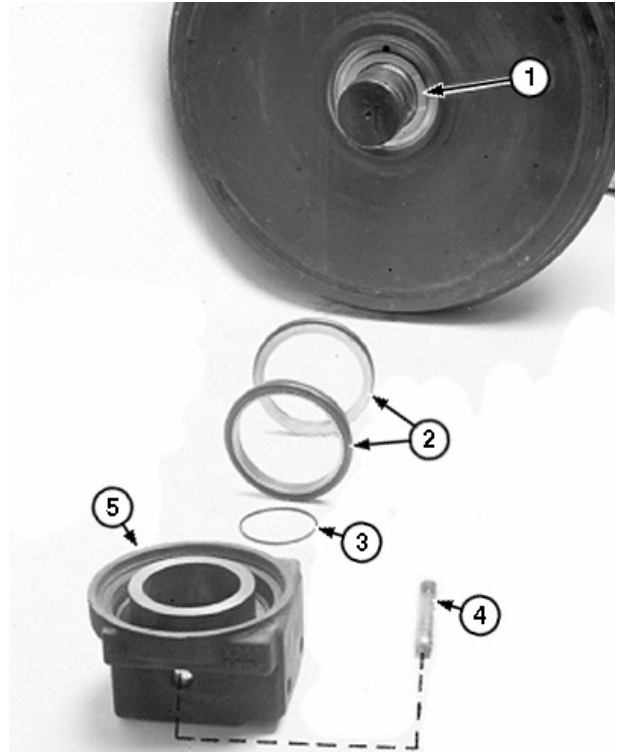
Apply equal pressure with fingers at four equally spaced points on seal ring face. Seal must "pop" down into place so O-ring is tight against seal bore. A volatile, non-petroleum base solvent or talcum powder may be used as a lubricant. Solvent MUST NOT damage the O-rings or leave an oil residue.

23. Wipe finger prints and foreign material off seal ring face using clean oil and lint-free tissues. Apply a thin film of oil to each seal ring face.

24. Install bracket.

25. Apply NEVER-SEEZ lubricant or an equivalent to pin (4). Install pin.

26. Fill front idler with 450 mL (15 fl oz) of oil.



1—Axle and Bracket
 2—Metal Face Seal
 3—O-Ring
 4—Pin
 5—Bracket

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TX1008239A -JUN-24MAY06

Track System

27. Turn front idler 10 revolutions and check for oil leakage.

MD46667,00000B8 -19-02AUG06-6/7

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28. Apply cure primer and pipe sealant to threads of drain plug (3). Install plug.

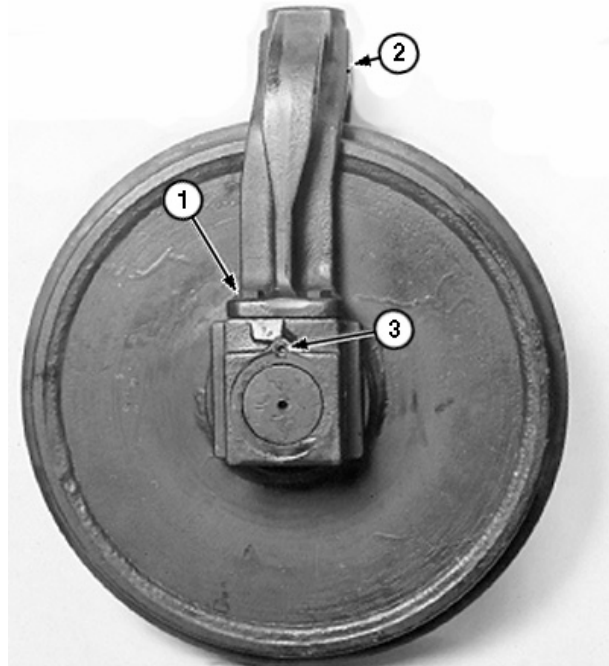
29. Install yoke (2). Tighten cap screws (1).

Specification

Yoke-to-Bracket Cap Screw—
Torque 390 N•m
287 lb-ft

30. Install guard.

- 1—Cap Screw (4 used)
- 2—Yoke
- 3—Drain Plug

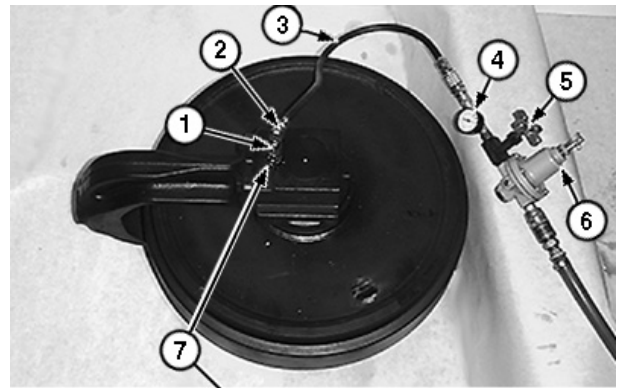


TX1008241A -JUN-24MAY06

MD46667,00000B8 -19-02AUG06-7/7

Front Idler Pressure Test

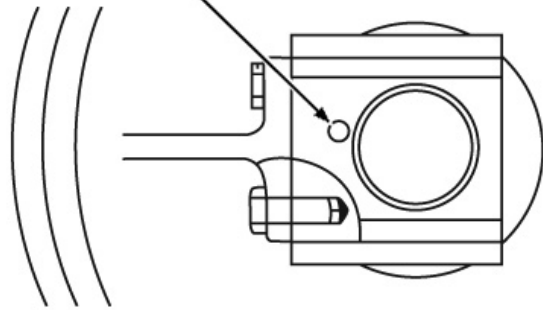
1. Turn shaft several turns to seat metal face seals.
2. Remove plug (7).
3. Install parts (1—6) as shown. Plug, barbed adapter, and connector are from a leak detector kit such as the D05361ST Rubber Stopper/Leak Detector Kit.
4. Holding plug so it is not pushed out, slowly pressurize oil cavity using air.



Specification

Front Idler Oil Leakage Test—	
Pressure	110 kPa 1.1 bar 16 psi

5. Close valve and wait for a minimum of 30 seconds to check for oil leakage. Check gauge to see if air pressure has decreased.
6. If there is external leakage, disassemble idler and replace parts as necessary. See Front Idler Disassemble and Assemble. (Group 0130.)
7. Check oil level in idler. If oil level is down and there is no external leakage, check for a leak from oil cavity to interior of idler wheel.
8. Clean threads of plug. Apply cure primer.
9. Apply pipe sealant to threads of plug. Install and tighten plug.



- 1—Plug, Adapter and Connector
- 2—Connector 1/8 M NPT x 7/16-20 M 37°
- 3—Hose
- 4—Pressure Gauge
- 5—Snubber (Needle) Valve
- 6—Air Pressure Regulator
- 7—Drain Plug

TX1008242A -JUN-24MAY06

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Track Adjuster and Recoil Spring Remove and Install

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CAUTION: Spring or rod may break if dropped while handling, transporting or disassembling. Nicks or weld craters in spring and rod assembly can cause stress concentration resulting in a weak spot. Weak spots can result in immediate or eventual failure creating a risk of personal injury. Put a heavy protective covering around spring assembly when handling, transporting, or disassembling.

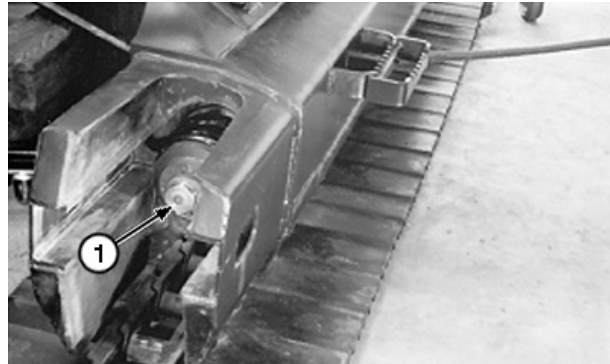
A compression tool must be used for disassembly and assembly because of the extreme preload on spring.

1. Remove track chain. See Track Chain Remove and Install and see Front Idler Remove and Install. (Group 0130.)

MD46667,00000B9 -19-02AUG06-1/3

2. Slide track adjuster (1) forward from rear using a pry bar.

1—Track Adjuster



TX1008244A - UN-24MAY06

Continued on next page

MD46667,00000B9 -19-02AUG06-2/3



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

3. Attach track to hoist, remove from frame, and repair or replace.

Track Adjuster and Recoil Spring—Specification

Track Adjuster and Recoil

Spring—Weight..... 240 kg approximate
530 lb approximate

4. See Track Adjuster and Recoil Spring Disassemble and Assemble and see Track Adjuster Cylinder Disassemble and Assemble. (Group 0130.)

5. Install track adjuster and recoil spring in track using hoist.

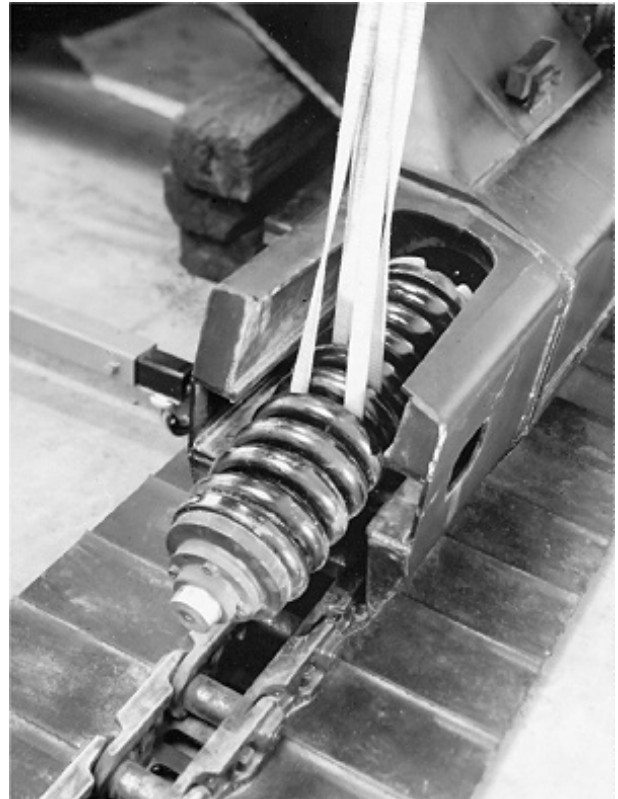
Track Adjuster and Recoil Spring—Specification

Adjusting Nut Out of Hole In

Frame—Distance..... 15 mm
0.6 in

6. Install front idler and track chain.

See Front Idler Remove and Install and see Track Chain Remove and Install. (Group 0130.)




T6657CY -UN-25OCT88

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Track Adjuster and Recoil Spring Disassemble and Assemble

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 **CAUTION:** Spring or rod may break if dropped while handling, transporting or disassembling. Nicks or weld craters in spring and rod assembly can cause stress concentration resulting in a weak spot that may result in immediate or eventual failure creating a risk of personal injury. Put a heavy protective covering around spring assembly when handling, transporting, or disassembling.

A compression tool must be used for disassembly and assembly because of the extreme preload on spring.

 **CAUTION:** Prevent Possible crushing injury from heavy component. Use appropriate lifting device.

1. Remove track adjuster and recoil spring. See Track Adjuster and Recoil Spring Remove and Install. (Group 0130.)

Specification

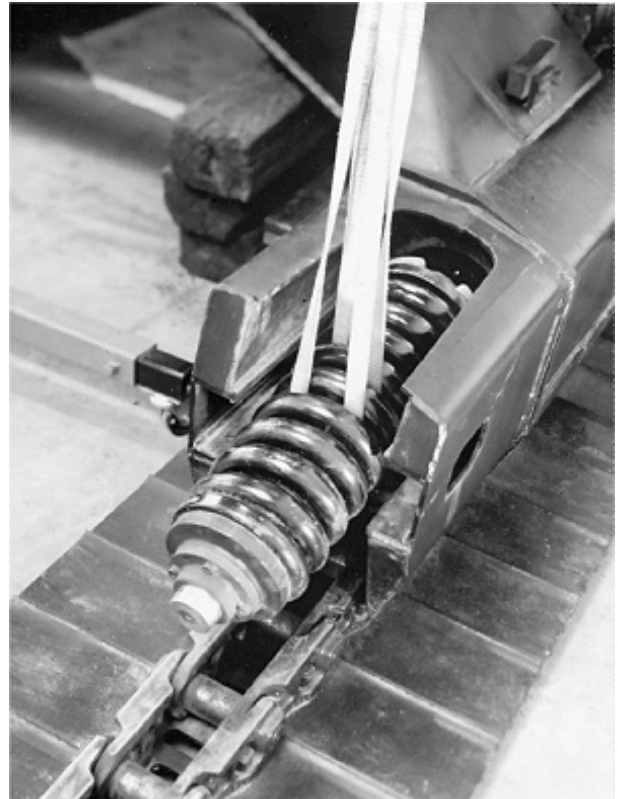
Track Adjuster and Recoil Spring—Weight.....	240 kg approximate 540 lb approximate
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MD46667,00000BA -19-02AUG06-1/4

Track System

2. Connect track adjuster and recoil spring to a hoist using a lifting strap.



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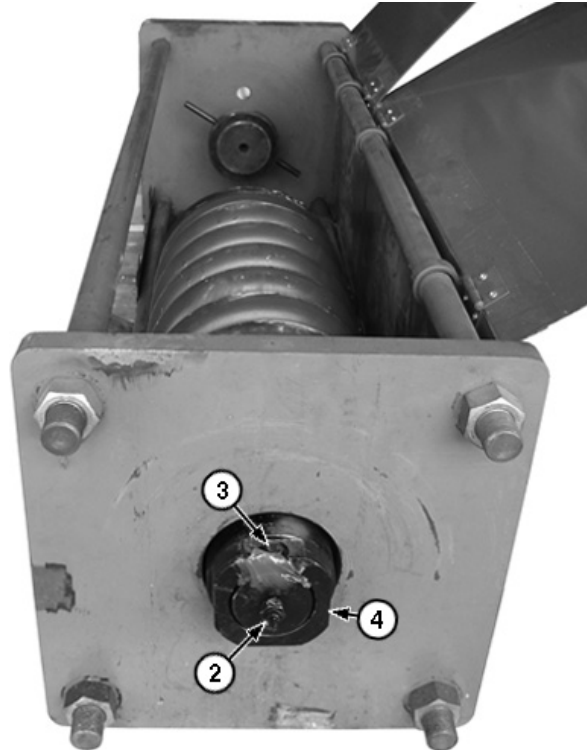
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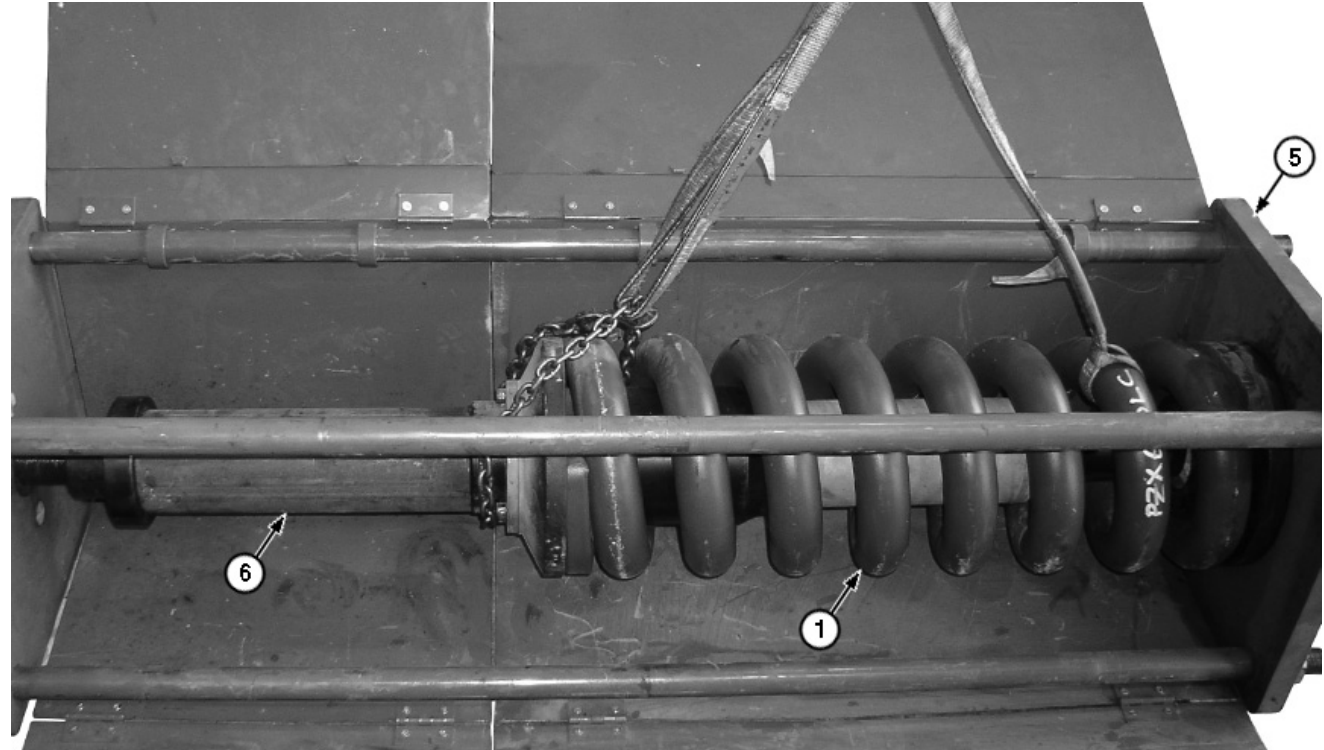
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Track System

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TX1010180A -UN-18JUL06



TX1010177A -UN-18JUL06

- 1—Track Adjuster and Recoil Spring
- 2—Valve
- 3—Plug
- 4—Nut
- 5—Track Recoil Spring Repair Tool
- 6—Spacer

Continued on next page

MD46667,00000BA -19-02AUG06-3/4

Track System

3. To compress track adjuster and recoil spring for disassembly use tool JDG07368 Track Recoil Spring Repair Tool with JDG10022 Track Recoil Spring Compressor Update Kit. Install track adjuster recoil spring to allow, access to nut, install nut end thru hole.
4. Install track adjuster and recoil spring in track recoil spring repair tool with Spacer JDG10421 on the cylinder end.
5. Put track adjuster cylinder in assembly tool with cylinder end on spacer.
6. Remove valve. Remove special plug.
7. Lower press ram to release spring force.
8. Operate press to compress spring, just enough, so nut can be removed, remove nut.
9. Continue to extend press to compress and release spring using speed nut with handles until there is enough travel to release spring to an approximate free length of 677 mm (26.7 in.).

Track Adjuster Cylinder and Recoil Spring—Specification

Recoil Spring—Free Length	677 mm 26.7 in.
---------------------------------	--------------------

10. Install spacer on rod.

11. Operate power ram compress spring to a length of 605 mm (23.8 in.).

Track Adjuster Cylinder and Recoil Spring—Specification

Recoil Spring—Compressed Length	605 mm 23.8 in.
---------------------------------------	--------------------

12. Install nut so hole is aligned with hole in rod. Tighten special plug.

Track Adjuster Cylinder and Recoil Spring—Specification

Special Plug—Torque.....	15 N•m 132 lb-in.
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13. Tighten valve.

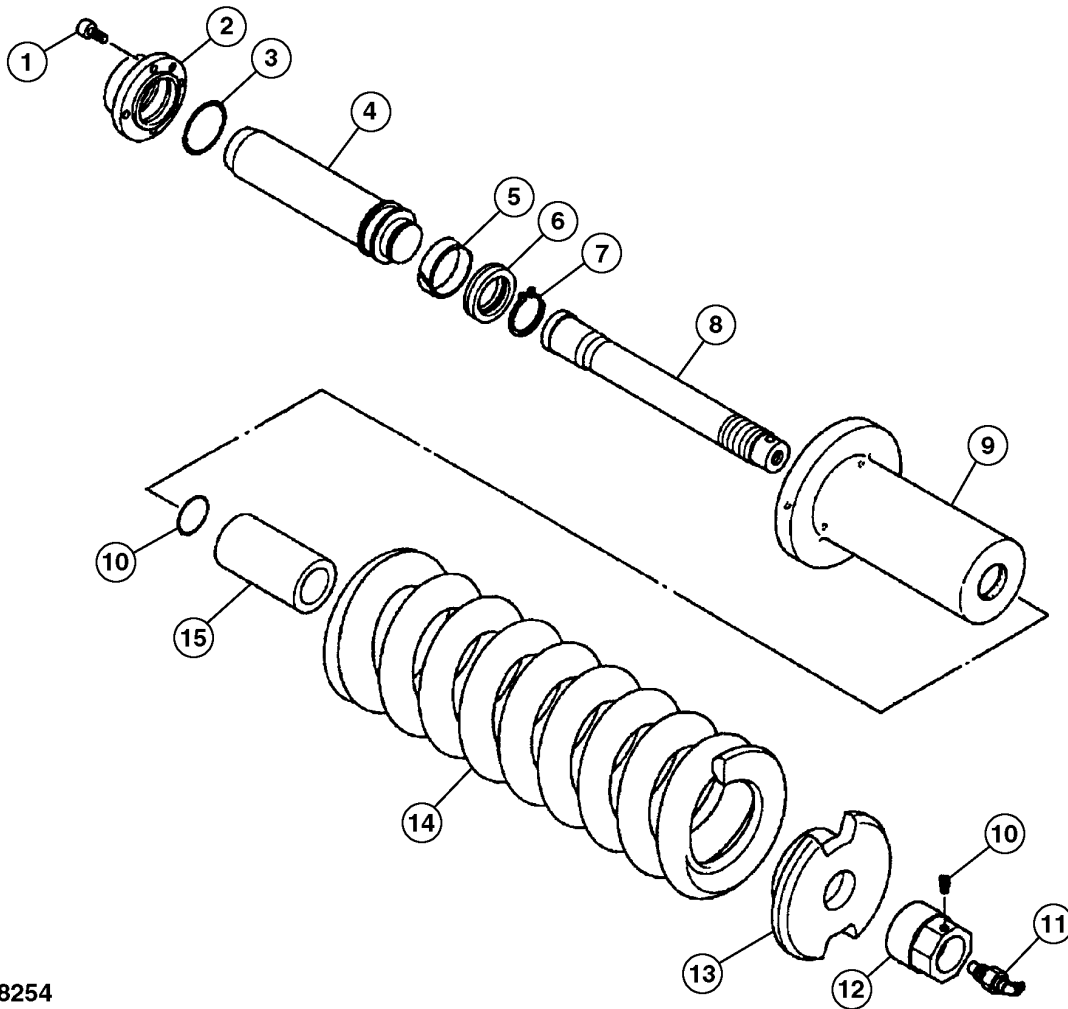
Track Adjuster Cylinder and Recoil Spring—Specification

Valve—Torque	147 N•m 110 lb-ft
--------------------	----------------------

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Track Adjuster Cylinder Disassemble and Assemble



TX1008254

- | | | | |
|----------------------|-------------|-----------------|-------------------|
| 1—Cap Screw (4 used) | 5—Wear Ring | 9—Cylinder | 13—Retainer Plate |
| 2—Flange | 6—U-Ring | 10—Special Plug | 14—Recoil Spring |
| 3—O-Ring | 7—Snap Ring | 11—Valve | 15—Spacer |
| 4—Piston Rod | 8—Rod | 12—Nut | 16—O-Ring |

Continued on next page

MD46667,00000BB -19-02AUG06-1/2

TX1008254 -JUN-26MAY06

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CAUTION: Spring or rod may break if dropped while handling, transporting or disassembling. Nicks or weld craters in spring and rod assembly can cause stress concentration resulting in a weak spot that may result in immediate or eventual failure creating a risk of personal injury. Put a heavy protective covering around spring assembly when handling, transporting, or disassembling.

A compression tool must be used for disassembly and assembly because of the extreme preload on spring.

NOTE: It is not necessary to remove the recoil spring (N) to replace wear ring (E) and U-ring (F). To replace O-ring (P), remove recoil spring (N) and rod (H). The recoil spring is removed using the JT07368 Track Recoil Spring Repair Tool with JDG10022 Track Recoil Spring Compressor Update Kit and JDG10421 Spacer. See Track Adjuster and Recoil Spring Disassemble and Assemble. (Group 0130.)

1. Remove spring (14) and spacer (15).
2. Remove cap screws (1). Remove parts (2—8).
3. Replace parts as necessary.
4. Apply multi-purpose grease to wear ring (5), U-ring (6), and O-rings (3 and 16). Fill grooves inside flange (2) with grease.
5. Install U-ring (6) with lip towards inside of cylinder.
6. Install parts (1—9).

NOTE: The recoil spring is removed and installed using the JT07368 Track Recoil Spring Repair Tool with JDG10022 Track Recoil Spring Compressor Update Kit and JDG10421 Spacer. See Track Adjuster and Recoil Spring Disassemble and Assemble. (Group 0130.)

7. Install spacer (15) and spring (14).

Track System

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Axles, Differentials and Suspension Systems

Section 02

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02

Contents

02

Group 0250 Axle Shaft, Bearings, and Reduction Gears

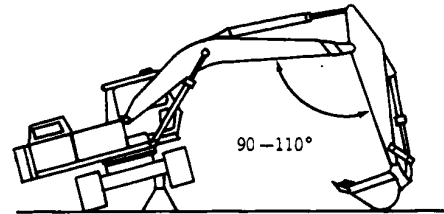
Travel Gearbox Remove and Install

1. Remove travel gearbox.

MD46667,00000C5 -19-02AUG06-1/5

Swing upperstructure 90° and lower bucket to raise track off the ground. Keep angle between boom and arm 90—110° and position round side of bucket on ground. Put a support stand under the undercarriage.

2. Disconnect track chain. See Track Chain Remove and Install. (Group 0130.)



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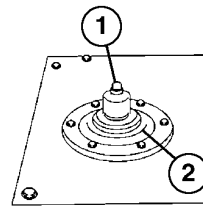
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MD46667,00000C5 -19-02AUG06-2/5



CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil can cause serious burns or penetrating injury.

3. Push hydraulic oil tank pressure release button to release pressure in the hydraulic oil tank.



TX1000859 -UN-01DEC05

1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

Continued on next page

MD46667,00000C5 -19-02AUG06-3/5

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove cap screws and washers (7) to remove travel motor cover (6).

Specification

Travel Motor Cover—Weight..... 32 kg approximate
71 lb approximate

- Disconnect lines (1, 2, 8, and 9) from the travel motor.

Attach identification tags to aid assembly. Install caps and plugs.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: The travel motor is removed with the travel gearbox because motor housing is part of gearbox.

- Connect travel gearbox and motor (5) to a hoist using lifting straps.

Specification

Travel Gearbox and Motor—
Weight..... 671 kg approximate
1479 lb approximate

See Travel Motor and Park Brake Disassemble and Assemble. (Group 0260.)

- Remove cap screws with washers (3) to remove travel gearbox and motor (5).

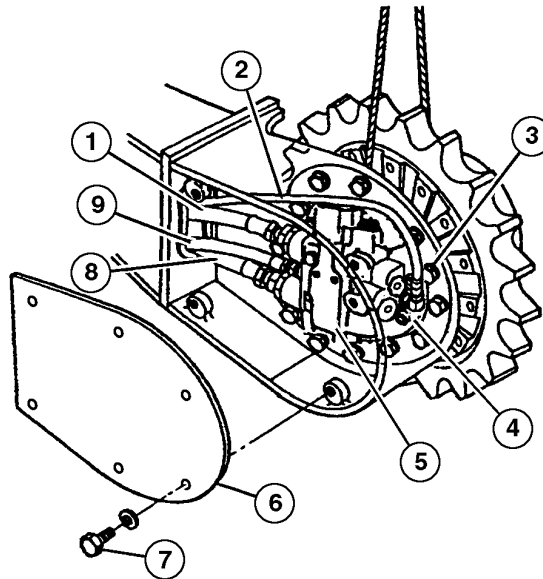
- Repair or replace parts as necessary.

- Install travel gearbox and motor. Tighten cap screws with washers (3).

Specification

Travel Motor Housing-to-Frame
Cap Screw—Torque..... 140 N•m
103 lb-ft

- Connect lines (1, 2, 8, and 9).



Right Travel Motor

- 1—Travel Motor Left Top Port-to-Rotary Manifold Right Drain Port Line
- 2—Travel Motor Right Port-to-Rotary Manifold Right Speed Change Port Line
- 3—Cap Screw and Washer (16 used)
- 4—Cap Screw (9 used)
- 5—Travel Gearbox and Motor
- 6—Travel Motor Cover
- 7—Cap Screw and Washer (6 used)
- 8—Travel Motor Left Bottom Port-to-Rotary Manifold Right Reverse Port Line
- 9—Travel Motor Left Middle Port-to-Rotary Manifold Right Forward Port Line

TX1008458 -JUN-07JUN06

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2

11. Fill travel gearbox with oil to check plug hole. See 450DLC Drain and Refill Capacities. (Operator's Manual.)

IMPORTANT: Travel motor will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new travel motor is installed or oil has been drained from the motor.

12. Perform Travel Motor and Park Brake Start-Up Procedure. (Group 0260.)



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

13. Install travel motor cover. Tighten cap screws.

Specification

Travel Motor Cover—Weight..... 32 kg approximate
71 lb approximate

Specification

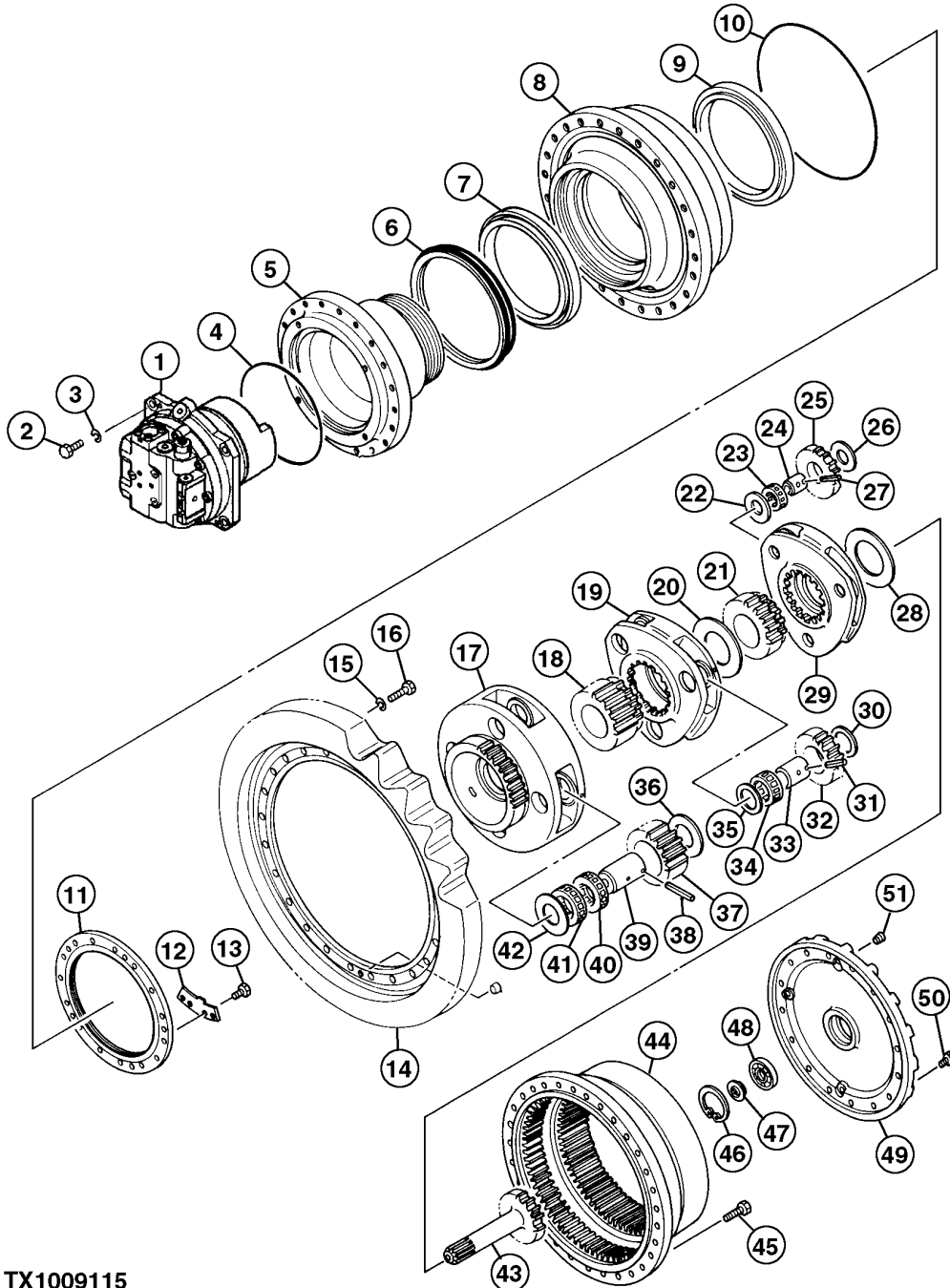
Travel Motor Cover-to-Frame Cap
Screw—Torque..... 98 N•m
72 lb-ft

14. Connect track chain. See Track Chain Remove and Install. (Group 0130.)

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3

Travel Gearbox Disassemble and Assemble



TX1009115

Travel Gearbox

Continued on next page

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TX1009115 -JUN-01AUG06

02
0250
4

Axle Shaft, Bearings, and Reduction Gears

- | | | | |
|--------------------------|-------------------------------------|--------------------------------------|----------------------------|
| 1—Motor | 15—Washer (24 used) | 28—Spacer | 39—Pin (4 used) |
| 2—Cap Screw (4 used) | 16—Cap Screw (24 used) | 29—First stage Carrier | 40—Needle Bearing (4 used) |
| 3—Spring Washer (4 used) | 17—Third Stage Carrier | 30—Thrust Plate (3 used) | 41—Needle Bearing (4 used) |
| 4—O-Ring | 18—Third Stage Sun Gear | 31—Spring Pin (3 used) | 42—Thrust Plate (4 used) |
| 5—Housing | 19—Second Stage Carrier | 32—Second Stage Planet Gear (3 used) | 43—Shaft |
| 6—Floating Seal | 20—Spacer | 33—Pin (3 used) | 44—Ring Gear |
| 7—Roller Bearing | 21—Second Stage Sun Gear | 34—Needle Bearing (3 used) | 45—Cap Screw (30 used) |
| 8—Drum | 22—Thrust Plate (3 used) | 35—Thrust Plate (3 used) | 46—Retaining Ring |
| 9—Roller Bearing | 23—Needle Bearing (3 used) | 36—Thrust Plate (4 used) | 47—Stopper Pin |
| 10—O-Ring | 24—Pin (3 used) | 37—Third Stage Planet Gear (4 used) | 48—Ball Bearing |
| 11—Bearing Nut | 25—First Stage Planet Gear (3 used) | 38—Spring Pin (4 used) | 49—Cover |
| 12—Lock Plate | 26—Thrust Plate (3 used) | | 50—Cap Screw (used 16) |
| 13—Cap Screw (2 used) | 27—Spring Pin (4 used) | | 51—Plug (3 used) |
| 14—Sprocket | | | |

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

Specification
 Travel Gearbox—Weight..... 671 kg approximate
 1479 lb approximate

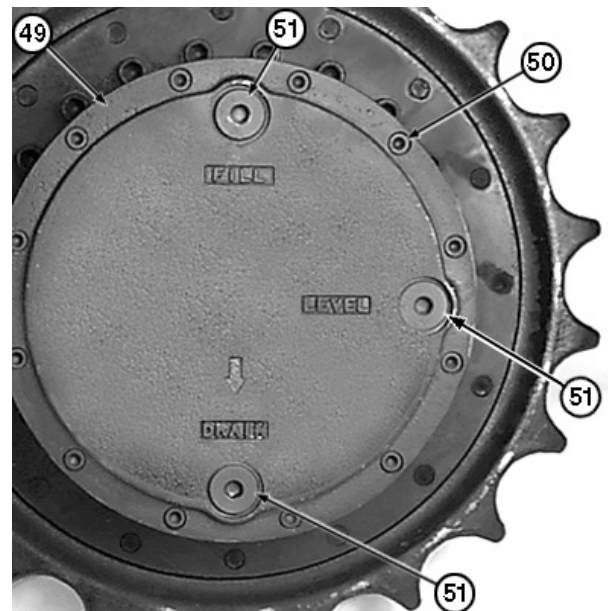
1. **Disassemble travel gearbox.** Place gearbox on solid work table with clean work area.

MD46667,00000C6 -19-15MAY08-2/14

2. Position drum (8) as shown.

CAUTION: Slowly loosen the plug (51) and completely release residual pressure. The plug may fly off and oil may spurt if the plug is loosened to quickly.

3. Remove top plug (51).
4. Remove bottom plug (51) and drain gear oil. See 450DLC Drain and Refill Capacities. (Operator's Manual.)
5. Place travel gearbox on a workbench with the motor side (1) facing up
6. Put matching marks on the mating positions of motor (1) and housing (5).
7. Remove motor (1) from housing (5).



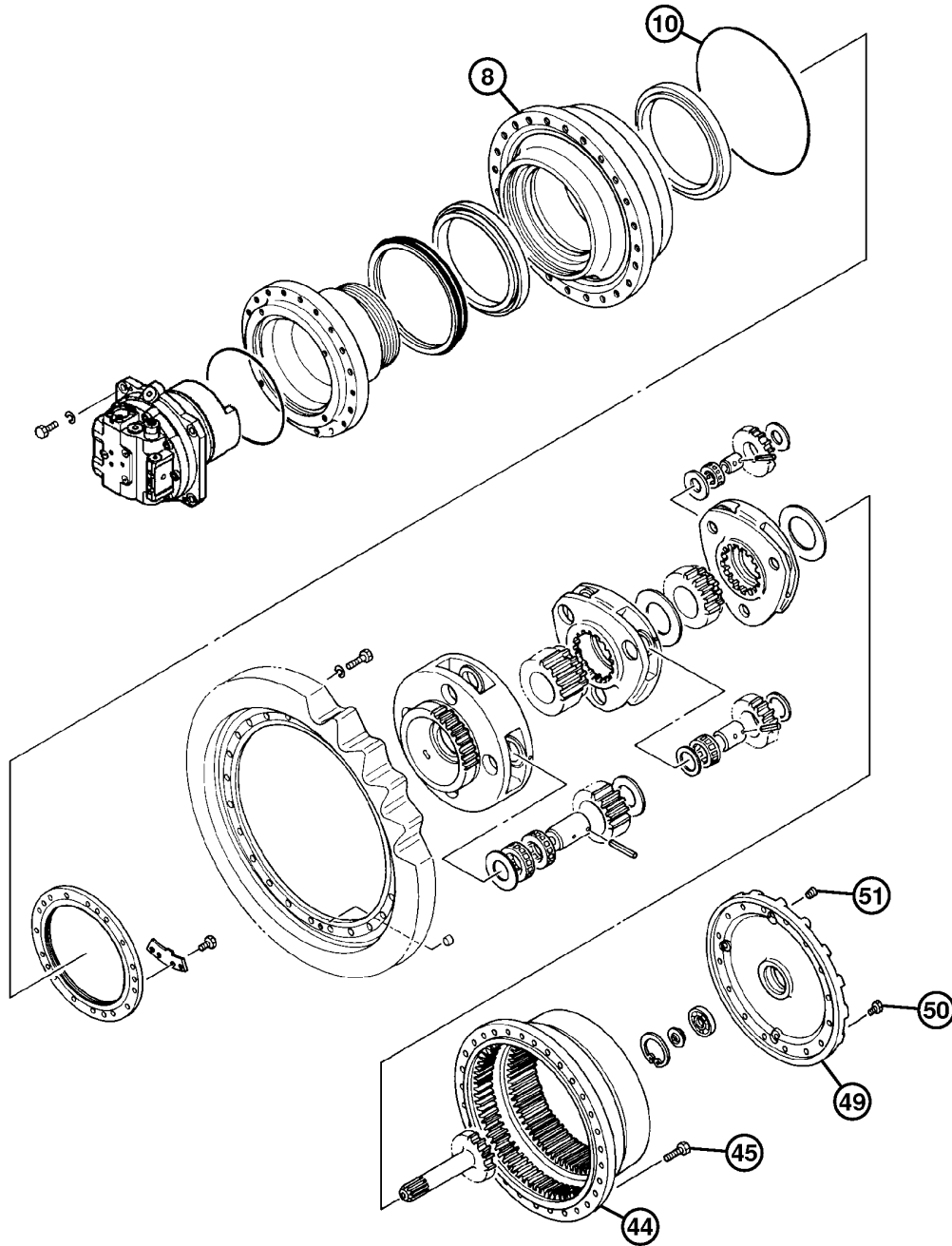
49—Travel Gearbox Cover
 50—Cap Screw (16 used)
 51—Plug (3 used)

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MD46667,00000C6 -19-15MAY08-3/14

Axle Shaft, Bearings, and Reduction Gears



TX1010351

8—Drum
10—O-Ring

44—Ring Gear
45—Cap Screw (30 used)

49—Cover
50—Cap Screw (used 16)

51—Plug (3 used)

8. Place travel gearbox on workbench with the cover (49) side facing up.

10. Put matching marks on the mating positions of cover (49) and ring gear (44).

9. Remove cap screws (50).

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Continued on next page

MD46667,00000C6 -19-15MAY08-4/14

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

11. Remove travel gearbox cover (49).

Specification
Travel Gearbox Cover—Weight 22 kg approximate
50 lb approximate

12. Put matching marks on the mating positions of sprocket (44) and the drum (8).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

13. Remove the sprocket (14) from drum (8).

Specification
Sprocket—Weight 70 kg approximate
154 lb approximate

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

14. Remove cap screws (45) from ring gear (44).
Remove ring gear from drum (8).

Specification
Ring Gear—Weight 70 kg
154 lb

15. Remove O-ring (10) from drum (8).

16. Put matching marks on the mating positions of ring gear (44) and drum (8).

17. Remove ring gear (44) from drum (8).

18. Remove shaft (43) from first stage carrier (29).

19. Remove first stage carrier assemblies (22—29) and the second stage sun gear (21) from second stage carrier (19).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

20. Remove second stage carrier assemblies (19, 20, 30—35) and third stage sun gear (18).

Specification
Second Stage Carrier—Weight 25 kg approximate
55 lb approximate

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

21. Remove third stage carrier assemblies (17, 36—42) from drum (8).

Specification
Third Stage Carrier—Weight 70 kg approximate
154 lb approximate

22. Remove cap screws (13) from lock plate (12).

23. Remove lock plate (12) from bearing nut. (11).

24. Install ST3136 to bearing nut (11). Remove bearing nut (11) from housing (5).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

25. Put matching marks on the mating positions of drum (8) and housing (5) remove drum.

Specification
Drum and Ring gear—Weight 180 kg approximate
400 lb approximate

26. Remove the drum (8) assembly from the housing (5). At this time the inner race of roller bearing (9) is also removed.

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IMPORTANT: Do not remove ball bearing assemblies unless replacement is necessary. In case the inner race of roller bearing (7) has been removed, replace with a new one.

- 27. If replacing, remove inner ball bearing (7).
- 28. Remove metal face seals (6) from housing (5) and drum (8). Keep metal face seals together as a matched set with metal faces together to protect surfaces.

IMPORTANT: Metal face seals can be reused if they are not worn or damaged. A used seal should be kept together as a set because of wear patterns on the seal ring face.

Inspect metal face seals. See Metal Face Seal Inspection. (Group 0130.) For seals that are reused, place a piece of cardboard between rings to protect seal ring face.

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

- 29. Put the matching marks on the mating positions of sprocket (14) and drum (8).

Specification	
Sprocket—Weight	85 kg approximate
	187 lb approximate

- 30. Remove cap screws (16) and washers (15) from sprocket (14) and remove sprocket (14) from drum (8).

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

- 31. Turn drum (8) over.

Specification	
Drum—Weight	100 kg approximate
	221 lb approximate

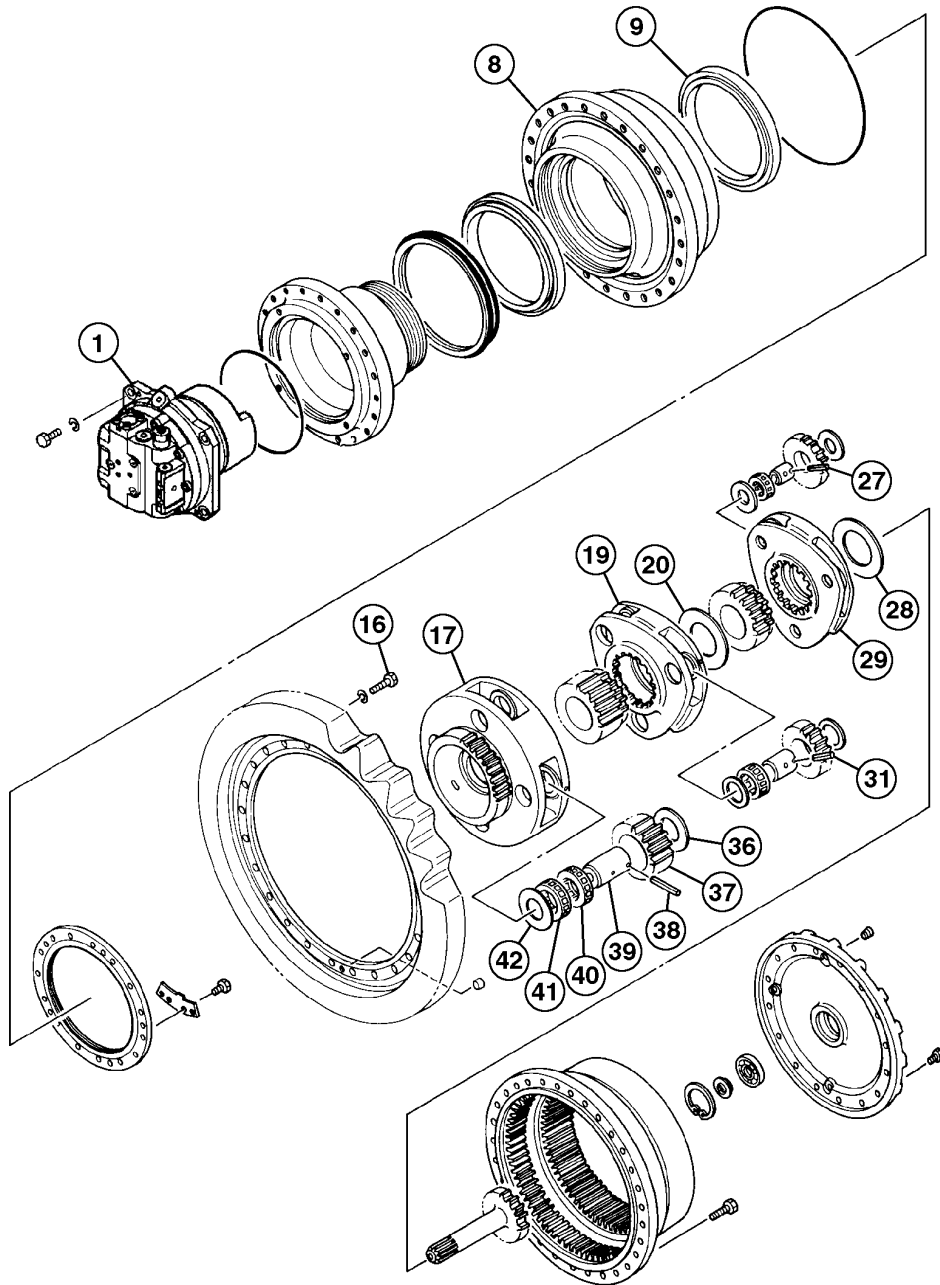
- 32. Remove the outer race of roller bearing (9) from drum (8).

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Axle Shaft, Bearings, and Reduction Gears



TX1010357

- | | | | |
|------------------------|-------------------------|-------------------------------------|----------------------------|
| 1—Motor | 19—Second Stage Carrier | 31—Spring Pin (3 used) | 39—Pin (4 used) |
| 8—Drum | 20—Spacer | 36—Thrust Plate (4 used) | 40—Needle Bearing (4 used) |
| 9—Roller Bearing | 27—Spring Pin (4 used) | 37—Third Stage Planet Gear (4 used) | 41—Needle Bearing (4 used) |
| 16—Cap Screw (24 used) | 28—Spacer | 38—Spring Pin (4 used) | 42—Thrust Plate (4 used) |
| 17—Third Stage Carrier | 29—First stage Carrier | | |

33. Remove spring pin (38) from third stage carrier (17), remove pin (39).

34. Remove third stage planet gear (37) and thrust plates (36, 42) from third stage carrier (17).

Continued on next page

MD46667,00000C6 -19-15MAY08-7/14

Axle Shaft, Bearings, and Reduction Gears

35. Remove needle bearings (40, 41) from third stage planet gear (37).
36. Remove spring pins (38) pins (39) third stage planet gears (37) thrust plates (36, 43) needle bearings (40, 41) from third stage carrier (17).
37. Disassemble the first stage carrier (29) and the second stage carrier (19) same as the third stage carrier
38. Remove spacer (28) from first stage carrier (29).
39. Remove spacer (20) from second stage carrier (19).
40. **Assemble travel gearbox.**

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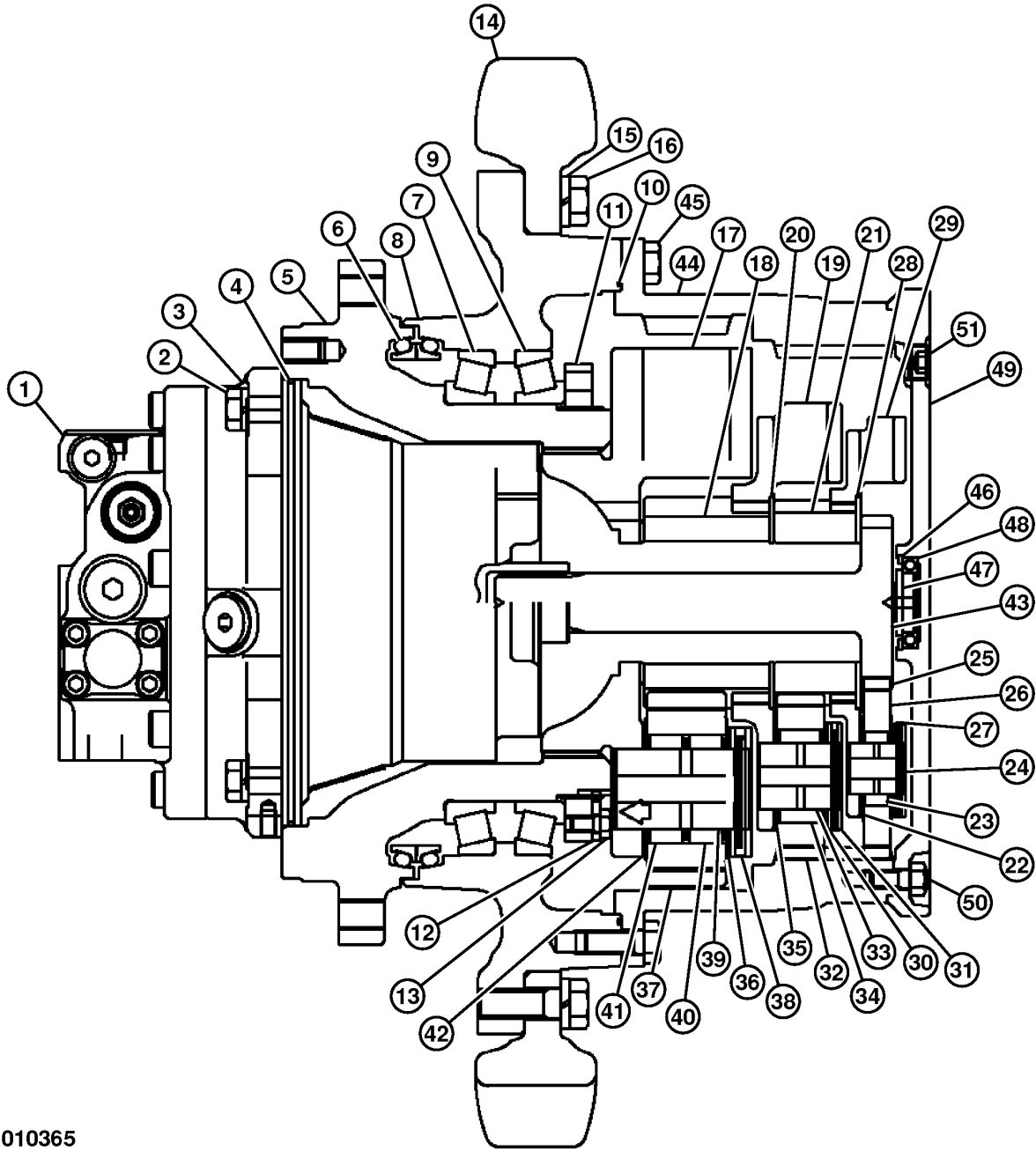
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Axle Shaft, Bearings, and Reduction Gears

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Axle Shaft, Bearings, and Reduction Gears



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12

TX1010365

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Axle Shaft, Bearings, and Reduction Gears

- | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1—Motor
2—Cap Screw (4 used)
3—Spring Washer (4 used)
4—O-Ring
5—Housing
6—Floating Seal
7—Roller Bearing
8—Drum
9—Roller Bearing
10—O-Ring
11—Bearing Nut
12—Lock Plate
13—Cap Screw (2 used)
14—Sprocket | 15—Washer (24 used)
16—Cap Screw (24 used)
17—Third Stage Carrier
18—Third Stage Sun Gear
19—Second Stage Carrier
20—Spacer
21—Second Stage Sun Gear
22—Thrust Plate (3 used)
23—Needle Bearing (3 used)
24—Pin (3 used)
25—First Stage Planet Gear (3 used)
26—Thrust Plate (3 used)
27—Spring Pin (4 used) | 28—Spacer
29—First stage Carrier
30—Thrust Plate (3 used)
31—Spring Pin (3 used)
32—Second Stage Planet Gear (3 used)
33—Pin (3 used)
34—Needle Bearing (3 used)
35—Thrust Plate (3 used)
36—Thrust Plate (4 used)
37—Third Stage Planet Gear (4 used)
38—Spring Pin (4 used) | 39—Pin (4 used)
40—Needle Bearing (4 used)
41—Needle Bearing (4 used)
42—Thrust Plate (4 used)
43—Shaft
44—Ring Gear
45—Cap Screw (30 used)
46—Retaining Ring
47—Stopper Pin
48—Ball Bearing
49—Cover
50—Cap Screw (used 16)
51—Plug (3 used) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Install one half of the floating seal (6) to housing (5).

- 41. Install the inner race of roller bearing (7) to housing (5).
- 42. Place drum (8) with ring gear (44) side facing down.
- 43. Install the outer race of roller bearing (7) to drum (8).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 44. Apply grease to O-ring of floating seal (6) on the drum (8) side. Install one half of floating seal (6) to drum (8).

Specification

Drum—Weight 90 kg approximate
 200 lb approximate

- 45. Turn drum (8) over so ring gear (44) side is facing up.

- 46. Install the outer race of roller bearing (9) to drum (8).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 47. Place sprocket (14) into drum (8).

Specification

Sprocket—Weight 84 kg approximate
 185 lb approximate

- 48. Apply LOCTITE 271® to Cap Screw (16). Install sprocket (14) to drum (8) with cap screws (16) and washers (15).
- 49. Align the matching marks made when disassembling. Check clearance around drum (8) in housing (5) is equal.
- 50. Place the drum (8) in housing (5).

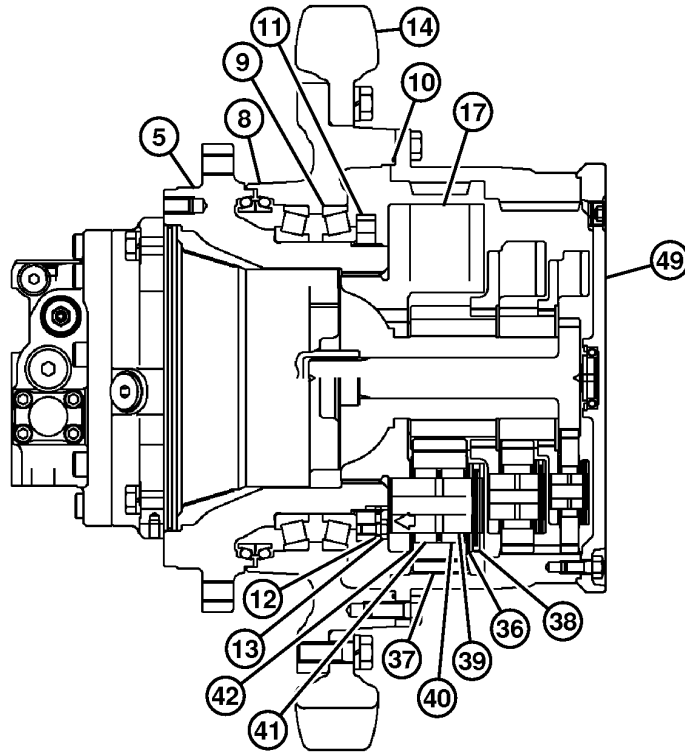
LOCTITE is a trademark of Loctite Corp.

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MD46667,00000C6 -19-15MAY08-10/14

02
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13

Axle Shaft, Bearings, and Reduction Gears



TX1010360

- | | | | |
|------------------|--------------------------|-------------------------------------|----------------------------|
| 5—Housing | 12—Lock Plate | 37—Third Stage Planet Gear (4 used) | 40—Needle Bearing (4 used) |
| 8—Drum | 13—Cap Screw (2 used) | 38—Spring Pin (4 used) | 41—Needle Bearing (4 used) |
| 9—Roller Bearing | 14—Sprocket | 39—Pin (4 used) | 42—Thrust Plate (4 used) |
| 10—O-Ring | 17—Third Stage Carrier | | 49—Cover |
| 11—Bearing Nut | 36—Thrust Plate (4 used) | | |

51. Install the inner race of roller bearing (9) to housing (5).
52. Install bearing nut (11) to housing (5) hand tight.
53. Install special tool ST3136 tighten bearing nut.

Specification

Bearing Nut—Torque..... 550 N•m
370 lb-ft

54. Hold and rotate sprocket (14) clockwise and counterclockwise 4 to 5 turns tapping with plastic hammer to adjust proper play.

NOTE: If spline lock plate (12) is not align with that of housing (5), tighten bearing nut (11) further in the tightening direction in order to align with the spline.

55. Apply LOCTITE 271® to Cap Screw (13). Install lock plate (12) to bearing nut (11) with cap screws (13).

56. Apply grease to O-ring (10) and install in drum (8).

NOTE: There is a groove in the third stage planet gear (37) install with the identification groove facing to the cover (49).

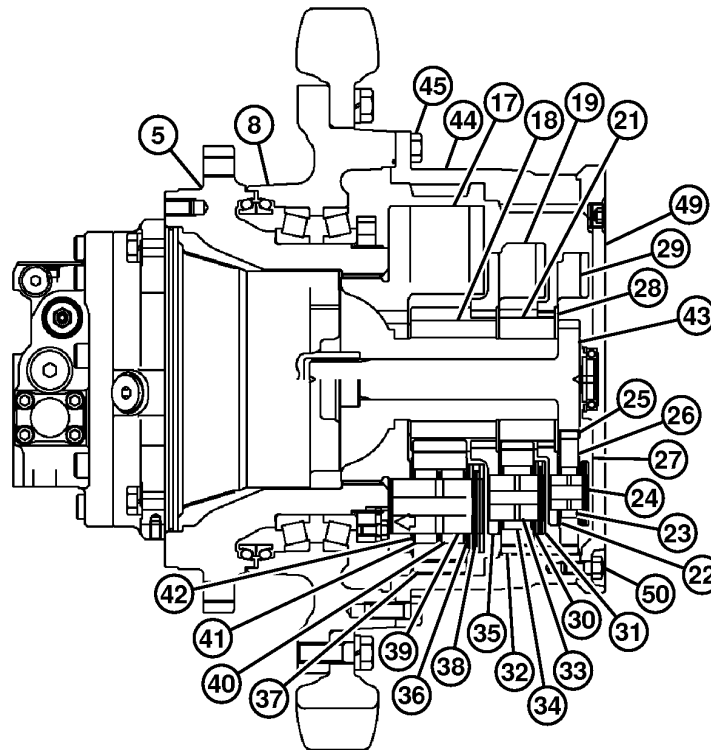
57. Install needle bearings (40, 41) to third stage planet gears (37)

58. Install third stage planet gear (37) to the third stage carrier (17).

59. Clamp third stage planet gear (37) with thrust plates (36, 42).

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TX1010360 -JUN-21JUL06



TX1010361

- | | | | |
|----------------------------|-------------------------------------|--------------------------------------|----------------------------|
| 5—Housing | 24—Pin (3 used) | 32—Second Stage Planet Gear (3 used) | 38—Spring Pin (4 used) |
| 8—Drum | 25—First Stage Planet Gear (3 used) | 33—Pin (3 used) | 39—Pin (4 used) |
| 9—Roller Bearing | 26—Thrust Plate (3 used) | 34—Needle Bearing (3 used) | 40—Needle Bearing (4 used) |
| 17—Third Stage Carrier | 27—Spring Pin (4 used) | 35—Thrust Plate (3 used) | 41—Needle Bearing (4 used) |
| 18—Third Stage Sun Gear | 28—Spacer | 36—Thrust Plate (4 used) | 42—Thrust Plate (4 used) |
| 19—Second Stage Carrier | 29—First stage Carrier | 37—Third Stage Planet Gear (4 used) | 43—Shaft |
| 21—Second Stage Sun Gear | 30—Thrust Plate (3 used) | | 49—Cover |
| 22—Thrust Plate (3 used) | 31—Spring Pin (3 used) | | 50—Cap Screw (used 16) |
| 23—Needle Bearing (3 used) | | | |

60. Align the spring pin (38) holes on the third stage carrier (17) and pin (39).

NOTE: Install spring pin (38), with the slit of pin (38) facing the end of pin (39).

61. Install spacer (28) to first stage carrier (29).

62. Install needle bearings (23) to first stage planet gears (25).

63. Clamp first stage planet gears (25) with thrust plates (26, 22).

64. Install first stage planet gear (25) to first stage carrier (29).

NOTE: Install spring pin (27) with the slit of spring facing the end of pin (24).

65. Install spring pins (27) into first stage carrier (29) and pin (24).

66. Assemble second stage carrier the same as in steps 21—25.

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16

! **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

67. Install third stage carrier (17) into housing (5).

Specification

Third Stage Carrier—Weight 70 kg approximate
150 lb approximate

68. Install third stage sun gear (18) into third stage carrier (17) with the thinner end facing to cover (49).

! **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

69. Install second stage carrier (19) assemblies (19, 20, 30—35) onto third stage sun gear (18).

Specification

Second Stage Carrier—Weight 25 kg approximate
60 lb approximate

70. Install first stage carrier (29) assemblies (22—29) to second stage carrier (19).

71. Insert shaft (43) into the center of carrier let it engage with first stage planet gears (25).

! **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

NOTE: Align the matching marks made during disassembly.

72. Install ring gear (44) onto drum (8).

Specification

Ring Gear—Weight 70 kg approximate
150 lb approximate

73. Apply LOCTITE 271® to Cap Screw (45) install ring gear (44) to drum (8) with cap screws (45).

74. Install ball bearing (48) to cover (49).

75. Install stopper pin (47) to ball bearing (48).

76. Install retaining ring (46) to cover (49).

NOTE: Install retaining ring (46) with chamfered surface facing to cover (49).

77. Apply LOCTITE 271® to Cap Screw (50) install cover (49) onto ring gear (44).

Specification

Cap Screw (50)—Torque 180 N•m
130 lb-ft

78. Apply seal tape onto plugs (51). Install plugs to cover (49).

Specification

Plug (49)—Torque 70 N•m
51 lb-ft

! **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

79. Turn travel gearbox over.

Specification

Travel Gearbox—Weight 540 kg approximate
1190 lb approximate

80. Fill travel gearbox with 8.5 L, (9.0 qt) oil See Travel Motor and Park Brake Start-Up Procedure. (Group 0260.)

81. Install O-ring (4) to motor (1).

! **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

82. Align the spline on shaft (43) with that on motor (1) and install travel motor to housing (5) with cap screws (2) and washers (3).

Axle Shaft, Bearings, and Reduction Gears

Specification

Travel Motor—Weight..... 130 kg approximate
290 lb approximate

Specification

Travel Motor Cap Screw—
Torque..... 300 N•m
220 lb-ft

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02
0250
17

Axle Shaft, Bearings, and Reduction Gears

02
0250
18

Travel Motor and Park Brake Remove and Install

CAUTION: Prevent possible injury from unexpected machine movement. Block both tracks when removing travel motors. When travel motors are removed, machine has no brakes and can move. The machine will roll free on a slope or while being towed.

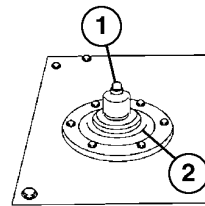
1. Block tracks.
2. Drain oil from travel gearbox. Approximate capacity is 8.5 L (9.0 qt).

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0260
1

CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil can cause serious burns or penetrating injury.

3. Push pressure release button on hydraulic oil tank cover to release pressure in tank.
4. Pull vacuum in hydraulic oil tank using vacuum pump or drain hydraulic oil tank. See 450DLC Drain and Refill Capacities. (Operator's Manual.)



1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

Continued on next page

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Hydraulic System

5. Disconnect lines. Attach identification tags to aid in assembly and close all open lines and fittings using caps and plugs.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: Cap screws used to hold valve to travel gearbox have heads longer than those holding valve to housing.

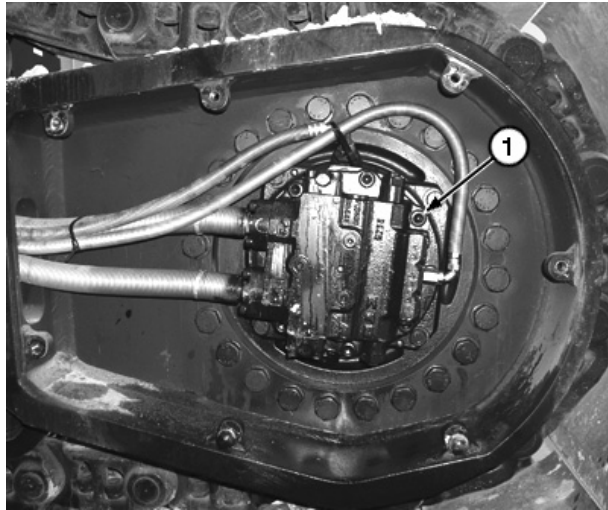
6. Loosen cap screws and lock washers (1).

Specification

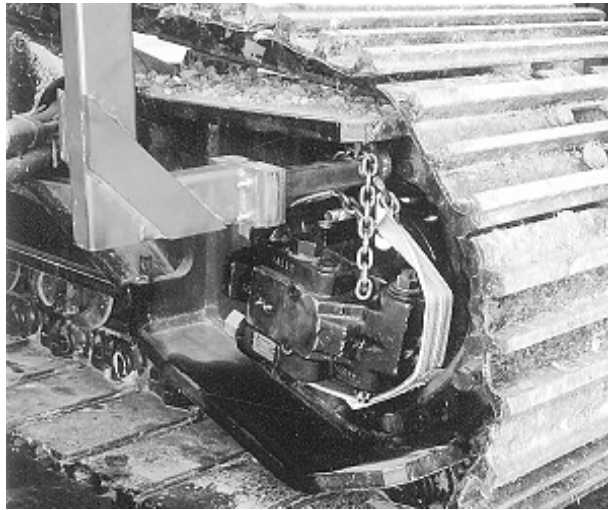
Hydraulic Motor—Weight..... 137 kg approximate
300 lb approximate

7. Connect hydraulic motor to hoist using DF1063 Lift Bracket and DFT1130 Adapter. (Group 9900.)

1—Cap Screw and Lock Washer (6 used)



TX1009088A -UN-27JUN06



T8318AC -UN-20SEP94

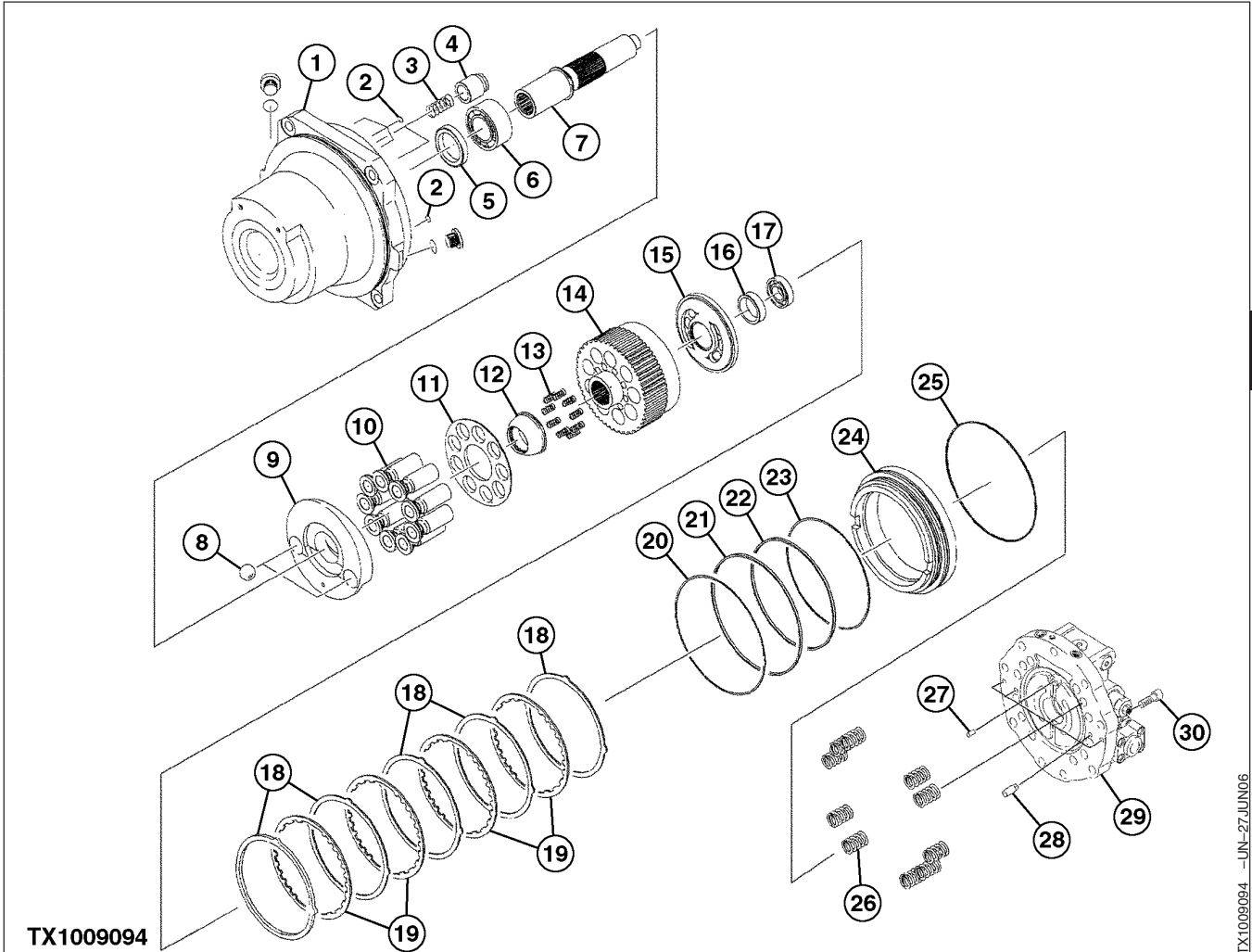
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2

Hydraulic System



TX1009094

- | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <p>1—Housing
2—O-Ring (4 Used)
3—Spring (2 Used)
4—Piston (2 Used)
5—Oil Seal
6—Roller Bearing
7—Shaft
8—Steel Ball (2 Used)</p> | <p>9—Swash Plate
10—Piston (9 Used)
11—Retainer
12—Holder
13—Spring (9 Used)
14—Cylinder Block
15—Valve Plate
16—Collar</p> | <p>17—Roller Bearing
18—Plate (5 Used)
19—Friction Plate (4 used)
20—Backup Ring
21—O-Ring
22—O-Ring
23—Backup Ring
24—Brake Piston</p> | <p>25—O-Ring
26—Spring (10 Used)
27—Pin
28—Pin (4 Used)
29—Valve Housing
30—Socket Cap Screw (9 Used)</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|

8. Remove cap screws (30) and remove valve (29) and remove O-ring (25).

9. Replace parts as necessary.

10. Install O-ring (25).

11. Install valve (29).

12. Install and tighten cap screws (30).

Specification

Valve-to-Travel Gearbox Cap	
Screw—Torque	400 N•m 295 lb-ft

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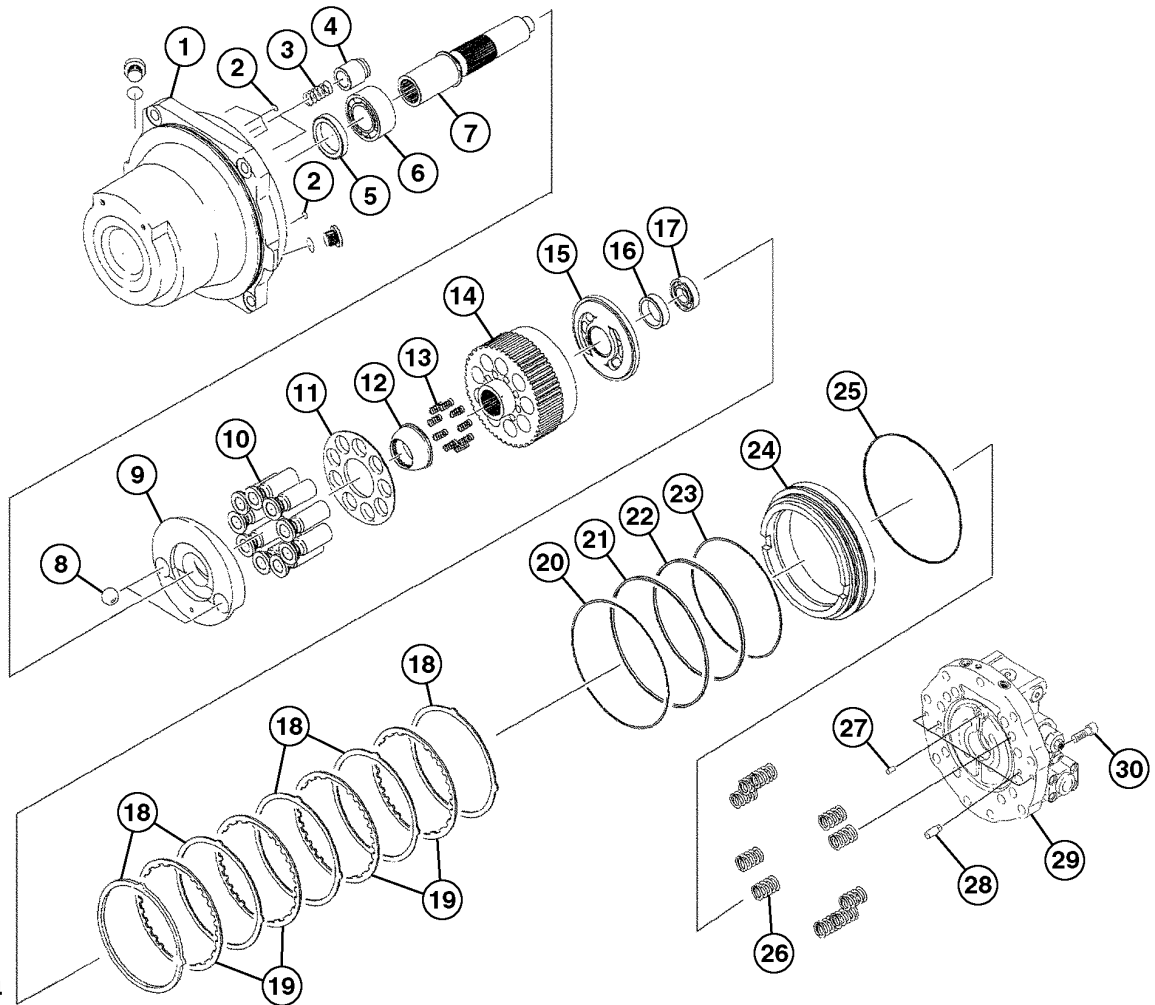
Hydraulic System

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 13. Connect lines. See Travel Hydraulic System Component Location. (Group 9025-15.) | (Operator's Manual.) and see Change Travel Gearbox Oil. (Operator's Manual.) |
| 14. Fill travel gearbox with oil. See 450DLC Drain and Refill Capacities (Operator's Manual.) and see Swing Gearbox and Travel Gearbox Oils | 15. Perform Travel Motor and Park Brake Start-Up Procedure. (Group 0260.) |

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Travel Motor and Park Brake Disassemble and Assemble



TX1009094

- | | | | |
|------------------------|--------------------|----------------------------|------------------------|
| 1—Housing | 9—Swash Plate | 17—Roller Bearing | 24—Brake Piston |
| 2—O-Ring (4 Used) | 10—Piston (9 Used) | 18—Plate (5 Used) | 25—O-Ring |
| 3—Spring (2 Used) | 11—Retainer | 19—Friction Plate (4 used) | 26—Spring (10 Used) |
| 4—Piston (2 Used) | 12—Holder | 20—Backup Ring | 27—Pin |
| 5—Oil Seal | 13—Spring (9 Used) | 21—O-Ring | 28—Pin (4 Used) |
| 6—Roller Bearing | 14—Cylinder Block | 22—O-Ring | 29—Valve Housing |
| 7—Shaft | 15—Valve Plate | 23—Backup Ring | 30—Cap Screws (9 Used) |
| 8—Steel Ball (2 Used) | 16—Collar | | |

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

IMPORTANT: Use care when removing valve (29), valve plate is easily damaged.

1. Remove cap screws (30) from valve housing (29).

Specification

Valve Housing—Weight..... 29 kg approximate
99 lb approximate

IMPORTANT: Remove needle bearing (17) only if replacement is necessary. Do not reuse needle bearing as it may have been damaged during removal.

2. Remove valve housing (29) from housing (1).
3. Remove springs (26), O-rings (2), pins (28), and O-ring (25) from housing.
4. Remove collar (16), and valve plate (15) from cylinder block (14).
5. Remove brake piston (24) from housing (1).
6. Remove O-rings (21, 22), backup rings (20, 23) from brake piston (24).
7. Remove plate (18) and friction plate (19) from housing (1) one by one alternately.
8. Remove cylinder block (14) assemblies (10—15) from housing (1).
9. Remove retainer (11), pistons (10), holder (12), and springs (13) from cylinder block (14).

IMPORTANT: Pistons must be installed into the same bores because of wear patterns. Mark location of pistons with respect to bores to aid in assembly.

Remove swash plate (9), pistons (4), springs (3), and steel balls (8), from housing (1).

IMPORTANT: Do not damage the spline on shaft (7) and contact part of oil seal (5) or oil leakage will occur.

10. Remove shaft (7) from housing (1). Remove the inner race of needle bearing (6) is removed with shaft (7) together.

IMPORTANT: Do not remove the inner race of needle bearing (6) from shaft (7) and the outer race of needle bearing (6) from case (1) unless necessary.

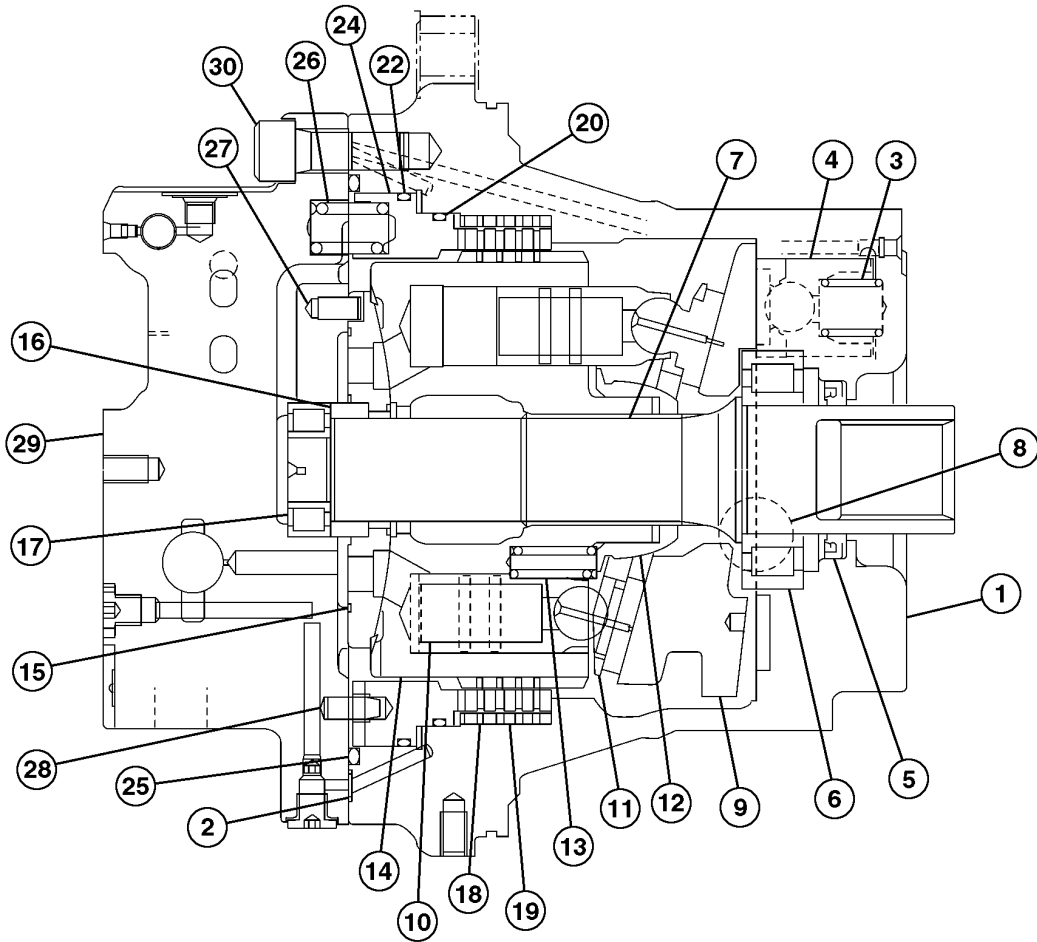
11. Remove inner race of needle bearing (6) from housing (1) with a press.
12. Remove the outer race of needle bearing (6) from housing (1) with a bar and hammer.
13. Remove oil seal (5) from housing (1).
14. Apply PM38656 Rigid Form-In-Place Gasket to the sealing surface.
15. Install parts (8, 12, 9, 11, and 2) using D01044AA Bushing, Bearing and Seal Driver Set.

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6

Hydraulic System



TX1009097

- | | | | |
|------------------------|--------------------|----------------------------|------------------------|
| 1—Housing | 9—Swash Plate | 17—Needle Bearing | 24—Brake Piston |
| 2—O-Ring (4 Used) | 10—Piston (9 Used) | 18—Plate (5 Used) | 25—O-Ring |
| 3—Spring (2 Used) | 11—Retainer | 19—Friction Plate (4 used) | 26—Spring (10 Used) |
| 4—Piston (2 Used) | 12—Holder | 20—Backup Ring | 27—Pin |
| 5—Oil Seal | 13—Spring (9 Used) | 21—O-Ring | 28—Pin (4 Used) |
| 6—Needle Bearing | 14—Cylinder Block | 22—O-Ring | 29—Valve Housing |
| 7—Shaft | 15—Valve Plate | 23—Backup Ring | 30—Cap Screws (9 Used) |
| 8—Steel Ball (2 Used) | 16—Collar | | |

- 16. Replace parts as necessary.
- 17. Install oil seal (5) to housing (1).
- 18. Install needle bearing (6) into housing (1).
- 19. Install shaft (7) to housing (1).
- 20. Install springs (3), pistons (4) and steel balls (8) to housing (1).



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 21. Install in housing (1).

Specification

Travel Motor Housing—Weight 54 kg approximate
120 lb approximate

Continued on next page

MD46667,00000BE -19-02AUG06-3/6

Hydraulic System

Specification

Travel Motor Cover-to-Travel
Motor Housing Cap Screw—
Torque..... 400 N•m
295 lb-ft



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

22. Install swash plate (9) to housing with thick side facing down.

23. Install springs (13) and holder (12) to cylinder block (14).

24. Install the cylinder block (14) assembly to shaft (7).

25. Install assembly in housing (1).

Specification

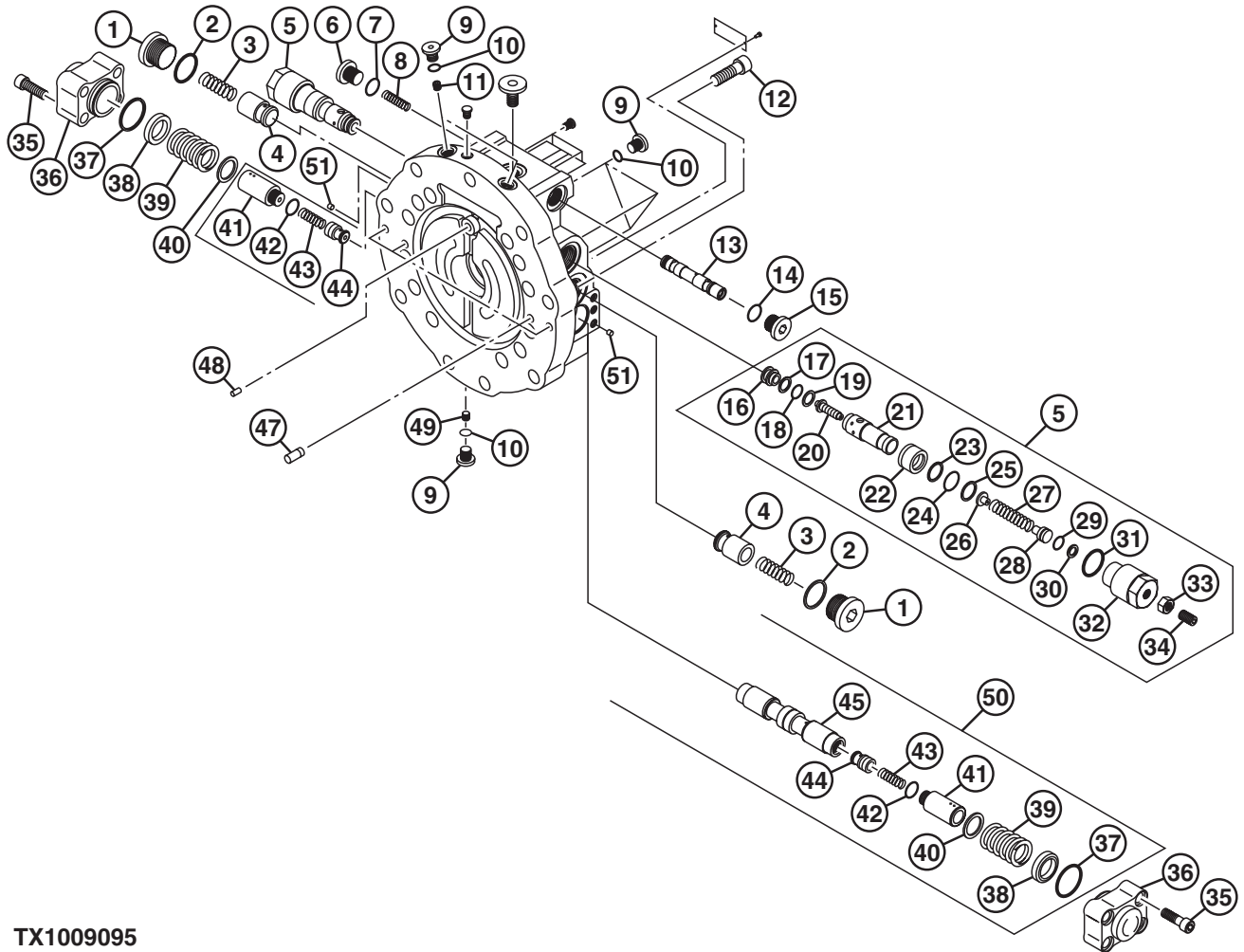
Travel Motor Housing—Weight 54 kg approximate
120 lb approximate

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Hydraulic System



TX1009095

- | | | | |
|-----------------------------------|--------------------------------|------------------------------|--------------------------|
| 1—Plug (2 Used) | 13—Travel Speed Selector Valve | 26—Spring Seat (2 Used) | 39—Spring (2 Used) |
| 2—O-Ring (2 Used) | 14—O-Ring | 27—Spring (2 Used) | 40—Spring Seat (2 Used) |
| 3—Spring (2 Used) | 15—Plug | 28—Spring Guide (2 Used) | 41—Plug (2 Used) |
| 4—Make-Up Check Valve (2 Used) | 16—Poppet Seat (2 Used) | 29—O-Ring (2 Used) | 42—O-Ring (2 Used) |
| 5—Crossover Relief Valve (2 Used) | 17—Backup Ring (2 Used) | 30—Backup Ring (2 Used) | 43—Spring (2 Used) |
| 6—Plug | 18—O-Ring (2 Used) | 31—O-Ring (2 Used) | 44—Check Valve (2 Used) |
| 7—O-Ring | 19—Backup Ring (2 Used) | 32—Plug (2 Used) | 45—Spool |
| 8—Spring | 20—Poppet (2 Used) | 33—Nut (2 Used) | 46—Valve Housing |
| 9—Plug (9 Used) | 21—Relief Housing (2 Used) | 34—Set Screw (2 Used) | 47—Pin (4 Used) |
| 10—O-Ring (6 Used) | 22—Piston (2 Used) | 35—Socket Cap Screw (8 Used) | 48—Pin |
| 11—Orifice (2 Used) | 23—Backup O-Ring (2 Used) | 36—Cap (2 Used) | 49—Orifice |
| 12—Socket Cap Screw (9 Used) | 24—O-Ring (2 Used) | 37—O-Ring (2 Used) | 50—Counter Balance Valve |
| | 25—Backup Ring (2 Used) | 38—Spring Seat (2 Used) | 51—Orifice (2 Used) |



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

26. Disassemble Park Brake

Continued on next page

MD46667,00000BE -19-02AUG06-5/6

Hydraulic System

Secure valve housing to bench.

Specification

Brake Valve—Weight..... 39 kg
90 lb

27. Remove plugs (6) and (15) with O-rings (7) and (14) and spring (8) from valve housing (46).

IMPORTANT: Remove travel speed selector valve while rotating if resistance is felt do not try to force return to original position and try again. Do not disassemble valve.

28. Remove travel speed selector valve (13).

29. Remove plugs (1), O-rings (2), springs (3), and check valves (4) from housing (46).

IMPORTANT: Do not disassemble relief valves (5) Relief valve should be replaced as assembly. Attach an identification tag to each relief valve to install to their original position.

30. Remove relief valves (5) from valve housing (46).

31. Remove cap screws (35) remove caps (36) from valve housing (46).

32. Remove spring seats (38) springs (29) and spring seats (40) from valve housing (46).

IMPORTANT: Remove counter balance valve while rotating if resistance is felt do not

try to force return to original position and try again.

33. Push and rotate spool assembly (50) remove from valve housing (46).

34. Remove plugs (41) from spool (45). Remove springs (43) and check valves (44) from spool

35. Install O-rings (7) and (14) to plugs (6) and (15)

36. Install valve assembly (13) spring (8) and plugs (6) and (15) to valve housing (46).

37. Install O-rings (2) to plugs (1).

38. Install check valves (4) springs (3) and plugs (1) to valve housing (46).

IMPORTANT: Install relief valve (5) to the former position before disassembling.

39. Install relief valves (5) to valve housing (46).

40. Slowly rotate and insert spool assembly (50) onto valve housing (46).

41. Install O-rings (37) to caps (36).

42. Install spring seats (40) springs (39) and spring seats (38) to valve housing (46).

43. Install caps (36) with cap screws (35).

MD46667.00000BE -19-02AUG06-6/6

Counterbalance Valve Remove and Install

See Travel Motor and Park Brake Disassemble and Assemble. (Group 0260.)

MD46667.00000C0 -19-01AUG06-1/1

Crossover Relief Valves Remove and Install

See Travel Motor and Park Brake Disassemble and Assemble. (Group 0260.)

MD46667.00000C1 -19-02AUG06-1/1

Make-Up Check Valve Remove and Install

See Travel Motor and Park Brake Disassemble and Assemble. (Group 0260.)

MD46667,00000C2 -19-01AUG06-1/1

Travel Speed Selector Valve Remove and Install

See Travel Motor and Park Brake Disassemble and Assemble. (Group 0260.)

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Travel Motor and Park Brake Start-Up Procedure

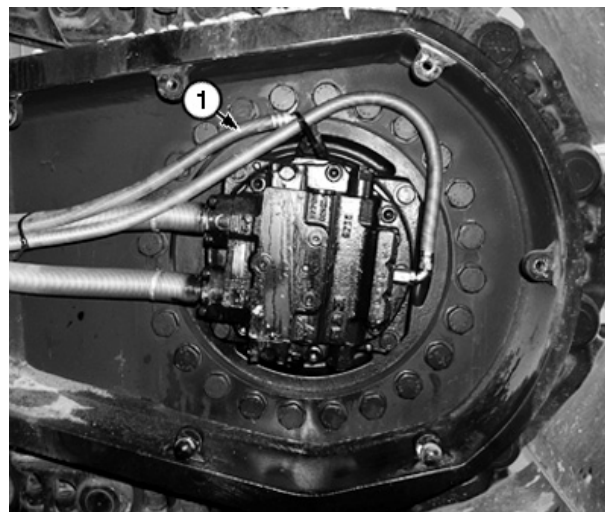
IMPORTANT: Travel motor will be damaged if not filled with oil before operating travel function. Procedure must be performed whenever a new travel motor is installed or oil has been drained from the motor.

1. Disconnect drain line (1).
2. Fill motor with hydraulic oil until oil reaches top of drain port.

NOTE: Use a funnel with suitable diameter neck to allow air to escape while filling.

3. Connect drain line (1).

1—Travel Motor Drain Line



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MD46667,00000C4 -19-10JUL06-1/1

Hydraulic System

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Section 04 Engine

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04

Contents

04

Engine Remove and Install

1. Disconnect negative battery cable.
2. Drain engine coolant. See Drain Cooling System. (Operator's Manual.) Approximate capacity is 46 L (12 gal).
3. Remove rear hood.
4. Disconnect turbo charger inlet pipe from air cleaner housing.

04
0400
1

TX17984,000001B -19-02AUG06-1/7



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

5. Remove hood frame.



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TX17984,000001B -19-02AUG06-2/7

Removal and Installation

- Remove muffler inlet pipe (3) to muffler inlet cap screws (2).

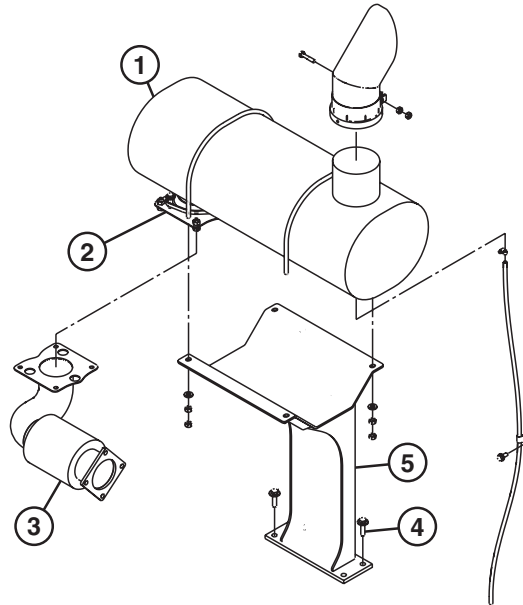
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove muffler (1) and muffler bracket (5).

Specification

Muffler—Weight..... 61 kg approximate
135 lb approximate

- Disconnect turbo charger intercooler hoses.
- Disconnect radiator hoses.
- Disconnect engine oil filter hoses from engine.
- Disconnect fuel inlet and return hoses.
- Remove A/C compressor. See Compressor Remove and Install. (Group 1830.)
- Disconnect alternator wire harness.
- Disconnect starter wire harness.
- Disconnect B15—engine oil level switch.
- Disconnect engine wire harness connectors.
- Remove heat shields around flywheel housing.



- 1—Muffler
- 2—Muffler Inlet Cap Screws
- 3—Muffler Inlet Pipe
- 4—Cap Screw (4 used)
- 5—Muffler Bracket

TX1010032 -UN-18JUL06

TX17984,000001B -19-02AUG06-3/7

- Support pump using DFT1119 Pump Support. Install cap screw to fasten pump support to hood support. See DFT1119 Pump Support for instructions to make tool. (Group 9900.)
- Remove pump to flywheel housing cap screws.
- Separate pump from flywheel housing.



TX1010337A -UN-18JUL06

Continued on next page

TX17984,000001B -19-02AUG06-4/7

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

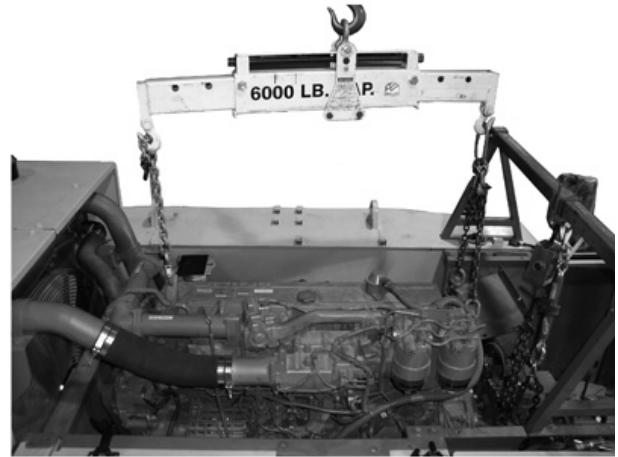
21. Attach hoist to engine.

	Specification	
Engine—Weight.....		1225 kg approximate 2700 lb approximate

22. Remove engine supporting cap screws.

23. Remove engine.

24. Inspect and repair as needed.



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

25. Install engine.

	Specification	
Engine—Weight.....		1225 kg 2700 lb

26. Install engine to mount cap screws.

	Specification	
Engine-to-Mount Cap Screws—		
Torque		1050 N•m 774 lb-ft

27. Install flywheel housing to mount cap screws.

	Specification	
Flywheel Housing-to-Mount Cap		
Screws—Torque.....		750 N•m 553 lb-ft

28. Install splitter box to flywheel housing. Tighten splitter box to flywheel housing cap screws to specification.

	Specification	
Splitter Box-to-Flywheel		
Housing—Torque.....		98 N•m 72 lb-ft


29. Remove pump support.

TX1010335A -UN-18JUL06

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30. Install heat shield around flywheel housing.
31. Connect engine wire harness connectors.
32. Connect B15—engine oil level switch.
33. Connect starter wire harness.
34. Connect alternator wire harness.
35. Install A/C Compressor. See Compressor Remove and Install. (Group 1830.)
36. Connect fuel inlet and return hoses.
37. Connect engine oil filter hoses.
38. Connect radiator hoses.
39. Connect turbo charger intercooler hoses.


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 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

40. Install muffler and muffler bracket.

	Specification	
Muffler—Weight		61 kg approximate 135 lb approximate

41. Install muffler inlet pipe.
42. Install hood frame.
43. Connect turbo charger inlet pipe from air cleaner housing.
44. Connect intake air temperature sensor.

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

45. Install rear hood.

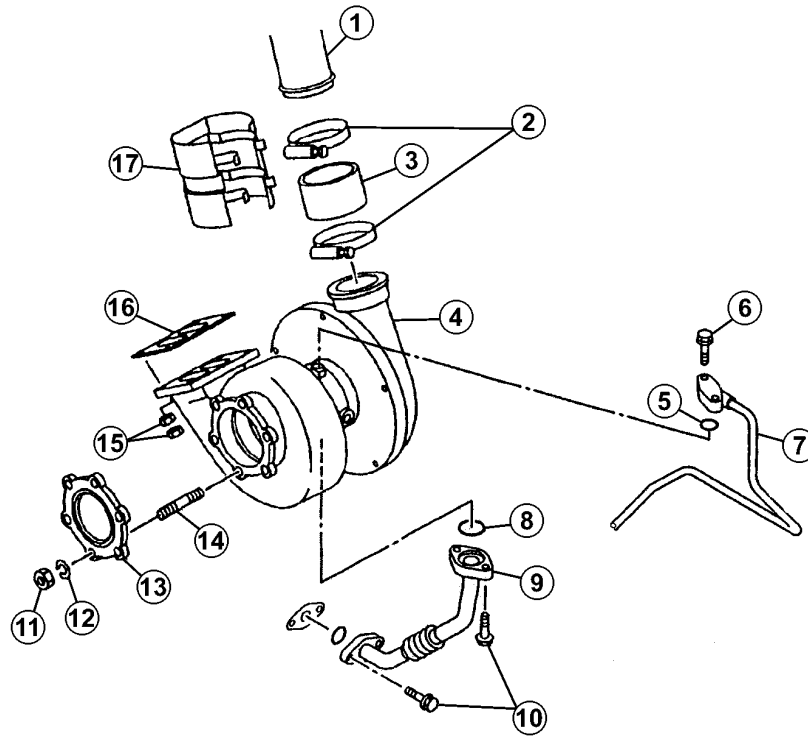
Removal and Installation

46. Perform Cooling System Fill and Deaeration Procedure. (Operator's Manual.) Approximate capacity is 46 L (12 gal).
47. Connect negative battery cable.

TX17984.000001B -19-02AUG06-7/7

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Turbocharger Remove and Install



T144223

- | | | | |
|--------------------|----------------------|-----------------------|-------------------|
| 1—Intercooler duct | 6—Cap Screw (2 used) | 10—Cap Screw (4 used) | 14—Stud (6 used) |
| 2—Clamp (2 used) | 7—Oil Feed Pipe | 11—Nut (6 used) | 15—Nut (8 used) |
| 3—Hose Coupling | 8—Gasket (2 used) | 12—Washer (6 used) | 16—Gasket |
| 4—Turbocharger | 9—Oil Return Pipe | 13—Gasket | 17—Heat Protector |
| 5—Gasket | | | |

1. Remove clamps (2) and hose coupling (3). Separate intercooler duct (1) from turbocharger (4).
2. Remove clamp from air intake duct.
3. Remove nuts (11) from turbocharger to exhaust pipe.
4. Remove oil supply pipe (7) and discard gasket (5).
5. Remove oil return pipe (9) and discard gasket (8). Plug turbocharger body oil ports and openings to prevent entry of foreign material or dust.
6. Remove nuts (15) attaching turbocharger (4) to exhaust manifold.
7. Remove turbocharger (4) and discard gasket (16).
8. Inspect and repair as necessary.
9. Install turbocharger with new gasket to exhaust manifold and tighten nuts.
10. Install oil return pipe with new gaskets to turbocharger. Tighten cap screws to specification.

Specification

Turbocharger-to-Exhaust	
Manifold Nut—Torque.....	40 N•m 30 lb-ft

Continued on next page

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T144223 -UN-08FEB02

Removal and Installation

	Specification
Oil Return Pipe-to-Turbocharger Cap Screw—Torque	50 N•m 37 lb-ft

- 11. Lubricate turbine shaft. Pour oil into supply hole while rotating turbine wheel with your hand.
- 12. Install oil supply pipe with new gasket to turbocharger. Tighten cap screws to specification.

	Specification
Oil Supply Pipe-to-Turbocharger Cap Screw—Torque	34 N•m 25 lb-ft

- 13. Install clamp from turbocharger to exhaust pipe.

	Specification
Exhaust Pipe-to-Turbocharger Clamp—Torque.....	14.7 N•m 130 lb-in.

- 14. Install clamp from air duct.

	Specification
Intercooler Duct-to-Inlet Manifold Clamp—Torque.....	4.4 N•m 39 lb-in.

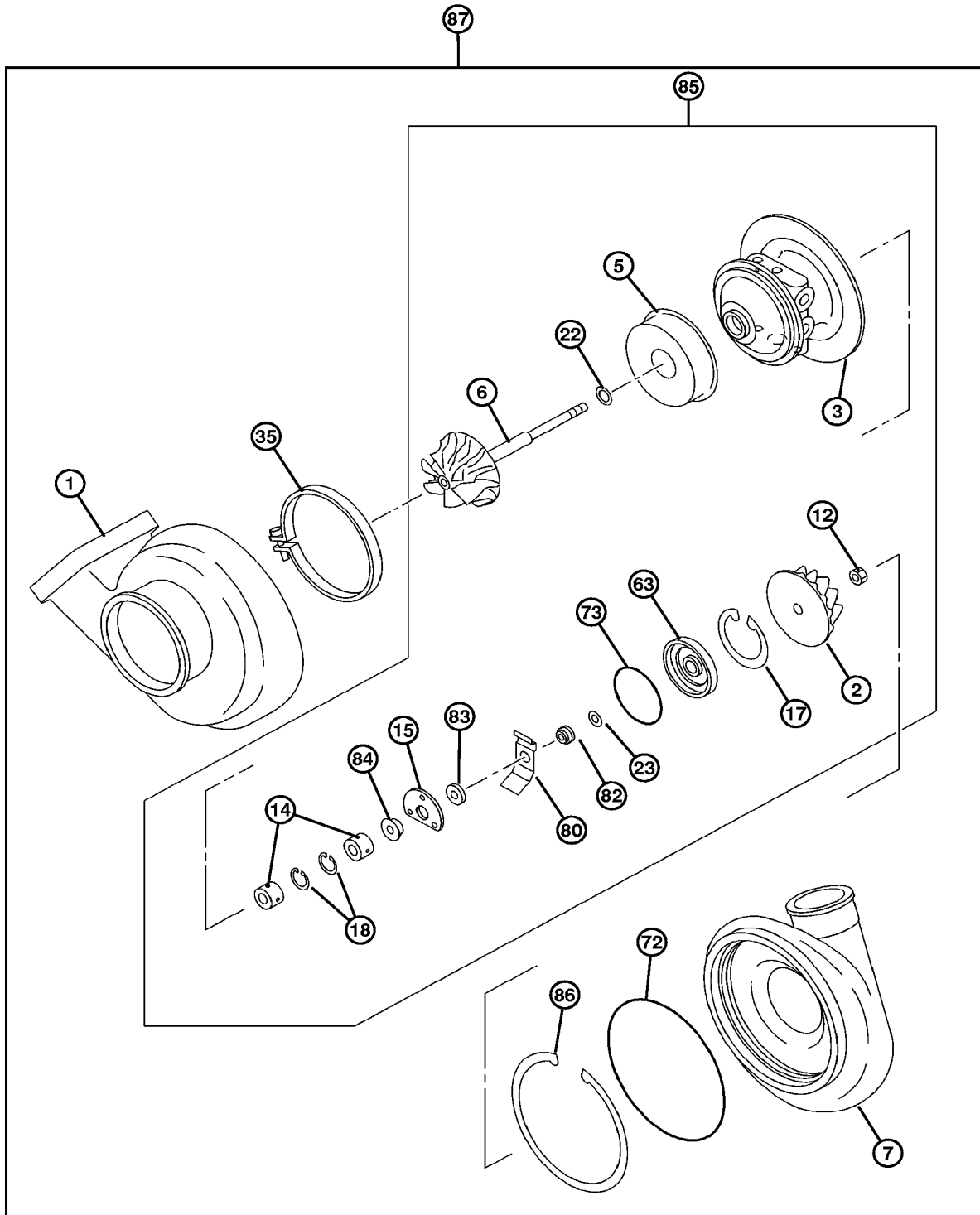
- 15. Connect rubber hose coupling between intercooler duct and turbocharger. Tighten with clamps to specification.

	Specification
Air Inlet Pipe-to-Turbocharger Clamp—Torque.....	4.4 N•m 39 lb-in.

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TX17984.000001C -19-03AUG06-2/2

Turbocharger Disassemble and Assemble



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T216659

Turbocharger Exploded View

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GD61784.0000003 -19-02AUG06-1/16

T216659 -UN-09NOV05

Removal and Installation

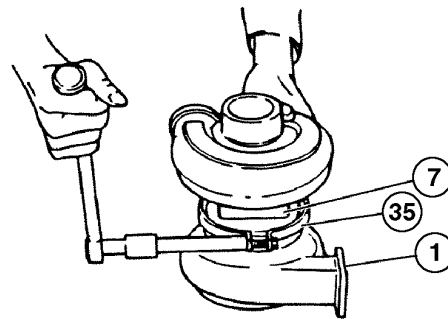
1—Turbine Housing	12—Lock Nut	23—Piston Ring	82—Thrust Sleeve
2—Compressor Impeller	14—Bearing (2 used)	35—Clamp	83—Thrust Bearing
3—Bearing Housing	15—Bearing	63—Insert	84—Thrust Ring
5—Turbine Back Cover	17—Snap Ring	72—O-Ring	85—Turbocharger
6—Shaft and Turbine Impeller	18—Snap Ring (2 used)	73—O-Ring	86—Snap Ring
7—Compressor Housing	22—Piston Ring	80—Oil Deflector	87—Turbocharger (complete)

GD61784,0000003 -19-02AUG06-2/16

IMPORTANT: When assembling the relationships between compressor cover, bearing housing, and turbine housing is very important.

1. Remove clamp (35).
2. Make reference marks on the turbine housing (1), compressor housing (7) and bearing housing to ensure proper assembly.

- 1—Turbine Housing
- 7—Compressor Housing
- 35—Clamp



Turbocharger

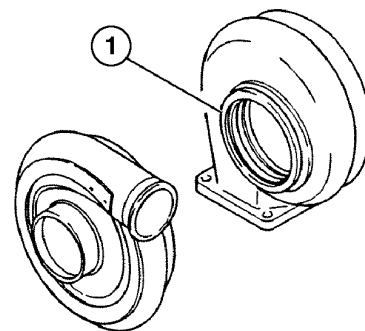
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TX1008230 -UN-06JUN06

GD61784,0000003 -19-02AUG06-3/16

3. Remove turbine housing (1).

- 1—Turbine Housing



Turbocharger Housing

TX1008256 -UN-06JUN06

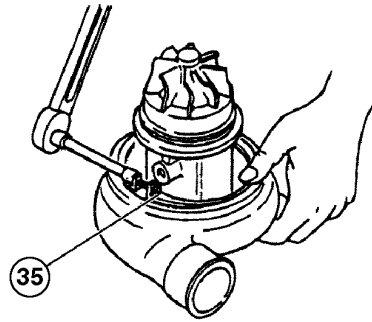
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GD61784,0000003 -19-02AUG06-4/16

Removal and Installation

4. Remove snap ring (86).

35—Clamp



Turbine Impeller

TX1008257 -UN-06JUN06

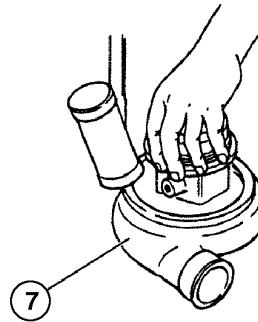
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GD61784,0000003 -19-02AUG06-5/16

IMPORTANT: Make sure that the compressor wheel does not hit compressor cover.

5. Remove the compressor cover (7) by gently tapping around its circumference using a plastic hammer or similar tool.
6. Use the compressor cover (7) as a holding fixture for further disassembly.

7—Compressor Housing



Compressor Cover

TX1008258 -UN-06JUN06

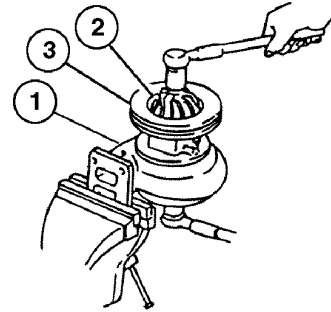
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GD61784,0000003 -19-02AUG06-6/16

Removal and Installation

7. Remove nut.

- 1—Turbine Housing
- 2—Compressor Impeller
- 3—Bearing Housing



Lock Nut

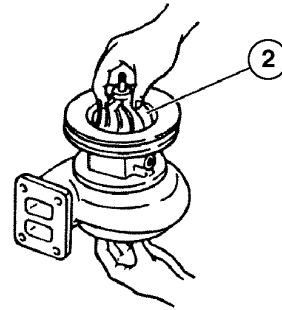
TX1008259 -UN-06JUN06

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GD61784,000003 -19-02AUG06-7/16

8. Remove the compressor impeller (2).

- 2—Compressor Impeller



Compressor Impeller

TX1008260 -UN-06JUN06

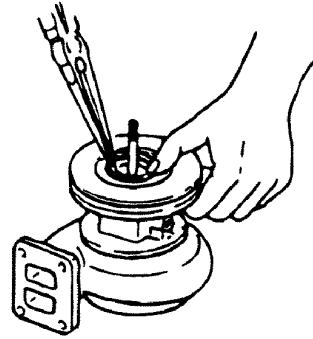
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GD61784,000003 -19-02AUG06-8/16

Removal and Installation

IMPORTANT: Do not attempt to repair damaged blades. Replace them with new parts.

9. Remove snap ring.



Snap Ring

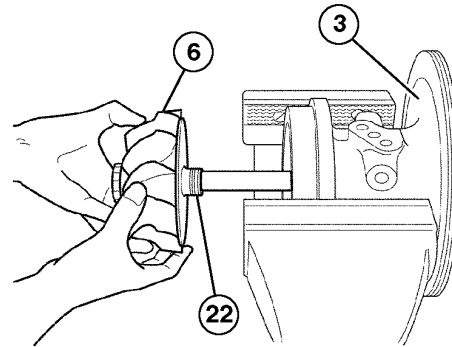
TX1008270 -UN-06JUN06

GD61784,0000003 -19-02AUG06-9/16

10. Remove the shaft and turbine impeller (6) from bearing housing (3).

11. Remove remaining parts from bearing housing.

12. Remove piston ring (22).



Shaft and Impeller Removal

TX1008269 -UN-06JUN06

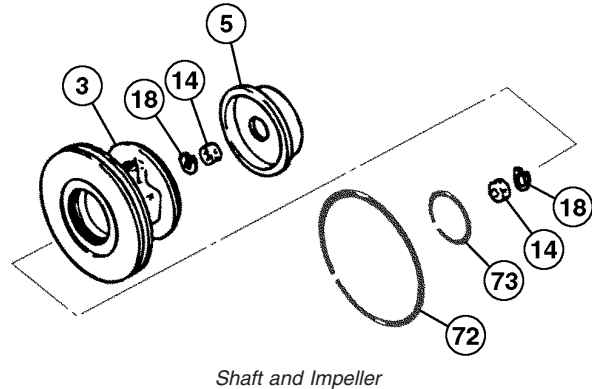
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GD61784,0000003 -19-02AUG06-10/16

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Removal and Installation

13. Remove turbine back cover (5).
14. Remove bearing (14).
15. Remove snap ring (18).
16. Remove O-rings.
17. Remove turbocharger. See Turbocharger Inspection. (Group 0400.)



- 3—Bearing Housing
- 5—Turbine Back Cover
- 14—Bearing (2 used)
- 18—Snap Ring (2 used)
- 72—O-Ring
- 73—O-Ring

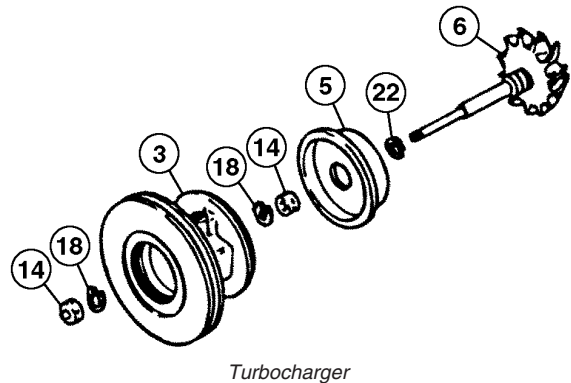
Shaft and Impeller

TX1008268 -JUN-27JUL06

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GD61784.0000003 -19-02AUG06-11/16

18. Install snap rings with the tapered side towards bearing.
19. Apply engine oil to the inner and outer surfaces of bearing.
20. Install the bearing.
21. Install turbine back cover (5).
22. Apply engine oil to piston ring (22).
23. Install piston ring (22) to the shaft and turbine impeller (6).
24. Install bearing housing (3) to the shaft and turbine impeller (6).



- 3—Bearing Housing
- 5—Turbine Back Cover
- 6—Shaft and Turbine Impeller
- 14—Bearing (2 used)
- 18—Snap Ring (2 used)
- 22—Piston Ring

Turbocharger

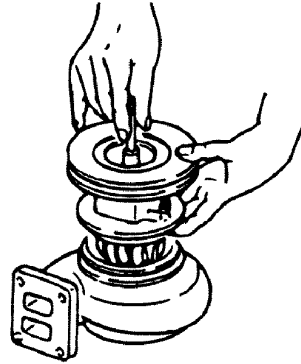
TX1008312 -JUN-27JUL06

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GD61784.0000003 -19-02AUG06-12/16

Removal and Installation

25. Install thrust ring.
26. Apply engine oil to the inner surface of thrust bearing.
27. Install thrust bearing.
28. Install oil deflector.
29. Apply grease to the O-ring.
30. Install O-ring inside bearing housing.
31. Install piston ring to thrust sleeve.
32. Install thrust sleeve to insert.
33. Install insert.
34. Install snap ring with the tapered side towards bearing.
35. Set up dial indicator on the shaft and turbine impeller.
36. Move the shaft and turbine impeller upward to check clearance between turbine housing and turbine impeller.



TX1008317 -UN-22JUN06

Specification

Turbine Impeller and Shaft Axis
Direction—Clearance..... 0.39—1.0 mm
0.015—0.039 in.

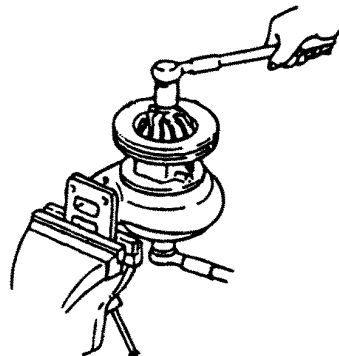
37. Install compressor impeller.
38. Apply molybdenum disulphide to thread section of lock nut.

GD61784,0000003 -19-02AUG06-13/16

39. Tighten lock nut to specification.

Specification

Compressor Impeller-to-Shaft and
Turbine Impeller Lock Nut—
Torque 20 N•m
177 lb-in.



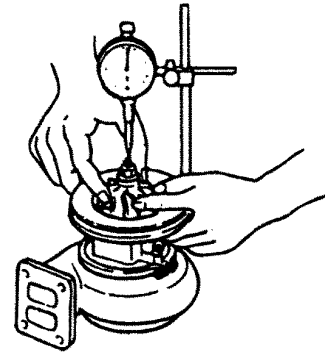
TX1010539 -UN-25JUL06

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GD61784,0000003 -19-02AUG06-14/16

Removal and Installation

- 40. Set up dial indicator on the shaft and turbine impeller.
- 41. Move the shaft and turbine impeller upward to check clearance between turbine housing and turbine impeller.



Specification

Compressor Impeller Shaft Axis	
Direction—Clearance.....	0.075—0.155 mm 0.001—0.006 in.

GD61784.0000003 -19-02AUG06-15/16

TX1010540 -UN-25JUL06

- 42. Measure clearance between turbine back cover and turbine impeller.

Specification

Turbine Back Cover-to-Turbine	
Impeller—Clearance	0.48—0.92 mm 0.019—0.036 in.



- 43. Apply grease to O-ring. Install O-ring.
- 44. Install compressor housing and turbine housing.
- 45. Install compressor housing.
- 46. Install snap ring.
- 47. Install turbine housing.
- 48. Apply grease coat to threaded section of clamp. Tighten to specification.

Specification

Turbine Housing-to-Bearing	
Housing Clamp—Torque	6 N•m 53 lb-in.

GD61784.0000003 -19-02AUG06-16/16

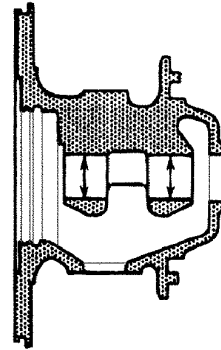
TX1010554 -UN-25JUL06

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Turbocharger Inspection

1. Measure internal diameter of bearing insert section of bearing housing.

	Specification
Maximum—ID	20.506 mm 0.807 in.



Bearing Housing

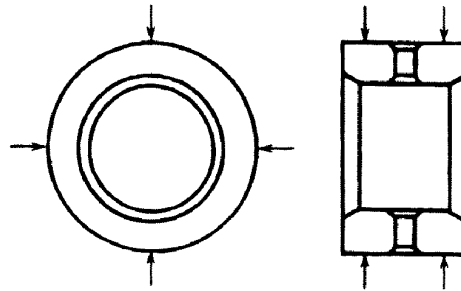
TX1008276 -UN-06JUN06

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TX17984,000001D -19-31JUL06-1/7

2. Measure external diameter of bearing.

	Specification
Minimum—OD	20.382 mm 0.802 in.



Bearing OD

TX1008277 -UN-06JUN06

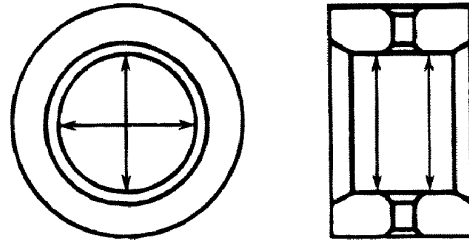
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TX17984,000001D -19-31JUL06-2/7

Removal and Installation

3. Measure internal diameter of bearing.

	Specification	
Maximum—ID.....		12.042 mm 0.474 in.



Bearing ID

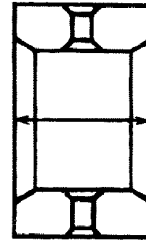
TX1008278 -UN-06JUN06

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TX17984.000001D -19-31JUL06-3/7

4. Measure bearing length.

	Specification	
Minimum—Length.....		11.94 mm 0.470 in.



Bearing Length

TX1008280 -UN-06JUN06

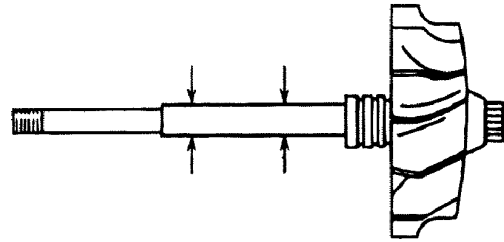
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TX17984.000001D -19-31JUL06-4/7

Removal and Installation

5. Measure shaft diameter.

	Specification
Minimum—OD	11.996 mm 0.472 in.



Shaft and Turbine Impeller

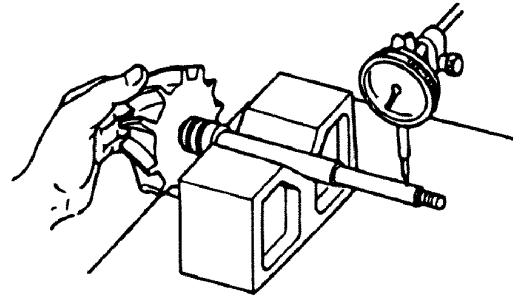
TX1008279 -UN-06JUN06

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TX17984,000001D -19-31JUL06-5/7

6. Check shaft runout.

	Specification
Maximum—Axial Runout	0.015 mm 0.001 in.



Shaft and Turbine Impeller

TX1008282 -UN-06JUN06

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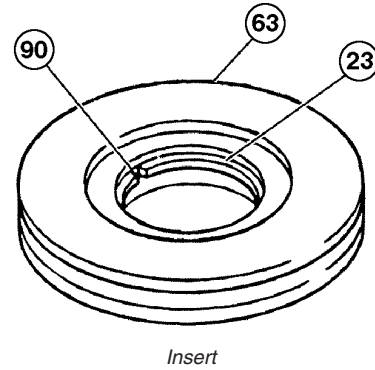
TX17984,000001D -19-31JUL06-6/7

Removal and Installation

7. Install a new piston ring into insert and measure piston ring joining section clearance.

Specification	
Piston Ring Joining Section—	
Clearance	0.05—0.25 mm 0.002—0.010 in.

- 23—Piston ring
- 63—Insert
- 90—Joining section

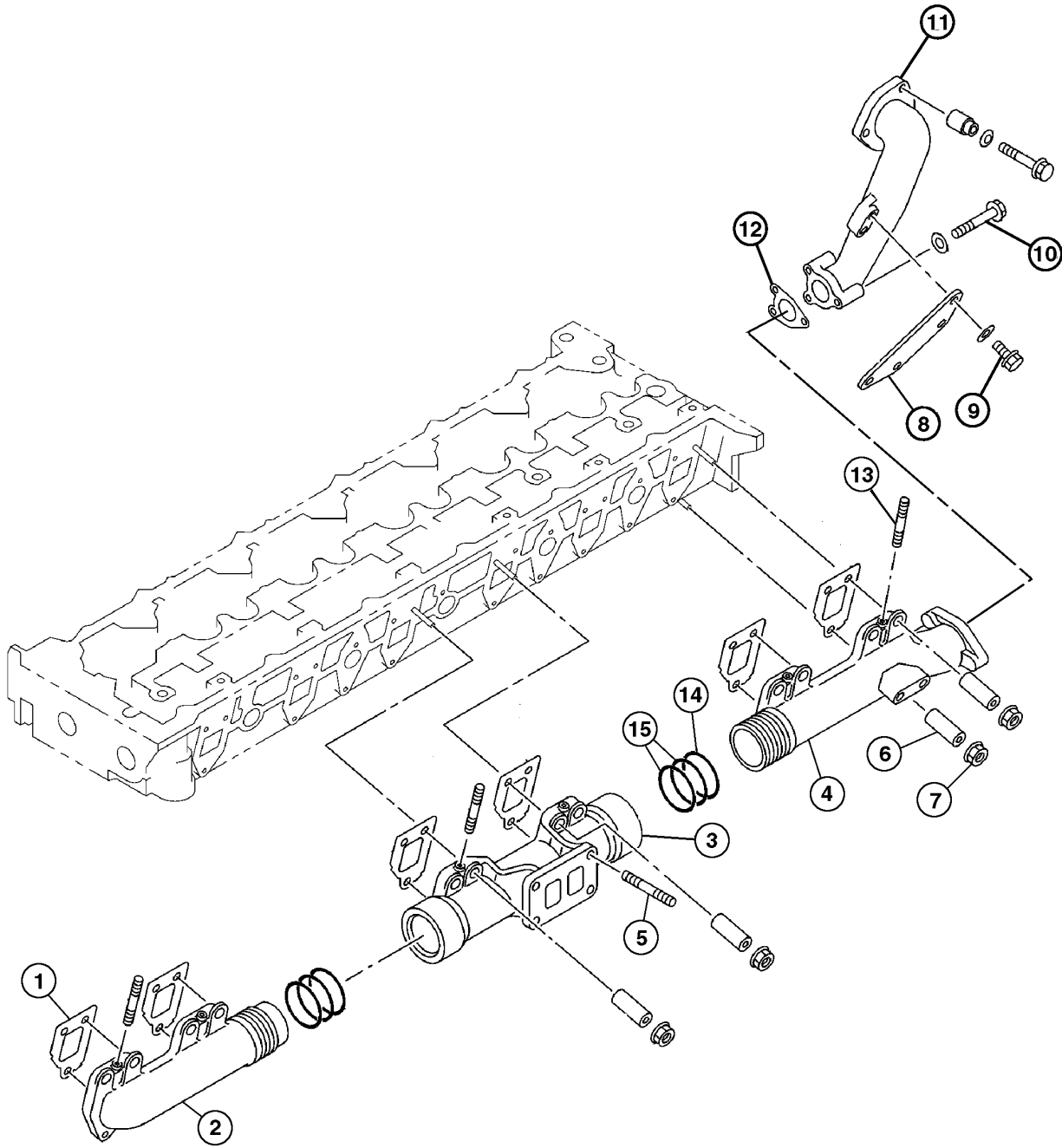


TX1008281 -JUN-06JUN06

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TX17984.000001D -19-31JUL06-7/7

Exhaust Manifold Remove and Install



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TX1009224

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TX17984,000001E -19-01AUG06-1/2

Removal and Installation

- | | | | |
|---------------------------|--------------------|-----------------------|------------------|
| 1—Gasket (6 used) | 5—Stud (4 used) | 9—Cap Screw (2 used) | 13—Stud (6 used) |
| 2—Rear Exhaust Manifold | 6—Spacer (18 used) | 10—Cap Screw (3 used) | 14—Seal (2) |
| 3—Center Exhaust Manifold | 7—Nut (18 used) | 11—EGR Air Duct | 15—Seal (4) |
| 4—Front Exhaust Manifold | 8—Bracket | 12—Gasket | |

1. Remove turbocharger. See Turbocharger Remove and Install for procedure. (Group 0400.)
2. Remove EGR air duct (11).
3. Remove exhaust manifolds (2, 3, and 4). Discard gaskets (1).
4. Clean all gasket residue from exhaust manifold and cylinder head mating surfaces.
5. Inspect and repair as necessary.
6. Install new gaskets.
7. Install exhaust manifolds (2, 3, and 4).
8. Install spacers and nuts. Tighten nuts to specifications.
9. Install EGR air duct.
10. Install Turbocharger. See Turbocharger Remove and Install for procedure. (Group 0400.)

Specification

Exhaust Manifold-to-Cylinder Head Nuts—Torque.....	48 N•m 35 lb-ft
-------------------------------------------------------	--------------------

TX17984.000001E -19-01AUG06-2/2

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Upper Valve Cover Remove and Install

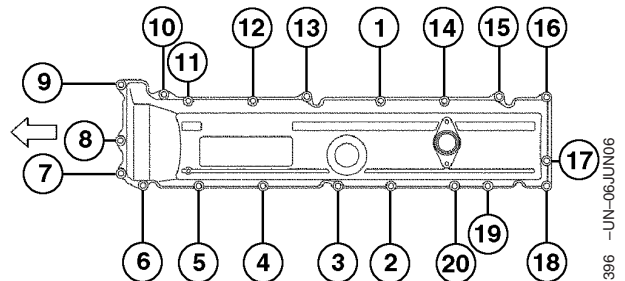
1. Disconnect air breather hose.
2. Remove valve cover.
3. Inspect and repair as necessary.
4. Install valve cover gasket.

TX17984.000001F -19-31JUL06-1/2

5. Install valve cover. Tighten cap screws in sequence.

	Specification
Valve Cover Cap Screws— Torque	15 N•m 133 lb-in.

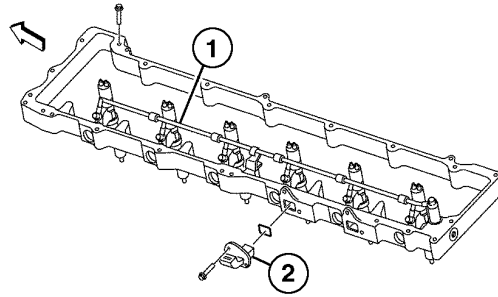
6. Connect air breather hose.



TX17984.000001F -19-31JUL06-2/2

Lower Valve Cover Remove and Install

1. Remove upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)
2. Remove fuel injection nozzle harness.
3. Remove fuel injection nozzle leak off lines (1).
4. Disconnect fuel injection nozzle harness connectors.
5. Remove lower valve cover.
6. Inspect and repair as needed.



1—Fuel Injection Nozzle Leak Off Lines
2—Fuel Injection Nozzle Harness Connectors

TX1009161 -UN-05JUL06

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Continued on next page

GD61784,0000010 -19-31JUL06-1/2

Removal and Installation

7. Apply PM37465 RTV 587 Blue Silicone or equivalent to timing gear cover-to-engine block joint.

8. Install lower valve cover and gasket.

Specification

Lower Valve Cover-to-Cylinder
Head Cap Screws—Torque 15 N•m
133 lb-in.

9. Install fuel injection nozzle harness connectors.

Specification

Fuel injection Nozzle Harness
Connector-to-Lower Valve Cover
Cap Screw—Torque 20 N•m
177 lb-in.

10. Install fuel injection leak off lines.

11. Connect and tighten fuel injection nozzle leak off line to specification.

Specification

Fuel injection Nozzle Leak Off
Line-to-Fuel injection Nozzle—
Torque 15 N•m
133 lb-in.

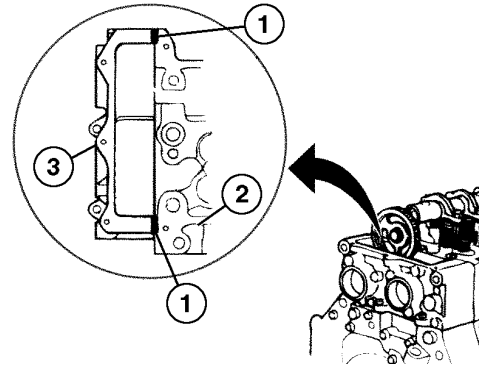
12. Connect and tighten fuel leak off line to adapter at lower valve cover.

Specification

Fuel injection Nozzle Leak Off
Line-to-Fuel Line Adapter—
Torque 20 N•m
177 lb-in.

13. Install fuel injection nozzle harness.

14. Install upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)



1—Sealant
2—Engine Block
3—Gear Case

TX1009152 -JUN-05JUL06

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GD61784,0000010 -19-31JUL06-2/2

Rocker Arm Shaft Assembly Remove and Install

1. Remove upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)
2. Remove lower valve cover. See Lower Valve Cover Remove and Install. (Group 0400.)

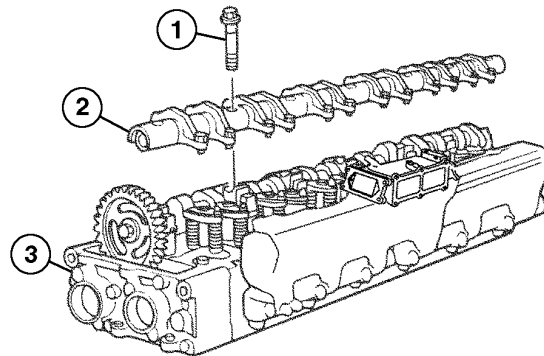
TX17984,0000020 -19-01AUG06-1/2

3. Remove cap screws holding rocker arm shaft assembly to cylinder head.
4. Remove rocker arm shaft assembly.
5. Perform Rocker Shaft Arm Assembly Disassemble and Assemble. (Group 0400.)
6. Install rocker arm shaft assembly.
7. Tighten cap screws from rocker arm shaft assembly to cylinder head.

Specification

Rocker Arm Shaft Assembly—	
Torque	90 N•m 66 lb-ft

8. Install lower valve cover. See Lower Valve Cover Remove and Install. (Group 0400.)
9. Install upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)



- 1—Cap Screw
- 2—Rocker Arm Shaft Assembly
- 3—Cylinder Head

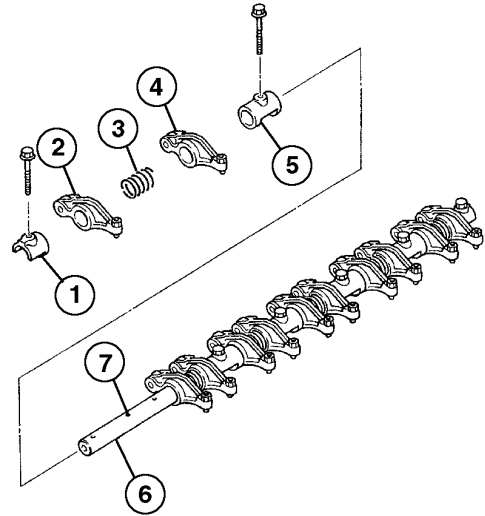
TX1009577 -UN-13JUL06

TX17984,0000020 -19-01AUG06-2/2

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Rocker Arm Shaft Assembly Disassemble and Assemble

1. Remove bracket (1) while compressing springs.
2. Remove rocker arm (2).
3. Remove spring (3).
4. Remove rocker arm (4).
5. Remove bracket (5).
6. Repeat for all rocker arms.
7. Perform Rocker Arm Shaft Assembly Inspection. (Group 0400.)
8. Apply a thin layer of engine oil to the rocker arm shaft.
9. Install bracket.
10. Apply engine oil to the bushing and roller section of rocker arm.
11. Position front mark on rocker arm shaft to the west install rocker arm with roller to the north.
12. Install spring.
13. Apply engine oil to the bushing and roller section of rocker arm.
14. Install rocket arm.
15. Compress springs. Install bracket.
16. Repeat for all rocker arms.



Rocker Arm Shaft Assembly

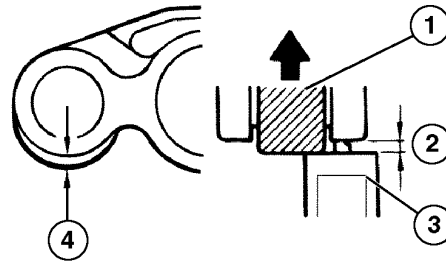
- 1—Bracket
- 2—Rocker Arm
- 3—Spring
- 4—Rocker Arm
- 5—Bracket
- 6—Rocker Arm Shaft
- 7—Front Mark

TX1008631 -JN-07JUN06

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Rocker Arm Shaft Assembly Inspection

1. Inspect roller surface for wear or damage.
2. Push rocker arm roller out to its limit.
3. Measure the difference between rocker arm and rocker arm roller (4) with rocker arm roller pushed out to its limit.
4. Measure the difference between rocker arm and rocker arm roller (2) with rocker arm roller pushed in to its limit.
5. The difference between measurement 4 and measurement 2 is the clearance between rocker arm roller and rocker arm pin.



Rocker Arm

TX1008636 -UN-07JUN06

Specification

Roller and Roller Pin—Clearance	0.036—0.069 mm new
	0.15 mm limit of use
	0.001—0.003 in. new
	0.006 in. limit of use

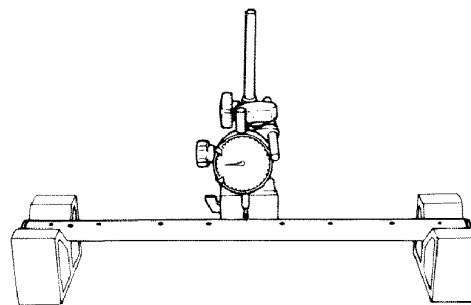
6. Inspect rocker arm shaft oil passage for debris.

TX17984,0000022 -19-02AUG06-1/3

7. Inspect rocker arm shaft for bend.

Specification

Rocker Arm Shaft—Axial Runout.....	0.3 mm
	0.12 in.



Rocker Arm Shaft

TX1008678 -UN-07JUN06

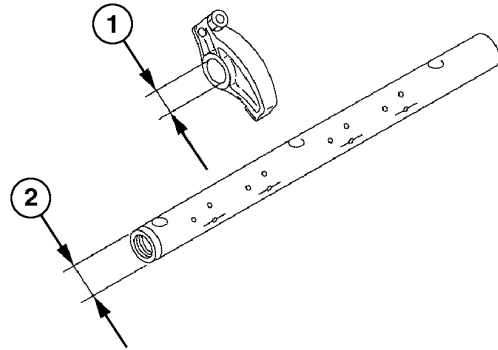
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TX17984,0000022 -19-02AUG06-2/3

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Removal and Installation

8. Measure inside diameter of rocker arm bushings (1).
9. Measure outside diameter of rocker arm shaft (2) in multiple places.
10. Subtract measurement 2 from measurement 1.



Rocker Arm and Shaft

Specification

Rocker Arm to Shaft—Clearance.....	0.02—0.074 mm new 0.20 mm limit of use 0.001—0.003 in. new 0.008 in. limit of use
------------------------------------	--------------------------------------------------------------------------------------------

Specification

Shaft Outer—Diameter.....	28 mm new 27.85 mm limit of use 1.102 in. new 1.096 in. limit of use
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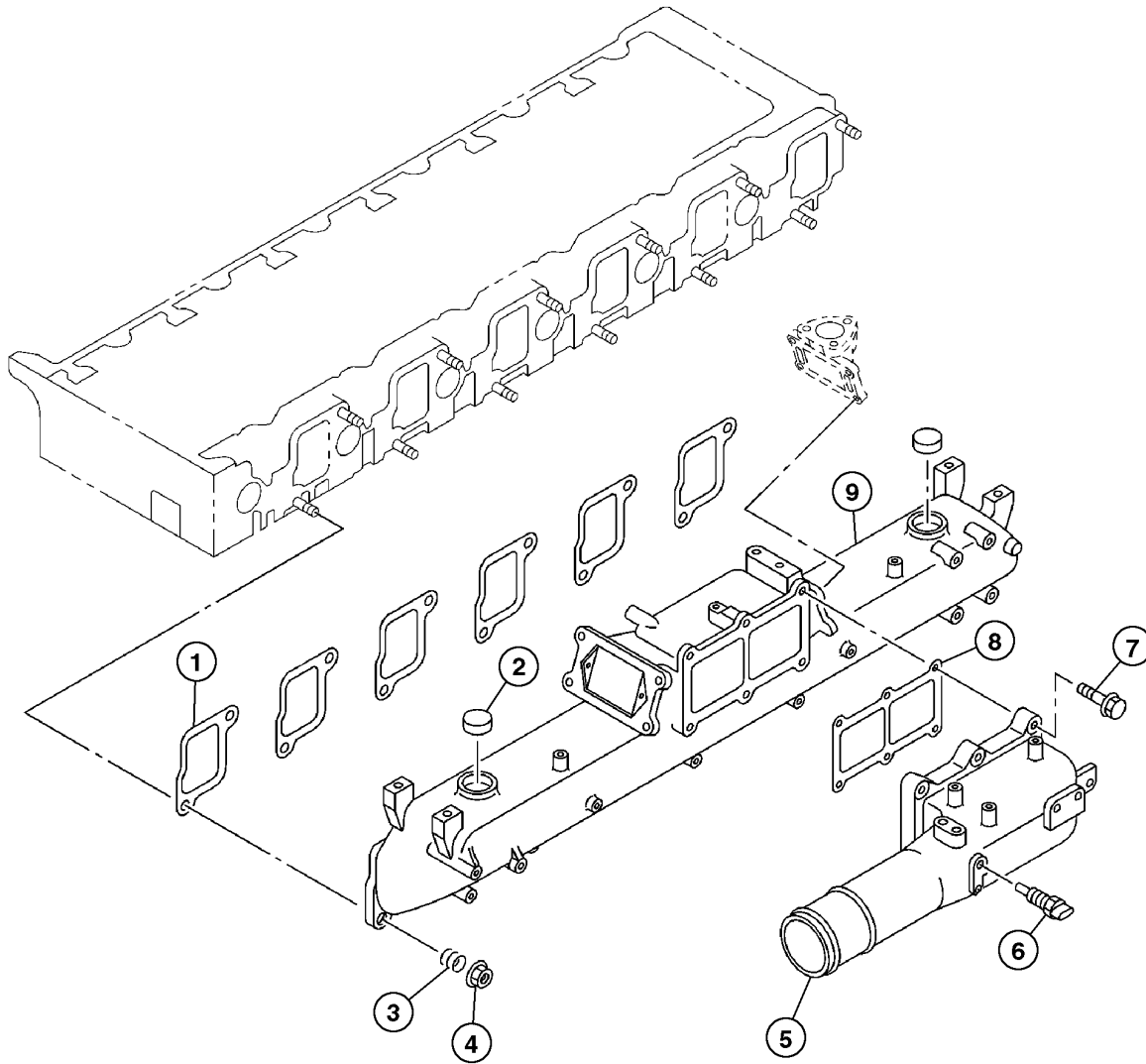
TX1008681 -JUN-07JUN06

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TX17984,000022 -19-02AUG06-3/3

Intake Manifold Remove and Install

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TX1010006

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GD61784,000000E -19-02AUG06-1/2

Removal and Installation

- 1—Gasket
- 2—Plug
- 3—Spring

- 4—Nut
- 5—Intake Pipe
- 6—Intake Air Temperature Sensor

- 7—Cap Screw
- 8—Gasket

- 9—Intake Manifold

1. Remove lead valves. See Lead Valve Remove and Install. (Group 0400.)
2. Disconnect wiring harness.
3. Remove air inlet pipe and install plug in turbocharger outlet.
4. Remove final fuel filter. See Final Fuel Filter Remove and Install. (Group 0560.)
5. Remove fuel injector pressure lines.
6. Remove intake pipe (5) and discard gasket (8). Close openings using caps and plugs.
7. Remove intake manifold (9) and discard gaskets (1).
8. Inspect and repair as needed.
9. Install intake manifold. Tighten nuts to specification.

Specification

Intake Manifold Nut—Torque..... 20 N•m
32 lb-ft

10. Install intake pipe. Tighten cap screws to specification.

Specification

Intake Pipe Cap Screw—
Torque..... 39 N•m
29 lb-ft

11. Install fuel injector lines. Tighten to specification.

Specification

Fuel Injector Line Fittings—
Torque..... 39 N•m
29 lb-ft

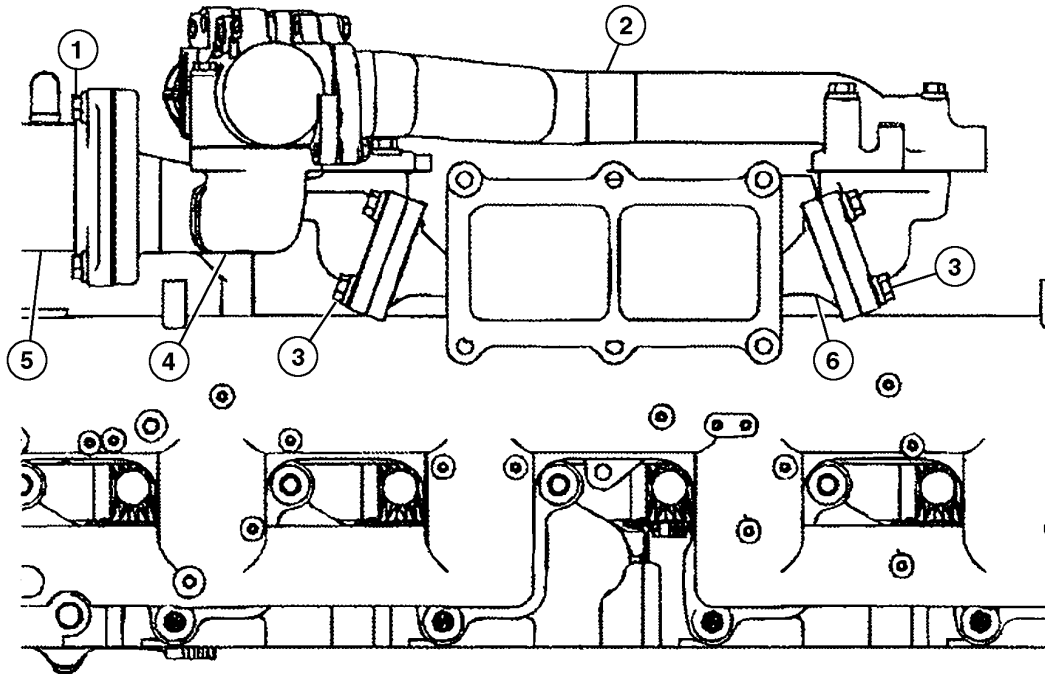
12. Install Final Fuel Filter. See Final Fuel Filter Remove and Install. (Group 0560.)

13. Connect wiring harness.

14. Install lead valves. See Lead Valve Remove and Install. (Group 0400.)

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Lead Valve Remove and Install



TX1010325

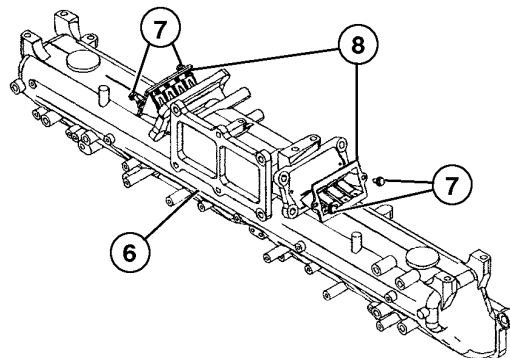
- | | | | |
|----------------------|----------------------|----------------------------------------------------|-------------------|
| 1—Cap Screw (3 used) | 3—Cap Screw (8 used) | 5—Secondary Exhaust Gas Recirculation (EGR) Cooler | 6—Intake Manifold |
| 2—EGR Valve Assembly | 4—Air Duct | | |

1. Remove secondary exhaust gas recirculation (EGR) cooler (5).
2. Remove EGR valve assembly (2).

GD61784.0000014 -19-31JUL06-1/2

3. Remove lead valves (8).
4. Repair and replace as necessary.
5. Install lead valves.
6. Install EGR valve assembly.
7. Install secondary exhaust gas recirculation (EGR) cooler.

- | |
|-----------------------|
| 6—Intake Manifold |
| 7—Cap Screw (4 used) |
| 8—Lead Valve (2 used) |



TX1010325 -UN-24JUL06

TX1010339 -UN-24JUL06

GD61784.0000014 -19-31JUL06-2/2

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Water Pump Remove and Install

1. Drain engine coolant. See Drain Cooling System. (Operator's Manual.)
2. Remove cap screw (1).
3. Remove water inlet pipe (3).
4. Remove thermostat housing. See Thermostat Housing Remove and Install . (Group 0400.)
5. Remove cap screw (4 and 6).
6. Remove water pump (8).
7. Remove and discard O-rings (5 and 9) and gasket (7).
8. Inspect and repair as necessary.

NOTE: Tighten cap screws (4) then cap screws (6).

9. Install water pump with new gasket and O-rings. Tighten cap screw (4 and 6) to specification.

Specification

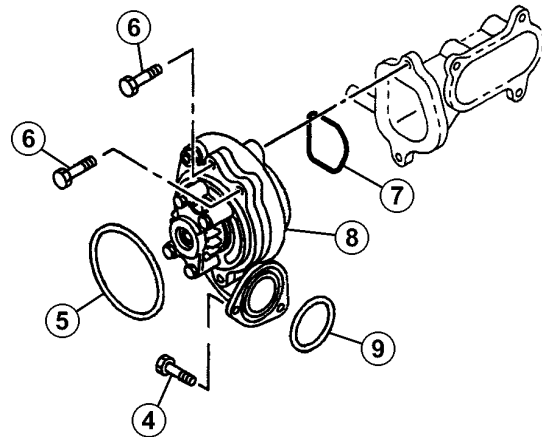
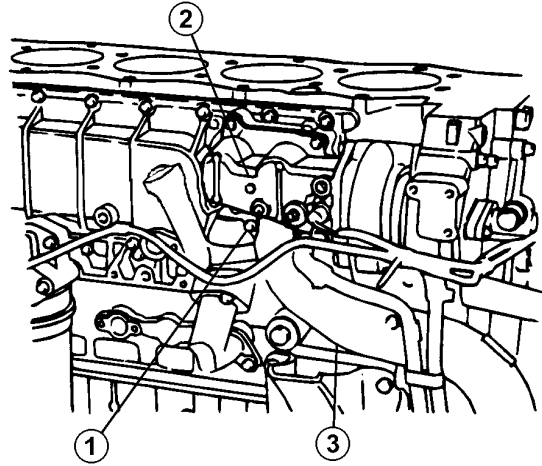
Water Pump Cap Screw—Torque..... 39 N•m
29 lb-ft

10. Install thermostat housing. See Thermostat Housing Remove and Install . (Group 0400.)
11. Install water inlet pipe (3).
12. Tighten cap screws (1).

Specification

Water Inlet Pipe Cap Screw—
Torque 39 N•m
29 lb-ft

13. Perform Cooling System Fill and Deaeration Procedure. (Operator's Manual.)



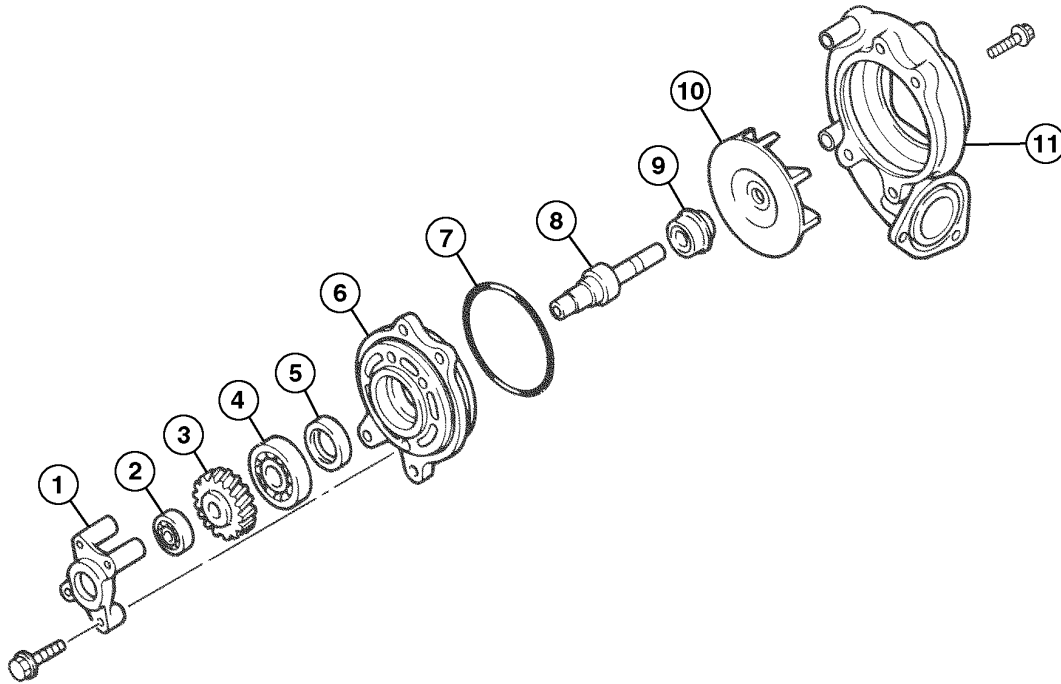
- 1—Cap Screw (2 used)
- 2—Thermostat Housing
- 3—Water Inlet Pipe
- 4—Cap Screw (2 used)
- 5—O-Ring (2 used)
- 6—Cap Screw (4 used)
- 7—Gasket
- 8—Water Pump
- 9—O-Ring

T153170 -UN-02APR02

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T153149 -UN-02APR02

Water Pump Disassemble and Assemble



TX1008931

1—Rear Cover
2—Small Bearing
3—Gear

4—Large Bearing
5—Oil Seal
6—Water Pump Housing

7—O-Ring
8—Shaft
9—Seal Unit

10—Impeller
11—Front Cover

1. Remove front cover (11).

2. Remove and discard O-ring (7).

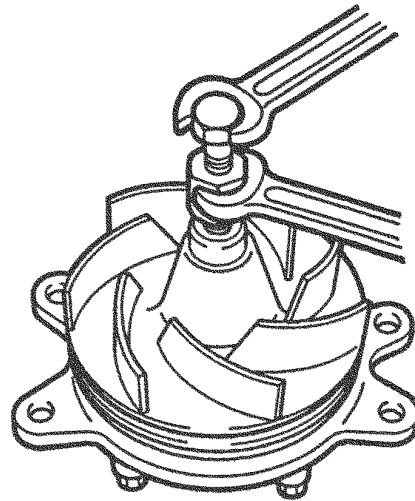
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TX17984,0000025 -19-02AUG06-1/4

TX1008931 -UN-22JUN06

Removal and Installation

3. Remove impeller (10) as shown using 1-8521-0062-0 Water Pump Impeller Remover.
4. Remove rear cover (1).
5. Remove bearing (2).
6. Remove gear (3).
7. Remove bearing (4).
8. Remove shaft (8).
9. Remove oil seal (5).
10. Remove seal unit (9).
11. Inspect and repair as necessary.
12. Apply engine oil to the inner side and outer circumference of oil seal.
13. Install oil seal into water pump housing.
14. Install large bearing into water pump housing.
15. Apply engine oil to shaft.
16. Press shaft into bearing.
17. Install gear.
18. Install small bearing.
19. Install rear cover. Tighten rear cover cap screws to specification.



Water Pump Impeller Removal

TX1008958 -UN-22JUN06

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Specification

Water Pump Rear Cover-to-Front	
Cover Cap Screw—Torque	27 N•m 20 lb-ft

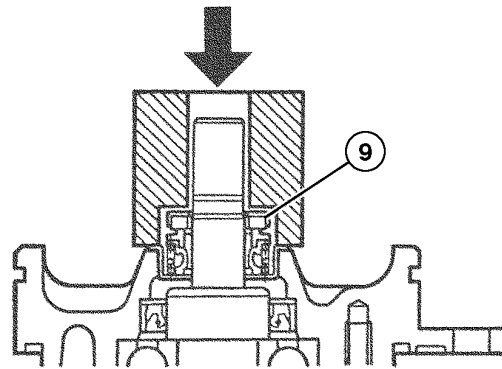
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TX17984.0000025 -19-02AUG06-2/4

Removal and Installation

20. Install seal unit (9) using 1-8522-0047-0 Water Pump Seal Unit Installer.

9—Seal Unit



TX1008961 -UN-22JUN06

TX17984.0000025 -19-02AUG06-3/4

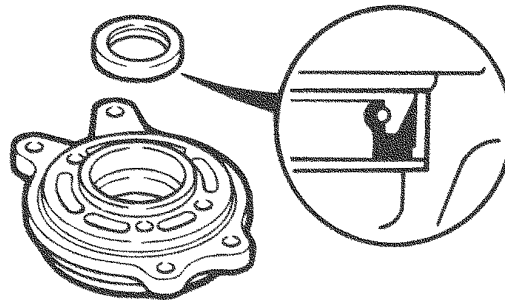
21. Install impeller.

Specification

Water Pump
Housing-to-Impeller—Clearance 1.7—2.7 mm
0.067—0.106 in.

22. Install O-ring.

23. Install front cover.



TX1008956 -UN-22JUN06

TX17984.0000025 -19-02AUG06-4/4

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Cylinder Head Remove and Install

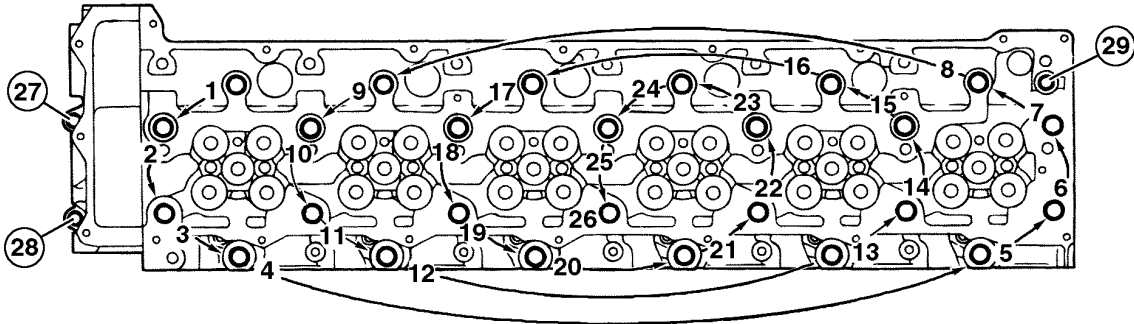
1. Drain engine coolant. See Draining Cooling System. (Operator's Manual.)
2. Remove exhaust manifold. See Exhaust Manifold Remove and Install. (Group 0400.)
3. Remove intake manifold. See Intake Manifold Remove and Install. (Group 0400.)
4. Remove upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)
5. Remove lower valve cover. See Lower Valve Cover Remove and Install. (Group 0400.)
6. Remove rocker arm shaft assembly. See Rocker Arm Shaft Assembly Remove and Install. (Group 0400.)
7. Remove fuel injection nozzle. See Fuel Injection Nozzle Remove and Install. (Group 0400.)
8. Remove camshaft. See Camshaft Remove and Install. (Group 0400.)
9. Remove bridges.

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TX17984,0000026 -19-01AUG06-1/4

Removal and Installation



TX1009516 -UN-13JUL06

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10. First, remove the M10 cap screws (27 and 28) and M12 cap screw (29). Second, remove the M18 cap screws in the 1 through 26 sequence shown.

11. Remove cylinder head.

12. Inspect and repair as needed.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

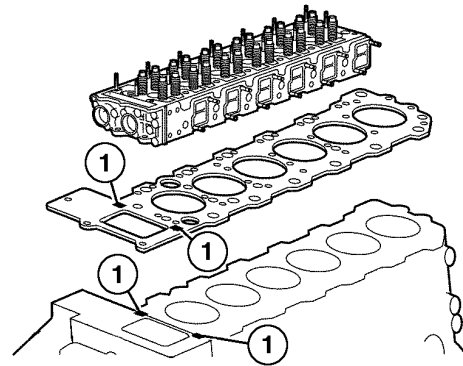
TX17984,0000026 -19-01AUG06-2/4

13. Apply PM37465 RTV 587 Blue Silicone or equivalent to locations (1) shown.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

14. Install cylinder head.

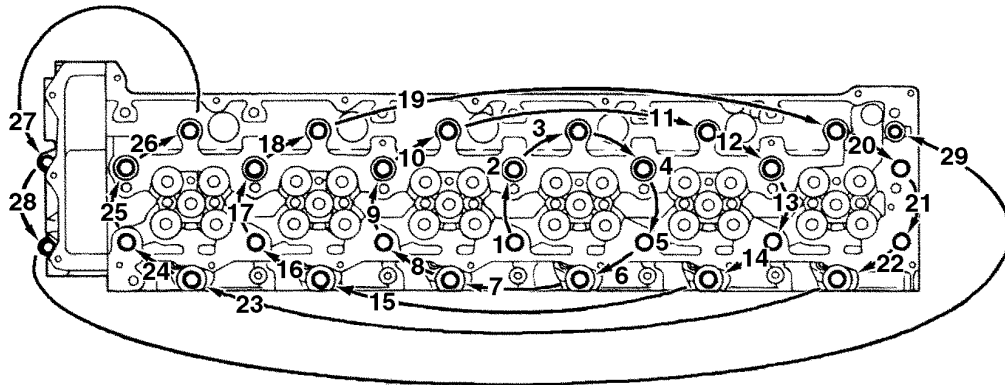
1—Silicone Location



TX1009519 -UN-13JUL06

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TX17984,0000026 -19-01AUG06-3/4



- 15. Apply molybdenum disulphide to the M18 cap screw.
- 16. First to third step, tighten the M18 cap screws to specification in the 1 to 26 sequence shown. Fourth to fifth step, tighten the M10 and M12 cap screws to specification in the 27 to 29 sequence shown.

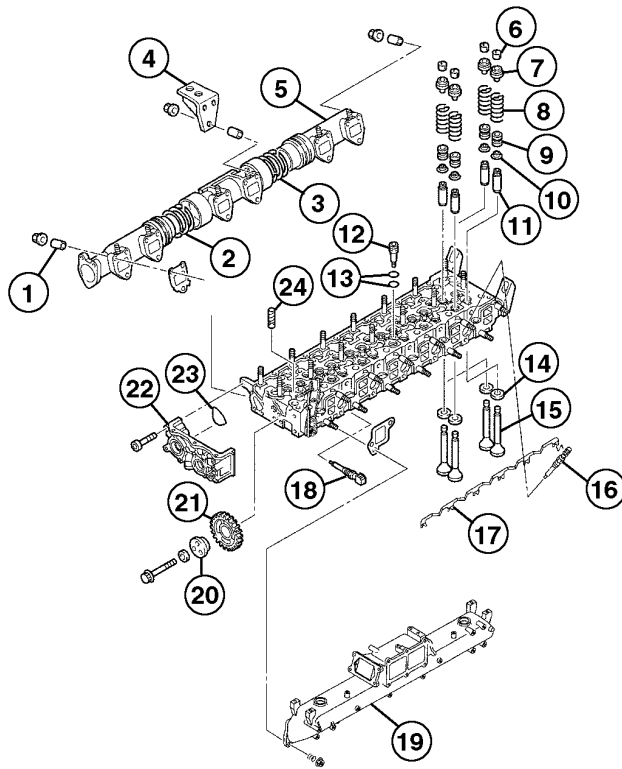
Specification

First Step—M18 Cylinder Head-to-Block Cap Screw—	
Torque.....	177 N•m 131 lb-ft
Second Step—M18 Cylinder Head-to-Block Cap Screw—	
Torque.....	245 N•m 181 lb-ft
Third Step—M18 Cylinder Head-to-Block Cap Screw—	
Torque Turn.....	60—90°
Fourth Step—M10 Cylinder Head-to-Block Cap Screw—	
Torque.....	38 N•m 28 lb-ft
Fifth Step—M12 Cylinder Head-to-Block Cap Screw—	
Torque.....	97 N•m 72 lb-ft

- 17. Install bridges.

- 18. Install camshaft. See Camshaft Remove and Install. (Group 0400.)
- 19. Install fuel injection nozzle. See Fuel Injection Nozzle Remove and Install. (Group 0400.)
- 20. Install rocker arm shaft assembly. See Rocker Arm Shaft Assembly Remove and Install. (Group 0400.)
- 21. Install lower valve cover. See Lower Valve Cover Remove and Install. (Group 0400.)
- 22. Install upper valve cover. See Valve Cover Remove and Install. (Group 0400.)
- 23. Install intake manifold. See Intake Manifold Remove and Install. (Group 0400.)
- 24. Install exhaust manifold. See Exhaust Manifold Remove and Install. (Group 0400.)
- 25. Perform Cooling System Fill and Deaeration Procedure. (Operator's Manual.)

Cylinder Head Disassemble and Assemble



TX1009923

- | | | | |
|------------------------|-----------------------|------------------------|----------------------|
| 1—Spacer | 7—Upper Spring Sheet | 13—O-Ring | 19—Intake Manifold |
| 2—Seal | 8—Valve Spring | 14—Valve Seat Insert | 20—Idle Gear Shaft C |
| 3—Seal | 9—Valve Stem Oil Seal | 15—Valve | 21—Idle Gear C |
| 4—Exhaust Pipe Bracket | 10—Lower Spring Sheet | 16—Glow Plug | 22—Gear Case |
| 5—Exhaust Pipe | 11—Valve Guide | 17—Glow Plug Connector | 23—O-Ring |
| 6—Split Collar | 12—Nozzle Sleeve | 18—Thermo Sensor | 24—Bridge Guide |

1. Remove the glow plug connector (17).
2. Remove glow plug (16).
3. Remove thermo sensor (18).

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TX17984,0000027 -19-03AUG06-1/23

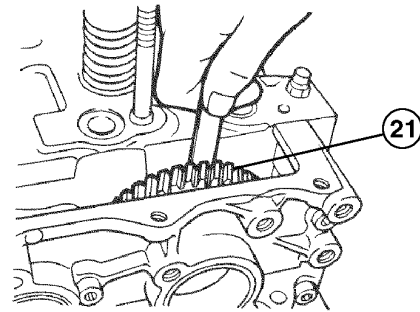
TX1009923 -UN-20.JUL.06

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Removal and Installation

4. Measure clearances of the idle gear C.

	Specification
Idle Gear C—Clearance	0.05-0.14 mm new 0.25 mm limit of use 0.002-0.006 in. new 0.01 in. limit of use



5. Remove the O-ring for the gear case.

6. Remove idle gear shaft C.

21—Idle Gear C

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TX17984,0000027 -19-03AUG06-2/23

7. Remove idle gear C.

8. Remove gear case.

9. Remove split collar using 1-8523-5013-0 Compressor.

10. Remove upper spring sheet.

11. Remove valve spring and valve.

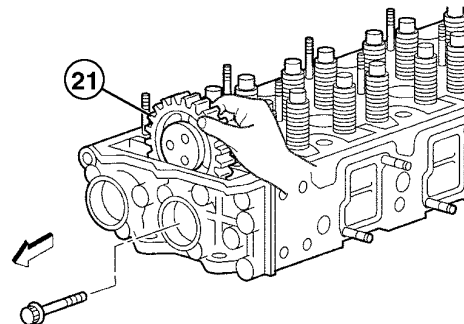
12. Number each valve cylinder.

13. Remove valve spring.

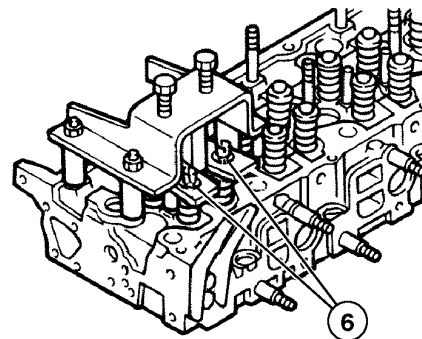
14. Remove lower spring sheet.

15. Remove valve.

16. Remove valve stem oil seal.



TX1009927 -JUN-20JUL06



TX1009930 -JUN-20JUL06

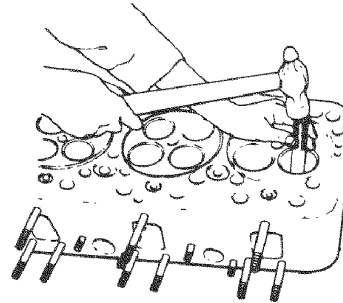
6—Split Collar
21—Idle Gear C

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TX17984,0000027 -19-03AUG06-3/23

Removal and Installation

17. Remove valve guide by inserting a 9-8523-1202-0 Replacer into the guide from the head underside. Hit valve guide with a hammer.



TX1009931 -UN-20JUL06

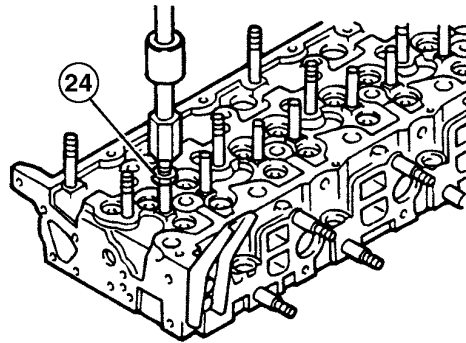
TX17984.0000027 -19-03AUG06-4/23

18. Remove bridge guide (24) only if replacement is necessary.

Electrically weld the cap screw to bridge guide.

19. Install a sliding hammer to the cap screw. Remove cap screw.

24—Bridge Guide



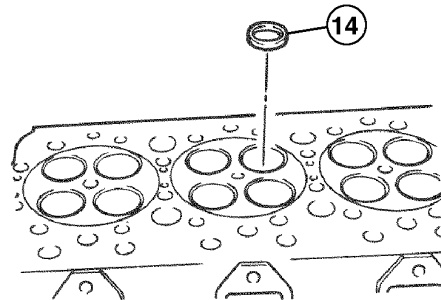
TX1009932 -UN-20JUL06

TX17984.0000027 -19-03AUG06-5/23

20. Remove valve seat (14) insert by heating 2 points on the inside of the insert. Heat until the two points are red hot.

21. Cool naturally for 3—5 minutes. Remove with a screwdriver.

14—Valve Seat Insert



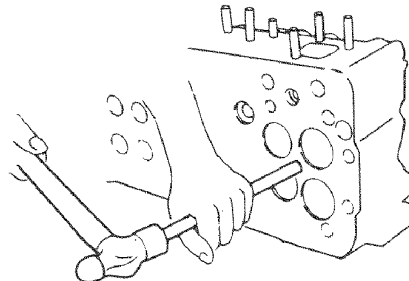
TX1009933 -UN-20JUL06

TX17984.0000027 -19-03AUG06-6/23

22. Remove nozzle sleeve by striking it from the head lower side to remove.

23. Remove nozzle sleeve O-ring.

24. Repair or replace as necessary.



TX1009935 -UN-20JUL06

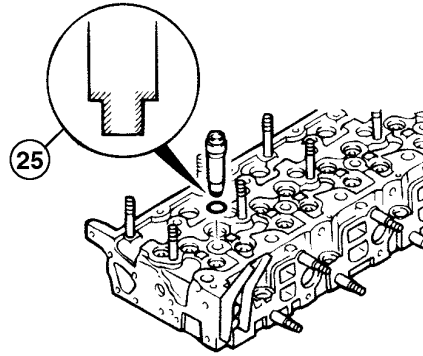
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TX17984.0000027 -19-03AUG06-7/23

Removal and Installation

25. Apply engine oil to the O-ring.
26. Install O-ring into the sleeve so that the red part is up and black part is down.
27. Apply PM38654 Thread Lock to nozzle sleeve outer circumference surface and end-bearing surface.
28. Press nozzle sleeve into cylinder head.

25—Thread Lock and Sealer



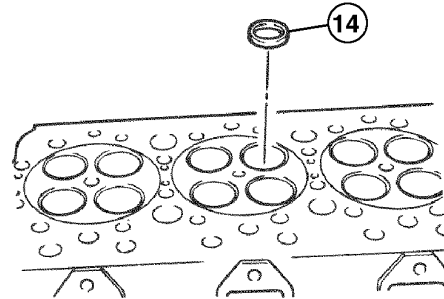
TX1009950 -UN-20JUL06

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TX17984,0000027 -19-03AUG06-8/23

29. Clean the installation face of the valve seat insert (14).
30. Push the valve seat insert with a press.

14—Valve Seat Insert



TX1009933 -UN-20JUL06

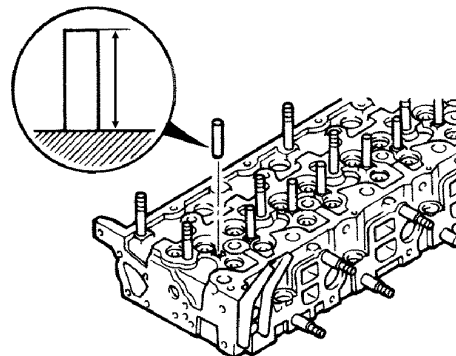
TX17984,0000027 -19-03AUG06-9/23

31. Apply engine oil to the outer circumference of the bridge guide.

Specification

Bridge Guide—Height..... 49 mm
1.93 in.

32. Install the bridge guide into the head with 9-8522-1324-0 Installer so that the guide is higher than the top face of the head.



TX1009957 -UN-20JUL06

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TX17984,0000027 -19-03AUG06-10/23

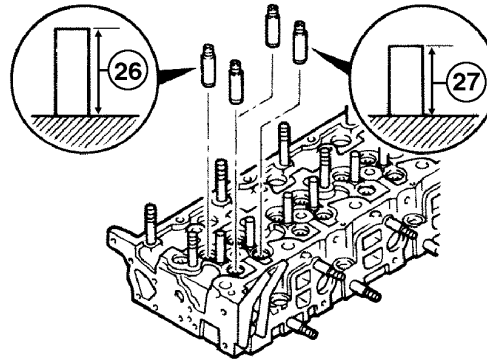
Removal and Installation

33. Apply engine oil to the full outer circumference of the valve guide.

Install the valve guide so that it is the standard height from the cylinder head surface to top of valve guide using 9-8523-1202-0 Replacer.

Specification
Intake Valve Guide—Height..... 27.0 mm
1.06 in.

Specification
Exhaust Valve Guide—Height..... 29.0 mm
1.14 in.



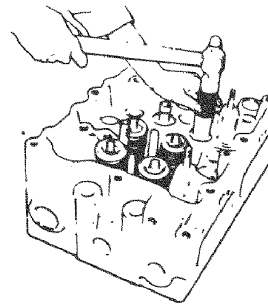
26—Exhaust Valve Guide
27—Intake Valve Guide

TX1009958 -UN-20JUL06

TX17984,000027 -19-03AUG06-11/23

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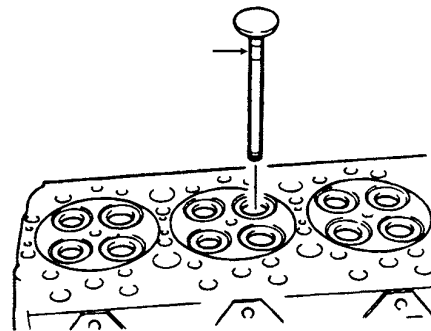
34. Install the valve guide stem seal using 1-8522-1140-1 Installer for intake and 1-8522-1184-0 Installer for exhaust.



TX17984,000027 -19-03AUG06-12/23

TX1009959 -UN-20JUL06

35. Apply engine oil to the valve stem. Insert the valve into the cylinder head.



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TX17984,000027 -19-03AUG06-13/23

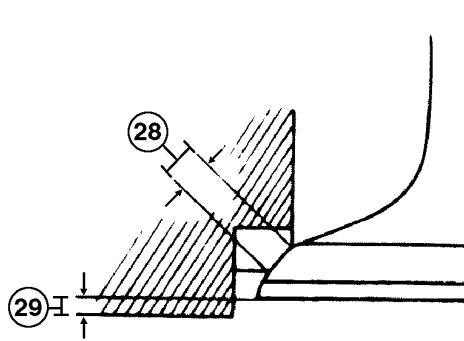
TX1009960 -UN-20JUL06

Removal and Installation

36. Apply a red lead primer to the valve insert and inspect the hit width (contact surface) on the sheet surface. Inspect whether the hit width (contact surface) position is in the center of the valve seat.

Specification	
Intake Valve Seat Hit Width (Contact Surface)—Width.....	3.3 mm new 3.7 mm limit of use 0.13 in. new 0.145 in. limit of use

Specification	
Exhaust Valve Seat Hit Width (Contact Surface)—Width.....	2.6 mm new 3.0 mm limit of use 0.102 in. new 0.118 in. limit of use



28—Valve Seat Hit Width (contact surface)
29—Amount Of Recess

TX1009961 -JUN-20JUL06

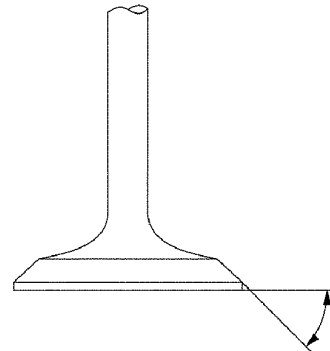
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TX17984,0000027 -19-03AUG06-14/23

37. If the valve hit width (contact surface) is worn, use a seat cutter that suits the seat angle and stem diameter to correct the problem.

Specification	
Valve Seat Angle—Angle.....	30° Intake Valve 45° Exhaust Valve

Specification	
Valve Stem Outer Diameter— Diameter	10.0 mm 0.39 in.



TX1009962 -JUN-20JUL06

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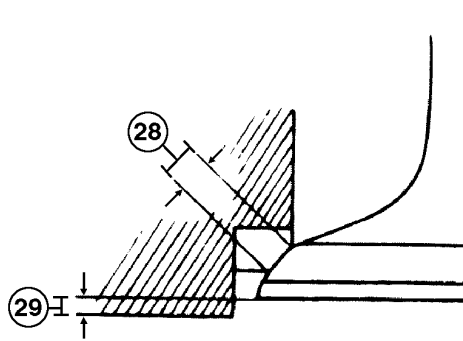
TX17984,0000027 -19-03AUG06-15/23

Removal and Installation

38. After correcting the valve seat by grinding, measure the valve recess to make sure it is within the limit.

Specification	
Intake Valve Recess—Distance.....	0.4 mm new 1.4 mm limit of use 0.015 in. new 0.055 in. limit of use

Specification	
Exhaust Valve Recess—Distance.....	0.3 mm new 1.3 mm limit of use 0.012 in. new 0.051 in. limit of use



28—Valve Seat Hit Width (contact surface)
29—Amount Of Recess

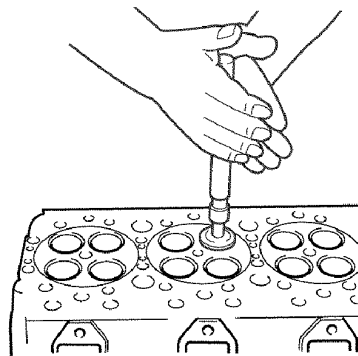
TX1009961 -UN-20JUL06

TX17984,0000027 -19-03AUG06-16/23

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44

39. If valve lapping is needed, apply compound to the contact surfaces of the insert and valve seat. Rotate valve and apply light pressure to lap them evenly.

After lapping is completed, thoroughly clean both the cylinder head and the valve.



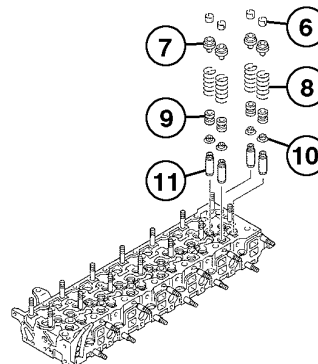
TX17984,0000027 -19-03AUG06-17/23

TX1009963 -UN-20JUL06

- 40. Install the lower spring sheet.
- 41. Install the valve spring.
- 42. Install the upper spring sheet.

Install the intake valve spring so that the narrower pitch is towards the underside of the head. There is no difference between the top and bottom of the exhaust valve spring.

- 6—Split Collar
- 7—Upper Spring Sheet
- 8—Valve Spring
- 9—Valve Stem Oil Seal
- 10—Lower Spring Sheet
- 11—Valve Guide



TX1009965 -UN-26JUL06

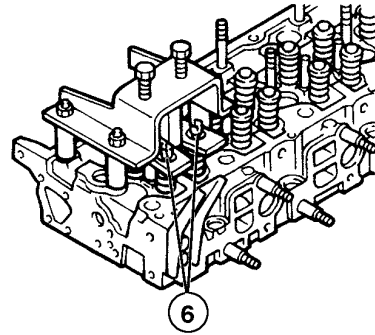
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TX17984,0000027 -19-03AUG06-18/23

Removal and Installation

43. Install split collar by compressing the valve spring using 1-8523-5013-0 Compressor. After installing, gently strike the valve stem head with a rubber hammer to set the split collar down.

6—Split Collar



TX17984.0000027 -19-03AUG06-19/23

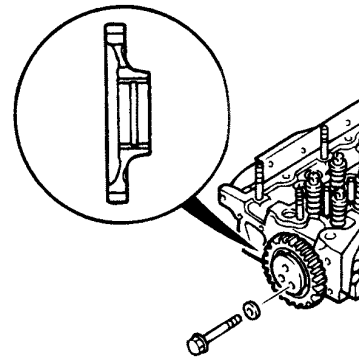
TX1009967 -UN-26JUL06

44. Apply engine oil to the idle gear C. Insert it on the idle gear shaft.
45. With the idle gear C assembled with the idle gear shaft C, assemble and tighten the cylinder head. Check that gears rotate smoothly.

Specification

Idle Gear C—Torque..... 46 N•m
34 lb-ft

46. Install the O-ring to the gear case.



TX17984.0000027 -19-03AUG06-20/23

TX1009974 -UN-20JUL06

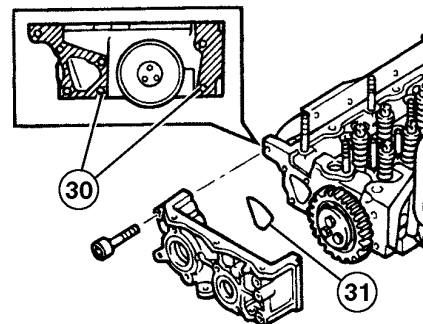
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47. Apply PM37465 RTV 587 Blue Silicone to gear case.
48. Install the gear case to the head.
49. Tighten the cap screws.

Specification

Gear Case Cap Screws—Torque 38 N•m
28 lb-ft

30—RTV 587 Blue Silicone
31—O-Ring



TX17984.0000027 -19-03AUG06-21/23

TX1009975 -UN-20JUL06

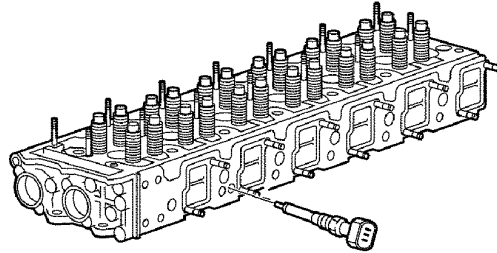
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Removal and Installation

50. Apply PM38654 Thread Lock (high strength) to thermo sensor threads.

Install thermo sensor to cylinder head.

Specification	
Thermo Sensor—Torque.....	20 N•m 177 lb-in.



TX1009976 -JUN-20JUL06

51. Install the glow plug to the cylinder head.

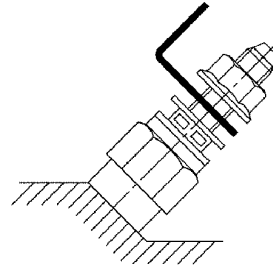
Specification	
Glow Plug—Torque	25 N•m 221 lb-in.

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TX17984,0000027 -19-03AUG06-22/23

52. Insert the glow plug connector between the glow plug nut and flat washer and tighten the nut.

Specification	
Glow Plug Nut—Torque	1.0 N•m 9 lb-in.



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TX17984,0000027 -19-03AUG06-23/23

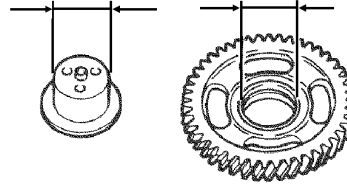
Cylinder Head Inspection

1. Inspect idle gear C for damage.
2. Measure OD of the idle gear shaft C.

	Specification
Idle Gear Shaft C—OD	49 mm new
	48.85 mm limit of use
	1.929 in. new
	1.923 in. limit of use

3. Measure ID of idle gear C.
4. Subtract OD from ID for clearance.

	Specification
Idle Gear Shaft C to Idle Gear	
C—Clearance	0.04—0.105 mm new
	0.20 mm limit of use
	0.002—0.004 in. new
	0.008 in. limit of use



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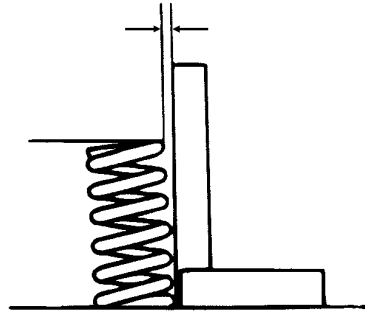
TX17984.0000028 -19-03AUG06-1/9

Removal and Installation

5. Measure perpendicularity of valve spring.

	Specification
Intake Valve Spring—	
Perpendicularity	3.5 mm new
	4.8 mm limit of use
	0.14 in. new
	0.19 in. limit of use

	Specification
Exhaust Valve Spring—	
Perpendicularity	4.5 mm new
	6.2 mm limit of use
	0.18 in. new
	0.24 in. limit of use

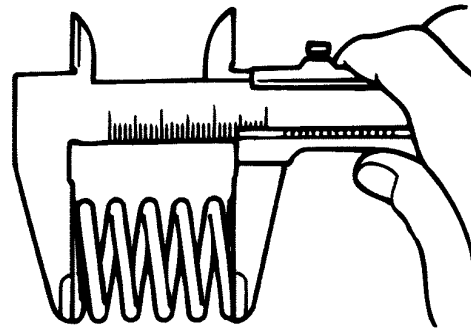


TX1009937 -UN-26JUL06

Measure the valve spring free length using vernier caliper.

	Specification
Intake Valve Spring—Length.....	79.3 mm new
	75.3 mm limit of use
	3.12 in. new
	2.97 in. limit of use

	Specification
Exhaust Valve Spring—Length	102.7 mm new
	97.6 mm limit of use
	4.04 in. new
	3.84 in. limit of use

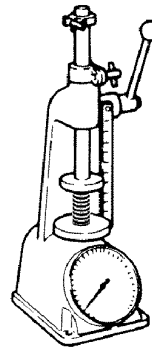


TX1009938 -UN-20JUL06

Measure valve spring force using spring tester.

	Specification
Intake Valve Spring—Force	392 N at 64 mm new
	372 N at 64 mm limit of use
	88.0 lb-force at 2.52 in. new
	84.0 lb-force at 2.52 in. limit of use

	Specification
Exhaust Valve Spring—Force	610 N at 69 mm new
	578 N at 69 mm limit of use
	137.0 lb-force at 2.717 in. new
	130.0 lb-force at 2.717 in. limit of use



TX1009939 -UN-20JUL06

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Removal and Installation

6. Inspect the valve stem end for wear. Repair slight abrasions using an oil stone.



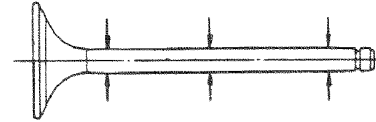
TX1009940 -UN-20JUL06

TX17984.0000028 -19-03AUG06-3/9

7. Measure the amount of wear of valve stem at the three points shown.

	Specification
Intake Valve Stem—OD	10 mm new 9.92 mm limit of use 0.394 in. new 0.391 in. limit of use

	Specification
Exhaust Valve Stem—OD	10 mm new 9.90 mm. limit of use 0.394 in. new 0.390 in. limit of use



TX1009941 -UN-20JUL06

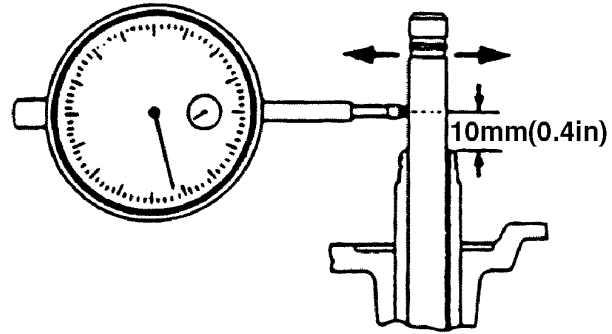
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TX17984.0000028 -19-03AUG06-4/9

Removal and Installation

8. Set dial indicator to measure valve stem-to-valve guide clearance. Move valve stem end from side to side while reading dial indicator. If the amount of valve stem wear is more than the limit of use, replace valve stem along with the guide.



TX1009942 -JN-20JUL06

Specification

Intake Guide And Valve Stem—	
Clearance	0.040—0.077 mm new
	0.15 mm limit of use
	0.002—0.003 in. new
	0.006 in. limit of use

Specification

Exhaust Guide And Valve Stem—	
Clearance	0.065—0.102 mm new
	0.25 mm limit of use
	0.003—0.004 in. new
	0.006 in. limit of use

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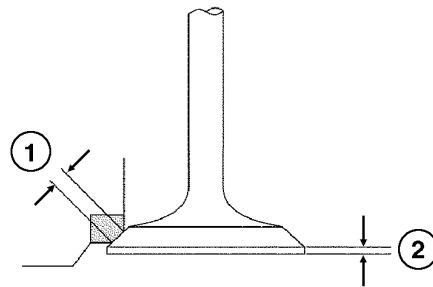
TX17984,0000028 -19-03AUG06-5/9

Removal and Installation

9. Inspect the hit with (contact surface) of valve seat insert for damage or abrasion. Measure the hit width (contact surface) (1).

Specification	
Intake Valve Hit Face (Contact Surface)—Width	3.3 mm new
	3.7 mm limit of use
	0.130 in. new
	0.146 in. limit of use

Specification	
Exhaust Valve Hit Face (Contact Surface)—Width	2.6 mm new
	3.0 mm limit of use
	0.102 in. new
	0.118 in. limit of use



1—Hit Width (contact surface)
2—Valve Thickness

Inspect the valve face for damage or abrasion. Measure the valve thickness (2).

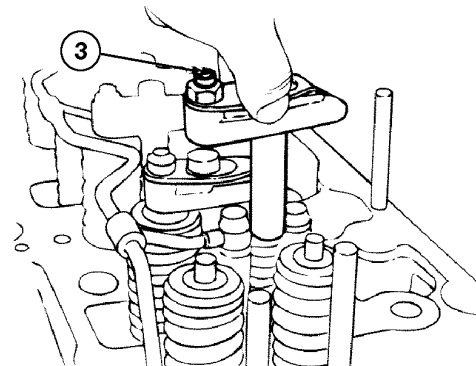
Specification	
Intake Valve Face—Thickness.....	2.02 mm new
	1.52 mm limit of use
	0.080 in. new
	0.060 in. limit of use

Specification	
Exhaust Valve Face—Thickness.....	2.48 mm new
	1.98 mm limit of use
	0.098 in. new
	0.078 in. limit of use

TX17984,0000028 -19-03AUG06-6/9

- 10. Measure bridge ID (3) bore using calipers.
- 11. Measure the bridge guide OD.
- 12. Subtract the OD from the ID for clearance between valve bridge ID and valve guide OD.

Specification	
Bridge to Bridge Guide—	
Clearance	0.0020—0.057 mm new
	0.10 mm limit of use
	0.001—0.002 in. new
	0.004 in. limit of use



3—Bridge

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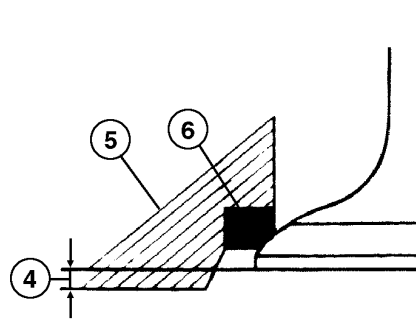
TX17984,0000028 -19-03AUG06-7/9

Removal and Installation

13. Measure valve recess (4) from cylinder head (5) lower surface using a gauge or straight edge.

Specification	
Intake Valve—Recess	0.4 mm new 1.4 mm limit of use 0.016 in. new 0.055 in. limit of use

Specification	
Exhaust Valve—Recess	0.3 mm new 1.3 mm limit of use 0.012 in. new 0.051 in. limit of use



4—Recess
5—Cylinder Head
6—Valve Seat Insert

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14. Measure the cylinder head flatness by placing a straight edge on the head installation surface. Measure 1—6 on the diagram with a feeler gauge.

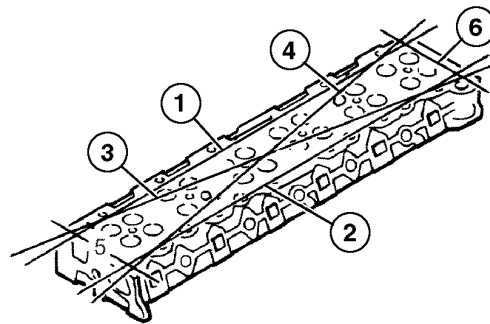
Specification	
Cylinder Head—Flatness.....	0.2 mm new 0.008 in. limit of use

15. Perform magnetic flux inspection to check cylinder head for damage.

16. Apply water pressure for 3 minutes to check cylinder head water jacket for leaks.

Specification	
Cylinder Head Water Pressure	
Test—Time	3 min

Specification	
Cylinder Head Water Jacket—	
Pressure	490 kPa 71 psi

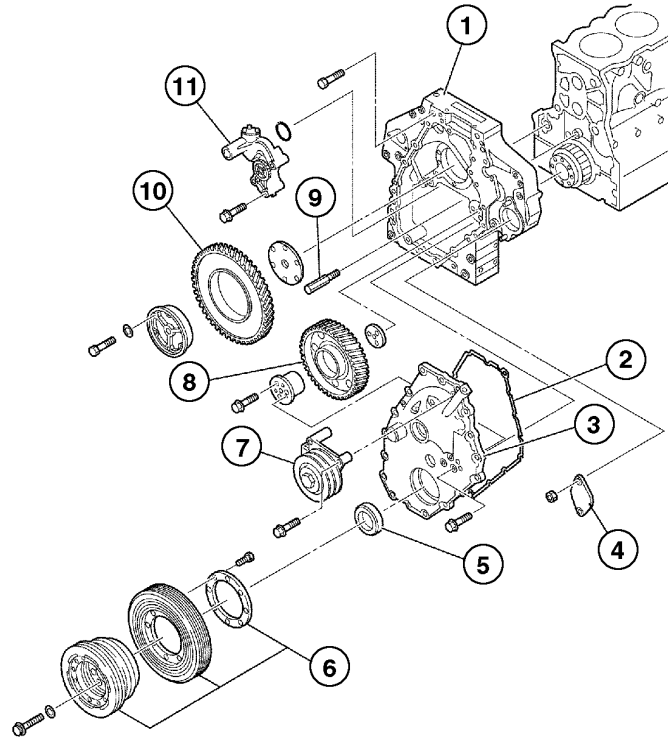


1—6—Measurement Locations

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TX17984,0000028 -19-03AUG06-9/9

Timing Gear Case Remove and Install



TX1010136

- | | | | |
|---------------------|----------------|-----------------------|------------------------|
| 1—Timing Gear Case | 4—Cover | 7—Belt Idler | 10—Timing Idler Gear B |
| 2—Gasket | 5—Seal | 8—Timing Idler Gear A | 11—Engine Oil Pump |
| 3—Timing Gear Cover | 6—Crank Pulley | 9—Stand-Off (3 used) | |

1. Remove alternator. See Alternator Remove and Install. (Group 0400.)
2. Remove cylinder head. See Cylinder Head Remove and Install. (Group 0400.)
3. Remove oil pan. See Oil Pan Remove and Install. (Group 0400.)
4. Remove crankshaft pulley (6).
5. Remove belt idler (7).
6. Remove high pressure fuel pump. See High Pressure Fuel Pump Remove and Install. (Group 0400.)
7. Remove timing gear cover (3).
8. Remove front crank seal (5).

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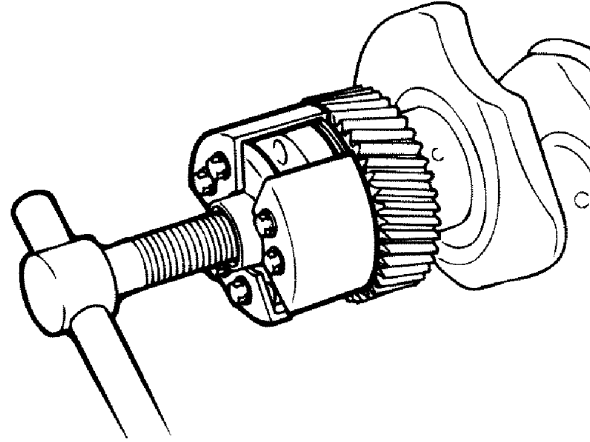
TX17984,0000029 -19-03AUG06-1/10

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TX1010136 -UN-18JUL06

Removal and Installation

9. Remove front crank slinger using 1-8521-0027-0 Slinger Remover.
10. Remove engine oil pump. See Engine Oil Pump Remove and Install. (Group 0400.)



TX1010143 -UN-18JUL06

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TX17984.0000029 -19-03AUG06-2/10

11. Measure idler gear backlash.

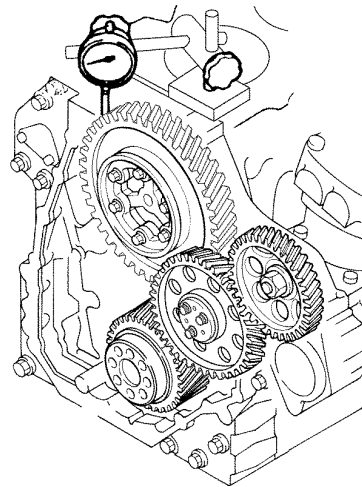
Specification

Timing Idler Gear Backlash—	
Backlash	0.060—0.095 mm new
	0.23 mm limit of use
	0.002—0.004 in. new
	0.001 in. limit of use

12. Measure idler gear shaft clearance.

Specification

Timing Idler Gear A—Clearance	0.165—0.230 mm new
	0.35 mm limit of use
	0.006—0.009 in. new
	0.014 in. limit of use
Timing Idler Gear B—Clearance	0.050—0.140 mm new
	0.25 limit of use
	0.002—0.006 in. new
	0.01 in. limit of use



TX1009393 -UN-17JUL06

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TX17984.0000029 -19-03AUG06-3/10

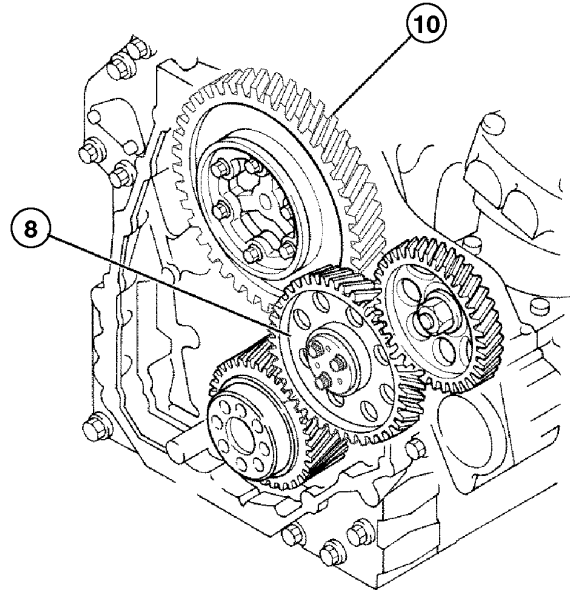
Removal and Installation

- Remove idler gears A (8) and B (10).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove timing gear case.
- Inspect and repair as needed.

8—Timing Gear A
10—Timing Gear B



TX1010110 -UN-18JUL06

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TX17984,0000029 -19-03AUG06-4/10

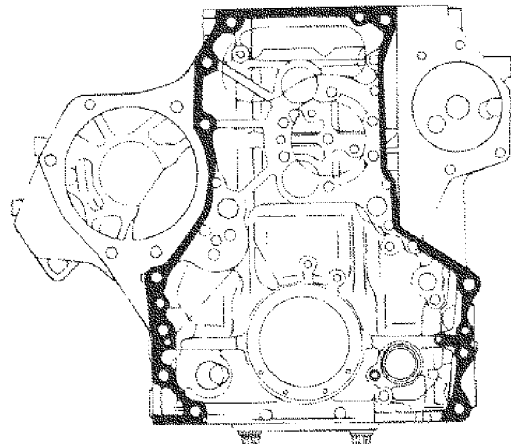
- Apply 3—4 mm (0.118—0.157 in.) bead of PM37465 RTV 587 Blue Silicone or equivalent to cylinder block, and crankcase mating surfaces.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Install timing gear case.
- Tighten cap screws to specification.

Specification

Timing Gear Case-to-Engine	
Block M14 Cap Screw—Torque.....	135 N•m 100 lb-ft
Timing Gear Case-to-Engine	
Block M10 Cap Screw—Torque.....	43 N•m 32 lb-ft



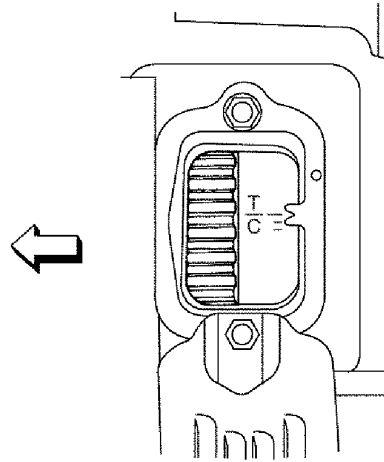
TX1010111 -UN-18JUL06

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TX17984,0000029 -19-03AUG06-5/10

Removal and Installation

19. Rotate the crankshaft clockwise, and line up the flywheel T/C mark to the pointer. At this time number 1 cylinder should be at TDC (top dead cylinder).



TX1010114 -UN-1&JUL06

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Removal and Installation

20. Install timing idler gear B. Tighten timing idler gear cap screws to specification.

Specification

Timing Idler Gear B-to-Timing
Gear Case Cap Screw—Torque 39 N•m
29 lb-ft

21. Install timing idler gear A with the timing gear marks lined up. Tighten timing idler gear cap screws to specification.

Specification

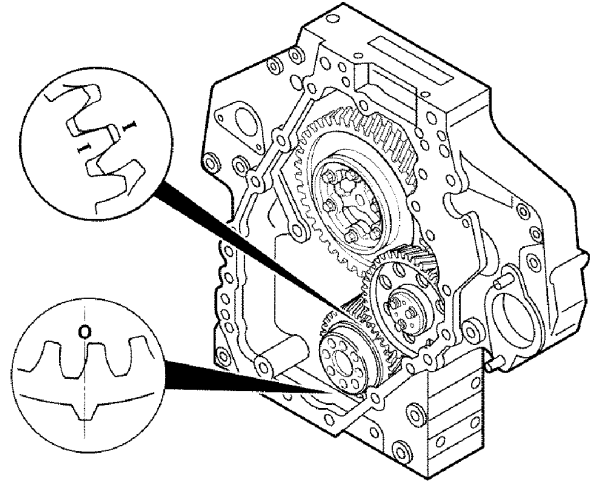
Timing Idler Gear A-to-Timing
Gear Case Cap Screw—Torque 108 N•m
80 lb-ft

22. Install stand-offs and tighten to specification.

Specification

Stand-Off-to-Timing Gear Case—
Torque 43 N•m
32 lb-ft

23. Install engine oil pump. See Engine Oil Pump Remove and Install. (Group 0400.)



TX1010118 -UN-18JUL06

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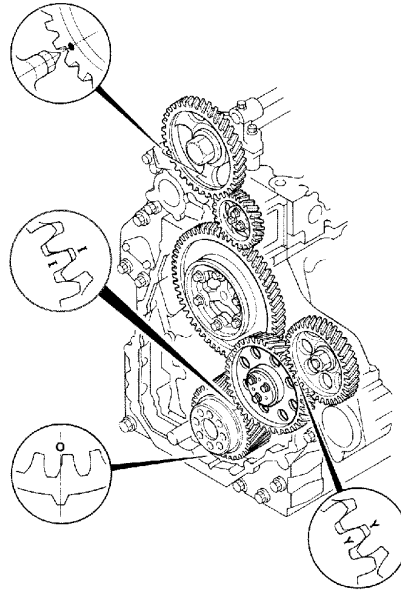
TX17984,0000029 -19-03AUG06-7/10

Removal and Installation

24. Check gear timing.
25. Install timing gear cover and new gasket.
26. Install timing gear cover cap screws and tighten to specification.

Specification

M10 Timing Gear	
Cover-to-Timing Gear Case Cap	
Screw—Torque.....	43 N•m 32 lb-ft
M8 Timing Gear Cover-to-Timing	
Gear Case Cap Screw—Torque.....	25 N•m 221 lb-in.

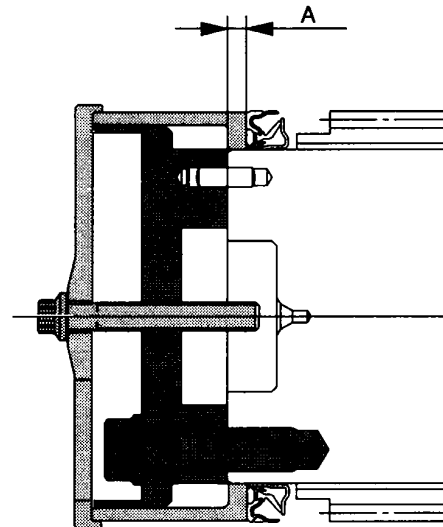


TX1010146 -UN-18JUL06

TX17984.0000029 -19-03AUG06-8/10

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27. Install front oil seal and slinger 1-8522-0043-0 Oil Seal Installer.
28. Install high pressure fuel pump. See High Pressure Fuel Pump Remove and Install. (Group 0400.)
29. Install belt idler.
30. Install crankshaft pulley.



T143925 -UN-08FEB02

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TX17984.0000029 -19-03AUG06-9/10

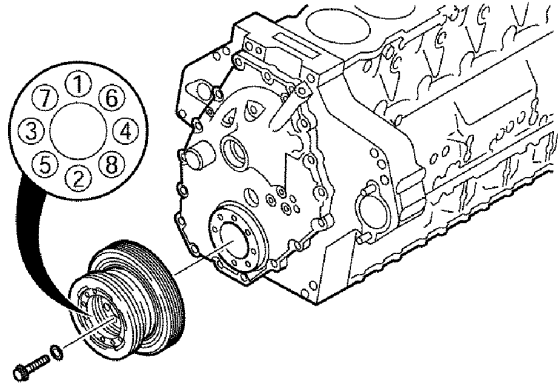
Removal and Installation

31. Install crankshaft pulley cap screws and tighten in sequence to specification.

Specification

Crankshaft Pulley-to-Crankshaft
 Cap Screws—Torque 267 N•m
 197 lb-ft

32. Install oil pan. See Oil Pan Remove and Install. (Group 0400.)
33. Install cylinder head. See Cylinder Head Remove and Install. (Group 0400.)
34. Install alternator. See Alternator Remove and Install. (Group 0400.)



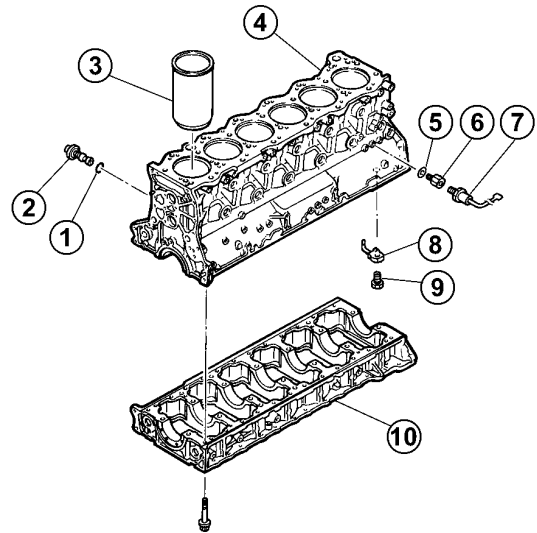
TX1010148 -UN-18JUL06

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TX17984.0000029 -19-03AUG06-10/10

Cylinder Block Disassemble and Assemble

1. Remove oil pressure relief valve (2) and gasket (1).
2. Remove oil pressure switch (7), adapter (6) and gasket (5).
3. Remove oil jets (8).
4. Remove cylinder liners (3).
5. Perform Cylinder Block Inspection. (Group 0400.)



- 1—Gasket
- 2—Oil Pressure Relief Valve
- 3—Cylinder Liner (6 used)
- 4—Cylinder Block
- 5—Gasket
- 6—Adapter
- 7—Oil Pressure Switch
- 8—Oil Jet (6 used)
- 9—Banjo Fitting (6 used)
- 10—Lower Crankcase

T145045

T145045 -UN-08FEB02

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TX17984.000002A -19-31JUL06-1/3

Removal and Installation

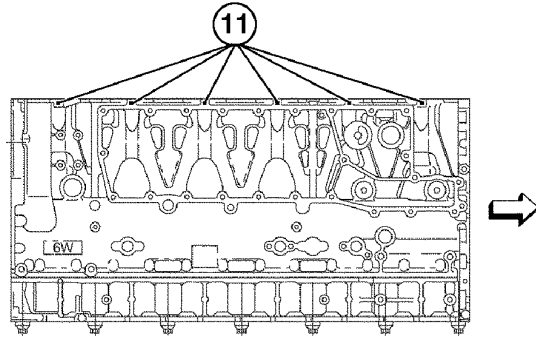
6. Check number on side of engine block for cylinder liner grade.

Specification

Cylinder Liner—Grade..... Number 1 or 2 on Block is a 1x Liner
Number 3 on Block is a 3x Liner

7. Apply engine oil to the outside of cylinder liner. Install cylinder liners.

11—Cylinder Liner Grade Marking



TX1010097 -UN-17JUL06

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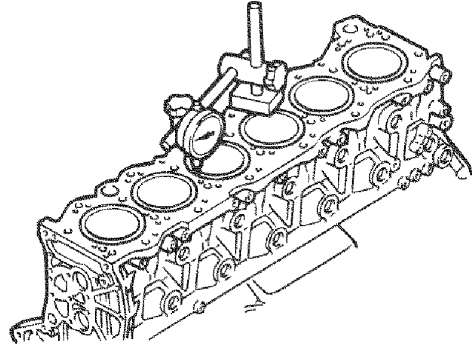
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TX17984.000002A -19-31JUL06-2/3

Removal and Installation

8. Measure amount of cylinder liner projection (height).
Check the difference in projection (height) of adjoining
liner must not exceed specification.

Specification	
Cylinder Liner—Projection (Height).....	0.05—0.09 mm 0.002—0.004 in.
Adjoining Cylinder Liner Difference—Projection (Height).....	0.025 mm or less 0.001 in. or less



TX1010104 -JUN-18JUL06

9. Install oil jets.

10. Tighten oil jet cap screw to specifications.

Specification	
Oil Jet Cap Screw—Torque	69 N•m 51 lb-ft

11. Install oil pressure switch, adapter, and gasket.
Tighten oil pressure switch and adapter to
specification.

Specification	
Oil Pressure Adapter—Torque	59 N•m 44 lb-ft
Oil Pressure Switch—Torque	18 N•m 159 lb-in.

12. Install oil pressure relief valve and gasket. Tighten oil
pressure relief valve to specification.

Specification	
Oil Pressure Relief Valve— Torque	20 N•m 177 lb-in.

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TX17984.000002A -19-31JUL06-3/3

Cylinder Block Inspection

1. Clean cylinder block.
2. Inspect cylinder liner for damage.

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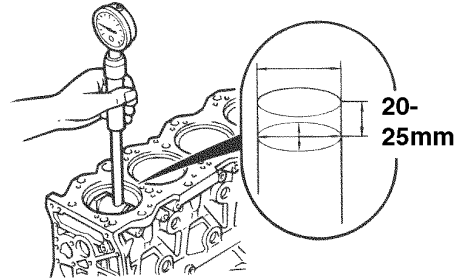
TX17984.000002B -19-31JUL06-1/4

Removal and Installation

3. Measure cylinder liner wear.

Specification

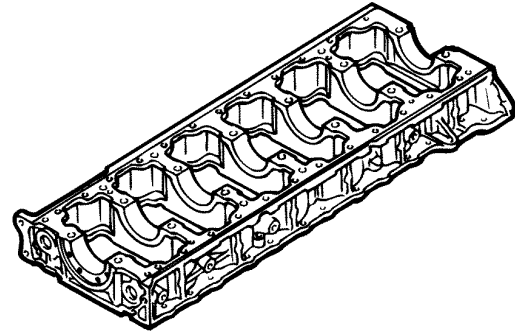
Cylinder Liner—Diameter	147 mm new
	147.3 mm limit of use
	5.787 in. new
	5.799 in. limit of use



TX1009717 -UN-17JUL06

TX17984,000002B -19-31JUL06-2/4

4. Inspect engine crankcase for cracks and damage.



TX1009719 -UN-17JUL06

TX17984,000002B -19-31JUL06-3/4

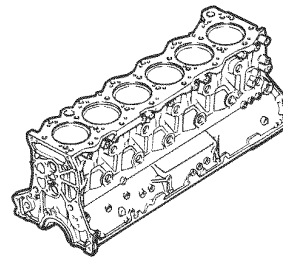
5. Inspect engine block for cracks and damage.

6. Inspection for blockage or corrosion of the coolant and oil lines.

7. Apply water pressure to cylinder block to check for leaks.

Specification

Cylinder Block Water Leak	
Check—Pressure	490 kPa for 3 minutes
	4.9 bar for 3 minutes
	71 psi for 3 minutes



TX1009983 -UN-17JUL06

TX17984,000002B -19-31JUL06-4/4

8. Inspect and clean all threaded holes.

9. Inspect bearing surface areas for wear and damage.

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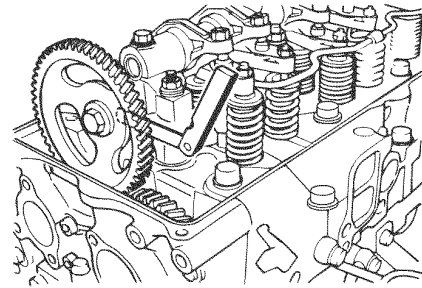
Camshaft Remove and Install

1. Remove upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)
2. Remove lower valve cover. See Lower Valve Cover Remove and Install. (Group 0400.)
3. Remove rocker arm shaft assembly. See Rocker Arm Shaft Assembly Remove and Install. (Group 0400.)

GD61784.0000019 -19-02AUG06-1/3

4. Measure camshaft clearance.

	Specification
Camshaft—Clearance	0.058—0.170 mm new 0.25 mm limit of use 0.002—0.007 in. new 0.010 in. limit of use



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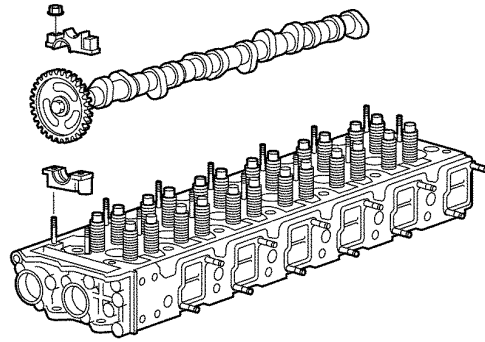
TX1005680 -UN-17JUL06

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GD61784.0000019 -19-02AUG06-2/3

Removal and Installation

5. Remove camshaft nuts.
6. Remove camshaft and brackets.
7. Perform Camshaft Disassemble and Assemble. (Group 0400.)
8. Install camshaft and brackets. Time camshaft to engine. See Timing Gear Case Remove and Install. (Group 0400.)
9. Install camshaft nuts.
10. Tighten camshaft nuts to specification.



TX1009681 -JUN-17JUL06

Specification

Camshaft Bracket-to-Cylinder	
Head Stud and Nut—Torque.....	76 N•m 56 lb-ft

11. Install rocker arm shaft assembly. See Rocker Arm Shaft Assembly Remove and Install. (Group 0400.)
12. Install lower valve cover. See Lower Valve Cover Remove and Install. (Group 0400.)
13. Install upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)

GD61784,0000019 -19-02AUG06-3/3

Camshaft Inspection

1. Remove camshaft gear.
2. Inspect camshaft gear.
3. Inspect camshaft gear key and keyway.

Continued on next page

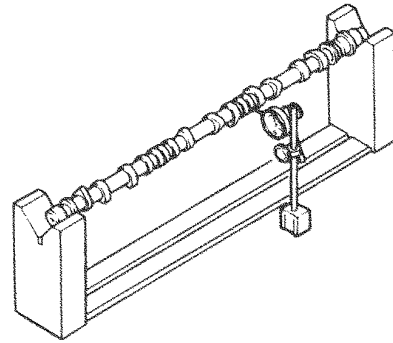
TX17984,000002F -19-31JUL06-1/5

Removal and Installation

4. Set camshaft journal number 1 and number 7 in V blocks.

5. Measure the axial runout of camshaft using a dial indicator on journal number 4.

Specification	
Camshaft—Axial Runout	0.08—0.1 mm 0.003—0.004 in.

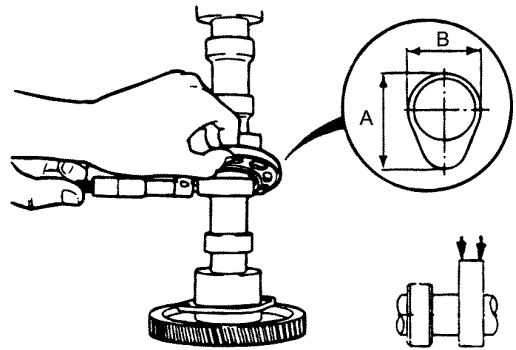


TX17984.000002F -19-31JUL06-2/5

TX1009700 -UN-17JUL06

6. Measure the camshaft lobe lift using a dial indicator.

Specification	
Camshaft Intake Lobe—Lift	8.85—9.4 mm 0.384—0.37 in.
Camshaft Exhaust Lobe—Lift	9.75—10.4 mm 0.384—0.409 in.



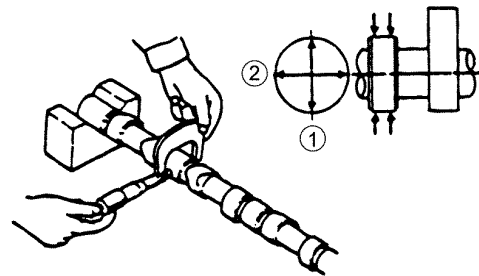
TX17984.000002F -19-31JUL06-3/5

TX1009701 -UN-17JUL06

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7. Measure the outer diameter of the journal.

Specification	
Camshaft Journal—Diameter	39.89—40 mm 1.57—1.575 in.



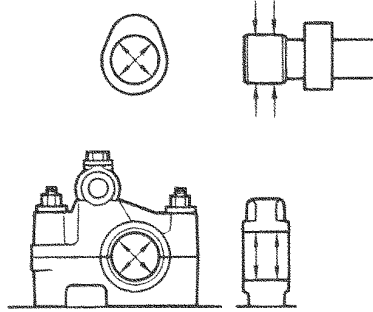
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TX17984.000002F -19-31JUL06-4/5

TX1009706 -UN-17JUL06

Removal and Installation

8. Measure the clearance between the camshaft journal and camshaft bracket.
9. Measure each of the 4 points as shown on the diagram with a micrometer.
10. Install camshaft bracket.



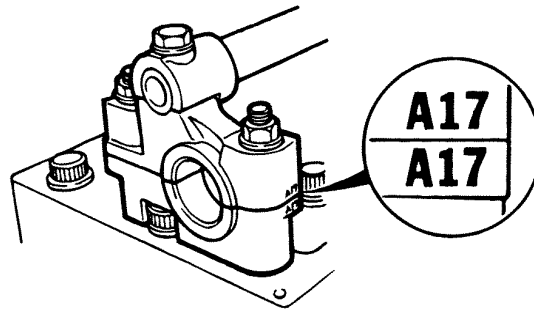
Specification

Camshaft Bracket-to-Cylinder
 Head Stud and Nut—Torque..... 75.5 N•m
 56 lb-ft

11. Measuring each of the 4 points shown on the diagram with a micrometer.

Specification

Camshaft-to-Camshaft Bracket—
 Clearance 0.065—0.15 mm
 0.026—0.006 in.



Specification

Camshaft Sprocket-to-Camshaft
 Cap Screw—Torque..... 137 N•m
 101 lb-ft

12. Install the camshaft gear.

TX1009708 -UN-17JUL06

TX1009707 -UN-17JUL06

TX17984,000002F -19-31JUL06-5/5

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Flywheel Remove and Install

1. Remove engine. See Engine Remove and Install. (Group 0400.)
2. Remove starter motor. See Starter Motor Remove and Install. (Group 0400.)

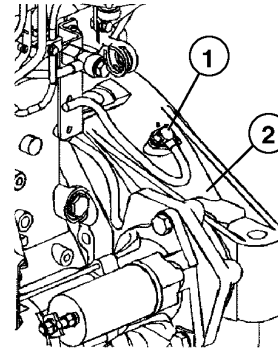
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TX17984,0000030 -19-01AUG06-1/4

Removal and Installation

3. Remove engine speed sensor (1).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.



1—Engine Speed Sensor
2—Flywheel Housing

4. Remove flywheel.

	Specification	
Flywheel—Weight.....		52 kg approximate 113 lb approximate

5. Inspect and repair as necessary.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

6. Install flywheel.

	Specification	
Flywheel—Weight.....		52 kg approximate 113 lb approximate

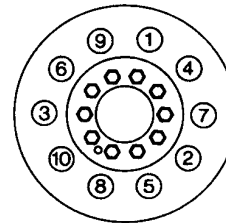
TX17984.0000030 -19-01AUG06-2/4

TX1008914 -UN-22JUN06

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67

7. Tighten cap screws to specification using sequence shown in three steps.

	Specification	
First Step—		
Flywheel-to-Crankshaft Cap		
Screw—Torque.....		79 N•m 58 lb-ft
Second Step—		
Flywheel-to-Crankshaft Cap		
Screw—Torque Turn		60°
Third Step—		
Flywheel-to-Crankshaft Cap		
Screw—Torque Turn		30°



T144309

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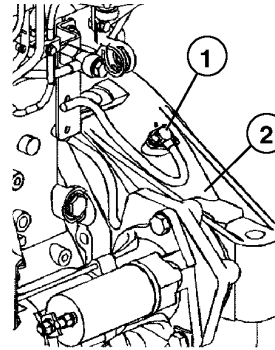
TX17984.0000030 -19-01AUG06-3/4

T144309 -UN-08FEB02

Removal and Installation

- 8. Install engine speed sensor.
- 9. Install starter motor. See Starter Motor Remove and Install. (Group 0400.)
- 10. Install engine. See Engine Remove and Install. (Group 0400.)

1—Engine Speed Sensor
2—Flywheel Housing



TX1008914 -JUN-22JUN06

TX17984,0000030 -19-01AUG06-4/4

Flywheel Disassemble and Assemble

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CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 1. Place flywheel with ring gear on flat wood surface.

Specification

Flywheel—Weight..... 52 kg approximate
113 lb approximate

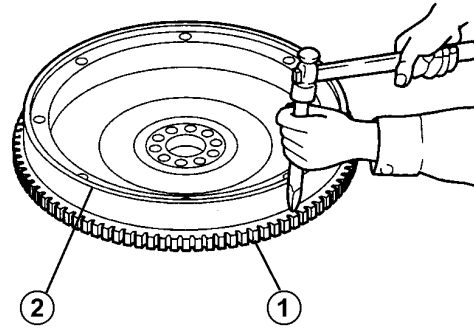
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TX17984,0000031 -19-31JUL06-1/3

Removal and Installation

2. Remove ring gear (1) a hammer and drift or brass punch.
3. Inspect and repair as necessary.

1—Ring Gear
2—Flywheel



T144417

T144417 -UN-08FEB02

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TX17984,0000031 -19-31JUL06-2/3



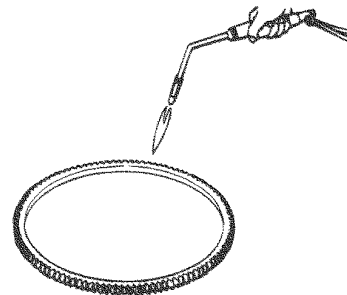
CAUTION: Prevent possible burn injury. Hot equipment and fluids can cause burns to unprotected skin. Wear gloves and protective cloths when working with hot equipment and fluids.

4. Heat ring gear uniformly with torch.

Specification

Ring Gear—Temperature 200°C or less
390°F or less

5. Install ring gear on flywheel with largest chamfer side to flywheel. Push ring gear on until bottomed out on flywheel.



TX1008851 -UN-16JUN06

TX17984,0000031 -19-31JUL06-3/3

Flywheel Housing Remove and Install

1. Remove flywheel. See Flywheel Remove and Install. (Group 0400.)

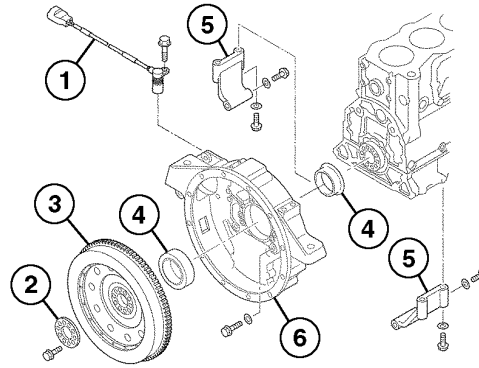
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

2. Remove flywheel housing (6).

Specification

Flywheel Housing—Weight 55 kg approximate
120 lb approximate

3. Remove rear oil seal.



- 1—Engine Speed Sensor
- 2—Washer
- 3—Flywheel
- 4—Oil Seal and Slinger
- 5—Flywheel Housing Supports
- 6—Flywheel Housing

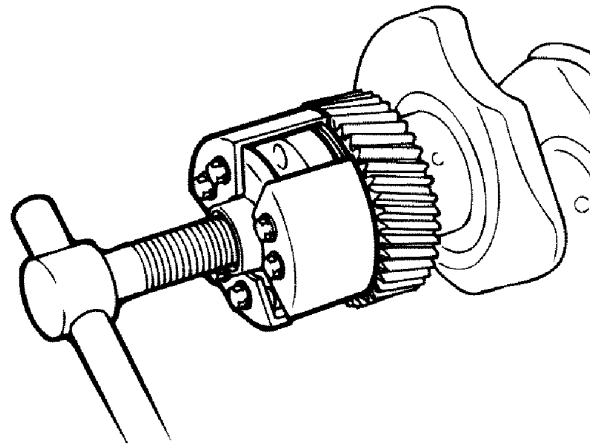
TX1008800 -UN-16/JUN06

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TX17984,0000032 -19-01AUG06-1/4

4. Remove oil slinger using 1-8521-0027-0 Slinger Remover.

5. Inspect and repair as necessary.



TX1010143 -UN-18/JUL06

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TX17984,0000032 -19-01AUG06-2/4

Removal and Installation

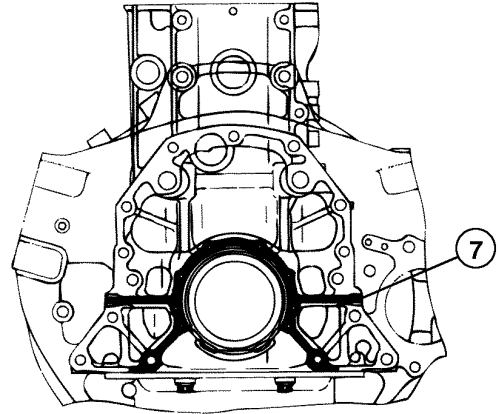
6. Apply PM38656 Rigid Form-in-Place Gasket or equivalent to rear of engine block as shown in figure.
7. Apply 3—4 mm (0.118—0.157 in.) bead of PM38656 Rigid Form-in-Place Gasket or equivalent to the flywheel housing (6).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

8. Install flywheel housing (6).

Specification
 Flywheel Housing—Weight 55 kg approximate
 120 lb approximate

Specification
 Flywheel Housing-to-Engine
 Block Cap Screw—Torque 123 N•m
 91 lb-ft



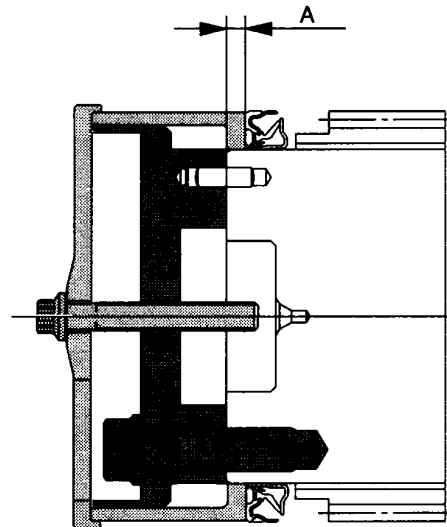
7—Sealant

TX1009305 -UN-10JUL06

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TX17984.0000032 -19-01AUG06-3/4

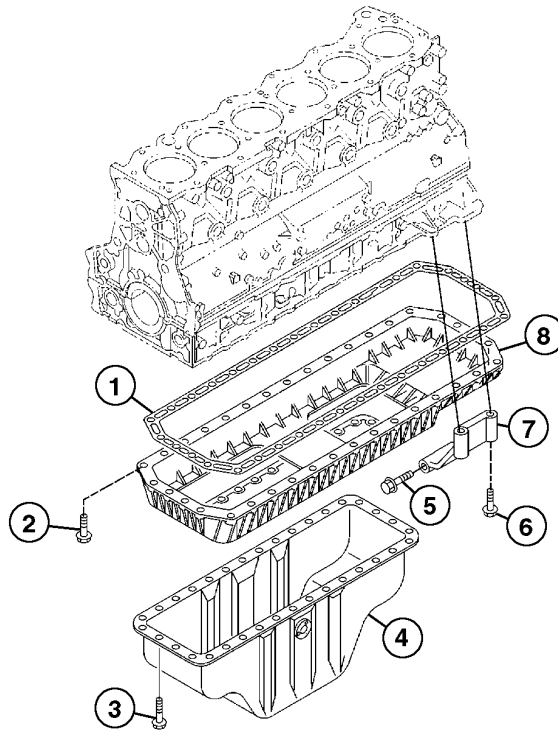
9. Install rear oil seal and slinger using 1-8522-0043-0 Oil Seal Installer.
10. Install flywheel. See Flywheel Remove and Install. (Group 0400.)



T143925 -UN-08FEB02

TX17984.0000032 -19-01AUG06-4/4

Oil Pan Remove and Install



TX1010052

- | | | | |
|-------------|-------------|-------------|--------------------|
| 1—Gasket | 3—Cap Screw | 5—Cap Screw | 7—Support (2 used) |
| 2—Cap Screw | 4—Oil Pan | 6—Cap Screw | 8—Oil Pan Spacer |

1. Drain engine oil.
2. Remove oil pan (4).
3. Remove supports (7).
4. Remove oil pan spacer (8) and discard gasket (1).
5. Clean gasket mating surfaces.
6. Inspect and repair as necessary.
7. Apply 3—4 mm (0.118—0.157 in.) bead of PM37465 RTV 587 Blue Silicone or equivalent to cylinder block, flywheel housing, and gearcase mating surfaces.
8. Install oil pan spacer with new gasket and tighten cap screws.

Specification
 Oil Pan Spacer—Torque 38 N•m
 28 lb-ft

9. Install supports.
10. Apply 3—4 mm bead of PM37465 RTV 587 Blue Silicone or equivalent around oil pan flange.
11. Install oil pan
12. Install oil pan. Tighten oil pan cap screws.

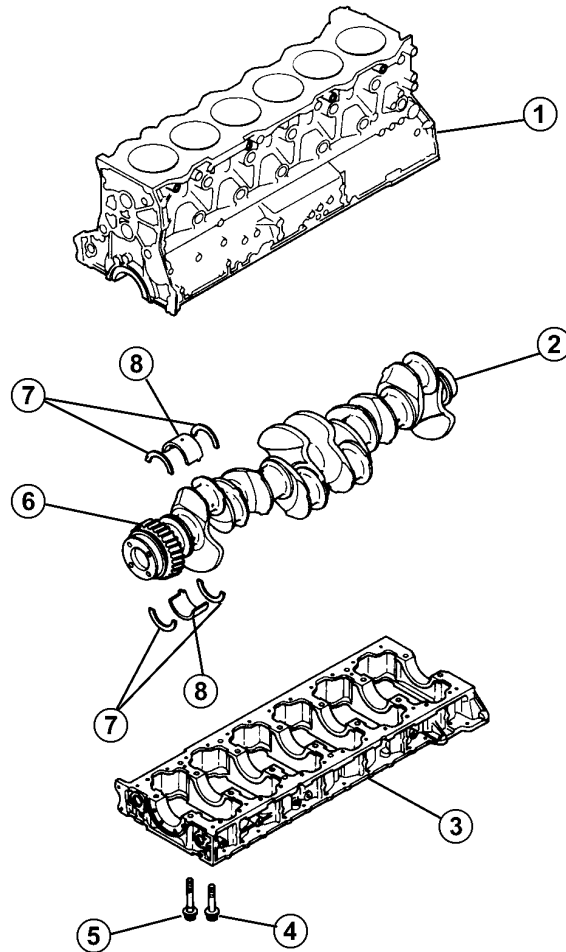
Specification
 Oil Pan Torque—Torque 19 N•m
 168 lb-in.

13. Fill engine with oil.

TX1010052 -JUN-18-JUL06

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72

Crankshaft Remove and Install



T144382

1—Cylinder Block
2—Crankshaft

3—Lower Crankcase
4—M12 Cap Screw (28 used)

5—M18 Cap Screw (14 used)
6—Crankshaft Gear

7—Thrust Bearing (2 used)
8—Journal Bearing (7 used)

1. Remove flywheel housing. See Flywheel Housing Remove and Install. (Group 0400.)
2. Remove cylinder head. See Cylinder Head Remove and Install. (Group 0400.)
3. Remove oil pan. See Oil Pan Remove and Install. (Group 0400.)

4. Remove timing gear case. See Timing Gear Case Remove and Install. (Group 0400.)
5. Remove pistons and connecting rods. See Piston and Connecting Rod Remove and Install. (Group 0400.)

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GD61784,000000B -19-02AUG06-1/6

Removal and Installation

6. Measure end play at number 1 crankshaft journal.

When crankshaft end play exceeds the limit of use, the thrust bearing must be replaced.

Specification

No. 1 Crankshaft Journal—End

Play	0.10—0.28 mm new
	0.30 mm limit of use
	0.004—0.011 in. new
	0.012 in. limit of use

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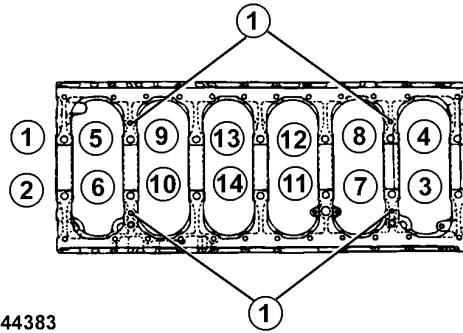
GD61784,000000B -19-02AUG06-2/6

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74

- Loosen lower cap screws in numerical order in increments.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Install lifting eyes into holes (1) and use for lifting lower crankcase from cylinder block.
- Remove lower half of crankshaft journal bearings. Keep bearings in order for installation into their original position.
- Remove crankshaft.



T144383

1—N10 Threaded Hole (4 used)

T144383 -UN-08FEB02

	Specification	
Crankshaft—Weight.....		155 kg approximate 340 lb approximate

- Remove upper half of crankshaft journal bearings, and thrust bearings.
- Inspect and repair as necessary. See Crankshaft Inspection. (Group 0400.)
- Clean cylinder block, crankshaft and bearings.

NOTE: All upper crankshaft bearings have oil grooves.

- Install upper bearings to their original location, if they are being reused.
- Apply engine oil to crankshaft journals and crankshaft bearing surfaces.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Install crankshaft.

	Specification	
Crankshaft—Weight.....		155 kg approximate 340 lb approximate

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Removal and Installation

17. Clean contact area between cylinder block and lower crankcase.

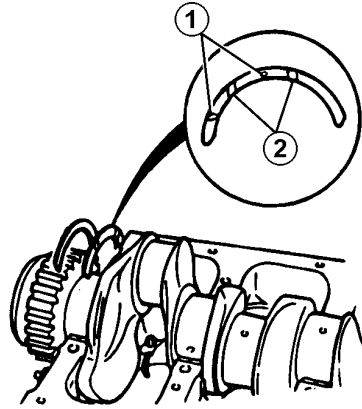
18. Apply engine oil to thrust bearing oil grooves.

NOTE: The thrust bearing oil grooves (2) must face the sliding surface.

19. Install upper half of thrust bearings to both sides of number 1 journal.

20. Install thrust bearing so oil grooves are towards the sliding surface.

1—Dowel Pin Hole (2 used)
2—Oil Groove (2 used)



TI152987 -JUN-29MAR02

GD61784,000000B -19-02AUG06-4/6

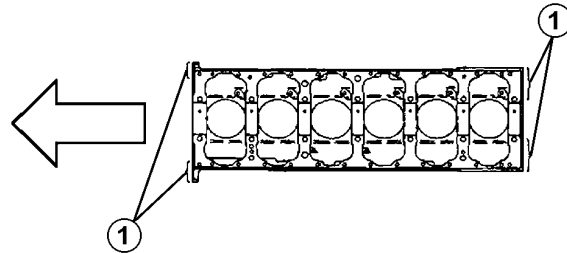
21. Apply 3—4 mm bead of PM37465 RTV 587 Blue Silicone or equivalent to cylinder block lower surface (1).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

22. Install lower crankcase to cylinder block.

23. Apply molybdenum disulfide grease to bearing surface area and M18 cap screws.

1—Sealant Area



TI144384 -JUN-29MAR02

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GD61784,000000B -19-02AUG06-5/6

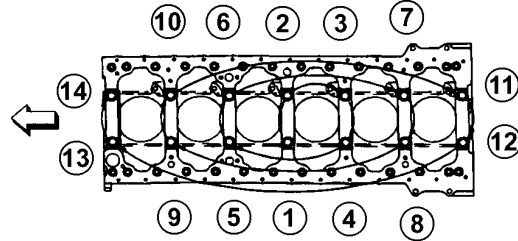
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Removal and Installation

24. Tighten M18 cap screws in step and in order shown .

Specification

Lower Crankcase M18 Cap	
Screw—Torque.....	49 N•m step one
	88 N•m step two
	36 lb-ft step one
	65 lb-ft step two
	90—120° turn step three



T144385

25. Apply engine oil to M12 cap screws and crankcase contact area and tighten.

Specification

Lower Crankcase M12 Cap	
Screw—Torque.....	96 N•m
	71 lb-ft

26. Install pistons and connecting rods. See Piston and Connecting Rod Remove and Install. (Group 0400.)

27. Install timing gear case. See Timing Gear Case Remove and Install. (Group 0400.)

28. Install oil pan. See Oil Pan Remove and Install. (Group 0400.)

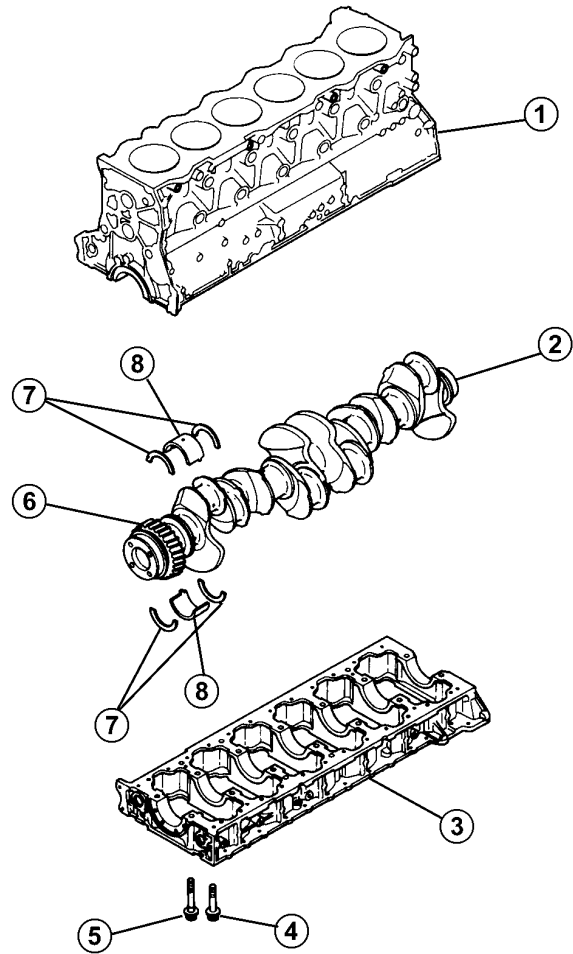
29. Install cylinder head. See Cylinder Head Remove and Install. (Group 0400.)

30. Install flywheel housing. See Flywheel Housing Remove and Install. (Group 0400.)

T144385 -UN-08FEB02

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Crankshaft Inspection



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T144382

1—Cylinder Block
2—Crankshaft

3—Lower Crankcase
4—Cap Screw (28 used)

5—Cap Screw (14 used)
6—Crankshaft Gear

7—Thrust Bearing (2 used)
8—Journal Bearing (7 used)

Continued on next page

GD61784,0000011 -19-03AUG06-1/9

T144382 -UN-08FEE02

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

IMPORTANT: Crankshaft must not be ground as it has been treated by soft nitriding to enhance crankshaft strength.

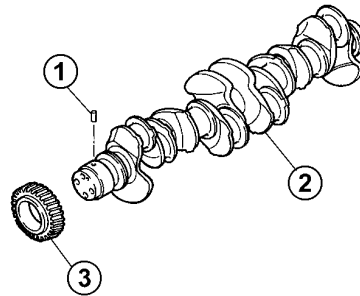
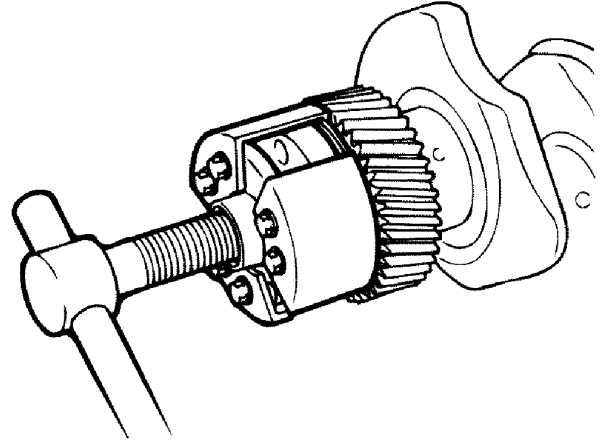
1. When slinger remains on crankshaft, use 1-8521-0027-0 Slinger Remover to remove it.

Specification

Crankshaft—Weight..... 155 kg approximate
340 lb approximate

2. Use 1-8521-0064-0 Crankshaft Gear Remover and remove crankshaft gear (3).

- 1—Dowel Pin
- 2—Crankshaft
- 3—Crankshaft Gear



T144471

TX1010143 -UN-18JUL06

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T144471 -UN-08FEB02

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GD61784.0000011 -19-03AUG06-2/9

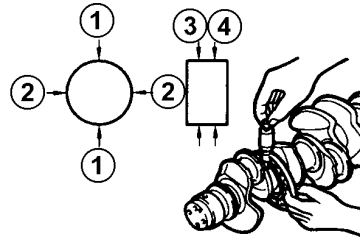
Removal and Installation

3. Measure crankshaft main journal diameter across points 1 and 2, at positions 3 and 4 as shown in illustration. When measured values are less than standard specification, crankshaft must be replaced.

Specification

Number 4 Main Journal—
Diameter 104.850—104.875 mm
4.128—4.129 in.

Number 1, 2 and 3 Main
Journal—Diameter..... 104.880—104.905 mm
4.129—4.130 in.



T144472

T144472 -UN-08FEB02

4. Measure crankshaft rod journal diameter across points 1 and 2, at positions 3 and 4 as shown in illustration. When measured values are less than standard specification, crankshaft must be replaced.

Specification

Rod Journal—Diameter 91.895—91.925 mm
3.618—3.619 in.

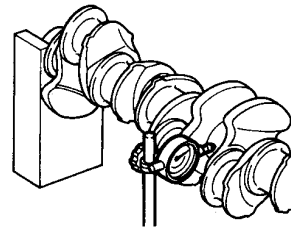
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GD61784,0000011 -19-03AUG06-3/9

5. Measure crankshaft runout at the center of main journal number 4. When measured value exceeds specification, crankshaft must be replaced.

Specification

Crankshaft Run-Out—Radial
Runout 0.120 mm new
0.15 mm limit of use
0.005 in. new
0.006 in. limit of use



T144473

T144473 -UN-08FEB02

6. Measure spread of number 4 journal bearing. When measured value exceeds specification, bearing must be replaced.

Specification

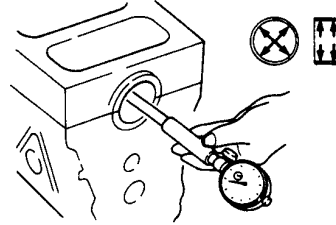
Number 4 Main Journal Bearing
Spread—Distance..... 111.5 mm
4.39 in.

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GD61784,0000011 -19-03AUG06-4/9

Removal and Installation

7. Install bearings in cylinder block and lower crankcase.
8. Install lower crankcase to cylinder block.
9. Apply molybdenum disulfide grease to crankcase contact area and M18 cap screws.



T144474

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GD61784.0000011 -19-03AUG06-5/9

T144474 -UN-08FEB02

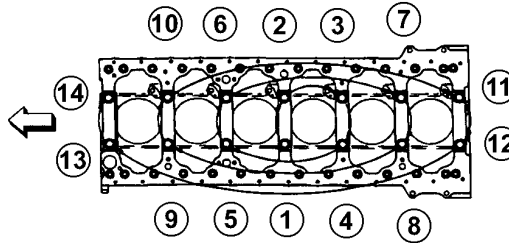
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81

Removal and Installation

10. Tighten M18 cap screws in sequence to specification.

Specification

Lower Crankcase M18 Cap Screw—Torque.....	49 N•m step one 36 lb-ft step one 88 N•m step two 65 lb-ft step two 90—120° turn step three
-------------------------------------------	---------------------------------------------------------------------------------------------------------



T144385

T144385 -JUN-08FEB02

11. Measure crankshaft main journal bearing inside diameter in two directions as shown.

12. Measure ID of crankshaft main journal bearing. Subtract OD of crankshaft main journal from ID of crankshaft main journal bearing to get clearance. The clearance between crankshaft main journal and bearing must be within specification.

Specification

Number 4 Main Journal-to-Bearing—Clearance	0.075—0.150 mm new 0.16 mm limit of use 0.003—0.006 in. new 0.006 in. limit of use
Number 1, 2, or 3 Main Journal-to-Bearing—Clearance	0.045—0.120 mm new 0.16 mm limit of use 0.002—0.005 in. new 0.006 in. limit of use

13. Remove lower crankcase from cylinder block.

14. Clean main bearing and main journal surfaces.

15. Install crankshaft into cylinder block.

Specification

Crankshaft—Weight.....	155 kg approximate 340 lb approximate
------------------------	------------------------------------------

16. Cut PLASTIGAGE® strips to same width as crankshaft journal . Put PLASTIGAGE® on journals.

17. Install lower crankcase to cylinder block.

18. Apply molybdenum disulfide grease to crankcase contact area and M18 cap screws.

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Removal and Installation

19. Tighten M18 cap screws in sequence to specification.

Specification

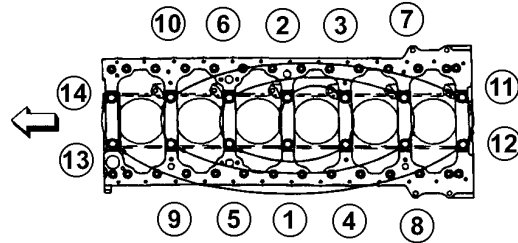
Lower Crankcase M18 Cap	
Screw—Torque.....	49 N•m step one
	36 lb-ft step one
	88 N•m step two
	65 lb-ft step two
	90—120° turn step three

20. Carefully remove lower crankcase from cylinder block.

21. Measure width of PLASTIGAGE® using scale that is printed on PLASTIGAGE® envelope.

Specification

Number 4 Main	
Journal-to-Bearing—Clearance	0.075—0.150 mm new
	0.16 mm limit of use
	0.003—0.006 in. new
	0.006 in. limit of use
Number 1, 2, or 3 Main	
Journal-to-Bearing—Clearance	0.045—0.120 mm new
	0.16 mm limit of use
	0.002—0.005 in. new
	0.006 in. limit of use



T144385

T144385 -UN-08FEB02

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PLASTIGAGE is a trademark of DANA Corp.

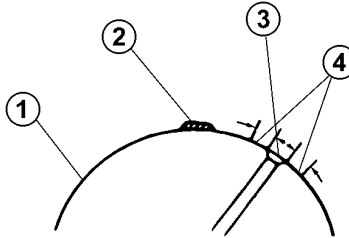
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GD61784.0000011 -19-03AUG06-7/9



CAUTION: Do not allow the solution to come into contact with eyes, hands, or clothing. Should the liquid get into someone's eye, immediately wash with large amounts of fresh water and seek immediate medical attention.

22. Use an organic cleaner to thoroughly clean crankshaft.
23. Prepare 5—10% solution of ammonium cuprous chloride (dissolved in distilled water).
24. Apply solution to test area (2) of crankshaft with a syringe using caution not allowing solution to come in contact with oil port (3) and surrounding area (4).
25. Hold surface of crankshaft perfectly horizontal to prevent solution from running.
26. Wait 30—40 seconds. If there is no discoloration, crankshaft is usable. If discoloration appears (surface area tested will become color of copper), crankshaft must be replaced.
27. Steam clean crankshaft surface immediately after completing test.



T144476

- 1—Journal Surface
- 2—Test Area
- 3—Oil Port
- 4—10 mm (0.4 in.) Area

T144476 -JUN-08FEB02

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CAUTION: Prevent possible burn injury. Hot equipment and fluids can cause burns to unprotected skin. Wear gloves and protective cloths when working with hot equipment and fluids.

28. Heat crankshaft gear to 170—180°C (338—356°F) using oil heater.

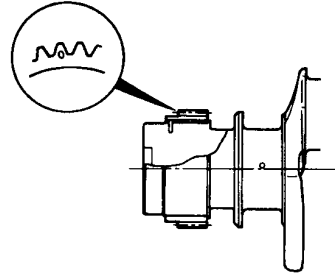
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GD61784,0000011 -19-03AUG06-8/9

Removal and Installation

IMPORTANT: When pressing gear onto crankshaft, be sure that the gear remains straight on shaft.

29. With timing alignment mark "O" on away from crankshaft, align key groove on gear with crankshaft dowel pin position. Install gear on crankshaft quickly using 1-8522-0045-0 Crankshaft Gear Installer before gear contracts due to cooling.



T144477

T144477 -UN-08FEB02

GD61784.0000011 -19-03AUG06-9/9

Piston and Connecting Rod Remove and Install

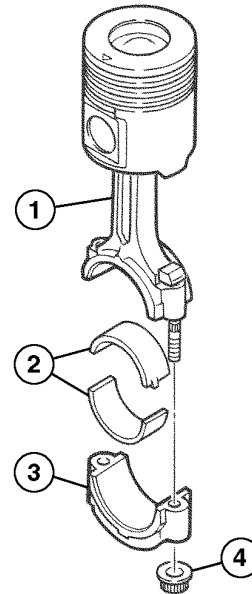
1. Remove oil pan. See Oil Pan Remove and Install. (Group 0400.)
2. Remove cylinder head. See Cylinder Head Remove and Install. (Group 0400.)

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TX17984.0000037 -19-02AUG06-1/4

3. Remove nuts (4) from connecting rod cap (3).
4. Remove connecting rod cap.
5. Remove piston and connecting rod (1) from engine.
6. Perform Piston and Connecting Rod Disassemble and Assemble. (Group 0400.)

- 1—Piston and Connecting Rod
- 2—Connecting Rod Bearings
- 3—Connecting Rod Cap
- 4—Nut



TX1009573 -UN-13JUL06

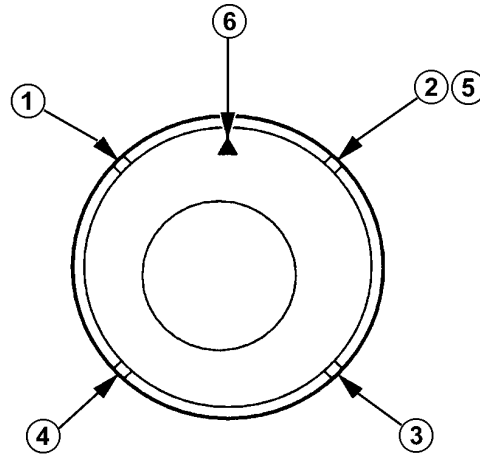
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TX17984.0000037 -19-02AUG06-2/4

7. Carefully wipe any oil or other foreign material from connecting rod bearing back faces and bearing fitting surfaces.
8. Install lower bearing to connecting rod cap.
9. Apply engine oil to circumference of each piston ring, piston, and journal.
10. Position piston ring gaps as shown.
11. Apply molybdenum disulfide grease to skirts of each piston to facilitate smooth break-in when engine is started after assembly.
12. Apply engine oil to cylinder liner bore.
13. Position piston head with front mark toward front of engine.
14. Compress piston rings using 1-8522-0059-0 Piston Setting Tool.
15. Rotate the engine so the crank journal for the piston
16. Use hammer grip to push piston into cylinder and at same time rotate crankshaft until rod journal is at bottom dead center.
17. Align connecting rod cap cylinder number marks with connecting rod cylinder marks.
18. Install connecting rod caps.
19. Apply molybdenum disulfide grease to threads and mating surfaces of each connecting rod stud and nut.
20. Tighten connecting rod nuts to specification in three steps.

Specification

1st Step Rod Cap-to-Connecting Rod Cap Screw and Nut—Torque	98 N•m 72 lb-ft
2nd Step Rod Cap-to-Connecting Rod Cap Screw and Nut—Torque	
Turn	30°
3rd Step Rod Cap-to-Connecting Rod Cap Screw and Nut—Torque	
Turn	30°



T144421

- 1—1st Compression Ring Gap
- 2—2nd Compression Ring Gap
- 3—3rd Compression Ring Gap
- 4—Oil Ring Gap
- 5—Coil Expander Gap
- 6—Front Mark

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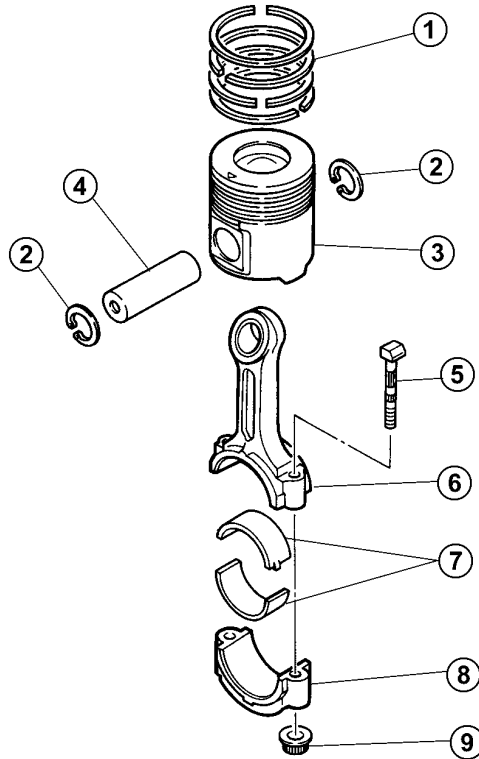
Removal and Installation

21. Install oil pan. See Oil Pan Remove and Install.
(Group 0400.)
22. Install cylinder head. See Cylinder Head Remove and
Install. (Group 0400.)

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Piston and Connecting Rod Disassemble and Assemble



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T144456

T144456 -UN-08FEB02

- | | | | |
|-----------------------------|-----------------------|---------------------------|--------------------|
| 1—Piston Ring (6 sets used) | 4—Piston Pin (6 used) | 6—Connecting Rod (6 used) | 8—Rod Cap (6 used) |
| 2—Snap Ring (12 used) | 5—Cap Screw (12 used) | 7—Bearing (6 Sets used) | 9—Nut (12 used) |
| 3—Piston (6 used) | | | |

1. Remove connecting rod bearings (7). Keep bearing sets in order to aid installation into their original position.
2. Remove piston rings (1).
3. Remove snap rings (2).
4. Remove piston pin (4) using a mallet and brass bar.
5. Remove pistons (3).
6. Install one snap ring in piston using a pair of snap ring pliers.
7. Position piston with piston head front mark and connecting rod front mark towards same direction.
8. Apply engine oil to piston pin.
9. Install pin through piston and connecting rod.
10. Install second snap ring in piston.
11. Apply engine oil to piston rings.
12. Verify identification mark on piston rings.
 - 1st Compression Ring—Red Color
 - 2nd Compression Ring—Blue Color
 - 3rd Compression Ring—Green Color
 - Oil Ring—Not Applicable
13. Install the three compression rings matching marks on piston rings using 1-8522-1025-0 Piston Ring Setting Tool.
14. Install oil ring the expander coil into oil ring groove so there is no gap on either side of expander coil.

Continued on next page

GD61784,0000015 -19-24JUL06-1/2

Removal and Installation

15. Verify that piston rings rotate smoothly in piston ring grooves.

GD61784,0000015 -19-24JUL06-2/2

Piston and Connecting Rod Inspection

1. Insert piston ring horizontally (in position it would be in if it were installed in piston) into cylinder liner bore.
2. Push ring into cylinder liner bore until it reaches point where bore is smallest. Do not allow ring to slant, it must remain perfectly horizontal.
3. Measure piston ring gap using a feeler gauge.

Specification

1st Compression Ring, 3rd Compression Ring, Oil Ring—	
Gap.....	0.35—0.50 mm new 1.0 mm limit of use 0.014—0.02 in. new 0.039 in. limit of use
2nd Compression Ring—Gap	0.80—0.95 mm new 1.5 mm limit of use 0.031—0.037 in. new 0.059 in. limit of use

Piston ring must be replaced when ring gap exceeds specification.

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GD61784,0000016 -19-02AUG06-1/6

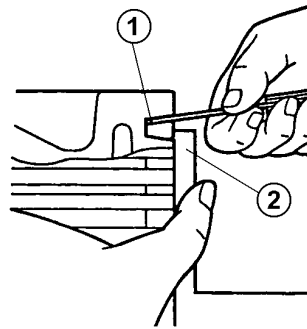
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Removal and Installation

4. Visually inspect piston ring grooves. Piston must be replaced when groove is damaged or distorted.

Push the 1st Compression Ring into the groove as shown using a straight edge.

5. Measure clearance between piston ring and ring groove at several points around piston using a feeler gauge (1).



T144461

1—Feeler Gauge
2—Straight Edge

T144461 -UN-08FEB02

Specification

1st Compression Ring—	
Clearance	0.115—0.160 mm new 0.24 mm limit of use 0.005—0.006 in. new 0.009 in. limit of use
2nd Compression Ring and 3rd	
Compression Ring—Clearance	0.10—0.135 mm new 0.20 mm limit of use 0.004—0.005 in. new 0.008 in. limit of use
Oil Ring—Clearance.....	0.025—0.065 mm new 0.15 mm limit of use 0.001—0.003 in. new 0.006 in. limit of use

Piston ring must be replaced when clearance exceeds specification.

6. Measure piston ring expansion force using an expansion force gauge.

Specification

1st Compression Ring	
Expansion—Force	38.5—49.2 N new 29 N limit of use 8.656—11.061 lb-force new 6.52 lb-force limit of use
2nd Compression Ring	
Expansion—Force	29.9—38.7 N new 20 N limit of use 6.722—8.701 lb-force new 4.496 lb-force limit of use
3rd Compression Ring	
Expansion—Force	28.1—36.6 N new 20 N limit of use 6.317—8.228 lb-force new 4.496 lb-force limit of use
Oil Ring Expansion—Force	85.3—104.9 N new 64 N limit of use 19.177—23.584 lb-force new 14.388 lb-force limit of use

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Piston ring must be replaced when force is less than specification.

IMPORTANT: Cylinder liner kit clearances are preset. However, cylinder liner installation procedures may result in slight decreases in clearances. Always measure cylinder liner clearance after installation to be sure that it is correct.

- 7. Check piston and cylinder liner bore clearance. Cylinder liner bore measurement must be taken with liner installed in cylinder block.
- 8. Measure cylinder liner bore in both thrust and axial directions of crankshaft.

Specification

Cylinder Liner Bore—ID 147.011—147.030 mm at 130 mm from top of cylinder
5.788—5.789 in. at 5.118 in. from top of cylinder

NOTE: Pistons installed at factory have a grade mark stamped on top. Pistons replaced as service parts may not have a grade marking.

- 9. Measure piston OD.

Specification

Piston—OD..... 146.830—146.845 mm at 113 mm from top of piston
5.7805—5.7813 in. at 4.449 in. from top of piston

- 10. Subtract piston outside diameter from the cylinder liner bore to get the piston to cylinder liner clearance.

Specification

Piston-to-Cylinder Liner—
Clearance 0.156—0.190 mm
0.006—0.007 in.

- 11. Piston and cylinder liner must be replaced when the clearance exceed specification. Cylinder liner and piston are a matched set. Replace liner and piston as an assembly.
- 12. Measure piston pin outside diameter at several points using a micrometer.

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Removal and Installation

Specification

Piston Pin—OD	56.000 mm new
	55.970 mm limit of use
	2.205 in. new
	2.204 in. limit of use

Piston pin must be replaced when OD is less than specification limits.

13. Measure pin bore diameter in piston. Subtract piston pin diameter measured in previous step from pin hole diameter. Difference is clearance value.

Specification

Pin Bore-to-Piston Pin—	
Clearance	0.008—0.021 mm new
	0.05 mm limit of use
	0.0003—0.001 in. new
	0.002 in. limit of use

Piston must be replaced when clearance value exceeds specification and piston pin diameter is within specification.

14. Measure clearance between piston pin and connecting rod small end bushing using a caliper and dial indicator to.

Specification

Pin-to-Connecting Rod Small End	
Bushing—Clearance.....	0.020—0.037 mm new
	0.10 mm limit of use
	0.001—0.001 in. new
	0.004 in. limit of use

Piston pin and/or connecting rod must be replaced when clearance value exceeds specification limit.

15. Measure distortion and parallelism between connecting rod large end bore and small end hole using a connecting rod alignment tool.

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GD61784,0000016 -19-02AUG06-4/6

Removal and Installation

Specification

Connecting Rod Alignment—

Distortion and Parallelism.....	0.05 mm maximum standard per of 100 mm length of connecting rod
	0.20 mm limit of use per of 100 mm length of connecting rod
	0.002 in. maximum standard per of 3.937 in. length of connecting rod
	0.008 in. limit of use per of 3.937 in. length of connecting rod

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GD61784.0000016 -19-02AUG06-5/6

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Removal and Installation

16. Measure crankshaft journals and connecting rod bearing.
17. Install bearings and bearing cap in connecting rod.
18. Apply molybdenum disulfide grease to connecting rod cap screw threads and end cap mating surface.
19. Install connecting rod and rod cap on the same crankshaft journal from which removed. Tighten cap screws and nuts to specification in three steps.

Specification

Step One—Connecting Rod Bearing Cap Nut—Torque.....	98 N•m 72 lb-ft
Step Two—Connecting Rod Bearing Cap Nut—Torque Turn	30°
Step Three—Connecting Rod Bearing Cap Nut—Torque Turn	30°

20. Measure clearance between connection rod and crankshaft journal using a feeler gauge.

Specification

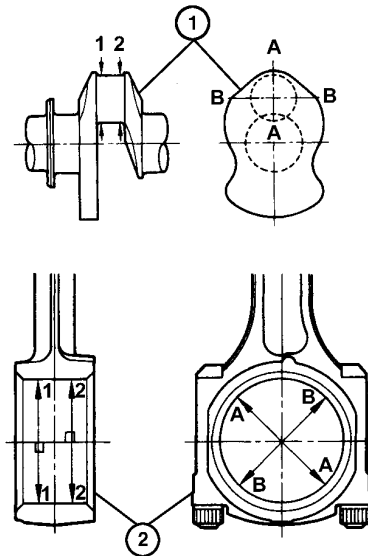
Connecting Rod-to-Crankshaft—	
Clearance	0.175—0.290 mm new 0.35 mm limit of use 0.007—0.011 in. new 0.014 in. limit of use

21. Measure corresponding journal diameter on crankshaft using a caliper.
22. Calculate journal and connecting rod rearing clearance.

Specification

Connecting Rod	
Bearing-to-journal—Clearance	0.033—0.103 mm new 0.16 mm limit of use 0.001—0.004 in. new 0.006 in. limit of use

Bearing and/or crankshaft must be replaced when clearance between connecting rod bearing and journal exceeds specification limit.



1—Crankshaft Measurements
2—Connecting Rod Measurements

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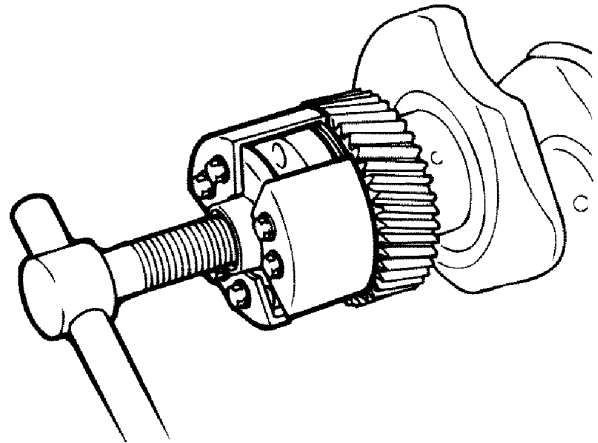
Engine Oil Pump Remove and Install

1. Remove alternator. See Alternator Remove and Install. (Group 0400.)
2. Remove belt idler.
3. Remove crankshaft pulley.
4. Remove timing gear cover cap screws.
5. Remove timing gear cover and discard gasket.

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TX17984,000003A -19-02AUG06-1/5

6. Remove front crank seal and slinger using 1-8521-0027-0 Slinger Remover.



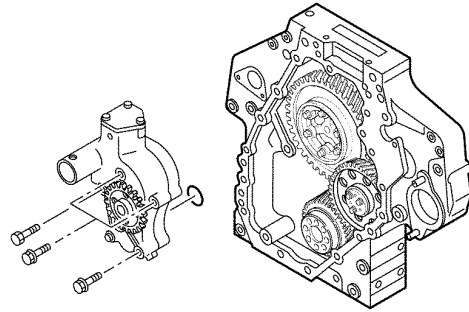
TX1010143 -UN-18JUL06

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TX17984,000003A -19-02AUG06-2/5

Removal and Installation

7. Remove oil pump.
8. Perform Engine Oil Pump Inspection. (Group 0400.)
9. Install oil pump with a new O-ring.
10. Install cap screws and tighten to specification.



TX1009654 -UN-17JUL06

Specification

Engine Oil Pump-to-Timing Gear	
Case Cap Screws—Torque.....	49 N•m 36 lb-ft

11. Install timing gear cover and tighten to specification.

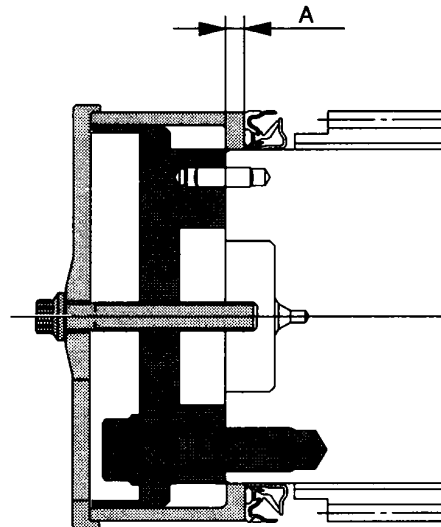
Specification

M10 Timing Gear	
Cover-to-Timing Gear Case Cap	
Screw—Torque.....	43 N•m 32 lb-ft
M8 Timing Gear Cover-to-Timing	
Gear Case Cap Screw—Torque	25 N•m 221 lb-in.

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TX17984,000003A -19-02AUG06-3/5

12. Install front oil seal and slinger using 1-8522-0043-0 Oil Seal Installer.



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TX17984,000003A -19-02AUG06-4/5

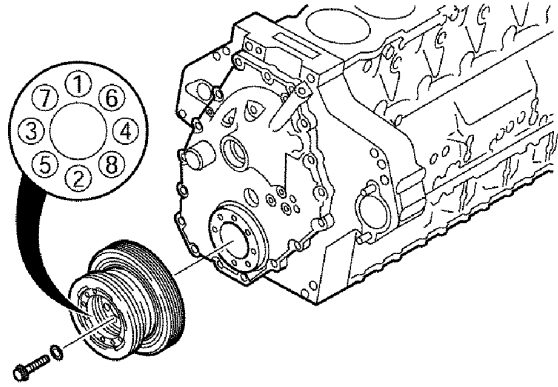
Removal and Installation

13. Install crankshaft pulley cap screws and tighten in sequence to specification.

Specification

Crankshaft Pulley-to-Crankshaft
Cap Screws—Torque 267 N•m
197 lb-ft

14. Install belt idler.
15. Install alternator. See Alternator Remove and Install. (Group 0400.)



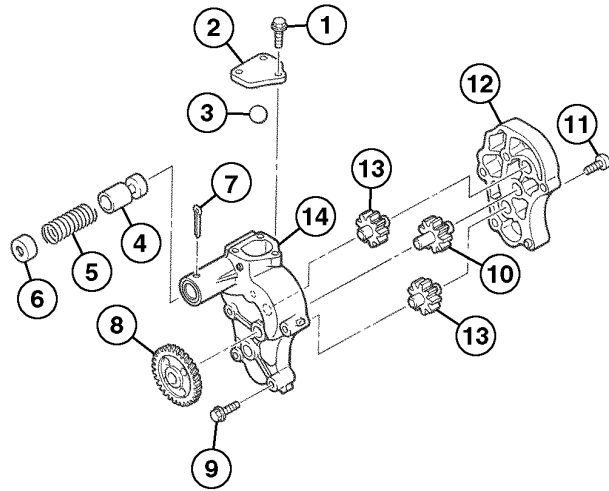
TX1010148 -UN-18/JUL06

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TX17984.000003A -19-02AUG06-5/5

Engine Oil Pump Disassemble and Assemble

1. Remove cap screws (1).
2. Remove cover (2).
3. Remove ball (3).
4. Hold spring seat (4) and remove cotter pin (7).
5. Remove spring seat (6), spring (5), and relief valve (4).
6. Remove cap screws (11) and (9).
7. Remove oil pump housing cover (12).
8. Remove driven gears (13).
9. Remove oil pump drive gear (8) using a gear puller.
10. Remove pilot gear (10).
11. Perform Engine Oil Pump Inspection. (Group 0400.)
12. Apply a small amount of engine oil to all internal parts.



- 1—Cap Screw (3 used)
- 2—Cover
- 3—Ball
- 4—Relief Valve
- 5—Spring
- 6—Spring Seat
- 7—Cotter Pin
- 8—Oil Pump Drive Gear
- 9—Cap Screw
- 10—Pilot Gear
- 11—Cap Screw (2 used)
- 12—Oil Pump Housing Cover
- 13—Driven Gear (2 used)
- 14—Oil Pump Housing

TX1009125 -JUN-02AUG06

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TX17984,000003B -19-01AUG06-1/2

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Removal and Installation

- 13. Install pilot gear in oil pump housing.
- 14. Install driven gears in oil pump housing.
- 15. Install oil pump housing cover.
- 16. Tighten cap screws (9 and 11) to specification.

Specification

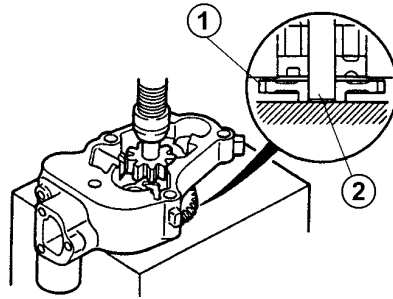
Oil Pump Cover-to-Oil Pump
Housing Cap Screw—Torque..... 18 N•m
159 lb-in.

T144817

Specification

Oil Pump Cover-to-Oil Pump
Housing Cap Screw M10—
Torque 39 N•m
29 lb-ft

1—Oil Pump Drive Gear
2—Pilot Gear Shaft



T144817 -UN-08FEB02

- 17. Install relief valve.
- 18. Install spring.
- 19. Install spring seat.
- 20. Install cotter pin. Bend long leg of cotter pin 90°.
- 21. Install ball.
- 22. Install cover. Tighten cap screws (1) to specification.

Specification

Oil Pump Relief Valve
Cover-to-Oil Pump Housing—
Torque 18 N•m
159 lb-in.

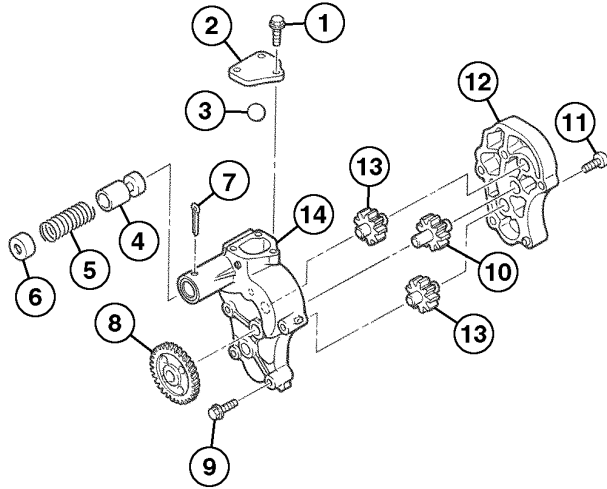
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Engine Oil Pump Inspection

- Carefully inspect ball (3) for scratches or damage.
- Inspect oil relief valve, spring, and spring seat (4—6) for damage.

- 1—Cap Screw (3 used)
- 2—Cover
- 3—Ball
- 4—Relief Valve
- 5—Spring
- 6—Spring Seat
- 7—Cotter Pin
- 8—Oil Pump Drive Gear
- 9—Cap Screw
- 10—Pilot Gear
- 11—Cap Screw (2 used)
- 12—Oil Pump Housing Cover
- 13—Driven Gear (2 used)
- 14—Oil Pump Housing



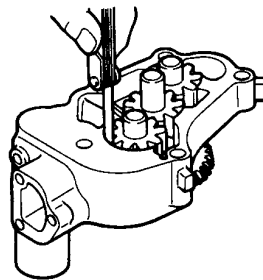
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- Measure clearance between driven gears and oil pump housing.

Specification

Oil Pump Housing-to-Driven	
Gears—Clearance	0.050—0.098 mm 0.002—0.004 in.



T144813

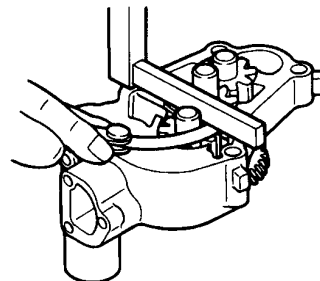
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- Measure clearance between oil pump cover and gears.

Specification

Oil Pump Cover-to-Gear Side—	
Clearance	0.040—0.094 mm 0.002—0.004 in.



T144814

T144814 -UN-08FEB02

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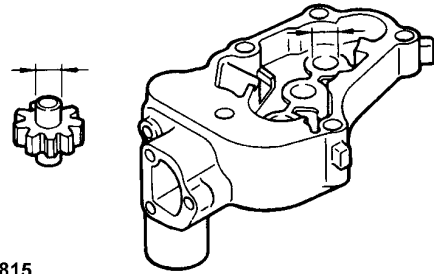
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Removal and Installation

5. Measure oil pump pilot gear diameter and oil pump housing bores.

Specification

Pilot Gear—Diameter	20.0 mm 0.787 in.
Pilot Gear-to-Pump Body— Clearance	0.040—0.074 mm 0.002—0.003 in.



T144815

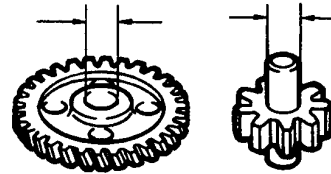
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6. Measure for interference fit at inside diameter of oil pump drive gear and outside diameter of drive gear shaft. (Oil pump drive gear ID—pilot gear OD = interference measurement.)

Specification

Oil Pump Drive Gear ID and Pilot Gear OD—Distance.....	0.019—0.047 mm 0.001—0.002 in.
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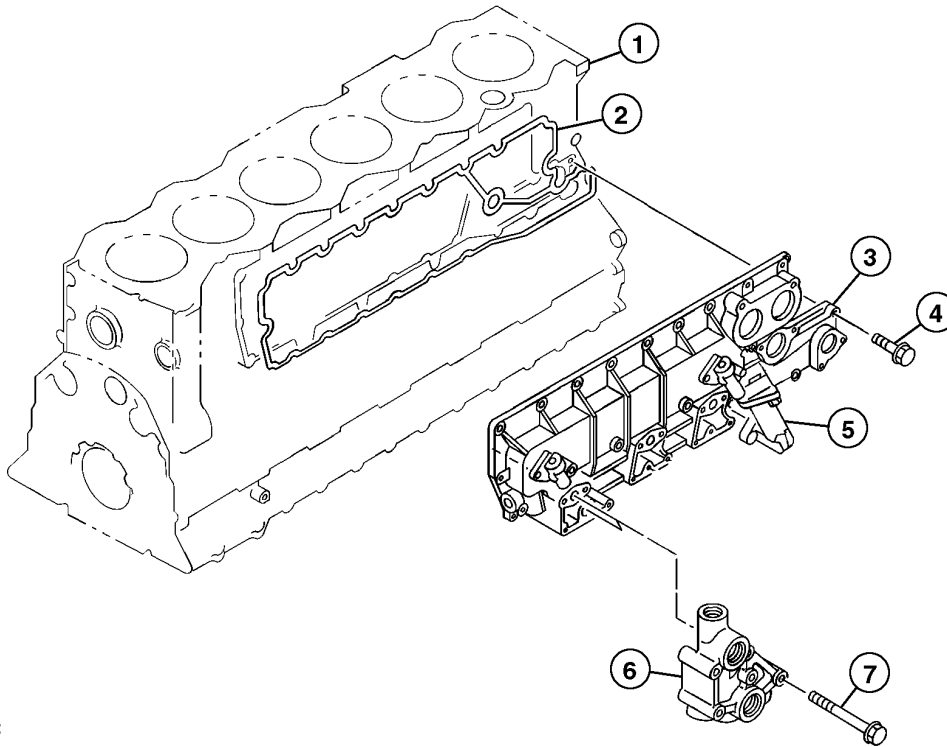
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Engine Oil Cooler Remove and Install



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TX1010163 -JUN-20JUL06

TX1010163

- 1—Engine Block
- 2—Gasket
- 3—Engine Oil Cooler
- 4—Cap Screw (26 used)
- 5—Oil Inlet Tube
- 6—Oil Port Cover
- 7—Cap Screws (4 used)

1. Remove thermostat housing. See Thermostat Housing Remove and Install. (Group 0400.)
2. Remove turbocharger. See Turbocharger Remove and Install. (Group 0400.)
3. Remove oil inlet pipe (5) to cylinder block cap screws.
4. Disconnect oil port cover pipes.
5. Remove water pump. See Water Pump Remove and Install. (Group 0400.)
6. Remove water drain pipe and bracket.
7. Remove oil cooler (3) and discard gasket (2).
8. Perform Engine Oil Cooler Disassemble and Assemble. (Group 0400.)

9. Apply PM37465 RTV 587 Blue Silicone or equivalent to mating surfaces of oil cooler and cylinder block.
10. Install oil cooler. Tighten cap screws to specification.
11. Install water drain tube. Tighten connector and bracket cap screw to specification.

Specification

Oil Cooler-to-Cylinder Block	
Cap Screw—Torque	50 N•m 37 lb-ft

Specification

Water Drain Pipe Connector—	
Torque.....	79 N•m 58 lb-ft

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GD61784,000001C -19-01AUG06-1/2

Removal and Installation

Specification

Water Drain Pipe Bracket Cap
Screw—Torque..... 69 N•m
51 lb-ft

12. Install water pump. See Water Pump Remove and Install. (Group 0400.)

13. Install oil port cover with new gasket. Tighten cap screws to specification.

Specification

Oil Port Cover Cap Screw—
Torque..... 43 N•m
32 lb-ft

14. Install oil inlet tube. Tighten cap screws to specification.

Specification

Oil Inlet Pipe-to-Cylinder Block
Cap Screw—Torque 39 N•m
29 lb-ft

15. Connect oil port cover pipes. Tighten oil port cover pipes to specification.

Specification

Oil Port Cover Pipe—Torque..... 43 N•m
32 lb-ft

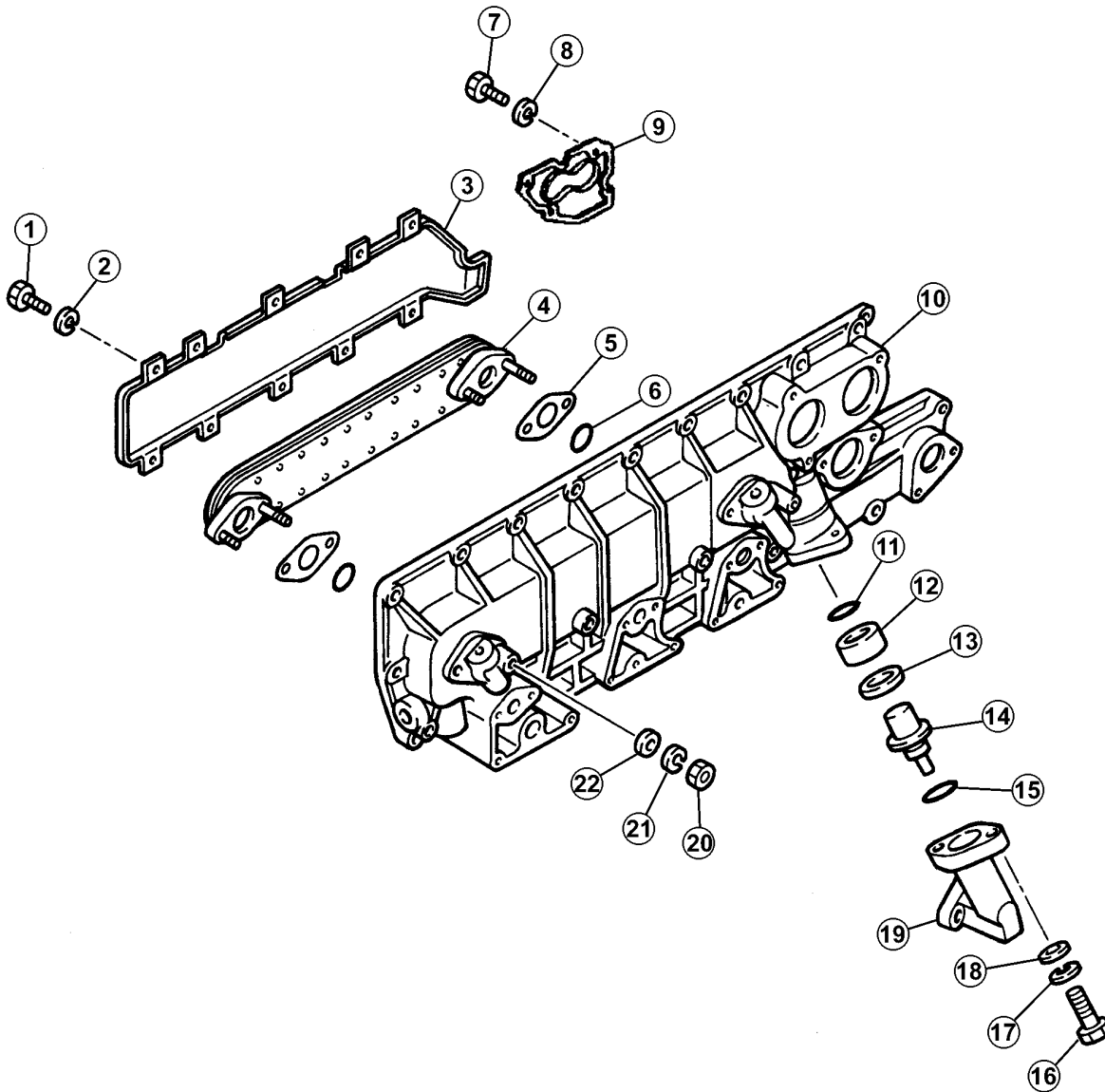
16. Install turbocharger. See Turbocharger Remove and Install. (Group 0400.)

17. Install thermostat housing. See Thermostat Housing Remove and Install. (Group 0400.)

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GD61784.000001C -19-01AUG06-2/2

Engine Oil Cooler Disassemble and Assemble



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T152731

T152731 -UN-29MAR02

- | | | | |
|-----------------------------|------------------------------|-------------------------|-------------------------|
| 1—Cap Screw (10 used) | 7—Cap Screw (4 used) | 13—Spacer | 18—Washer (2 used) |
| 2—Washer (10 used) | 8—Washer (4 used) | 14—Oil Thermostat | 19—Oil Inlet Pipe |
| 3—Baffle Plate | 9—Thermostat Cover | 15—Gasket | 20—Nut (4 used) |
| 4—Engine Oil Cooler Element | 10—Engine Oil Cooler Housing | 16—Cap Screw (2 used) | 21—Lock Washer (4 used) |
| 5—Gasket (2 used) | 11—Seal Ring | 17—Lock Washer (2 used) | 22—Washer (4 used) |
| 6—Gasket (2 used) | 12—Oil Thermostat Support | | |

1. Remove oil inlet pipe cap screws (16).

Continued on next page

GD61784,000001D -19-31JUL06-1/2

Removal and Installation

2. Remove oil inlet pipe (19), oil thermostat (14), and oil thermostat support (12).

3. Remove baffle plate (3).

4. Remove engine oil cooler element. Discard gaskets (5) and O-rings (6).

5. Remove thermostat cover (9).

6. Inspect and repair as needed.

7. Install thermostat cover.

8. Install thermostat cover cap screws. Tighten cap screws to specification.

Specification	
Thermostat Cover-to-Engine Oil	
Cooler Housing—Torque	18 N•m 159 lb-in.

9. Install engine oil cooler with new gaskets and O-rings.

10. Install engine oil cooler nuts. Tighten nuts to specification.

Specification	
Engine Oil Cooler	
Element-to-Engine Oil Cooler	
Housing Nuts—Torque	25 N•m 221 lb-in.

11. Install baffle plate. Tighten cap screws to specification.

Specification	
Baffle Plate-to-Engine Oil	
Cooler Housing Cap Screws—	
Torque.....	4 N•m 35 lb-in.

12. Install oil inlet pipe, oil thermostat, and support. Tighten cap screws to specification.

Specification	
Oil Inlet Pipe-to-Engine Oil	
Cooler Housing Cap Screws—	
Torque.....	37 N•m 27 lb-ft

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Thermostat Housing Remove and Install

1. Drain engine coolant. See Drain Cooling System. (Operator's Manual.)
2. Remove thermostat housing (5).
3. Remove gasket (4).
4. Remove O-ring (6).
5. Inspect and repair as necessary.
6. Install O-ring.
7. Install gasket.
8. Install thermostat housing and cap screws.
9. While holding thermostat housing to engine oil cooler, tighten thermostat housing-to-water pump cap screws to specification.

Specification

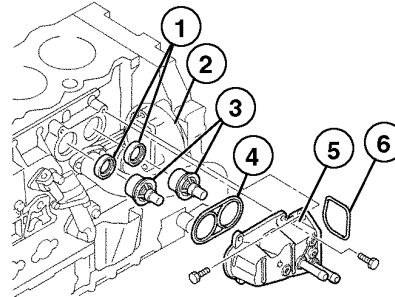
Thermostat Housing-to-Water Pump Cap Screw—Torque	39 N•m 29 lb-ft
---------------------------------------------------------	--------------------

10. Tighten thermostat housing-to-engine oil cooler cap screws to specification.

Specification

Thermostat Housing-to-Engine Oil Cooler Cap Screw—Torque	39 N•m 29 lb-ft
----------------------------------------------------------------	--------------------

11. Perform Cooling System Fill and Deaeration Procedure. (Operator's Manual.)

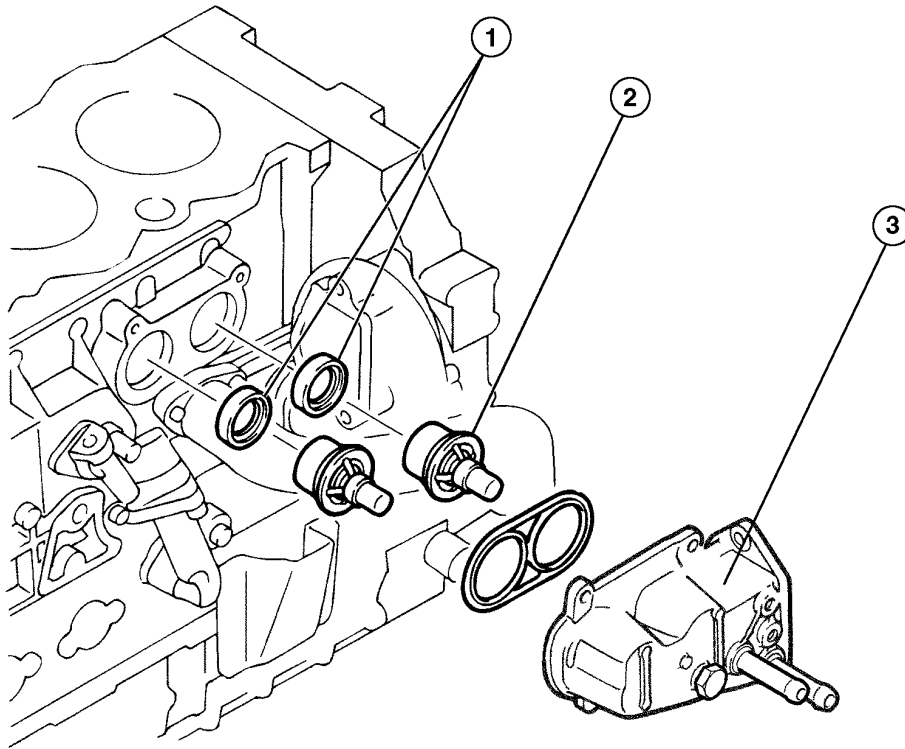


- 1—Seal ring (2 used)
- 2—Water Pump
- 3—Thermostat (2 used)
- 4—Gasket
- 5—Thermostat Housing
- 6—O-Ring
- 7—Cap Screw (5 used)

TX1008603 -JUN-17JUL06

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Thermostat Remove and Install



1—Seal (2 used)

2—Thermostat (2 used)

3—Thermostat Housing

1. Remove thermostat housing. See Thermostat Housing Remove and Install. (Group 0400.)
2. Remove thermostats (2).
3. Remove and discard seals (1) using 1-8521-0067-0 Thermostat Seal Puller.
4. Perform Thermostat Inspection. (Group 0400.)
5. Install new thermostat seals using 1-8522-1034-0 Thermostat Seal Installer.
6. Install thermostats.
7. Install thermostat housing. See Thermostat Housing Remove and Install. (Group 0400.)

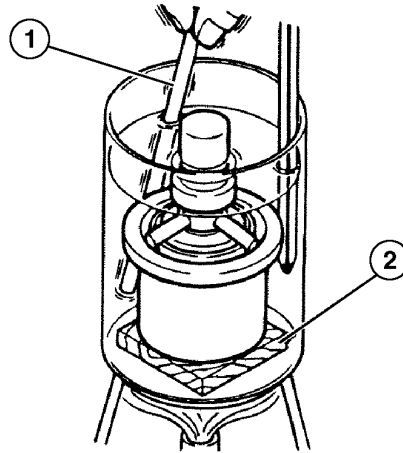
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TX1010209 -UN-18.JUL06

Thermostat Inspection

1. Inspect thermostat for visual damage.
2. Place thermostat into a container of water on top of a noncombustible block.
3. Slowly heat water while stirring.
4. Measure temperature that the thermostat first starts to open and when it is fully opened.



	Specification	
Thermostat First Opening—		
Temperature		82°C
		179°F
Thermostat Fully Opened—		
Temperature		95°C
		203°F

5. Measure the amount of lift from closed position to the opened position.

	Specification	
Thermostat—Lift		11 mm at 95°C
		0.433 in. at 203°F

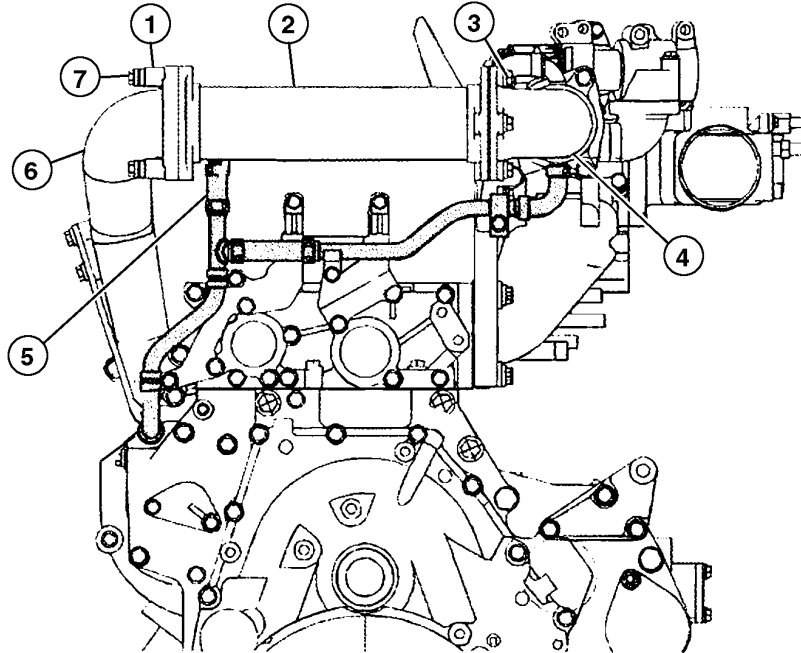
1—Thermostat
2—Block

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Primary Exhaust Gas Recirculation (EGR) Cooler Remove and Install



TX1010294

- | | | | |
|--------------------------------------------------|----------------------------------------------------|--------------------|----------------|
| 1—Spacer (3 used) | 3—Cap Screw (3 used) | 5—Water Inlet Pipe | 7—Nut (3 used) |
| 2—Primary Exhaust Gas Recirculation (EGR) Cooler | 4—Secondary Exhaust Gas Recirculation (EGR) Cooler | 6—Air Duct | |

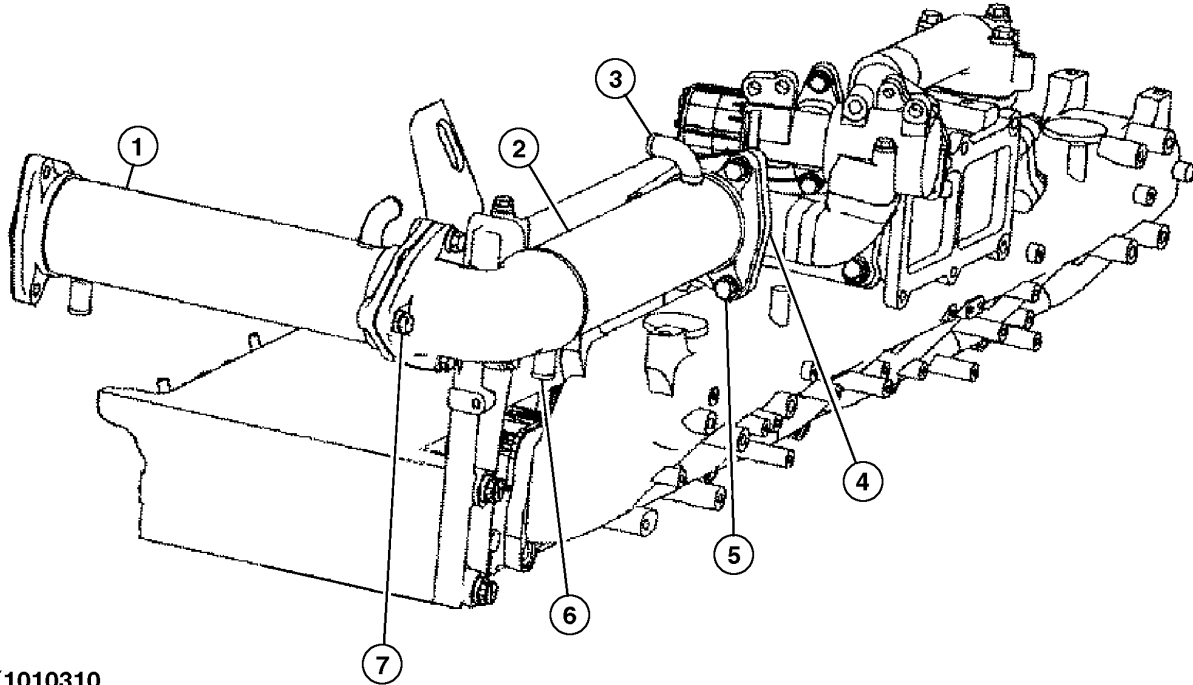
1. Drain engine coolant. See Drain Cooling System. (Operator's Manual.)
2. Remove water inlet pipe (5).
3. Remove water return pipe.
4. Remove primary exhaust gas recirculation (EGR) cooler (6) and discard gaskets.
5. Repair and replace as necessary.
6. Install primary exhaust gas recirculation (EGR) cooler with new gaskets.
7. Install water return pipe.
8. Install water inlet pipe.
9. Perform Cooling System Fill and Deaeration Procedure. (Operator's Manual.)

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TX1010294 -UN-20JUL06

Secondary Exhaust Gas Recirculation (EGR) Cooler Remove and Install



TX1010310

- | | | | |
|----------------------------------------------------|---------------------|----------------------|----------------------|
| 1—Primary Exhaust Gas Recirculation (EGR) Cooler | 3—Water Return Pipe | 5—Cap Screw (3 used) | 7—Cap Screw (3 used) |
| 2—Secondary Exhaust Gas Recirculation (EGR) Cooler | 4—Air Duct | 6—Water Inlet Pipe | |

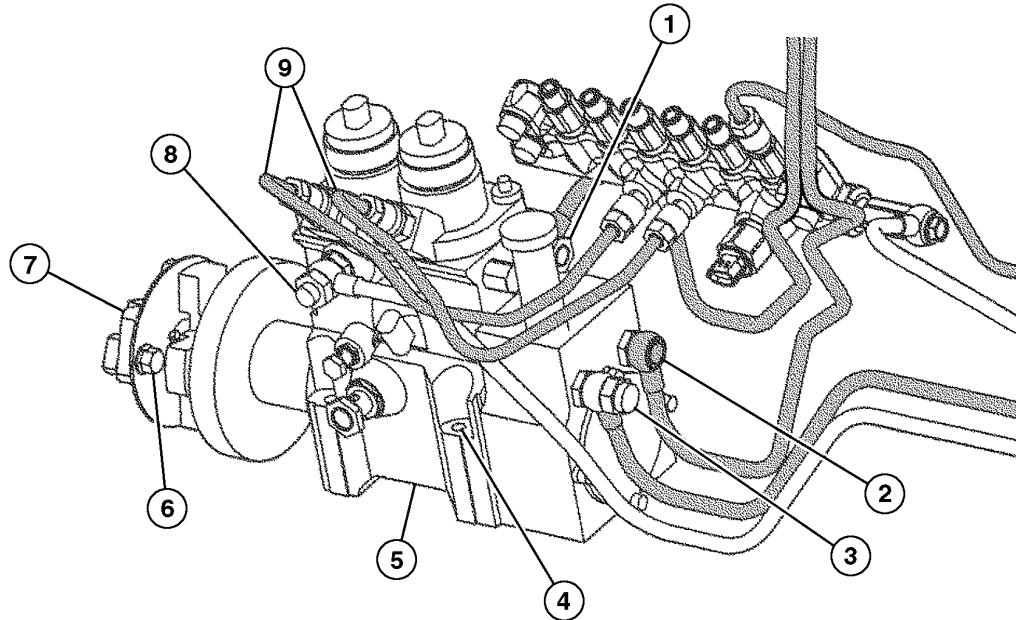
1. Drain engine coolant. See Drain Cooling System. (Operator's Manual.)
2. Remove water inlet pipe (6).
3. Remove water return pipe (3).
4. Remove secondary exhaust gas recirculation (EGR) cooler (2) and discard gaskets.
5. Repair and replace as necessary.
6. Install secondary exhaust gas recirculation (EGR) cooler with new gaskets.
7. Install water return pipe.
8. Install water inlet pipe.
9. Perform Cooling System Fill and Deaeration Procedure. (Operator's Manual.)

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TX1010310 -UN-20JUL06

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High Pressure Fuel Pump Remove and Install



1—Fuel Pump Supply Line
2—Fuel Filter Supply Line
3—Fuel Supply Line

4—Cap Screw (4 used)
5—High Pressure Fuel Pump
6—Cap Screw (4 used)

7—Coupling
8—Fuel Return Line

9—High Pressure Line (2 used)

1. Disconnect fuel filter supply line (2).
2. Disconnect fuel supply line (3).
3. Disconnect fuel return line (8).
4. Disconnect high pressure lines (9).
5. Disconnect fuel pump supply line (1).
6. Disconnect oil feed and return lines.
7. Remove coupling (7).
8. Remove high pressure fuel pump cap screws (4).
9. Remove high pressure fuel pump.
10. Repair and Replace as necessary.
11. Install high pressure fuel pump.

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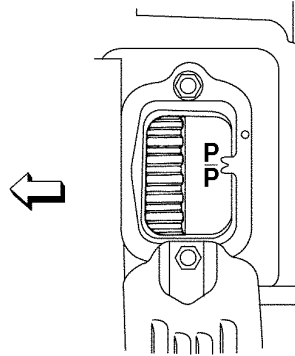
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TX1010362 -UN-27JUL06

Removal and Installation

12. Turn crankshaft counterclockwise until the number 1 cylinder is at BDC (bottom dead center). Turn crankshaft clockwise until the P—P mark aligns with the timing pointer. Number 1 cylinder must be near TDC (top dead center).



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13. Line up the fuel pump mark (11) to the coupling mark (12).

14. Install coupling cap. Tighten cap screws (10) to specification.

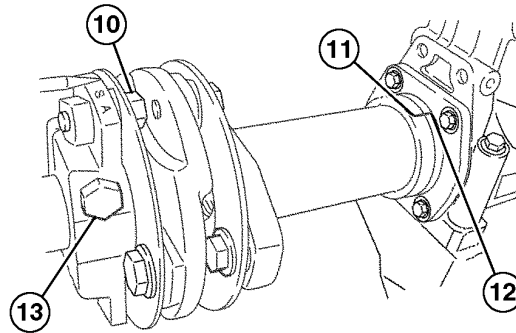
Specification

High Pressure Fuel Pump	
Coupling—Torque.....	62 N•m 46 lb-ft

15. Check that there are no bends in the coupling lamination. Tighten the cotter cap screw (13) to specification.

Specification

High Pressure Fuel Pump Cotter	
Cap Screw—Torque.....	91 N•m 67 lb-ft



TX1010617 -UN-27JUL06

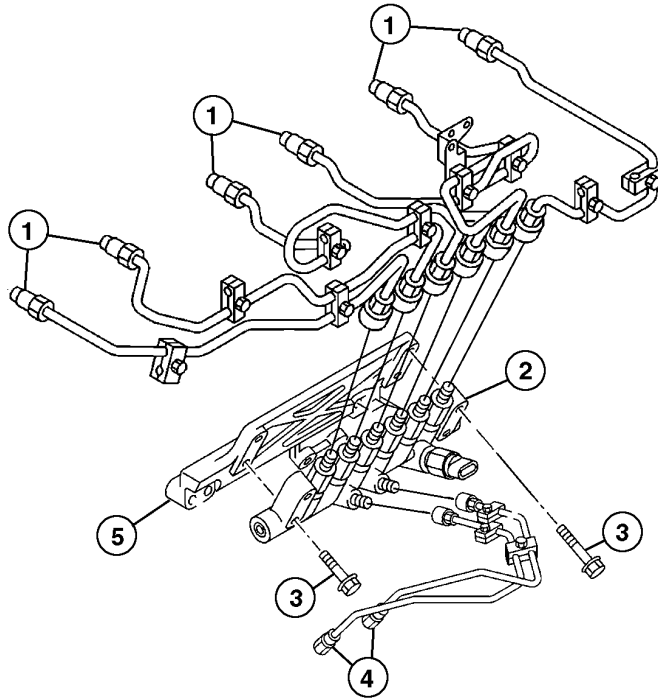
- 10—Coupling Cap Screws
- 11—Fuel Pump Mark
- 12—Coupling Mark
- 13—Cotter Cap Screw

16. Connect oil feed and return lines.
17. Connect fuel pump supply line.
18. Connect high pressure lines.
19. Connect fuel return line.
20. Connect fuel supply line.
21. Connect fuel filter supply line.

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High Pressure Fuel Rail Remove and Install



TX1010345

- 1—Fuel Injection Nozzle Pressure Line (6 used)
- 2—High Pressure Fuel Rail
- 3—Cap Screw (4 used)
- 4—High Pressure Fuel Rail Supply Line (2 used)
- 5—Bracket

1. Disconnect fuel injection nozzle pressure lines (1).
2. Disconnect high pressure fuel rail feed lines (4).
3. Disconnect the pressure relief line.
4. Remove high pressure fuel rail (2).
5. Remove high pressure fuel rail (2).
6. Repair and replace as necessary.
7. Install high pressure fuel rail. Tighten cap screws to specification.
8. Connect the pressure relief line.
9. Connect high pressure fuel rail feed lines. Tighten high pressure fuel rail feed lines to specification.
10. Connect fuel injection nozzle pressure lines. Tighten fuel injection nozzle pressure lines to specification.

Specification	
High Pressure Fuel Rail-to-Bracket Cap Screw—	
Torque.....	22 N•m 195 lb-in.

Specification	
Fuel Injection Nozzle Pressure Line-to-High Pressure Fuel Rail—Torque.....	54 N•m 40 lb-ft
Fuel Injection Nozzle Pressure Line-to-High Pressure Fuel Rail—Torque.....	39 N•m 29 lb-ft

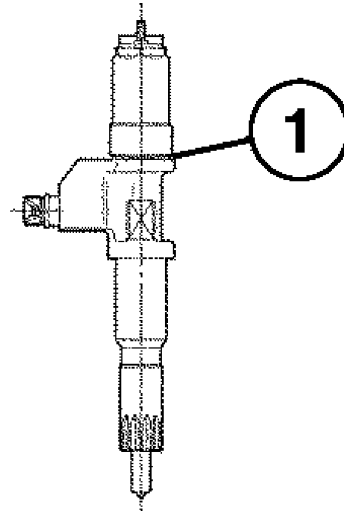
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TX1010345 -UN-24JUL06

Fuel Injection Nozzle Remove and Install

1. Remove upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)
2. Remove fuel injector nozzle leak off pipe.
3. Disconnect fuel injector nozzle pressure line at injector.

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4. Place a tag on fuel injector nozzle.
5. Remove for fuel injector nozzle hold down.



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Removal and Installation

6. Remove fuel injector nozzle using slide hammer (1) and fuel injector remover (2).
7. Inspect and replace as needed.
8. Install fuel injector nozzle.
9. Tighten fuel injector nozzle hold down cap screw.

Specification

Fuel Injector Nozzle Hold Down-To-Cylinder Head Cap Screw—Torque.....	20 N•m 177 lb-in.
-----------------------------------------------------------------------------	----------------------

10. Connect fuel injector nozzle pressure line.
11. Install fuel injector nozzle leak off line.
12. Tighten fuel injection nozzle to specification.

Specification

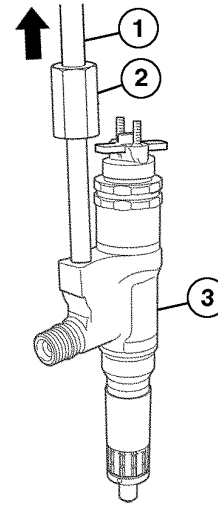
Fuel Injection Nozzle Leak Off Line-to-Fuel injection Nozzle— Torque	15 N•m 133 lb-in.
----------------------------------------------------------------------------------	----------------------

13. Tighten fuel leak off line to adapter at lower valve cover.

Specification

Fuel Injection Nozzle Leak Off Line-to-Fuel Line Adapter— Torque	20 N•m 177 lb-in.
------------------------------------------------------------------------------	----------------------

14. Install upper valve cover. See Upper Valve Cover Remove and Install. (Group 0400.)



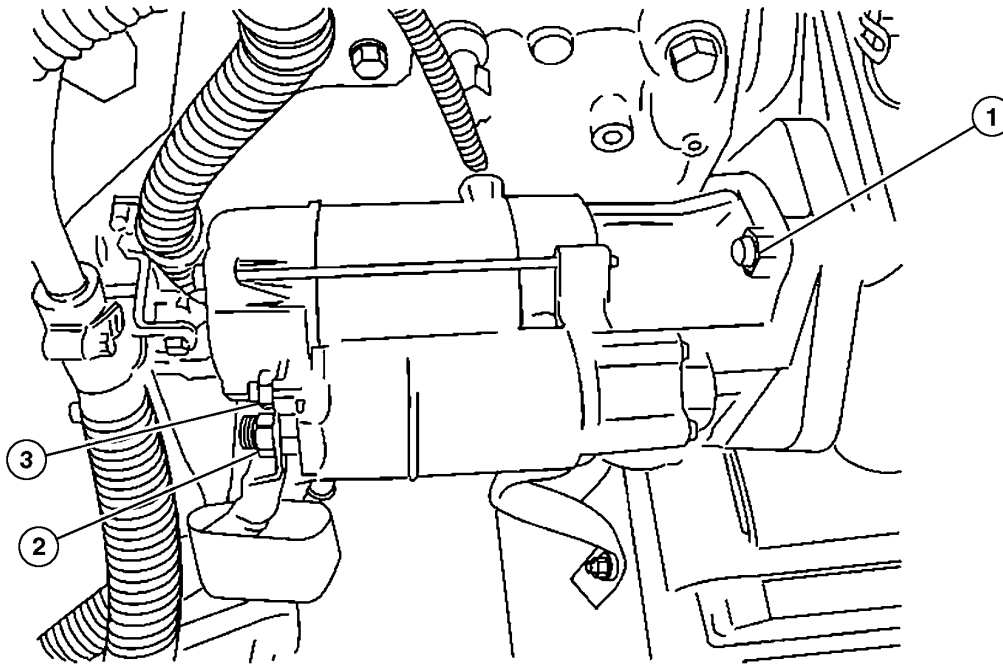
1—Slide hammer
2—Fuel injector remover
3—Fuel injector

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Starter Motor Remove and Install



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TX1010419

1—Nut (2 used)

2—B Terminal Nut

3—S Terminal Nut

1. Disconnect negative (-) battery cables at battery.
2. Remove B terminal nut (2). Disconnect B terminal wire.
3. Remove S terminal nut (3). Disconnect S terminal wire.
4. Disconnect wiring leads at starter solenoid.
5. Remove starter nuts (1).
6. Remove starter.

7. Inspect and repair as necessary.
8. Install starter. Install and tighten starter nuts.

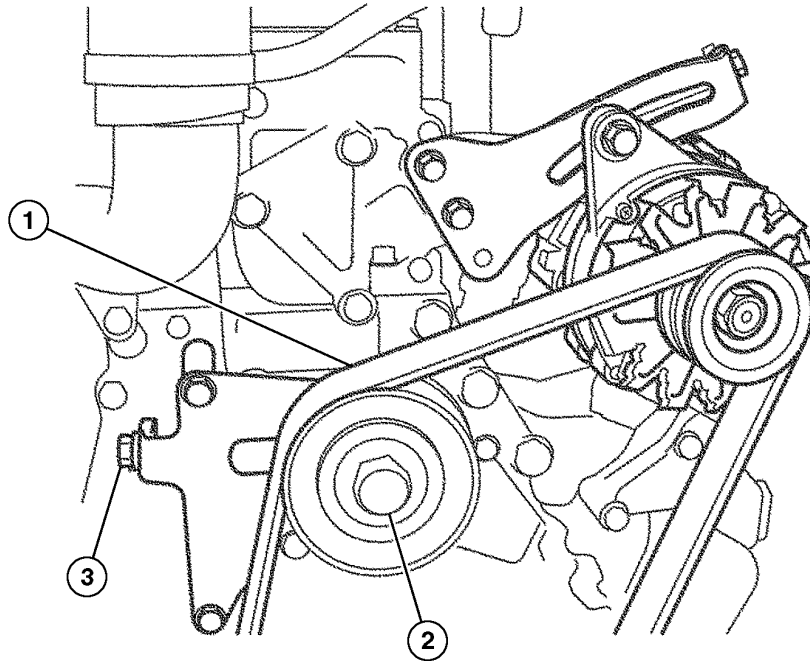
Specification

Starter Nuts—Torque..... 103 N•m
76 lb-ft

9. Connect S terminal wire. Install S terminal nut.
10. Connect B terminal wire. Install B terminal nut.
11. Connect negative (-) battery cables at battery.

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Serpentine Belt Remove and Install



1—Serpentine Belt

2—Nut

3—Adjuster

1. Loosen nut (2) on serpentine belt idler.
2. Loosen serpentine belt idler adjuster (3).
3. Remove serpentine belt (1).
4. Replace as necessary.
5. Install serpentine belt.

Continued on next page

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TX1010517 -UN-25JUL06

Removal and Installation

- Adjust serpentine belt tension at adjuster.

Specification

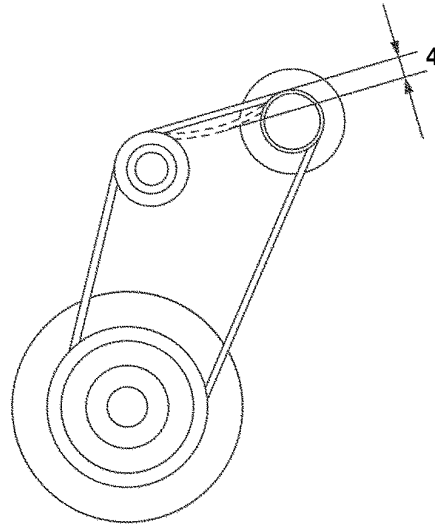
Serpentine Belt—Deflection 6—8 mm at 98 N
0.24—0.32 in. at 22 lb-force

- Tighten nut on serpentine belt adjuster.

Specification

Serpentine Belt Adjuster—Torque..... 147 N•m
108 lb-ft

4—Serpentine Belt Deflection

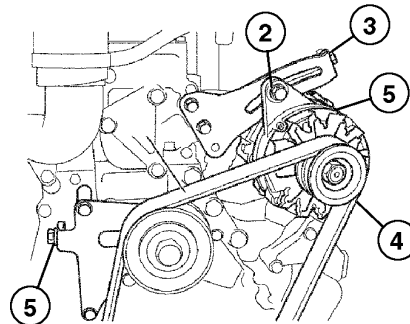


TX1010519 -UN-25JUL06

GD61784.0000013 -19-31JUL06-2/2

Alternator Remove and Install

- Disconnect negative (-) battery cables at battery.
- Remove serpentine belt. See Serpentine Belt Remove and Install. (Group 0400.)
- Disconnect wires from alternator.
- Remove alternator (5).
- Inspect and repair as needed.
- Install alternator (5).
- Connect wires.
- Install serpentine belt. See Serpentine Belt Remove and Install. (Group 0400.)
- Connect (-) battery cables at battery.



1—Serpentine belt
2—Cap Screw
3—Adjuster
4—Cap Screw
5—Alternator

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Section 05 Engine Auxiliary System

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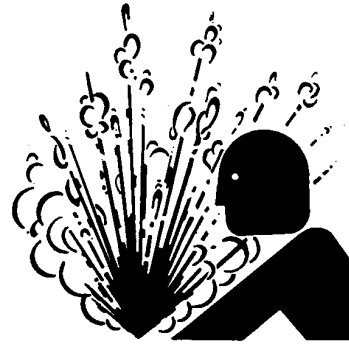
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Radiator Remove and Install

 **CAUTION:** Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

1. Drain engine coolant. See Drain Cooling System. (Operator's Manual.) Approximate capacity is 46 L (12 gal).



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05
0510
1

Cooling System

2. Remove intercooler. See Intercooler Remove and Install. (Group 0510.)
3. Remove cooler frame cover.
4. Remove upper and lower coolant pipe (8 and 9).
5. Remove upper radiator hose (2) and lower radiator hose (5). Close openings using caps and plugs.



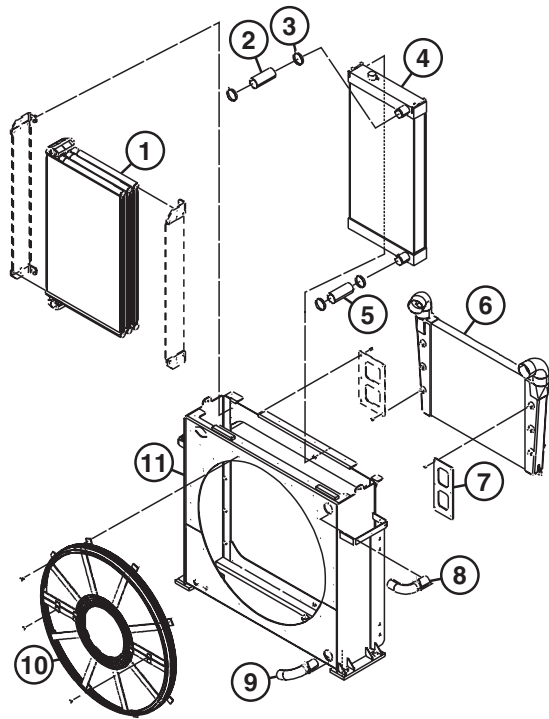
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

6. Remove radiator (4) from cooler frame (11).

Specification

Radiator Core—Weight 23 kg approximate
50 lb approximate

7. Repair or replace parts as necessary.
8. Install radiator in cooler frame.
9. Install upper and lower radiator hose.
10. Install upper and lower coolant pipe.
11. Install cooler frame cover.
12. Install intercooler. See Intercooler Remove and Install. (Group 0510.)
13. Perform Cooling System Fill and Deaeration Procedure. (Group 1830.)



- 1—Hydraulic Oil Cooler
- 2—Upper Radiator Hose
- 3—Hose Clamp (4 used)
- 4—Radiator
- 5—Lower Radiator Hose
- 6—Intercooler
- 7—Bracket
- 8—Upper Coolant Pipe
- 9—Lower Coolant Pipe
- 10—Fan Guard
- 11—Cooler Frame

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Hydraulic Oil Cooler Remove and Install

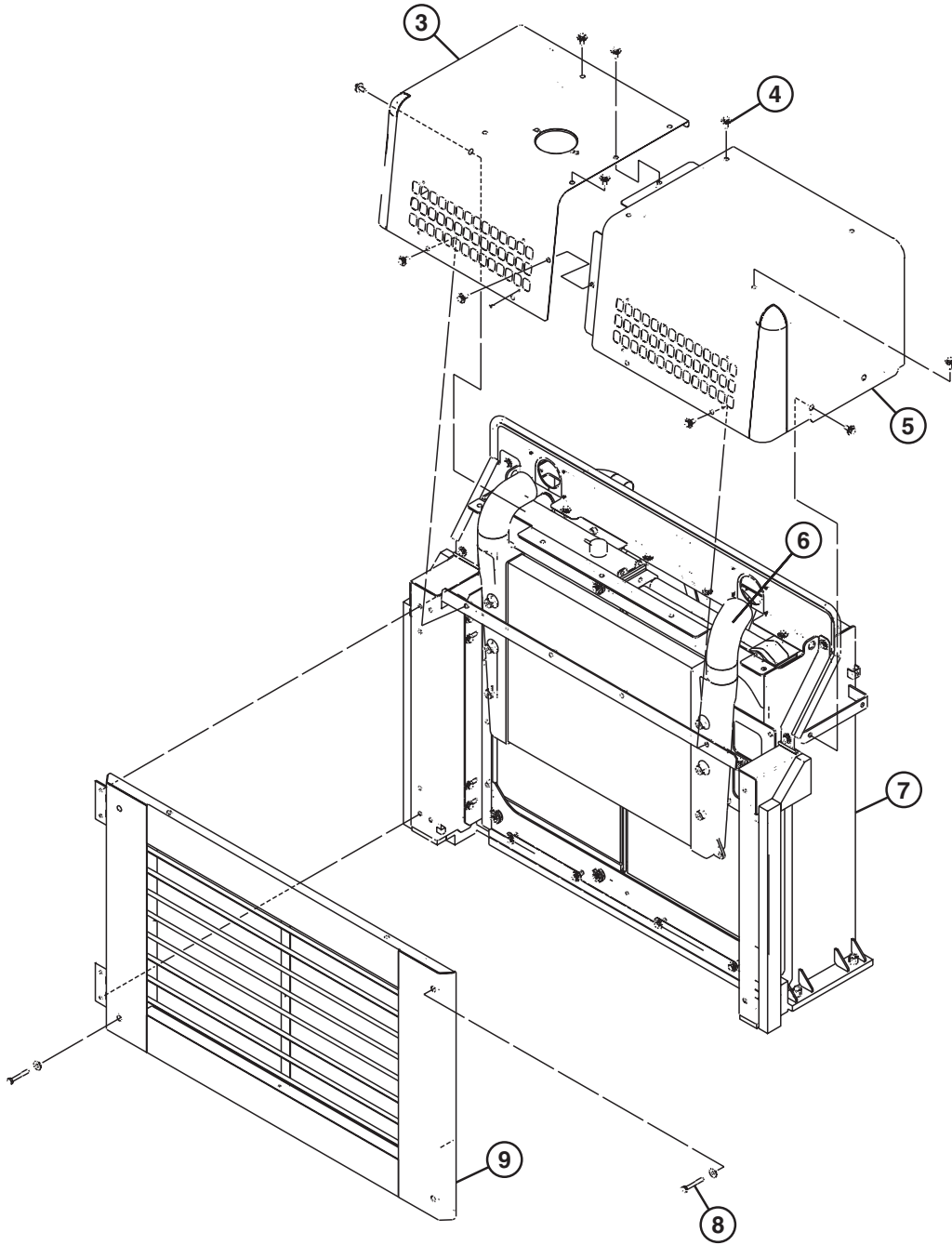
See Hydraulic Oil Cooler Remove and Install. (Group 3360.)

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Cooling System

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3

Intercooler Remove and Install



05
0510
4

TX1010436

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TX1010436 -UN-24JUL06

Cooling System

3—Rear Cover
4—Cap Screw (20 used)

5—Front Cover
6—Intercooler

7—Cooling Package
8—Cap Screw (4 used)

9—Cooling Package Door

1. Open cooling package door (9).
2. Remove front cover (5).
3. Remove rear cover (3).

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4. Loosen hose clamps (10).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

5. Attach hoist to intercooler (6) and remove intercooler. Close all openings using caps and plugs.

Specification	
Intercooler—Weight.....	41 kg approximate 90 lb approximate

6. Repair or replace parts as necessary.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

7. Install intercooler using hoist.

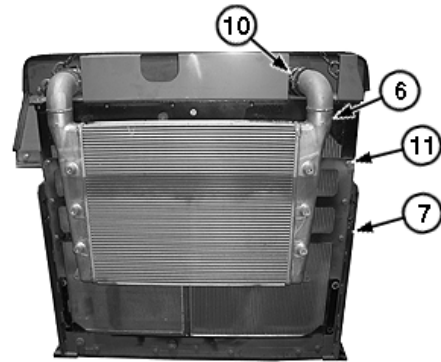
Specification	
Intercooler—Weight.....	41 kg approximate 90 lb approximate

8. Tighten hose clamps.

9. Install front cover.

10. Install rear cover.

11. Close cooling package door.



6—Inter Cooler
7—Cooling Package
10—Hose Clamp
11—Cap Screw (6 used)

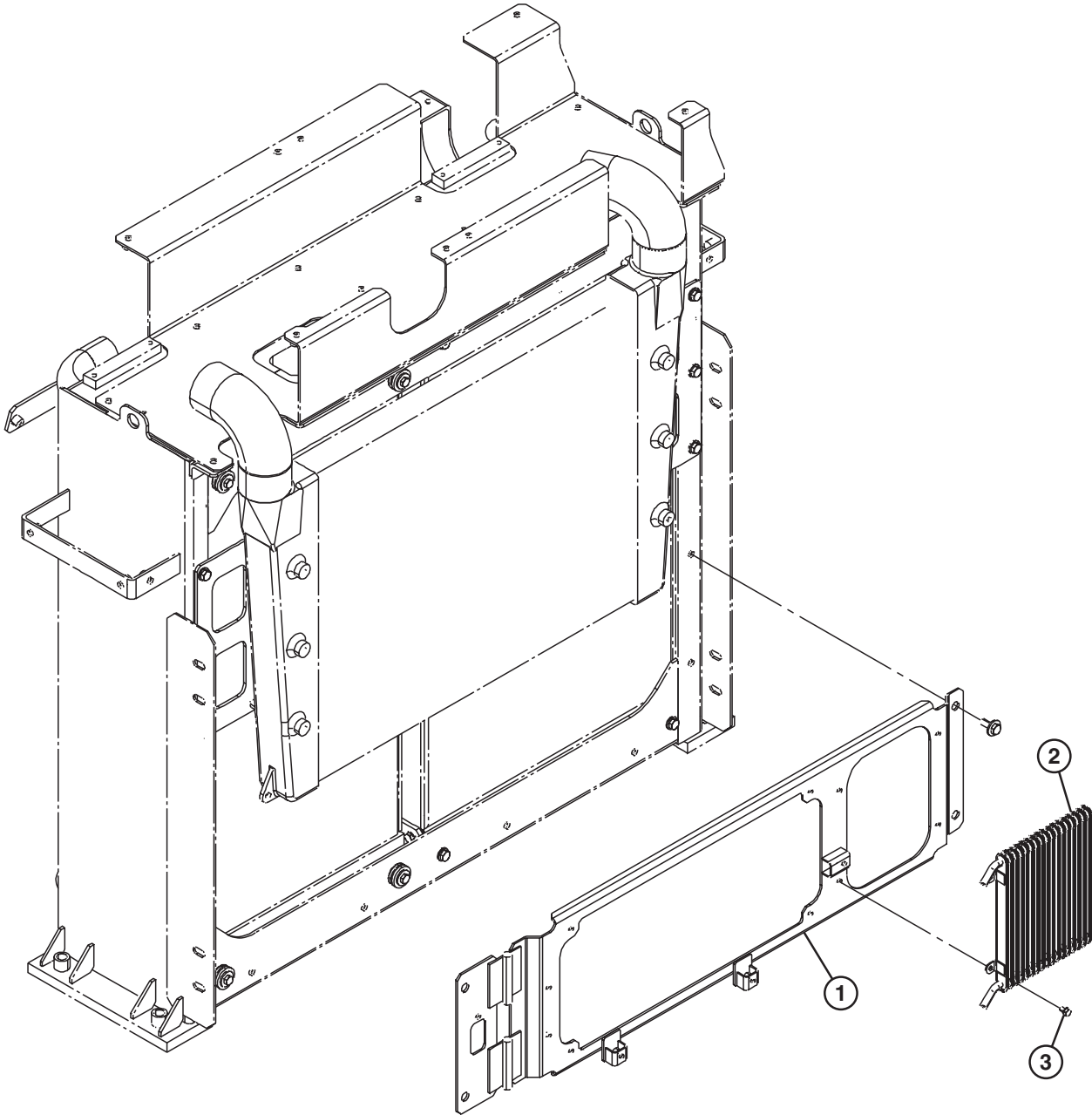
TX1010453A -JUN-24-JUL06

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Fuel Cooler Remove and Install

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6



TX1010423

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Cooling System

1—Bracket

2—Fuel Cooler

3—Cap Screw (4 used)

1. Open cooling package door.
2. Loosen fuel cooler hose clamps to disconnect hoses. Close openings using caps and plugs.
3. Remove fuel cooler (2).
4. Repair or replace parts as necessary.
5. Install fuel cooler.
6. Connect hoses. Tighten hose clamps.
7. Close cooling package door.

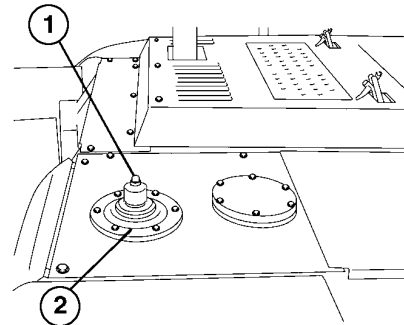
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Cooling Package Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing button on top of hydraulic tank.
2. Drain hydraulic oil. Approximate capacity is 322 L (85 gal).



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

T214924 -UN-17NOV05

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0510
7

Continued on next page

GD61784.0000026 -19-01AUG06-1/19



CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

- 3. Drain Coolant. See Drain Cooling System. (Operator's Manual.) Approximate capacity is 46 L (12 gal).



TS281 -UN-23AUG88



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 4. Remove front engine hood.

Specification

Front Engine Hood—Weight 32 kg approximate
71 lb approximate

- 5. Remove rear engine hood.

Specification

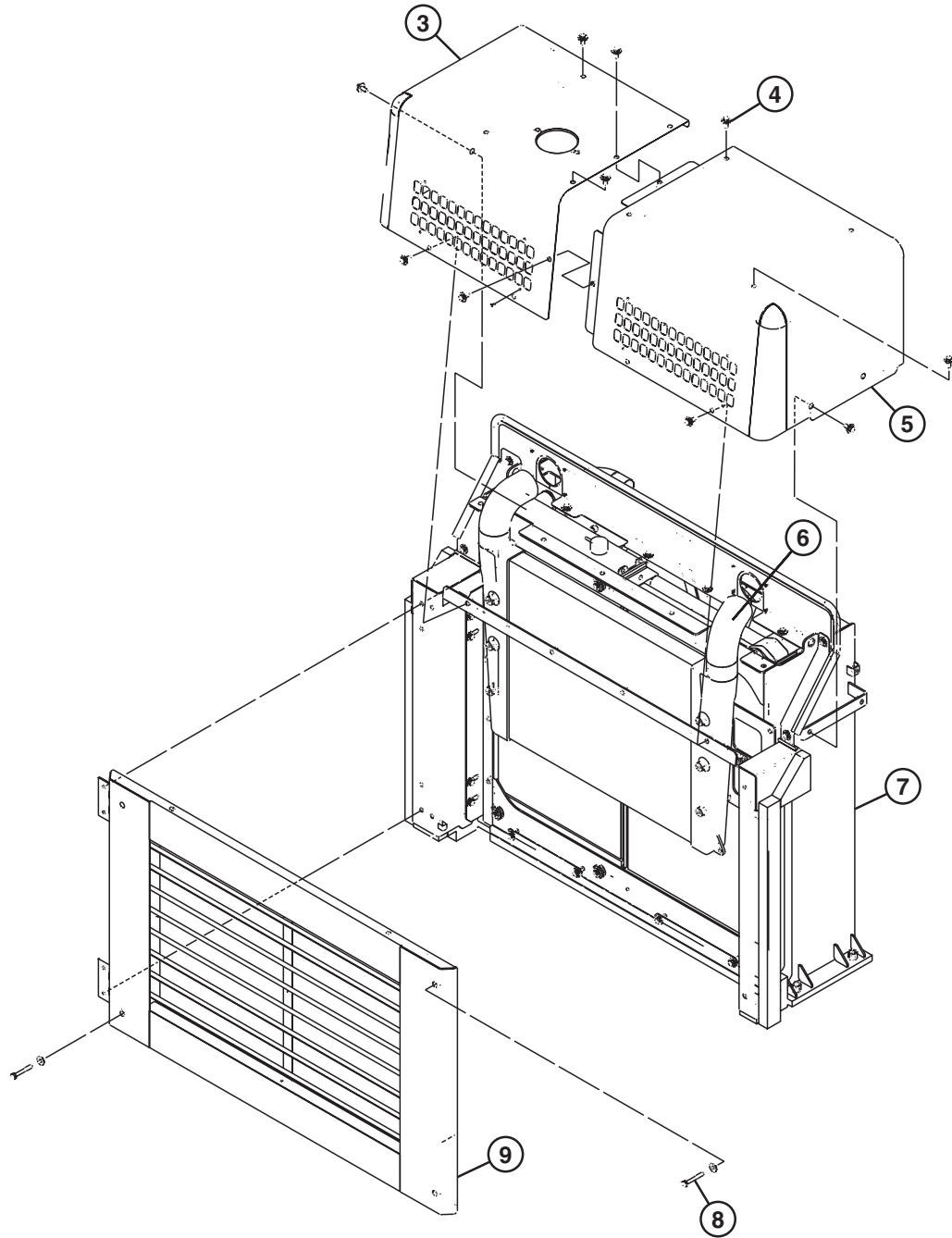
Rear Engine Hood—Weight 23 kg approximate
50 lb approximate

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Continued on next page

GD61784,000026 -19-01AUG06-2/19

Cooling System



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TX1010436

3—Rear Cover
4—Cap Screw (20 used)

5—Front Cover
6—Intercooler

7—Cooling Package
8—Cap Screw (4 used)

9—Cooling Package Door

Continued on next page

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Cooling System

6. Open cooling package door (9).

8. Remove front cover (5).

7. Remove rear cover (3).

GD61784.0000026 -19-01AUG06-4/19

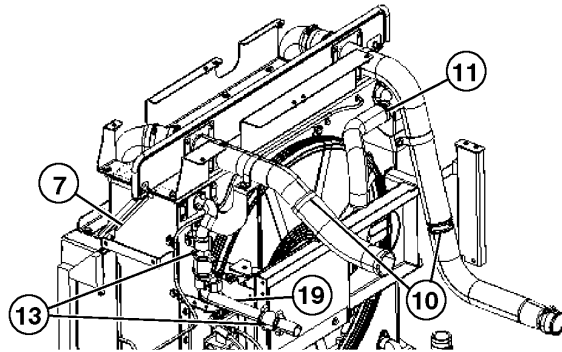
9. Loosen nut on hose clamps (10).

10. Disconnect intercooler inlet and outlet hoses.

11. Disconnect recovery hose from cooling package.

12. Disconnect radiator hoses (11).

7—Cooler Frame
10—Hose Clamp (2 used)
11—Radiator Hose (2 used)
13—Coupling (2 used)
19—Hydraulic Oil Cooler Inlet Pipe



TX1010592 -UN-26JUL06

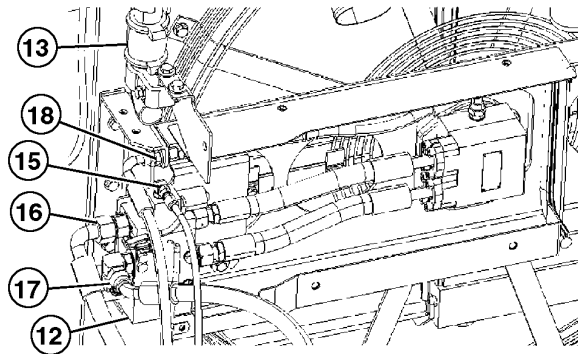
GD61784.0000026 -19-01AUG06-5/19

13. Disconnect fan valve hydraulic lines (15—17).

14. Disconnect hydraulic line (18).

15. Disconnect fan valve wire connector.

12—Fan Valve
13—Coupling (2 used)
15—Fan Valve Hydraulic Line
16—Fan Valve Hydraulic Line
17—Fan Valve Hydraulic Line
18—Hydraulic Line



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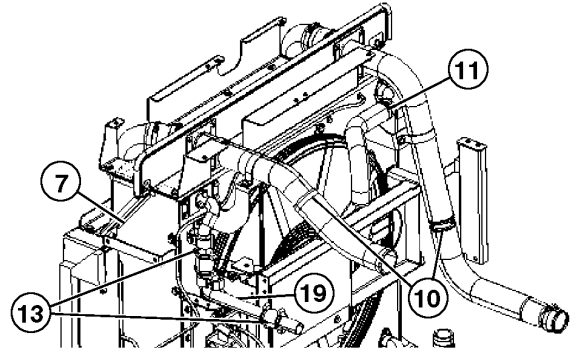
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Cooling System

16. Remove couplings (13).
17. Remove hydraulic oil cooler inlet pipe (19).
18. Disconnect hydraulic oil cooler outlet pipe. Close openings using caps and plugs.

7—Cooler Frame
10—Hose Clamp (2 used)
11—Radiator Hose (2 used)
13—Coupling (2 used)
19—Hydraulic Oil Cooler Inlet Pipe



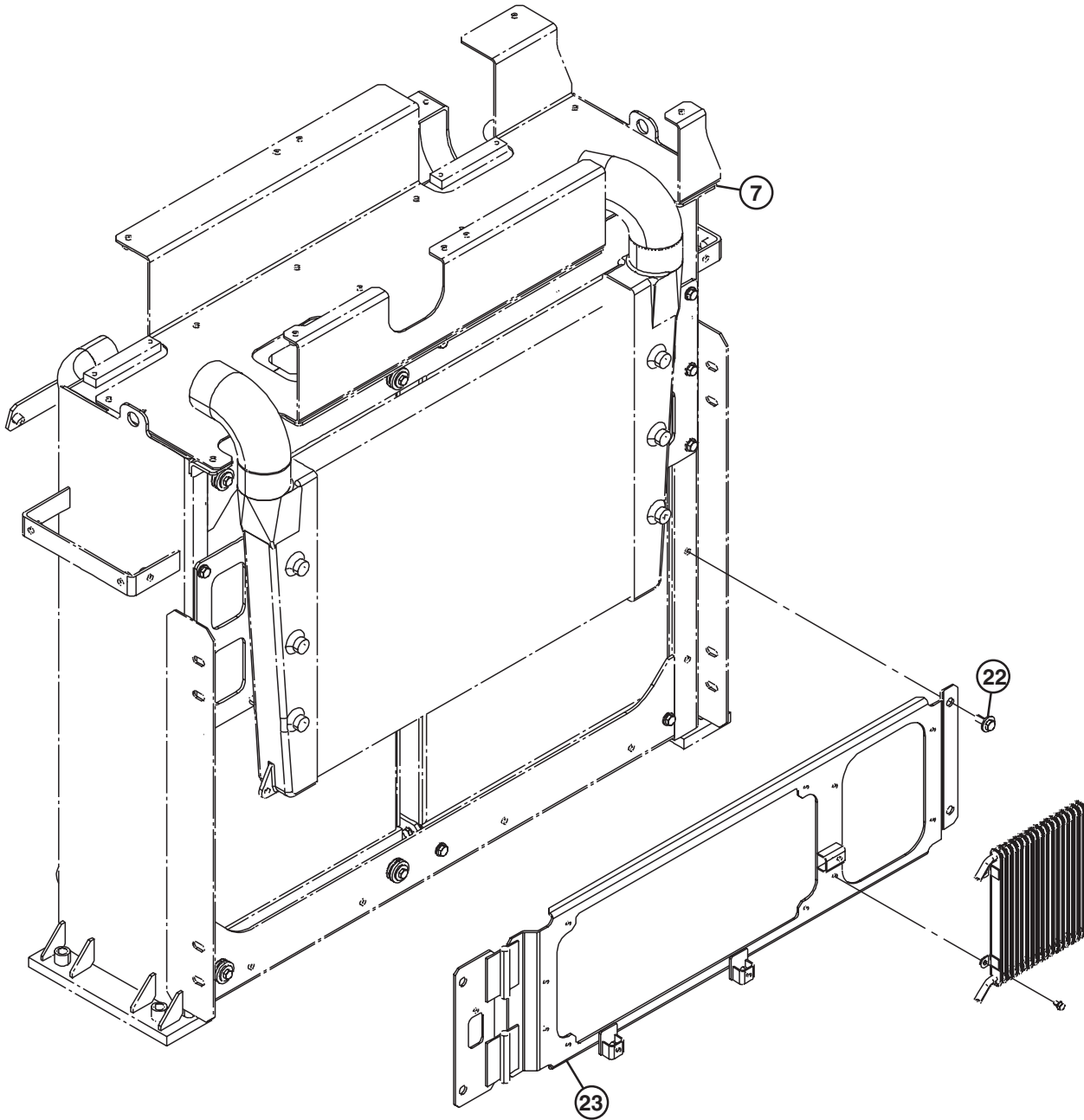
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GD61784,0000026 -19-01AUG06-7/19

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Cooling System



05
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12

TX1010608

7—Cooler Frame

22—Cap Screw (4 used)

23—A/C Condenser-Fuel
Cooler Bracket

Continued on next page

GD61784.0000026 -19-01AUG06-8/19

TX1010608 -JUN-28JUL06

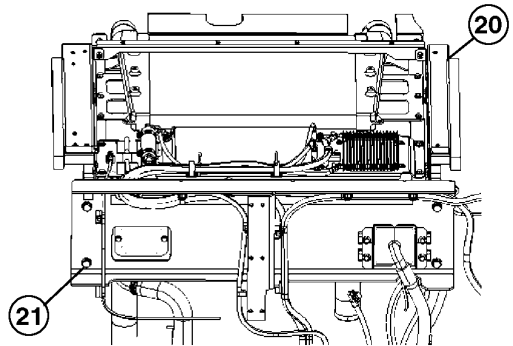
Cooling System

- 19. Remove and move A/C condenser-fuel cooler bracket (23) out of the way without disconnecting A/C and fuel lines.

GD61784,0000026 -19-01AUG06-9/19

- 20. Remove cap screws (21 and 20).

20—M12 Cap Screw (4 used)
21—M20 Cap Screw (4 used)



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GD61784,0000026 -19-01AUG06-10/19

- 21. Remove cooling package.

Specification

Cooling Package—Weight..... 572 kg approximate
1260 lb approximate

- 22. Inspect and repair as necessary.

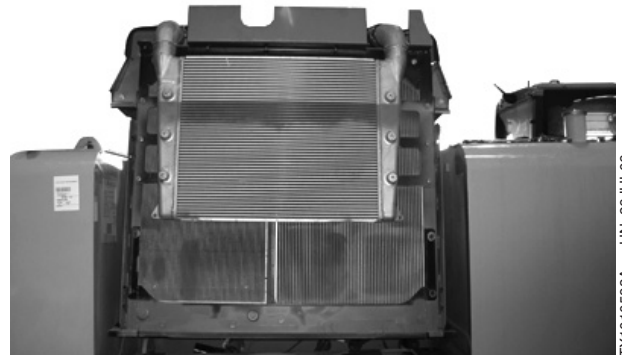


CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 23. Install cooling package.

Specification

Cooling Package—Weight..... 572 kg approximate
1260 lb approximate



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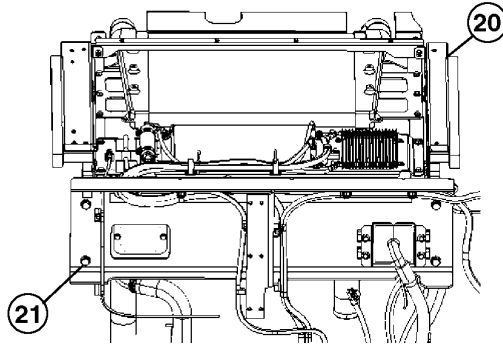
Cooling System

24. Apply PM38654 Thread Lock (high strength) to cap screws (20 and 21). Install cap screws and tighten cap screws to specification.

Specification

M20 Cooling Package-to-Frame Cap Screws—Torque	550 N•m 405 lb-ft
M12 Cooling Package-to-Frame Cap Screws—Torque	90 N•m 66 lb-ft

20—M12 Cap Screw (4 used)
21—M20 Cap Screw (4 used)



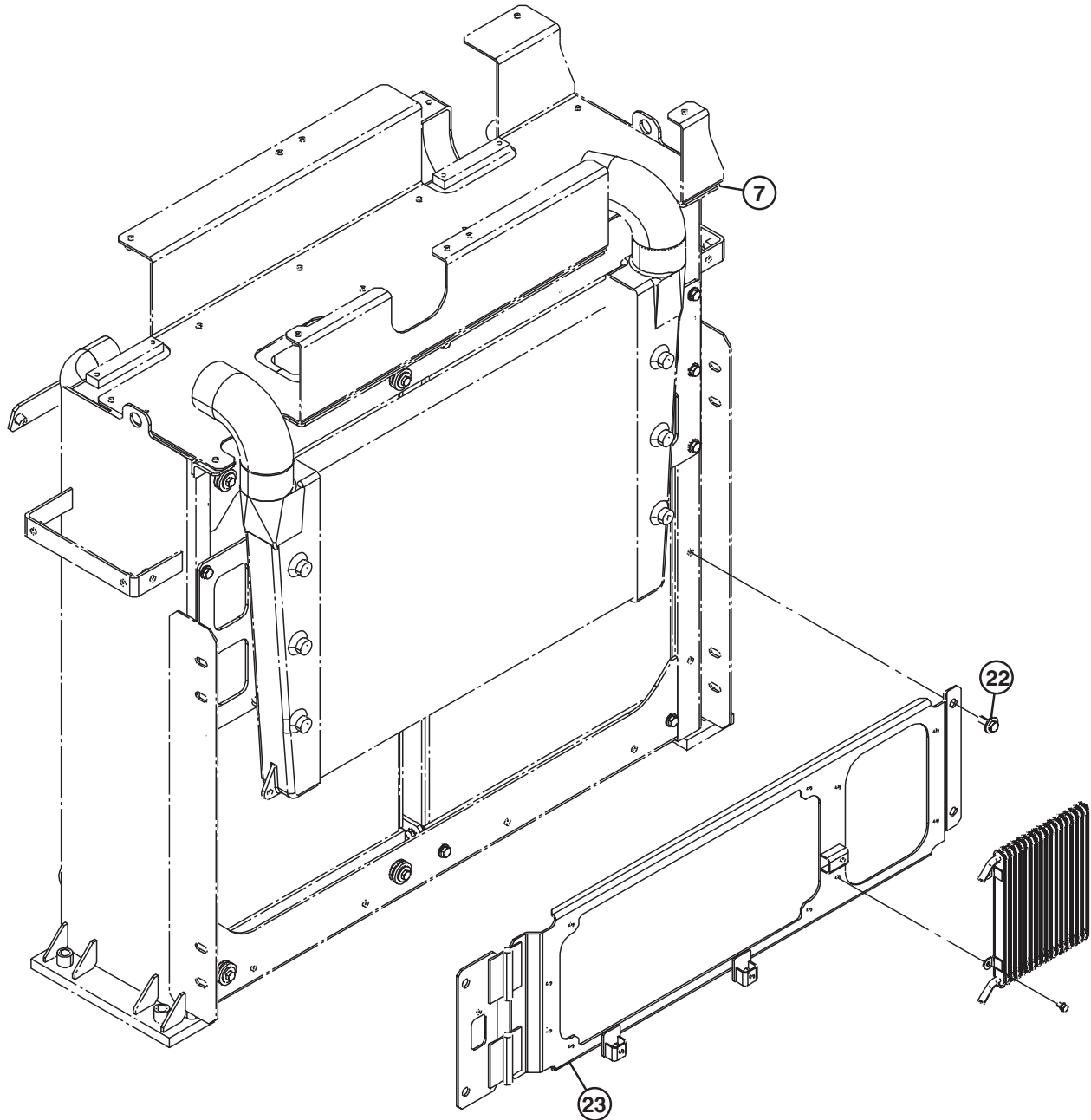
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GD61784,0000026 -19-01AUG06-12/19

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Cooling System



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15

TX1010608

7—Cooling Package

22—Cap Screw (4 used)

23—A/C Condenser-Fuel
Cooler Bracket

Continued on next page

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TX1010608 -JUN-28JUL06

Cooling System

25. Install A/C condenser-fuel cooler bracket assembly (23).

27. Connect hydraulic oil cooler outlet pipe.

26. Remove all caps and plugs.

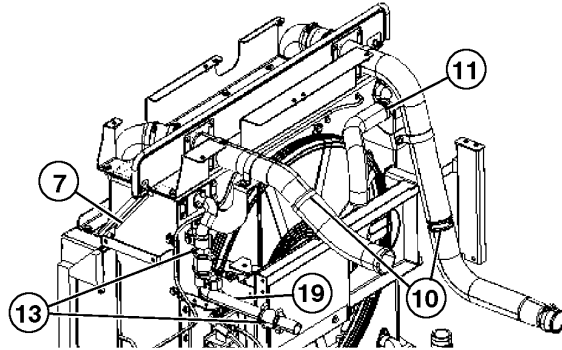
GD61784,0000026 -19-01AUG06-14/19

28. Install hydraulic oil cooler inlet pipe (19).

29. Install couplings (13).

30. Connect fan valve wire connector.

- 7—Cooling Package
- 10—Hose Clamp (2 used)
- 11—Radiator Hose (2 used)
- 13—Coupling (2 used)
- 19—Hydraulic Oil Cooler Inlet Pipe



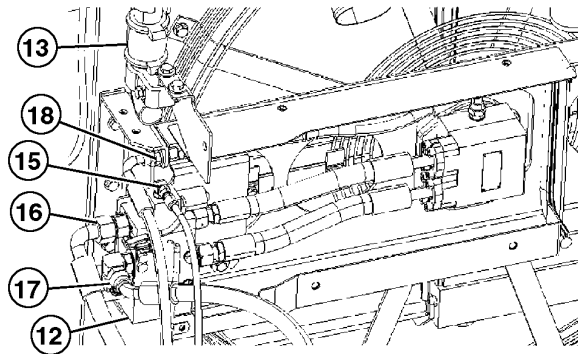
TX1010592 -UN-26JUL06

GD61784,0000026 -19-01AUG06-15/19

31. Connect hydraulic line (18).

32. Connect fan valve hydraulic lines (15—17).

- 12—Fan Valve
- 13—Coupling (2 used)
- 15—Fan Valve Hydraulic Line
- 16—Fan Valve Hydraulic Line
- 17—Fan Valve Hydraulic Line
- 18—Hydraulic Line



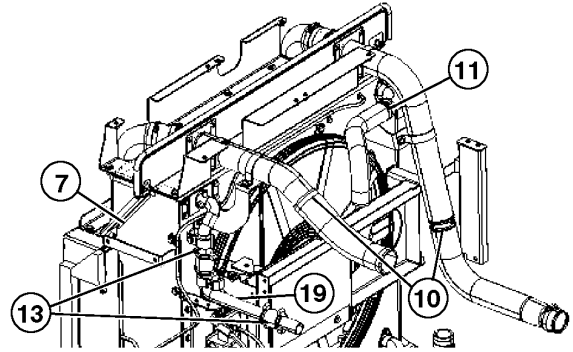
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Cooling System

33. Connect radiator hoses (11).
34. Connect recovery hose from cooling package.
35. Connect intercooler inlet and outlet hoses.
36. Tighten nut on hose clamps (10).
37. Install cover (5).
38. Install rear cover (3).



TX1010592 -UN-26JUL06

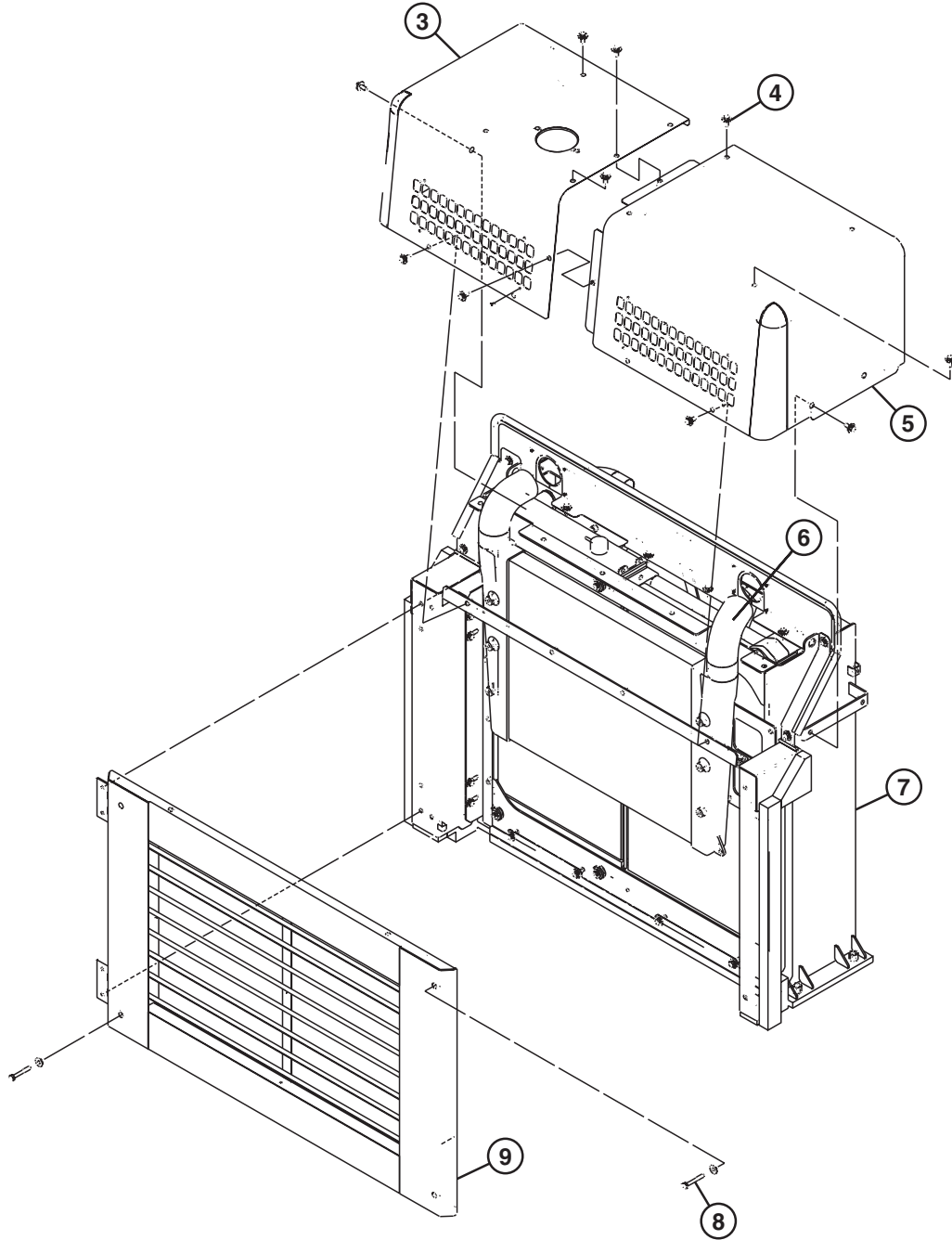
- 7—Cooling Package
- 10—Hose Clamp (2 used)
- 11—Radiator Hose (2 used)
- 13—Coupling (2 used)
- 19—Hydraulic Oil Cooler Inlet Pipe

Continued on next page

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Cooling System



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18

TX1010436

3—Rear Cover
4—Cap Screw (20 used)

5—Front Cover
6—Intercooler

7—Cooling Package
8—Cap Screw (4 used)

9—Cooling Package Door

Continued on next page

GD61784,0000026 -19-01AUG06-18/19

TX1010436 -JUN-24JUL06

Cooling System

39. Close cooling package door (9).



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

40. Install rear engine hood.

Specification

Rear Engine Hood—Weight..... 23 kg approximate
50 lb approximate

41. Install front engine hood.

Specification

Front Engine Hood—Weight..... 32 kg approximate
71 lb approximate

42. Perform Cooling System Fill and Deaeration Procedure. (Group 1830.) Approximate capacity is 46 L (12 gal).

43. Fill hydraulic oil. See Hydraulic Oil. Approximate capacity is 322 L (85 gal).

GD61784,0000026 -19-01AUG06-19/19

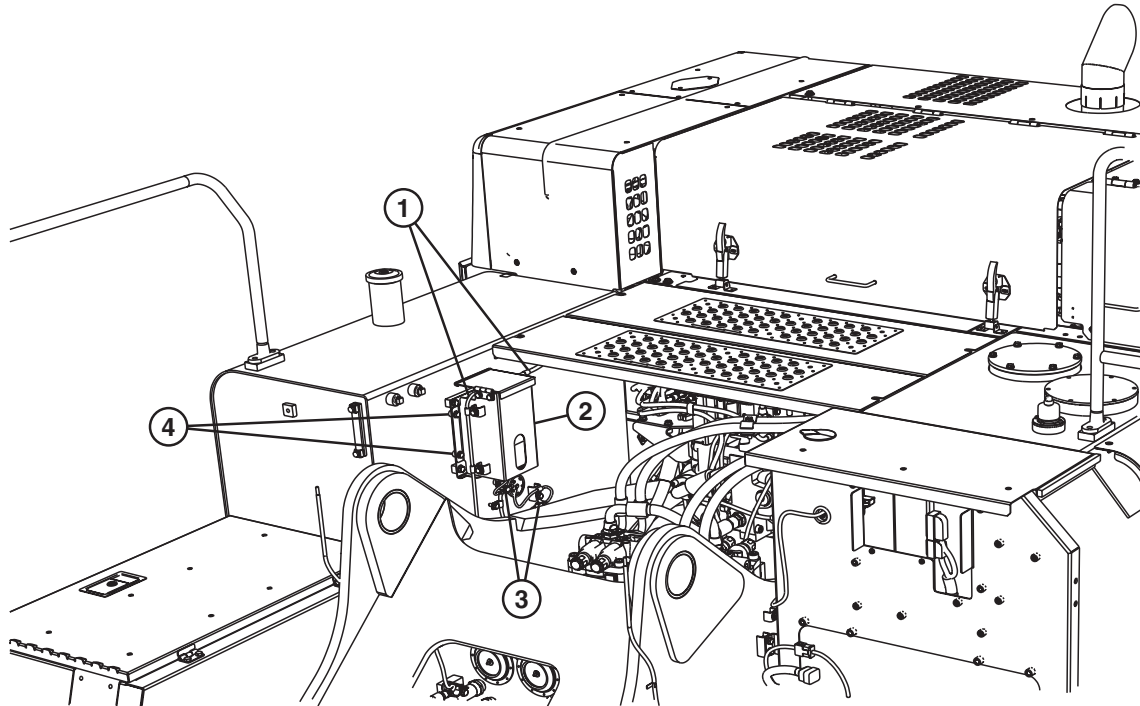
Fan, Fan Guard, and Fan Shroud Remove and Install

See Fan Drive Motor Remove and Install. (Group 3360.)

TX17984,000004A -19-18JUL06-1/1

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Coolant Recovery Tank Remove and Install



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TX1010488

1—Recovery Tank Hose 2—Recovery Tank 3—Electrical Connector 4—Cap Screw (4 used)

1. Disconnect recovery tank hoses (1).
2. Disconnect electrical connector (3).
3. Remove cap screws (4).
4. Remove recovery tank (2).
5. Repair or replace parts as necessary.
6. Install recovery tank.
7. Install cap screws.
8. Connect electrical connector.
9. Connect recovery tank hoses.

TX1010488 -UN-25JUL06

GD61784,0000029 -19-31JUL06-1/1

Air Intake System Leakage Check



CAUTION: Engine intake air must be filtered to prevent dirt and debris from entering the engine. If intake air piping is damaged or loose, unfiltered air will enter the engine and cause premature wear.

Visually inspect for loose clamps or damage between the intake air piping, air cleaner, turbocharger and intake manifold.

Replace damaged pipes and hoses. Tighten loose clamps.

Air Intake Leakage—Specification

Clamps—Torque..... 8.5 N•m (75 lb-in.)

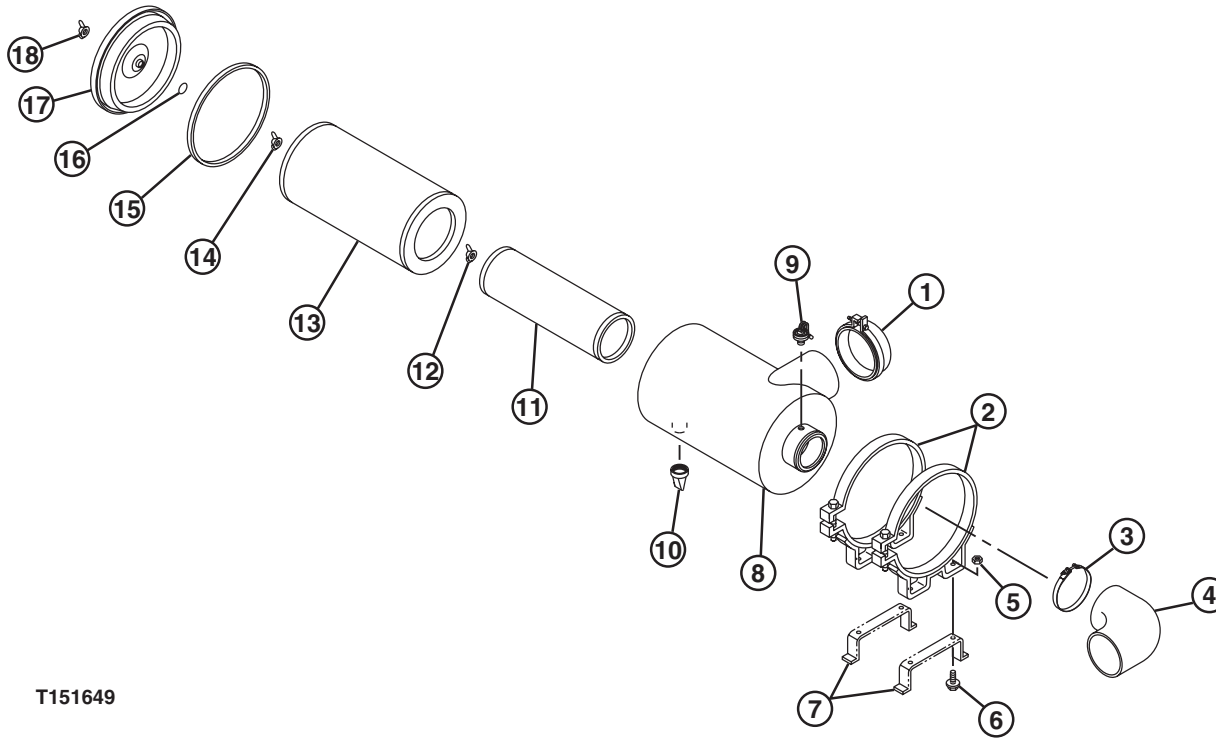
Operate the engine at full throttle and maximum load and check for air leaks. Listen for whistling noise caused by high pressure air leaks.

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RR71361,0000132 -19-05JUL06-1/1

Intake System

Air Cleaner Remove and Install



T151649

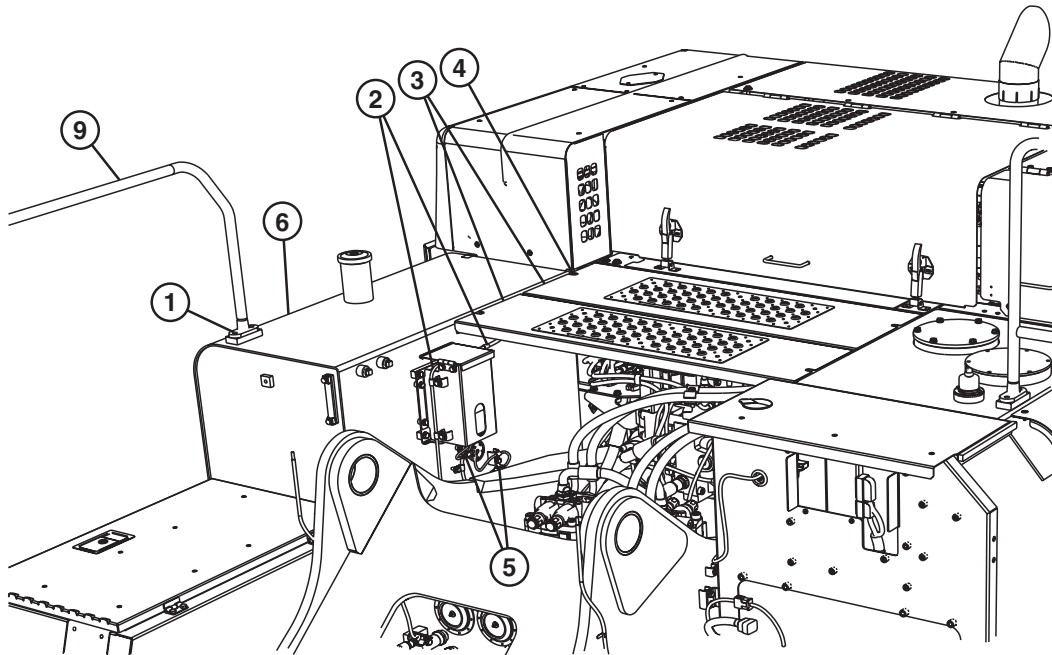
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- | | | | |
|-----------------|----------------------|---------------------------|-------------|
| 1—Screen | 6—Cap Screw (4 used) | 11—Filter Element (inner) | 15—Gasket |
| 2—Band (2 used) | 7—Bracket | 12—Wing Nut | 16—Clip |
| 3—Hose Clamp | 8—Housing | 13—Filter Element (outer) | 17—Cover |
| 4—Hose | 9—Indicator | 14—Wing Nut | 18—Wing Nut |
| 5—Nut | 10—Valve | | |

RR71361.0000131 -19-27JUL06-1/1

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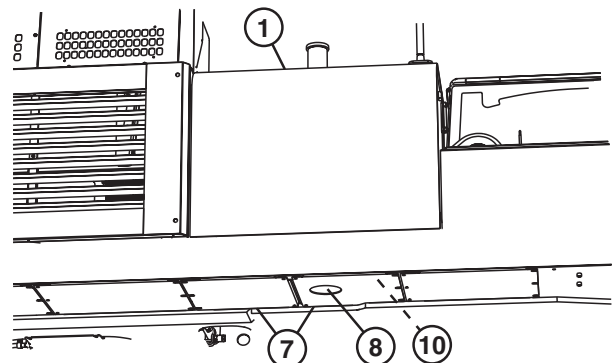
Fuel Tank Remove and Install



TX1009586

Fuel Tank

1. Remove cap screws (4).
2. Remove panels (3).
3. Disconnect wiring connector (5).
4. Disconnect fuel return and suction hoses. Install caps and plugs.
5. Disconnect recovery tank hose (2).
6. Remove cap screws (1).
7. Remove handrail (9).
8. Remove bottom cover (7).
9. Drain fuel from fuel tank. Approximate capacity is 725 L (191.5 gal).
10. Remove cap screws and washers (10).



Fuel Tank Drain

- 1—Cap Screw (6 used)
- 2—Recovery Tank Hose (2 used)
- 3—Panel (2 used)
- 4—Cap Screw (8 used)
- 5—Wiring Connector
- 6—Fuel Tank
- 7—Bottom Cover
- 8—Fuel Tank Drain
- 9—Handrail
- 10—Cap Screw and Washer (8 used)

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TX1009588 -UN-18JUL06



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

11. Remove fuel tank (6).

Specification

Fuel Tank—Weight..... 285 kg approximate without fuel
630 lb approximate without fuel

12. Repair or replace parts as necessary.

13. For float (fuel level sender), apply PM37477 Thread Lock (medium strength) to threads of cap screws.

Install float and gasket. Tighten cap screws.

Specification

Float-to-Fuel Tank Cap Screw—
Torque 4.5 N•m
40 lb-in.

14. Install fuel tank (6). Tighten cap screws and washers to specification (10).

Specification

Main Frame-to-Fuel Tank Cap
Screw—Torque..... 210 N•m
155 lb-ft

15. Install bottom cover (7).

16. Install handrail (9).

17. Install cap screws (1).

18. Connect recovery tank hose (2).

19. Connect fuel return and suction hoses.

20. Connect wiring connector (5).

21. Install panel (3).

22. Install cap screws (4).

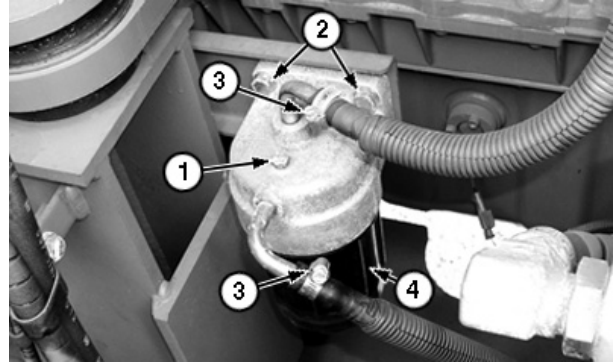
23. Fill fuel tank with proper fuel. See Diesel Fuel. (Operator's Manual.)

24. Perform Bleed Fuel System. (Operator's Manual.)

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Primary Fuel Filter (Water Separator) Remove and Install

1. See Replace Water Separator to replace filter element.
2. Clean area thoroughly prior to removal.
3. Remove hose clamps (3).
4. Disconnect fuel lines.
5. Remove cap screws (2).
6. Remove filter base (1).
7. Repair or replace parts as necessary.
8. Install filter bases (1).
9. Install cap screws (2).
10. Connect fuel lines.
11. Install hose clamp (3).
12. Perform Bleed Fuel System. (Operator's Manual.)



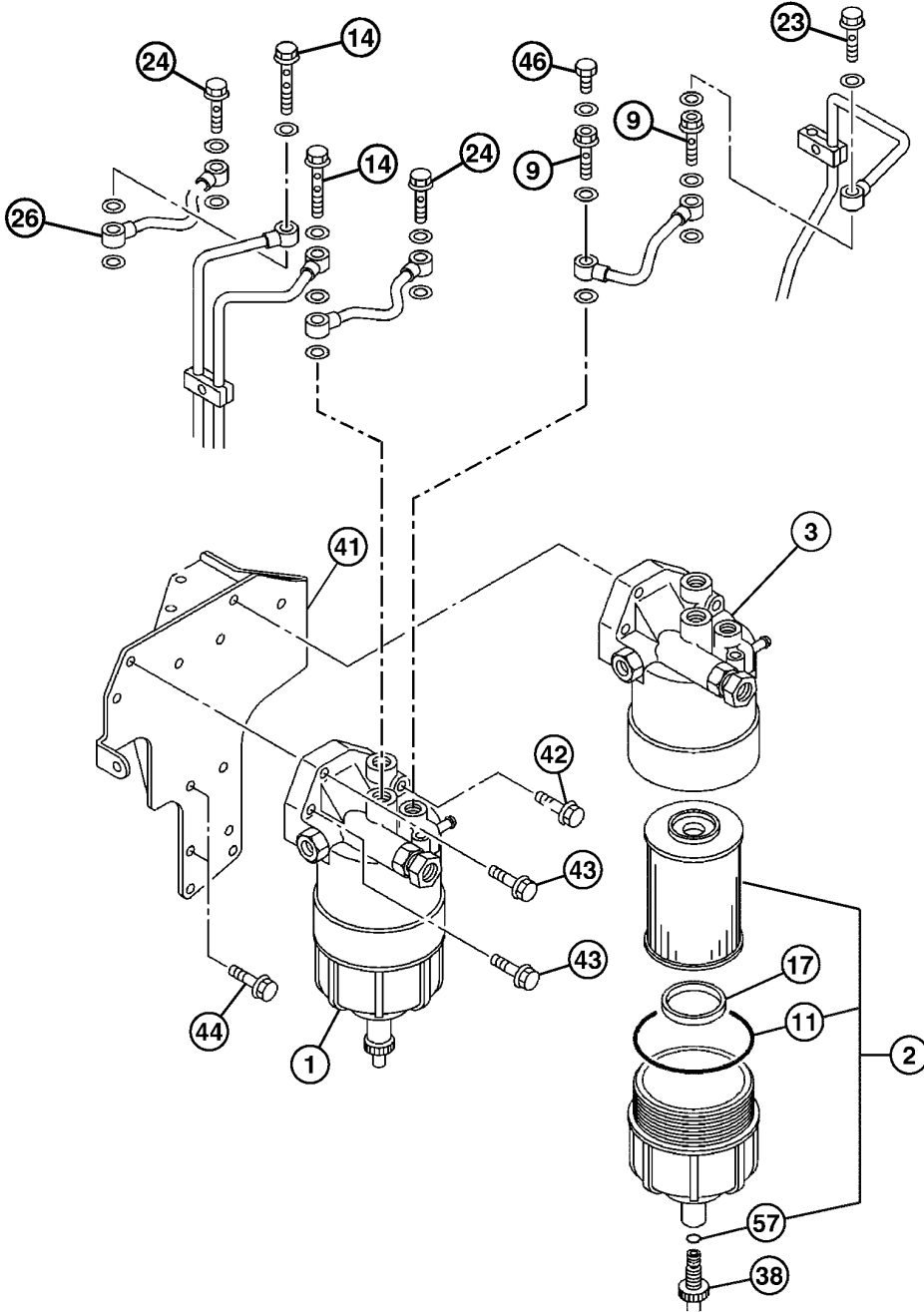
Water Separator

- 1—Filter Base
- 2—Cap Screw (2 used)
- 3—Hose Clamp (2 used)
- 4—Filter

TX1009567A -UN-17JUL06

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Final Fuel Filter Remove and Install



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TX1009477

Fuel Filter

Continued on next page

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TX1009477 -UN-12JUL06

External Fuel Supply System

1—Fuel Filter (2 used)	11—Gasket	24—Stud and Gasket (2 used)	43—Cap Screw (2 used)
2—Filter Element	14—Stud and Gasket (2 used)	38—Plug	44—Cap Screw (2 used)
3—Fuel Filter Head	17—Float	41—Bracket	46—Pipe Plug
9—Stud and Gasket (2 used)	23—Stud and Gasket	42—Cap Screw	57—Gasket

1. Clean area thoroughly prior to removal.
2. See Replace Fuel Filters to replace filter elements (2).
3. Remove studs and gaskets (9, 14, 23, 24) to disconnect fuel lines.
4. Remove cap screws (42, 43) to remove fuel filter.
5. Repair or replace parts as necessary.
6. Install fuel filters. Install cap screws.
7. Connect fuel lines.
8. Install studs and gaskets (14, 24).

Specification	
Stud and Gasket—Torque.....	35 N•m 26 lb-ft

9. Install stud and gasket (23).

Specification	
Stud and Gasket—Torque.....	15 N•m 11 lb-ft

10. Install stud and gasket (9).

Specification	
Stud and Gasket—Torque.....	28 N•m 21 lb-ft

11. Perform Bleed Fuel System. (Operator's Manual.)

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External Fuel Supply System

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6

Section 07 Dampener Drive (Flex Coupling)

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Group 0752—Elements

Dampener Drive (Flex Coupling) Remove and
Install.....07-0752-1

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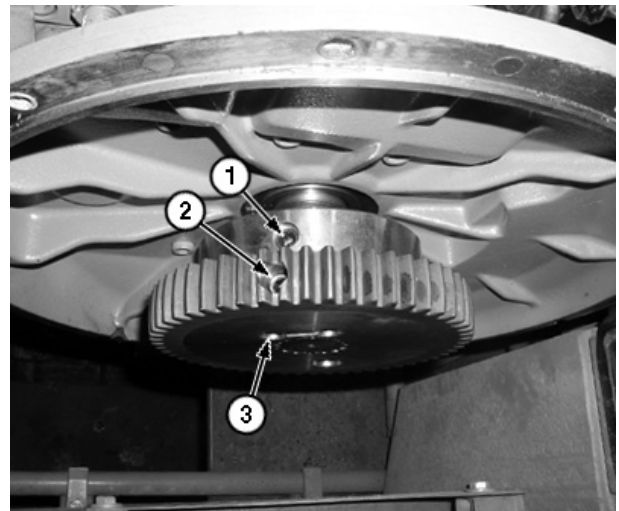
Dampener Drive (Flex Coupling) Remove and Install

1. Remove engine. See Engine Remove and Install. (Group 400.)

JH38101.000001A -19-15MAY08-1/4

2. Loosen set screws (1) and (2).
3. Remove dampener gear (3).

- 1—Set Screw
- 2—Set Screw
- 3—Dampener Gear



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JH38101.000001A -19-15MAY08-2/4

Elements

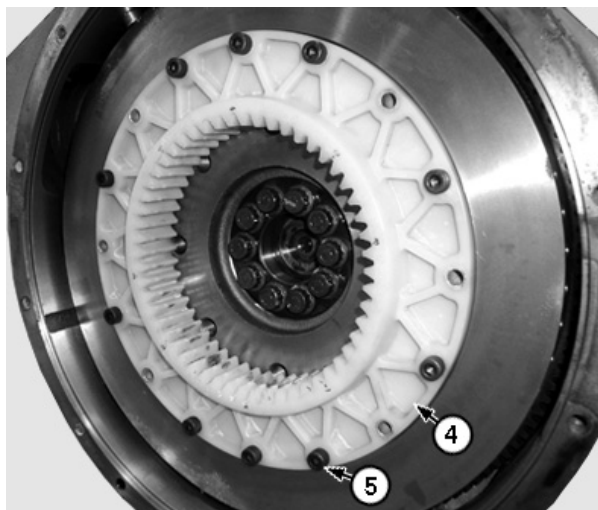
4. Remove cap screw (5).

IMPORTANT: Note direction of dampener to prevent damage to dampener gear and pump. Mark Dampener to aid in installation.

5. Remove dampener (4).

6. Clean out tapped cap screw inserts and cap screw threads to remove foreign material.

7. Apply PM38654 Thread Lock (high strength) to cap screws (5). Tighten cap screws.



TX1009425A -UN-13JUL06

Specification

Dampener Mounting Cap	
Screws—Torque	49 N•m 36 lb-ft

- 4—Dampener
- 5—Cap Screw (10 used)

JH38101.000001A -19-15MAY08-3/4

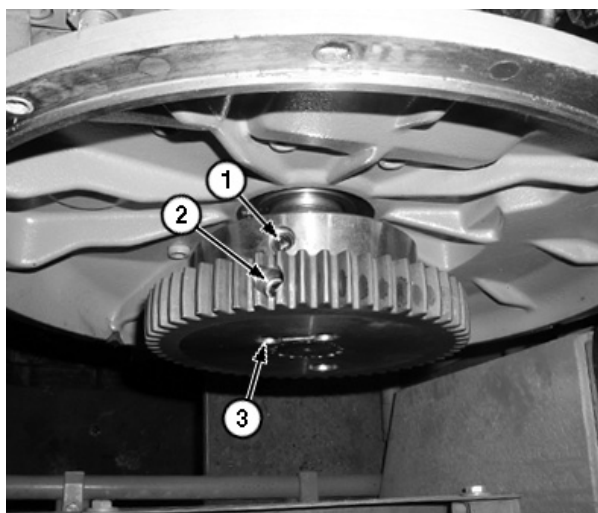
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8. Install dampener gear even with the face of drive shaft. Tighten set screws.

Specification

Dampener Gear Mounting Cap	
Screws—Torque	150 N•m 110 lb-ft

- 1—Set Screw
- 2—Set Screw
- 3—Dampener Gear



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Section 17 Frame or Supporting Structure

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Welding Repair of Major Structure17-1740-2

Group 1749—Chassis Weights

Counterweight Remove and Install17-1749-1

Contents

Welding On Machine

IMPORTANT: Disconnect battery ground strap or turn battery disconnect switch to OFF (if applicable).

Disconnect both negative and positive battery cables and microprocessor unit (if applicable).

IMPORTANT: Have only a qualified welder do this job. Connect welder ground clamp close to each weld area so electrical current does not pass through any bearings.

Remove or protect all parts that can be damaged by heat or weld splatter.

WELD METAL SPECIFICATIONS	
Item	Specification
Tensile Strength	482.6 mPa (70 000 psi)
Yield Strength	413.7 mPa (60 000 psi)
Elongation	22%

Use one of the following weld processes:

- AWS-E-7018 covered electrode with shielded metal arc welding (SMAW) process.
- AWS-ER-70S-3f wire electrode with gas metal arc welding (GMAW) process.
- AWS-E70T-1 or E71T-1 wire electrode with flux core arc welding (FCAW) process.

TX,WELD,II -19-11APR95-1/1

Welding Repair of Major Structure



CAUTION: Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

If you sand or grind paint, avoid breathing the dust. Wear an approved respirator. If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

1. Remove paint before welding or heating.

IMPORTANT: Electrical current traveling from the welder through the machine electrical system may damage the machine electrical system, including battery, machine information center, and pump and valve controller. Disconnect battery ground cable, machine information center, and pump and valve controller electrical connectors before welding on the machine.

Have only a qualified welder do this job. Connect welder ground clamp close to each weld area so electrical current does not pass through any bearings. Remove or protect all parts that can be damaged by heat or weld splatter.

2. Use one of the following weld processes:
 - AWS-E-7018 covered electrode with shielded metal arc welding (SMAW) process.
 - AWS-ER-70S-3 wire electrode with gas metal arc welding (GMAW) process.
 - AWS-E70T-1 or E71T-1 wire electrode with flux core arc welding (FCAW) process.

Frame Installation

Welding Repair of Major Structure—Specification

Weld Metal—Tensile Strength.....	482.6 mPa
	70,000 psi
Yield Strength.....	413.7 mPa
	60,000 psi
Elongation.....	22%

IMPORTANT: Area to be repaired must be preheated to allow better weld penetration.

3. To repair weld metal failure, remove failed weld metal using arc or grinding equipment. Thoroughly clean area to be welded. Preheat structural assemblies to a minimum of 38°C (100°F). Preheat ground engaging tools (cutting edges, skid shoes, and teeth shanks) to 177°C (350°F).

To repair base metal failure remove enough material to allow weld to penetrate to the bottom of crack. Preheat structural assemblies to a minimum of 38°C (100°F). Preheat ground engaging tools (cutting edges, skid shoes, and teeth shanks) to 177°C (350°F).

Welding Repair of Major Structure—Specification

Structural Assemblies—Preheat	
Temperature	38°C
	100°F
Ground Engaging Tools—Preheat	
Temperature	177°C
	350°F

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Frame Installation

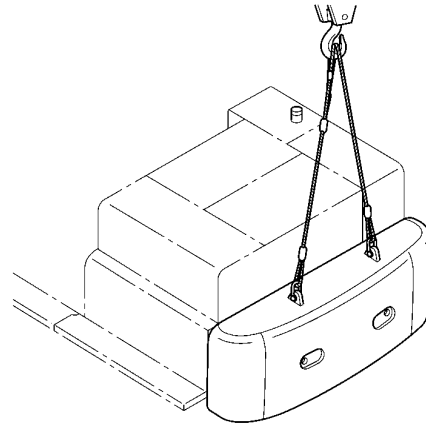
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Counterweight Remove and Install

⚠ CAUTION: Avoid crushing injury from heavy component. Use appropriate lifting device.

1. Attach appropriate lifting device to lifting bracket on counterweight.

	Specification
Counterweight—Weight.....	9150 kg 20,200 lb



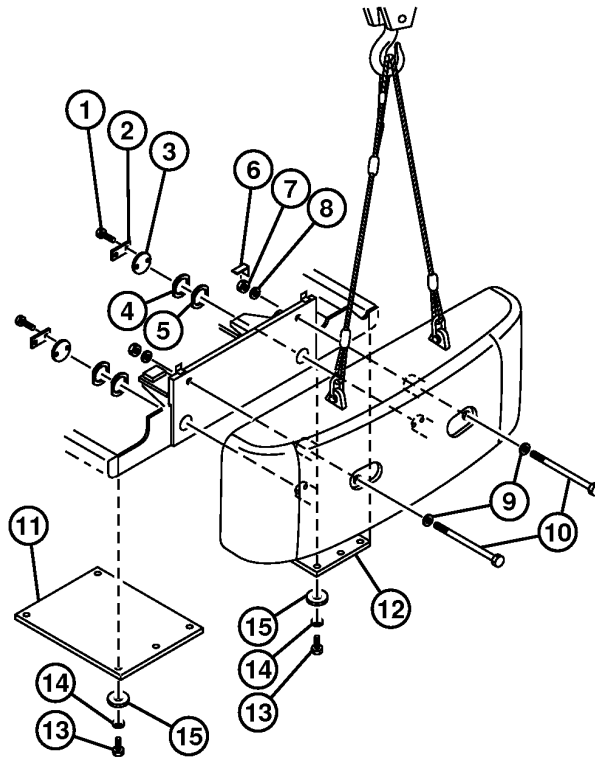
Counterweight

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Chassis Weights



TX1009186

Counterweight and Fastening Components

- | | | | |
|----------------------|-------------------|-----------------------|----------------------------|
| 1—Cap Screw (2 used) | 5—Shim (2 used) | 9—Washer (2 used) | 13—Cap Screw (11 used) |
| 2—Washer (2 used) | 6—Shim | 10—Cap Screw (2 used) | 14—Spring Washer (11 used) |
| 3—Plate (2 used) | 7—Nut (2 used) | 11—Cover | 15—Washer (11 used) |
| 4—Shim (2 used) | 8—Washer (2 used) | 12—Cover | |

2. Remove cap screws (13), spring washers (14) and washers (15). Remove covers (11 and 12).

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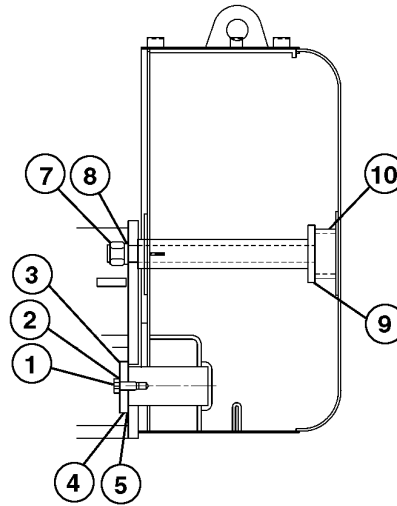
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IMPORTANT: Shim (6) is installed in the clearance between nut (7) and the bracket.

3. Remove cap screws (10), washers (9), nuts (7), shims (6), and washers (8).
4. Remove cap screws (1), washers (2), plates (3), and shims (4 and 5).
5. Use appropriate lifting device to remove counterweight from machine.
6. Repair or replace parts as necessary.
7. Install counterweight protrusion into hole in mounting bracket.
8. Apply lubricant to cap screws (10) and install to frame with washers (9), washers (8), nuts (7), and shims (6). Tighten cap screw (10) to specification.



Counterweight Cross Section

- 1—Cap Screw (2 used)
- 2—Washer (2 used)
- 3—Plate (2 used)
- 4—Shim (2 used)
- 5—Shim (2 used)
- 7—Nut (2 used)
- 8—Washer (2 used)
- 9—Washer (2 used)
- 10—Cap Screw (2 used)

Specification

Counterweight Rear Cap Screw—	
Torque	2350 N•m 1730 lb-ft

NOTE: Shims (4 and 5) are installed in the clearance between plate (3) and bracket.

9. Install shims (4 and 5), plate (3), washer (2), and cap screw (1). Tighten cap screw (1) to specification.

Specification

Counterweight Front Cap	
Screw—Torque	440 N•m 325 lb-ft

10. Install covers (11 and 12) with spring washers (14), washers (15), and cap screws (13). Tighten cap screws (13) to specification.

Specification

Counterweight Cover Cap	
Screws—Torque	90 N•m 66 lb-ft

TX1009185 -UN-05JUL06

17
1749
3

Chassis Weights

17
1749
4

Section 18 Operator's Station

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Contents

Group 1800 Removal and Installation

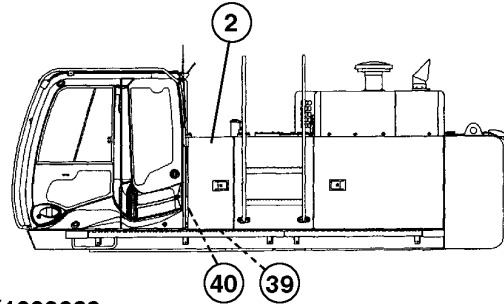
Cab Remove and Install

1. Park machine on flat level surface. Lower boom to ground.

TX17984,0000056 -19-07JUL06-1/11

2. Disconnect negative (-) battery cable.
3. Open access door (2) and remove forward access panel (40).
4. Remove panel (39) underneath compartment.

2—Access Door
39—Panel
40—Forward Access Panel



TX1008369

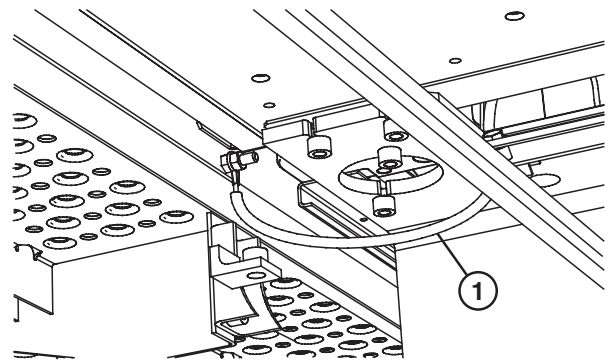
Access Door

TX1008369 -UN-10JUL06

TX17984,0000056 -19-07JUL06-2/11

5. Disconnect ground (17).

17—Ground Wire



Ground Location

TX1008386 -UN-06JUN06

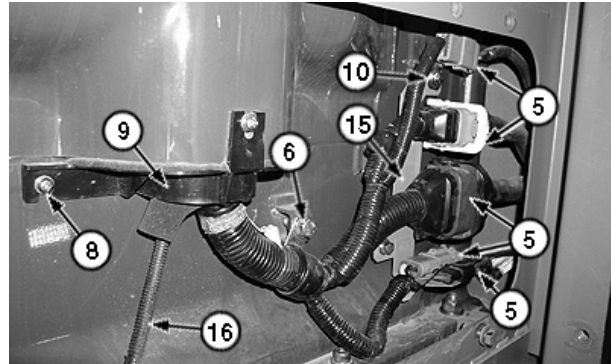
18
1800
1

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TX17984,0000056 -19-07JUL06-3/11

Removal and Installation

6. Disconnect electrical connectors (5) in back of cab.
7. Remove cap screws (10).
8. Remove bracket (15) that holds electrical connectors .
9. Remove clamps (6) that hold cab harness.
10. Remove screws (8) and remove harness holder (9) on back of cab.
11. Disconnect hose from washer fluid reservoir and drain reservoir or disconnect hose and cap off reservoir tank.
12. Remove seat. See Seat Remove and Install. (Group 1821.)



TX1008393A -JUN-10JUL06

Electrical Connectors

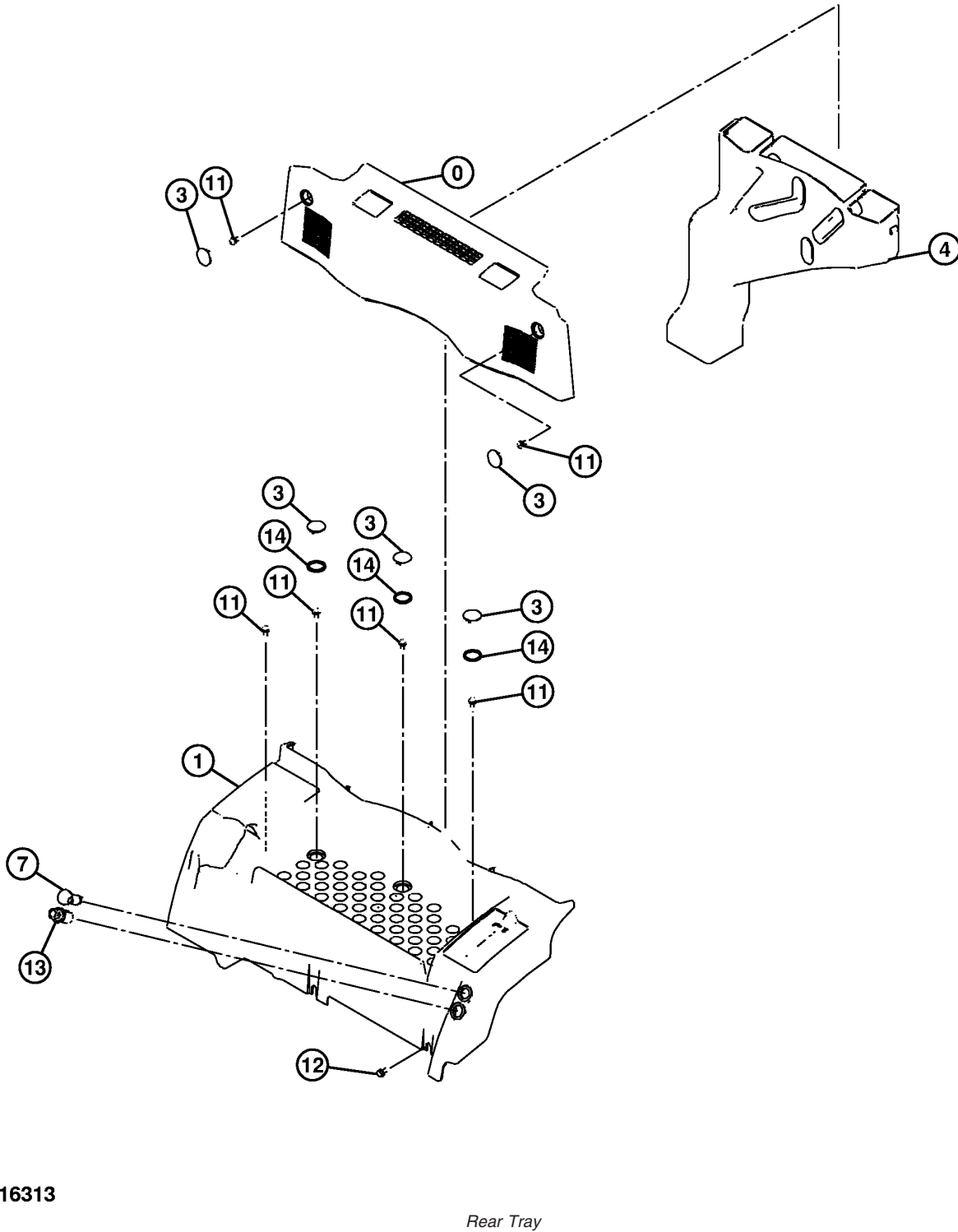
- 2—Harness Holder
- 5—Electrical Connector
- 6—Clamp (2 used)
- 8—Screw (3 used)
- 10—Cap Screw (2 used)
- 15—Bracket
- 16—Ground

Continued on next page

TX17984,0000056 -19-07JUL06-4/11

Removal and Installation

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1800
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18
1800
4

T216313

Rear Tray

T216313 -UN-20OCT05

Continued on next page

TX17984,0000056 -19-07JUL06-5/11

Removal and Installation

- 0—Cover
- 1—Tray
- 3—Cap (5 used)

- 4—Air Duct
- 7—Electrical Connector Terminal

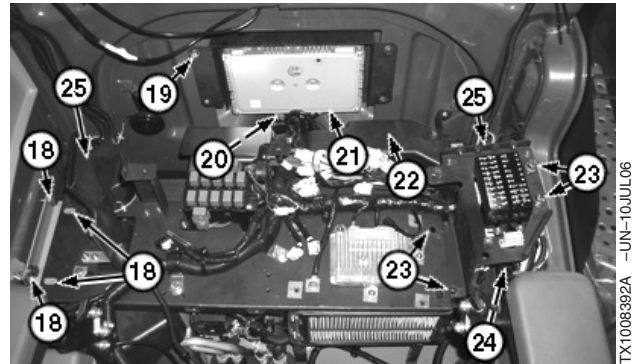
- 11—Screw (6 used)
- 12—Cap Screw with Washer

- 13—Mechanical Lighter
- 14—Isolator (3 used)

- 13. Remove trim cover (0) and rear tray (1) behind seat.

TX17984,0000056 -19-07JUL06-6/11

- 14. Remove cap screws (18, and 23) that attach bracket to cab.
- 15. Remove fresh air duct (24) and filter on left side of cab.
- 16. Remove fresh air duct (22) behind A/C unit.
- 17. Remove cap screws (19) that hold MCF (21) to back of cab and lay MCF to the side.
- 18. Feed electrical connectors through hole (20) in back of cab.
- 19. Disconnect electrical connectors (25) from the rear corners of the cab.



Panel Behind Seat

- 18—Cap Screw
- 19—Cap Screw
- 20—Hole in Rear of Cab
- 21—MCF (main controller)
- 22—Fresh Air Duct
- 23—Cap Screw
- 24—Fresh Air Duct
- 25—Electrical Connectors

TX1006392A -UN-10JUL06

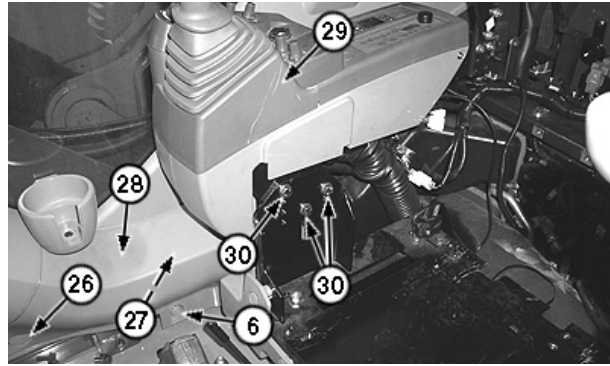
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TX17984,0000056 -19-07JUL06-7/11

18
1800
5

Removal and Installation

20. Remove cap screws (30) that hold right arm assembly (29) to seat base bracket and lay the arm assembly down.
21. Remove trim cap (26) and screw under trim cap holding the right trim cover.
22. Remove right trim cover (28).
23. Remove fresh air duct (27) located behind the right trim cover.
24. Remove floor mat.

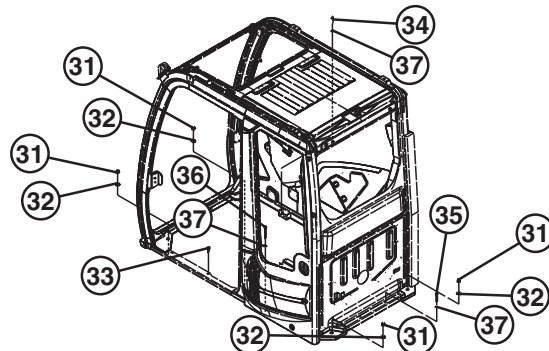


Right Arm Assembly

- 26—Trim Cap
- 27—Air Duct
- 28—Trim Cover
- 29—Right Arm Assembly
- 30—Cap Screw (3 used)

TX17984,0000056 -19-07JUL06-8/11

25. Remove cap screws (33, 34, 35, and 36) that bolt cab to cab floor plate.
26. Remove lock nuts (31) and washers (32) on each corner of the cab. Discard lock nuts.



Cab to Floor Plate Mounting

- 31—Lock Nut (12 used)
- 32—Washer (6 used)
- 33—Screw with Washer (6 used)
- 34—Screw (2 used)
- 35—Bolt (2 used)
- 36—Bolt
- 37—Washer (5 used)

Continued on next page

TX17984,0000056 -19-07JUL06-9/11

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

27. Connect cab to lifting brackets (38) and use lifting straps to hoist cab .

	Specification	
Cab—Weight		385 kg approximate 850 lb approximate

28. Slowly lift cab from platform.

Move cab slightly forward as cab is being raised so front of cab can clear propel pedals.

29. Repair or replace parts as necessary.

30. Before installing cab, check that all lines and wiring harnesses are out of the way so they are not pinched when cab is installed.

31. Lower cab to floor plate, being careful to clear propel pedals.

32. Install new lock nuts (31) and washers (32).

	Specification	
Lock Nut—Torque		210 N•m 155 lb-ft

33. Install cap screws (33, 34, 35, and 36) and washers that bolt cab to cab floor plate.

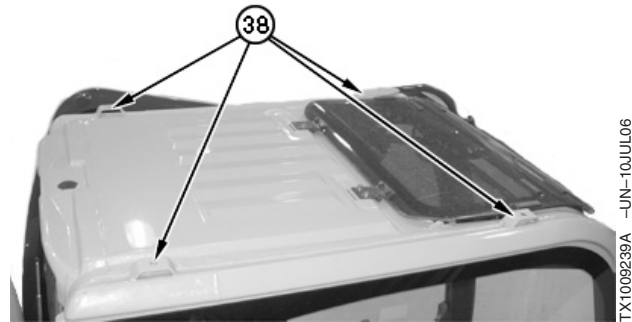
	Specification	
Lock Nut—Torque		50 N•m 37 lb-ft

34. Install floor mat.

35. Install fresh air duct (27) located behind the right trim cover.

36. Install right trim cover (28).

37. Install screw and trim cap (26) that hold the right trim cover (28).



Cab Lifting Points

38—Lifting Brackets

TX1009239A -UN-10JUL06

Removal and Installation

38. Install right arm assembly (29) with bolts (30) that hold arm assembly to the seat base bracket.
39. Feed electrical connectors through hole (20) in back of cab.
40. Position MCF to back of cab and install cap screws (19).
41. Install fresh air duct (22) behind A/C unit
42. Install fresh air duct (24) and filter on left side of cab.
43. Install cap screws (18 and 23) that attach bracket to cab.
44. Install trim cover (0) and tray (1) behind seat.
45. Install seat. See Seat Remove and Install. (Group 1821.)
46. Re-connect hose to washer fluid reservoir and fill reservoir with washer fluid.
47. Install harness holder (9) on back of cab and install screws (8).
48. Install clamps (6) that hold cab harness.
49. Install bracket (15) that holds the electrical connectors.
50. Re-connect electrical connectors (5) in back of cab.
51. Install cap screws (10).
52. Install forward access panel (40).
53. Re-connect ground (17) to frame.
54. Install panel (39) underneath compartment.
55. Re-connect negative (-) battery cable.

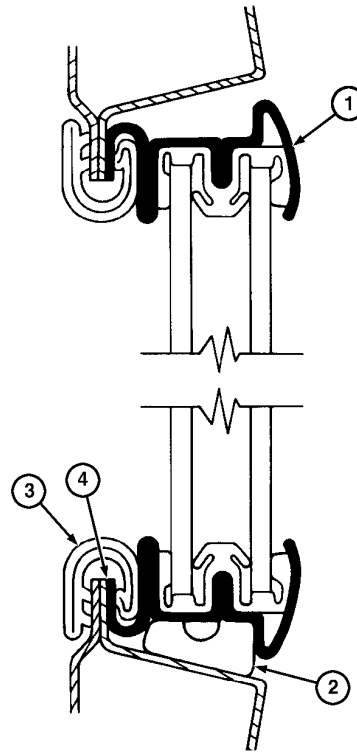
18
1800
8

Sliding Windows Remove and Install

1. Pull molding (3) from inside of window.
2. Cut adhesive (4) between cab flange and window frame (1) using a putty knife.

IMPORTANT: Use extreme care to avoid damaging frame and windowpane. Remove window using two people; one to push window out, the other to keep window from falling.

3. Carefully push window frame from cab.
4. Lift frame slightly at the top-center to remove and install windowpanes.
5. Apply instant gel adhesive to cab flange.
6. Install windows and frame with spacers (2) at the bottom.
7. Using water as a lubricant, push window frame tight against cab flange.
8. Install molding (3) around window and cab flange.



T140968

- 1—Window Frame
- 2—Bottom Spacer (4 used)
- 3—Molding
- 4—Adhesive

T140968 -UN-30APR01

TX17984,0000059 -19-22MAY06-1/1

Windowpanes Remove and Install

The adhesive used to hold the windowpanes in place is a urethane adhesive that is used on most automobile windshields. Urethane adhesive manufactured by Loctite Corporation or equivalent is recommended. Do not use any other type of adhesive. **It is also recommended that an auto glass dealer install the windowpanes.**

IMPORTANT: Windowpanes must have an ultra-violet barrier around the edge of the glass since ultra-violet rays will deteriorate the adhesive. Windowpanes ordered through John Deere Parts have the ultra-violet barrier. If the windowpane is purchased through a glass dealer, the dealer must put an ultra-violet barrier on the glass. Do not apply paint to the border of the glass.

If an auto glass dealer is not installing the windowpanes, use the following procedure:

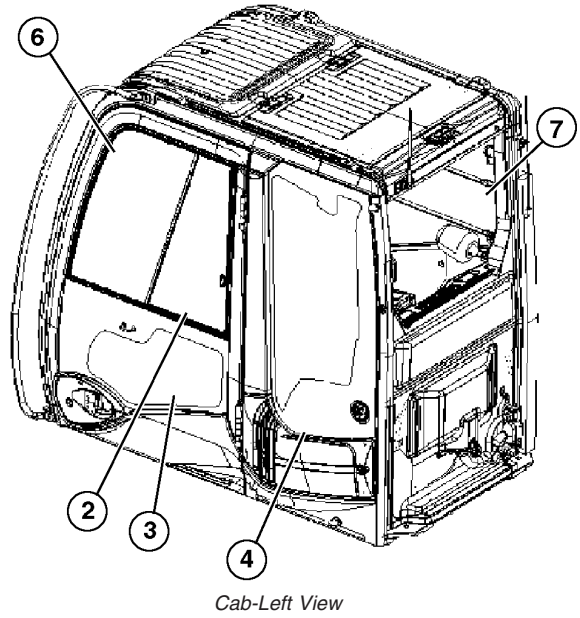
1. Purchase urethane adhesive from your local auto glass dealer.
2. If window frame is removable, remove frame from cab.
3. Scrape broken glass off existing adhesive. Do not remove adhesive from window frame or cab.

IMPORTANT: Adhesive will not stick to bare metal.

4. If existing adhesive is removed from frame and paint is scraped off window frame, paint window frame. Paint must be fully cured before installing windowpane.
5. Trim existing adhesive so it has a smooth surface.
6. Follow the manufacturer's instructions for using the adhesive.
7. Apply a 6 mm (1/4 in.) bead of adhesive on top of the existing adhesive.
8. Put a new windowpane into position. Use hand pressure to force windowpane down around the edges until even with metal frame.
9. If windowpane is installed directly on cab, use duct tape to hold it in place while adhesive cures.
10. Allow adhesive to cure for 24 hours before operating machine.

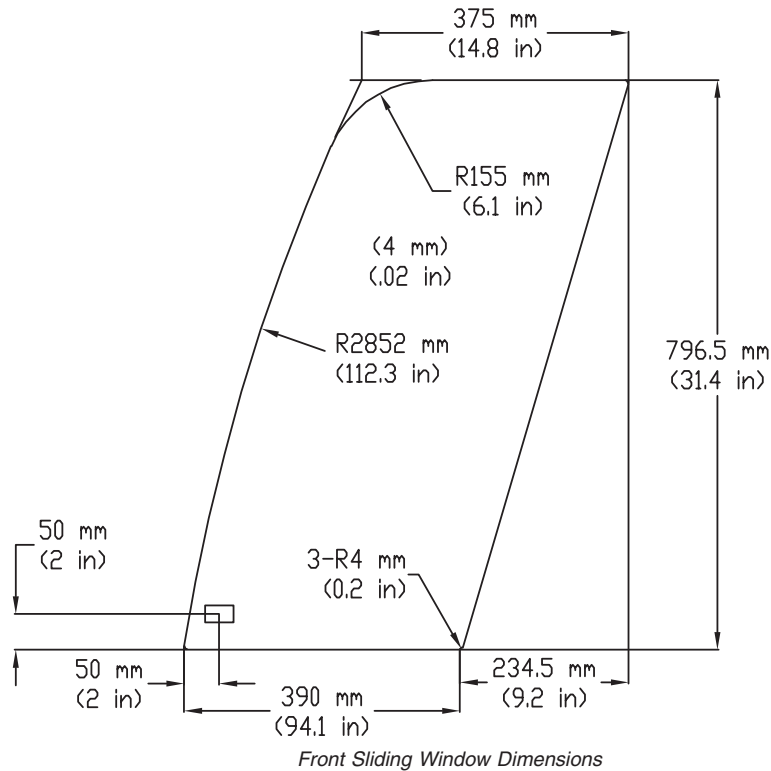
Windowpane Dimensions

- 2—Rear Sliding Window
- 3—Bottom Door Window
- 4—Left Side Window
- 6—Front Sliding Window
- 7—Rear Window



TX1008295 -UN-10JUL06

AH91621,00002B2 -19-26JUL06-1/22



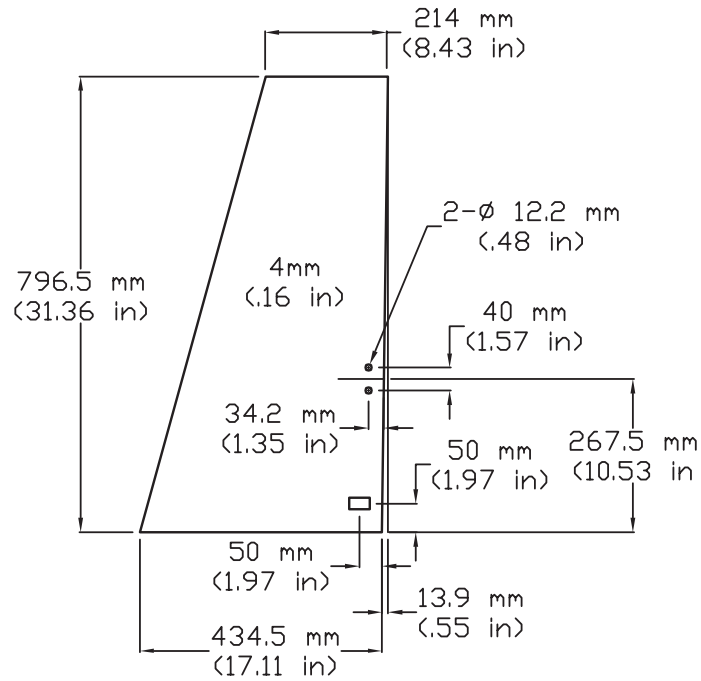
18
1810
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TX1008293 -UN-31MAY06

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AH91621,00002B2 -19-26JUL06-2/22

Operator Enclosure



TX1008294

Rear Sliding Window Dimensions

TX1008294 -UN-26JUL06

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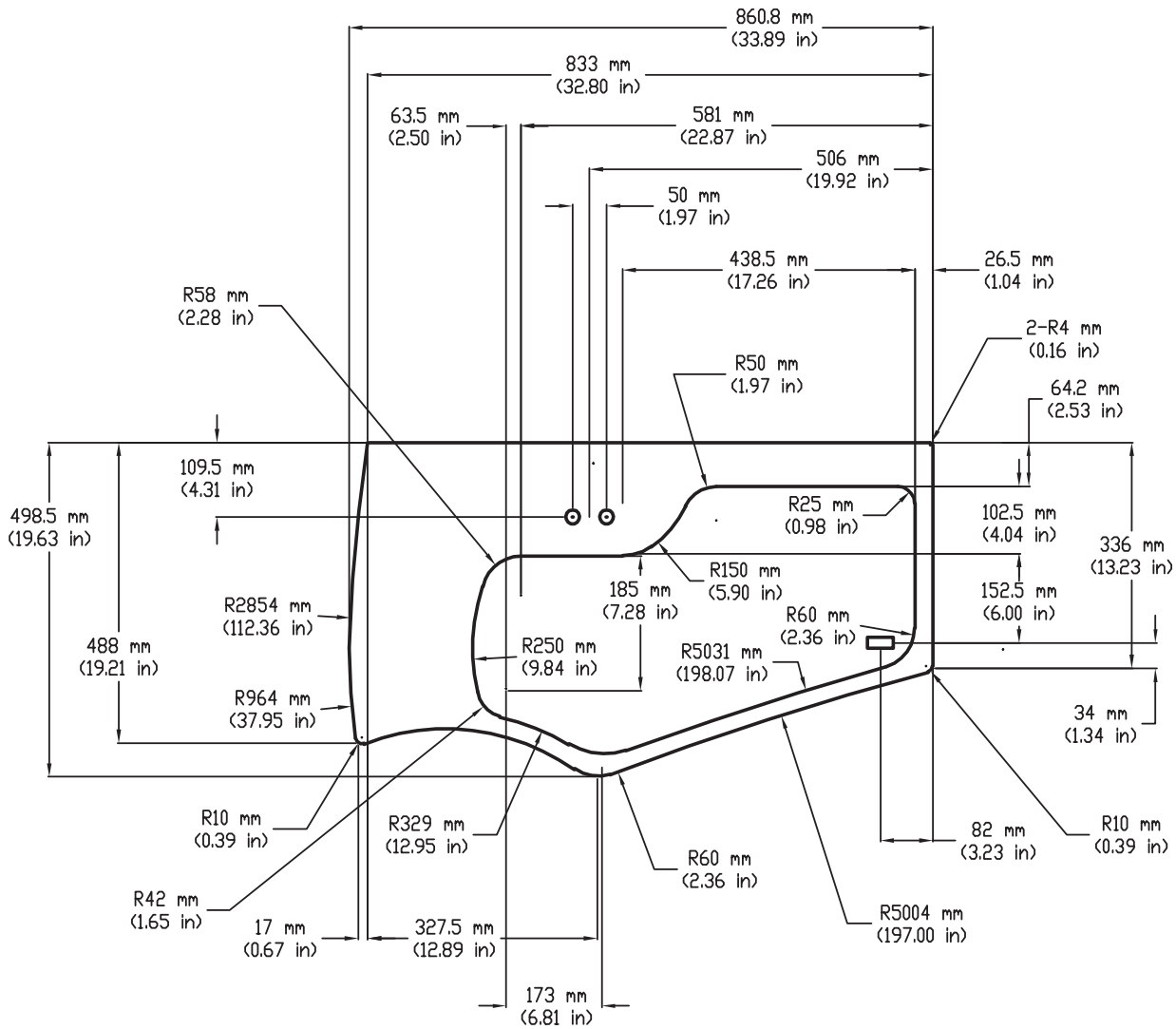
AH91621.00002B2 -19-26JUL06-3/22

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Operator Enclosure

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1810
5

Operator Enclosure



Bottom Door Window Dimensions

TX1008296

TX1008296 -UN-01.JUN06

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AH91621.00002B2 -19-26JUL06-4/22

Operator Enclosure

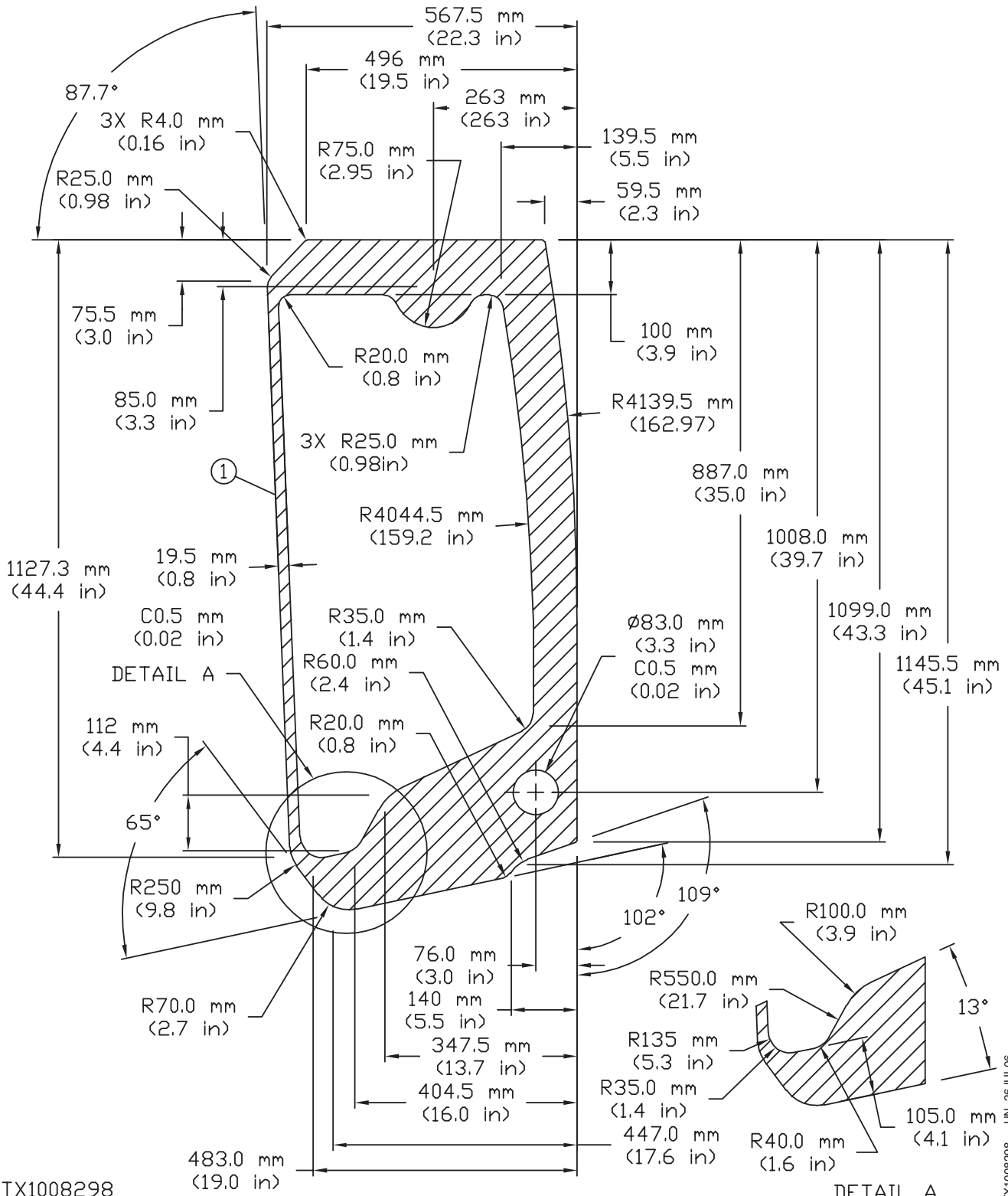
**1—Black Ceramic Coating
Range**

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AH91621,00002B2 -19-26JUL06-5/22

18
1810
7

Operator Enclosure



Left Side Window Dimensions

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AH91621.00002B2 -19-26JUL06-6/22

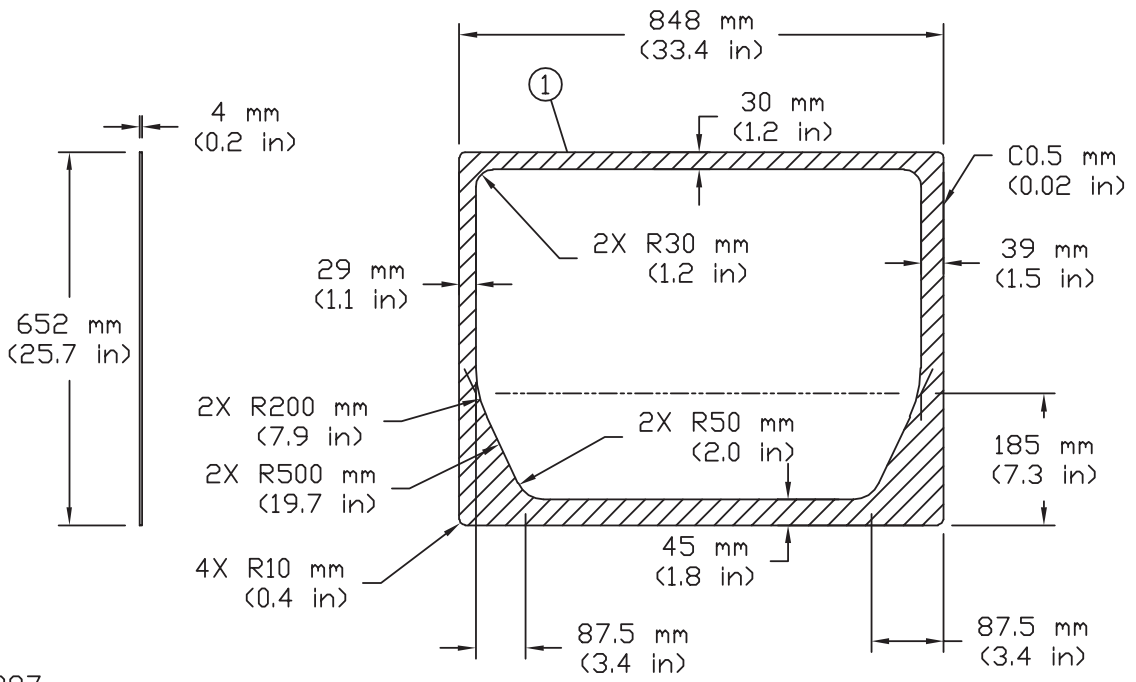
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TX1008298 -UN-26JUL06

Operator Enclosure

1—Black Ceramic Coating
Range

AH91621,00002B2 -19-26JUL06-7/22



TX1008297

Rear Window Dimensions

1—Black Ceramic Coating
Range

TX1008297 -JUN-26-JUL06

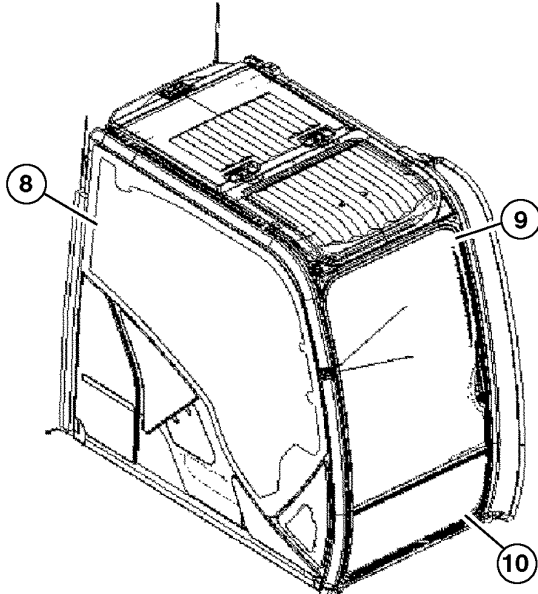
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AH91621,00002B2 -19-26JUL06-8/22

18
1810
9

Operator Enclosure

- 8—Right Side Window
- 9—Front Window
- 10—Lower Front Window



Cab-Right View

TX1008289 -JUN-10JUL06

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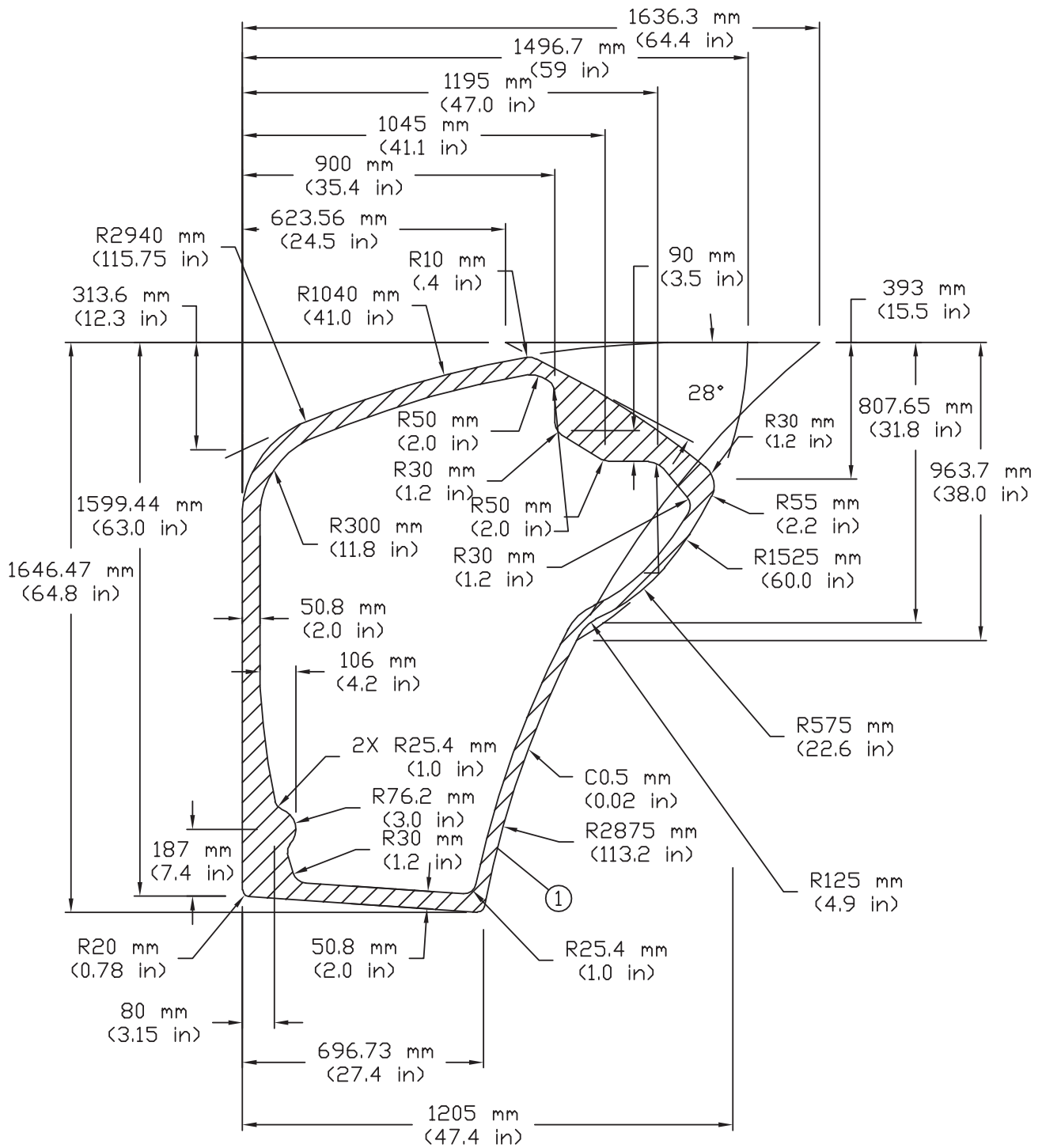
AH91621.00002B2 -19-26JUL06-9/22

18
1810
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Operator Enclosure

18
1810
11

Operator Enclosure



Right Side Window Dimensions

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12

TX1008299

TX1008299 -UN-26JUL06

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AH91621,00002B2 -19-26JUL06-10/22

Operator Enclosure

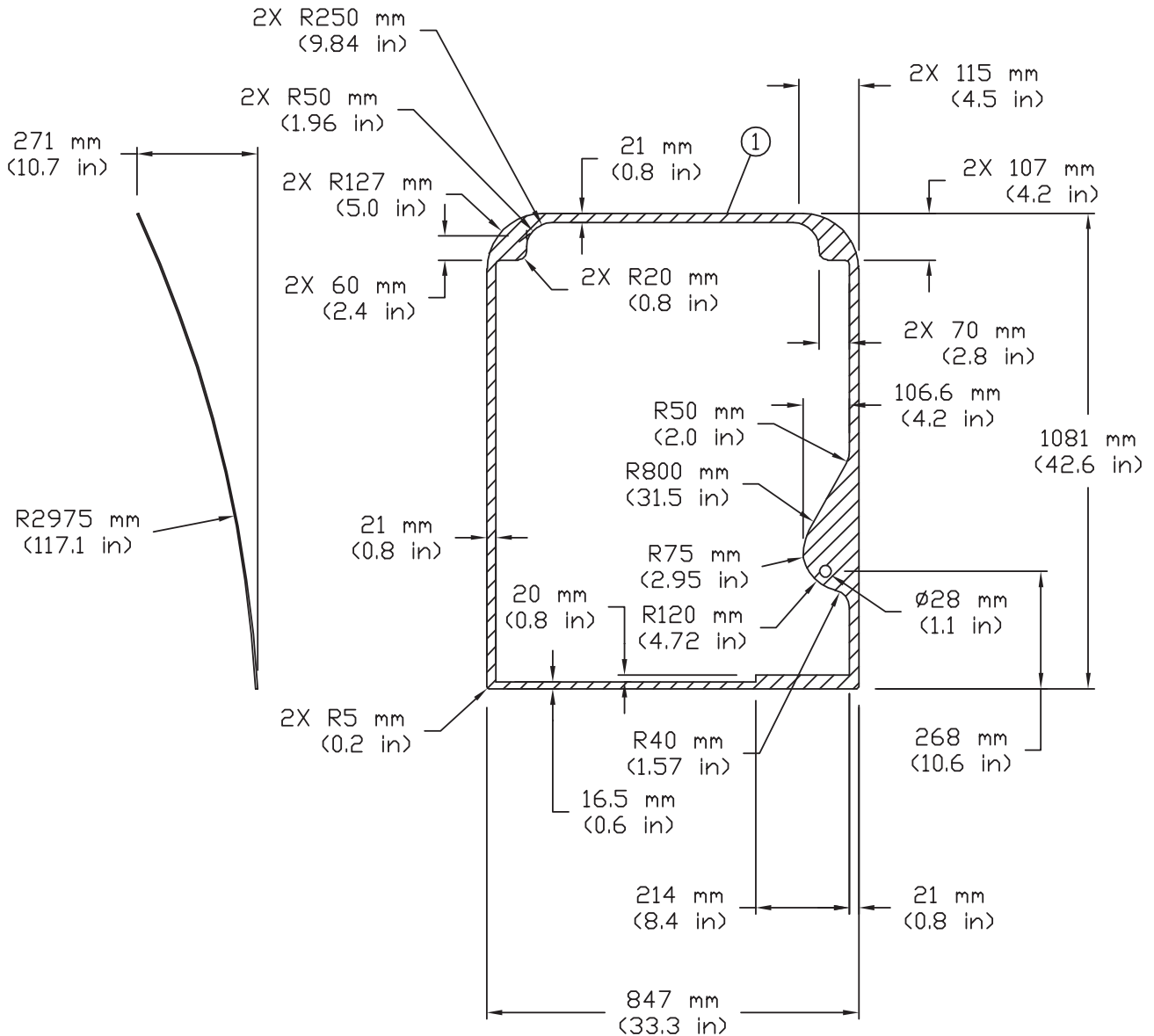
**1—Black Ceramic Coating
Range**

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AH91621.00002B2 -19-26JUL06-11/22

18
1810
13

Operator Enclosure



Front Window Dimensions

TX1008288

TX1008288 -UN-26.JUL06

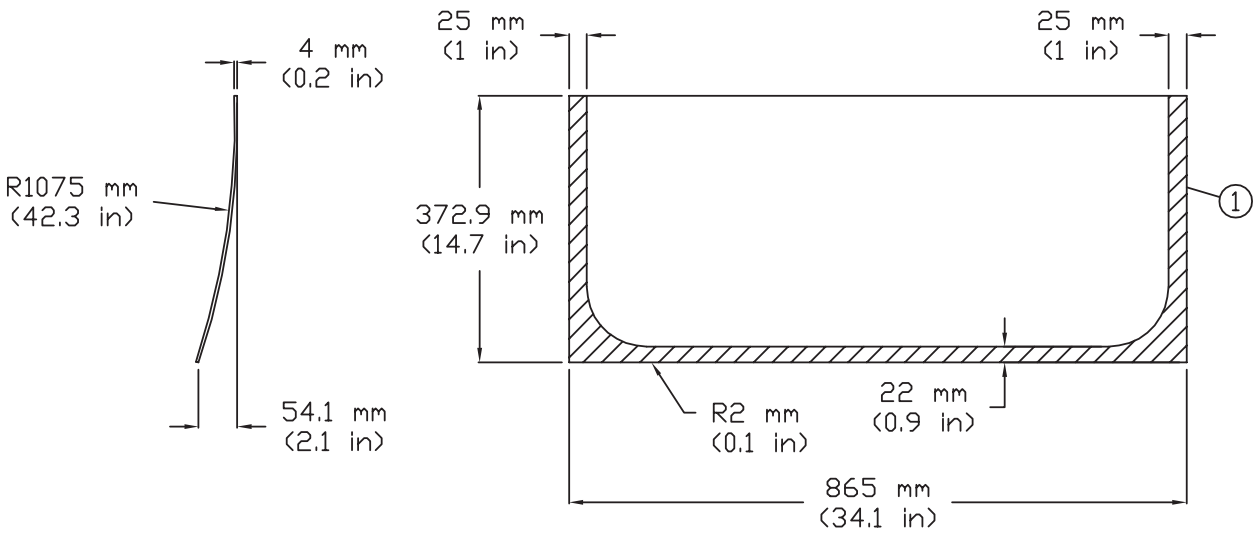
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AH91621,00002B2 -19-26JUL06-12/22

Operator Enclosure

1—Black Ceramic Coating
Range

AH91621.00002B2 -19-26JUL06-13/22



TX1008290

Lower Front Window Dimensions

1—Black Ceramic Coating
Range

TX1008290 -JUN-26-JUL06

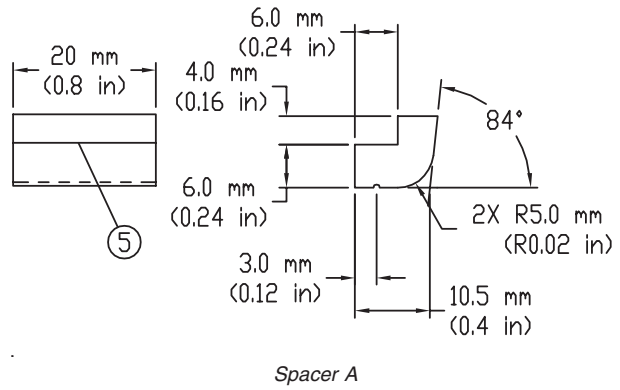
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AH91621.00002B2 -19-26JUL06-14/22

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Operator Enclosure

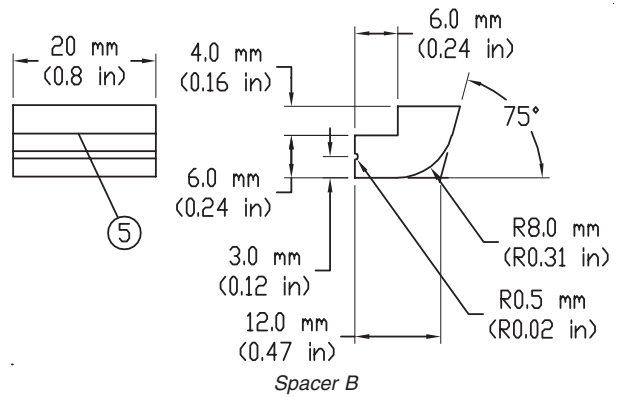
5—Apply Adhesive to Both Sides



TX1008300 -JUN-31MAY06

AH91621,00002B2 -19-26JUL06-15/22

5—Apply Adhesive to Both Sides



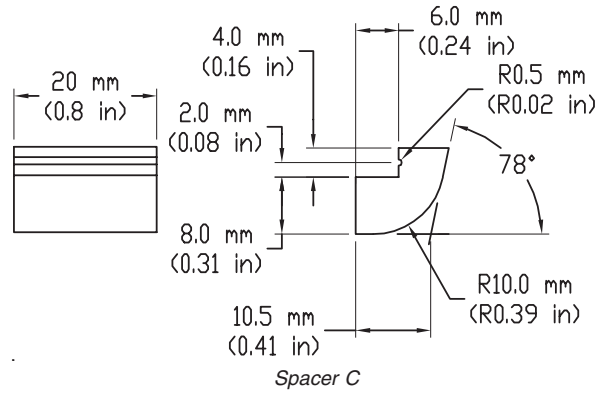
TX1008301 -JUN-31MAY06

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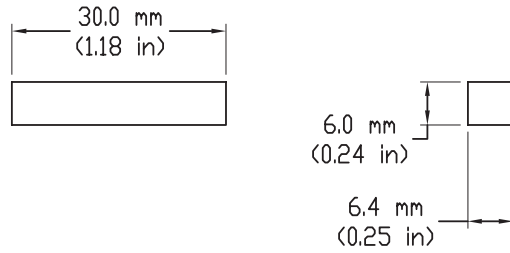
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1810
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Operator Enclosure



TX1008302 -UN-31MAY06

AH91621.00002B2 -19-26JUL06-17/22



TX1008303 -UN-31MAY06

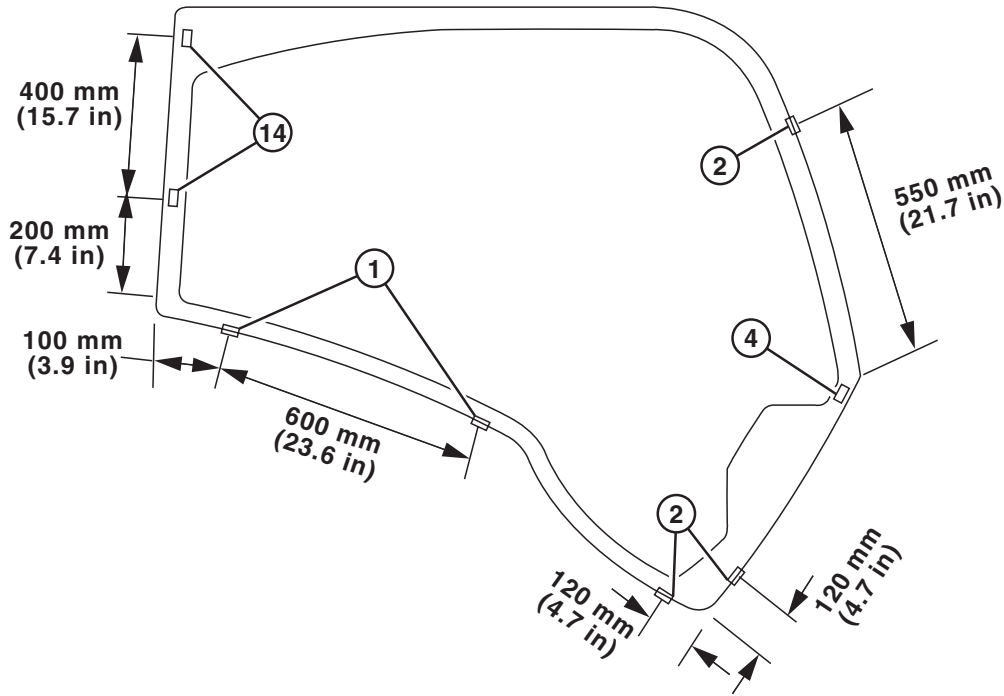
Dam Rubber

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AH91621.00002B2 -19-26JUL06-18/22

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1810
17

Operator Enclosure



TX1008304

Right Side Window Spacer Location

11—Spacer A

12—Spacer B

14—Dam Rubber

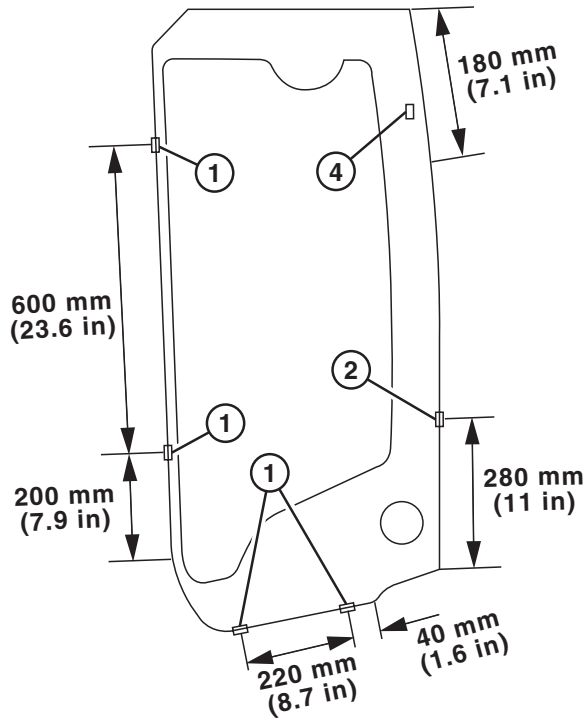
TX1008304 -UN-20JUN06

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AH91621.00002B2 -19-26JUL06-19/22

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1810
18

Operator Enclosure



TX1008306

Left Side Window Spacer Location

11—Spacer A

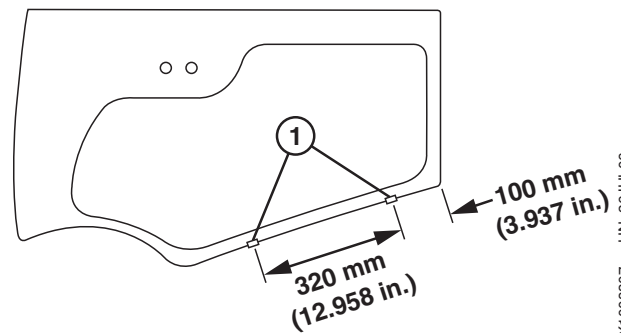
12—Spacer B

14—Dam Rubber

AH91621.00002B2 -19-26JUL06-20/22

TX1008306 -UN-31MAY06

11—Spacer A



Lower Door Window Spacer Location

18
1810
19

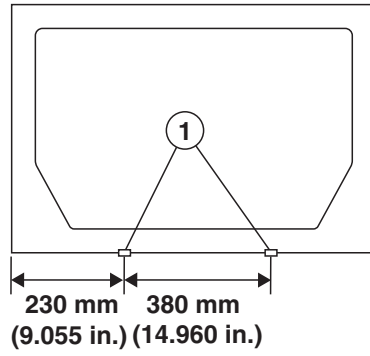
TX1008307 -UN-26JUL06

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AH91621.00002B2 -19-26JUL06-21/22

Operator Enclosure

13—Spacer C



Rear Window Spacer Location

TX1008308 -UN-26JUL06

AH91621,00002B2 -19-26JUL06-22/22

18
1810
20

Seat Remove and Install

1. Move the seat to the most forward position.
2. Remove cap screws (1) and seat stop (2).
3. Remove screws (3).
4. Move the seat to the most rearward position.

- 1—Cap Screw (2 used)
- 2—Seat Stop



Seat Stop

TX1009893A -UN-10JUL06

AH91621.00002B7 -19-07JUL06-1/2

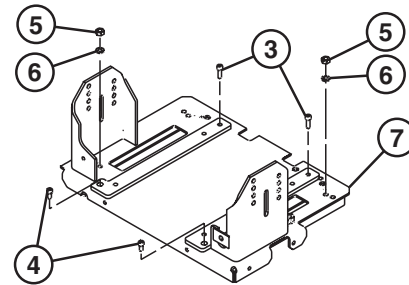
5. Remove screws (4).

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

6. Remove seat.

Specification	
Seat—Weight.....	37 kg approximate 82 lb approximate

7. Repair or replace parts as necessary.
8. Install seat.
9. Install screws (4).
10. Move the seat to the most forward position.
11. Install screws (3).
12. Install seat stop and cap screws.



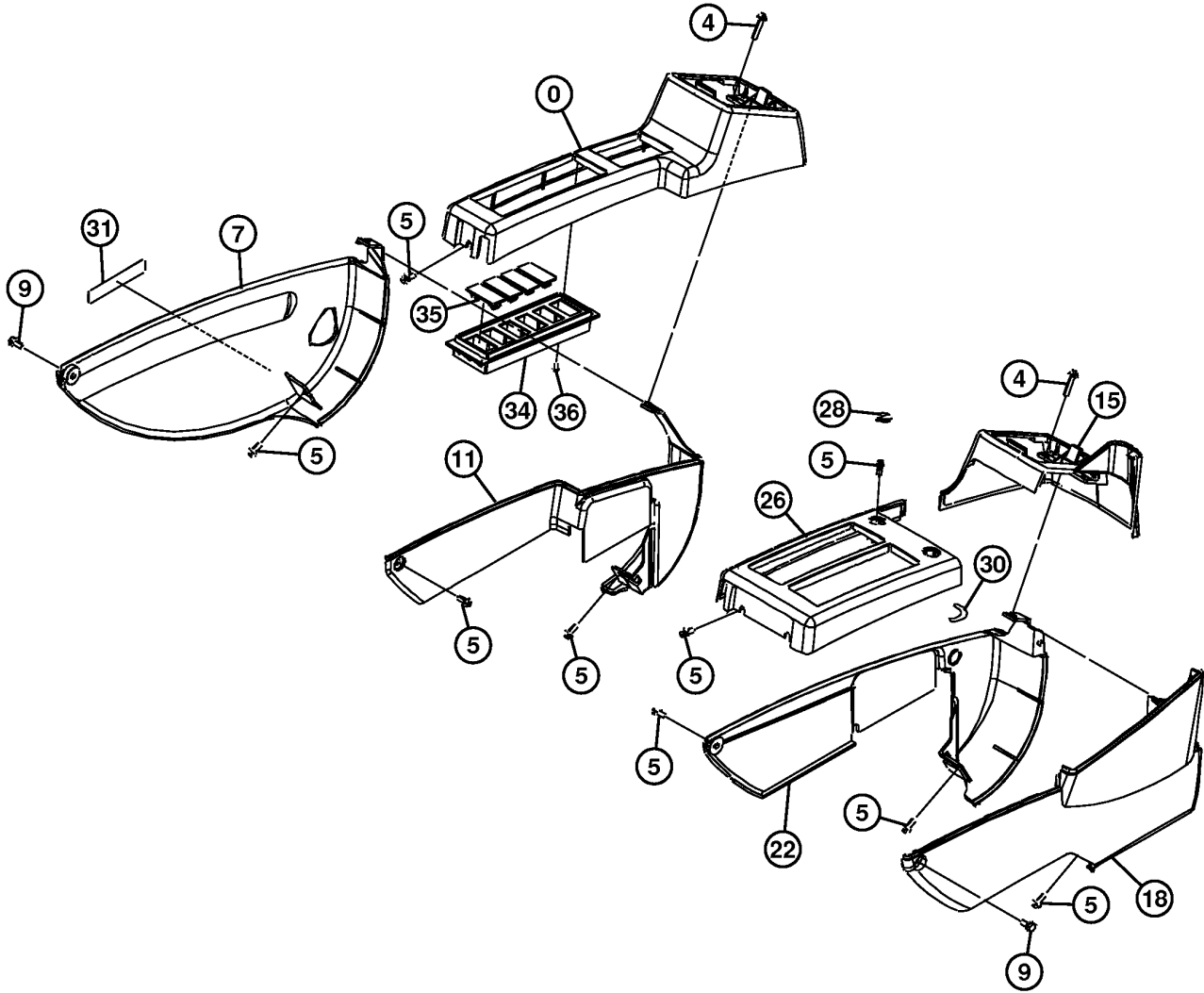
Seat Base

- 3—Screw (2 used)
- 4—Screw (2 used)
- 5—Nut (8 used)
- 6—Washer (8 used)
- 7—Seat Base

TX1009902 -UN-14JUL06

AH91621.00002B7 -19-07JUL06-2/2

Left and Right Console Covers Remove and Install



18
1821
2

TX1001645

Left and Right Console Covers

Continued on next page

TX17984,000005F -19-07JUL06-1/2

TX1001645 -JUN-09JAN06

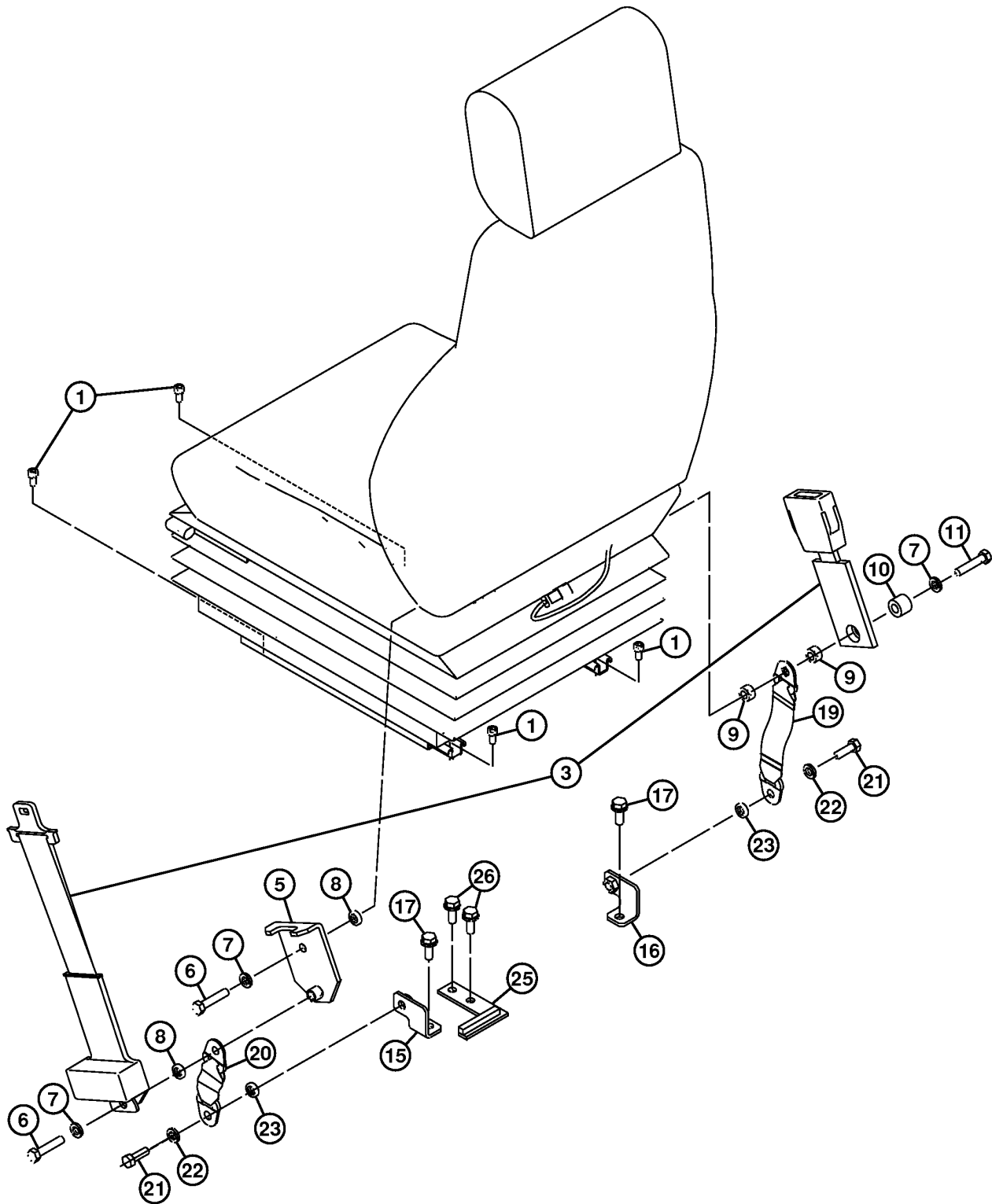
Seat and Seat Belt

0—Cover	9—Cap Screw	22—Cover	31—Label
4—Screw	11—Cover	26—Cover	34—Case
5—Cap Screw and Washers	15—Cover	28—Cap	35—Cap
7—Cover	18—Cover	30—Label	36—Screw

TX17984,000005F -19-07JUL06-2/2

18
1821
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Seat Belt Remove and Install



18
1821
4

TX1003137

Seat Belt

Continued on next page

TX17984,000005C -19-06JUL06-1/2

TX1003137 -UN-08FEB06

Seat and Seat Belt

1—Screw (4 used)
3—Seat Belt
5—Bracket
6—Cap Screw (2 used)
7—Washer (3 used)
8—Washer (2 used)

9—Spacer
10—Spacer
11—Bolt
15—Bracket
16—Bracket

17—Cap Screw and Washer (2 used)
19—Belt Set
20—Strap
21—Cap Screw (2 used)

22—Washer (2 used)
23—Washer (2 used)
25—Bracket
26—Cap Screw and Washer (2 used)

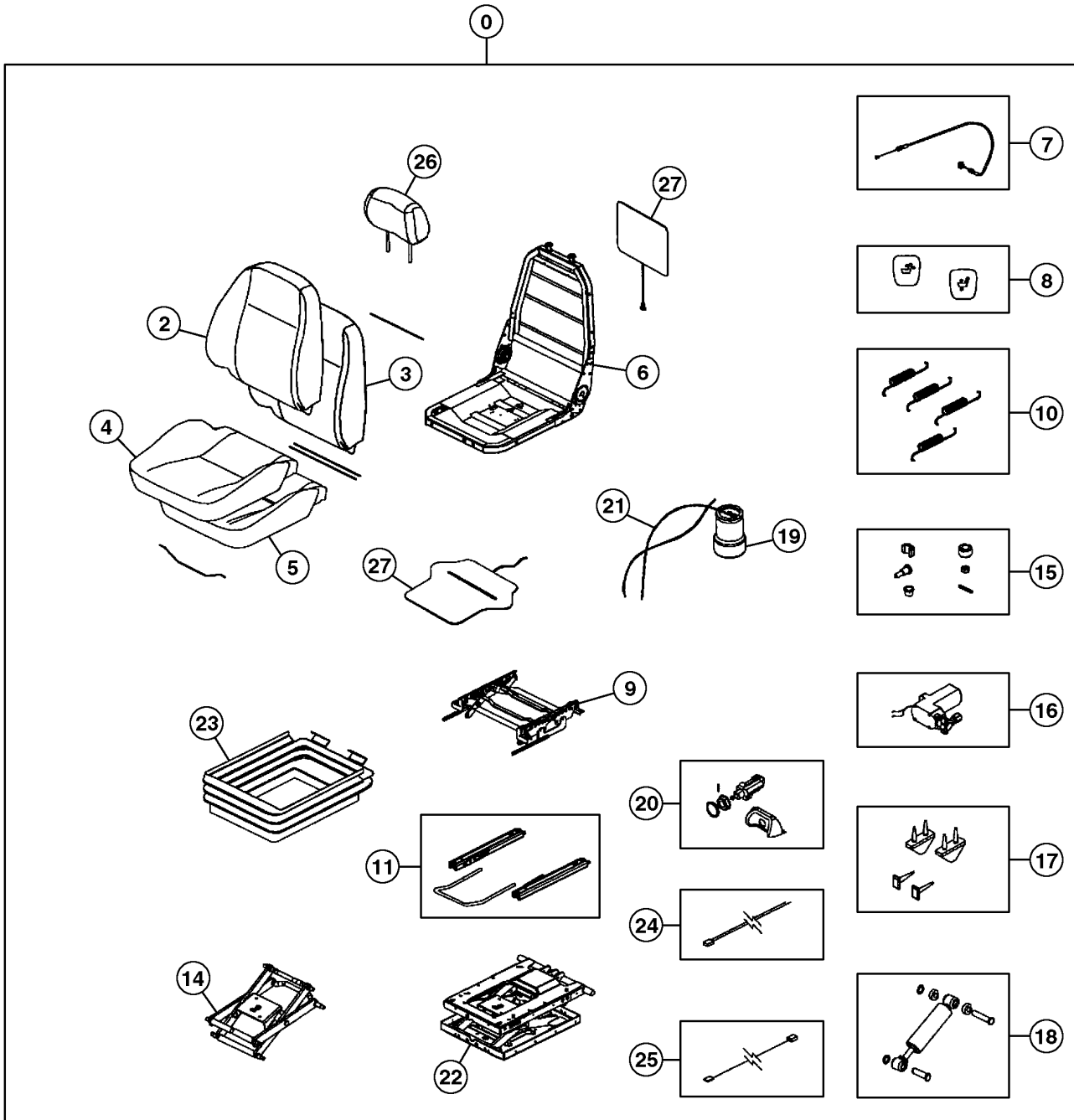
1. Disassemble as necessary.
2. When assembling, install spacers (9 and 10) in correct locations.
3. Install washers (7, 8, 22, and 23) in correct locations.

4. Tighten cap screws (6, 11 and 21) to specifications.

Specification	
Seat Belt Cap Screw—Torque	50 N•m 37 lb-ft

TX17984.000005C -19-06JUL06-2/2

Air Suspension Seat Disassemble and Assemble



18
1821
6

TX1000789

Air Suspension Seat

Continued on next page

TX17984,000005E -19-05JUN06-1/2

TM2362 (25JUN08)

18-1821-6

450DLC Excavator Repair

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Seat and Seat Belt

0—Seat Assembly
2—Cushion Cover
3—Pad
4—Cushion
5—Pad
6—Frame
7—Cable

8—Handle
9—Stand
10—Spring
11—Seat Slide Track Kit
14—Lever Kit
15—Bearing Kit

16—Compressor
17—Lever
18—Torsional Damper
19—Air Spring Seat Kit
20—Valve
21—Hose Kit

22—Seat Suspension
23—Seat Suspension Boot Kit
24—Seat Adjustment Cable Kit
25—Wiring Lead
26—Head Rest
27—Heater

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Seat and Seat Belt

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Refrigerant Cautions and Proper Handling



CAUTION: DO NOT allow liquid refrigerant to contact eyes or skin. Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

If liquid refrigerant contacts eyes or skin, DO NOT rub the area. Splash large amounts of COOL water on affected area. Go to a physician or hospital immediately for treatment.

DO NOT allow refrigerant to contact open flames or very hot surfaces such as electric welding arc, electric heating element and lighted smoking materials.

DO NOT heat refrigerant over 52°C (125°F) in a closed container. Heated refrigerant will develop high pressure which can burst the container.

Keep refrigerant containers away from heat sources. Store refrigerant in a cool place.

DO NOT handle damp refrigerant container with your bare hands. Skin may freeze to container. Wear gloves.

If skin freezes to container, pour COOL water over container to free the skin. Go to a physician or hospital immediately for treatment.

IMPORTANT: To meet government standards relating to the use of refrigerants,

R134a is used in the air conditioning system. Because it does not contain chlorine, R134a is not detrimental to the ozone in the atmosphere. However, it is illegal to discharge any refrigerant into the atmosphere. It must be recovered using the appropriate recovery stations.

Use correct refrigerant recovery, recycling and charging stations. Never mix refrigerants, hoses, fittings, components or refrigerant oils.

Use only John Deere approved R134a refrigerant products. Mixing of products not compatible will cause system damage and contaminate recovery, recycling and charging station equipment. Care must be taken to identify and use equipment, refrigerant oil and refrigerant designed only for R134a refrigerant systems. Refrigerant should be tested for type and purity before recovery, recycling or charging of system. JT02167A refrigerant test instrument should be used before any testing or repair to system is preformed.

Continued on next page

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Heating and Air Conditioning

Prism Pro Refrigerant Identification

Instrument.JT02167A

To safely identify type and check purity of refrigerant prior to recovery, recycling and recharging of A/C systems.

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Flush and Purge Air Conditioner System

NOTE: Flushing can be performed on machine.

1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Perform Recover R134a Refrigerant. (Group 1830.)
3. Add TY25601 Air Conditioning Flush Solvent to system using JT02075 Air Conditioning Flusher and JT02098 Flushing Fitting Kit.
4. Remove compressor. Measure oil drained from both ports. See Compressor Remove and Install. (Group 1830.)

5. To clean compressor:

- a. Pour air conditioning flush solvent into suction port and discharge port. Install JT02099 and JT02100 Adaptors with JT03194 Caps to close both ports.

Specification

Flushing Solvent in Suction	
Port—Volume.....	240 mL
	8 fl oz
Flushing Solvent in Discharge	
Port—Volume.....	120 mL
	4 fl oz

- b. Turn compressor end for end, roll it side to side.
- c. Remove caps and adapters from both ports. Drain solvent from compressor.
- d. Connect battery power to compressor clutch coil. Rotate pulley at least five revolutions to move solvent out of compressor ports.
- e. Invert compressor, turn end for end, roll side to side. Drain thoroughly.
- f. Let compressor sit inverted for three to five minutes.

- g. Repeat previous two steps at least three times.

6. Remove and discard receiver-dryer. See Receiver-Dryer Remove and Install. (Group 1830.)

7. Divide system into two circuits:

- a. Condenser, including inlet and outlet hoses.
- b. Evaporator, including inlet and outlet hoses.

IMPORTANT: DO NOT attempt to flush through compressor or receiver-dryer. Flushing through expansion valve is acceptable if refrigerant oil has normal odor and appearance.

8. To Flush Condenser:

- a. Connect flusher outlet hose to inlet end of compressor discharge line using JT02102 Adapter.
- b. Attach a return hose and aerator nozzle to outlet end of receiver-dryer inlet hose using JT03197 Reducer. Put nozzle in container to collect flushing solvent.
- c. Fill flusher tank with solvent. Fasten all connections.

Specification

Flusher Tank—Capacity	4 L
	1 gal

- d. Connect a supply line of moisture-free compressed air or dry nitrogen to flusher air valve.

Air pressure must be at least at specification for flushing and purging.

Specification

Air Compressor—Pressure 620 kPa minimum
 6.2 bar minimum
 90 psi minimum

- e. Open air valve to force flushing solvent into condenser circuit. Flusher tank is empty when hose pulsing stops. Additional flushing cycles are required if system is heavily contaminated with burned oil or metal particles.

NOTE: Purging the condenser circuit takes 10—12 minutes to thoroughly remove solvent.

- f. Disconnect hose from aeration nozzle to check circuit for solvent. Hold hose close to a piece of cardboard; continue purging until cardboard is dry.

NOTE: Perform the following step if system is contaminated with burned refrigerant oil or debris. Skip the following step to flush evaporator through expansion valve, if oil appears normal.

9. To Flush Evaporator:

- a. Remove evaporator. See Heater and Air Conditioner Remove and Install. (Group 1830.)
- b. Force flushing solvent through evaporator inlet with compressed air.
- c. Purge system until dry.
- d. Install evaporator. See Heater and Air Conditioner Remove and Install. (Group 1830.)

10. To Flush Evaporator Through Expansion Valve:

- a. Connect flusher outlet hose to connection of receiver-dryer outlet hose using JT03188 Adapter.

- b. Attach a hose and aerator nozzle to compressor inlet line using JT02101 Adapter. Put nozzle in a container to collect solvent.
- c. Fill flusher tank with solvent. Fasten all connections.

Specification

Flusher Tank—Capacity 4 L
 1 gal

- d. Connect a supply line of moisture-free compressed air or dry nitrogen to flusher air valve.

Air pressure must be at least at specification for flushing and purging.

Specification

Air Compressor—Pressure 620 kPa minimum
 6.2 bar minimum
 90 psi minimum

- e. Open air valve to force flushing solvent into condenser circuit. Flusher tank is empty when hose pulsing stops. Additional flushing cycles are required if system is heavily contaminated with burned oil or metal particles.

NOTE: Purging the evaporator circuit takes 12—15 minutes to thoroughly remove solvent.

- f. Disconnect hose from aeration nozzle to check circuit for solvent. Hold hose close to a piece of cardboard. Continue purging until cardboard is dry.

- g. Install a new receiver-dryer compatible with R134a refrigerant. See Receiver-Dryer Remove and Install. (Group 1830.)

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h. Add required oil. See R134a Refrigerant Oil Information. (Group 1830.)

i. Install compressor. See Compressor Remove and Install. (Group 1830.)

IMPORTANT: Air compressors used for purging systems require a water separator. Purging without a separator adds moisture, creating hydrofluoric acid when combined with refrigerant oil. Acid is corrosive to metal tubing.

11. To purge system:

a. Connect dry nitrogen hose to JT02051 Manifold Pressure Gauge center hose.

b. Connect gauge manifold suction hose to compressor suction port. Open valve.

c. Connect gauge manifold discharge hose to compressor discharge port. Open valve.

d. Disconnect discharge hose from gauge manifold to allow purging nitrogen to atmosphere.

e. Open nitrogen tank valve and adjust regulator to specification.

Specification

Nitrogen Tank Regulator—	
Pressure.....	275 kPa 2.75 bar 40 psi

f. Purge system for two minutes. Disconnect nitrogen supply.

12. Perform Evacuate R134a System. (Group 1830.)

13. Perform Charge R134a System. (Group 1830.)

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R134a Refrigerant Oil Information



CAUTION: All new compressors are charged with a mixture of nitrogen, R134a refrigerant and TY22025 (R134a) refrigerant oil. Wear safety goggles and discharge the compressor slowly to avoid possible injury.

IMPORTANT: Do not add any more oil than required or maximum cooling will be reduced.

DO NOT leave system or R134a compressor oil containers open. Refrigerant oil easily absorbs moisture. **DO NOT** spill R134a compressor oil on acrylic or ABS plastic. This oil will deteriorate these materials rapidly. Identify R134a oil containers and measures to eliminate accidental mixing of different oils.

New compressor from parts depot contains new oil. Oil level visible through suction port normally is below drive shaft.

Normal operating oil level of compressor removed from operation cannot be seen through suction port of compressor.

Compressors can be divided into three categories when determining correct oil charge for system.

- New compressor from parts depot
- Used compressor removed from operation
- Compressor internally washed with flushing solvent

Determining amount of system oil charge prior to installation of compressor on machine.

When complete system, lines, and components are flushed add correct amount of oil as described.

Specification

Oil—Total System Volume	180 mL 6.09 fl oz
R134a—Weight.....	1100—1200 g 2.43— 2.65 lb

If any section of hose is removed and flushed or replaced, measure length of hose and use formula 3 mL per 30 cm (0.1 fl oz per ft) to determine correct amount of oil to be added.

Drain compressor oil into graduated container while rotating compressor shaft and record amount.

If oil drained from compressor removed from operation is very black or amount of oil is less than 6 mL (0.2 fl oz), perform the following and discard oil properly:

- Determine if R134a leakage was detected, remove component and repair or replace component. See Refrigerant Leak Test. (Group 9031-25.)
- Remove and discard receiver-dryer. See Receiver-Dryer Remove and Install. (Group 1830.)
- Flush complete system with TY16134 Air Conditioning Flushing Solvent. See Flush and Purge Air Conditioner System. (Group 1830.)

If component is serviceable, pour flushing solvent in ports and internally wash out old oil and discard oil properly.

1. Install new receiver-dryer. See Receiver-Dryer Remove and Install. (Group 1830.)
2. Pour required amount of TY22025 Refrigerant Oil in compressor.
3. Connect all components. Perform Evacuate R134a System. (Group 1830.)
4. Perform Charge R134a System. (Group 1830.)

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R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure

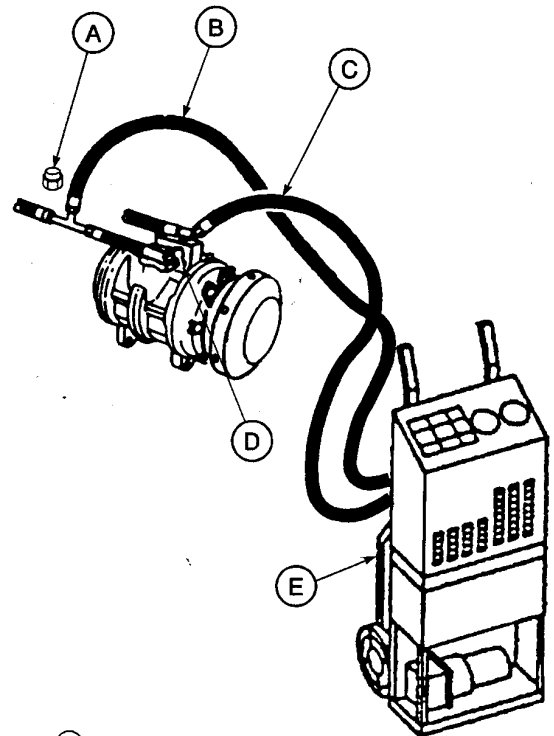
CAUTION: Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

IMPORTANT: Use only John Deere approved R134a refrigerant products. Mixing of products not compatible will cause system damage and contaminate recovery, recycling and charging station equipment.

CAUTION: Do not remove high pressure relief valve (D). Air conditioning station will discharge rapidly causing possible injury.

IMPORTANT: Use only John Deere approved refrigerant recovery/recycling and charging stations. **DO NOT** mix refrigerant, hoses, fittings, components or refrigerant oils.

1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Close both high-side and low-side valves on refrigerant recovery/recycling and charging station (E).
3. Remove cap from low-side charge port.
4. Connect blue hose (C) from refrigerant recovery/recycling and charging station (E) to low-side test port.
5. Remove cap (A) from charge port on high pressure hose and connect red hose (B).
6. Follow the charging station manufacturers' instructions when using refrigerant recovery/recycling and charging station.



T8118AG (CV)


A—High Pressure Hose Charge Port Cap
B—Red Hose
C—Blue Hose
D—High Pressure Relief Valve
E—Refrigerant Recovery/Recycling and Charging Station

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Recover R134a Refrigerant

 **CAUTION:** Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

 **CAUTION:** Do not remove high pressure relief valve. Air conditioning system will discharge rapidly causing possible injury.

IMPORTANT: Use correct refrigerant recovery/recycling and charging stations. **DO NOT** mix refrigerant, hoses, fittings, components or refrigerant oils.

1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Run air conditioning system for three minutes to help in recovery process. Turn air conditioning system off before proceeding with recovery steps.
3. With engine OFF identify refrigerant type using JT02167A Refrigerant Identification Instrument.
4. Connect refrigerant recovery system. See R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure. (Group 1830.)
5. Follow charging station manufacturers' instructions when using refrigerant recovery/recycling and charging station.

Evacuate R134a System



CAUTION: Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

Do not remove high pressure relief valve. Air conditioning system will discharge rapidly causing possible injury.

1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Connect refrigerant recovery system. See R134a Refrigerant Recovery/Recycling and Charging Station Installation Procedure. (Group 1830.)
3. Open low-side and high-side valves on refrigerant recovery/recycling and charging station.
4. Follow charging station manufacturers' instructions to evacuate system.
5. Evacuate system until low-side gauge vacuum reading is to specification.

Vacuum specification listed is for sea level conditions. Subtract the specified value for elevation above sea level.

Specification

Evacuate System—Vacuum..... 98 kPa
980 mbar
29 in. Hg

Value to Subtract for Elevation

Above Sea Level—Vacuum..... 3.4 kPa from 98 kPa for each
300 m elevation above sea
level
34 mbar from 980 mbar for
each 300 m elevation above
sea level
1 in. Hg from 29 in. Hg for each
1000 ft elevation above sea
level

If the specified vacuum reading cannot be obtained in 15 minutes, check the system for leaks. See Refrigerant Leak Test. (Group 9031-25.)

6. Close low-side and high-side valves when specified vacuum reading is obtained.
7. Turn vacuum pump off.
8. Observe the gauge for 5 minutes to see if the vacuum decreases. A vacuum decrease more than the specification indicates a leak in the system.

Specification

Allowable System Decrease—
Vacuum..... 3.4 kPa
34 mbar
1 in. Hg

Repair the leak. See Refrigerant Leak Test. (Group 9031-25.)

9. Start the vacuum pump.

Open low-side and high-side valves.

Continue to evacuate the system for 30 minutes.

Specification

Evacuation Procedure—Time..... 30 minutes

10. Close low-side and high-side valves. Turn vacuum pump off.
11. Perform Charge R134a System. (Group 1830.)

Charge R134a System



CAUTION: Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.

IMPORTANT: Use only John Deere approved refrigerant recovery/recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.

1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Identify refrigerant type using JT02167A Refrigerant Identification Instrument.
3. Perform Evacuate R134a System. (Group 1830.)
4. Follow charging station manufacturers' instructions to charge the system.

Before beginning to charge air conditioning system, the following conditions must exist:

- Engine stopped.
- System must be evacuated and hold a vacuum.

5. Add refrigerant to system.

Specification

Air Conditioning System	
Refrigerant—Capacity.....	1100—1200 g 2.43—2.65 lb

6. Check air conditioning for proper function. See Diagnose Air Conditioning System Malfunctions. (Group 9031-25.)

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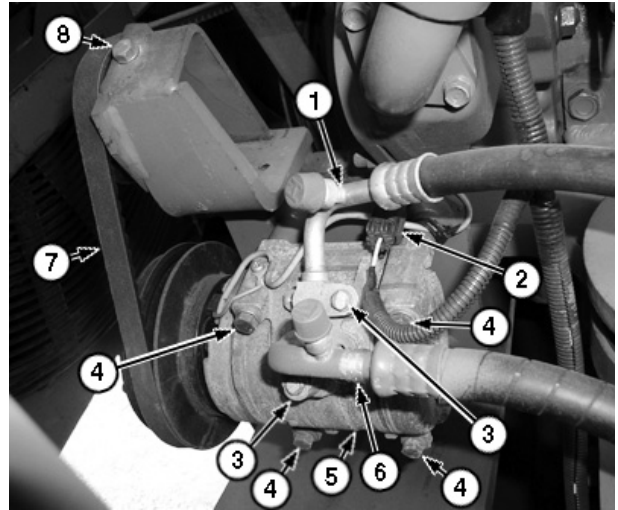
Compressor Remove and Install

1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Open engine cover (hood). See Open Engine Cover for Service (450DLC and 650DLC Only). (Operator's Manual.)
3. Perform Recover R134a Refrigerant. (Group 1830.)

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4. Turn cap screw (8) until belt (7) tension is relieved.
5. Remove belt.
6. Disconnect electrical connector (2).
7. Remove cap screws (3) to disconnect refrigerant lines (1 and 6). Close lines using caps and plugs.
8. Remove cap screws (4) to remove compressor (5).
9. Repair or replace parts as necessary.
10. Install compressor.
11. Connect refrigerant lines.
12. Connect electrical connector.
13. Install belt.
14. Perform Check and Adjust A/C V-Belt. (Operator's Manual.)
15. Perform Evacuate R134a System. (Group 1830.)
16. Perform Charge R134a System. (Group 1830.)



Compressor

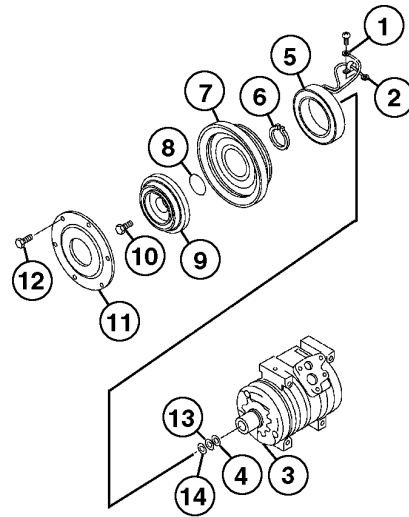
- 1—High Pressure Refrigerant Line
- 2—Electrical Connector
- 3—Cap Screw (2 used)
- 4—Cap Screw (4 used)
- 5—Compressor
- 6—Low Pressure Refrigerant Line
- 7—Belt
- 8—Cap Screw

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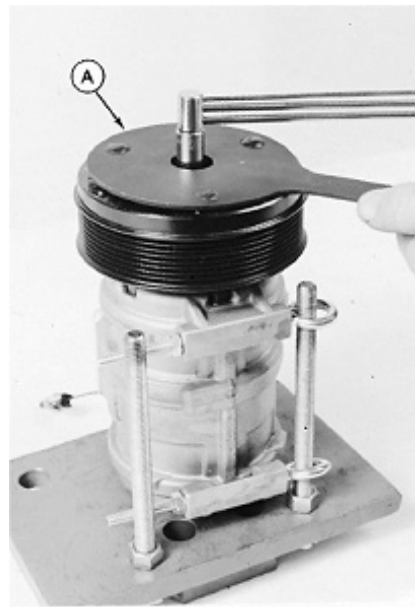
Compressor Clutch Remove and Install

1. Remove compressor (3) from machine. See Compressor Remove and Install. (Group 1830.)
2. Install compressor on DFRW20 Compressor Holding Fixture using two 6 in. x 1/4 in. eyebolts and nuts as illustrated. See DFRW20 Compressor Holding Fixture. (Group 9900.)
3. Remove cap screws (12).
4. Remove dust cover (11).
5. Hold clutch hub (9) using JDG747 Compressor Clutch Spanner (A) to remove clutch hub-to-shaft cap screw (10).
6. Remove clutch hub. Remove washers (4, 13, and 14) from clutch hub and save for installation.
7. Remove and discard ring (8).
8. Remove pulley (7) using a 3-jaw puller or a V-belt pulley pulling attachment.
9. Remove the screw for the ground wire (1) and clamp for clutch coil wire (2).
10. Remove and discard snap ring (6).
11. Remove clutch coil (5).
12. Repair or replace parts as necessary.

- A—JDG747 Compressor Clutch Spanner
 1—Ground Wire
 2—Clutch Coil Wire
 3—Compressor
 4—Washer
 5—Clutch Coil
 6—Snap Ring
 7—Pulley
 8—Ring
 9—Clutch Hub
 10—Clutch Hub-to-Shaft Cap Screw
 11—Dust Cover
 12—Cap Screw (6 used)
 13—Washer
 14—Washer



Compressor



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13. Install clutch coil.
14. Install new snap ring, flat side toward coil.
15. Connect clutch coil wire.
16. Connect ground wire.
17. Install pulley.
18. Install new ring, flat side toward pulley.
19. Apply grease to washers. Install in clutch hub.
20. Install clutch hub.
21. Install clutch hub-to-shaft cap screw. Tighten to specification.

Specification

Clutch Hub-to-Shaft Bolt—Torque..... 14 N•m
120 lb-in.

TX17984.000006B -19-02AUG06-2/3

NOTE: The clutch coil is NOT polarity sensitive.

22. Check pulley-to-clutch hub clearance using a dial indicator as illustrated. Connect a set of jumper wires from the compressor to a 12V battery to engage clutch.

Check clearance at three equally spaced locations around the clutch hub. Add or remove washers as required.

Specification

Pulley-to-Clutch Hub—Clearance..... 0.35—0.65 mm
0.014—0.026 in.

23. Install dust cover.
24. Install compressor. See Compressor Remove and Install. (Group 1830.)
25. Perform Evacuate R134a System. (Group 1830.)
26. Perform Charge R134a System. (Group 1830.)



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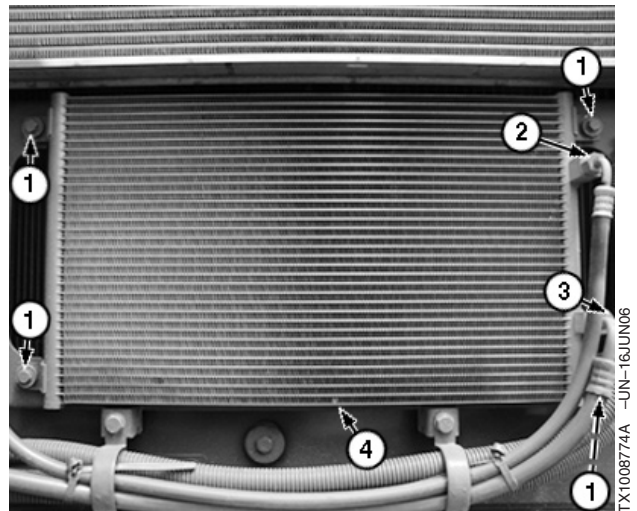
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Condenser Remove and Install

1. Remove cooling package door cap screws to open.
2. See Refrigerant Cautions and Proper Handling. (Group 1830.)
3. Perform Recover R134a Refrigerant. (Group 1830.)

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4. Disconnect refrigerant lines (2 and 3). Close lines using caps and plugs.
5. Remove cap screws (1) to remove condenser (4).
6. Repair or replace parts as necessary.
7. Install condenser.
8. Connect refrigerant lines.
9. Perform Evacuate R134a System. (Group 1830.)
10. Perform Charge R134a System. (Group 1830.)
11. Close cooling package door and install cap screws.



Condenser

- 1—Cap screw (4 used)
- 2—High Pressure Output Refrigerant Line
- 3—High Pressure Input Refrigerant Line
- 4—Condenser

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Heater and Air Conditioner Remove and Install

NOTE: Evaporator and heater core are integral parts of the air conditioner. If evaporator or heater core need replacement, replace entire air conditioner unit.

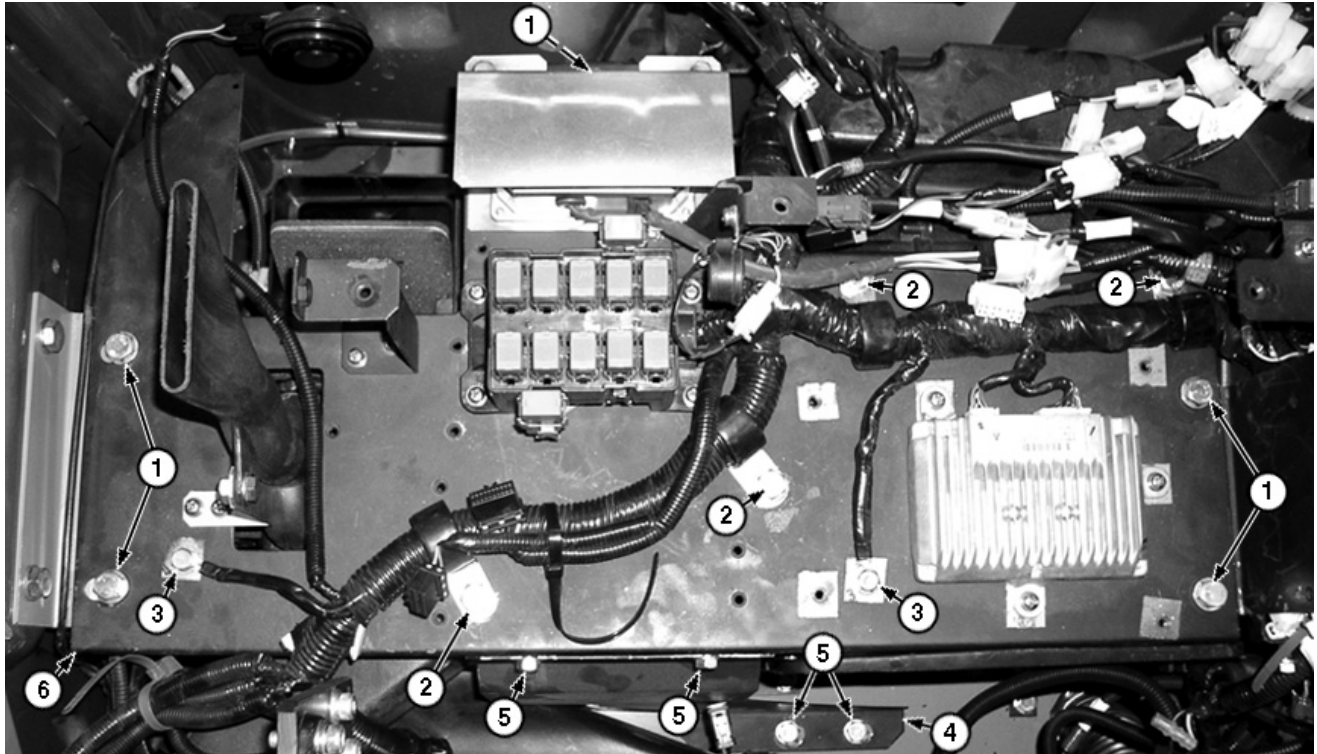
1. See Refrigerant Cautions and Proper Handling. (Group 1830.)
2. Perform Drain Cooling System. (Operator's Manual.) Approximate capacity is 48 L (12.7 gal).
3. Perform Recover R134a Refrigerant. (Group 1830.)
4. Remove seat. See Seat Remove and Install. (Group 1821.)

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Heating and Air Conditioning



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- | | | | |
|----------------------|------------------------|----------------------|---------|
| 1—Cap Screw (5 used) | 3—Ground Wire (2 used) | 5—Cap Screw (4 used) | 6—Cover |
| 2—Cap Screw (4 used) | 4—Mount Bracket | | |

- | | |
|-------------------------------------------------------|----------------------------------------------------------|
| 5. Remove cap screws (5) to remove mount bracket (4). | 7. Remove cap screws (2) to disconnect ground wires (3). |
| 6. Disconnect all electrical connectors. | 8. Remove cap screws (1) to remove cover (6). |

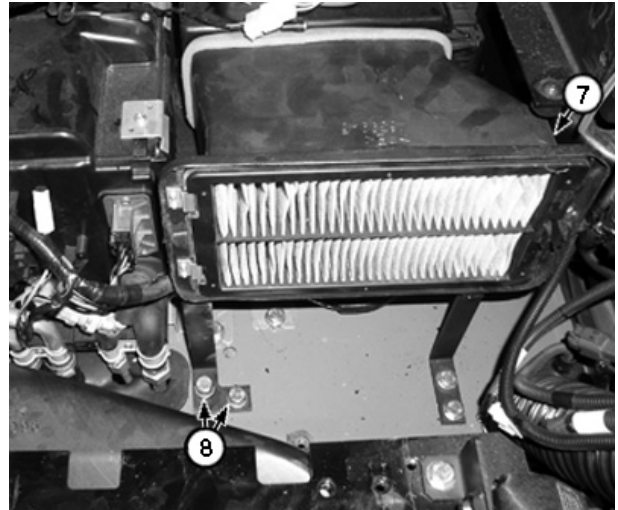
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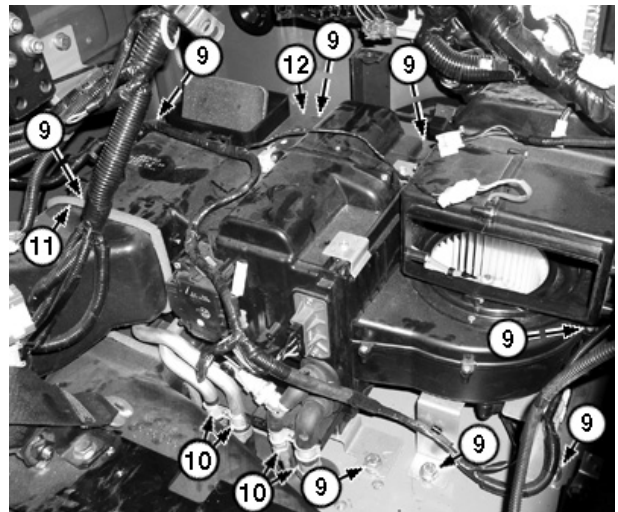
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Heating and Air Conditioning

9. Remove cap screws (8) to remove air duct (7).
10. Disconnect refrigerant lines (10). Close lines using caps and plugs.
11. Disconnect all electrical connectors.
12. Disconnect air duct (11).
13. Remove cap screws (9) to remove heater and air conditioner unit (12).
14. Repair or replace parts as necessary.
15. Install heater and air conditioner unit.
16. Connect electrical connectors.
17. Connect refrigerant lines.
18. Install air ducts.
19. Install cover.
20. Connect remaining electrical connectors.
21. Install mount bracket.
22. Install seat. See Seat Remove and Install. (Group 1821.)
23. Perform Evacuate R134a System. (Group 1830.)
24. Perform Charge R134a System. (Group 1830.)
25. Perform Cooling System Fill and Deaeration Procedure. (Group 1830.)



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TX1009498A -UN-12JUL06

- 7—Air Duct
- 8—Cap Screw (2 used)
- 9—Cap Screw (8 used)
- 10—Refrigerant Line (4 used)
- 11—Air Duct
- 12—Heater and Air Conditioner Unit

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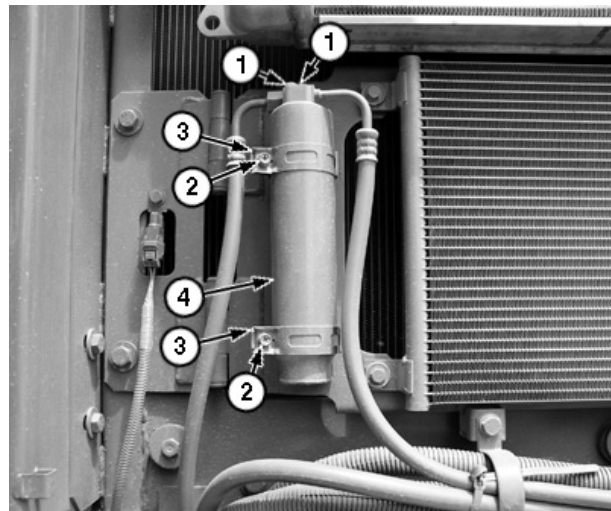
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Receiver-Dryer Remove and Install

1. Remove cooling package door cap screws to open.
2. See Refrigerant Cautions and Proper Handling. (Group 1830.)
3. Perform Recover R134a Refrigerant. (Group 1830.)

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4. Remove cap screws (1) to disconnect lines. Close lines using caps and plugs.
5. Remove cap screws (2) to loosen brackets (3).
6. Remove receiver-dryer (4).
7. Repair or replace parts as necessary.
8. Install receiver-dryer.
9. Connect lines.
10. Perform Evacuate R134a System. (Group 1830.)
11. Perform Charge R134a System. (Group 1830.)
12. Close cooling package door and install cap screws.



Receiver-Dryer

- 1—Cap Screw (2 used)
- 2—Cap Screw (2 used)
- 3—Bracket (2 used)
- 4—Receiver-Dryer

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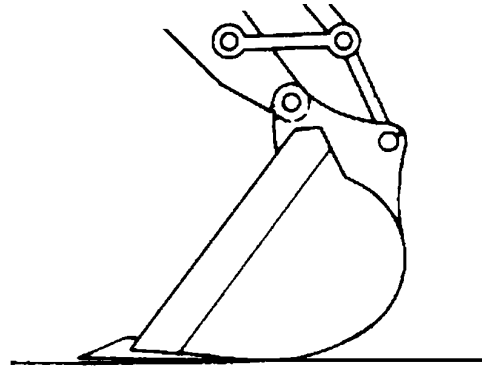
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Bucket Remove and Install

1. Park the machine on level ground.

TX17984,000006E -19-02AUG06-1/5

2. Lower the bucket to the ground and roll the bucket so the flat surface is touching the ground.

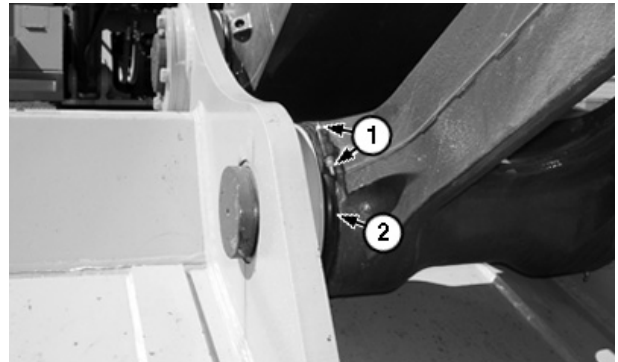


TX1010083 -JUN-18JUL06

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3. Remove O-rings (2).

- 1—Nut (16 used)
- 2—O-ring (4 used)

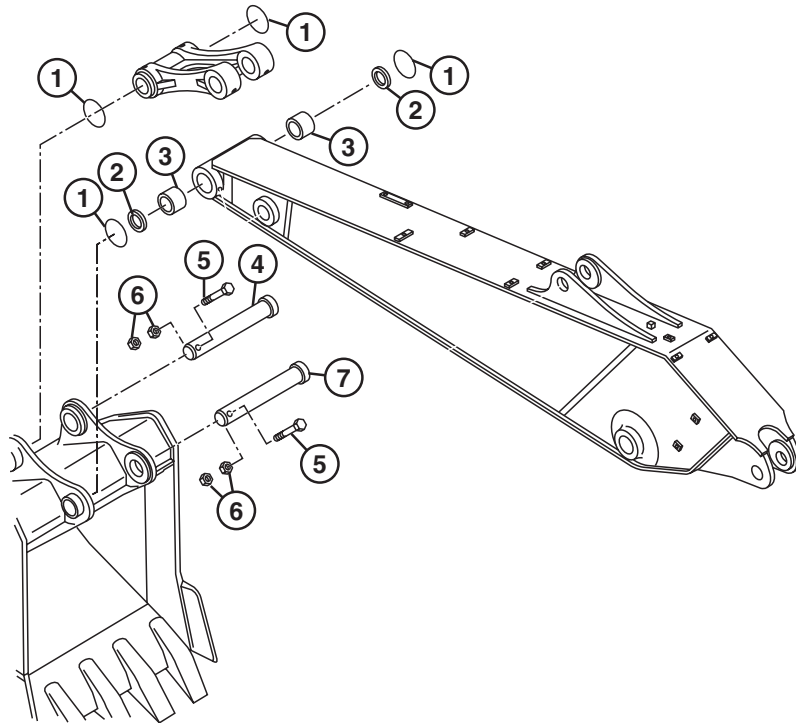


TX1010642A -JUN-26JUL06

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TX17984,000006E -19-02AUG06-3/5

Buckets



TX1010393

TX1010393 -UN-24.JUL06

1—O-ring (4 used)
2—Seal (2 used)

3—Bushing (2 used)
4—Pin

5—Cap Screw (2 used)
6—Nut (4 used)

7—Pin

4. Remove cap screws (5).
5. Remove pins (4 and 7).

CAUTION: Bucket could possibly roll. Place a wood block under the bucket to avoid injury.

6. Separate bucket from arm.
7. Check pins and bushings for wear. See Inspect Pins, Bushings and Bosses—Front Attachment. (Group 3340.)
8. Clean pins and bores.
9. Apply grease to pins and bores.

10. Align machine arm with bucket and install pins (4 and 7).
11. Adjust bucket to arm joint. See Adjust Bucket To Arm Joint. (Operator's Manual.)

NOTE: Tighten nut against nut when installing cap screws.

12. Install cap screws (5).

Specification

Cap Screw Nut—Torque 400 N•m
290 lb-ft

33
3302
2

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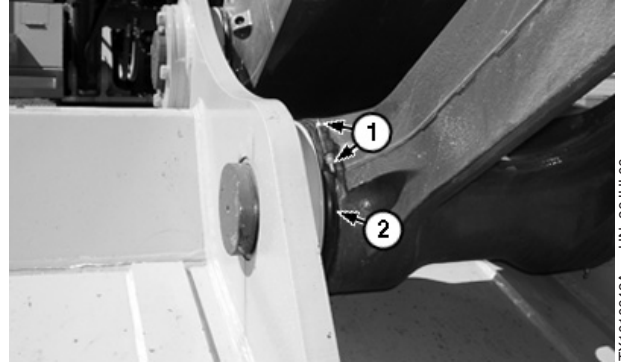
TX17984,000006E -19-02AUG06-4/5

Buckets

NOTE: Install O-rings with the separation section away from making contact with soil. This will prevent it from being damaged quickly from soil or foreign matter.

Install nuts so there is no gap in O-ring. Cut off excess bolt so as not to cause damage to the O-ring from soil being trapped between the bolt and O-ring.

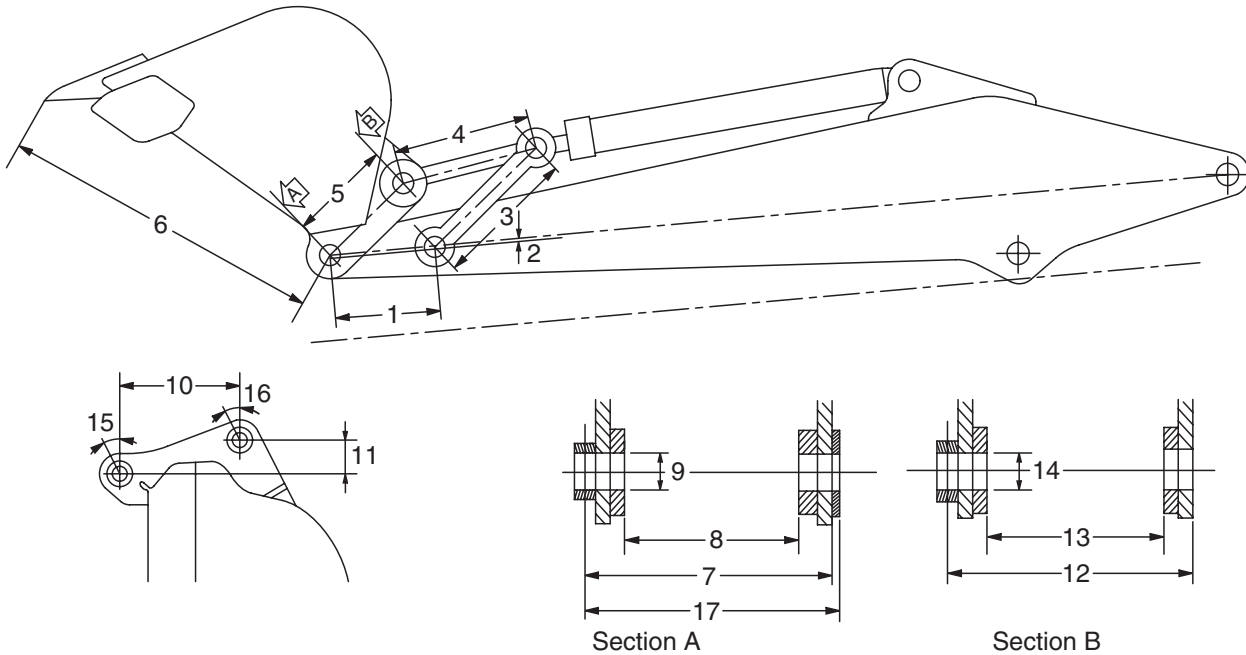
13. Install O-rings (2).
14. Grease working tool pivots. See Grease Working Tool Pivots and Links. (Operator's Manual.)



1—Nuts (16 used)
2—O-ring (4 used)

TX17984,000006E -19-02AUG06-5/5

Bucket Pin-Up Data



TX1009665

Bucket Pin-Up Data

- | | | | |
|-----------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| 1—Bucket Pin A-to-Guide Link Arm Pin Distance | 7—Bucket Pin A Cap Screw Hole-to-Pin End (Minimum—Without Shim) | 11—Bucket Pin Vertical Offset (Bucket Resting Flat on Ground) | 15—Bucket Pin A Locking Cap Screw Angle |
| 2—Guide Link Arm Pin-to-Arm Centerline Offset | 8—Bucket Pin A Bucket Ear Bushing Inner Distance | 12—Bucket Pin B Cap Screw Hole-to-Pin End (Minimum) | 16—Bucket Pin B Locking Cap Screw Angle |
| 3—Guide Link Length | 9—Bucket Pin A Bucket Ear Bushing Bore Size | 13—Bucket Pin B Bucket Ear Bushing Inner Distance | 17—Bucket Pin A Cap Screw Hole-to-Pin End (Minimum—With Shim) |
| 4—Bucket Link Length | 10—Bucket Pin Distance (Bucket Resting Flat on Ground) | 14—Bucket Pin B Bucket Ear Bushing Bore Size | |
| 5—Bucket Pin Distance | | | |
| 6—Bucket Arm Pin-to-Bucket Tooth Tip Distance | | | |

Continued on next page

TX17984,0000070 -19-24JUL06-1/2

TX1009665 -UN-14JUL06

Buckets

Item	Measurement (mm)	Measurement (in.)
1	520	20.47
2	10	0.39
3	750	29.53
4	710	27.95
5	568	22.36
6	1911	75.24
7	-	-
8	470.5—471.0	18.25—18.54
9	110	4.33
10	558	21.97
11	106	4.17
12	648	25.51
13	471	18.54
14	110	4.33
15	45°	45°
16	45°	45°
17	680	26.77

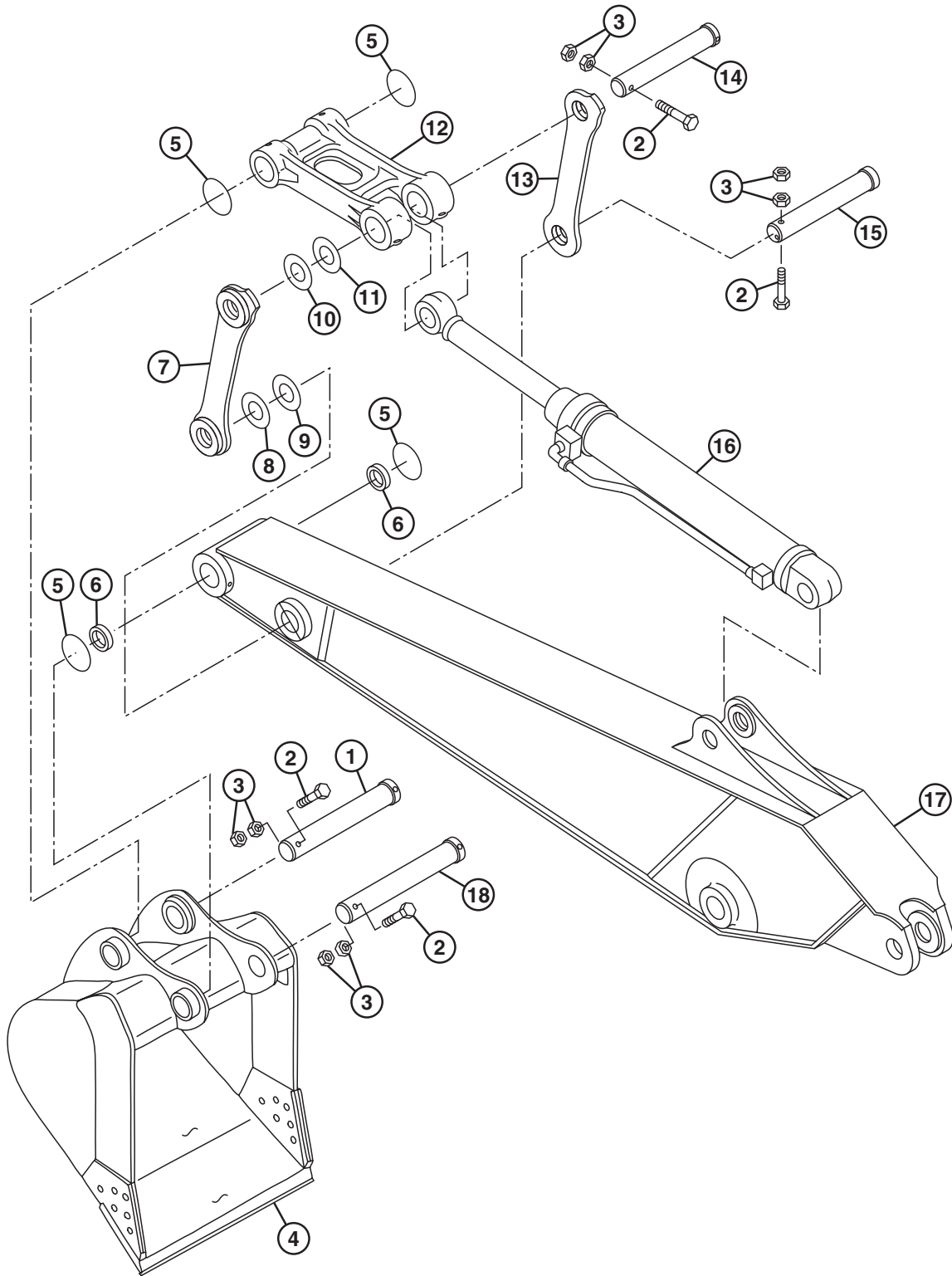
TX17984,000070 -19-24JUL06-2/2

33
3302
5

Buckets

33
3302
6

Bucket Links Remove and Install



33
3340
2

TX1009934

Arm Bucket Linkage

Continued on next page

CP94658,0000010 -19-02AUG06-1/2

TM2362 (25JUN08)

33-3340-2

450DLC Excavator Repair

062508

PN=348

TX1009934 -UN-24/UJ.06

Frames

- 1—Pin Fastener
- 2—Cap Screw (4 used)
- 3—Nut (8 used)
- 4—Bucket
- 5—O-Ring (4 used)

- 6—Seal (2 used)
- 7—Link
- 8—Washer
- 9—Washer
- 10—Washer

- 11—Washer
- 12—Link
- 13—Link
- 14—Pin Fastener

- 15—Pin Fastener
- 16—Cylinder
- 17—Arm
- 18—Pin

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

1. Lower bucket (4) to the ground with flat surface resting on the ground to prevent roll over.

	Specification	
Bucket—Weight		1633 kg approximate 3600 lb approximate

	Specification	
Bucket Link—Weight		185 kg approximate 408 lb approximate

	Specification	
Arm Link—Weight.....		53 kg approximate 118 lb approximate

2. Slide O-ring (5) onto boss on bucket.
3. Remove parts (1—3) and (18). Remove bucket.

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

	Specification	
Bucket Cylinder—Weight.....		390 kg approximate 840 lb approximate

4. Support bucket cylinder using wood blocks.
5. Remove parts (2 and 3).
6. Remove O-ring (5) and seal (6).

7. Remove washers (8—11).
8. Remove pin fasteners (14 and 15).
9. Remove links (7 and 13).
10. Remove bucket link (12) and links.
11. Replace parts as needed.
12. Inspect seals and bushings in links (12). See Bushings and Seal Remove and Install. (Group 3340.)

IMPORTANT: To prevent the seizure and galling of new or cleaned pins and bushings, apply grease to pins and bushings before assembly. Grease may not flow to all points of pin and bushing at the initial lubrication causing metal-to-metal contact. After assembly, lubricate pivot joint until grease escapes from joint. Then lubricate every 4 hours for the next 20 hours, then daily for the next 30 to 100 hours, and then at the regular maintenance interval.

13. Apply grease to pin fasteners and link pin bores.
14. Install links, bucket, and pins.

CP94658,0000010 -19-02AUG06-2/2

Arm Remove and Install

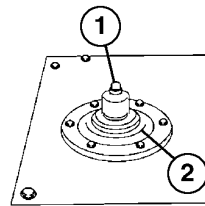
1. Remove bucket. See Bucket Remove and Install. (Group 3302.)
2. Retract arm cylinder and lower front attachment to the ground.
3. Release pressure in front attachment hydraulic circuit. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)

TX17984,0000072 -19-02AUG06-1/8



CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

4. Release hydraulic oil tank pressure by pushing release button on top of hydraulic oil tank.



TX1000859 -JUN-01DEC05

1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

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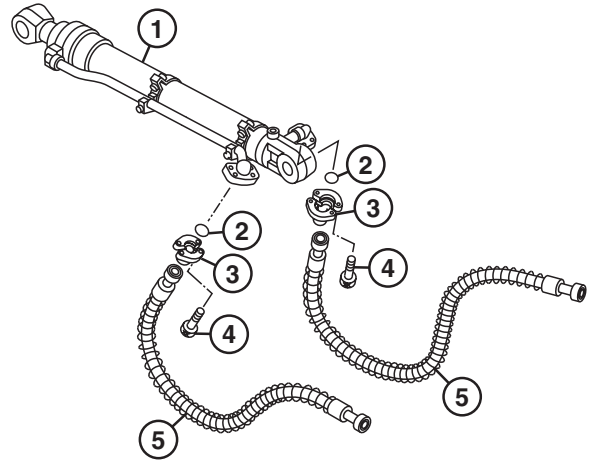
TX17984,0000072 -19-02AUG06-2/8



CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

5. Disconnect hydraulic hoses (5). Close all openings using caps and plugs.

- 1—Bucket Cylinder
- 2—O-ring (2 used)
- 3—Flange (2 used)
- 4—Cap Screw (8 used)
- 5—Hydraulic Hose (2 used)

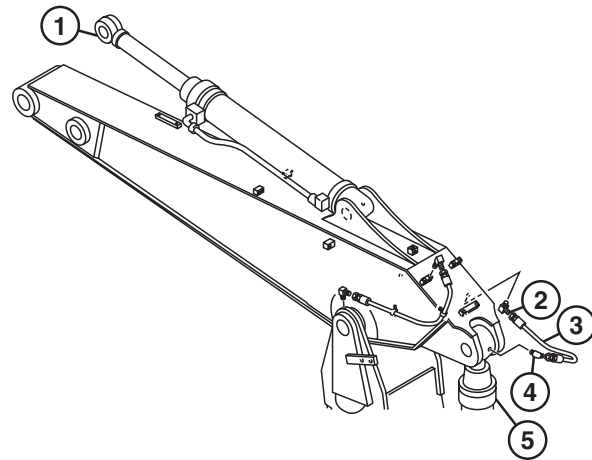


TX1010516 -UN-28JUL06

TX17984.0000072 -19-02AUG06-3/8

6. Disconnect lubrication hose (3). Close all openings using caps and plugs.

- 1—Bucket Cylinder
- 2—Elbow
- 3— Lubrication Hose
- 4—Elbow
- 5—Arm Cylinder



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3340
5

Continued on next page

TX17984.0000072 -19-02AUG06-4/8

7. Remove cap screw (12).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

8. Remove arm cylinder pin (13).

Specification
 Arm Cylinder Pin—Weight..... 24 kg approximate
 55 lb approximate

9. Remove retaining plate (6).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

10. Support arm with hoist and remove arm pin (11).

Specification
 Arm with Bucket Cylinder—
 Weight..... 2550 kg approximate
 5620 lb approximate

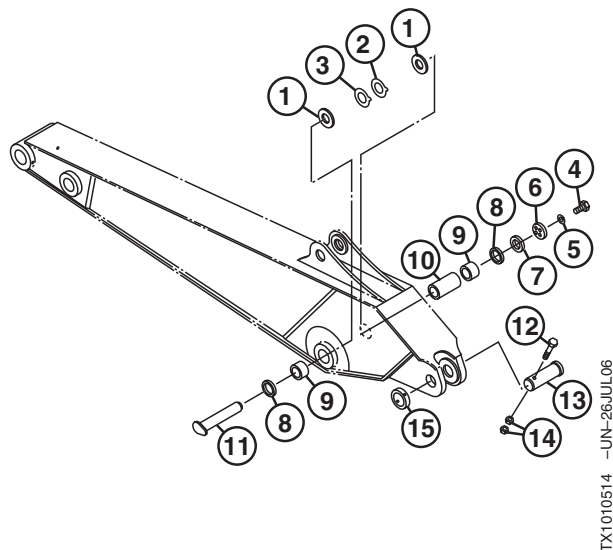
Specification
 Arm Pin—Weight..... 116 kg approximate
 257 lb approximate

11. Remove arm.

12. Inspect pins and bushings for wear. See Inspect Pins, Bushings and Bosses—Front Attachment. (Group 3340.)

13. Clean pins and bores.

14. Apply grease to pins and bores.



- 1—Thrust Plate (2 used)
- 2—Shim
- 3—Shim
- 4—Cap Screw (4 used)
- 5—Washer (4 used)
- 6—Retaining Plate
- 7—Bushing
- 8—Seal
- 9—Bushing (2 used)
- 10—Spacer
- 11—Arm Pin
- 12—Cap Screw
- 13—Arm Cylinder Pin
- 14—Nut (2 used)
- 15—Stop

Continued on next page

TX17984,0000072 -19-02AUG06-5/8

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: Maintain clearance between arm and thrust plate at 1.5 mm (0.06 in.) or less with the use of shims.

15. Support arm with hoist and install arm pin (11), thrust plates (1) equally to each side. Add shims (2 and 3) to attain arm thrust plate clearance.

Specification	
Arm with Bucket Cylinder—	
Weight.....	2550 kg approximate 5620 lb approximate

Specification	
Arm Pin—Weight.....	116 kg approximate 257 lb approximate

Specification	
Arm Thrust Plate—Clearance	0—1.5 mm 0—0.06 in.

16. Install retaining plate (6).

Specification	
Arm Pin Cap Screw—Torque.....	400 N•m 295 lb-ft

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

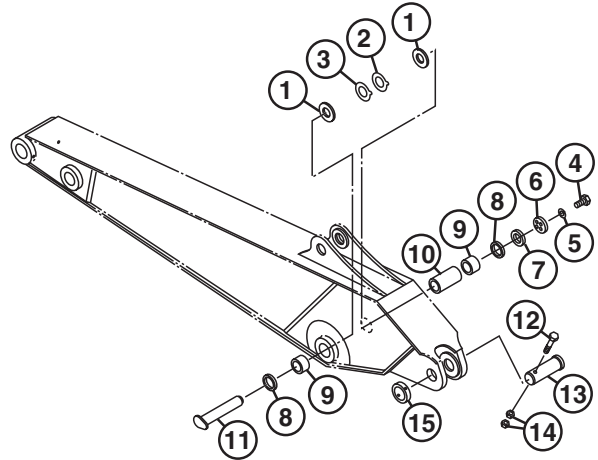
17. Install arm cylinder pin (13).

Specification	
Arm Cylinder Pin—Weight.....	24 kg approximate 55 lb approximate

NOTE: Tighten nut against nut when installing cap screw nuts.

18. Install cap screw (12).

Specification	
Cap Screw Nut—Torque	400 N•m 295 lb-ft



- 1—Thrust Plate (2 used)
- 2—Shim
- 3—Shim
- 4—Cap Screw (4 used)
- 5—Washer (4 used)
- 6—Retaining Plate
- 7—Bushing
- 8—Seal
- 9—Bushing (2 used)
- 10—Spacer
- 11—Arm Pin
- 12—Cap Screw
- 13—Arm Cylinder Pin
- 14—Nut (2 used)
- 15—Stop

TX1010514 - UN-26JUL06

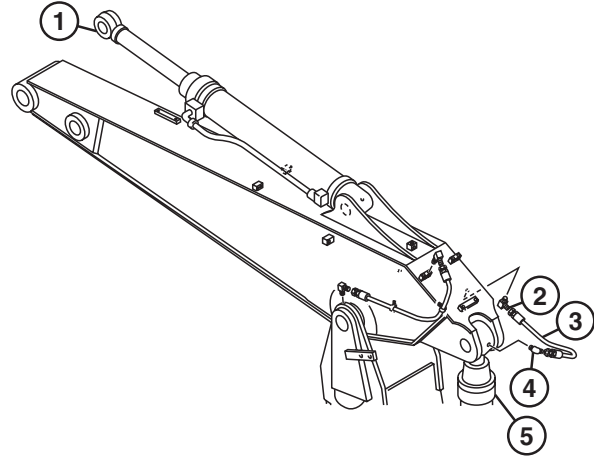
19. Connect lubrication hose (3).

Specification

Arm Cylinder Lubrication Hose—

Torque 29.5 N•m
22 lb-ft

- 1—Bucket Cylinder
- 2—Elbow
- 3— Lubrication Hose
- 4—Elbow
- 5—Arm Cylinder



TX11010512 -UN-26JUL06

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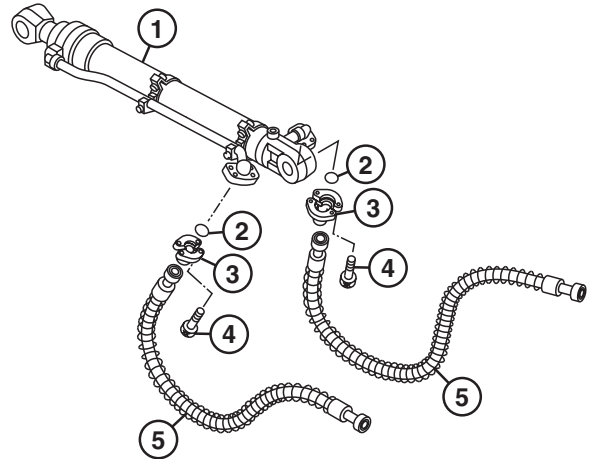
TX17984,0000072 -19-02AUG06-7/8

20. Connect hydraulic hoses (5).

Specification

Hydraulic Hose Cap Screw—
 Torque 140 N•m
 103 lb-ft

- 21. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)
- 22. Bleed air from bucket cylinder. See Hydraulic Cylinder Bleed Procedure. (Group 3360.)
- 23. Install bucket. See Bucket Remove and Install. (Group 3302.)
- 24. Grease arm and arm cylinder pin joints. See Grease Front End Pin Joints. (Operator's Manual.)



- 1—Bucket Cylinder
- 2—O-ring (2 used)
- 3—Flange (2 used)
- 4—Cap Screws (8 used)
- 5—Hydraulic Hoses (2 used)

TX1010516 -JUN-28JUL06

TX17984,0000072 -19-02AUG06-8/8

Boom Remove and Install

- 1. Remove bucket. See Bucket Remove and Install. (Group 3302.)
- 2. Remove arm. See Arm Remove and Install. (Group 3340.)
- 3. Release pressure in boom hydraulic circuit. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)

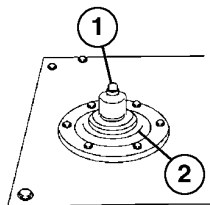
33
3340
9

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TX17984,0000073 -19-15MAY08-1/10

CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

- Release hydraulic oil tank pressure by pushing release button on top of hydraulic oil tank.



TX1000869 -UN-01DEC05

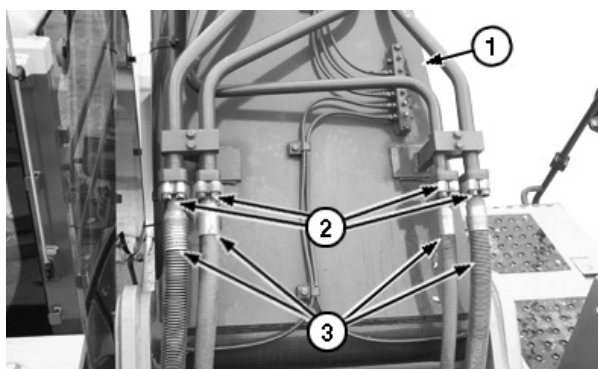
1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

TX17984.0000073 -19-15MAY08-2/10

CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

- Disconnect hydraulic hoses (3). Close all openings using caps and plugs.

- 1—Boom
- 2—Cap Screw (16 used)
- 3—Hydraulic Hose (4 used)

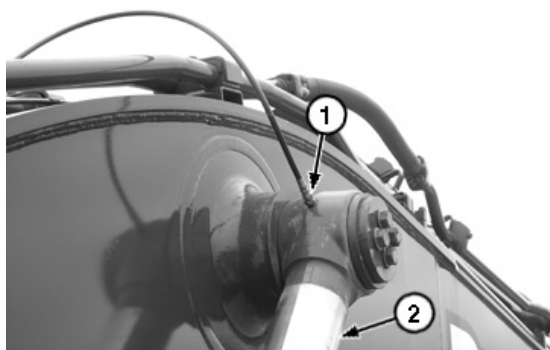


TX1010556A -UN-26JUL06

TX17984.0000073 -19-15MAY08-3/10

- Disconnect lubrication hoses (1). Close all openings using caps and plugs.

- 1—Lubrication Hose (2 used)
- 2—Boom Cylinder



TX1010555A -UN-26JUL06

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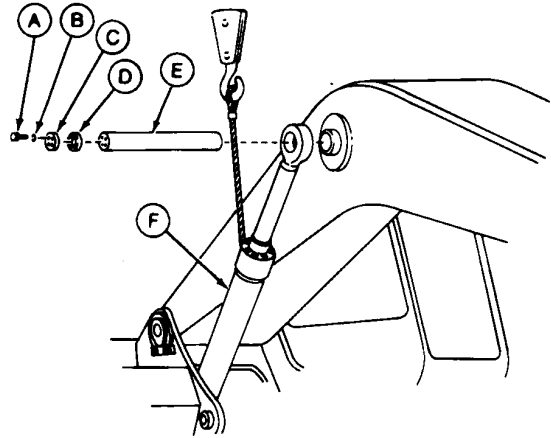
TX17984.0000073 -19-15MAY08-4/10

7. Remove retaining plate (C).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: Boom cylinder pin can be pushed out of boom to lower one cylinder at a time.

8. Support boom cylinder with hoist and remove boom cylinder pin (E).



Specification

Boom Cylinder—Weight 522 kg approximate
1150 lb approximate

Specification

Boom Cylinder Pin—Weight 37 kg approximate
82 lb approximate

9. Lower boom cylinder.

10. Repeat steps 8—9 for other boom cylinder.

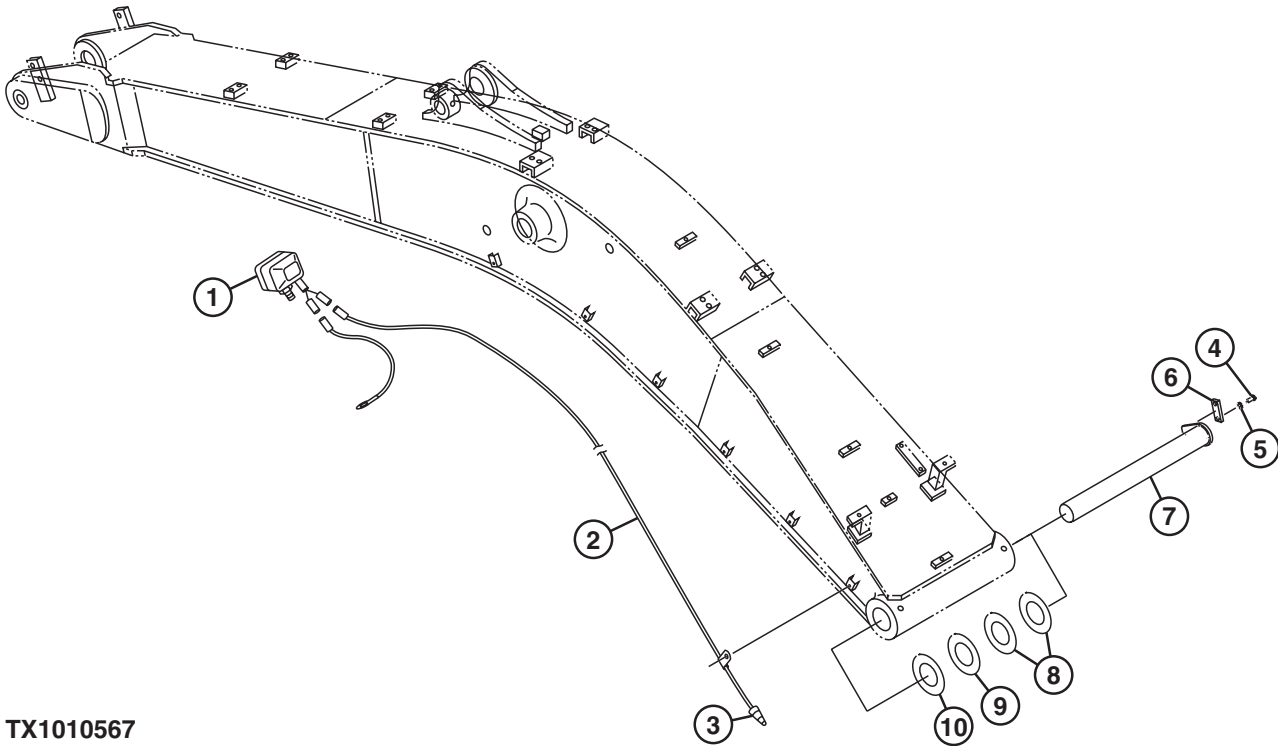
- A—Cap Screw (8 used)
- B—Lock Washer (8 used)
- C—Retaining Plate (2 used)
- D—Washer (2 used)
- E—Boom Cylinder Pin
- F—Boom Cylinder (2 used)

T77029JB -UN-07JUN89

Continued on next page

TX17984,0000073 -19-15MAY08-5/10

Frames



TX1010567

- 1—Light
- 2—Wiring Harness
- 3—Wiring Connector

- 4—Cap Screw (2 used)
- 5—Washer (2 used)
- 6—Retaining Plate

- 7—Boom Pin
- 8—Shim (2 used)

- 9—Washer
- 10—Washer

- 11. Disconnect wiring connector (3).
- 12. Remove retaining plate (6).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 13. Support boom with hoist and remove boom pin (7).

Specification

Boom with Arm Cylinder—
Weight..... 3370 kg approximate
7430 lb approximate

Specification

Boom Pin—Weight 116 kg approximate
257 lb approximate

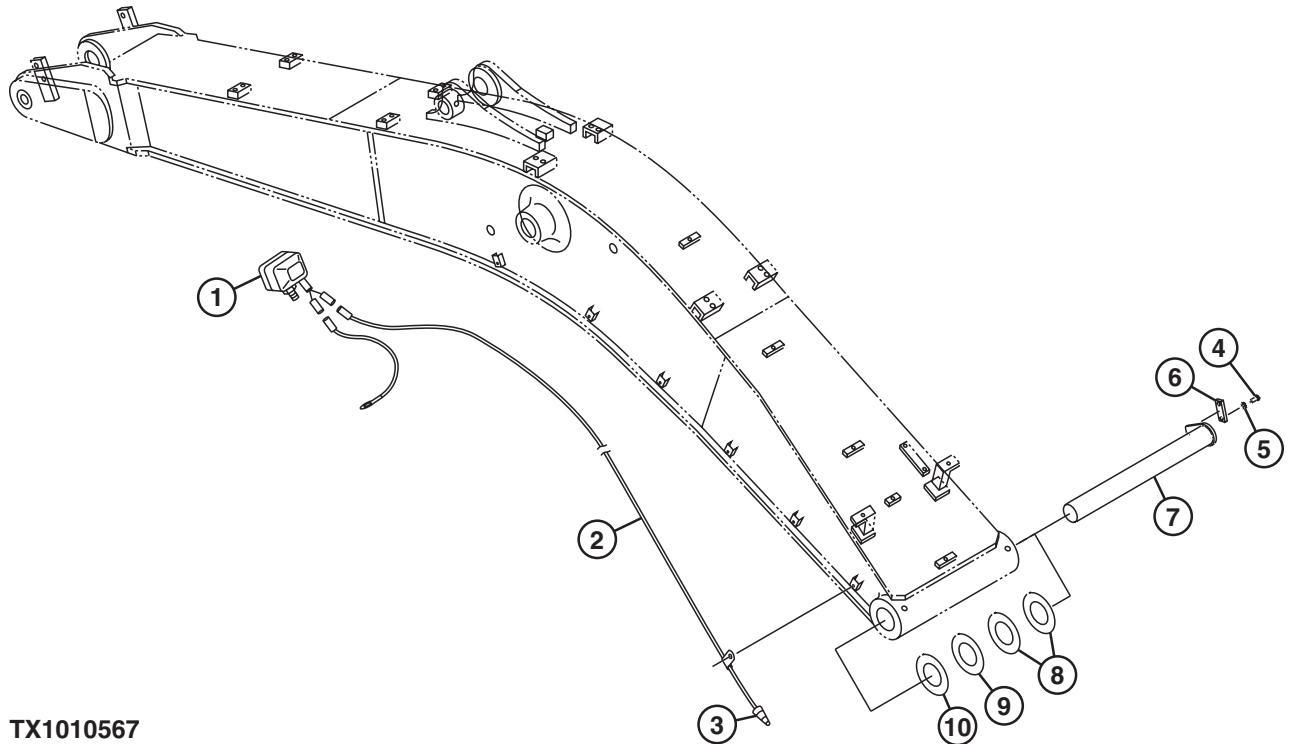
- 14. Remove boom.
- 15. Inspect pins and bushings for wear. See Inspect Pins, Bushings and Bosses—Front Attachment. (Group 3340.)
- 16. Clean pins and bores.
- 17. Apply grease to pins and bores.

TX1010567 -JUN-28-JUL-06

Continued on next page

TX17984.0000073 -19-15MAY08-6/10

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3340
12



TX1010567

- 1—Light
- 2—Wiring Harness
- 3—Wiring Connector

- 4—Cap Screw (2 used)
- 5—Washer (2 used)
- 6—Retaining Plate

- 7—Boom Pin
- 8—Shim (2 used)

- 9—Thrust Plate
- 10—Thrust Plate

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: Maintain clearance between boom and thrust plate at 1.5 mm (0.06 in.) or less with the use of shims.

18. Support boom with hoist and install boom pin (7), thrust plates (9 and 10) equally to each side. Add shims (8) to attain boom thrust clearance.

	Specification
Boom with Arm Cylinder—	
Weight.....	3370 kg approximate 7430 lb approximate

	Specification
Boom Pin—Weight	116 kg approximate 257 lb approximate

	Specification
Boom Thrust Plate—Clearance.....	0—1.5 mm 0—0.06 in.

19. Install retaining plate (6).

	Specification
Boom Pin Cap Screw—Torque	400 N•m 295 lb-ft

20. Connect wiring connector (3).

TX1010567 -UN-28JUL06

33
3340
13

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: Boom cylinder pin can be pushed in boom to raise one cylinder at a time.

21. Support boom cylinder with hoist and install boom cylinder pin (E).

Specification
 Boom Cylinder—Weight..... 522 kg approximate
 1150 lb approximate

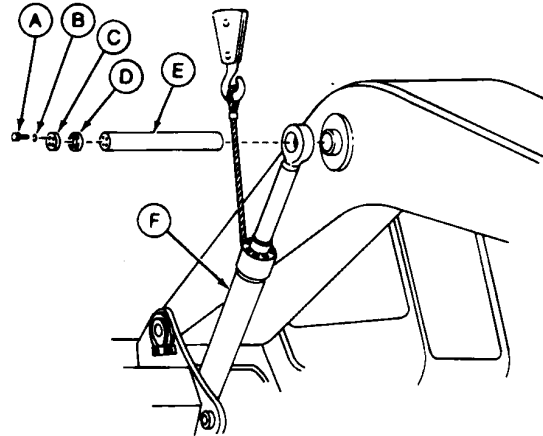
Specification
 Boom Cylinder Pin—Weight..... 37 kg approximate
 82 lb approximate

22. Install retaining plate (C).

Specification
 Boom Cylinder Pin Cap Screw—
 Torque 400 N•m
 295 lb-ft

23. Repeat steps 20—21 for other boom cylinder.

- A—Cap Screw (8 used)
- B—Lock Washer (8 used)
- C—Retaining Plate (2 used)
- D—Washer (2 used)
- E—Boom Cylinder Pin
- F—Boom Cylinder (2 used)



T7029JB -JUN-07/JUN89

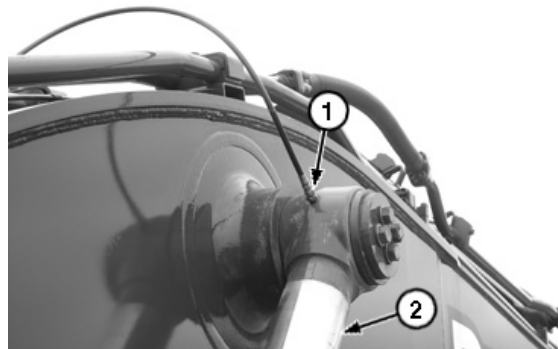
TX17984,0000073 -19-15MAY08-8/10

33
3340
14

24. Connect lubrication hoses (1).

Specification
 Lubrication Hose—Torque..... 30 N•m
 22 lb-ft

- 1—Lubrication Hose (2 used)
- 2—Boom Cylinder



Continued on next page

TX17984,0000073 -19-15MAY08-9/10

TX1010555A -JUN-26/JUL06

25. Connect hydraulic hoses (3).

Specification

Hydraulic Hose Cap Screw—
Torque 140 N•m
103 lb-ft

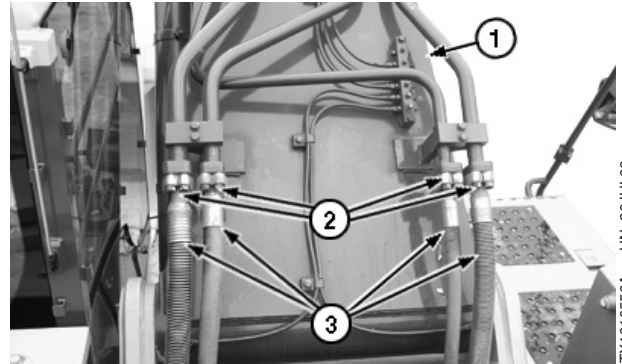
26. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

27. Bleed air from boom and arm cylinders. See Hydraulic Cylinder Bleed Procedure. (Group 3360.)

28. Install arm. See Arm Remove and Install. (Group 3340.)

29. Install bucket. See Bucket Remove and Install. (Group 3302.)

30. Grease boom pin joints. See Grease Front End Pin Joints. (Operator's Manual.)

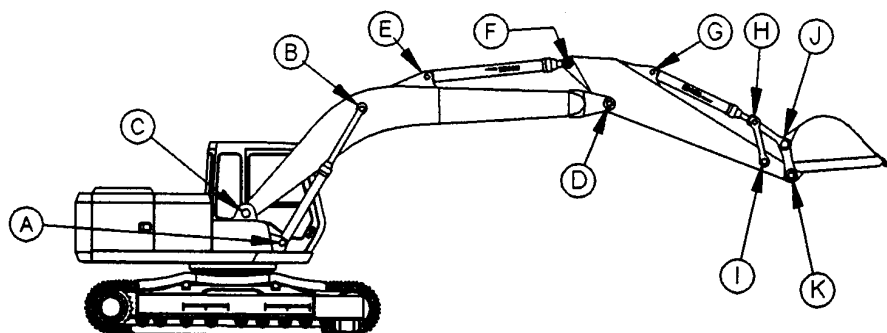


TX1010556A -UN-26JUL06

- 1—Boom
- 2—Cap Screw (16 used)
- 3—Hydraulic Hose (4 used)

TX17984.0000073 -19-15MAY08-10/10

Inspect Pins, Bushings and Bosses—Front Attachment



T7779AC (CV)

T7779AC -UN-11JUN92

- A—Fame-to-Boom Cylinder Joint
- B—Cylinder Rod End-to-Boom Joint
- C—Frame-to-Boom Joint
- D—Boom-to-Arm Joint
- E—Boom-to-Cylinder Head End Joint
- F—Cylinder Rod End-to-Arm Joint
- G—Arm-to-Cylinder Head End Joint
- H—Cylinder Rod End-to-Side and Center Link Joint
- I—Side Link-to-Arm Joint
- J—Center Link-to-Bucket Joint
- K—Arm-to-Bucket Joint

Specification

Fame-to-Boom Cylinder Joint—	
Pin—OD	110.0 mm nominal 109.0 mm limit of use 4.33 in. nominal 4.29 in. limit of use

Specification

Fame-to-Boom Cylinder Joint—	
Bushing—OD	130 mm nominal 5.12 in. nominal

Specification

Fame-to-Boom Cylinder Joint—	
Bushing Frame Side—ID	110.0 mm nominal 111.5 mm. limit of use 4.33 in. nominal 4.39 in. limit of use

Specification

Fame-to-Boom Cylinder Joint—	
Bushing Cylinder Side—ID	110.0 mm nominal 111.5 mm limit of use 4.33 in. nominal 4.39 in. limit of use

Specification

Cylinder Rod End-to-Boom	
Joint—Pin—OD	120.0 mm nominal 119.0 mm limit of use 4.72 in. nominal 4.69 in. limit of use

Specification

Cylinder Rod End-to-Boom	
Joint—Bushing—ID	120.0 mm nominal 121.5 mm limit of use 4.72 in. nominal 4.78 in. limit of use

Specification

Cylinder Rod End-to-Boom	
Joint—Pin Hole—ID	120.0 mm nominal 4.72 in. nominal

Specification

Frame-to-Boom Joint—Bushing	
Frame Side—ID	120.0 mm nominal 121.5 mm limit of use 4.72 in. nominal 4.78 in. limit of use

Specification

Frame-to-Boom Joint—Bushing	
Frame Side—OD	140.0 mm nominal 5.51 in. nominal

Specification

Frame-to-Boom Joint—Pin—	
OD	120.0 nominal 119.0 mm limit of use 4.72 in. nominal 4.69 in. limit of use

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3340
16

Continued on next page

CP94658.000001E -19-02AUG06-1/3

Frames

Specification

Frame-to-Boom Joint—Bushing	
Boom Side—ID	120.0 mm nominal
	121.5 mm limit of use
	4.72 in. nominal
	4.78 in. limit of use

Specification

Frame-to-Boom Joint—Bushing	
Boom Side—OD	140.0 mm nominal
	5.51 in. nominal

Specification

Boom-to-Arm Joint—Bushing	
Boom Side—ID	120.0 mm in. nominal
	121.5 mm limit of use
	4.72 in. nominal
	4.78 in. limit of use

Specification

Boom-to-Arm Joint—Bushing	
Boom Side—OD	140 mm in. nominal
	5.51 in. nominal

Specification

Boom-to-Arm Joint—Bushing	
Arm Side—ID	120.0 mm in. nominal
	121.5 mm limit of use
	4.72 in. nominal
	4.78 in. limit of use

Specification

Boom-to-Arm Joint—Bushing	
Arm Side—OD	140 mm in. nominal
	5.51 in. nominal

Specification

Boom-to-Arm Joint—Pin—OD	120 mm. nominal
	119 mm. limit of use
	4.72 in. nominal
	4.29 in. limit of use

Specification

Boom-to-Cylinder Head End	
Joint—Bushing Cylinder Side—	
ID	110.0 mm in. nominal
	111.5 mm in. limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

Boom-to-Cylinder Head End	
Joint—Pin Hole Boom Side—ID	110.0 mm. nominal
	4.33 in. nominal

Specification

Boom-to-Cylinder Head End	
Joint—Pin—OD	110.0 mm nominal
	109.0 mm limit of use
	4.33 in. nominal
	4.29 in. limit of use

Specification

Cylinder Rod End-to-Arm	
Joint—Bushing Cylinder Side—	
ID	110.0 mm nominal
	111.5 mm limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

Cylinder Rod End-to-Arm	
Joint—Pin—ID	110.0 mm nominal
	109 mm. limit of use
	4.33 in. nominal
	4.29 in. limit of use

Specification

Cylinder Rod End-to-Arm	
Joint—Pin Hole Arm Side—ID	110 mm. nominal
	4.33 in. nominal

Specification

Arm-to-Cylinder Head End	
Joint—Pin—OD	100.0 mm nominal
	99 mm limit of use
	3.94 in. nominal
	3.90 in. limit of use

Specification

Arm-to-Cylinder Head End	
Joint—Bushing Cylinder Side—	
ID	100.0 mm nominal
	101.5 mm limit of use
	3.94 in. nominal
	4.00 in. limit of use

Specification

Arm-to-Cylinder Head End	
Joint—Pin Hole Arm Side—ID	100 mm nominal
	3.94 in. nominal

Specification

Cylinder Rod End-to-Side and	
Center Links Joint—Pin—OD	110.0 mm nominal
	109.0 mm limit of use
	4.33 in. nominal
	4.29 in. limit of use

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Continued on next page

CP94658,000001E -19-02AUG06-2/3

Frames

Specification

Cylinder Rod End-to-Side and Center Link Joint—Bushing Link Side—ID	110.0 mm nominal
	111.5 mm limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

Cylinder Rod End-to-Side and Center Link Joint—Bushing—OD	130 mm nominal
	5.12 in. nominal

Specification

Cylinder Rod End-to-Side and Center Link Joint—Bushing Cylinder Side—ID	110.0 mm nominal
	111.5 mm limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

Side Link-to-Arm Joint—Pin—OD	100 mm nominal
	99 mm limit of use
	3.94 in. nominal
	3.90 in. limit of use

Specification

Side Link-to-Arm Joint—Bushing Arm Side—ID	100.0 mm in. nominal
	101.5 mm limit of use
	3.94 in. nominal
	4.00 in. limit of use

Specification

Side Link-to-Arm Joint—Bushing—OD	115 mm nominal
	4.53 in. nominal

Specification

Center Link-to-Bucket Joint—Pin—OD	110.0 mm nominal
	109.0 mm limit of use
	4.331 in. nominal
	4.291 in. limit of use

Specification

Center Link-to-Bucket Joint—Bushing Link Side—ID	110.0 mm nominal
	111.5 mm limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

Center Link-to-Bucket Joint—Bushing Link Side—OD	130 mm nominal
	5.12 in. nominal

Specification

Center Link-to-Bucket Joint—Bushing Bucket Side—OD	130 mm nominal
	5.12 in. nominal

Specification

Center Link-to-Bucket Joint—Bushing Bucket Side—ID	110.0 mm nominal
	109.0 mm limit of use
	4.33 in. nominal
	4.29 in. limit of use

Specification

Arm-to-Bucket Joint—Pin—OD	110.0 mm nominal
	109.0 mm limit of use
	4.33 in. nominal
	4.29 in. limit of use

Specification

Arm-to-Bucket Joint—Bushing Arm Side—ID	110.0 mm nominal
	111.5 mm limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

—Arm-to-Bucket Joint—Bushing Arm side OD	130 mm nominal
	5.12 in. nominal

Specification

Arm-to-Bucket Joint—Bushing Bucket Side—ID	110.0 mm nominal
	111.5 mm limit of use
	4.33 in. nominal
	4.39 in. limit of use

Specification

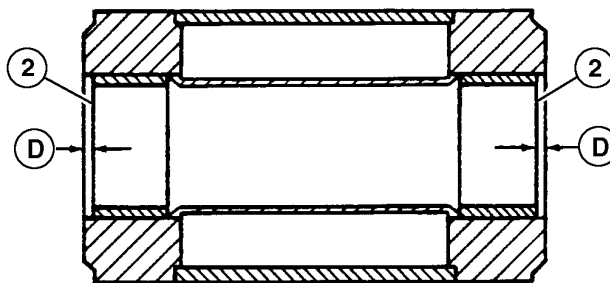
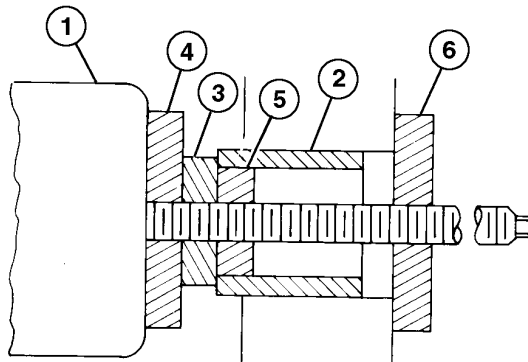
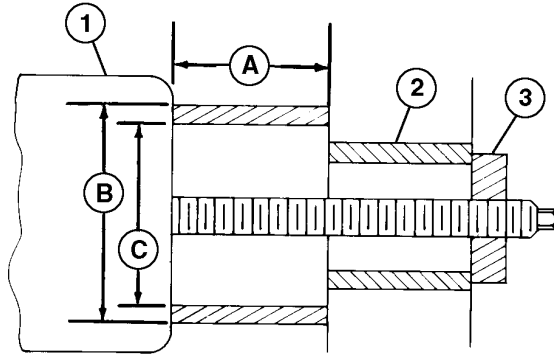
Arm-to-Bucket Joint—Bushing Bucket Side—OD	130 mm nominal
	5.12 in. nominal

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18

Frames

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19

Bushings and Seal Remove and Install



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TX1010480

Bushing and Seal Remove and Install
Continued on next page

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TX1010480 -UN-24JUL06

Frames

Dim. A—Pipe-Length of
Bushing

Dim. B—Pipe-Maximum O.D.

Dim. C—Pipe-Minimum
I.D.-to-Clear Bushing
O.D.

Dim. D—Thickness of Seal

1—Hydraulic Ram

2—Bushing

3—Disks

4—Bushing Stop (Disk)

5—Pilot (Disk)

6—Ram Stop (Disk)

NOTE: Bushing can also be removed by welding three to five weld beads on the inside of bushing. Bushing will shrink enough to permit removal using a hammer.

1. Remove bushings and dust seals using bushing, bearing, and seal driver set.
2. Install bushings and dust seals using D01072AA Bushing, Bearing And Seal Driver Sets.

3. Install bushings with lubrication hole in alignment with lubrication passage in pivot.
4. Install bushings to thickness of seal (D).
5. Install seals with lip towards the outside of component.

CP94658,000001B -19-02AUG06-2/2

Frames

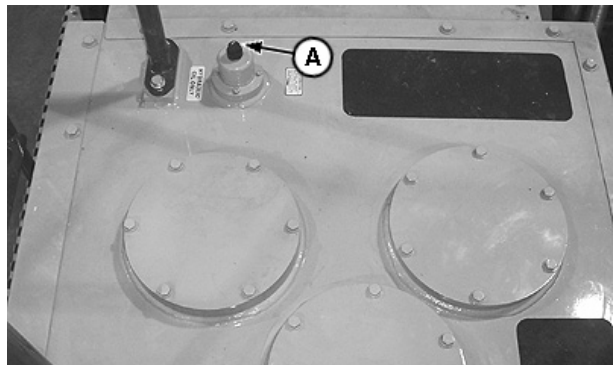
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Apply Vacuum to Hydraulic Oil Tank

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (A).
2. Assemble fittings and hydraulic oil line adapter from D15032NU Vacuum Pump Kit, and JT07085A Vacuum Pump Set.

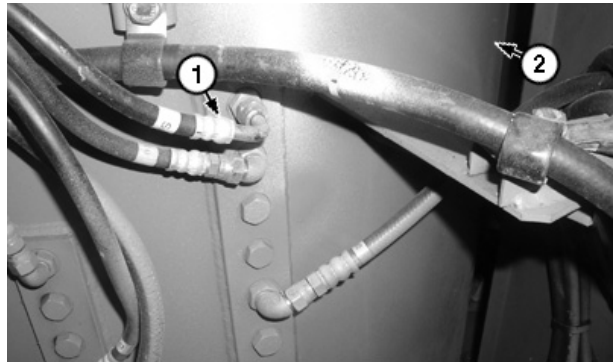
A—Pressure Release Button



JH38101,0000038 -19-27JUL06-1/2

3. Install JT03001 Tee, 7/16-20 M 37° x 7/16-20 F 37° Sw x 7/16-20 M 37° to line (1).
4. Install hydraulic oil line adapter from D15032NU Vacuum Pump Kit, and JT07085A Vacuum Pump Set to JT03001 Tee, on line (1). Refer to pump instructions for operating information.

1—Line
2—Hydraulic Oil Tank



JH38101,0000038 -19-27JUL06-2/2

Hydraulic Circuit Pressure Release Procedure

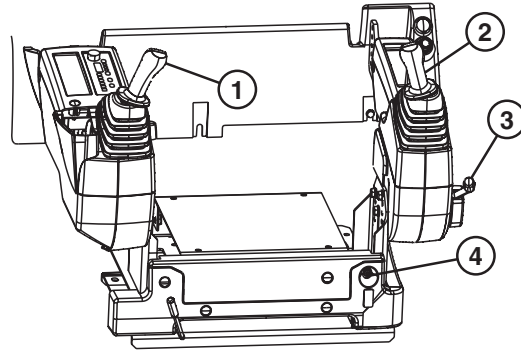
1. Push pilot shutoff lever (3) to the unlock (down) position.

NOTE: When engine stop switch is in the STOP position, the starter motor will crank the engine but it will not start. With engine cranking, the pilot pump will generate enough pilot oil flow and pressure to shift the spools in the control valve releasing circuit pressure.

2. Push pilot shutoff lever to the unlock (down) position.
3. Push engine stop switch (4) down to the STOP position.

IMPORTANT: Prevent starter motor damage. Never operate starter motor for more than 20 seconds at a time. Wait for about 2 minutes, then try again.

4. Turn key switch to the START position and hold.
5. Move the left and right control levers (1 and 2) to all functions four to five times to release any pressure in the hydraulic circuit.
6. Turn key switch to the OFF position.
7. Pull pilot shutoff lever to the lock (up) position.
8. Push engine stop switch to the OFF position.



Engine Stop Switch

- 1—Right Control Lever
- 2—Left Control Lever
- 3—Pilot Shutoff Lever
- 4—Engine Stop Switch

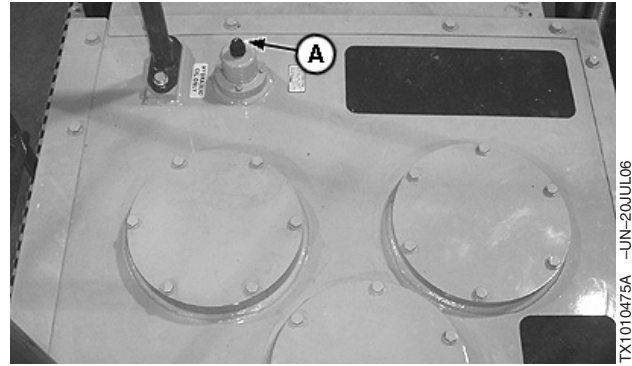
TX1009541 -UN-13JUL06

OUT3035,000003E -19-19JUL06-1/1

Pump 1 and 2 Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (A).
2. Apply vacuum or drain hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank (Group 3360.) or See Change Hydraulic Tank Oil, Clean Suction Screen. (Operator's Manual.)



A—Pressure Release Button

JH38101,0000027 -19-01AUG06-1/12

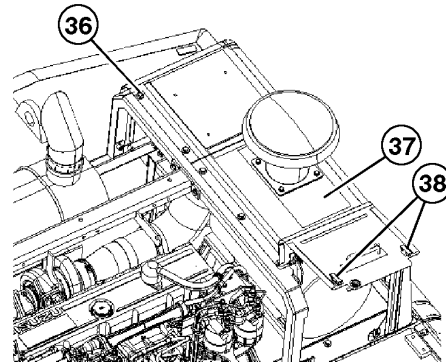
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

3. Remove catches (38) and cap screws (36) to remove rear engine hood (37).

Specification

Rear Engine Hood—Weight..... 32 kg approximate
70 lb approximate

- 36—Cap Screws (11 used)
- 37—Rear Engine Hood
- 38—Catch (2 used)



TX1009823 -UN-27JUL06

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JH38101,0000027 -19-01AUG06-2/12

Hydraulic System

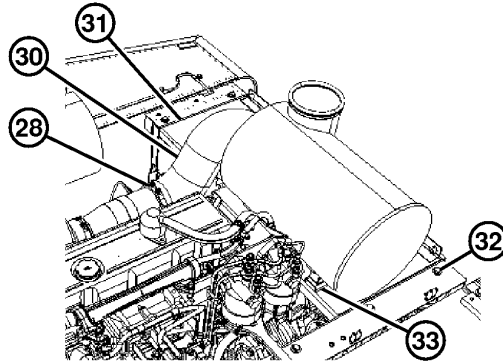
- Loosen hose clamp (28). Disconnect air line (30).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove air cleaner.

	Specification	
Air Cleaner—Weight.....		35 kg approximate 77 lb approximate

- Remove cap screws (32) to remove mounting bracket (31).
- Remove bottom engine covers.



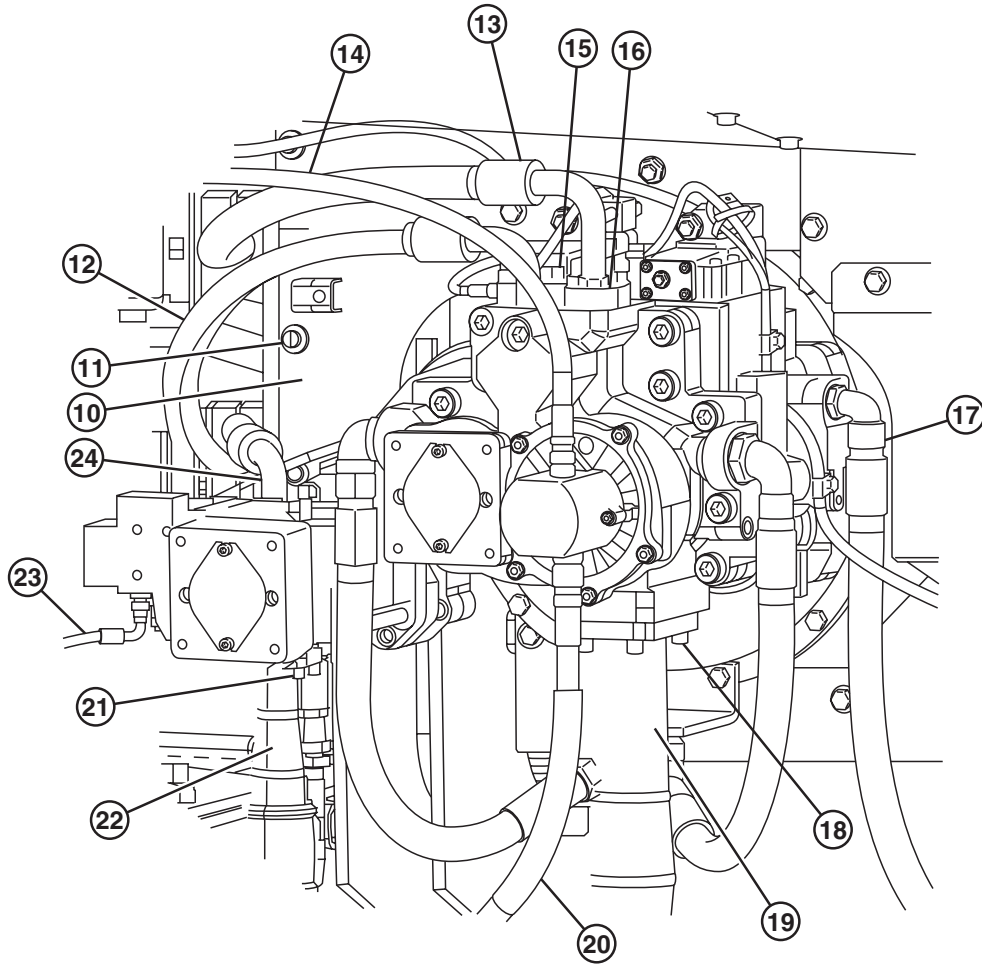
- 28—Hose Clamp
- 30—Air Inlet Line
- 31—Mounting Bracket
- 32—Cap Screw (5 used)
- 33—Cap Screw (4 used)

TX1009798 -UN-17JUL06

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JH38101.0000027 -19-01AUG06-3/12

Hydraulic System



10—Panel (2 used)	15—Cap Screws (4 used)	19—Pump 1 and 2 Suction Line	23—Pilot Filter Line-to-Fan Drive Pump Regulating Valve Line
11—Cap Screw (8 used)	16—Cap Screws (4 used)	20—Pilot Pump Suction Line	24—Fan Drive Pump Delivery Line
12—Pump 2 Delivery Line	17—Pump 1 Case Drain Line-to-Pump Case Drain Filter	21—Cap Screws (4 used)	
13—Pump 1 Delivery Line	18—Cap Screws (4 used)	22—Fan Drive Pump Suction Line	
14—Pilot Pump-to-Pilot Filter Line			

8. Disconnect hydraulic lines (12—14,17, and 22—24).

10. Remove cap screws (11) to remove panels (10).

9. Disconnect all wire harness connectors.

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JH38101.0000027 -19-01AUG06-4/12

TX1009756 -JUN-19-JUL06

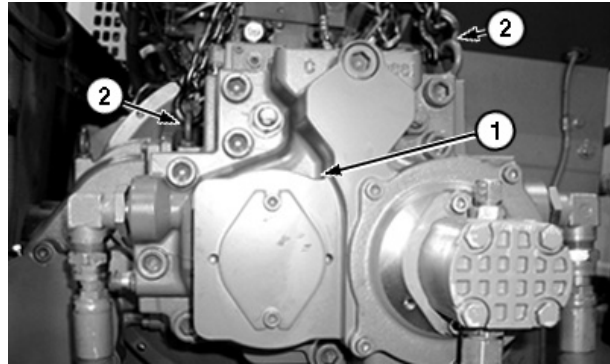
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3360
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CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

11. Attach hoist to lifting eyebolts (2) on pumps.

	Specification	
Pump 1 and 2—Weight.....		686 kg approximate 1510 lb approximate

- 1—Pumps 1 and 2
- 2—Eyebolt (2 used)



TX1009675A -JUN-18JUL06

JH38101.0000027 -19-01AUG06-5/12

12. Remove cap screws (25—27) to remove Pumps 1 and 2.

13. Replace parts as necessary.

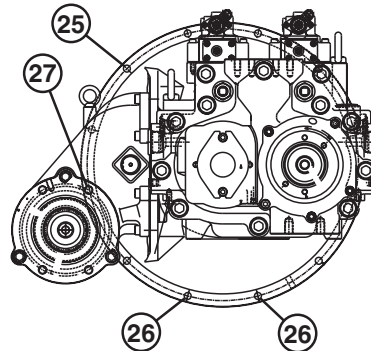
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

14. Attach hoist to lifting eyebolts (2).

	Specification	
Pump 1 and 2—Weight.....		686 kg approximate 1510 lb approximate

15. Apply PM38654 Thread Lock (high strength) cap screws (25—27).

16. Due to limited space install cap screw (27) a few turns before installation of pumps.



- 25—Cap Screw (7 used)
- 26—Cap Screw (2 used)
- 27—Cap Screw

TX1009759 -JUN-18JUL06

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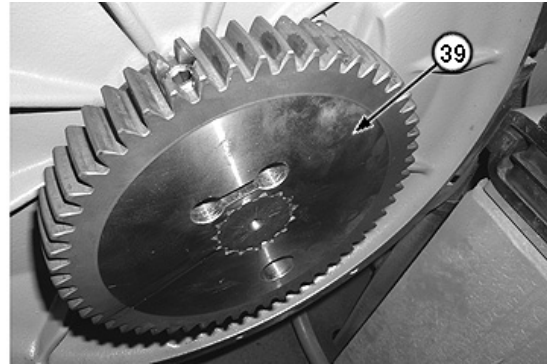
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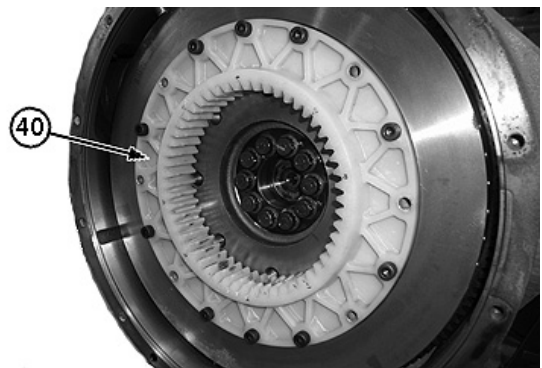
Hydraulic System

17. Align dampener gear (39) with dampener (40).

- 39—Dampener Gear
- 40—Dampener



TX1009827A -UN-18JUL06



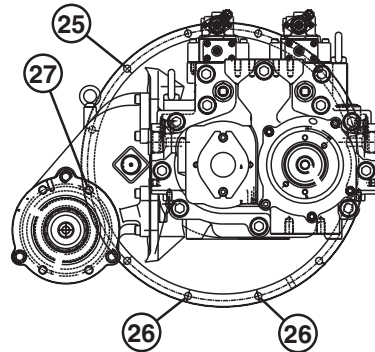
TX1009828A -UN-18JUL06

JH38101.0000027 -19-01AUG06-7/12

18. Install hydraulic pump and tighten cap screws (25—27).

	Specification	
Cap Screw—Torque		98 N•m 75 lb-ft

- 25—Cap Screw (7 used)
- 26—Cap Screw (2 used)
- 27—Cap Screw



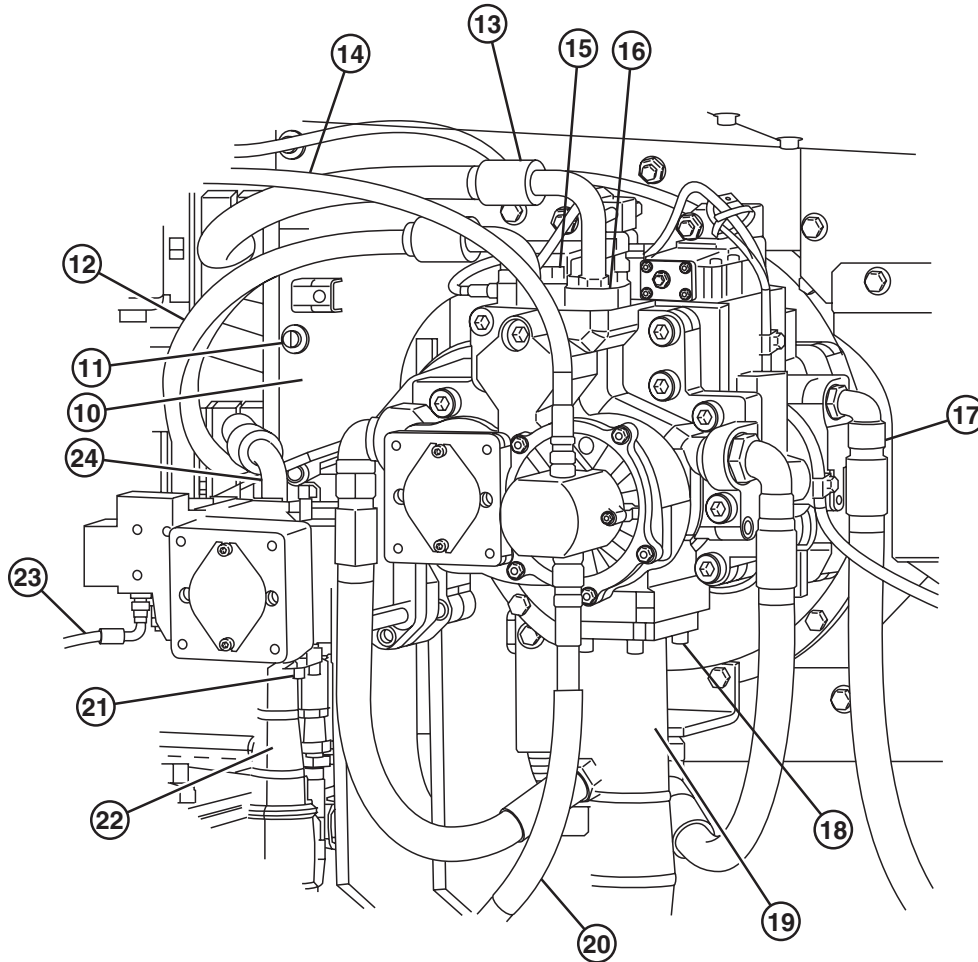
TX1009759 -UN-18JUL06

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JH38101.0000027 -19-01AUG06-8/12

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Hydraulic System



- | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <p>10—Panel (2 used)
 11—Cap Screw (8 used)
 12—Pump 2 Delivery Line
 13—Pump 1 Delivery Line
 14—Pilot Pump-to-Pilot Filter Line</p> | <p>15—Cap Screws (4 used)
 16—Cap Screws (4 used)
 17—Pump 1 Case Drain Line-to-Pump Case Drain Filter
 18—Cap Screws (4 used)</p> | <p>19—Pump 1 and 2 Suction Line
 20—Pilot Pump Suction Line
 21—Cap Screws (4 used)
 22—Fan Drive Pump Suction Line</p> | <p>23—Pilot Filter Line-to-Fan Drive Pump Regulating Valve Line
 24—Fan Drive Pump Delivery Line</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|

19. Install panels (10).

20. Install electrical connectors. See Pump Harness (W8) Component Location. (Group 9015-10.)

21. Install hydraulic lines. See Pump 1, Pump 2 and Pilot Pump Line Identification. (Group 9025-15.)

22. Connect lines (12, 13, and 24). Tighten cap screws.

Specification

Line Mounting Cap Screw—	
Torque.....	90 N•m 66 lb-ft

23. Connect lines (19 and 22) and tighten cap screws (18 and 21).

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3360
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JH38101.0000027 -19-01AUG06-9/12

Hydraulic System

Specification

Line Mounting Cap Screw—	
Torque.....	210 N•m 155 lb-ft

24. Install bottom covers.

JH38101.0000027 -19-01AUG06-10/12

25. Install mounting bracket (29) and tighten cap screws (32).

Specification

Mounting Bracket Cap Screws—	
Torque	90 N•m 66 lb-ft



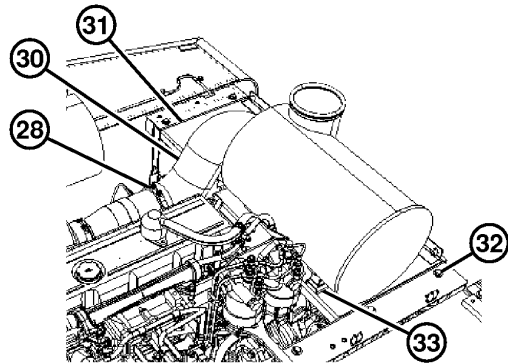
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

26. Apply PM38654 Thread Lock (high strength) cap screws (33). Install air cleaner to mounting bracket and tighten cap screws.

Specification

Air Cleaner—Weight.....	35 kg approximate 77 lb approximate
Air Cleaner Mounting Cap Screws—Torque.....	50 N•m 37 lb-ft

27. Connect air line (30).



- 28—Hose Clamp
- 30—Air Inlet Line
- 31—Mounting Bracket
- 32—Cap Screw (5 used)
- 33—Cap Screw (4 used)

TX1009798 -UN-17JUL06

JH38101.0000027 -19-01AUG06-11/12



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

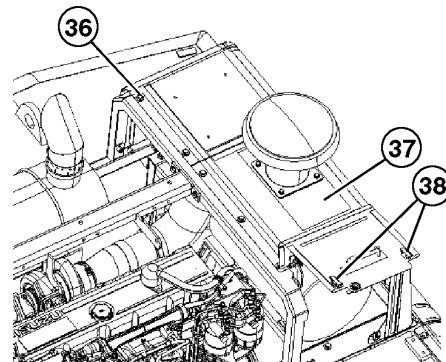
28. Install rear engine hood (37).

Specification

Rear Engine Hood—Weight.....	32 kg approximate 70 lb approximate
------------------------------	----------------------------------------

29. Fill hydraulic oil tank. See 450DLC Drain and Refill Capacities. (Operator's Manual.)

30. Fill pump housing with hydraulic oil. See Pump 1 and 2 Start-Up Procedure. (Group 3360.)



- 36—Cap Screws (11 used)
- 37—Rear Engine Hood
- 38—Catch (2 used)

TX1009823 -UN-27JUL06

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3360
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JH38101.0000027 -19-01AUG06-12/12

Hydraulic System

Pump 1 and 2 Disassemble and Assemble

1. Remove pumps. See Pump 1 and 2 Remove and Install. (Group 3360.)

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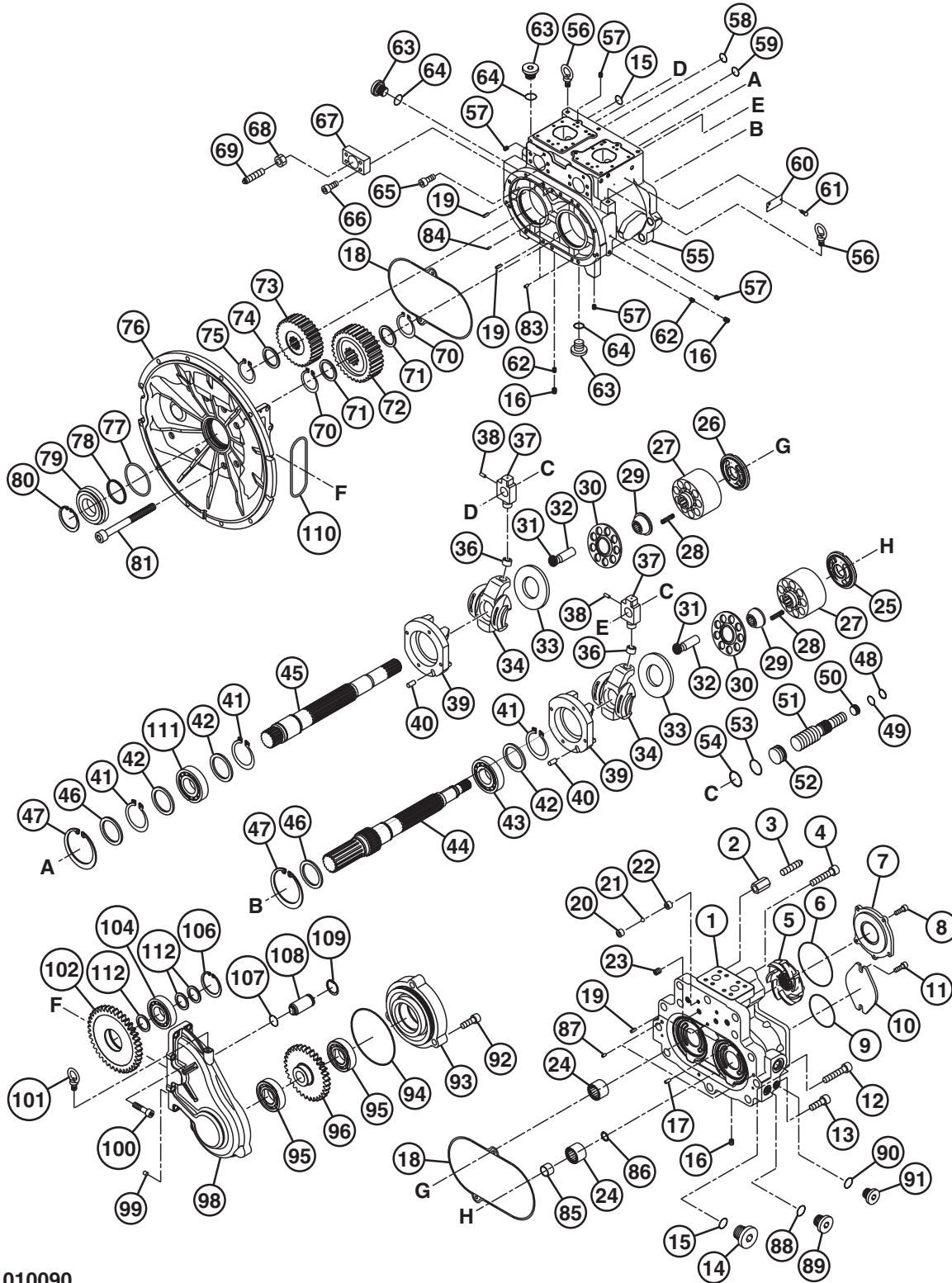
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Hydraulic System

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11

Hydraulic System



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TX1010090

TX1010090 -UN-21JUL06

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JH38101.000003B -19-01AUG06-2/10

Hydraulic System

1—Valve Cover	29—Spherical Bushing (2 used)	55—Pump Casing	83—Pin (4 used)
2—Nut (2 used)	30—Retainer (2 used)	56—Eyebolt (2 used)	84—Pin
3—Cap Screw	31—Shoe (18 used)	57—Plug (20 used)	85—Inner Spacer
4—Cap Screw	32—Plunger (18 used)	58—O-Ring (5 used)	86—Stop Ring
5—Booster	33—Shoe Plate (2 used)	59—O-Ring (5 used)	87—Pin (4 used)
6—O-Ring	34—Swash Plate (2 used)	60—Name Plate	88—O-Ring (2 used)
7—Booster Cover	36—Tilt Bushing (2 used)	61—Rivet (2 used)	89—Plug (2 used)
8—Cap Screw (5 used)	37—Tilt Pin (2 used)	62—Screw (4 used)	90—O-Ring (2 used)
9—O-Ring	38—Feedback Pin (2 used)	63—Plug (3 used)	91—Plug (2 used)
10—Cover	39—Swash Plate Stand (2 used)	64—O-Ring (3 used)	92—Cap Screws (3 used)
11—Cap Screw (2 used)	40—Pin (2 used)	65—Cap Screws (8 used)	93—Cover
12—Cap Screw (2 used)	41—Snap Ring (3 used)	66—Cap Screws (8 used)	94—O-Ring
13—Cap Screw (9 used)	42—Bearing Spacer (3 used)	67—Servo Cover (2 used)	95—Needle Bearing (2 used)
14—Plug (2 used)	43—Roller Bearing	68—Nut (2 used)	96—Drive Gear
15—O-Ring (2 used)	44—Drive Shaft	69—Cap Screw (2 used)	98—Housing
16—Plug (12 used)	45—Driven Shaft	70—Snap Ring	99—Pin (2 used)
17—Valve Plate Pin (2 used)	46—Bearing Spacer (2 used)	71—Spacer (2 used)	100—Cap Screws (8 used)
18—Seat Packing (2 used)	47—Snap Ring (2 used)	72—Drive Gear	101—Eyebolt
19—Pin (4 used)	48—Backup Ring (2 used)	73—Driven Gear	102—Relay Gear
20—Stopper (2 used)	49—O-Ring (2 used)	74—Spacer	104—Needle Bearing
21—Steel Ball (2 used)	50—Stopper (2 used)	75—Snap Ring (2 used)	106—Snap Ring
22—Seat (2 used)	51—Servo Piston	76—Front Casing	107—O-Ring
23—Plug (2 used)	52—Stopper	77—O-Ring	108—Shaft
24—Needle Bearing (2 used)	53—O-Ring (2 used)	78—Oil Seal	109—Snap Ring
25—Valve Plate	54—Backup Ring (2 used)	79—Front Cover	110—O-Ring
26—Valve Plate		80—Snap Ring	111—Roller Bearing
27—Cylinder Block (2 used)		81—Cap Screw (11 used)	112—Bearing Spacer (3 used)
28—Cylinder Spring (18 used)			

2. Remove plugs (63) and drain oil.
 3. Remove cap screws (8) to remove booster cover (7).
 4. Remove cap screws (11) to remove cover (10).
 5. Install eyebolt M12 x 1.75 mm to valve cover (1).
- ⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**
6. Remove cap screws (4, 12, and 13) to remove valve cover (1).
 7. Remove needle bearing (24) only when worn or damaged.
 8. Remove stop ring (86), inner spacer (85) and valve plate (25) from drive shaft (44).
 9. Remove valve plate (26) from driven shaft (45).
 10. Remove parts (27—32) from drive shaft (44) and driven shaft (45).
 11. Remove shoe plates (33) and swash plates (34). Separate plates and inspect for wear.
 12. Do not loosen nuts (2 and 68). When loosen nuts (2 and 68) and cap screws (3 and 69), flow rate is changed.
 13. Remove stopper (52), stopper (50), servo piston (51), tilt pin (37) and servo cover (67).
 14. Remove snap ring (80) to front cover (79).

Specification

Valve Cover—Weight	60 kg approximate
	130 lb approximate

Continued on next page

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Hydraulic System



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 15. Remove cap screws (81) to remove front casing (76).

	Specification
Front Casing—Weight	32 kg approximate 70 lb approximate

- 16. Remove parts (70—75).
- 17. Remove parts (46, 47, 41, and 42).
- 18. Remove roller bearing (43 and 111) only when worn or damaged.
- 19. Remove seat packing (18).
- 20. Remove cap screws (65) to remove swash plate stand (39).
- 21. Remove drive shaft (44).
- 22. Remove driven shaft (45).



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 23. Remove cap screws (100) to remove housing (98).

	Specification
Housing—Weight	28 kg approximate 62 lb approximate

- 24. Remove snap ring (109) and shaft (108).
- 25. Remove relay gear (102).
- 26. Remove needle bearing (104).
- 27. Remove snap ring (106) to remove bearing spacers (112).
- 28. Remove cover (93).
- 29. Remove needle bearing (95) only when worn or damaged.
- 30. Remove drive gear (96).
- 31. Inspect and replace parts as necessary. See Pump 1 and 2 Inspection. (Group 3360.)

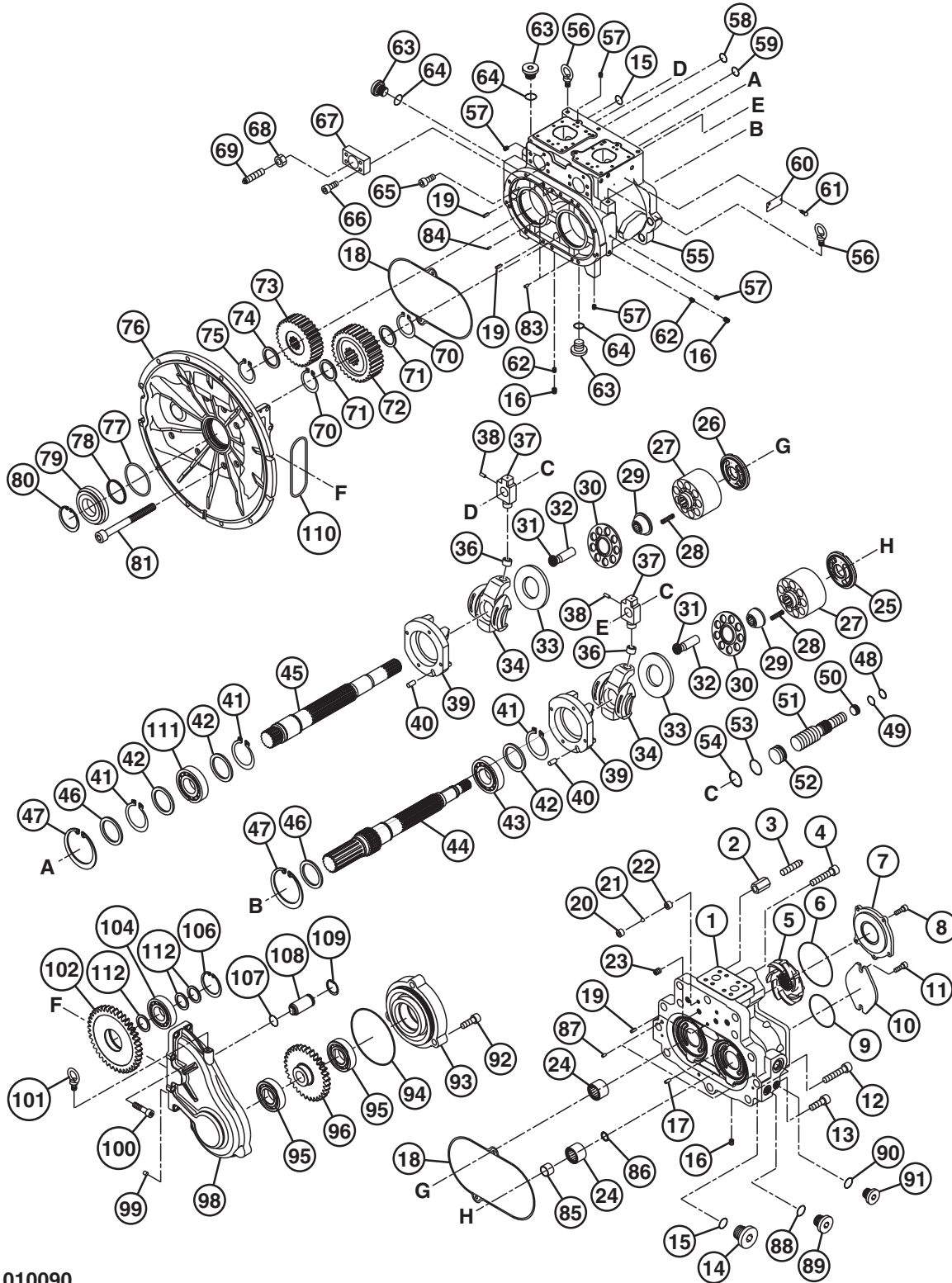
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JH38101,000003B -19-01AUG06-4/10

Hydraulic System

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3360
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Hydraulic System



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TX1010090

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Continued on next page

JH38101.000003B -19-01AUG06-5/10

Hydraulic System

- | | | | |
|------------------------------|-------------------------------|-------------------------|-----------------------------|
| 1—Valve Cover | 29—Spherical Bushing (2 used) | 55—Pump Casing | 83—Pin (4 used) |
| 2—Nut (2 used) | 30—Retainer (2 used) | 56—Eyebolt (2 used) | 84—Pin |
| 3—Cap Screw | 31—Shoe (18 used) | 57—Plug (20 used) | 85—Inner Spacer |
| 4—Set Screw | 32—Plunger (18 used) | 58—O-Ring (5 used) | 86—Stop Ring |
| 5—Booster | 33—Shoe Plate (2 used) | 59—O-Ring (5 used) | 87—Pin (4 used) |
| 6—O-Ring | 34—Swash Plate (2 used) | 60—Name Plate | 88—O-Ring (2 used) |
| 7—Booster Cover | 36—Tilt Bushing (2 used) | 61—Rivet (2 used) | 89—Plug (2 used) |
| 8—Cap Screw (5 used) | 37—Tilt Pin (2 used) | 62—Screw (4 used) | 90—O-Ring (2 used) |
| 9—O-Ring | 38—Feedback Pin (2 used) | 63—Plug (3 used) | 91—Plug (2 used) |
| 10—Cover | 39—Swash Plate Stand (2 used) | 64—O-Ring (3 used) | 92—Cap Screws (3 used) |
| 11—Cap Screw (2 used) | 40—Pin (2 used) | 65—Cap Screws (8 used) | 93—Cover |
| 12—Cap Screw (2 used) | 41—Snap Ring (3 used) | 66—Cap Screws (8 used) | 94—O-Ring |
| 13—Cap Screw (9 used) | 42—Bearing Spacer (3 used) | 67—Servo Cover (2 used) | 95—Needle Bearing (2 used) |
| 14—Plug (2 used) | 43—Roller Bearing | 68—Nut (2 used) | 96—Drive Gear |
| 15—O-Ring (2 used) | 44—Drive Shaft | 69—Screw (2 used) | 98—Housing |
| 16—Plug (12 used) | 45—Driven Shaft | 70—Snap Ring | 99—Pin (2 used) |
| 17—Valve Plate Pin (2 used) | 46—Bearing Spacer (2 used) | 71—Spacer (2 used) | 100—Cap Screws (8 used) |
| 18—Packing (2 used) | 47—Snap Ring (2 used) | 72—Drive Gear | 101—Eyebolt |
| 19—Pin (4 used) | 48—Backup Ring (2 used) | 73—Driven Gear | 102—Relay Gear |
| 20—Stopper (2 used) | 49—O-Ring (2 used) | 74—Spacer | 104—Needle Bearing |
| 21—Steel Ball (2 used) | 50—Stopper (2 used) | 75—Snap Ring (2 used) | 106—Snap Ring |
| 22—Seat (2 used) | 51—Servo Piston | 76—Front Casing | 107—O-Ring |
| 23—Plug (2 used) | 52—Stopper | 77—O-Ring | 108—Shaft |
| 24—Needle Bearing (2 used) | 53—O-Ring (2 used) | 78—Oil Seal | 109—Snap Ring |
| 25—Valve Plate | 54—Backup Ring (2 used) | 79—Front Cover | 110—O-Ring |
| 26—Valve Plate | | 80—Snap Ring | 111—Roller Bearing |
| 27—Cylinder Block (2 used) | | 81—Cap Screw (11 used) | 112—Bearing Spacer (3 used) |
| 28—Cylinder Spring (18 used) | | | |

32. Apply PM38654 Thread Lock (high strength) to cap screws (65). Install swash plate stand (39) and tighten cap screws.

Specification

Dampener Mounting Cap
Screws—Torque 34 N•m
25 lb-ft

33. Install roller bearing (43), bearing spacer (42) and snap ring (41) to drive shaft (44).
34. Install drive shaft (44) to pump casing (55).
35. Install bearing spacer (46) and snap ring (47).
36. Install parts (70—72) to drive shaft (44).
37. Install snap ring (41), bearing spacer (42), and roller bearing (111) to driven shaft (45).
38. Install driven shaft.

39. Install bearing spacer (46) and snap ring (47) to driven shaft (45).

40. Install parts (73—75) to driven shaft.

41. Install pins (19, 83, and 84) to pump casing (55).

42. Apply multi-purpose grease onto the seat packing (18) mounting surface of pump casing (55).

43. Install seat packing (18) to pump casing (55).

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

44. Install front casing (76) to pump casing (55). Tighten cap screws (81).

Hydraulic System

Specification

Front Casing—Weight	32 kg approximate 70 lb approximate
Front Casing Mounting Cap Screws—Torque	98 N•m 72 lb-ft

45. Apply multi-purpose grease to the lip part in oil seal (78).

46. Install oil seal (78) to front cover (79).
47. Install front cover (79) and snap ring (80).
48. Apply PM38654 Thread Lock (high strength) to the thread part of servo piston (51).

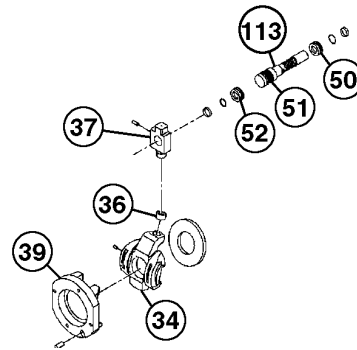
JH38101,000003B -19-01AUG06-7/10

49. Apply PM38654 Thread Lock (high strength) to the mounting position for the tilt pin in servo piston.
50. Install servo piston (51), tilt pin (37), stoppers (50 and 52).
51. Install servo cover (67) on to pump casing. Tighten cap screws (66).

Specification

Servo Cover-to-Pump Casing Cap Screws—Torque	98 N•m 72 lb-ft
-------------------------------------------------------	--------------------

52. Install swash plate onto swash plate support (42). Make sure swash plate moves smoothly.
53. Install parts (28—32) into cylinder block (27).
54. Align the splines and install spherical bushings (29) and the cylinder block.



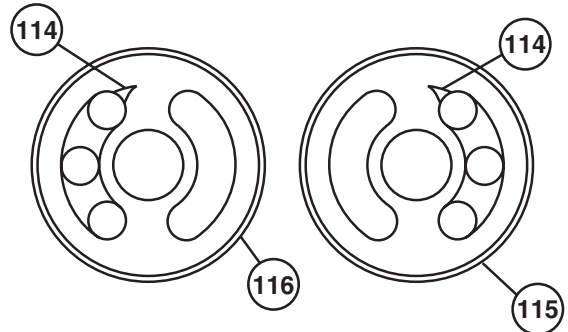
- 34—Swash Plate (2 used)
- 36—Tilt Bushing (2 used)
- 37—Tilt Pin (2 used)
- 39—Swash Plate Stand (2 used)
- 50—Stopper
- 51—Servo Piston
- 52—Stopper
- 113—Mounting Position for Tilt Pin

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Continued on next page

JH38101,000003B -19-01AUG06-8/10

- 55. The direction of rotation is different for drive gear (72) and driven gear (73). Drive side is installed clockwise (115) and driven side is installed counterclockwise (116).
- 56. Align the valve plate pin (17) positions and install valve plates (25 and 26) to valve cover (1).
- 57. Install check valves (20—22).
- 58. Install O-rings (15, 58, and 59).
- 59. Install pins (19) to valve cover (1).



Valve Plate Check

- 114—Notch
- 115—Clockwise
- 116—Counterclockwise

TX1010207 -UN-18JUL06

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 60. Install valve cover (1). Tighten cap screws (4, 12, and 13) from valve cover to pump casing (55).

Specification

Valve Cover—Weight	60 kg approximate 130 lb approximate
Valve Cover-to-Pump Casing Cap Screws—Torque	630 N•m 465 lb-ft

- 61. Install booster (5) and O-ring (6) to booster cover (7).
- 62. Install booster cover and tighten cap screws (8).

Specification

Booster Cover-to-Valve Cover Cap Screws—Torque	57 N•m 42 lb-ft
---------------------------------------------------------	--------------------

- 63. Install O-ring (9) to cover (10).
- 64. Install cover (10) to valve cover (1). Tighten cap screws (11).

Specification

Cover-to-Valve Cover Cap Screws—Torque	57 N•m 42 lb-ft
-------------------------------------------------	--------------------

- 65. Install drive gear (96).

Hydraulic System

66. Install cover. Tighten cap screws (92).

Specification

Cover-to-Housing Cap Screws—
Torque 240 N•m
175 lb-ft

67. Install needle bearing (104) to relay gear (102).

68. Insert snap ring (106) into relay gear.

69. Install bearing spacers (112) to relay gear.

70. Install relay gear.

71. Install O-ring (107) to shaft (108).

72. Install snap ring (109) shaft (108).

73. Install shaft (108).

74. Install O-ring (110) to front casing (76).

75. Install housing (98). Tighten cap screws (100).

Specification

Housing-to-Front Casing Cap
Screws—Torque..... 98 N•m
72 lb-ft

76. Install pumps. See Pump 1 and 2 Remove and Install.
(Group 3360.)

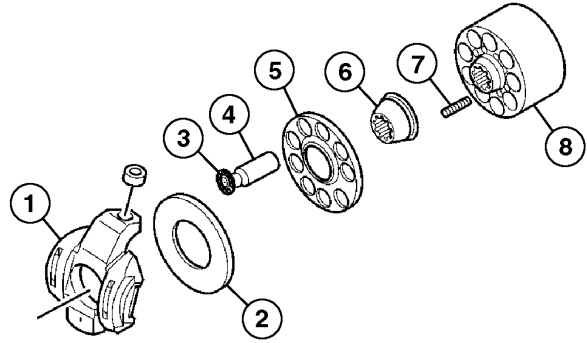
JH38101,000003B -19-01AUG06-10/10

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Pump 1 and 2 Inspection

1. See Pump 1 and Pump 2 Disassemble and Assemble.
(Group 3360.)

- 1—Swash Plate
- 2—Plate
- 3—Slipper (9 used)
- 4—Piston (9 used)
- 5—Retainer
- 6—Spherical Bushing
- 7—Spring (9 used)
- 8—Cylinder



TX1010289 -UN-21JUL06

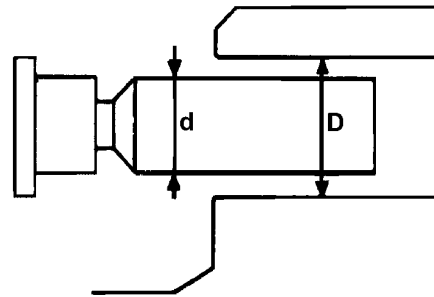
JH38101.000002C -19-26JUL06-1/5

2. Clearance between piston (4) outer diameter (d) and cylinder (8) bore diameter (D).

Specification

Bore Diameter and Piston
Diameter—Clearance 0.038 mm (0.001 in) new
0.078 mm (0.003 in) maximum
wear

d—Outer Diameter
D—Bore Diameter



T144080 -UN-16JUL01

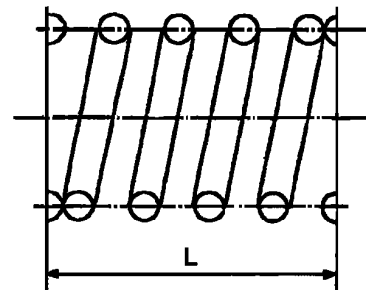
JH38101.000002C -19-26JUL06-2/5

3. Check free length (L) of spring (7).

Specification

Spring Length—Free Length 40.9 mm (1.61 in) new length
40.1 mm (1.58 in) minimum
length

L—Free Length



T144081 -UN-16JUL01

Continued on next page

JH38101.000002C -19-26JUL06-3/5

Hydraulic System

4. Check wear (e) between plunger (4) and slipper (3).

Specification

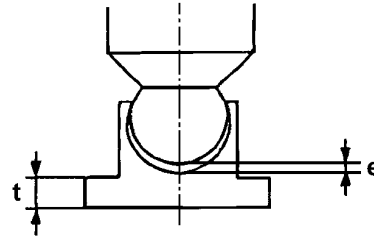
Plunger-to-Slipper—Clearance..... 0 to 0.1 mm (0 to 0.004 in) new
 0.35 mm (0.014 in) maximum wear

5. Check thickness (t) of slipper (3).

Specification

Slipper—Thickness..... 5.4 mm (0.21 in) new
 5.0 mm (0.20 in) maximum wear

e—Wear
t—Thickness



T144082 -UN-16JUL01

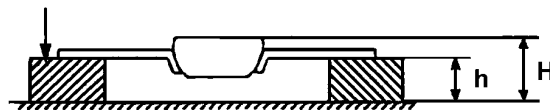
JH38101.000002C -19-26JUL06-4/5

6. The distance between face of retainer (5) to top of spherical bushing (6).

Specification

Cover Plate and Spherical Bushing—Height..... 13.5 mm (0.53 in) new
 12.5 mm (0.49 in) maximum wear

h—Cover Plate
H—Spherical Bushing



T144083 -UN-16JUL01

JH38101.000002C -19-26JUL06-5/5

Pump 1 and 2 Start-Up Procedure

1. Add oil to hydraulic oil tank until level is between marks on sight glass. Check Hydraulic Oil Level. (Operator's Manual.)

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JH38101.000002E -19-01AUG06-1/3

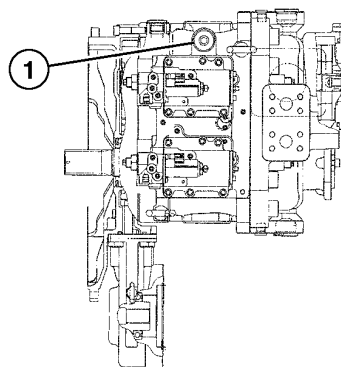
Hydraulic System

2. Remove plug (1).
3. Fill the pump with oil through plug port.
4. Install plug (1).

IMPORTANT: Place pilot control shut-off lever in the LOCK position. If pilot controls are operated damage may occur to pumps.

5. Start the engine and run at low idle.

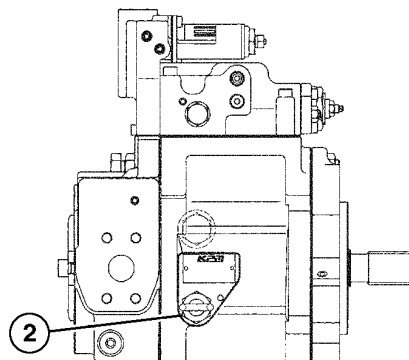
1—Plug



TX1010313 -UN-21JUL06

JH38101,000002E -19-01AUG06-2/3

6. Slowly loosen plug (2) to release trapped air. Install plug when air stops and oil flows from the plug.
7. Remove plug on top of fan pump and fill the pump with oil through plug hole.
8. After filling the pump with hydraulic oil, install plug on top of fan pump.
9. Run engine at low idle and operate all control levers slowly and smoothly for 15 minutes.
10. Position the machine with the arm and bucket cylinder fully retracted.
11. Lower the bucket to the ground.
12. Turn the auto-idle switch off.
13. Stop engine.
14. Check hydraulic oil tank level, add oil if needed. See Check Hydraulic Oil Level. (Operator's Manual.) See Hydraulic Oil. (Operator's Manual.)



2—Plug

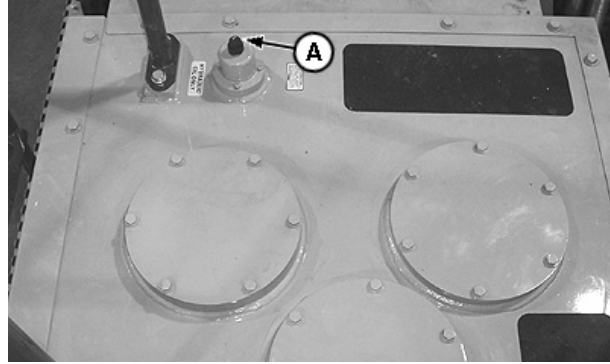
TX1010319 -UN-21JUL06

JH38101,000002E -19-01AUG06-3/3

Pump 1 and 2 Regulator Remove and Install

! **CAUTION:** High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (A).
2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank (Group 3360.) or See Change Hydraulic Tank Oil, Clean Suction Screen. (Operator's Manual.) See 450DLC Drain and Refill Capacities. (Operator's Manual.)
3. Disconnect lines at pump regulators. Close all openings using caps and plugs.
4. Disconnect electrical connectors at pump regulators.



A—Pressure Release Button

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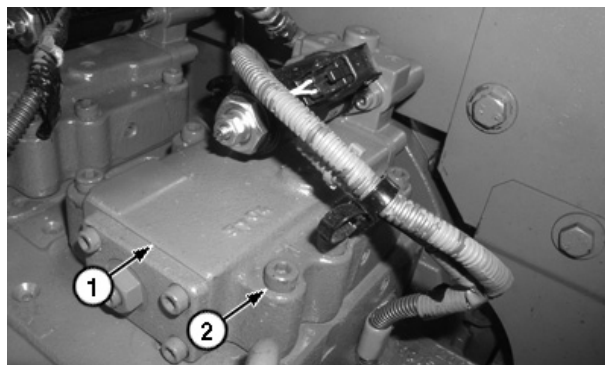
JH38101.0000035 -19-01AUG06-1/2

Hydraulic System

5. Remove cap screws (2).
6. Remove regulator (1).
7. Repair or replace parts as necessary.
8. Install regulator (1). Tighten cap screws (2).

Specification

Pump 1 and 2 Regulator-to-Pump	
Housing Cap Screws—Torque.....	29 Nm 21 lb-ft



TX1010425A -UN-26JUL06

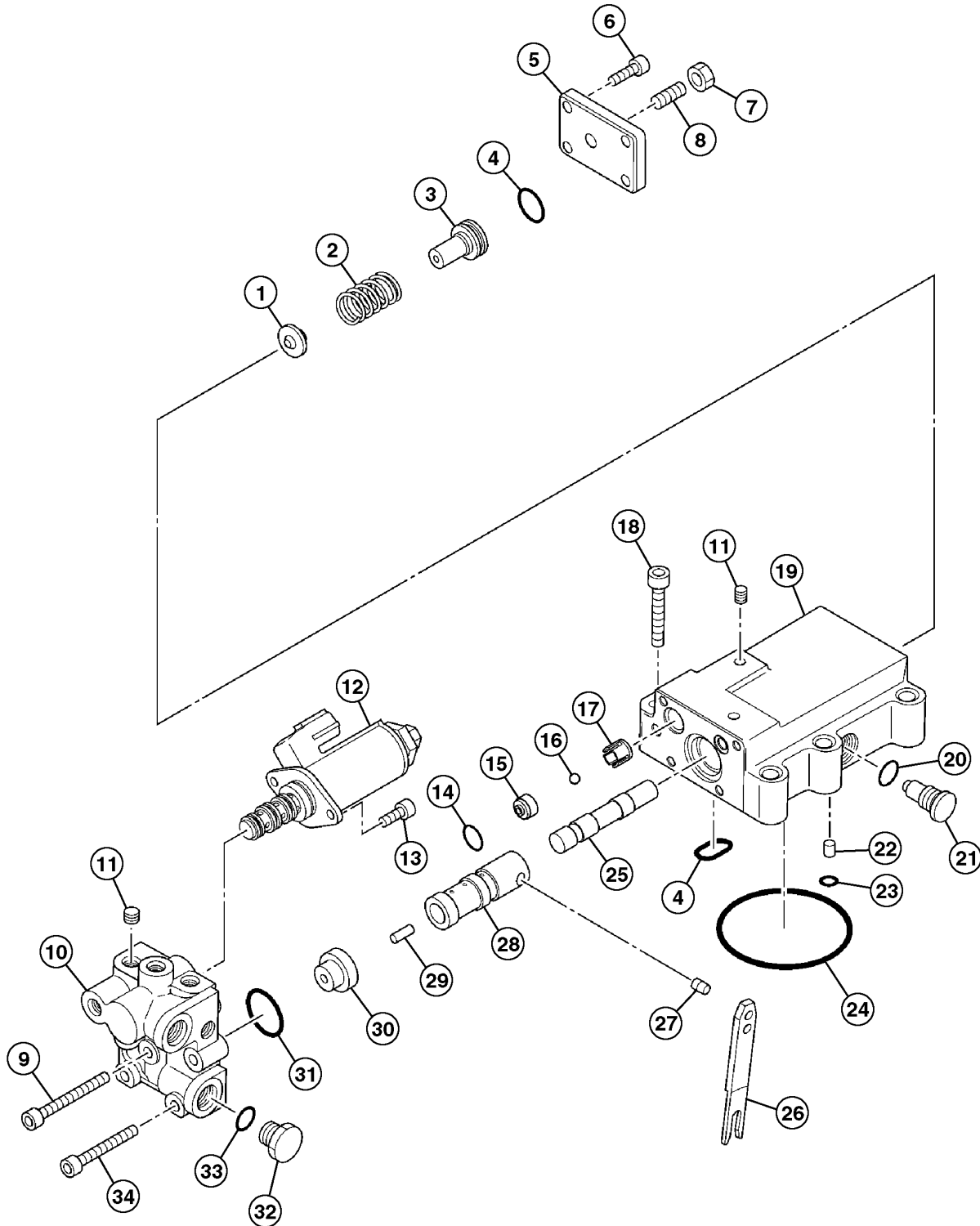
9. Connect electrical connectors. See Pump Harness (W8) Component Location. (Group 9015-10.)
10. Connect lines. See Pump 1, Pump 2 and Pilot Pump Line Identification. (Group 9025-15.)
11. Fill hydraulic oil tank. See Hydraulic Oil. (Operator's Manual.) See 450DLC Drain and Refill Capacities. (Operator's Manual.)
12. See Pump 1 and 2 Start-Up Procedure. (Group 3360.)

1—Regulator
2—Cap Screw (6 used)

JH38101.0000035 -19-01AUG06-2/2

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Pump 1 and 2 Regulator Disassemble and Assemble



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TX1008041

Pump 1 and 2 Regulator Exploded View
Continued on next page

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TX1008041 -UN-24MAY06

Hydraulic System

1—Spring Seat	10—Solenoid Valve Housing	19—Regulator Valve Housing	27—Pin
2—Spring	11—Plug (9 used)	20—O-Ring	28—Sleeve
3—Stopper	12—Solenoid Valve	21—Plug	29—Pin
4—O-Ring (2 used)	13—Cap Screw (2 used)	22—Pin	30—Sleeve
5—Cover	14—O-Ring (2 used)	23—O-Ring	31—O-Ring
6—Cap Screw (4 used)	15—Seat (2 used)	24—O-Ring	32—Plug
7—Lock Nut	16—Steel Ball (2 used)	25—Spool	33—O-Ring
8—Screw	17—Stopper (2 used)	26—Feedback Lever	34—Cap Screw (4 used)
9—Cap Screw	18—Cap Screw (6 used)		

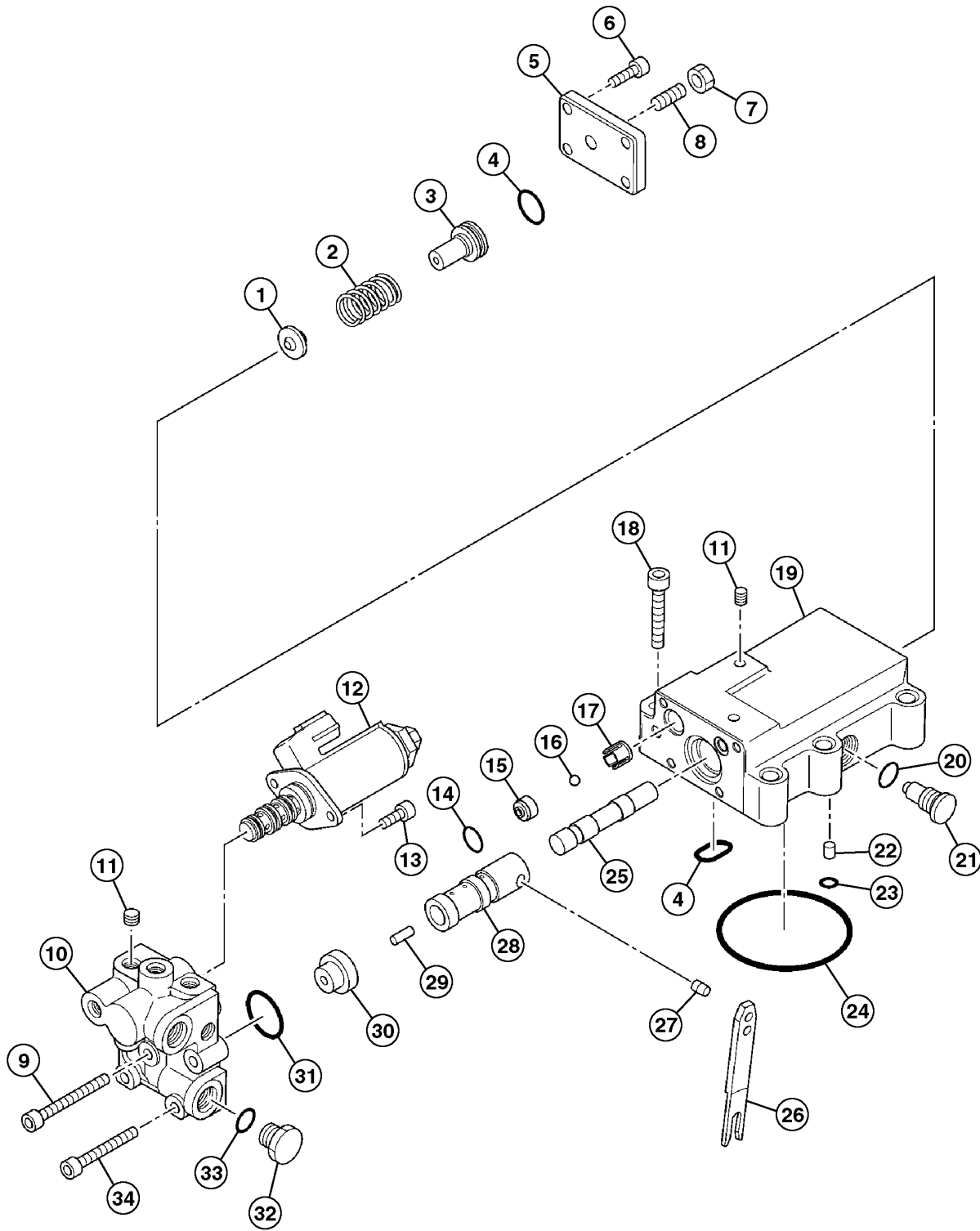
1. Remove regulator valve housing (19). Rate (Displacement) Test and Adjustment. (Group 9025-25.)
2. Remove O-rings (4, 23, and 24) and pin (22).
3. Remove solenoid valve (12).
4. Remove solenoid valve housing (10) from regulator housing (19).
5. Remove O-rings (14), seats (15), steel balls (16), and stoppers (17).
6. Remove O-ring (31), sleeve (30) and pin (29).
7. Do not remove screw (8) and nut (7). Valve settings will be lost and must be adjusted. See Pump Flow
8. Remove cover (5).
9. Remove stopper (3) and spring (2).
10. Remove spring seat (1) with M4 cap screw.
11. Remove plug (21).
12. Remove feedback lever (26), pin (27), sleeve (28) and spool (25).
13. Repair or replace parts as necessary.

Continued on next page

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Hydraulic System



TX1008041

Pump 1 and 2 Regulator Exploded View

Continued on next page

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Hydraulic System

- | | | | |
|----------------------|---------------------------|----------------------------|-----------------------|
| 1—Spring Seat | 10—Solenoid Valve Housing | 19—Regulator Valve Housing | 27—Pin |
| 2—Spring | 11—Plug (9 used) | 20—O-Ring | 28—Sleeve |
| 3—Stopper | 12—Solenoid Valve | 21—Plug | 29—Pin |
| 4—O-Ring (2 used) | 13—Cap Screw (2 used) | 22—Pin | 30—Sleeve |
| 5—Cover | 14—O-Ring (2 used) | 23—O-Ring | 31—O-Ring |
| 6—Cap Screw (4 used) | 15—Seat (2 used) | 24—O-Ring | 32—Plug |
| 7—Lock Nut | 16—Steel Ball (2 used) | 25—Spool | 33—O-Ring |
| 8—Screw | 17—Stopper (2 used) | 26—Feedback Lever | 34—Cap Screw (4 used) |
| 9—Cap Screw | 18—Cap Screw (6 used) | | |

14. Install stopper (17), steel ball (16), seat (15) and O-ring (14).
15. Install sleeve (28) and spool (25).
16. Install feedback lever (26) to sleeve (28) with pin (27).
17. Install O-ring and plug (10 and 21).

Specification

Pump 1 and 2 Regulator	
Plug—Torque.....	36 N•m 27 lb-ft

18. Align plug (21) with pin hole on feedback lever (26) and tighten plug.

Specification

Pump 1 and 2 Regulator	
Plug—Torque.....	36 N•m 27 lb-ft

19. Install spring seat (1), spring (2), stopper (3) and O-ring (4).
20. Install cover (5). Tighten cap screws (6).

Specification

Pump 1 and 2 Regulator Cover	
Cap Screw—Torque	12 N•m 106 lb-in.

21. Install pin (29), sleeve (30) and O-ring (31).
22. Install stopper (17), steel ball (16), seat (15) and O-ring (14).
23. Install solenoid valve (12). Tighten cap screws (13).

Specification

Pump 1 and 2 Regulator	
Solenoid Valve Cap Screw—	
Torque.....	7 N•m 61 lb-in.

24. Install solenoid valve housing (10). Tighten cap screws (9).

Specification

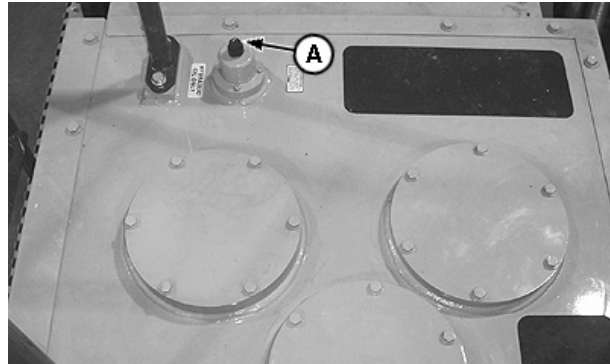
Pump 1 and 2 Regulator	
Housing-to-Solenoid Valve	
Housing Cap Screw—Torque.....	12 N•m 106 lb-in.

Pilot Pump Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (A).
2. Drain pump drive gearbox oil. See Pump Gearbox Oil. (Operator's Manual.)

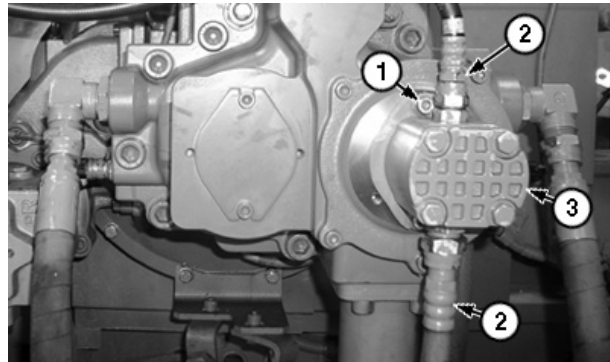
A—Pressure Release Button



TX1010475A -UN-20JUL06

JH38101,000002F -19-01AUG06-1/2

3. Disconnect lines (2). Close all openings using caps and plugs.
4. Remove cap screws (1).
5. Remove pilot pump (3).
6. Replace parts as necessary.
7. Install pilot pump and tighten cap screws.



TX1010474A -UN-20JUL06

Specification

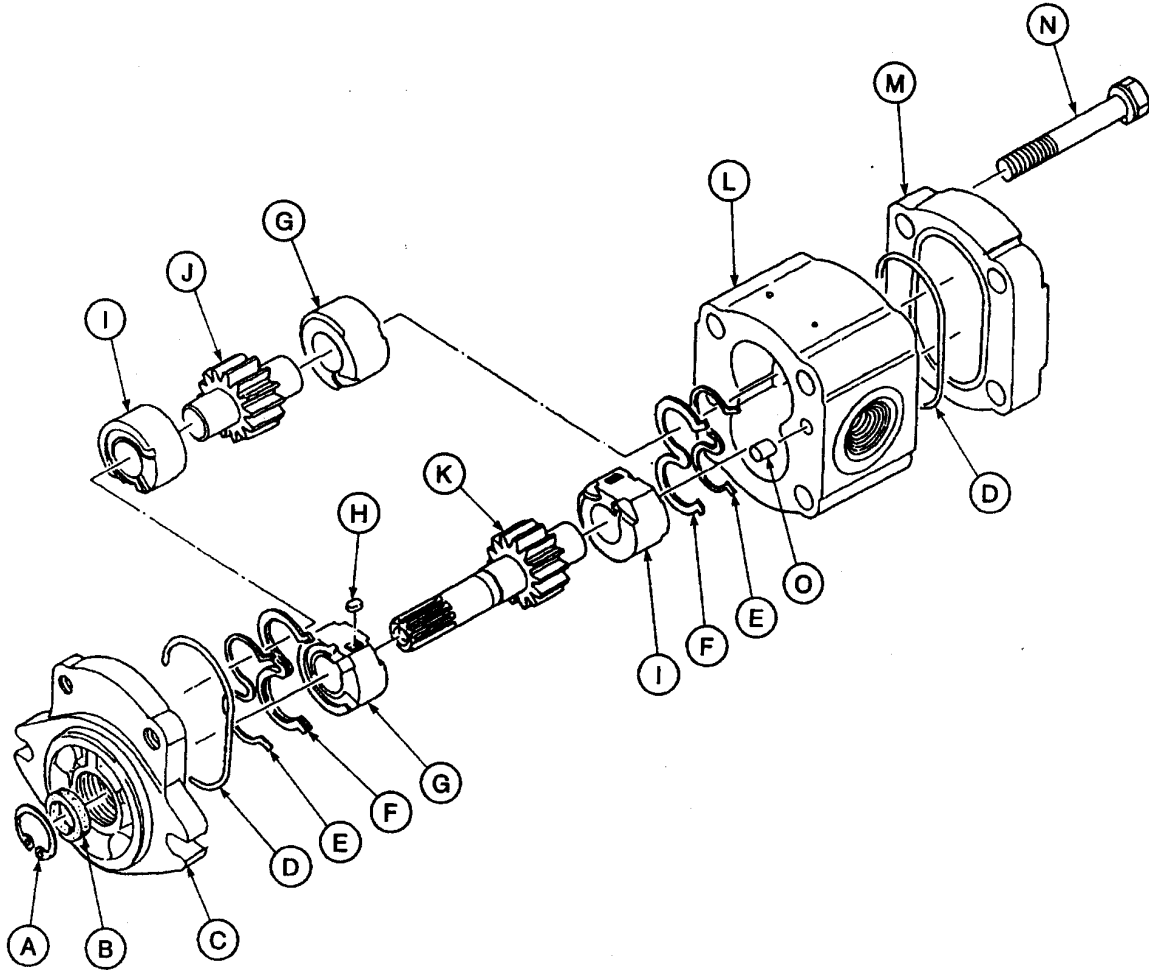
Pilot Pump Mounting Cap
Screws—Torque..... 49 N•m
36 lb-ft

- 1—Cap Screw (2 used)
- 2—Line (2 used)
- 3—Pilot Pump

8. Connect lines.
9. Perform Pump 1 and 2 Start-Up Procedure. (Group 3360.)

JH38101,000002F -19-01AUG06-2/2

Pilot Pump Disassemble and Assemble



A—Snap Ring
 B—Seal
 C—Mounting Flange
 D—O-Ring (2 used)

E—Back-Up Ring (2 used)
 F—Seal (2 used)
 G—Bushing (2 used)
 H—Key (2 used)

I—Bushing (2 used)
 J—Driven Gear
 K—Drive Gear
 L—Housing

M—Cover
 N—Cap Screw (4 used)
 O—Dowel Pin (2 used)

1. Remove snap ring (A).
2. Remove cap screws (N).
3. Remove mounting flange (C).
4. Check bushings (G). If inside diameter and surface toward gear are rough or worn, replace pump.
5. Check gears (J and K) and housing (L). If gear teeth, shaft and inside of housing are rough or worn, replace pump.

Continued on next page

TX17984,000007E -19-01AUG06-1/2

Hydraulic System

IMPORTANT: Premature pump failure will result if pump is assembled dry. Apply clean hydraulic oil to all parts while assembling.

6. Install front bushings (G and I) with seal groove toward cover (M).
7. Install rear bushings (G and I) with seal groove toward mounting flange (C).

8. Tighten cap screws (N).

Specification

Cover-to-Housing Cap Screw—
Torque..... 41 N•m
31 lb-ft

TX17984.000007E -19-01AUG06-2/2

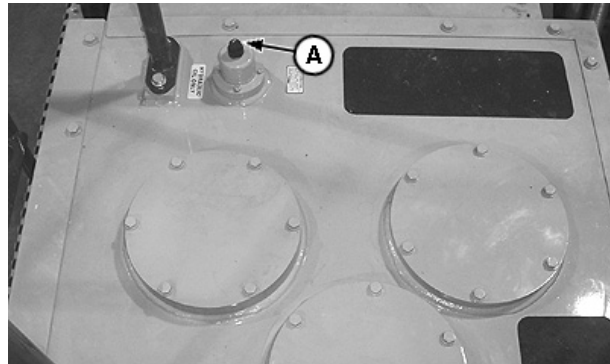
Pilot Filter and Pressure Regulating Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (A).

A—Pressure Release Button



Continued on next page

TX17984.000007F -19-01AUG06-1/2

Hydraulic System

2. Disconnect lines. Close all openings using caps and plugs.
3. Remove cap screws (3) to remove pilot pressure regulating valve (2) and pilot filter element (4).
4. Repair or replace parts as necessary.
5. Install pilot pressure regulating valve. Tighten cap screws (3).

Specification

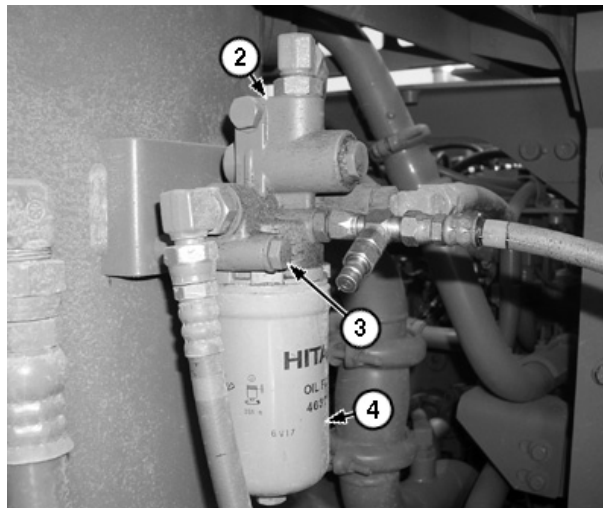
Filter Head-to-Support Cap	
Screw—Torque.....	49 N•m 36 lb-ft

6. Replace pilot filter element (4). Tighten cap screws (4).

Specification

Pilot Filter Element	
Housing-to-Filter Head—Torque	25 N•m 18 lb-ft

7. Connect lines. See Pump 1, Pump 2 and Pilot Pump Line Identification. (Group 9025-15.)
8. Check pilot pressure setting. See Pilot Pressure Regulating Valve Test and Adjustment. (Group 9025-25.)



TX1010364A -UN-19JUL06

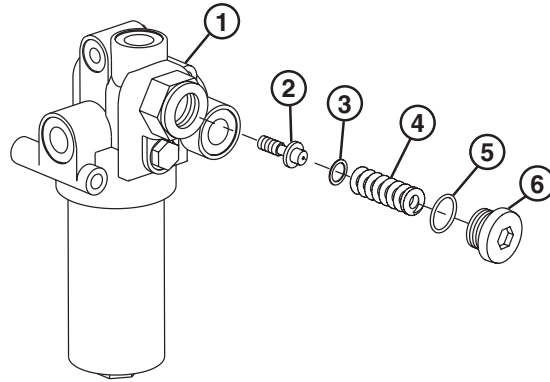
- 2—Pilot Pressure Regulating Valve
- 3—Cap Screw (2 used)
- 4—Pilot Filter Element

TX17984,000007F -19-01AUG06-2/2

33
3360
33

Pilot Filter and Pressure Regulating Valve Disassemble and Assemble

1. Remove plug (6) with O-ring (5).
2. Remove parts (2—4).
3. Inspect, clean and replace parts as necessary.
4. Check that poppet (2) slides smoothly in pilot pressure regulating valve housing (1).
5. Install parts (2—4).
6. Tighten plug (6).



T143094 -JUN-20JUL01

Specification

Plug-to-Housing—Torque..... 49 N•m
36 lb-ft

- 1—Pilot Pressure Regulating Valve Housing
- 2—Poppet
- 3—Shim (As Required)
- 4—Spring
- 5—O-Ring
- 6—Plug

TX17984,00000D3 -19-01AUG06-1/1

Pilot Shutoff Solenoid Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

1. Push hydraulic oil tank pressure release button.

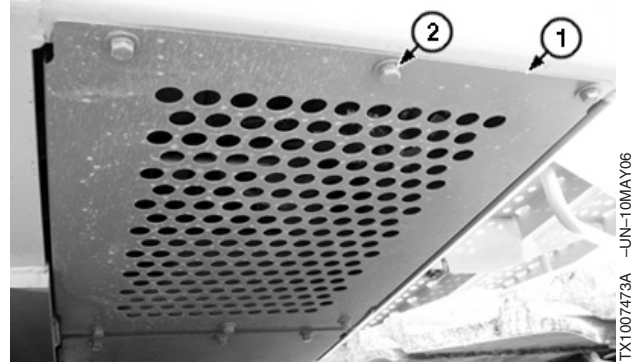
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TX17984,00000D4 -19-09MAY06-1/4

Hydraulic System

2. Remove cap screws (2) and cover (1).

1—Cover
2—Cap Screw (6 used)



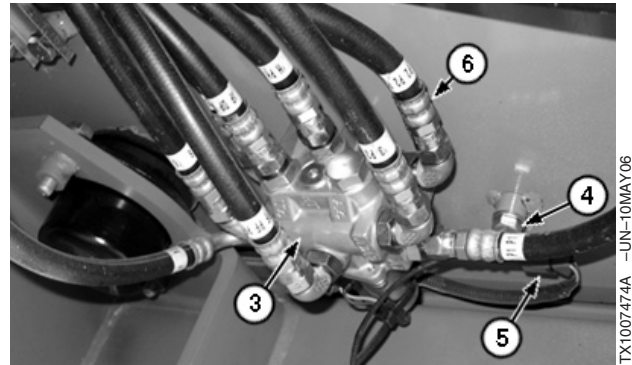
Pilot Shutoff Valve Cover

TX1007473A -UN-10MAY06

TX17984,00000D4 -19-09MAY06-2/4

3. Disconnect connector (5) and remove cap screw (4).
4. Remove hydraulic lines (6) from pilot shutoff valve (3). Note location of lines for installation. Cap and plug lines.

3—Pilot Shutoff Valve
4—Cap Screw
5—Harness Connector
6—Hydraulic Line (9 used)



Pilot Shutoff Valve

TX1007474A -UN-10MAY06

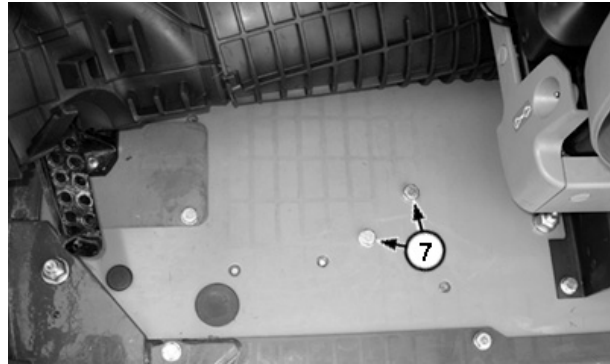
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TX17984,00000D4 -19-09MAY06-3/4

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35

Hydraulic System

- Lift floor mat in cab and remove cap screws (7). Remove pilot shutoff valve and solenoid.
- Repair or replace parts as necessary.
- Install pilot shutoff valve to machine.
- Connect hydraulic lines to pilot shutoff valve. See Pilot Control Valve-to-Pilot Signal Manifold Component Location—Excavator Pattern or See Pilot Control Valve-to-Pilot Signal Manifold Component Location—Backhoe Pattern. (Group 9025-15.)
- Install cap screw (4) and connect harness connector.
- Install cover and cap screws.



Cab Cap Screws

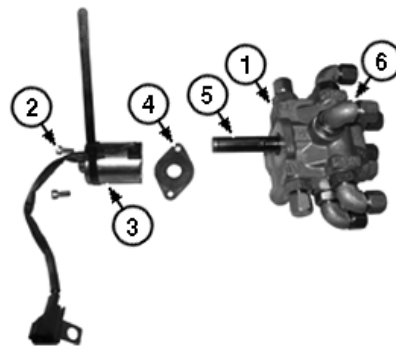
7—Cap Screw (2 used)

TX17984,00000D4 -19-09MAY06-4/4

Pilot Shutoff Solenoid Valve Disassemble and Assemble

- Remove cap screw (2), solenoid coil (3) and spacer (4) from valve housing (1).

- 1—Pilot Shutoff Solenoid Valve Housing
- 2—Cap Screw (2 used)
- 3—Solenoid Coil
- 4—Spacer
- 5—Solenoid Core
- 6—Fitting
- 15—Screen



Pilot Shutoff Solenoid Valve Coil

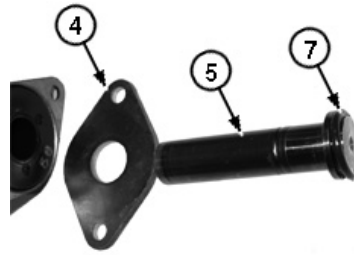
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TX17984,00000D5 -19-25JUL06-1/4

Hydraulic System

2. Remove solenoid core (5) and O-ring (7).

- 5—Solenoid Core
- 7—O-Ring



Pilot Shutoff Valve Core

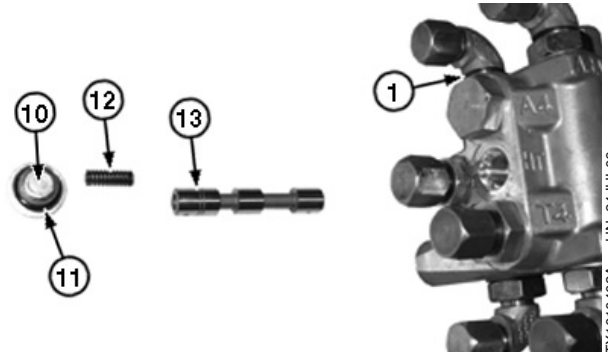
TX1010402A -UN-26JUL06

TX17984,00000D5 -19-25JUL06-2/4

3. Remove plug (10), O-ring, spring (12) and spool (13).

IMPORTANT: Spool (13) is a non-serviceable component. Use caution when removing spool from valve housing.

- 1—Pilot Shutoff Solenoid Valve Housing
- 10—Plug
- 11—O-Ring
- 12—Spring
- 13—Spool



Pilot Shutoff Solenoid Valve Spool

TX1010403A -UN-24JUL06

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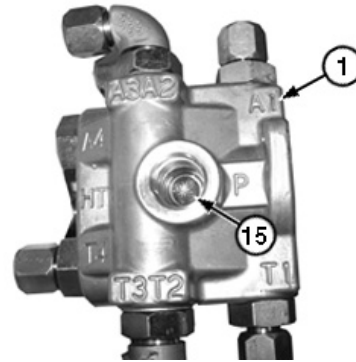
TX17984,00000D5 -19-25JUL06-3/4

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37

- Remove fitting (6) from port P in pilot shutoff solenoid valve housing (1) and inspect screen (15).

IMPORTANT: Screen (15) is a non-serviceable component. Do not damage screen.

- Repair or replace parts as necessary.
- Install fitting into port P.
- Install spool, spring, O-ring and plug. Tighten plug to specification.



Pilot Shutoff Solenoid Valve Screen

1—Pilot Shutoff Solenoid Valve Housing
15—Screen

Specification

Pilot Shutoff Solenoid Valve	
Plug—Torque.....	26.5 N•m 234 lb-in.

- Install O-ring to core.
- Install core, spacer, solenoid coil and cap screws to valve housing. Tighten Cap screws to specification.

Specification

Pilot Shutoff Solenoid Valve Cap	
Screw—Torque.....	3.92 N•m 35 lb-in.

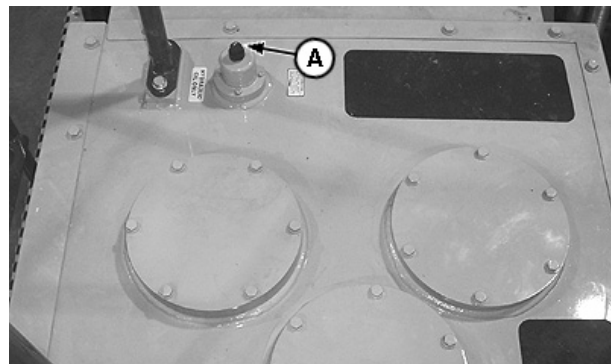
TX1010404A -UN-24JUL06

TX17984,00000D5 -19-25JUL06-4/4

Fan Drive Pump Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

- Release pressure from hydraulic oil tank by pushing pressure release button (A).
- Apply vacuum to hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)



A—Pressure Release Button

TX1010475A -UN-20JUL06

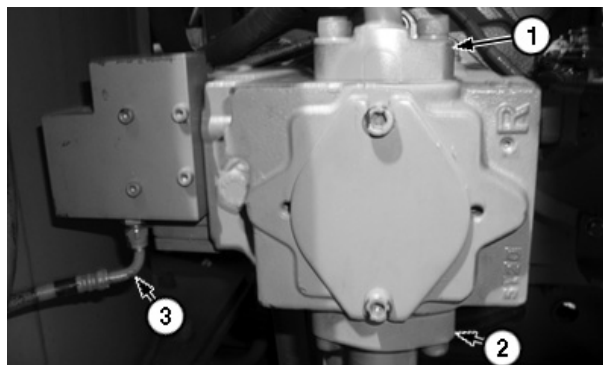
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TX04577,0000113 -19-01AUG06-1/5

Hydraulic System

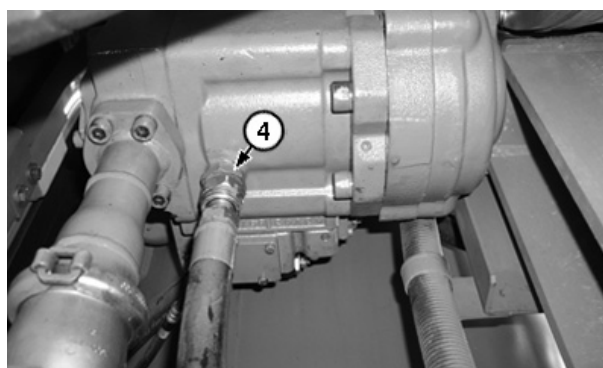
3. Remove socket head screws and four bolt flange on inlet tube (2) and outlet hose (1). Cap off openings.
4. Remove case drain hose (4) from pump.
5. Remove pilot hose (3) on pump control valve. Cap and plug open hose and port.

- 1—Outlet Hose—Four Bolt Flange Socket Head Screw (4 used)
- 2—Inlet Tube—Four Bolt Flange Socket Head Screws (4 used)
- 3—Pilot Pump Hose
- 4—Case Drain Hose



TX1010735A -UN-28JUL06

Fan Pump Connections—Inlet and Outlet



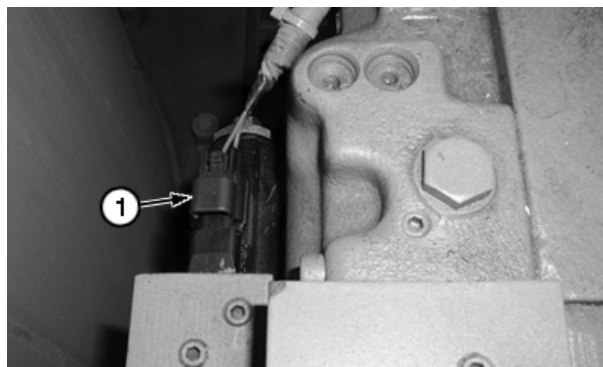
TX1010734A -UN-28JUL06

Fan Pump Connections—Bottom Side

TX04577,0000113 -19-01AUG06-2/5

6. Disconnect wire harness connector (1) on the pump control valve.

- 1—Wire Harness Connector



TX1010735A -UN-28JUL06

Continued on next page

TX04577,0000113 -19-01AUG06-3/5

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3360
39

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

7. Attach a hoist using a strap around pump housing and DFT1250 Lifting Bracket and JT01748 lifting strap.

Specification

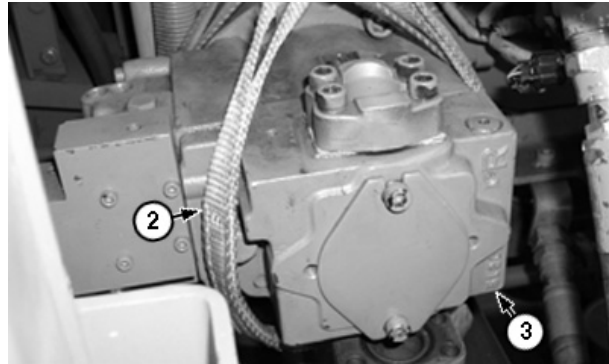
Fan Pump—Weight 54 kg approximate
120 lb approximate

8. Remove mounting socket head screws.

9. Remove fan pump (3) with hoist.

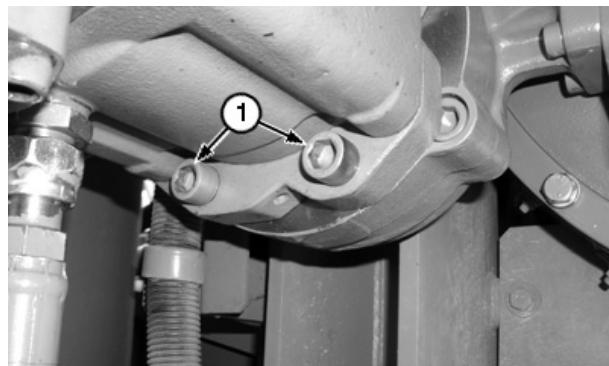
10. Replace or repair as necessary. See Fan Drive Pump Disassemble and Assemble. (Group 3360.)

- 1—Socket Head Screws (4 used)
- 2—Lift Strap
- 3—Fan Pump



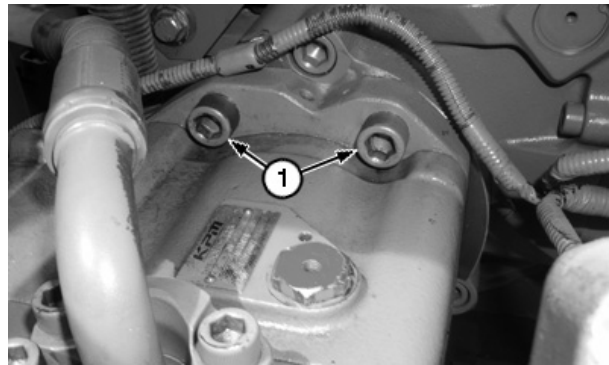
Fan Pump Lift Strap

TX1010763A -UN-26JUL06



Fan Pump Mounting Hardware—Bottom

TX1010770A -UN-28JUL06



Fan Pump Mounting Hardware—Top

TX1010769A -UN-28JUL06

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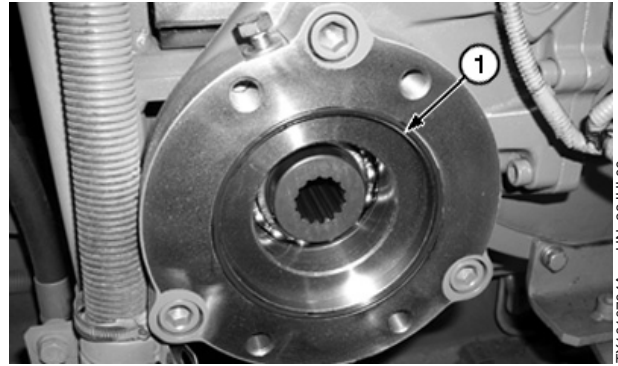
TX04577,0000113 -19-01AUG06-4/5

Hydraulic System

11. Clean mounting surface and install new O-ring (1) on pump mounting face.
12. With hoist install pump with four socket head screws. Tighten to specifications.

Specification

Fan Pump Mounting Socket Head
Screw—Torque..... 230 N•m
170 lb-ft



TX1010764A -JUN-28JUL06

1—O-Ring

13. Connect wire harness connector to solenoid on fan pump control valve.
14. Install case drain hose to pump.
15. Install pilot hose to pump control valve.
16. Install inlet tube and outlet hose to pump with four bolt flange and socket head screws.

Specification

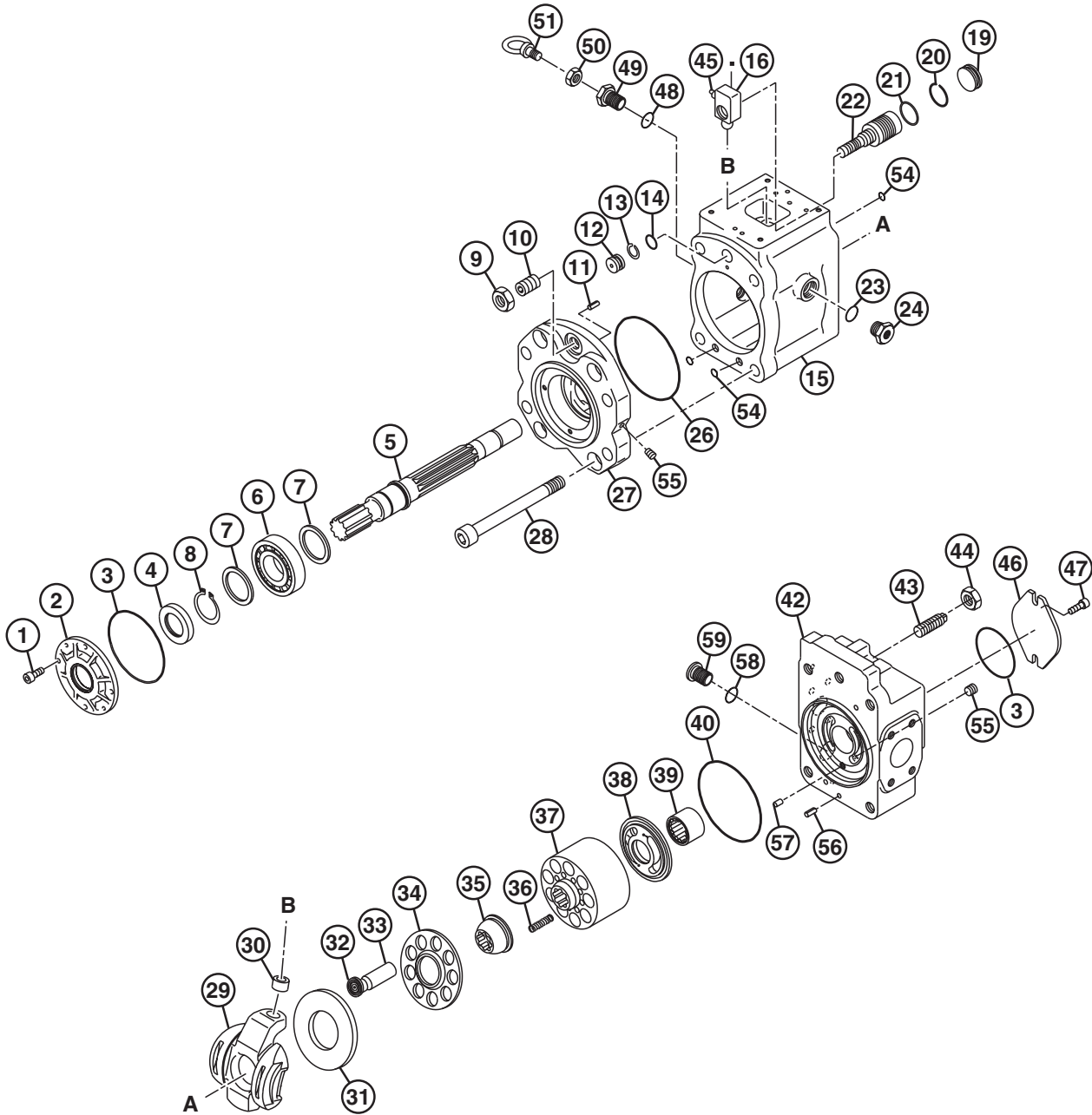
Fan Pump Hydraulic Four Bolt
Flange Mounting Socket Head
Screw—Torque..... 50 N•m
37 lb-ft

17. Remove vacuum pump.
18. Fill fan pump case with hydraulic oil. See Pump 1 and 2 Start-Up Procedure. (Group 3360.)

TX04577,0000113 -19-01AUG06-5/5

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3360
41

Fan Drive Pump Disassemble and Assemble



33
3360
42

TX1007619

Fan Drive Pump Exploded View

Continued on next page

TX17984,0000084 -19-27JUL06-1/8

TX1007619 -UN-12MAY06

Hydraulic System

- 1—Cap Screw (4 used)
- 2—Cover
- 3—O-Ring (2 used)
- 4—Oil Seal
- 5—Shaft
- 6—Bearing
- 7—Spacer (2 used)
- 8—Retaining Ring
- 9—Nut (2 used)
- 10—Adjusting Screw
- 11—Spring Pin (2 used)
- 12—Stopper
- 13—Backup Ring
- 14—O-Ring

- 15—Housing
- 16—Tilt Pin
- 19—Stopper
- 20—Backup Ring
- 21—O-Ring
- 22—Servo Piston
- 23—O-Ring (2 used)
- 24—Plug (2 used)
- 26—O-Ring
- 27—Swash Plate Holder
- 28—Cap Screw (4 used)
- 29—Swash Plate
- 30—Bushing

- 31—Shoe Plate
- 32—Shoe (9 used)
- 33—Piston (9 used)
- 34—Retainer Plate
- 35—Spherical Bushing
- 36—Spring (9 used)
- 37—Cylinder Block
- 38—Valve Plate
- 39—Bearing
- 40—O-Ring
- 42—Cover
- 43—Adjusting Screw
- 44—Nut (2 used)

- 45—Feedback Pin
- 46—Cover
- 47—Cap Screw (2 used)
- 48—O-Ring (2 used)
- 49—Plug (2 used)
- 50—Nut
- 51—Eyebolt
- 54—O-Ring
- 55—Plug (8 used)
- 56—Pin (2 used)
- 57—Pin
- 58—O-Ring
- 59—Plug

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

1. Remove plug (24) from housing (15) and drain hydraulic oil from pump.

Specification

Fan Drive Pump—Weight..... 51 kg approximate
110 lb approximate

2. Remove regulator from pump housing.
3. Remove cap screws (47) and remove cover (46) from cover (42).

IMPORTANT: Do not remove needle bearing (39) unless bearing is to be replaced.

4. Remove cap screws (28). Remove cover (42) and valve plate (38) from housing (15).
5. Remove cylinder block (37), pistons (33), shoes (32), spherical bushing (35), and retainer plate (34) as an assembly.
6. Remove retainer plate (34), piston (33), and shoes (32) as an assembly from cylinder block (37).

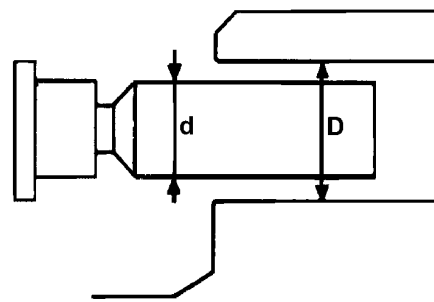
TX17984,0000084 -19-27JUL06-2/8

7. Check clearance between cylinder bore diameter (D) and piston diameter (d).

Specification

Bore Diameter D and Piston Diameter d—Clearance..... 0.028 mm Standard
0.001 in Standard
0.056 mm Maximum Wear
0.002 in Maximum Wear

8. Remove pistons (33) and shoes (32) from retainer plate (34).



Pump Piston Clearance

T144080 -UN-16JUL01

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3360
43

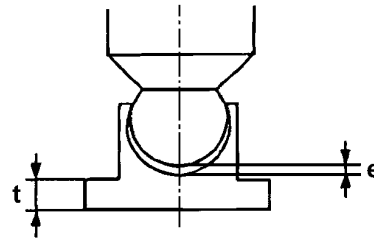
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TX17984,0000084 -19-27JUL06-3/8

9. Check clearance (e) between piston and shoe and measure thickness (t) of shoe.

Specification

Piston-to-Shoe—Clearance.....	0.0—0.1 mm Standard
	0.0—0.004 in. Standard
	0.3 mm Maximum Wear
	0.012 in. Maximum Wear
Shoe—Thickness.....	3.9 mm Standard
	0.15 in. Standard
	3.7 mm Maximum Wear
	0.14 in. Maximum Wear



Piston and Shoe

T144082 -UN-16JUL01

IMPORTANT: Do not remove oil seal (4) unless oil seal is to be replaced.

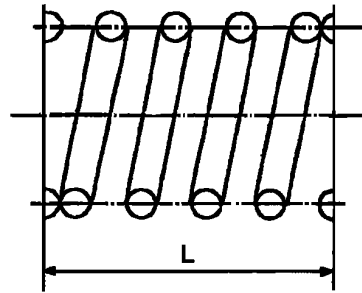
10. Remove spherical bushing (35) and springs (36) from cylinder block (37).

TX17984,0000084 -19-27JUL06-4/8

11. Check free length (L) of spring.

Specification

Spring Length—Free Length.....	31.3 mm Standard
	1.23 in. Standard
	30.2 mm Maximum Wear
	1.19 in. Maximum Wear



Spring Length

T144081 -UN-16JUL01

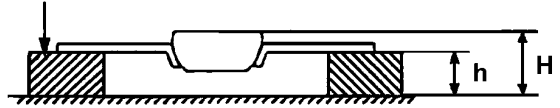
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TX17984,0000084 -19-27JUL06-5/8

- Check height of retainer plate (h) and height of spherical bushing (H).

Specification

Retainer Plate and Spherical	
Bushing—Height.....	19.0 mm Standard
	0.75 in. Standard
	18.3 mm Maximum Wear
	0.72 in. Maximum Wear



T144083 -UN-16JUL01

Retainer Plate and Spherical Bushing Height

- Remove cap screws (1). Remove cover (2) from swash plate holder (27).
- Remove swash plate holder (27) from housing (15).
- Remove swash plate (29) and shoe plate (31) from housing (15).
- Remove shaft (5) from swash plate holder (27).

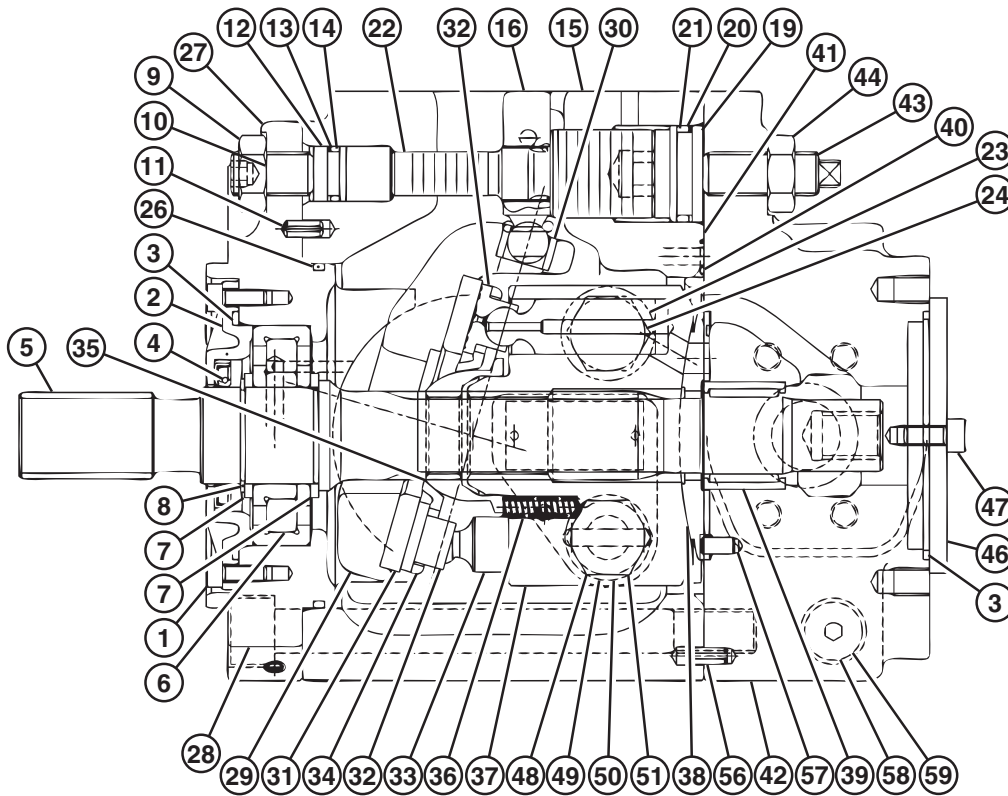
IMPORTANT: Thread lock and sealer has been applied between tilt pin (16) and servo piston (22). Do not damage servo piston when disassembling.

- Remove stoppers (12 and 19), servo piston (22) and tilt pin (16) from housing (15).
- Remove retaining ring (8), spacers (7), and bearing (6) from shaft (5).
- Repair or replace parts as necessary.

Continued on next page

TX17984,0000084 -19-27JUL06-6/8

Hydraulic System



TX1007620

Fan Drive Pump Cross Section

- | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> 1—Cap Screw (4 used) 2—Cover 3—O-Ring (2 used) 4—Oil Seal 5—Shaft 6—Bearing 7—Spacer (2 used) 8—Retaining Ring 9—Nut (2 used) 10—Adjusting Screw 11—Spring Pin (2 used) 12—Stopper 13—Backup Ring 14—O-Ring | <ul style="list-style-type: none"> 15—Housing 16—Tilt Pin 19—Stopper 20—Backup Ring 21—O-Ring 22—Servo Piston 23—O-Ring (2 used) 24—Plug (2 used) 26—O-Ring 27—Swash Plate Holder 28—Cap Screw (4 used) 29—Swash Plate 30—Bushing | <ul style="list-style-type: none"> 31—Shoe Plate 32—Shoe (9 used) 33—Piston (9 used) 34—Retainer Plate 35—Spherical Bushing 36—Spring (9 used) 37—Cylinder Block 38—Valve Plate 39—Bearing 40—O-Ring 42—Cover 43—Adjusting Screw 44—Nut (2 used) | <ul style="list-style-type: none"> 45—Feedback Pin 46—Cover 47—Cap Screw (2 used) 48—O-Ring (2 used) 49—Plug (2 used) 50—Nut 51—Eyebolt 54—O-Ring 55—Plug (8 used) 56—Pin (2 used) 57—Pin 58—O-Ring 59—Plug |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- 20. Apply thread lock and sealer (medium strength) to contacting surface between servo piston (22) and tilt pin (16).
- 21. Install tilt pin (16) and servo piston (22) to housing (15).
- 22. Install O-ring (21) and backup ring (20) to stopper (19). Install stopper (19) to housing (15).
- 23. Install O-ring (13) and backup ring (14) to stopper (12). Install stopper (12) to housing (15).
- 24. Install spacer (7), bearing (6), spacer (7) and retaining ring (8) to shaft (5).
- 25. Install spring pin (11) and O-ring (26) to swash plate holder (27). Install swash plate holder (27) to housing (15).

TX1007620 -UN-12MAY06

Continued on next page

TX17984,0000084 -19-27JUL06-7/8

Hydraulic System

26. Install shoe plate (31) to swash plate (29). Align swash plate (29) with tilt pin (16) and install swash plate to housing (15). Check if swash plate moves smoothly.

27. Install O-ring (3) and oil seal (4) to cover (2).

28. Install shaft (5) to swash plate holder (27). Install cover (2) to swash plate holder (27) with cap screw (1).

Specification

Fan Drive Pump Cover Cap	
Screw—Torque	20 N•m 177 lb-in.

29. Install springs (36) and spherical bushing (35) to cylinder block (37).

30. Install pistons (33) and shoes (32) to retainer plate (34). Install retainer plate (34) to cylinder block (37).

31. Install cylinder block (37) to shaft (5).

32. Install pins (56 and 57) and O-ring (40) to cover (42).

33. Apply grease to valve plate (38). Align valve plate with pin (54) and install valve plate.

34. Install cover (42) to housing (15) with cap screws (28).

Specification

Fan Drive Pump Housing Cap	
Screws—Torque	400 N•m 295 lb-ft

35. Install O-ring (3) to cover (46). Install cover (46) to cover (42) with cap screws (47).

Specification

Fan Drive Pump Housing Cover	
Cap Screws—Torque	50 N•m 37 lb-ft

36. Align feedback lever in regulator with tilt pin (16). Install regulator to housing (15).

Specification

Fan Drive Pump Regulator	
Mounting Cap Screws—Torque	20 N•m 177 lb-in.

37. Install O-ring (23) to plug (24). Install plug (24) to housing (15).

Specification

Fan Drive Pump Plug—Torque	147 N•m 108 lb-ft
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TX17984,0000084 -19-27JUL06-8/8

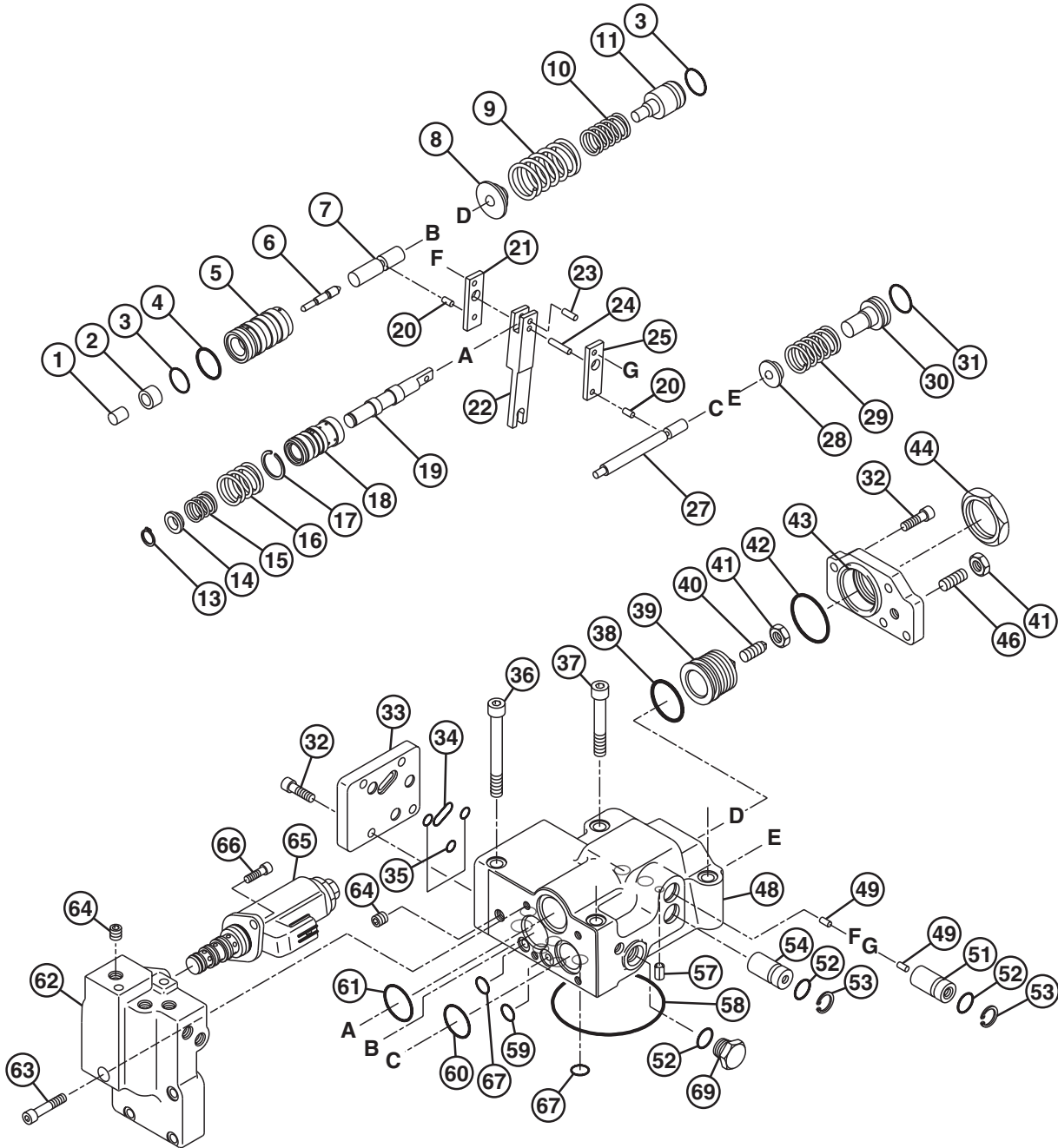
Fan Drive Pump Regulator Remove and Install

For Fan Drive Pump Regulator Remove and Install, See Fan Drive Pump Regulator Disassemble and Assemble. (Group 3360.)

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TX17984,00000D6 -19-11MAY06-1/1

Fan Drive Pump Regulator Disassemble and Assemble



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3360
48

TX1007664

Fan Drive Pump Regulator Exploded View

Continued on next page

TX17984,00000D7 -19-11MAY06-1/5

TX1007664 -UN-16MAY06

Hydraulic System

1—Pin	18—Sleeve	34—O-Ring	52—O-Ring (3 used)
2—Sleeve	19—Spool	35—O-Ring (3 used)	53—Retaining Ring (2 used)
3—O-Ring (2 used)	20—Pin (2 used)	36—Cap Screw (2 used)	54—Adjusting Plug
4—O-Ring	21—Lever	37—Cap Screw (2 used)	57—Pin
5—Sleeve	22—Feedback Lever	38—O-Ring	58—O-Ring
6—Compensating Piston	23—Pin	39—Adjusting Screw	59—O-Ring
7—Compensating Rod	24—Pin	40—Adjusting Screw	60—O-Ring
8—Spring Set	25—Lever	41—Nut (2 used)	61—O-Ring
9—Spring	27—Pilot Piston	42—O-Ring	62—Cover
10—Spring	28—Spring Seat	43—Cover	63—Cap Screw (4 used)
11—Adjusting Disc	29—Spring	44—Nut	64—Plug (11 used)
13—Retaining Ring	30—Adjusting Disc	46—Adjusting Screw	65—Solenoid Valve
14—Spring Seat	31—O-Ring	48—Housing	66—Cap Screw (2 used)
15—Spring	32—Cap Screw (8 used)	49—Pin (2 used)	67—O-Ring (9 used)
16—Spring	33—Cover	51—Adjusting Plug	69—Plug
17—Retaining Ring			

1. Remove cap screws (36 and 37). Remove regulator housing (48) from pump.

IMPORTANT: Do not remove adjusting screws (39, 40, and 46) and nuts (41 and 44). Removal of adjusting screws and nuts will put pump out of adjustment.

2. Remove cap screws (32). Remove cover (33) from housing (48).
3. Remove cap screws (63). Remove cover (62) from housing (48).
4. Remove cap screws (66). Remove solenoid valve (65) from cover (62).
5. Remove pin (1), sleeves (2 and 5), and compensating piston (6) from housing (48).
6. Remove retaining ring (13), spring seat (14), and springs (15 and 16) from housing (48).
7. Remove cap screws (32). Remove cover (43), adjusting disc (11), springs (9 and 10), spring seat (8), adjusting disc (30), spring (29), and spring seat (29) from housing (48).

IMPORTANT: Do not remove pin (49) from adjusting plug (51). Mark adjusting plugs (51 and 54) to note location for installation.

8. Remove retaining ring (53) from housing (48). Remove adjusting plugs (51 and 54) using M6 cap screw.

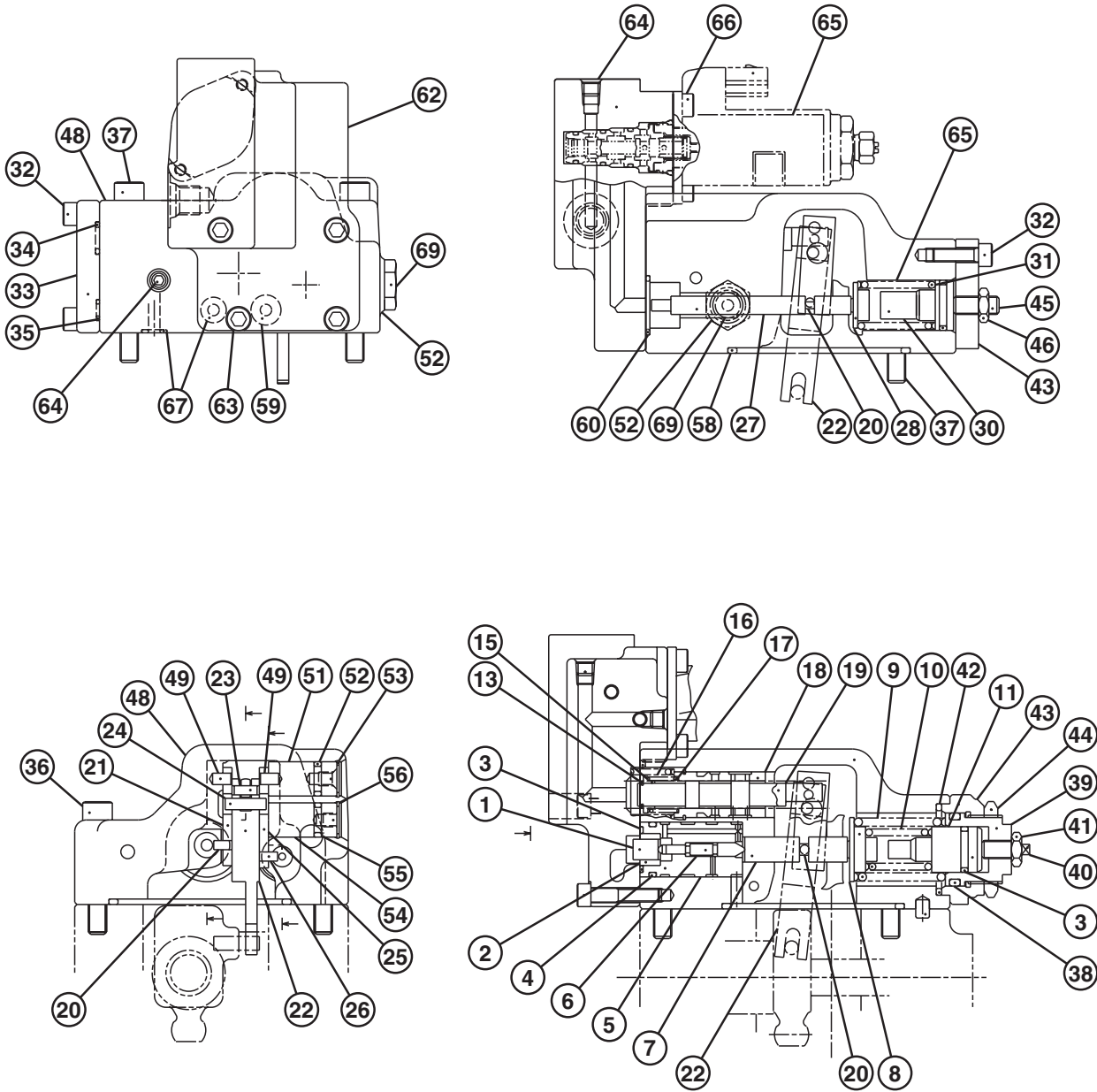
IMPORTANT: Do not remove pin (20) from lever (25).

9. Remove lever (25) and pilot piston (27) from housing (48).
10. Remove pin (23) in feedback lever (22) through the mounting hole on adjusting plug (51). Remove feedback lever (22), sleeve (18) and spool (19) from housing (48).

IMPORTANT: Do not remove pins (20 and 49) from lever (21).

11. Remove lever (21) and compensating rod (7) from housing (48).
12. Repair or replace parts as necessary.

Hydraulic System



33
3360
50

TX1007665

Fan Drive Pump Regulator Cross Section

TX1007665 -JUN-16MAY06

Continued on next page

TX17984,00000D7 -19-11MAY06-3/5

Hydraulic System

1—Pin	18—Sleeve	34—O-Ring	52—O-Ring (3 used)
2—Sleeve	19—Spool	35—O-Ring (3 used)	53—Retaining Ring (2 used)
3—O-Ring (2 used)	20—Pin (2 used)	36—Cap Screw (2 used)	54—Adjusting Plug
4—O-Ring	21—Lever	37—Cap Screw (2 used)	57—Pin
5—Sleeve	22—Feedback Lever	38—O-Ring	58—O-Ring
6—Compensating Piston	23—Pin	39—Adjusting Screw	59—O-Ring
7—Compensating Rod	24—Pin	40—Adjusting Screw	60—O-Ring
8—Spring Set	25—Lever	41—Nut (2 used)	61—O-Ring
9—Spring	27—Pilot Piston	42—O-Ring	62—Cover
10—Spring	28—Spring Seat	43—Cover	63—Cap Screw (4 used)
11—Adjusting Disc	29—Spring	44—Nut	64—Plug (11 used)
13—Retaining Ring	30—Adjusting Disc	46—Adjusting Screw	65—Solenoid Valve
14—Spring Seat	31—O-Ring	48—Housing	66—Cap Screw (2 used)
15—Spring	32—Cap Screw (8 used)	49—Pin (2 used)	67—O-Ring (9 used)
16—Spring	33—Cover	51—Adjusting Plug	69—Plug
17—Retaining Ring			

13. Insert compensating rod (7) and lever (21) into housing (48).

14. Align pin (49) hole on lever (21) with the pin hole on housing (48). Align pin (20) in lever (21) with stepped part on compensating rod (7). Install lever (21) to housing (48).

15. Install retaining ring (17) to sleeve (18). Install sleeve (18) and spool (19) to housing (48).

IMPORTANT: Check that spool (19) moves smoothly before installing feedback lever (22).

16. Align the pin hole on spool (19) with hole on feedback lever (22). Install pin (23) through mounting hole of support plug (51).

17. Insert pilot piston (27) and lever (25) into housing (48).

IMPORTANT: Check that piston (27) moves smoothly before installing lever (25).

18. Align pin (26) in lever (25) with stepped part on pilot piston (27) and install lever (25).

19. Install O-ring (52) and pin (49) to adjusting plug (51).

20. Align pin (49) in adjusting plug (51) with pin hole on lever (25) and install adjusting plug (51). Install retaining ring (53) to housing (48).

21. Install O-ring (55) to adjusting plug (54). Install adjusting plug (54) to housing (48). Install retaining ring (56) to housing (48).

22. Install O-ring (31) to stopper (30).

23. Install spring seat (28), spring (29), and stopper (30) to housing (48).

24. Install O-ring (3) to stopper (11).

25. Install O-ring (42) to housing (48). Install spring seat (8), springs (9 and 10), and stopper (11) to housing (48). Install cover (43) to housing (48) with cap screws (32).

Specification

Fan Drive Pump Regulator	
Adjusting Screw Cover Cap	
Screw—Torque	12 N•m 106 lb-in.

26. Install spring (15), spring seat (14) and retaining ring (13) to spool (19).

Hydraulic System

27. Install O-ring (4) to sleeve (5). Install sleeve (5), compensating piston (6), O-ring (3), sleeve (2), and pin (1) to housing (48).

28. Install spring (16) and O-rings (59, 60, and 61) to housing (48). Install cover (62) with cap screws (63).

Specification

Fan Drive Pump Regulator	
Solenoid Valve Cover Cap	
Screw—Torque	12 N•m 106 lb-in.

29. Install O-rings (34 and 35) to cover (33).

30. Install cover (33) to housing (48) with cap screws (32).

Specification

Fan Drive Pump Regulator Side	
Cover Cap Screw—Torque	12 N•m 106 lb-in.

31. Install solenoid valve (65) to cover (62) with cap screws (66).

32. Install regulator to pump with cap screws (36 and 37).

Specification

Fan Drive Pump-to-Regulator	
Cap Screws—Torque	12 N•m 106 lb-in.

TX17984,00000D7 -19-11MAY06-5/5

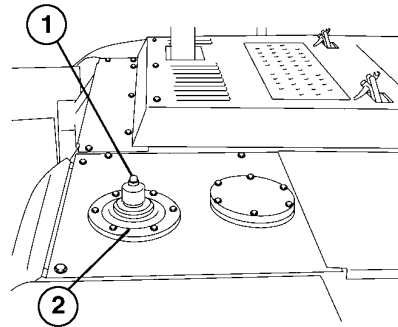
Fan Drive Motor Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Fan Drive Motor Remove

Release pressure from hydraulic oil tank by pushing pressure release button (1) at top of hydraulic oil tank.

- 1—Pressure Release Button
- 2—Hydraulic Oil Tank Cover



T214924 -UN-17NOV05

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TX04577,000010A -19-02AUG06-1/33

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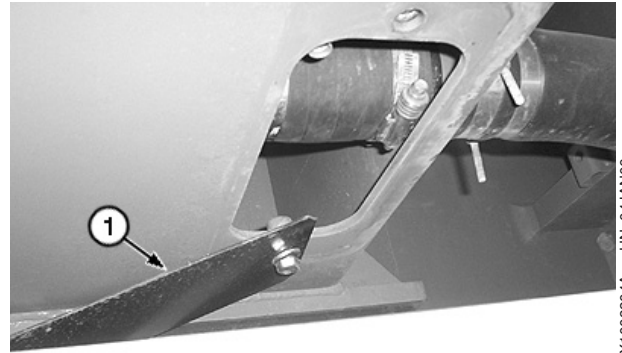
Hydraulic System

NOTE: Radiator coolant is partially drained to allow radiator top coolant hose to be removed later.

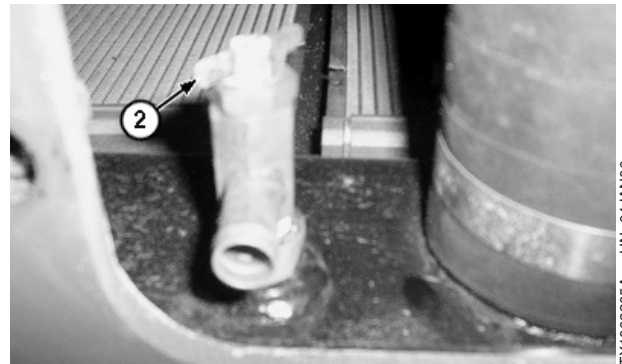
CAUTION: Prevent possible injury from hot spraying water. Do not remove radiator fill cap unless engine coolant is cool. Then turn radiator cap slowly to stop.

2. With engine coolant cooled open radiator cap to allow drain down of coolant. Remove radiator access cover (1) and drain approximately 5 gallons of coolant from drain valve (2). Install radiator cap after draining is completed.

1—Radiator Access Panel
2—Radiator Drain Valve



Radiator Access Panel

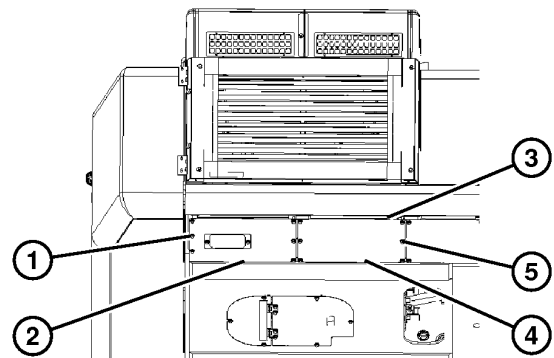


Radiator Drain Valve

TX04577,000010A -19-02AUG06-2/33

3. Remove cap screws (1 and 5) and covers (2 and 4) from main frame (3).

1—Cap Screws (6 used)
2—Cover
3—Main Frame
4—Cover
5—Cap Screws (6 used)



Lower Covers—Main Frame

TX1010187 -UN-19JUL06

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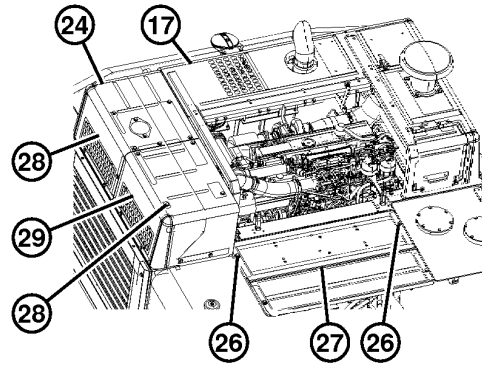
TX04577,000010A -19-02AUG06-3/33

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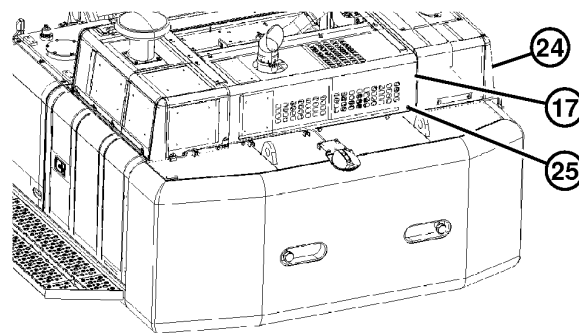
Hydraulic System

4. Remove cap screws (28) and radiator covers (24 and 29).
5. Remove cap screws (25) and cover (17) from main frame.
6. Remove cap screws (26) and cover (27) from center section.

- 17—Muffler Cover
- 24—Radiator cover
- 25—Cap Screws (8 used)
- 26—Cap Screws (2 used)
- 27—Cover—Center Section
- 28—Cap Screws (18 used)
- 29—Radiator Cover



Cover Removal—Top View



Cover Removal—Rear View

TX04577.000010A -19-02AUG06-4/33

TX1010188 -UN-19JUL06

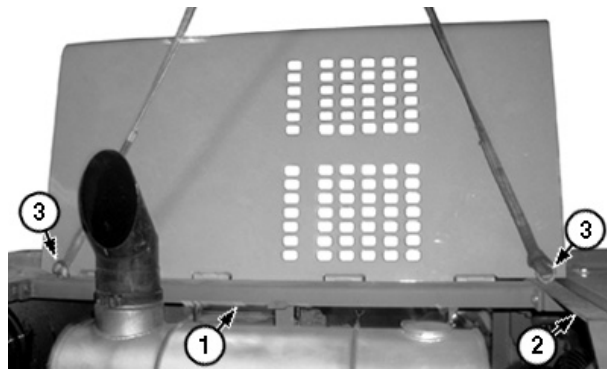
TX1010189 -UN-19JUL06

7. Attach hoist, lift strap and eye bolts (3) to engine hood support assembly (1) and support (2) as shown.

Specification

Engine Hood and Support
 Assembly—Weight 115 kg
 250 lb

- 1—Engine Hood Support Assembly
- 2—Support
- 3—Eye Bolts



Engine Hood Assembly

TX1010203A -UN-19JUL06

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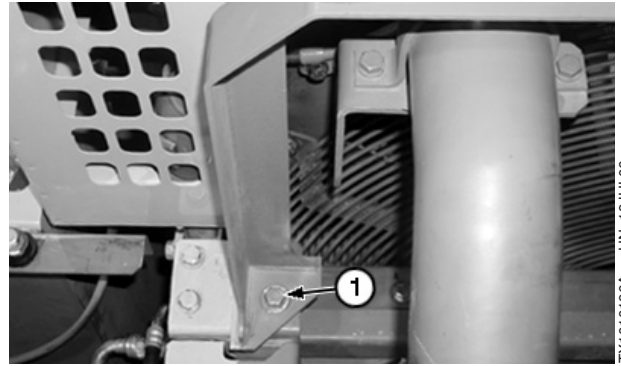
TX04577.000010A -19-02AUG06-5/33

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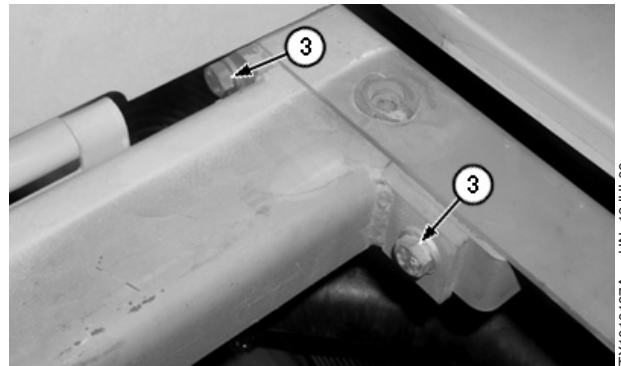
Hydraulic System

8. Remove cap screws (1, 2 and 3) from engine hood assembly. Lift with hoist and place on floor

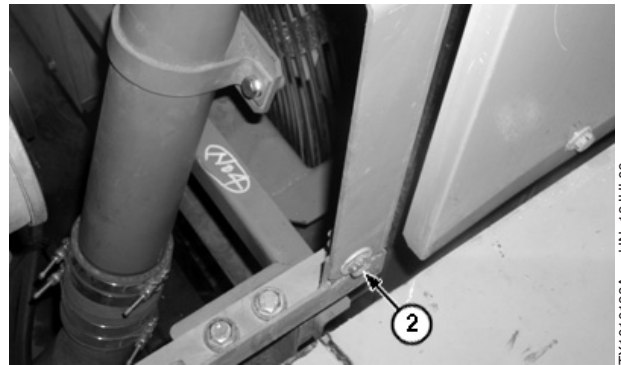
- 1—Cap Screw—Left Side
- 2—Cap Screw—Right Side
- 3—Cap Screws—Center Support (4 used)



Engine Hood Support Assembly—Right Side



Engine Hood Support Assembly—Left Side



Engine Hood Support Assembly—Center

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TX04577,000010A -19-02AUG06-6/33

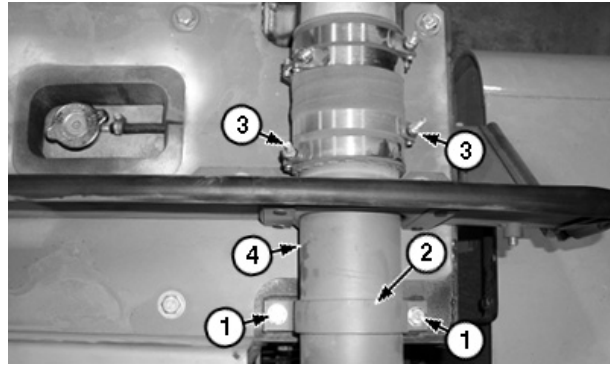
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Hydraulic System

9. Remove cap screws (1) and clamps (2).

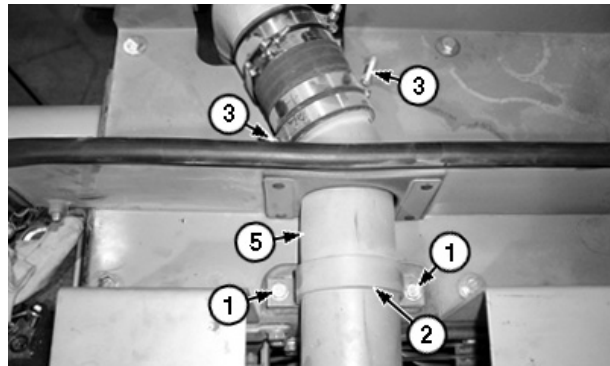
Loosen hose clamps (3) on tube (4 and 5).

- 1—Cap Screws (4 used)
- 2—Clamp (2 used)
- 3—Clamp Screw (4 used)
- 4—Intercooler Inlet Tube
- 5—Intercooler Outlet Tube



TX1010227A -JUN-19JUL06

Radiator Tube Connections



TX1010226A -JUN-19JUL06

Radiator Tube Connections

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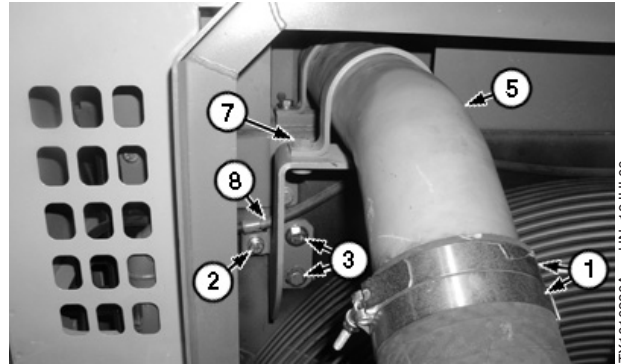
TX04577.000010A -19-02AUG06-7/33

Hydraulic System

- Loosen clamps (1) on inlet tube (4) and outlet tube (5). Remove tubes (4 and 5) and lay to the side with bracket (6 and 7) remaining attached to tube. Cover openings to protect for contamination.

Remove cap screw (2) from clamp (8) to allow overflow hose to lay on side.

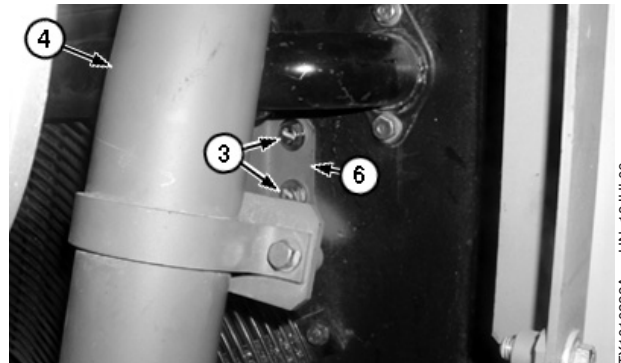
- 1—Hose Clamp (4 used)
- 2—Cap Screw
- 3—Cap Screw (2 used per clamp)
- 4—Intercooler Inlet Tube
- 5—Intercooler Outlet Tube
- 6—Bracket—Inlet Tube
- 7—Bracket—Outlet Tube
- 8—Clamp—Overflow Hose



Intercooler Outlet Tube Mounting



Intercooler Inlet Tube Mounting



Bracket—Inlet Tube Mounting

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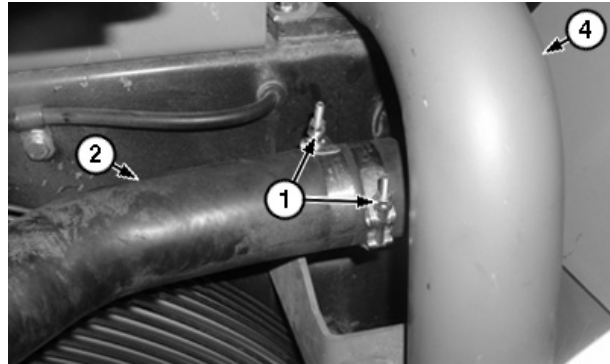
TX04577,000010A -19-02AUG06-8/33

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3360
57

Hydraulic System

11. Loosen clamps (1) and coolant hose (2). Remove hose from tube and cover openings to protect for contamination.

- 1—Clamps (2 used)
- 2—Coolant Hose
- 4—Intercooler Inlet Tube



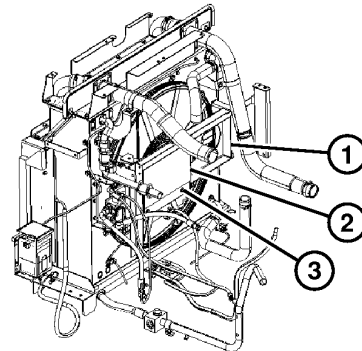
Coolant Hose

TX1010219A -UN-19JUL06

TX04577,000010A -19-02AUG06-9/33

12. Remove cap screws (3) and cover (2) from fan bracket (1).

- 1—Bracket—Fan Mounting
- 2—Cover
- 3—Cap Screws (6 used)



Fan Motor Cover

TX1010195 -UN-19JUL06

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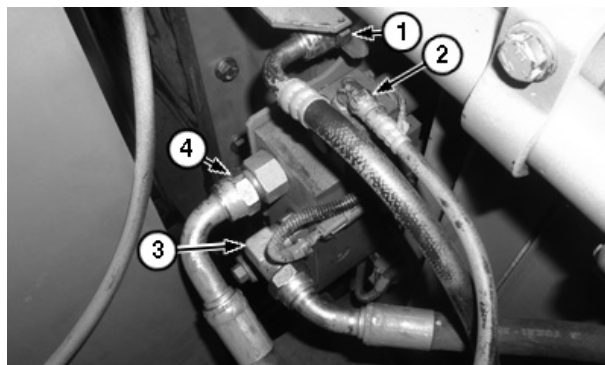
TX04577,000010A -19-02AUG06-10/33

Hydraulic System

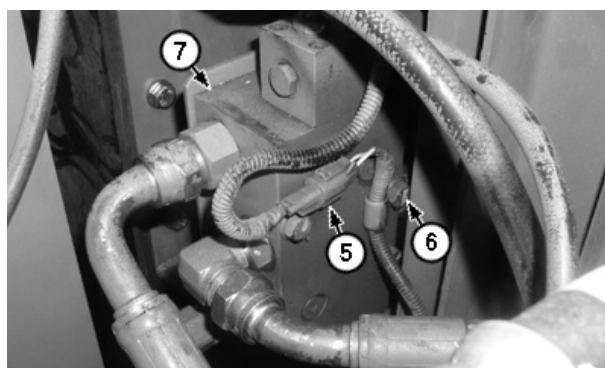
13. Remove hoses (1, 2, 3 and 4) from valve (7). Cap and plug hoses and fittings on valve.

Remove clamp and cap screw (6) on harness.
Disconnect harness at connector (5).

- 1—Hose—Case Drain
- 2—Hose—Pilot
- 3—Hose—Return Outlet
- 4—Hose—Pressure Inlet
- 5—Connector
- 6—Clamp
- 7—Fan Control Valve Reversing Valve



Fan Control Reversing Valve Hose Connections

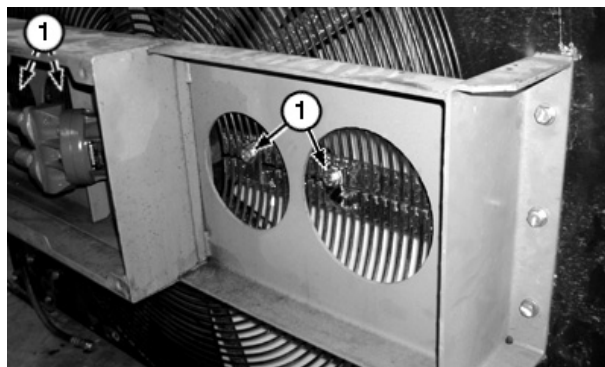


Fan Control Reversing Valve Connector Harness

TX04577.000010A -19-02AUG06-11/33

14. Remove cap screws (1) from fan guard to split and remove the guard later.

- 1—Cap Screws (4 used)



Fan Guard

Continued on next page

TX04577.000010A -19-02AUG06-12/33

33
3360
59

Hydraulic System

15. Remove cap screws (1) on top half of guard (2).
Remove guard.

Remove cap screws (1) on bottom half of guard (2).
Allow guard half to rest on the frame cross support.

- 1—Cap Screws (8 used)
- 2—Fan Guard



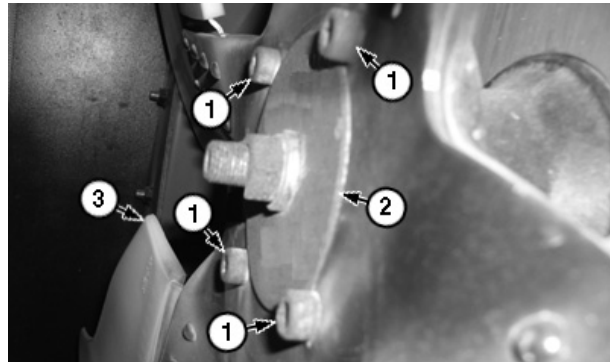
TX1010117A -JUN-18JUL06

Fan Guard Mounting Hardware

TX04577,000010A -19-02AUG06-13/33

16. Reaching in between fan blade and cooling package with socket wrench remove four allen head socket head screws (1) from fan hub (2). Rest fan blade (3) in cooling package open area.

- 1—Socket Head Screws (4 used)
- 2—Fan Hub
- 3—Fan Blade



TX1010124A -JUN-18JUL06

Fan Blade

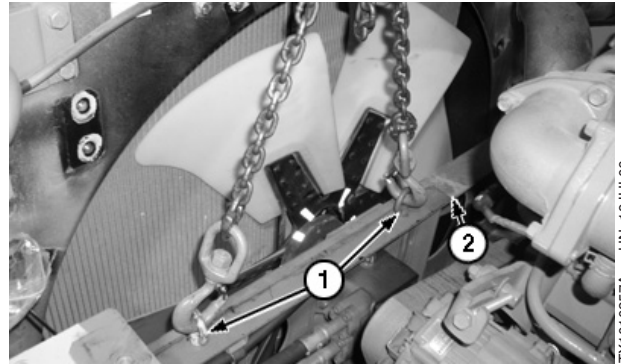
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TX04577,000010A -19-02AUG06-14/33

Hydraulic System

17. Install eye bolts in fan motor support. Attach hoist and chain to eye bolts as shown.

- 1—Eye Bolts
- 2—Fan Motor Support



Fan Motor Assembly

TX1010257A -UN-19JUL06

TX04577,000010A -19-02AUG06-15/33

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

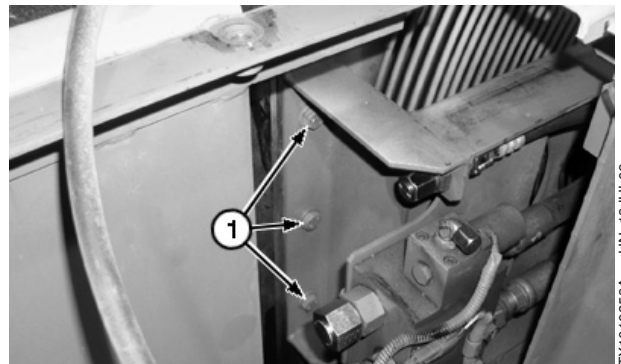
NOTE: For photo purpose only fan guard shows attached to motor hub but is not when this step is performed.

18. Remove six cap screws (1) from fan motor support with hoist attached. Slowly lift up and remove assembly from machine.

Specification

Fan Motor Support Assembly—
 Weight..... 95 kg approximate
 210 lb approximate

- 1—Cap Screws (6 used)



Fan Motor Assembly Mounting Hardware—Front

TX1010259A -UN-19JUL06



TX1010120A -UN-18JUL06

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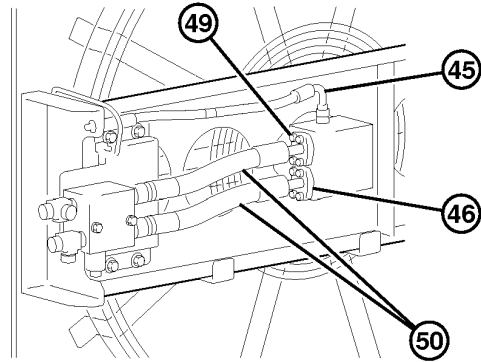
TX04577,000010A -19-02AUG06-16/33

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3360
61

Hydraulic System

19. Remove four bolt flanges (49 and 46) and hoses (50) from motor (46). Remove hose (45). Cap and plug all openings..

- 45—Drain Hose
- 46—Four Bolt Flange
- 49—Four Bolt Flange
- 50—Hose (2 used)



TX1010500 -UN-01AUG06

Fan Motor Mounting

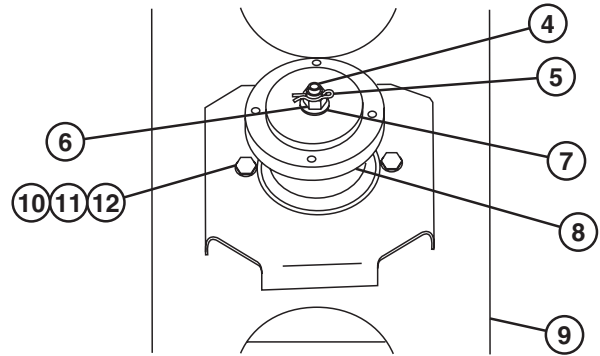
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TX04577,000010A -19-02AUG06-17/33

Hydraulic System

NOTE: Fan blade was removed in earlier step but is shown in art for informational purpose only.

20. Remove lock pin (5) from motor shaft (4) and remove hex nut (6).
21. Remove hub (8) with puller by using two of the four threaded holes for the fan mounting.
22. Remove hex nuts, washers and cap screws (10, 11, and 12) and fan drive motor (1) from support (9).



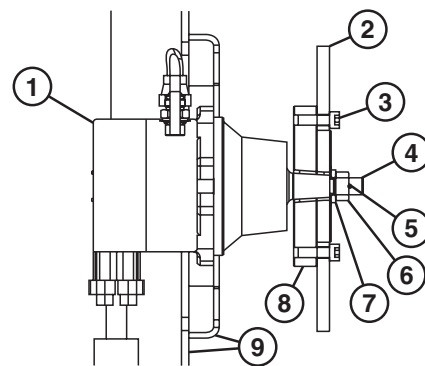
TX1010798 -JUN-31JUL06

Specification

Fan Drive Motor—Weight..... 20 kg approximate
44 lb approximate

23. Replace fan drive motor or repair as required. For repair of fan motor. See Fan Drive Motor Disassemble and Assemble. (Group 3360.)

- 1—Fan Drive Motor
- 2—Fan Blade (removed in earlier step)
- 3—Socket Head Screw (4 used)
- 4—Motor Shaft
- 5—Lock Pin
- 6—Hex Nut
- 7—Washer
- 8—Hub
- 9—Support—Fan Motor
- 10—Cap Screw (2 used)
- 11—Washer (2 used)
- 12—Hex Nut (2 used)



Fan Drive Motor Shaft

TX1010797 -JUN-31JUL06

Continued on next page

TX04577,000010A -19-02AUG06-18/33

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63

1. Install Fan Drive Motor

Install hex nuts, washers and cap screws (10, 11, and 12) and fan drive motor (1) to support (9). Tighten to specification.

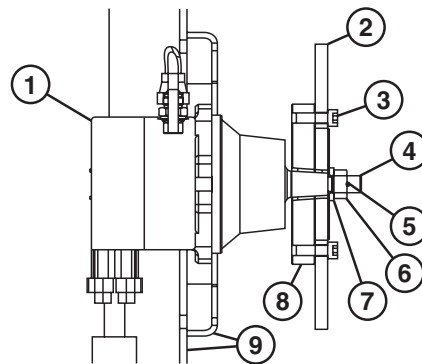
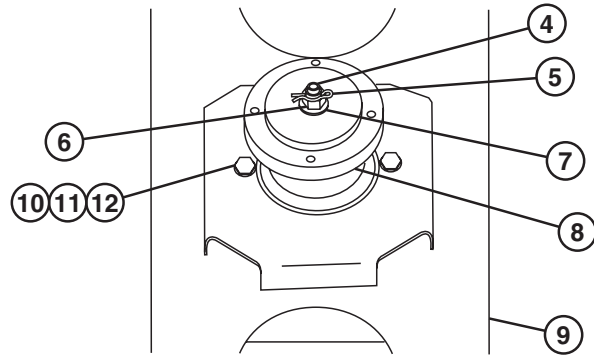
Specification	
Fan Drive Motor-to-Support—	
Torque	90N•m 66 lb-ft

2. Install hub (8) on fan drive motor shaft (4).

3. Apply PM38654 Thread Lock (high strength) to the hex nut (6). Install onto fan drive motor shaft (4). Tighten to specification.

Specification	
Fan Drive Motor Shaft-to-Hub	
Hex Nut—Torque.....	100 N•m 75 lb-ft

- 1—Fan Drive Motor
- 2—Fan Blade (removed in earlier step)
- 3—Socket Head Screw (4 used)
- 4—Motor Shaft
- 5—Lock Pin
- 6—Hex Nut
- 7—Washer
- 8—Hub
- 9—Support—Fan Motor
- 10—Cap Screw (2 used)
- 11—Washer (2 used)
- 12—Hex Nut (2 used)



Fan Drive Motor Shaft

TX1010798 -UN-31JUL06

TX1010797 -UN-31JUL06

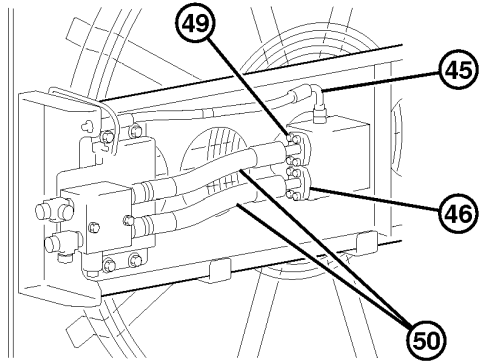
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TX04577,000010A -19-02AUG06-19/33

- Remove caps and plugs and install four bolt flanges (49 and 46) and hoses (50) to motor (46). Install hose (45).

IMPORTANT: If hydraulic motor is not filled with oil it will be damaged upon start up. Fill fan motor case is with hydraulic oil before installing in machine.

- Fill fan drive motor case with oil before installing in machine.



Fan Motor Mounting

- 45—Drain Hose
- 46—Four Bolt Flange
- 49—Four Bolt Flange
- 50—Hose (2 used)

TX1010500 -UN-01AUG06

TX04577,000010A -19-02AUG06-20/33



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: For photo purpose only fan guard shows attached to motor hub but is not when this step is performed.

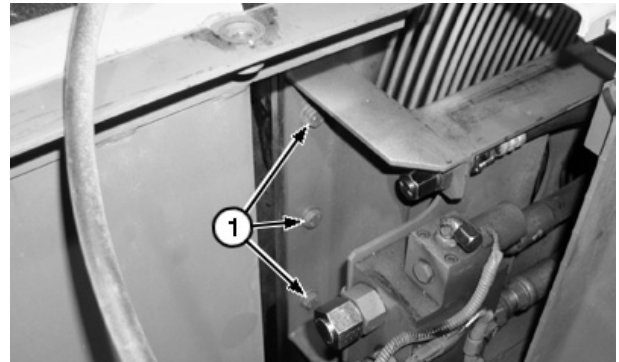
- With hoist lower fan motor support assembly in machine. Install cap screws (1) to mount fan motor support. Tighten cap screws to specification.

Specification

Fan Motor Support Assembly—	
Weight.....	95 kg approximate 210 lb approximate
Fan Motor Support-to-Radiator	
Cap Screw—Torque	89 N•m 66 lb-ft

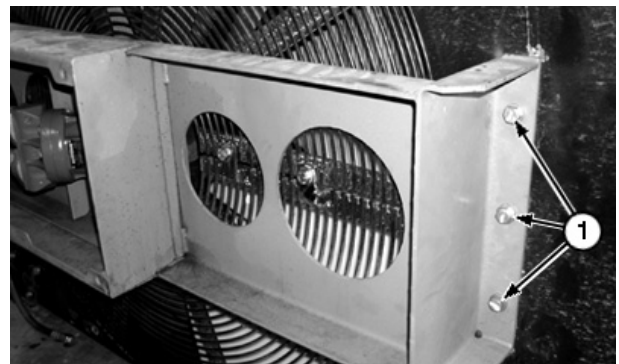
- Remove lifting chain and eye bolts from fan motor support assembly.

1—Cap Screws (6 used)



Fan Motor Assembly Mounting Hardware—Front

TX1010259A -UN-19JUL06



Fan Motor Assembly Mounting Hardware—Rear

TX1010120A -UN-18JUL06

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TX04577,000010A -19-02AUG06-21/33

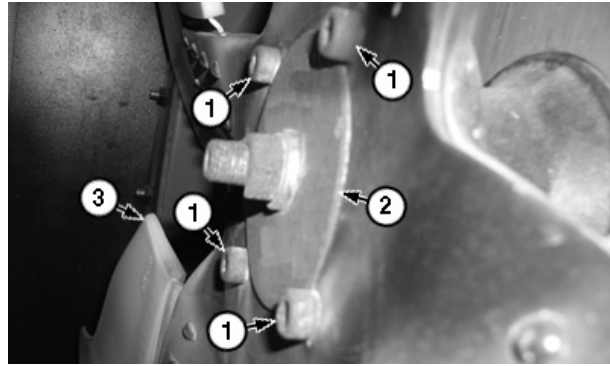
Hydraulic System

8. Apply PM38654 Thread Lock (high strength) to the threads of socket head screws (1). Install fan blade (3) to hub (2) with four allen head cap screws (1). Tighten to specification.

Specification

Fan Blade-to-Hub Socket Head
Screws—Torque..... 50 N•m
37 lb-ft

- 1—Socket Head Screws (4 used)
- 2—Fan Hub
- 3—Fan Blade



Fan Blade

TX1010124A -JUN-18JUL06

TX04577,000010A -19-02AUG06-22/33

9. Install bottom and top half of fan guard (2) with cap screws (1).

Tighten to specifications.

Specification

Fan Blade-to-Hub Socket Head
Screws—Torque..... 50 N•m
66 lb-ft

- 1—Cap Screws (8 used)
- 2—Fan Guard



Fan Guard Mounting Hardware

TX1010117A -JUN-18JUL06

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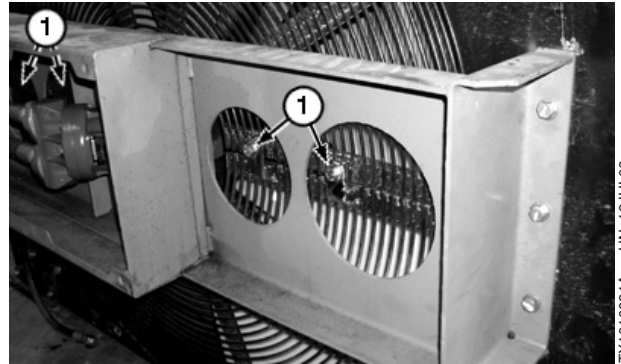
TX04577,000010A -19-02AUG06-23/33

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Hydraulic System

10. Install cap screws (1) in fan guard (2) on four places.

- 1—Cap Screws (4 used)
- 2—Fan Guard



Fan Guard

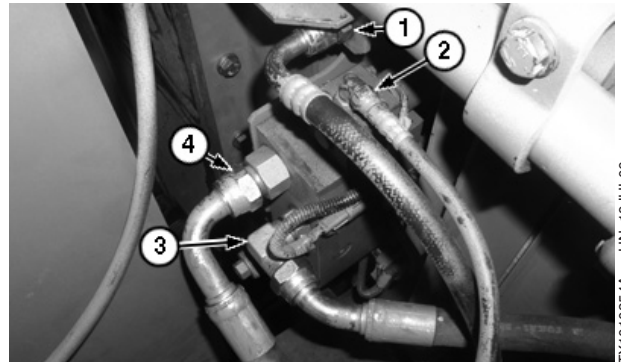
TX1010081A -UN-18JUL06

TX04577,000010A -19-02AUG06-24/33

11. Remove cap and plug from hoses and fittings on valve. Connect hoses (1, 2, 3 and 4) on valve (7).

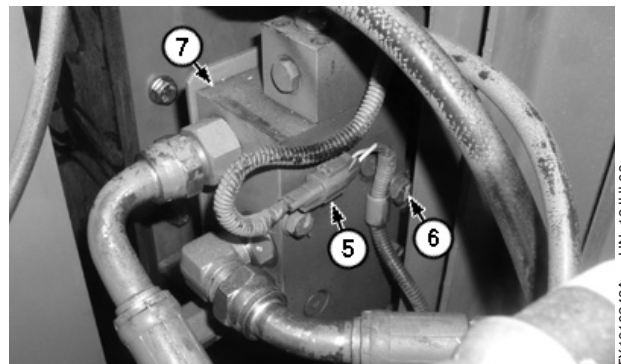
Install clamp and cap screw (6) on harness. Connect harness at connector (5).

- 1—Hose—Case Drain
- 2—Hose—Pilot
- 3—Hose—Return Outlet
- 4—Hose—Pressure Inlet
- 5—Connector
- 6—Clamp
- 7—Fan Control Valve Reversing Valve



Fan Control Reversing Valve Hose Connections

TX1010254A -UN-19JUL06



Fan Control Reversing Valve Connector Harness

TX1010249A -UN-19JUL06

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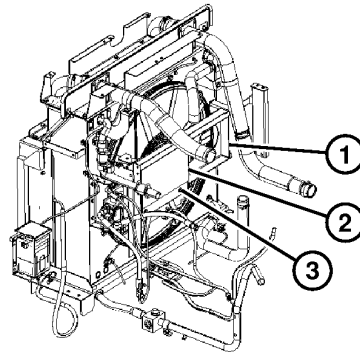
TX04577,000010A -19-02AUG06-25/33

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Hydraulic System

12. Install cover (2) with cap screws (3) onto fan bracket (1).

- 1—Bracket—Fan Mounting
- 2—Cover
- 3—Cap Screws (6 used)



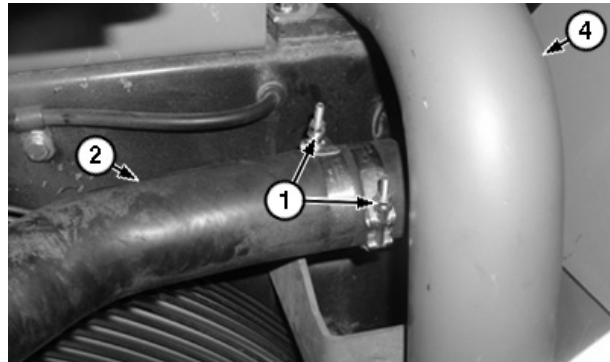
Fan Motor Cover

TX1010195 -UN-19JUL06

TX04577,000010A -19-02AUG06-26/33

13. Position coolant hose and fasten with clamps (1) to coolant hose (2).

- 1—Clamps (2 used)
- 2—Coolant Hose
- 4—Intercooler Inlet Tube



Coolant Hose

TX1010219A -UN-19JUL06

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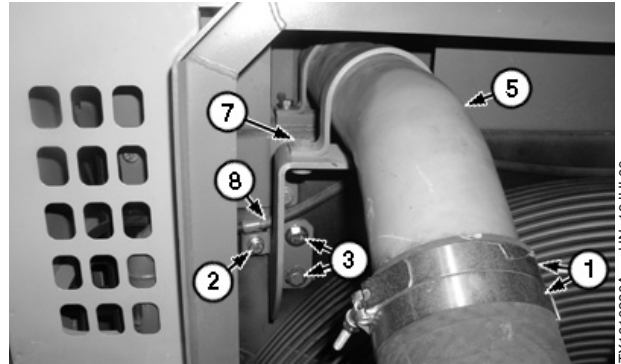
TX04577,000010A -19-02AUG06-27/33

Hydraulic System

14. Install tubes (4 and 5) to proper positions. Align clamps (1) and tighten screws.

Install clamp (8) with cap screw (2) on overflow hose.

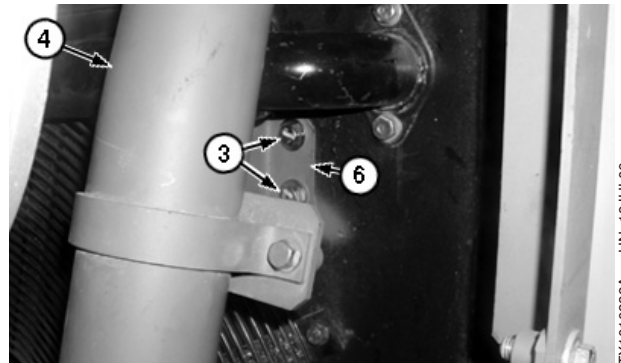
- 1—Hose Clamp (4 used)
- 2—Cap Screw
- 3—Cap Screw (2 used per clamp)
- 4—Intercooler Inlet Tube
- 5—Intercooler Outlet Tube
- 6—Bracket—Inlet Tube
- 7—Bracket—Outlet Tube
- 8—Clamp—Overflow Hose



Intercooler Outlet Tube Mounting



Intercooler Inlet Tube Mounting



Bracket—Inlet Tube Mounting

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TX04577,000010A -19-02AUG06-28/33

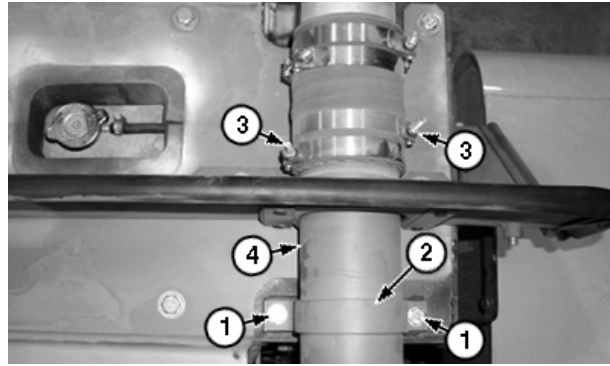
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Hydraulic System

15. Install cap screws (1) and clamps (2).

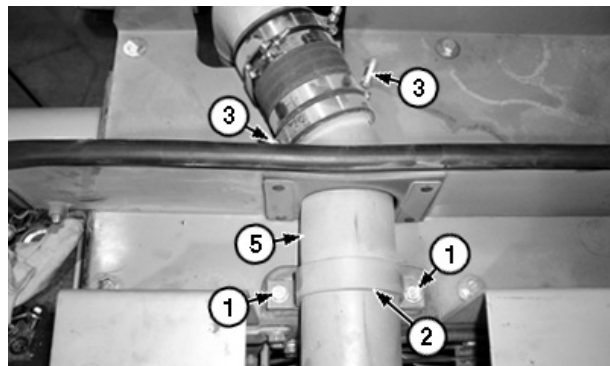
Tighten hose clamps (3) on tube (4 and 5).

- 1—Cap Screws (4 used)
- 2—Clamp (2 used)
- 3—Clamp Screw (4 used)
- 4—Intercooler Inlet Tube
- 5—Intercooler Outlet Tube



TX1010227A -JUN-19JUL06

Radiator Tube Connections



TX1010226A -JUN-19JUL06

Radiator Tube Connections

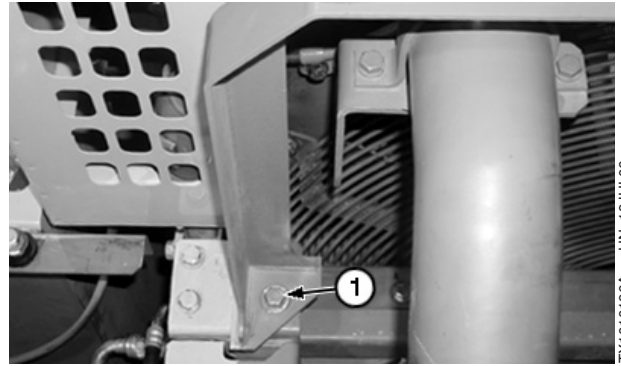
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TX04577,000010A -19-02AUG06-29/33

Hydraulic System

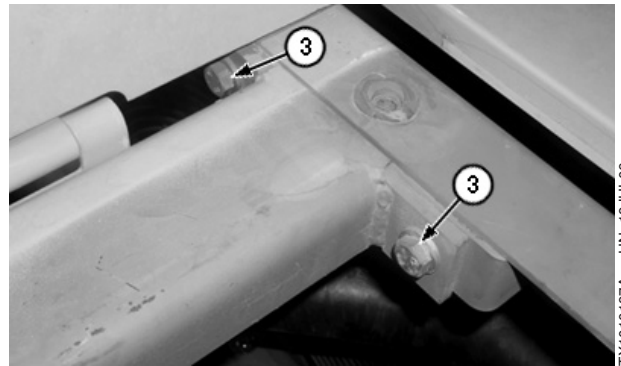
16. With hoist install engine hood assembly with cap screws (1, 2 and 3).

- 1—Cap Screw—Left Side
- 2—Cap Screw—Right Side
- 3—Cap Screws—Center Support (4 used)



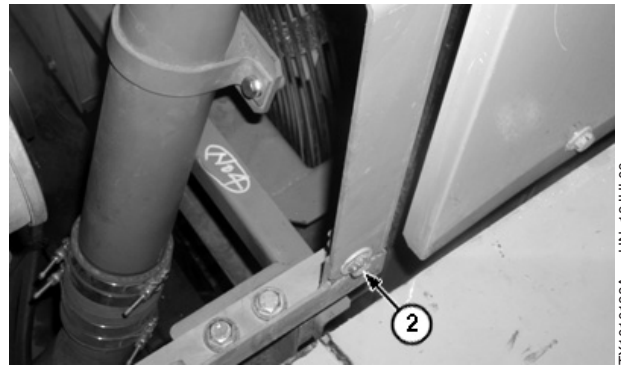
TX1010196A -JUN-19JUL06

Engine Hood Support Assembly—Right Side



TX1010197A -JUN-19JUL06

Engine Hood Support Assembly—Left Side



TX1010198A -JUN-19JUL06

Engine Hood Support Assembly—Center

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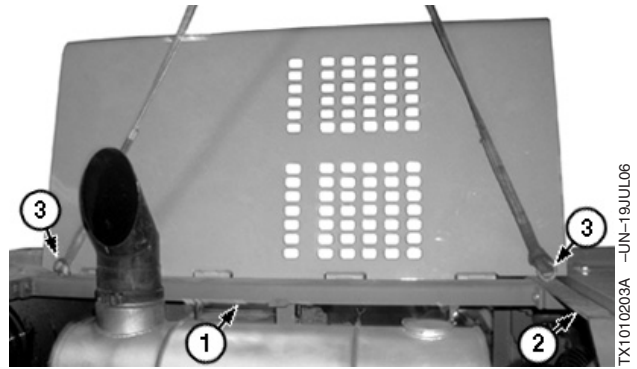
TX04577,000010A -19-02AUG06-30/33

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Hydraulic System

17. Remove eye bolts from engine hood assembly.

- 1—Engine Assembly Support
- 2—Support
- 3—Eye Bolts



Engine Hood Assembly

TX1010203A -UN-19JUL06

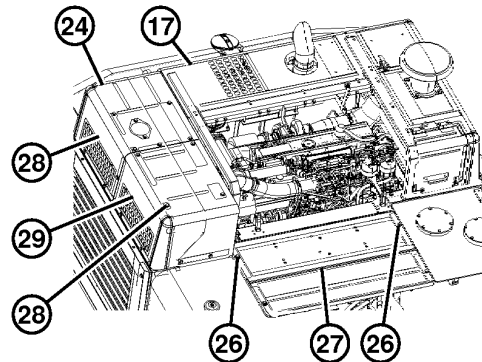
TX04577,000010A -19-02AUG06-31/33

18. Install cap screws (28) with radiator covers (24 and 29).

Install cap screws (25) with cover (17) to main frame.

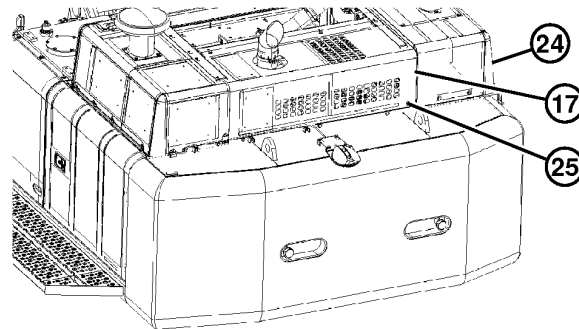
Install cap screws (26) and cover (27) on center section.

- 17—Muffler Cover
- 24—Radiator cover
- 25—Cap Screws (8 used)
- 26—Cap Screws (2 used)
- 27—Cover—Center Section
- 28—Cap Screws (18 used)
- 29—Radiator Cover



Cover Removal—Top View

TX1010188 -UN-19JUL06



Cover Removal—Rear View

TX1010189 -UN-19JUL06

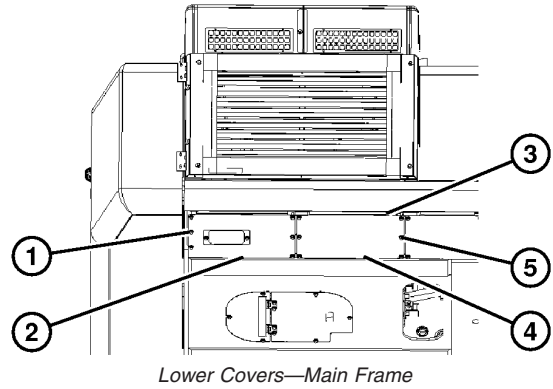
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TX04577,000010A -19-02AUG06-32/33

Hydraulic System

19. Install cap screws (1 and 5) in covers (2 and 4) to main frame (3).
20. Fill radiator coolant to proper level. Perform Cooling System Fill and Deaeration Procedure

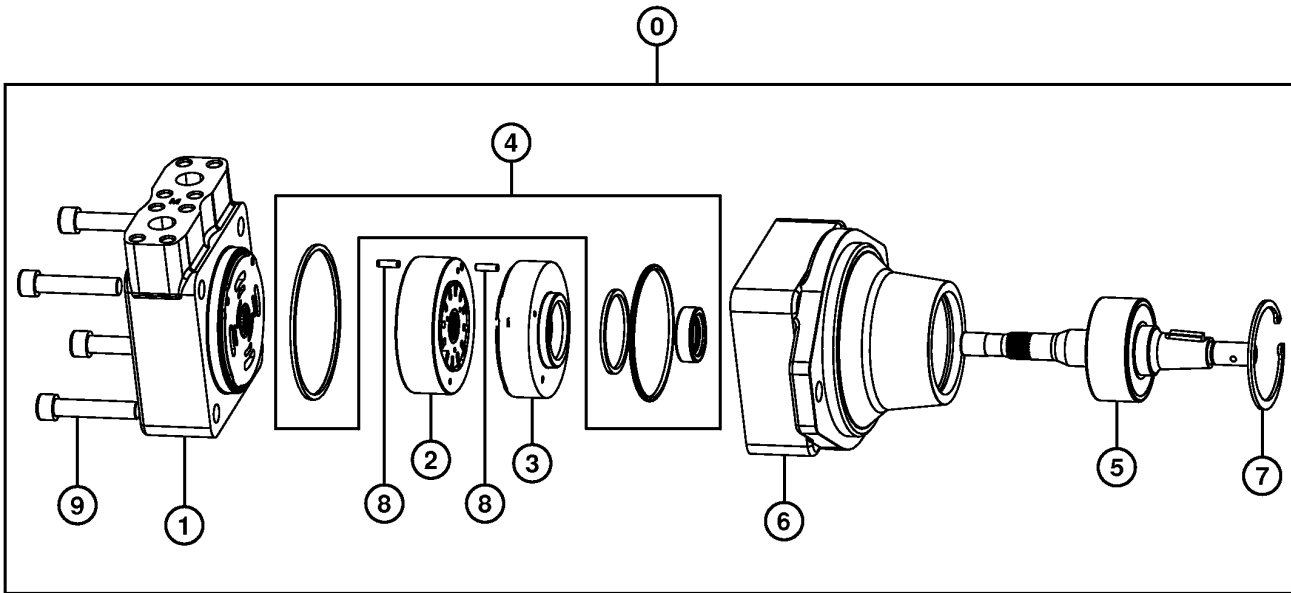
- 1—Cap Screws (6 used)
- 2—Cover
- 3—Main Frame
- 4—Cover
- 5—Cap Screws (6 used)



TX1010187 —UN—19JUL06

TX04577,000010A —19—02AUG06—33/33

Fan Drive Motor Disassemble and Assemble



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TX1002032

Continued on next page

TX17984,0000086 -19-02AUG06-1/2

Hydraulic System

0—Motor
1—Cap
2—Cam Rotary Assembly

3—Plate
4—Seal Kit
5—Shaft

6—Housing
7—Snap Ring

8—Dowel Pin (2 used)
9—Cap Screws (4 used)

1. Drain hydraulic oil from motor (0).
2. Clean external surface of motor (0).
3. Prepare a clean, lint free surface to place internal parts for inspection and repair.
4. Remove cap (1).

NOTE: When removing cam rotary assembly (2) from housing, take care to not have the valve springs and shoes fall out of the cam rotary assembly.

5. Install two 10-24 UNC-2B by two inch long screws in the tapped holes in cam (2). Lift out slowly with fingers to make sure cam plate and rotary cam assembly do not come apart.

Oil suction may also pull out plate (3). If not install screws in plate (3) and remove by lifting out with fingers.

6. Remove dowel pins (8).
7. Remove snap ring (7).
8. Tap shaft (5) to remove.

9. Repair and replace parts as necessary.
10. Use clean hydraulic oil to lubricate all internal parts.
11. Tap shaft (5) in place.
12. Install snap ring (7)
13. Install plate (3).
14. Install dowel pins (8).
15. Install cam rotary assembly (2) being careful to make sure the cam rotary assembly with group stay together.
16. Install cap (1) and tighten cap screws (9).

Specification

Cap Mounting Cap Screws—	100 N•m
Torque.....	136 lb-ft

17. Fill motor with clean hydraulic oil.

TX17984,0000086 -19-02AUG06-2/2

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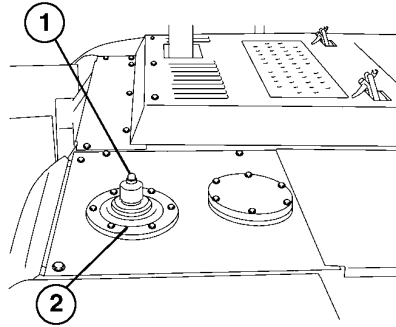
Fan Drive Reversing Control Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. The fan drive reversing control valve is located on the right side between the main frame and the main control valve. For fan hydraulic system schematic see Hydraulic System Schematic fan drive schematic. (Group 9025.)

Release pressure from hydraulic oil tank by pushing pressure release button (1) at top of hydraulic oil tank.



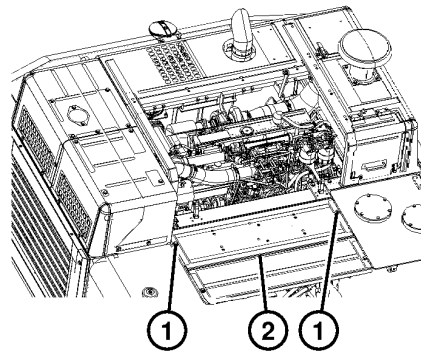
1—Pressure Release Button
2—Hydraulic Oil Tank Cover

TX14924 -UN-17NOV05

TX04577,000010D -19-01AUG06-1/11

2. Remove cap screws (1) and cover (2) for access to fan reverse valve.

1—Cap Screws (2 used)
2—Cover



Cover—Top of Main Control Valve

TX1010697 -UN-27JUL06

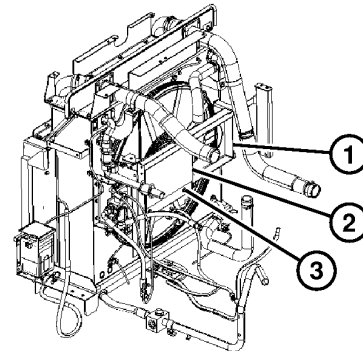
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TX04577,000010D -19-01AUG06-2/11

Hydraulic System

3. Open and lock engine cover. Remove cap screws (2) and fan motor cover (3).

- 1—Bracket
- 2—Cap Screw (6 used)
- 3—Cover



Fan Motor Cover

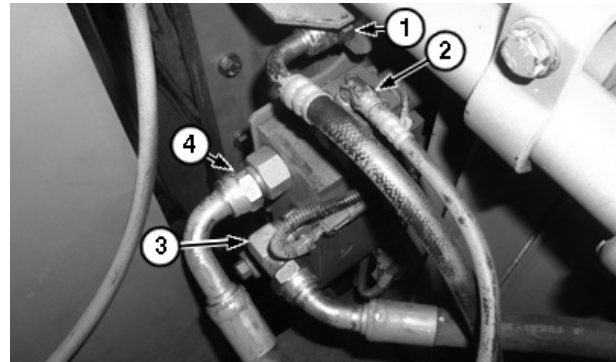
TX1010195 -UN-19JUL06

TX04577.000010D -19-01AUG06-3/11

4. Remove hoses (1, 2, 3 and 4) from valve (7). Cap and plug hoses and fittings on valve.

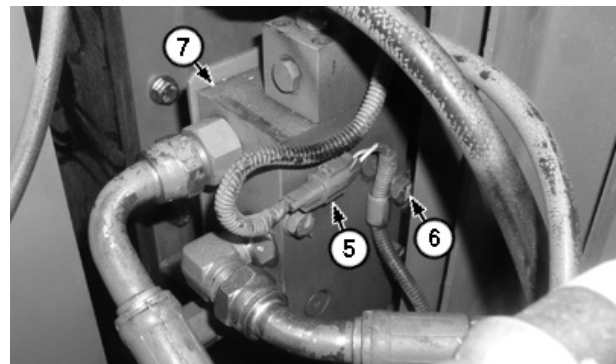
Remove clamp and cap screw (6) on harness. Disconnect harness at connector (5).

- 1—Hose—Case Drain
- 2—Hose—Pilot
- 3—Hose—Return Outlet
- 4—Hose—Pressure Inlet
- 5—Connector
- 6—Clamp
- 7—Fan Control Valve Reversing Valve



Fan Control Reversing Valve Hose Connections

TX1010254A -UN-19JUL06



Fan Control Reversing Valve Connector Harness

TX1010249A -UN-19JUL06

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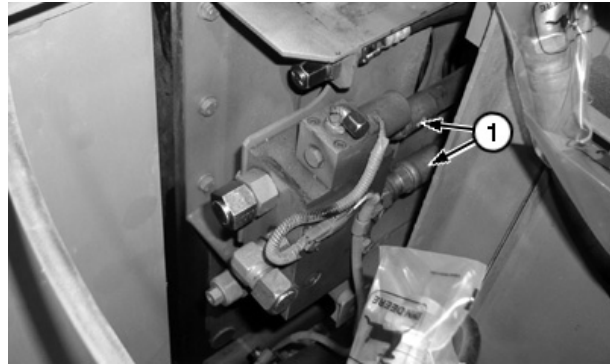
TX04577.000010D -19-01AUG06-4/11

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Hydraulic System

5. Remove hoses (1) going from valve to fan motor. Plug and cap ends and fitting ports in valve.

1—Hose (2 used)



TX1010700A -UN-26JUL06

Fan Reverse Valve Connections

TX04577,000010D -19-01AUG06-5/11

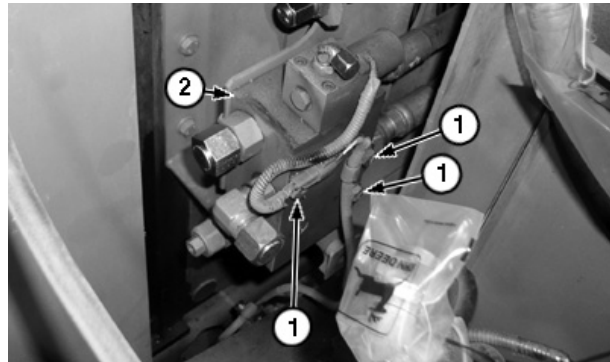
6. Remove cap screws (1) and fan drive reversing control valve (2).

Specification

Fan Drive Reversing Control Valve—Weight..... 32 lbs. (approximate)

7. Disassemble or replace as necessary. See Fan Drive Reversing Control Valve Disassemble and Assemble. (Group 3360.)

1—Cap screws (3 used)
2—Fan Drive Reversing Control Valve



TX1010701A -UN-28JUL06

Fan Reversing Valve Attaching Hardware

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TX04577,000010D -19-01AUG06-6/11

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78

Hydraulic System

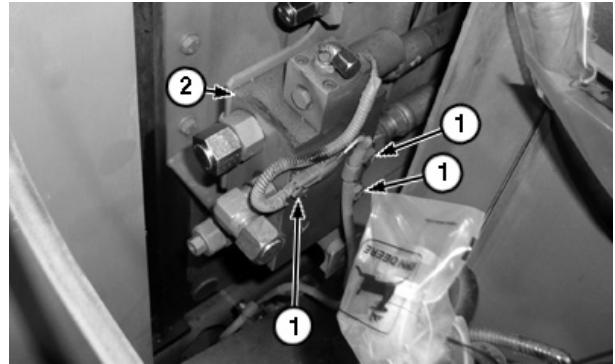
8. Install valve (2) onto mounting bracket with cap screws (1).

Tighten to specification.

Specification

Fan Drive Reversing Control Valve-to-Mounting Bracket—	
Torque	48.8 N•m 36 lb-ft

- 1—Cap screws (3 used)
- 2—Fan Drive Reversing Control Valve



Fan Reversing Valve Attaching Hardware

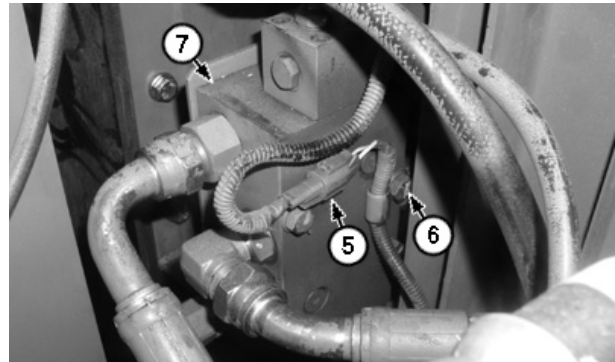
TX1010701A -JUN-28JUL06

TX04577.000010D -19-01AUG06-7/11

9. Remove caps and plugs in hose ends and port fittings. Install hoses (1, 2, 3 and 4) from valve (7).

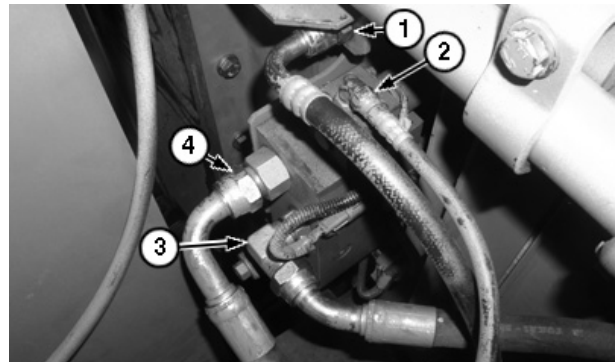
Install clamp and cap screw (6) on harness. Disconnect harness at connector (5).

- 1—Hose—Case Drain
- 2—Hose—Pilot
- 3—Hose—Return Outlet
- 4—Hose—Pressure Inlet
- 5—Connector
- 6—Clamp
- 7—Fan Control Valve Reversing Valve



Fan Control Reversing Valve Connector Harness

TX1010249A -JUN-19JUL06



Fan Control Reversing Valve Hose Connections

TX1010254A -JUN-19JUL06

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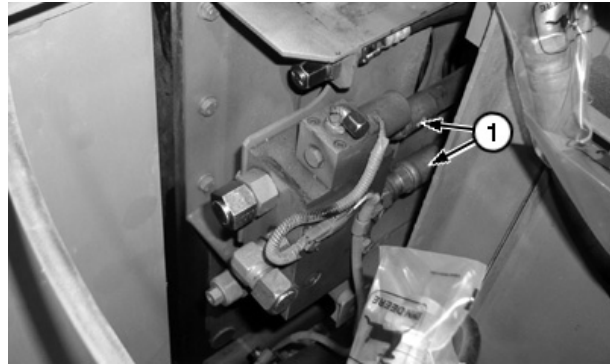
TX04577.000010D -19-01AUG06-8/11

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Hydraulic System

10. Install hoses (1) onto reverse valve.

1—Hose (2 used)



TX1010700A -UN-26JUL06

Fan Reverse Valve Connections

TX04577,000010D -19-01AUG06-9/11

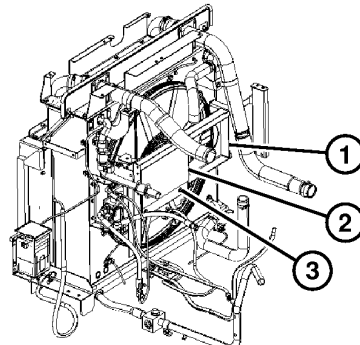
11. Install cap screws (2) and fan motor cover (3). Install cover (3) to cross member bracket. Tighten to specification.

Specification

Cover-to-Frame Cross Member.—	
Torque	90 N•m 66 lb-ft

12. Close and lock engine cover.

1—Bracket
2—Cap Screw (6 used)
3—Cover



TX1010195 -UN-19JUL06

Fan Motor Cover

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TX04577,000010D -19-01AUG06-10/11

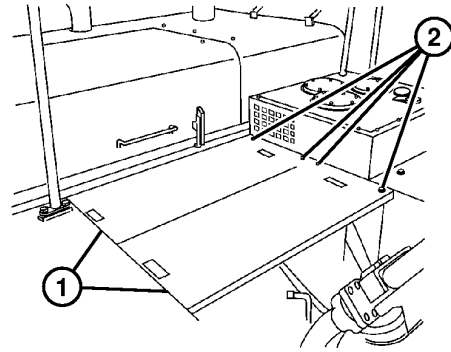
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Hydraulic System

13. Install two covers (1) removed. Tighten to specification.

Specification	
Covers—Over Main Control Valve—Torque.....	90 N•m 66 lb-ft

- 1—Cap Screws (4 used)
- 2—Covers (2 used)

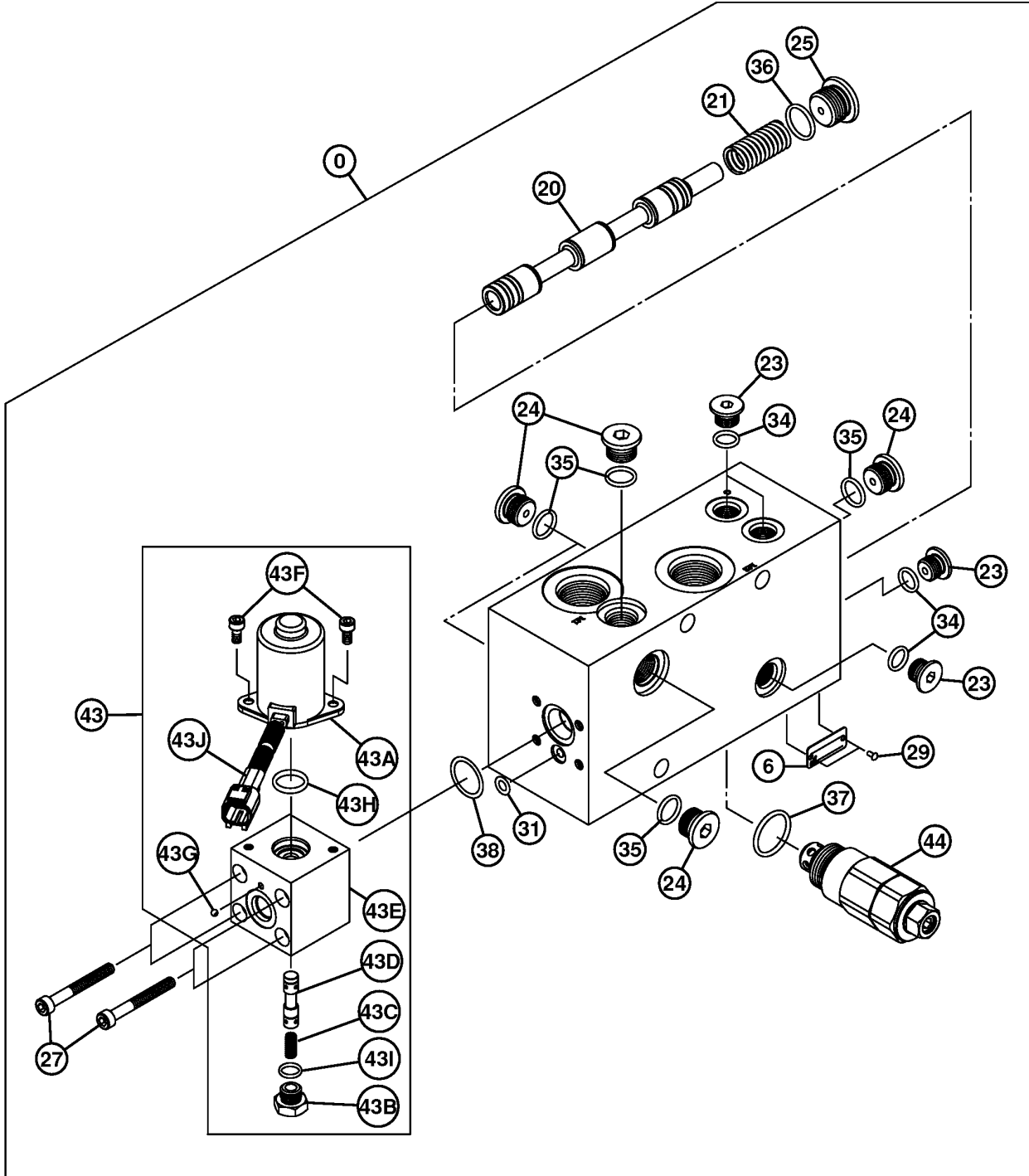


Cover—Center Over Main Control Valve

TX1009141 -UN-01AUG06

TX04577,000010D -19-01AUG06-11/11

Fan Drive Reversing Control Valve Disassemble and Assemble



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TX1002366

Fan Reverse Control Valve Components

Continued on next page

TX17984,0000088 -19-31JUL06-1/2

TM2362 (25JUN08)

33-3360-82

450DLC Excavator Repair

062508
PN=450

TX1002366 -JUN-13JAN06

Hydraulic System

0—Fan Reverse Control Valve Assembly	27—Socket Head Screw (4 used)	38—O-Ring	43E—Housing
6—S.N. Plate	29—Screw (2 used)	43—Reversing Solenoid Assembly	43F—Screws (2 used)
20—Spool	31—O-Ring	43A—Solenoid	43G—Steel Ball
21—Spring (spool)	34—Packing (4 used)	43B—Plug	43H—Packing
23—Plug (4 used)	35—O-Ring (5 used)	43C—Spring	43I—O-Ring
24—Plug (5 used)	36—O-Ring	43D—Spool	43J—Harness—Solenoid
25—Plug (spool end)	37—O-Ring		44—Pressure Relief Valve

See Fan Drive Hydraulic System Component Location. (Group 9025-15.)

See Fan Drive Reversing Control Valve Remove and Install. (Group 3360.)

See Fan Drive Hydraulic System Line Connections. (Group 9025-15.)

TX17984,0000088 -19-31JUL06-2/2

Fan Drive System Relief Valve Remove and Install

The fan drive system relief valve is mounted into the fan reversing valve located on the right side frame to right of main control valve area. See Fan Drive System Component Location. (Group 9025-15.)

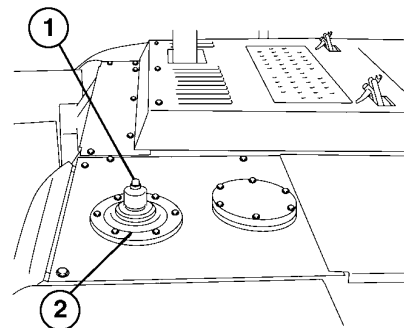
TX04577,000010E -19-01AUG06-1/4



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (1) at top of hydraulic oil tank.

1—Pressure Release Button
2—Hydraulic Oil Tank Cover



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TX04577,000010E -19-01AUG06-2/4

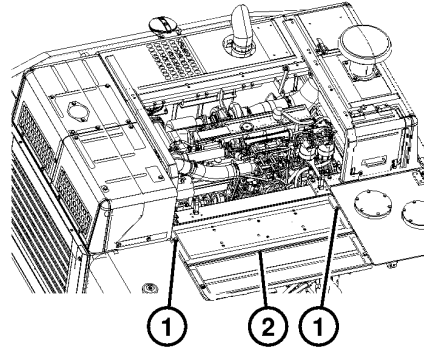
T214924 -UN-17NOV05

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Hydraulic System

2. Remove cap screws (1) and cover (2) for access to fan drive system relief valve.

- 1—Cap Screws (2 used)
- 2—Cover



Cover—Top of Main Control Valve

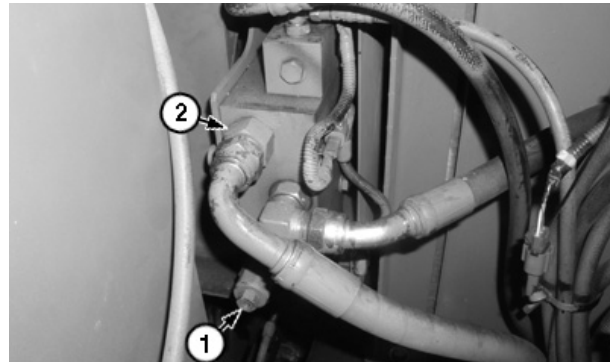
TX1010697 -UN-27JUL06

TX04577,000010E -19-01AUG06-3/4

3. Remove relief valve (1).
4. Inspect or replace as if required.
5. Install relief valve.
6. Install cover with cap screws.

For adjustment See Fan Drive System Relief Valve Test and Adjustment. (Group 9025.)

- 1—Relief Valve
- 2—Fan Drive Reversing Control Valve



Fan Drive System Relief Valve

TX1010707A -UN-28JUL06

TX04577,000010E -19-01AUG06-4/4

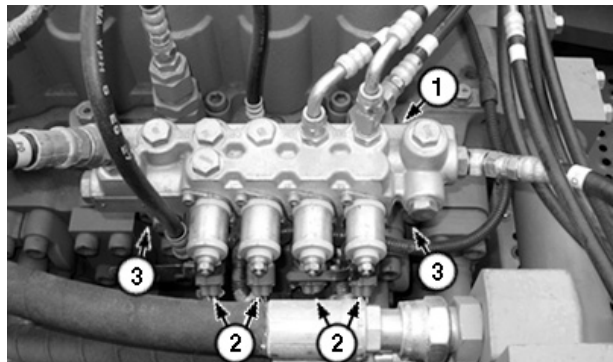
Solenoid Valve Manifold Remove and Install

⚠ CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

1. Push hydraulic oil tank pressure release button.
2. Disconnect hydraulic lines from solenoid valve manifold. Note location of lines for installation. Cap and plug lines.

TX17984,000008A -19-09MAY06-1/2

3. Disconnect harness connectors (2) from solenoids.
4. Remove cap screws (3) and remove solenoid valve manifold (1).
5. Repair or replace parts as necessary.
6. Install solenoid valve manifold and cap screws.
7. Connect hydraulic lines and harness connectors.

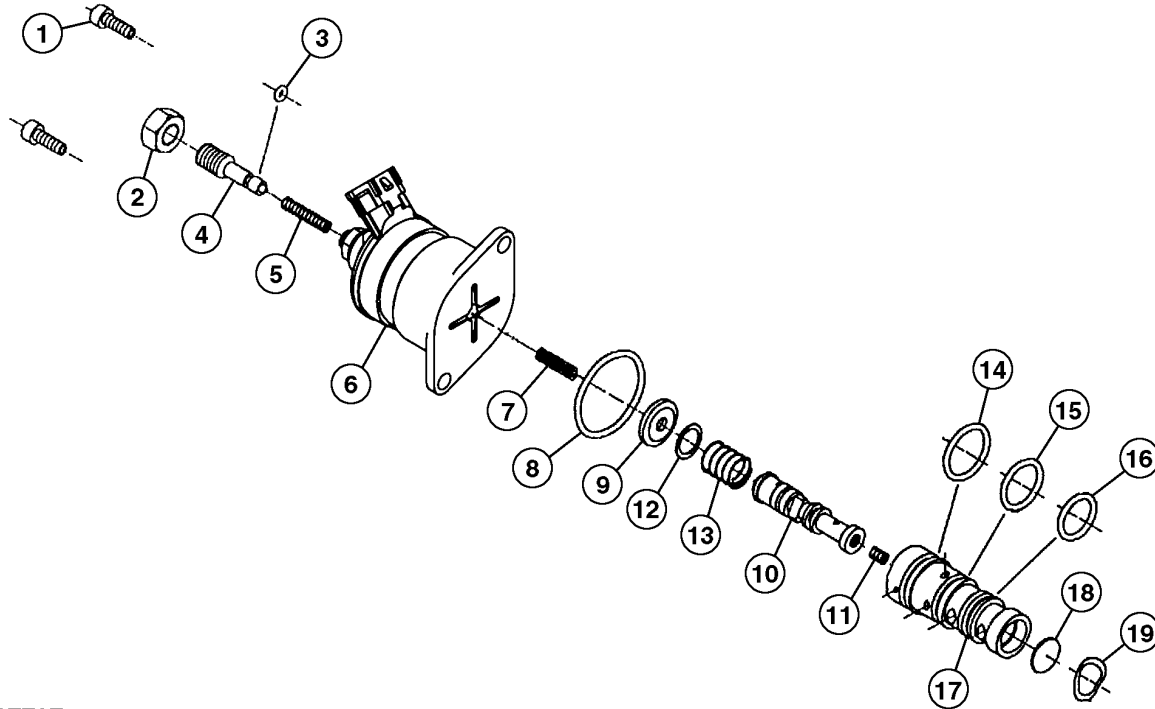


Solenoid Valve Manifold

- 1—Solenoid Valve Manifold
- 2—Solenoid Harness Connectors (4 used)
- 3—Cap Screw (2 used)

TX17984,000008A -19-09MAY06-2/2

Solenoid Valve Remove and Install—Power Dig (SG), Travel Speed (SI), Boom Mode (SC) and Boom Flow Rate (SF)



TX1007787

Solenoid Valve Exploded View

- | | | | |
|----------------------|-------------|------------|----------------|
| 1—Cap Screw (2 used) | 6—Solenoid | 11—Orifice | 16—O-Ring |
| 2—Lock Nut | 7—Spring | 12—Washer | 17—Sleeve |
| 3—O-Ring | 8—O-Ring | 13—Spring | 18—Plate |
| 4—Adjusting Screw | 9—Diaphragm | 14—O-Ring | 19—Wave Spring |
| 5—Spring | 10—Spool | 15—O-Ring | |

IMPORTANT: Do not disassemble lock nut (2) and adjusting screw (4).

IMPORTANT: Do not remove orifice (11) from sleeve (17).

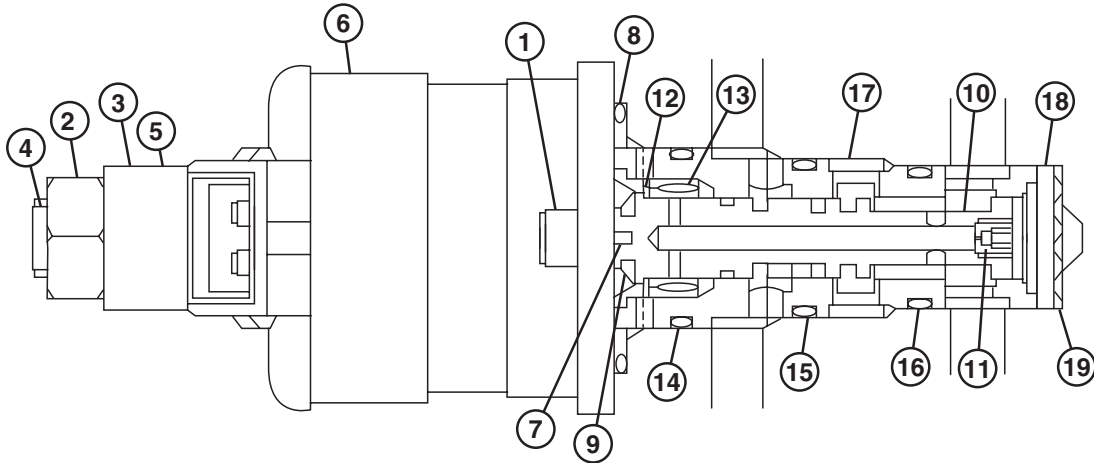
1. Remove cap screws (1). Remove solenoid (6) and O-ring (8) from housing.
2. Remove spool (10), diaphragm (9), washer (12), and spring (13) from sleeve (17).
3. Remove sleeve (17), plate (18), and wave spring (19) from housing.
4. Remove O-rings (14, 15 and 16) from sleeve (17).
5. Repair or replace parts as necessary.

TX1007787 -JUN-16MAY06

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TX17984,000008B -19-15MAY06-1/2



TX1007788

Solenoid Valve Cross Section

- | | | | |
|----------------------|-------------|------------|----------------|
| 1—Cap Screw (2 used) | 6—Solenoid | 11—Orifice | 16—O-Ring |
| 2—Lock Nut | 7—Spring | 12—Washer | 17—Sleeve |
| 3—O-Ring | 8—O-Ring | 13—Spring | 18—Plate |
| 4—Adjusting Screw | 9—Diaphragm | 14—O-Ring | 19—Wave Spring |
| 5—Spring | 10—Spool | 15—O-Ring | |

6. Install wave spring (19) and plate (18) to housing.
7. Install O-rings (14, 15, and 16) on sleeve (17). Insert sleeve (17) into housing.

8. Install diaphragm (9), washer (12) and spring (13) to spool (10). Install spool (10) to sleeve (17).
9. Install spring (7) to solenoid (6). Install solenoid (6) to housing with cap screws (1).

IMPORTANT: Do not damage edge inside sleeve (17) when installing spool (10). Check that spool moves smoothly after installing spool (10) to sleeve (17).

Specification

Proportional Solenoid Cap
Screw—Torque 5 N•m
44 lb-in.

TX1007788 -UN-17MAY06

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TX17984,000008B -19-15MAY06-2/2

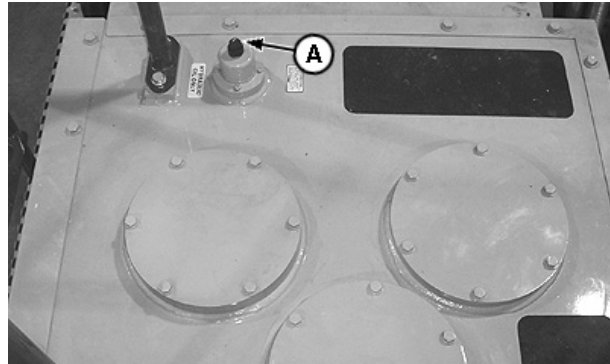
Pump Case Drain Filter and Bypass Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release pressure from hydraulic oil tank by pushing pressure release button (A).

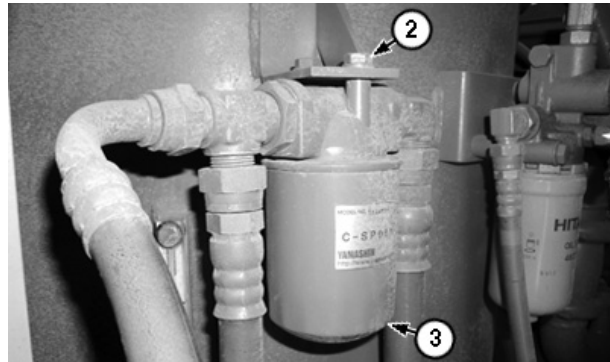
A—Pressure Release Button



TX1010475A -UN-20JUL06

JH38101,0000030 -19-31JUL06-1/2

2. Disconnect lines. Close all openings using caps and plugs.
3. Remove filter (3). See Replace Pump Case Drain Filter. (Operator's Manual.)
4. Remove cap screws (2).
5. Install cap screws.
6. Install new filter. See Replace Pump Case Drain Filter. (Operator's Manual.)
7. Connect lines. See Pump 1, Pump 2 and Pilot Pump Line Identification. (9025-15.)



TX1010378A -UN-19JUL06

2—Cap Screws (2)
3—Pump Case Drain Filter

JH38101,0000030 -19-31JUL06-2/2

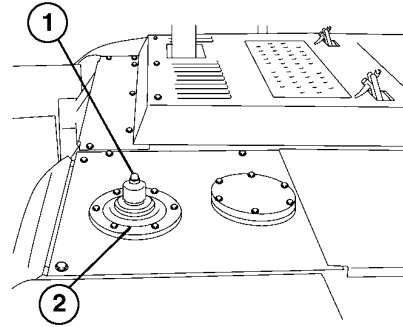
Pilot Control Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Push pressure release button (1).
2. Perform Seat Remove and Install. (Group 1821.)
Remove seat.

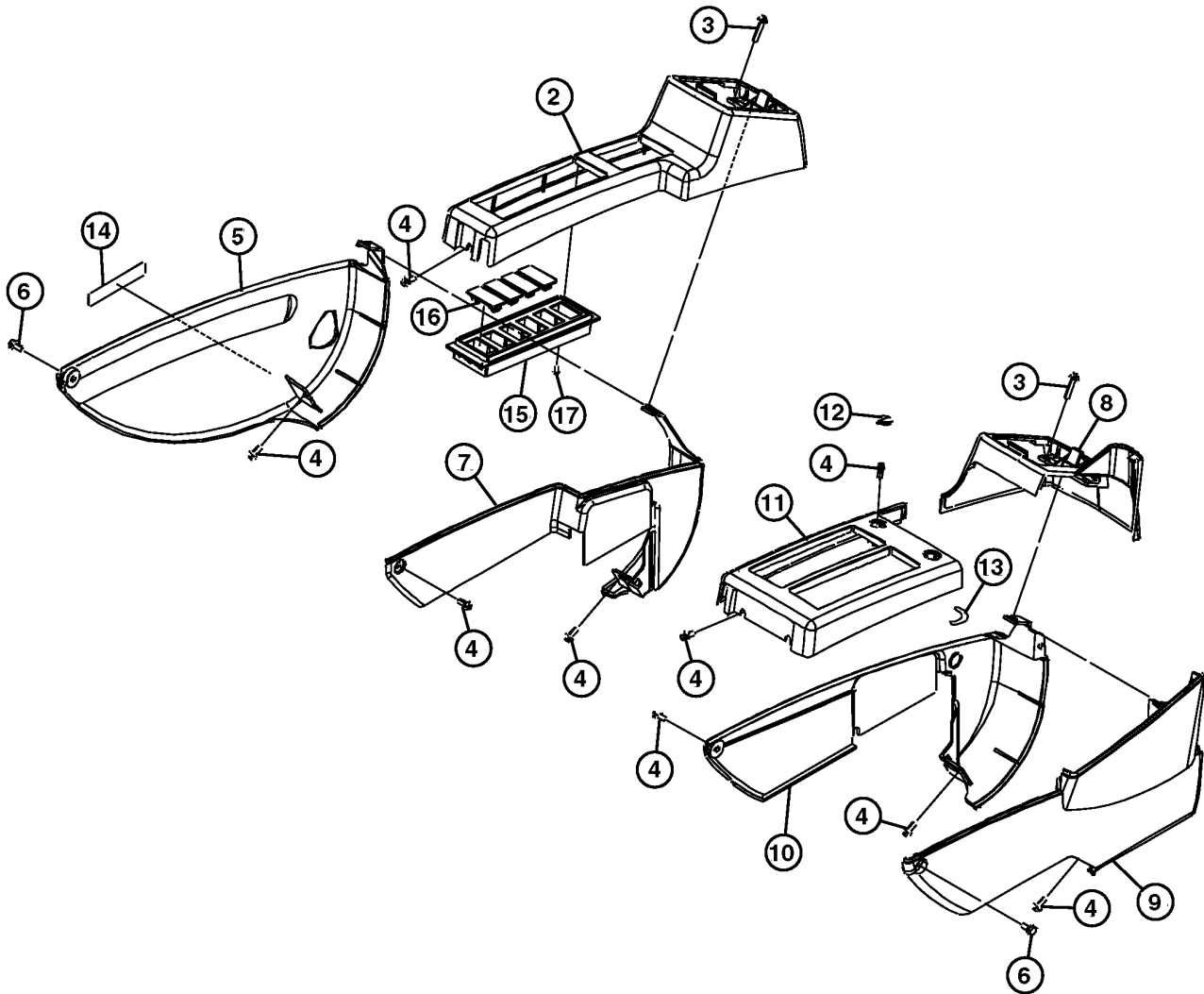
1—Pressure Release Button
2—Hydraulic Oil Tank Cover



T214924 -UN-17NOV05

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TX17984,000008D -19-02AUG06-1/5



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TX1010100

Console Covers

TX1010100 -UN-18JUL06

Continued on next page

TX17984,000008D -19-02AUG06-2/5

Hydraulic System

2—Left Hand Upper Cover	6—Cap Screw	11—Right Hand Upper Rear	14—Label
3—Screw (8 used)	7—Left Hand Inside Cover	Cover	15—Case
4—Cap Screw, Washer and	8—Right Hand Upper Cover	12—Cap (2 used)	16—Cap (4 used)
Lock Washer (14 used)	9—Right Hand Outside Cover	13—Label	17—Screw (4 used)
5—Left Hand Outside Cover	10—Right Hand Inside Cover		

3. Remove caps (12).

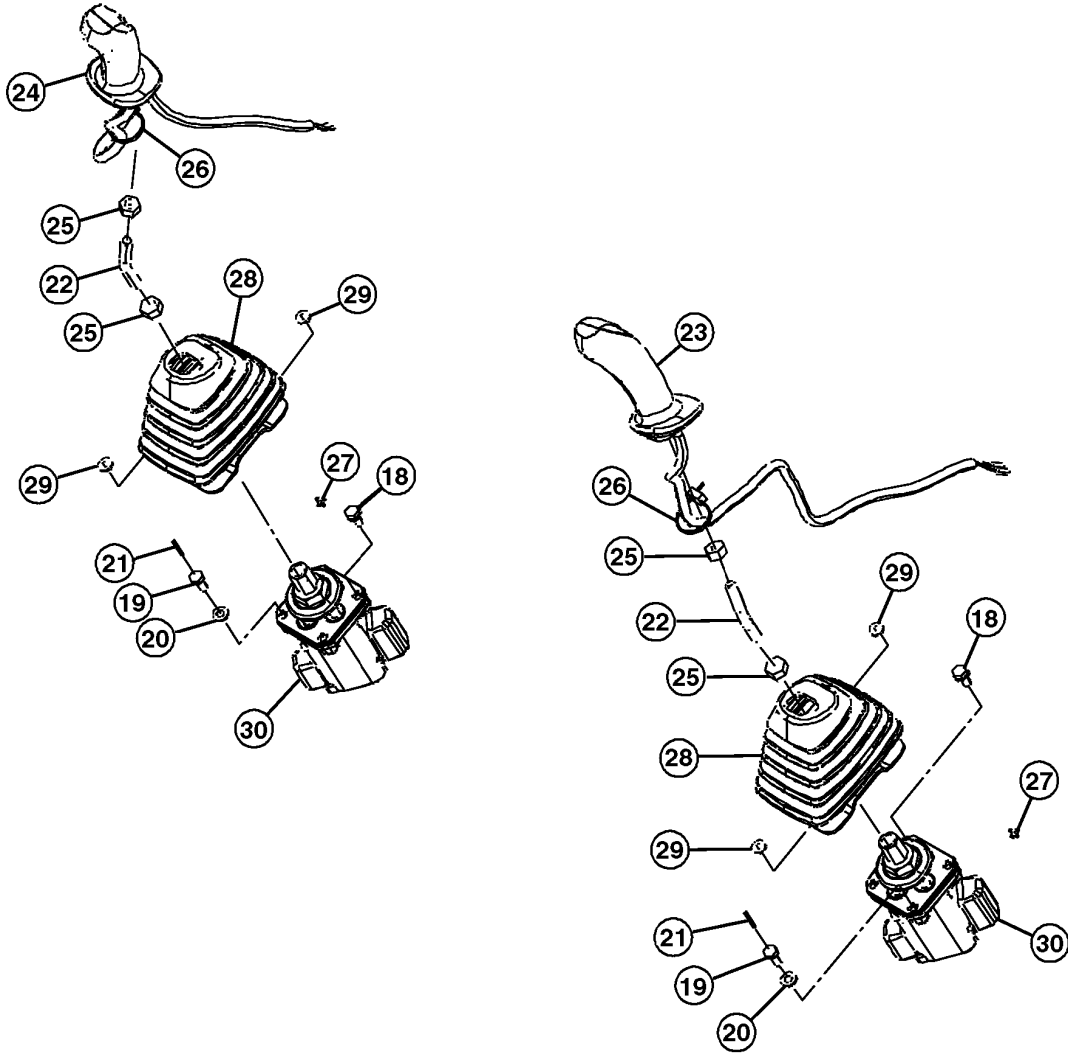
4. Remove screws (3 and 17).

5. Remove cap screws (4 and 6).

6. Remove right and left hand covers (2, 5, 7, 8, 9, 10 and 11)

Continued on next page

TX17984.000008D -19-02AUG06-3/5



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TX1010105

Pilot Control Valves and Levers

Continued on next page

TX17984,000008D -19-02AUG06-4/5

TX1010105 -JUN-17-JUL06

Hydraulic System

18—Cap Screw (6 used)
 19—Cap Screw (2 used)
 20—Washer (2 used)
 21—Spring Pin (2 used)

22—Shaft
 23—Left Hand Grip
 24—Right Hand Grip

25—Nut (4 used)
 26—Tie Band (2 used)
 27—Tie band (2 used)

28—Boot (2 used)
 29—Washer (8 used)
 30—Pilot Valve (2 used)

7. Disconnect wiring harness and remove hand grips (23 and 24).
8. Attach identification tags to lines and disconnect. Close all openings using caps and plugs.
9. Remove cap screws (18 and 19) to remove pilot valves (30) from console.
10. Repair or replace parts as necessary.
11. Install pilot control valves. Position cap screws (19) with spring pins (21), in lower left hole of left pilot control valve, and lower right hole of right pilot control valve. Tighten cap screws (18 and 19).

Specification

Pilot Valve-to-Console Cap
 Screw—Torque 20 N•m
 177 lb-in.

Component Location—Excavator Pattern. (Group 9025-15.)

For Backhoe pattern see Pilot Control Valve-to-Pilot Signal Manifold Component Location—Backhoe Pattern. (Group 9025-15.)

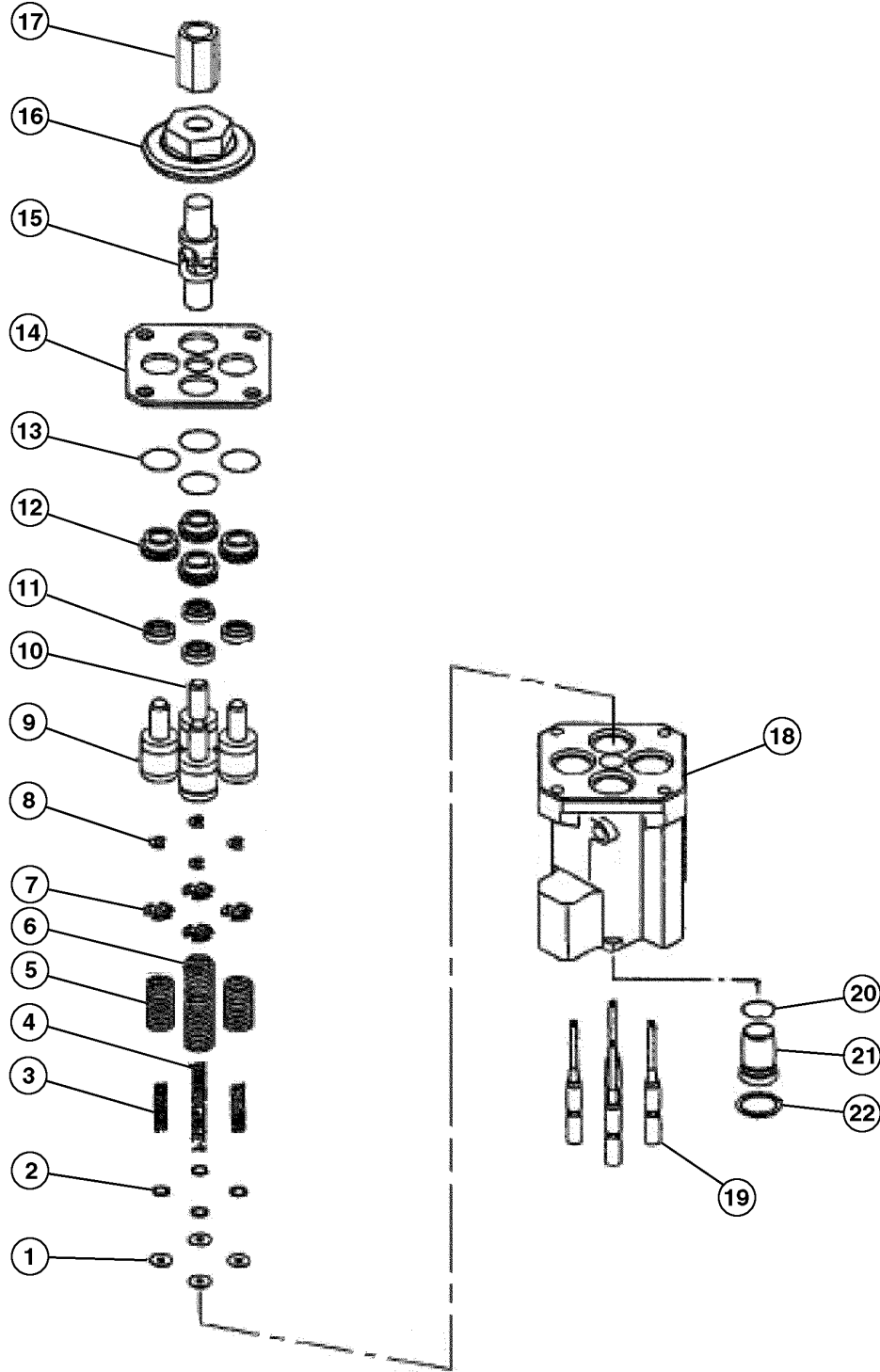
13. Connect wire harness and install hand grips.
14. After pilot control valve is installed, check operation of all functions. See Control Lever Pattern Operation. (Operator's Manual.)
15. Install right and left hand covers.
16. Install cap screws.
17. Install screws.
18. Install caps (12).

12. Connect hydraulic lines. For Excavator pattern see Pilot Control Valve-to-Pilot Signal Manifold

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Pilot Control Valve Disassemble and Assemble



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TX1010121

Pilot Control Valve Components Exploded View
Continued on next page

TX1010121 -UN-17JUL06

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Hydraulic System

1—Spacer (4 used)	7—Spring Guide (4 used)	13—O-Ring (4 used)	18—Case
2—Shim (4 used)	8—Snap Ring (4 used)	14—Plate	19—Spool (4 used)
3—Balance Spring A (2 used)	9—Pusher A (2 used)	15—Universal Joint	20—O-Ring
4—Balance Spring B (2 used)	10—Pusher B (2 used)	16—Cam	21—Plug
5—Return Spring A (2 used)	11—Oil Seal (4 used)	17—Screw Joint	22—Snap Ring
6—Return Spring B (2 used)	12—Sleeve (4 used)		

1. Clamp screw joint (17) in a vise. Turn cam (16) by using a spanner wrench. Remove screw joint.

2. Clamp the flat surface of case (18) in a vise lightly. Remove cam from universal joint (15).

3. Remove universal joint using a spanner wrench.

4. Remove plate (14).

IMPORTANT: Insert a piece of soft rubber between the sleeve and the tool to prevent damage to sleeve surface.

NOTE: Sleeves and oil seals must be replaced as an assembly.

5. Pull out sleeves (12) using a pliers.

IMPORTANT: Pushers from ports one and three are different than pushers from ports two and four. Parts for each port must be kept together and installed into the same port from which it was removed. The port numbers are stamped on the case.

6. Remove pushers (9 and 10) from case.

Continued on next page

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7. Install tool ST 4145 Spool Holder (24) to the port hole on case.

Install tool ST 4146 Spring Compressor (23) to the pusher hole on case. Push tool to compress the springs (3, 4, 5 and 6). Use a M14 x 2 cap screw with spring compressor to hold spring.

Remove snap rings (8) from spools (19).

8. Remove spool holder. Remove spring guides (7), return springs A and B (5 and 6) and balance springs A and B (3 and 4) from spools.

IMPORTANT: The quantity of shims has been determined for each port during the performance testing at the factory. Keep the shims carefully in order to install the shims correctly during assembly.

9. Remove shims (2) and spacers (1) from spools.

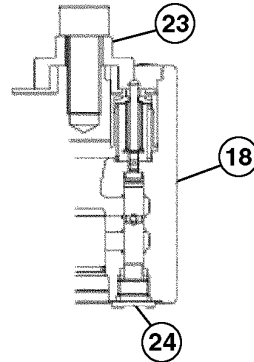
IMPORTANT: Spools have been selected to match the holes of case. Spools and case must be replaced as an assembly.

10. Remove spring compressor from case. Slowly turn and remove spools from case.

11. Remove snap ring (22) from case.

Install a M8 x 1.25 cap screw to plug (21) to remove from case.

12. Inspect parts, repair or replace as needed.



Spring Removal Tools

- 18—Case
- 23—ST 4146 Spring Compressor
- 24—ST 4145 Spool Holder

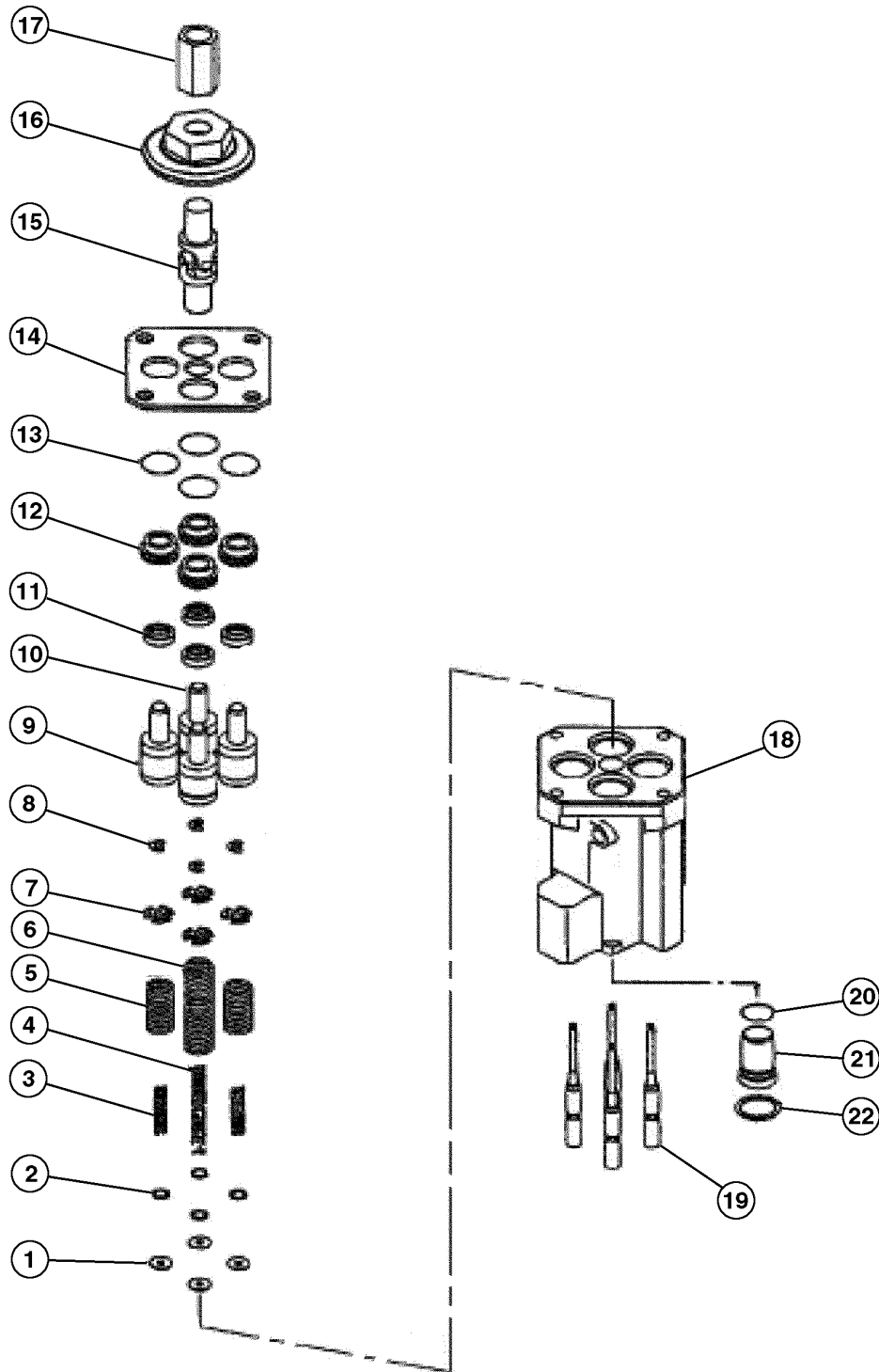
TX10101.40 -JUN-17JUL06

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Hydraulic System

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TX1010121

Pilot Control Valve Components Exploded View

Continued on next page

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Hydraulic System

1—Spacer (4 used)	7—Spring Guide (4 used)	13—O-Ring (4 used)	18—Case
2—Shim (4 used)	8—Snap Ring (4 used)	14—Plate	19—Spool (4 used)
3—Balance Spring A (2 used)	9—Pusher A (2 used)	15—Universal Joint	20—O-Ring
4—Balance Spring B (2 used)	10—Pusher B (2 used)	16—Cam	21—Plug
5—Return Spring A (2 used)	11—Oil Seal (4 used)	17—Screw Joint	22—Snap Ring
6—Return Spring B (2 used)	12—Sleeve (4 used)		

13. Install spools to their corresponding port holes in case.

TX17984.000008E -19-03AUG06-5/8

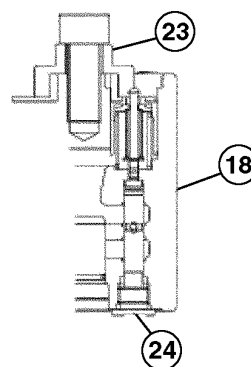
14. Install tool ST 4145 Spool Holder to the port hole on case (18).
15. Install spacers to spool.
16. Install shims to spools making sure to use the same number of shims in spools at disassembly.

IMPORTANT: Ports one and three use short balance springs. Ports two and four use long balance springs.

17. Install balance springs to spools.

IMPORTANT: Ports one and three use short return springs. Ports two and four use long return springs.

18. Install return springs to spools.
19. Install tool ST 4146 Spring Compressor to the pusher holes in case. Secure spring compressor with M14 x 2 cap screws.



Spring Removal Tools

- 18—Case
23—ST 4146 Spring Compressor
24—ST 4145 Spool Holder

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Continued on next page

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20. Install snap rings to ring holder tool ST 4144 Snap Ring Holder (25).

21. Install snap rings to the groove on the head of the spools out of spring compressor.

IMPORTANT: Ports one and three use pushers with one outer groove. Ports two and four use pushers with two outer grooves.

22. Install pushers to case.

After installing pushers by hand remove them. Check if snap ring falls off or balance rings are located correctly.

After checking, install pushers to case.

23. Apply grease to the ball ends of pushers.

24. Apply grease to the joint part of universal joint.

25. Apply grease to the inner surface of oil seals.

NOTE: Sleeves and oil seals must be replaced as an assembly.

26. Install sleeves by pushing the sleeves in by hand until O-ring is inserted into the hole on sleeves.

IMPORTANT: Align cap screw hole in plate with cap screw hole in case.

27. Apply PM38654 Threadlocker to the threads of universal joint. Place plate on case and install universal joint.

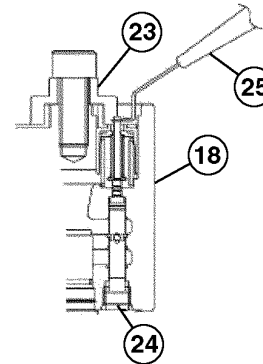
Specification

Universal Joint—Torque..... 25 N•m
217 lb-in.

28. Install cam to universal joint. Check the clearance between cam and pushers.

Specification

Cam-to-Pushers—Clearance..... 0—0.2 mm
0—0.008 in.



Retaining Ring Installation Tool

- 18—Case
- 23—ST 4146 Spring Compressor
- 24—ST 4145 Spool Holder
- 25—ST 4144 Snap Ring Holder

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Hydraulic System

29. Secure cam by using a spanner wrench. Tighten screw joint by using a spanner wrench.

Specification

Screw Joint—Torque..... 68 N•m
50 lb-ft

TX17984.000008E -19-03AUG06-8/8

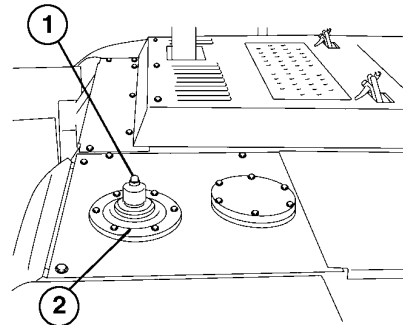
Boom Up Shockless Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Push pressure release button (1).

1—Pressure Release Button
2—Hydraulic Oil Tank Cover

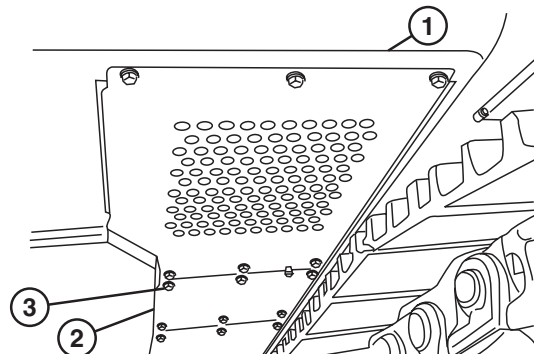


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TX17984.00000D9 -19-02AUG06-1/3

2. Remove cap screws (3) and cover (2) from main frame (1) under cab.

1—Main Frame
2—Cover
3—Cap Screw (6 used)



Cap Screws and Cover

TX1010156 -UN-18JUL06

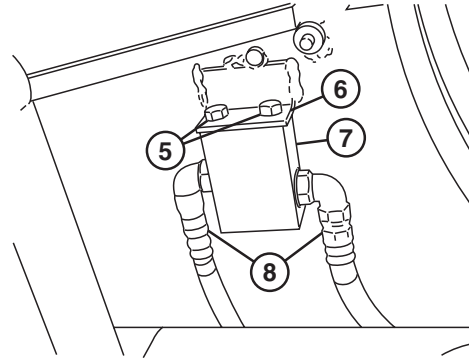
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Hydraulic System

3. Install identification tags to all fittings. Disconnect hydraulic lines (8). Close all openings using caps and plugs.
4. Remove cap screws (5). Remove boom up shockless valve (7) from bracket (6).
5. Repair or replace as necessary. See Boom Up Shockless Valve Disassemble and Assemble. (Group 3360.)
6. Install boom up shockless valve to bracket. Tighten cap screws to specification.



Boom Up Shockless Valve

TX1010158 -UN-18JUL06

Specification

Boom Up Shockless	
Valve-to-Bracket Cap Screw—	
Torque	20 N•m 177 lb-in.

- 5—Cap Screw (2 used)
- 6—Bracket
- 7—Boom Up Shockless Valve
- 8—Hydraulic Line (2 used)

7. Connect hydraulic lines to boom up shockless valve. See Pilot Control Valve-to-Pilot Signal Manifold Component Location—Excavator Pattern. (Group 9025-15.) or See Pilot Control Valve-to-Pilot Signal Manifold Component Location—Backhoe Pattern
8. Install cover to main frame. Tighten cap screws to specification.

Specification

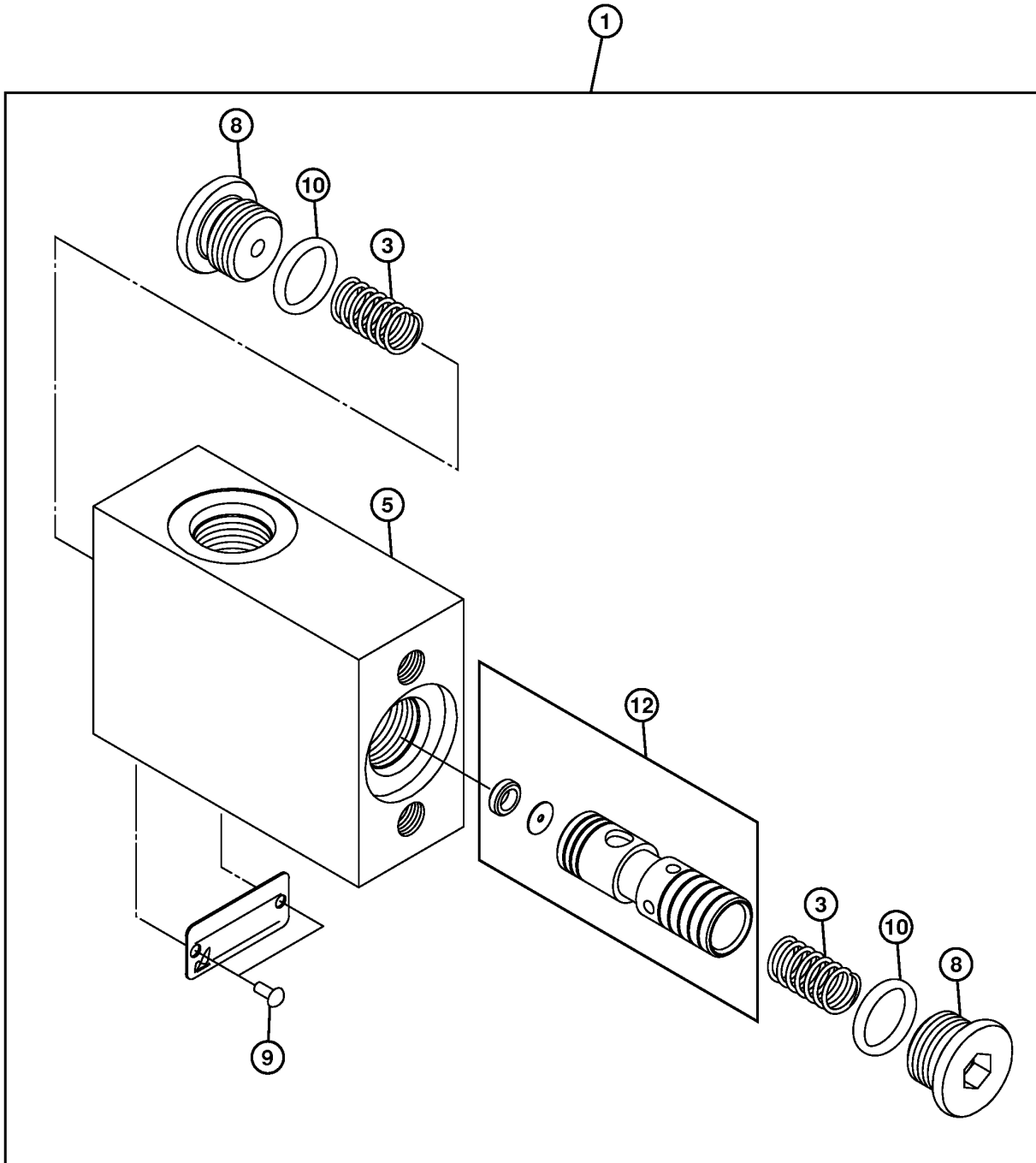
Cover-to-Main Frame Cap	
Screws—Torque.....	
	90 N•m 66 lb-ft

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Hydraulic System

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Boom Up Shockless Valve Disassemble and Assemble



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TX1002502

Boom Up Shockless Valve

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TM2362 (25JUN08)

33-3360-104

450DLC Excavator Repair

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TX1002502 -UN-10JAN06

Hydraulic System

- | | | | |
|---------------------------|----------------------|--------------------|------------|
| 1—Boom Up Shockless Valve | 5—Housing | 9—Screw (2 used) | 12—Plunger |
| 3—Spring (2 used) | 8—8 mm Plug (2 used) | 10—O-Ring (2 used) | |

Repair or replace parts as necessary.

Tighten 8 mm plugs (8) to specification.

Specification

8 mm Plug to Boom Up	
Shockless Valve—Torque	39 N•m 29 lb-ft

TX17984,00000DA -19-02AUG06-2/2

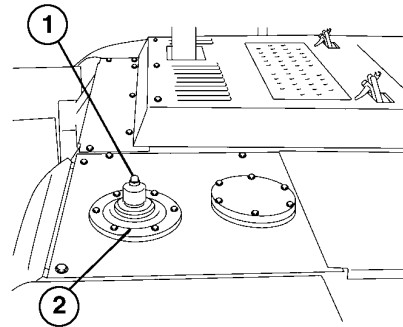
Travel Pilot Control Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Push pressure release button (1).
2. Remove cover on bottom of main frame of cab.

- | |
|----------------------------|
| 1—Pressure Release Button |
| 2—Hydraulic Oil Tank Cover |

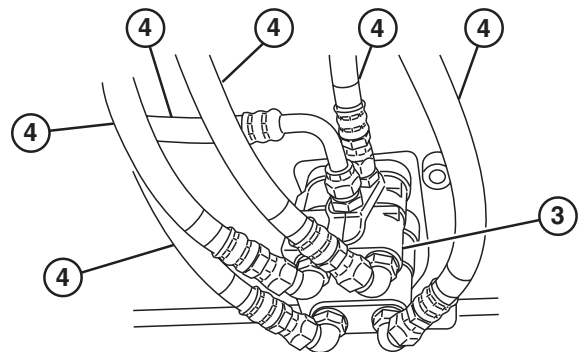


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3. Attach identification tags to lines and fittings. Disconnect hydraulic lines (4). Close all openings using caps and plugs.
4. Remove rubber mat from cab.

- | |
|------------------------------|
| 3—Travel Pilot Control Valve |
| 4—Hydraulic Line (6 used) |



Travel Pilot Control Valve Hydraulic Lines

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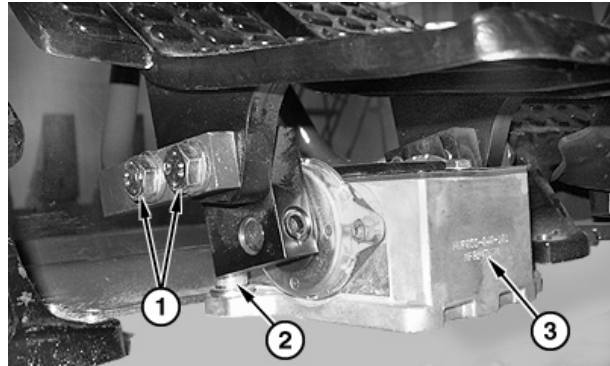
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Hydraulic System

5. Remove cap screws (1), remove pedals and levers.
6. Remove cap screws (2) to remove travel pilot control valve (3).
7. Repair or replace parts as necessary. See Travel Pilot Control Valve Disassemble and Assemble. (Group 3360.)
8. Install travel pilot control valve. Tighten cap screws to specification.



- 1—Cap Screw (4 used)
2—Cap Screw (2 used)
3—Travel Pilot Control Valve

Specification

Travel Pilot Control Valve Cap	
Screws—Torque	50 N•m 37 lb-ft

9. Install levers and pedals to travel pilot control valve. Tighten cap screws to specification.

Specification

Levers and Pedals-to-Travel Pilot Control Valve Cap Screw—	
Torque	50 N•m 37 lb-ft

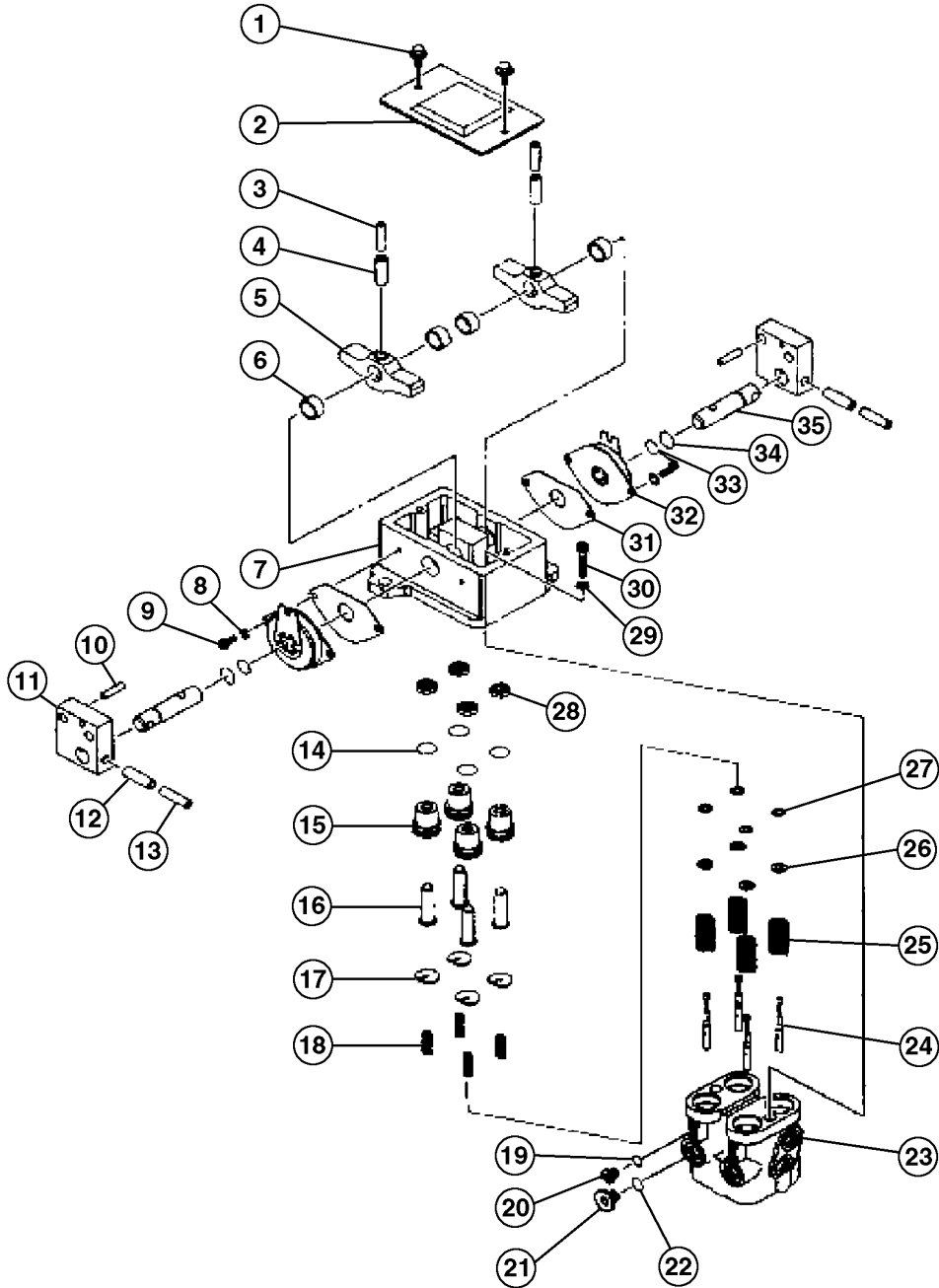
10. Connect hydraulic lines to travel pilot control valve. See Travel Hydraulic System Line Connection. (Group 9025-15.)
11. After travel pilot control valve is installed, check the operation of all functions to verify they operate correctly.
12. Install rubber mat to cab.
13. Install cover to bottom of main frame of cab.

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Hydraulic System

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Travel Pilot Control Valve Disassemble and Assemble



Travel Pilot Control Valve Exploded View

Continued on next page

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Hydraulic System

1—Cap Screw (2 used)	10—Spring Pin	19—O-Ring (2 used)	28—Oil Seal (4 used)
2—Cover	11—Bracket (2 used)	20—Plug (2 used)	29—Spring Washer (2 used)
3—Spring Pin (2 used)	12—Spring Pin (2 used)	21—Plug (2 used)	30—Cap Screw (2 used)
4—Spring Pin (2 used)	13—Spring Pin (2 used)	22—O-Ring (2 used)	31—Rubber Seat (2 used)
5—Cam (2 used)	14—O-Ring (4 used)	23—Case	32—Damper (2 used)
6—Bushing (4 used)	15—Bushing (4 used)	24—Spool	33—O-Ring (2 used)
7—Holder	16—Pusher (4 used)	25—Return Spring (4 used)	34—O-Ring (2 used)
8—Spring Washer (4 used)	17—Spring Guide (16 used)	26—Spacer (4 used)	35—Pin
9—Cap Screw (4 used)	18—Balance Spring (4 used)	27—Shim (12 used)	

1. Clamp case (23) in a vise.
2. Remove cap screws (1). Remove cover (2) from holder (7).
3. Remove cap screws (30) and spring washers (29). Remove holder (7) from case.
4. Pull out the bushings (15) and pushers (16) together from the case.
5. Remove the pushers, oil seals (28) and O-rings (14) from the bushings.

IMPORTANT: Mark the four spools to indicate which port they belong in for assembly. Spools have been selected to match the holes in case. Replace spools and case as an assembly.

6. Remove spools (24) from case.

IMPORTANT: The quantity of shims has been determined during the performance testing at the factory. Keep the shims together with the spools and locations from which removed.

7. Push balance spring (18). Remove spring guides (17), balance springs, shims (27) and spacers (26) from spools.
8. Remove return springs (25) from case.

IMPORTANT: Spring pins can only be removed in one direction.

IMPORTANT: Do not remove spring pin attached with bracket unless necessary. The outside of spring pin is crimped.

9. Place a block of wood under bracket (11). Remove spring pins (12 and 13) from bracket at the same time. Remove bracket.
10. Remove cap screws (9) and spring washers (8).
11. Remove dampers (32), rubber seats (31) and O-rings (34) from pin (35).
12. Remove O-rings (33) from pin.
13. Place holder with the casing mounting surface facing upward.

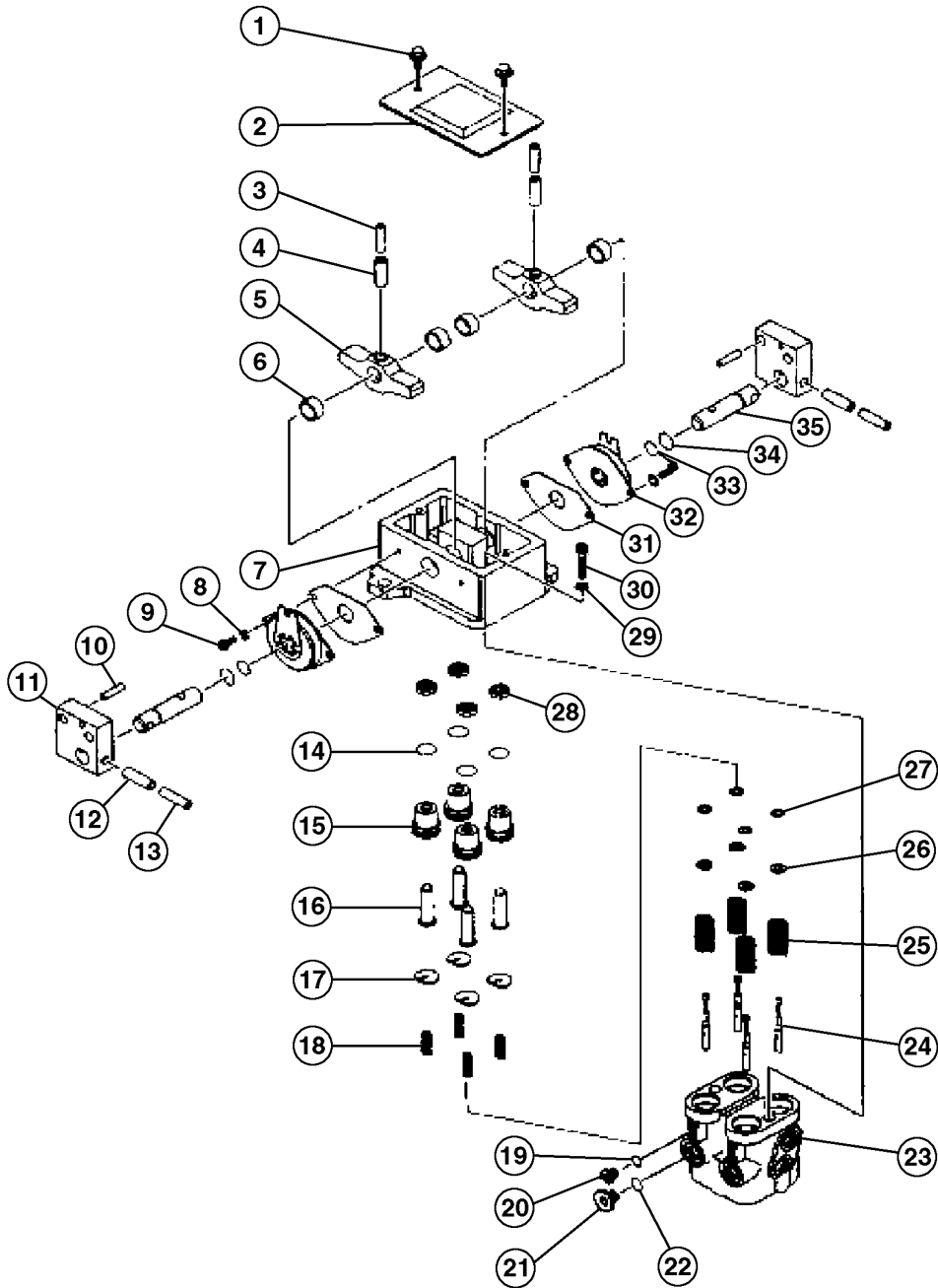
NOTE: Spring pins are stepped and crimped. They may feel tight when removing.

14. Remove spring pins (3 and 4) from cams (5) at the same time.
15. Remove bushings (6) from holder.
16. Remove pin (35) by using a bar and hammer.
17. Remove cams with pins.
18. Remove plugs (20 and 21) and O-rings (19 and 22) from casing.
19. Repair or replace parts as necessary.

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TX17984,00000DC -19-02AUG06-2/5

Hydraulic System



Travel Pilot Control Valve Exploded View

- | | | | |
|--------------------------|----------------------------|---------------------------|---------------------------|
| 1—Cap Screw (2 used) | 10—Spring Pin | 19—O-Ring (2 used) | 28—Oil Seal (4 used) |
| 2—Cover | 11—Bracket (2 used) | 20—Plug (2 used) | 29—Spring Washer (2 used) |
| 3—Spring Pin (2 used) | 12—Spring Pin (2 used) | 21—Plug (2 used) | 30—Cap Screw (2 used) |
| 4—Spring Pin (2 used) | 13—Spring Pin (2 used) | 22—O-Ring (2 used) | 31—Rubber Seat (2 used) |
| 5—Cam (2 used) | 14—O-Ring (4 used) | 23—Case | 32—Damper (2 used) |
| 6—Bushing (4 used) | 15—Bushing (4 used) | 24—Spool | 33—O-Ring (2 used) |
| 7—Holder | 16—Pusher (4 used) | 25—Return Spring (4 used) | 34—O-Ring (2 used) |
| 8—Spring Washer (4 used) | 17—Spring Guide (16 used) | 26—Spacer (4 used) | 35—Pin |
| 9—Cap Screw (4 used) | 18—Balance Spring (4 used) | 27—Shim (12 used) | |

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TX17984.00000DC -19-02AUG06-3/5

IMPORTANT: The quantity of shims has been determined during the performance testing at the factory. Install the shims together with the spools they came out of.

- 20. Install spacers, shims and balance springs into spools.
- 21. Push balance springs by hand. Install spring guides to spools with the stepped end facing toward balance springs.
- 22. Apply hydraulic oil onto internal parts.
- 23. Insert the return springs into case.
- 24. While turning, install spools into the same port in case as they were before disassembly.
- 25. Install oil seals to bushings.
- 26. Apply grease to the inner surface of oil seals.
- 27. Install O-rings to bushings.
- 28. Install pushers into bushings.
- 29. Apply grease to the head of pushers.
- 30. Install the pushers into the case.
- 31. Install bushings by driving inner bushings from both ends with a bushing driver until the inside end of bushings are flush with the inside wall of holder.
- 32. Drive the outer bushings with a bushing driver so that the outside ends are flush with the outside of holder.
- 33. Install O-rings to pin. Apply grease to O-rings. Assemble pins and cams to holder.
- 34. Install spring pins to cams so that the pins are displaced with their slits at 90° from each other. Drive pins until they make contact with the stepped part of hole.

- 35. Crimp the hole edge of cams in two places where spring pins are inserted using a punch.
- 36. Install holder to case. Install cap screws and spring washers. Tighten cap screws to specification.

Specification

Holder-to-Case Cap Screws—	
Torque.....	49 N•m 36 lb-ft

- 37. Install rubber seats to pin.
- 38. Install dampers to pin with the lever facing top of travel pilot control valve.
- 39. Install cap screws and spring washers to secure damper and rubber seat to holder. Tighten cap screws to specification.

Specification

Damper-to-Holder Cap	
Screws—Torque	7 N•m 65 lb-in.

- 40. Apply grease to O-rings. Push O-rings to the end of pin.
- 41. Install brackets to pins aligning the inserting holes for spring pins.
- 42. Place a block of wood under bracket. Install spring pins into brackets so that the slits are displaced at 90° from each other. Drive spring pins until they contact the stepped end.
- 43. Crimp the hole edge of brackets where spring pins are inserted using a punch.
- 44. Install cover to holder. Tighten cap screws to specification.

Specification

Holder-to-Cover Cap Screws—	
Torque.....	5 N•m 44 lb-in.

- 45. Apply grease to the spring pin contact part of dampers.

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Hydraulic System

46. Install O-rings to smaller plugs. Install smaller plugs to case, tighten to specification.

	Specification
Plug-to-Case—Torque	10 N•m 89 lb-in.

47. Install O-rings to larger plugs. Install larger plugs to case, tighten to specification.

	Specification
Plug-to-Case—Torque	20 N•m 177 lb-in.

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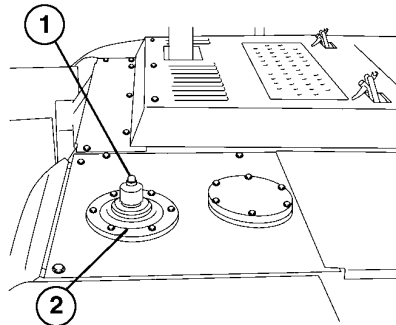
Pilot Accumulator Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

Push pressure release button (1).

- 1—Pressure Release Button
- 2—Hydraulic Oil Tank Cover



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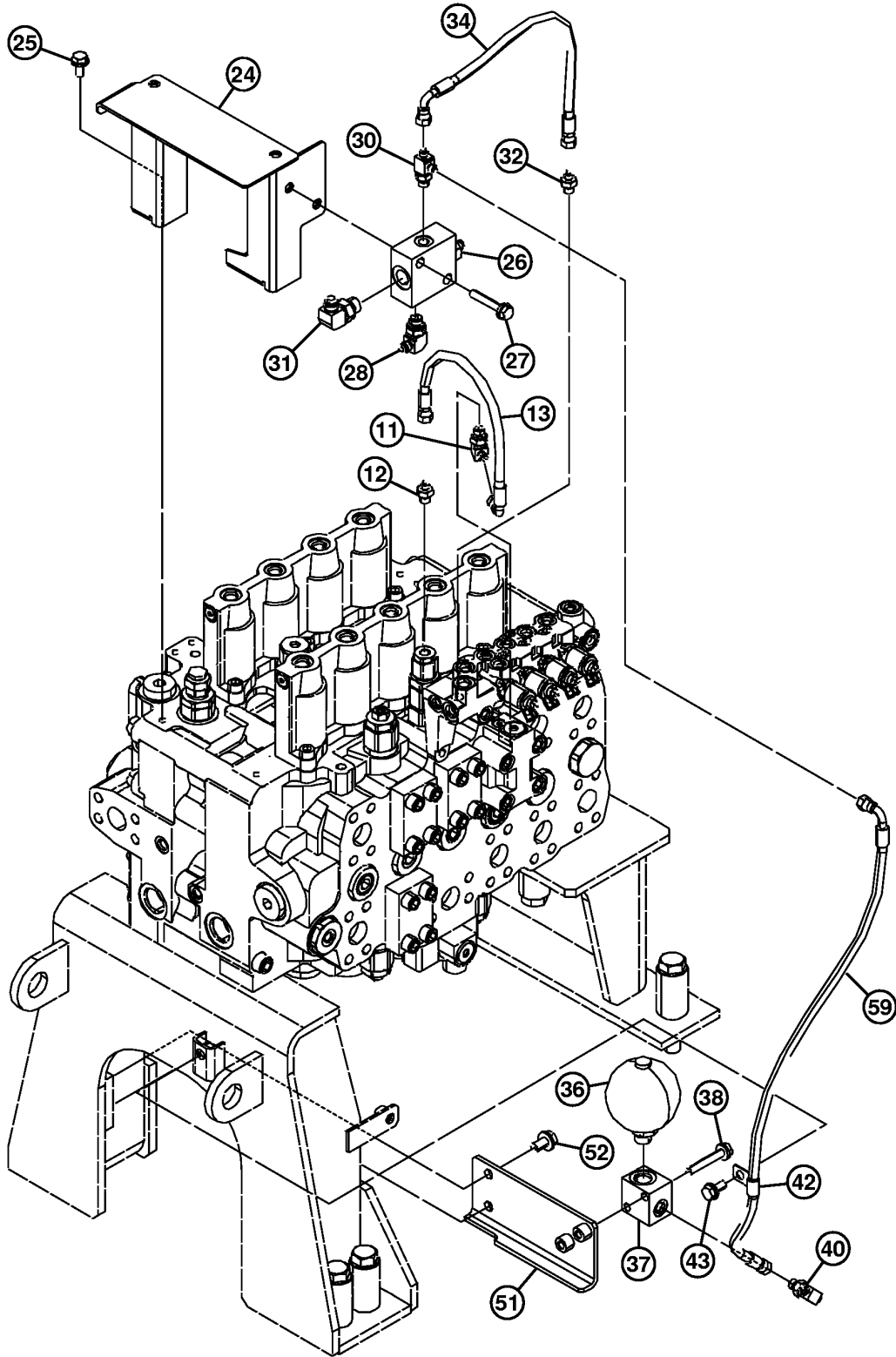
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Hydraulic System

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Hydraulic System



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Pilot Accumulator Location

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Hydraulic System

11—Elbow Fitting	27—Cap Screw (2 used)	34—Hydraulic Line	42—Clip
12—Adapter Fitting	28—Elbow Fitting	36—Pilot Accumulator	43—Cap Screw
13—Hydraulic Line	30—Tee Fitting	37—Manifold	51—Bracket
24—Bracket	31—Elbow Fitting	38—Cap Screw (2 used)	52—Cap Screw (2 used)
25—Cap Screw (2 used)	32—Adapter Fitting	40—Tee Fitting	59—Hydraulic Line
26—Pilot Check Valve Manifold			

Replace pilot accumulator (36) as necessary.

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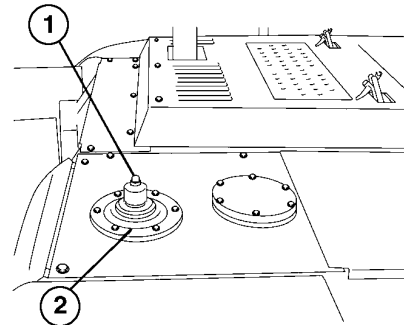
Pilot Check Valve Manifold Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Push pressure release button (1).

1—Pressure Release Button
2—Hydraulic Oil Tank Cover



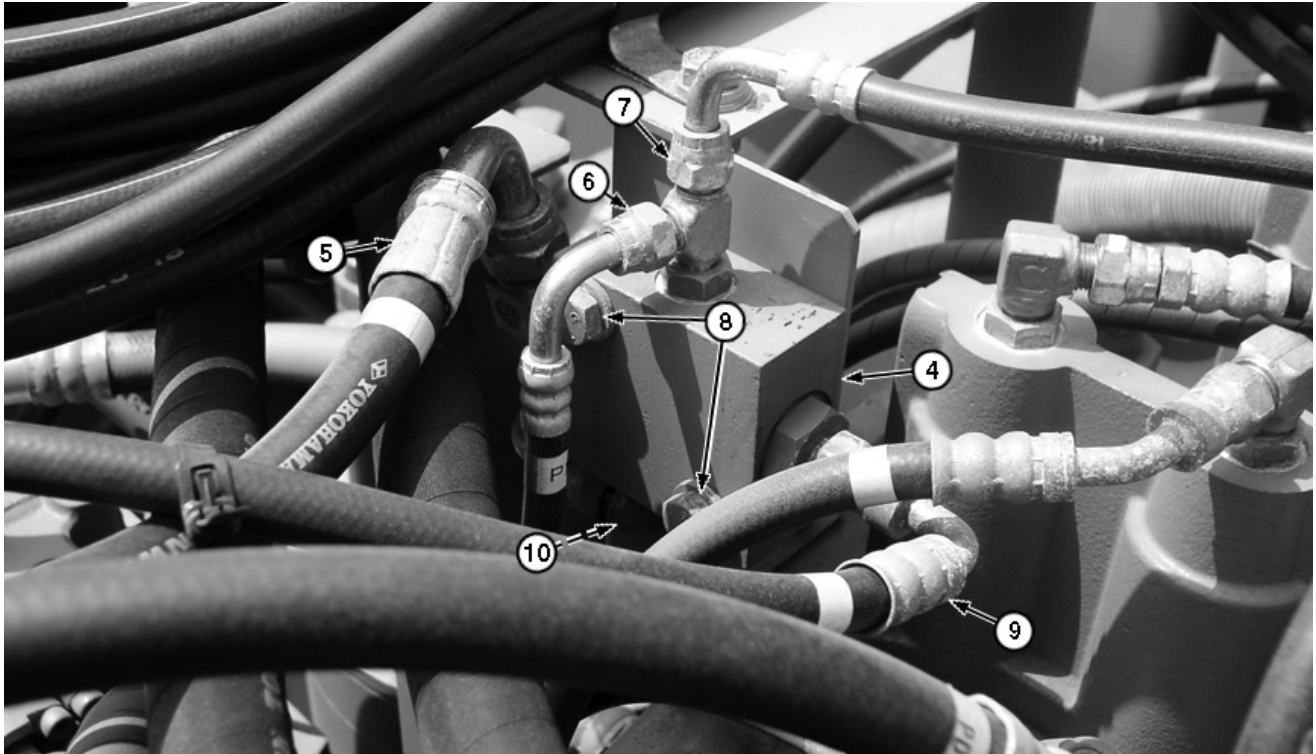
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Hydraulic System



Pilot Check Valve Manifold

- | | | | |
|------------------------------|------------------|----------------------|-------------------|
| 4—Pilot Check Valve Manifold | 6—Hydraulic Line | 8—Cap Screw (2 used) | 10—Hydraulic Line |
| 5—Hydraulic Line | 7—Hydraulic Line | 9—Hydraulic Line | |

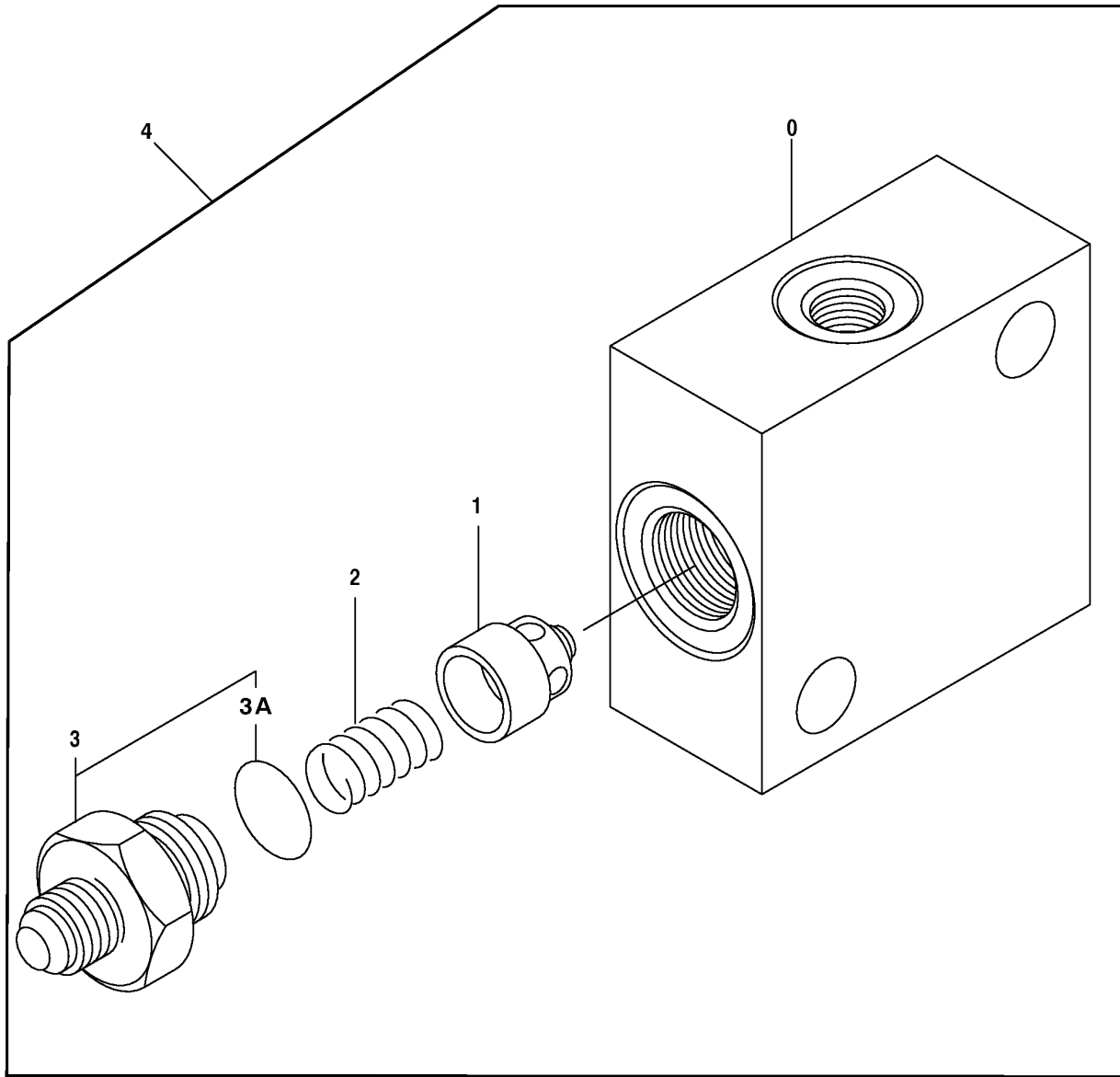
2. Attach identification tags to lines and fittings. Disconnect hydraulic lines (5, 6, 7, 9 and 10) from pilot check valve manifold (4). Close all openings using caps and plugs.
3. Remove cap screws (8) and remove pilot check valve manifold (4).

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Hydraulic System

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Pilot Check Valve Manifold Exploded View

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Hydraulic System

0—Housing
1—Piston

2—Spring
3—Adapter Fitting

3A—O-Ring

4—Pilot Check Valve Manifold

4. Repair or replace parts as necessary.
5. Install pilot check valve manifold. Tighten cap screws.
6. Connect hydraulic lines to pilot check valve manifold.

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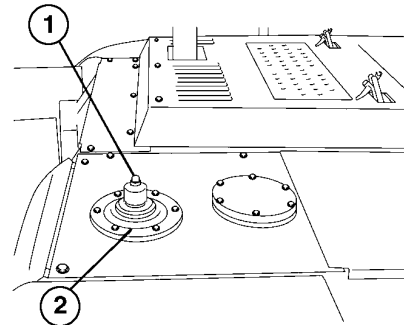
Digging Sensor Manifold Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Push pressure release button (1).

1—Pressure Release Button
2—Hydraulic Oil Tank Cover



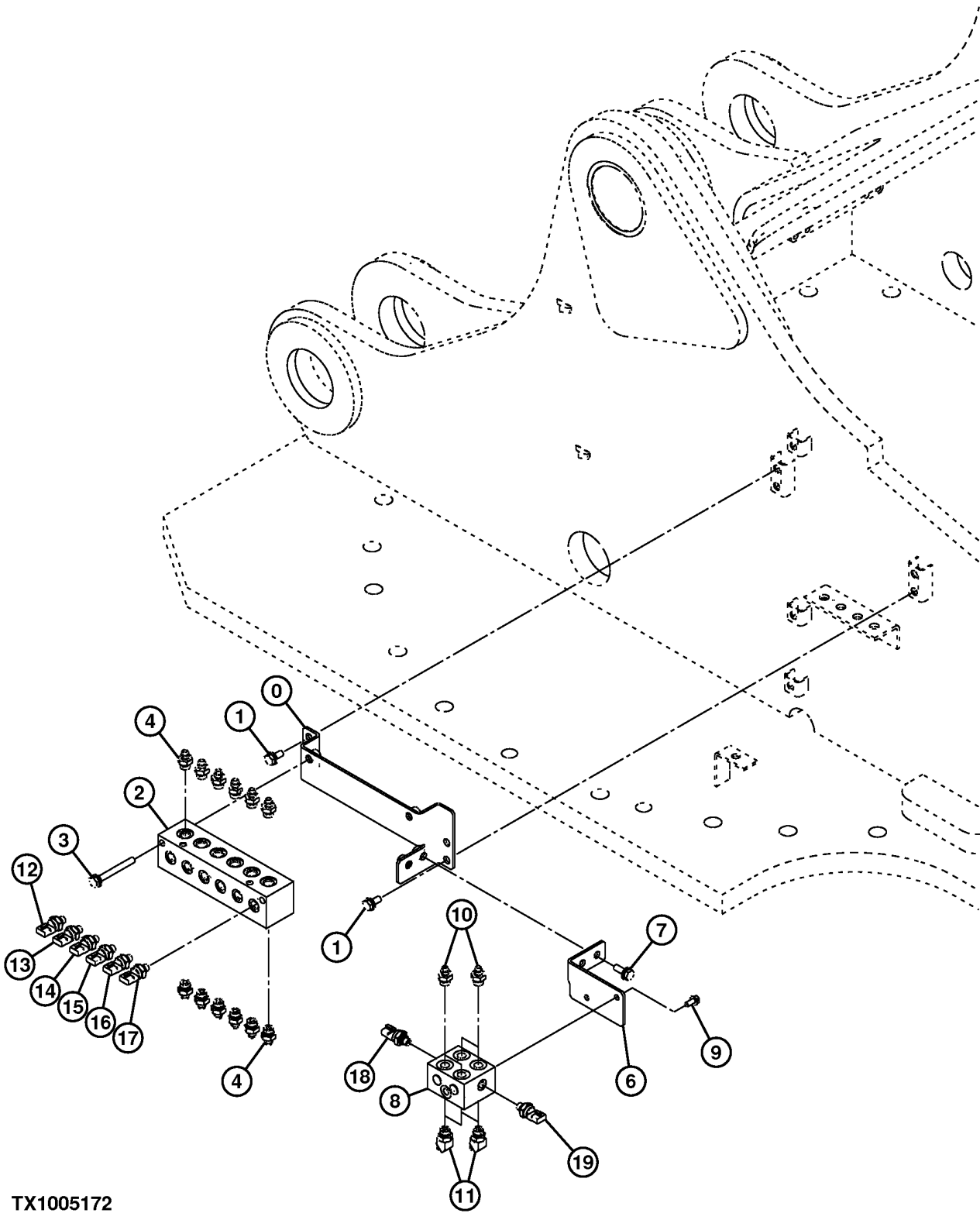
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Hydraulic System



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Hydraulic System

0—Bracket	6 —Bracket	11—Elbow Fitting (4 used)	16—Arm In Sensor
1—Cap Screw (4 used)	7—Cap Screw (2 used)	12—Boom Down Sensor	17—Arm Out Sensor
2—Digging Sensor Manifold	8—Travel Sensor Manifold	13—Boom Up Sensor	18—Right Travel Sensor
3—Cap Screw (2 used)	9—Cap Screw (2 used)	14—Bucket Dump Sensor	19—Left Travel Sensor
4—Adapter Fitting (12 used)	10—Adapter Fitting (4 used)	15—Bucket Curl Sensor	

2. Attach identification tags to lines and fittings. Disconnect hydraulic lines from digging sensor manifold (2). Close all openings using caps and plugs.
3. Remove cap screws (3) to remove digging sensor manifold (2) from bracket (0).
4. Repair or replace parts as necessary.
5. Install digging sensor manifold to bracket using cap screws.
6. Connect hydraulic lines. See Pilot Control Valve-to-Pilot Signal Manifold Component Location—Excavator Pattern. (Group 9025-15.)

See Pilot Control Valve-to-Pilot Signal Manifold Component Location—Backhoe Pattern. (Group 9025-15.)

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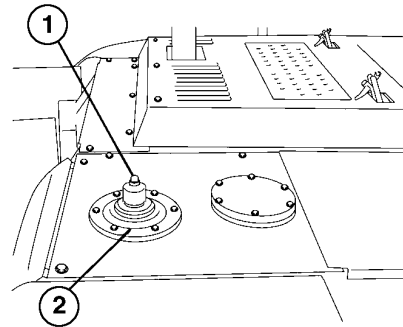
Travel Sensor Manifold Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Release pressure by pushing hydraulic oil tank pressure release button (1).

1—Pressure Release Button
2—Hydraulic Oil Tank Cover



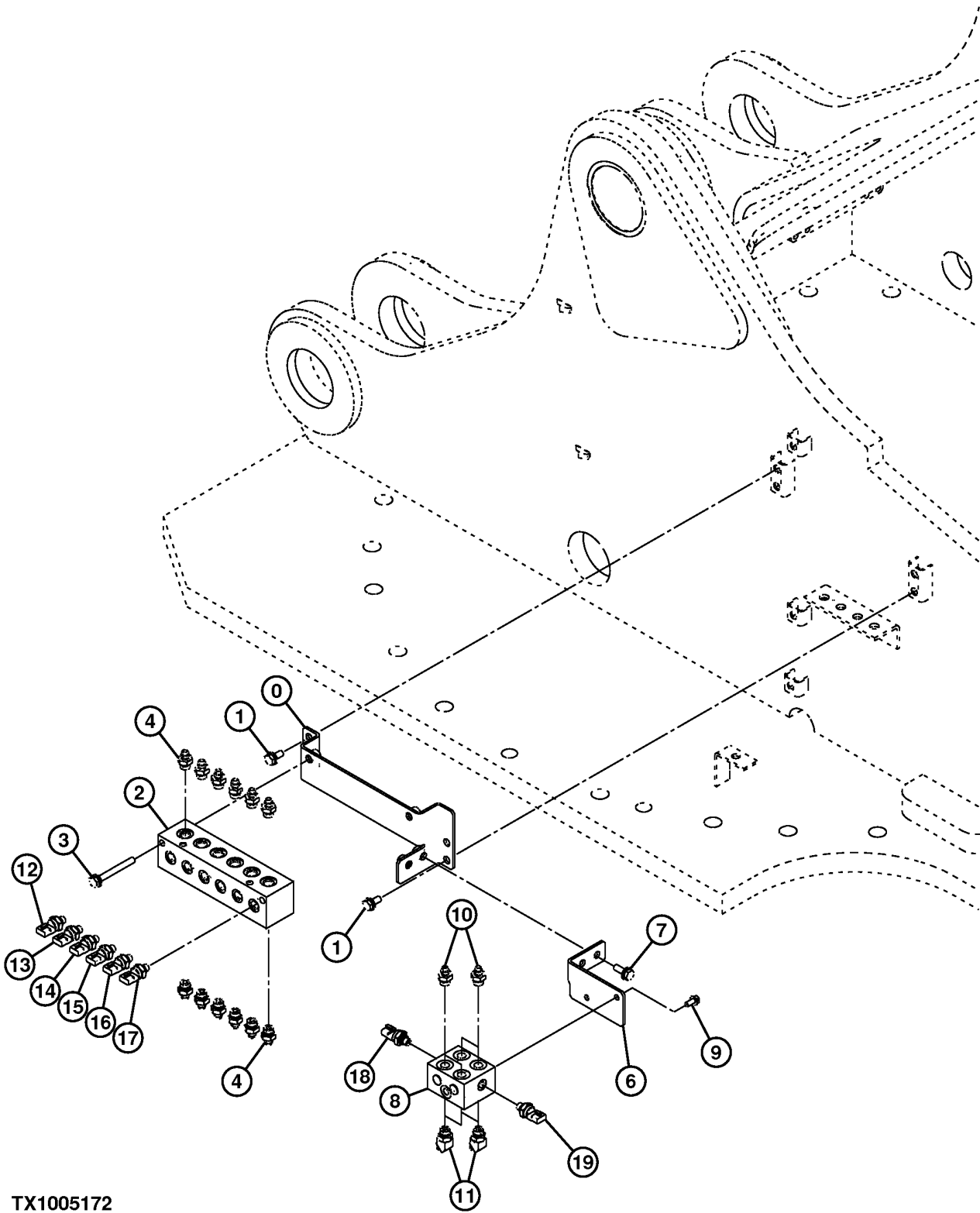
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Hydraulic System



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Hydraulic System

0—Bracket	6 —Bracket	11—Elbow Fitting (4 used)	16—Arm In Sensor
1—Cap Screw (4 used)	7—Cap Screw (2 used)	12—Boom Down Sensor	17—Arm Out Sensor
2—Digging Sensor Manifold	8—Travel Sensor Manifold	13—Boom Up Sensor	18—Right Travel Sensor
3—Cap Screw (2 used)	9—Cap Screw (2 used)	14—Bucket Dump Sensor	19—Left Travel Sensor
4—Adapter Fitting (12 used)	10—Adapter Fitting (4 used)	15—Bucket Curl Sensor	

2. Attach identification tags to lines and fittings. Disconnect hydraulic lines from travel sensor manifold (8). Close all openings using caps and plugs.
3. Remove cap screws (9) to remove travel sensor manifold (8) from bracket (6).
4. Repair or replace parts as necessary.
5. Install travel sensor manifold to bracket using cap screws.
6. Connect hydraulic lines to travel sensor manifold.

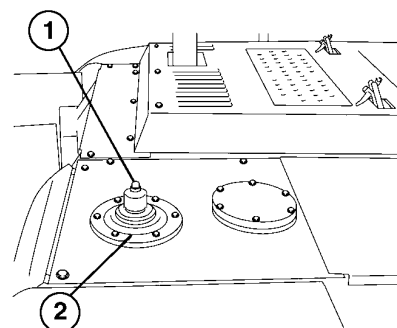
TX17984,00000E0 -19-02AUG06-3/3

Pilot Signal Manifold Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing pressure release button.

1. Push pressure release button (1).
2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)

See 450DLC Drain and Refill Capacities. (Operator's Manual.)



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

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Hydraulic System

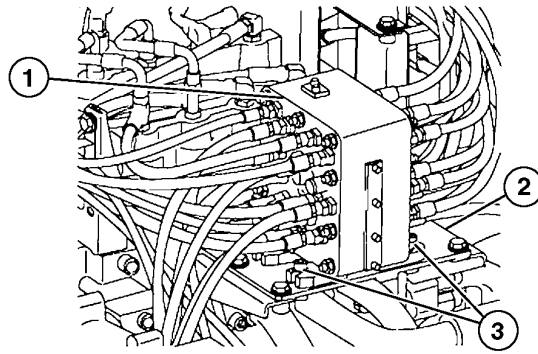
3. Attach identification tags to fittings. Disconnect hydraulic lines. Close all openings using caps and plugs.
4. Attach identification tags to electrical connectors and disconnect.
5. Remove cap screws (3).
6. Remove pilot signal manifold (1).
7. Repair or replace parts as necessary.
8. Position pilot signal manifold on bracket (2) and tighten cap screws to specification.

Specification

Pilot Signal Manifold-to-Bracket	
Cap Screw—Torque.....	50 N•m 36 lb-ft

9. Connect electrical connectors. See System Functional Schematic, Wiring Diagram, and Component Location Master Legend. (Group 9015-10.)
10. Connect hydraulic lines. For Excavator pattern see Pilot Control Valve-to-Pilot Signal Manifold Component Location—Excavator Pattern. (Group 9025-15.)

For Backhoe pattern see Pilot Control Valve-to-Pilot Signal Manifold Component Location—Backhoe Pattern. (Group 9025-15.)
11. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)



Pilot Signal Manifold

- 1—Pilot Signal Manifold
- 2—Bracket
- 3—Cap Screw (4 used)

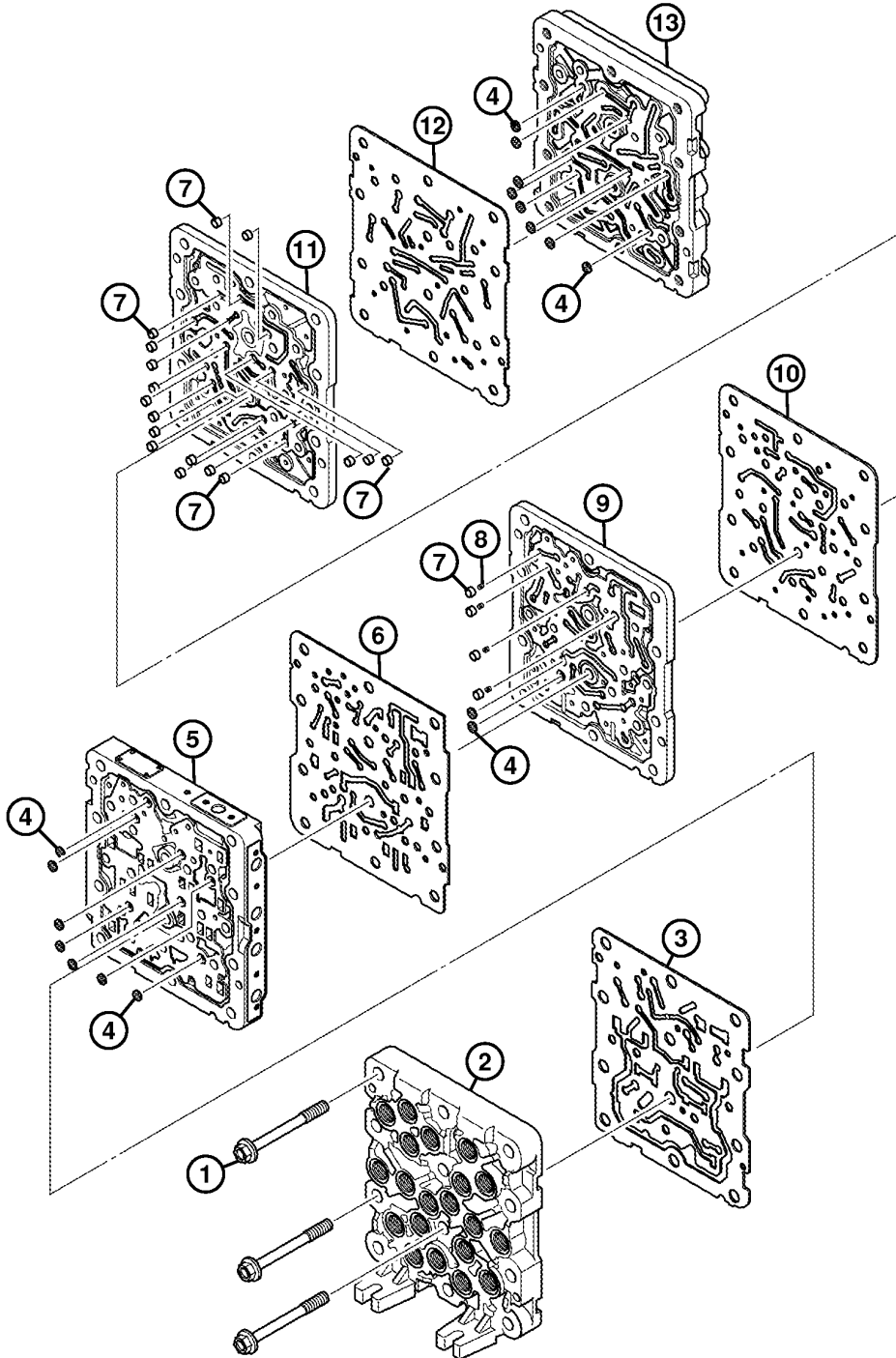
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Hydraulic System

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Pilot Signal Manifold Disassemble and Assemble



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Pilot Signal Manifold 1 of 2

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Hydraulic System

1—Cap Screw (10 used)
2—Body 1
3—Gasket
4—Filter (17 used)

5—Body 2
6—Gasket
7—Sleeve (21 used)

8—Spring (4 used)
9—Body 3
10—Gasket

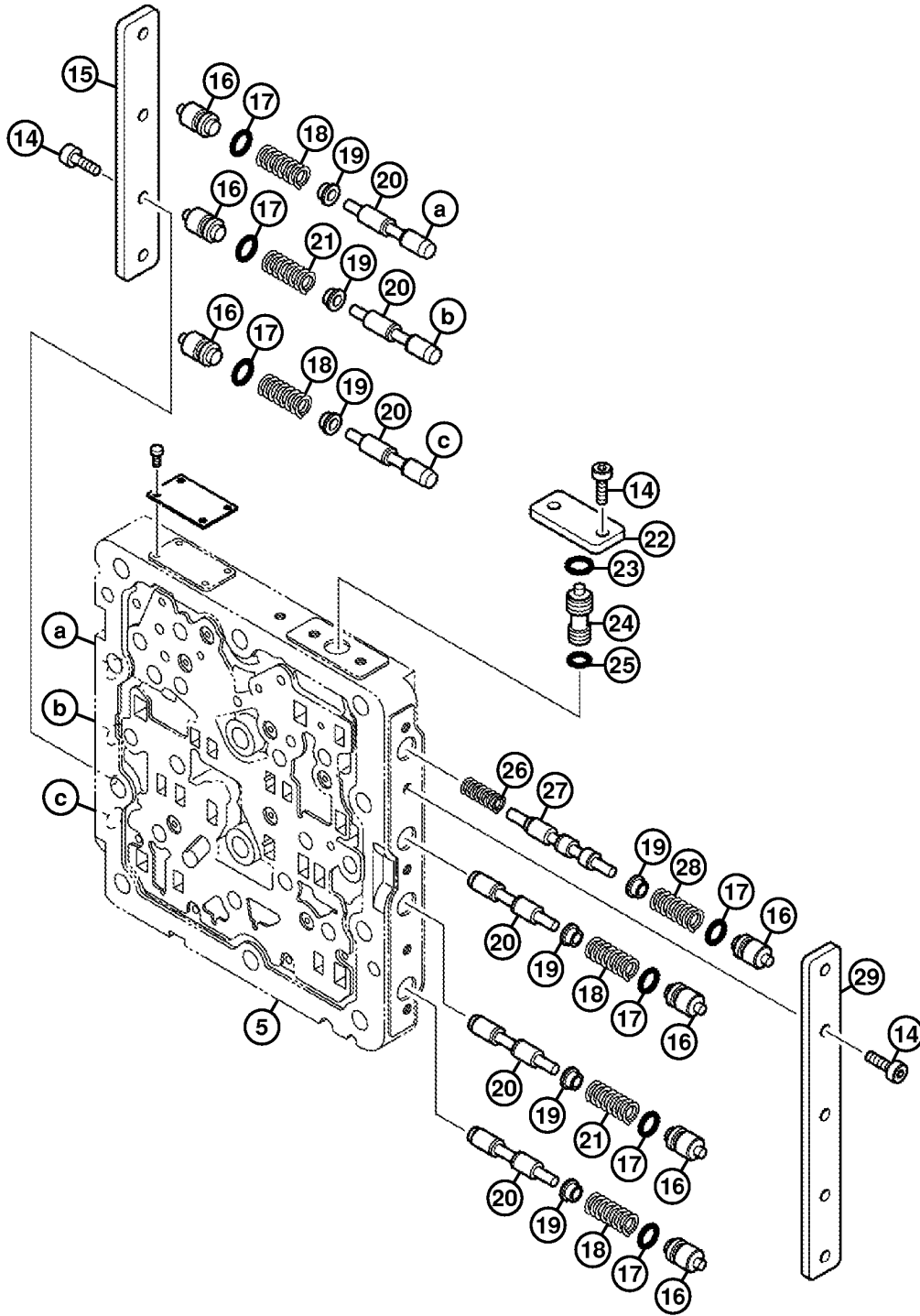
11—Body 4
12—Gasket
13—Body 5

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Hydraulic System



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Pilot Signal Manifold Body 2

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Hydraulic System

5—Body 2	18—Spring (4 used)	22—Plate	26—Spring
14—Cap Screw (11 used)	19—Spring Guide (7 used)	23—O-Ring	27—Spool
15—Plate	20—Spool (6 used)	24—Shuttle Valve	28—Spring
16—Plug (7 used)	21—Spring (2 used)	25—O-Ring	29—Plate
17—O-Ring (7 used)			

1. Disassemble, clean and inspect all parts.
2. Replace parts as necessary.
3. Apply hydraulic oil to parts (16—28) and assemble.

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Counterweight Pilot Control Valve Remove and Install

1. Release hydraulic circuit pressure. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)



CAUTION: High Pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

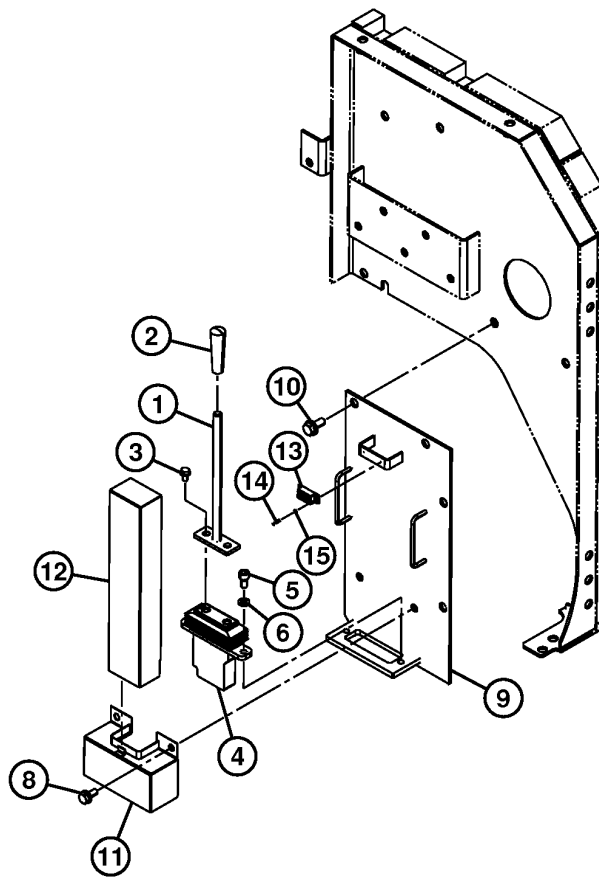
2. Push pressure release button on top of hydraulic oil tank to relieve tank pressure.
3. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)

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Hydraulic System



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Hydraulic System

- | | | | |
|-------------------------------------|---------------------------------|----------------------------------|-------------------------|
| 1—Lever | 5—Cap Screw (2 used) | 9—Plate | 12—Cover |
| 2—Grip | 6—Lock Washer (2 used) | 10—Cap Screw and Washer (4 used) | 13—Catch |
| 3—Cap Screw and Washer (2 used) | 8—Cap Screw and Washer (2 used) | 11—Cover | 14—Cap Screw (2 used) |
| 4—Counterweight Pilot Control Valve | | | 15—Lock Washer (2 used) |

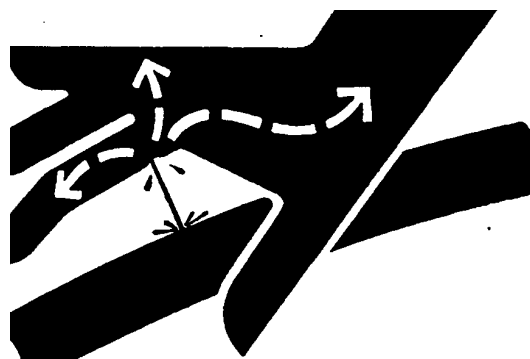
4. Remove cover (12).

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CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other line. Tighten all connections before applying pressure.

5. Disconnect hoses from counterweight pilot control valve (4). Close all openings using caps and plugs. See Counterweight Removal Hydraulic System Line Connections. (Group 9025-15.)
6. Remove cover (11).
7. Remove counterweight pilot control valve.
8. Repair or replace parts as necessary.
9. Install counterweight pilot control valve (4).
10. Install cover (11).
11. Connect hoses to counterweight pilot control valve. See Counterweight Removal Hydraulic System Line Connections. (Group 9025-15.)
12. Install cover (12).
13. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

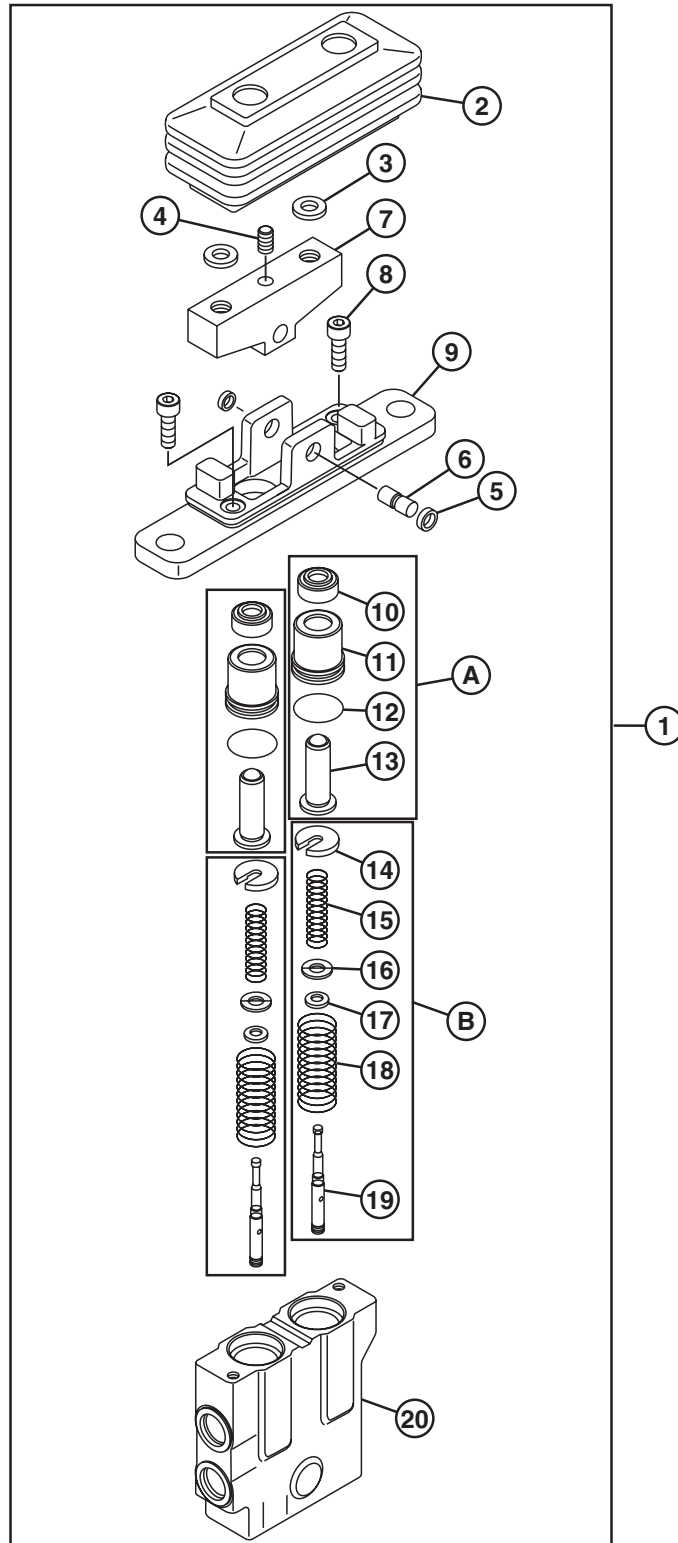


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Counterweight Pilot Control Valve Disassemble and Assemble



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Hydraulic System


A—Piston Assembly (2 used)	5—Bushing (2 used)	11—Bushing (2 used)	16—Shim (6 used)
B—Spool Assembly (2 used)	6—Pin	12—O-Ring (2 used)	17—Spacer (2 used)
1—Valve	7—Cam	13—Piston (2 used)	18—Compression Spring (2 used)
2—Boot	8—Cap Screw (2 used)	14—Guard (2 used)	19—Spool (2 used)
3—Spacer (2 used)	9—Base	15—Compression Spring (2 used)	20—Case
4—Set Screw	10—Seal (2 used)		

1. Remove boot (2) and spacers (3).
2. Remove parts (4—6) to remove cam (7).
3. Remove cap screws (8) to remove base (9).
- NOTE: Keep each set of parts together so they can be installed into the same bore from which they were removed.*
4. Remove piston assemblies (A) and spool assemblies (B) from case (20).
5. Remove parts (10—12) from pistons (13).
6. Remove parts (14—18) from spools (19).
7. Repair or replace parts as necessary.
8. Apply clean hydraulic oil to all internal parts.
9. Assemble parts (14—19).
10. Assemble parts (10—13).
11. Install piston assemblies (A) and spool assemblies (B) in same bores from which they were removed.
12. Push down on base so screws (8) can be started into case (20).
13. Tighten screws evenly until base (9) is against case (20).
14. Install parts (2—7).

TX17984,00000E2 -19-02AUG06-2/2

Counterweight Slow Return Valve Remove and Install

1. Release hydraulic circuit pressure. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)

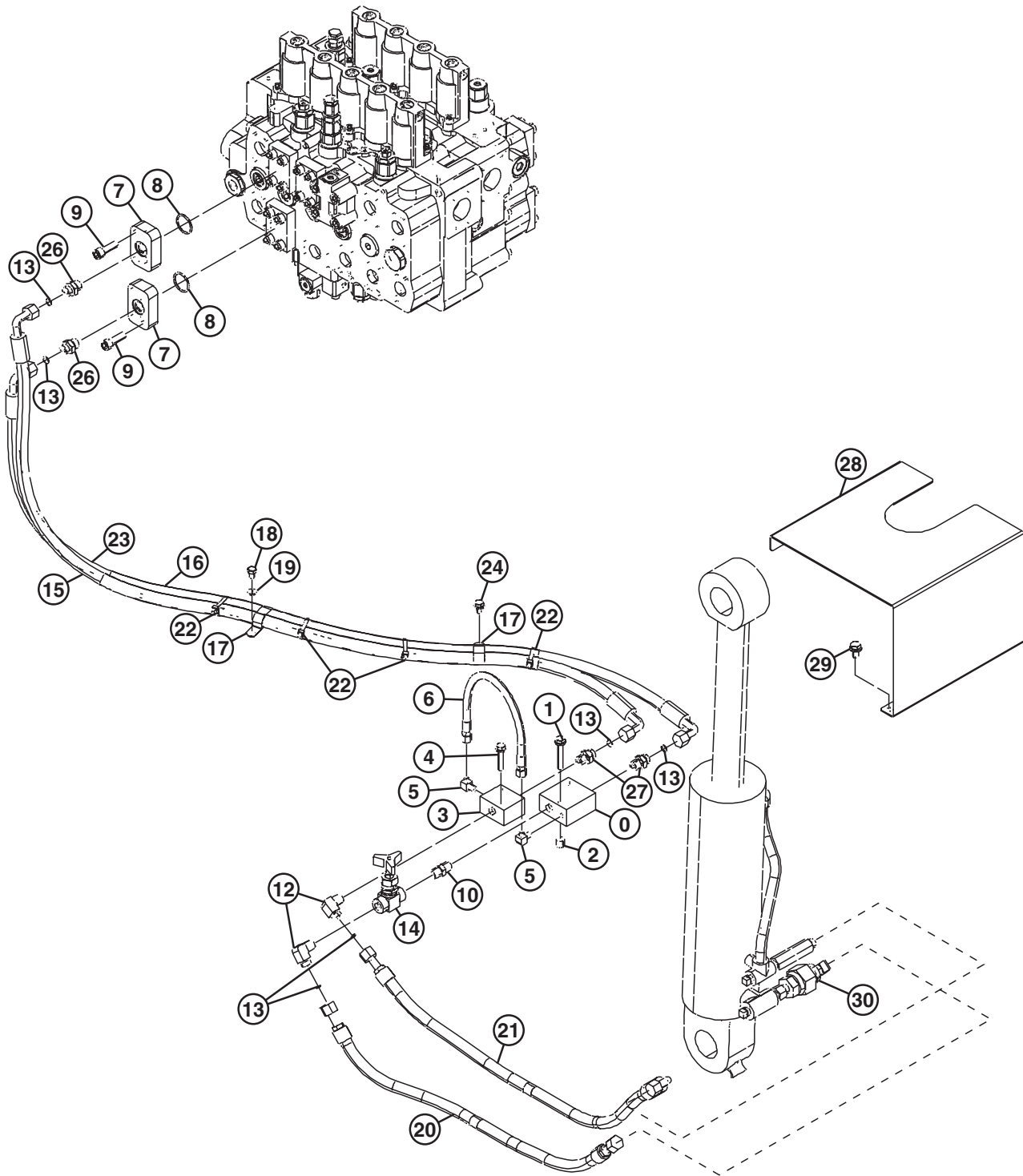
 **CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.**

2. Push pressure release button on top of hydraulic oil tank to relieve tank pressure.
3. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)

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Hydraulic System



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Hydraulic System

0—Check Valve	6—Hydraulic Hose	16—Hose Guard (4 used)	24—Cap Screw and Washer
1—Cap Screw and Washer (2 used)	7—Flange Fitting (2 used)	17—Clamp (2 used)	26—Adapter Fitting (2 used)
2—Spacer (2 used)	8—O-Ring (2 used)	18—Cap Screw	27—Adapter Fitting (2 used)
3—Manifold	9—Cap Screw (8 used)	19—Lock Washer	28—Cover
4—Cap Screw and Washer (2 used)	10—Adapter Fitting	20—Hydraulic Hose	29—Cap Screw and Washer (3 used)
5—Elbow Fitting (2 used)	12—Elbow Fitting (2 used)	21—Hydraulic Hose	30—Slow Return Valve
	13—O-Ring (6 used)	22—Tie Band	
	14—Shutoff Valve	23—Hydraulic Hose (2 used)	

4. Remove cover (28).



CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

5. Disconnect hydraulic hose (20). Close all openings using caps and plugs.

6. Remove slow return valve (30).

7. Repair or replace parts as necessary.

8. Install slow return valve (30).

9. Connect hydraulic hose (20).

10. Install cover (28).

11. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

TX17984.00000E3 -19-02AUG06-3/3

Counterweight Shutoff Valve Remove and Install

1. Release hydraulic circuit pressure. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

2. Push pressure release button on top of hydraulic oil tank to relieve tank pressure.

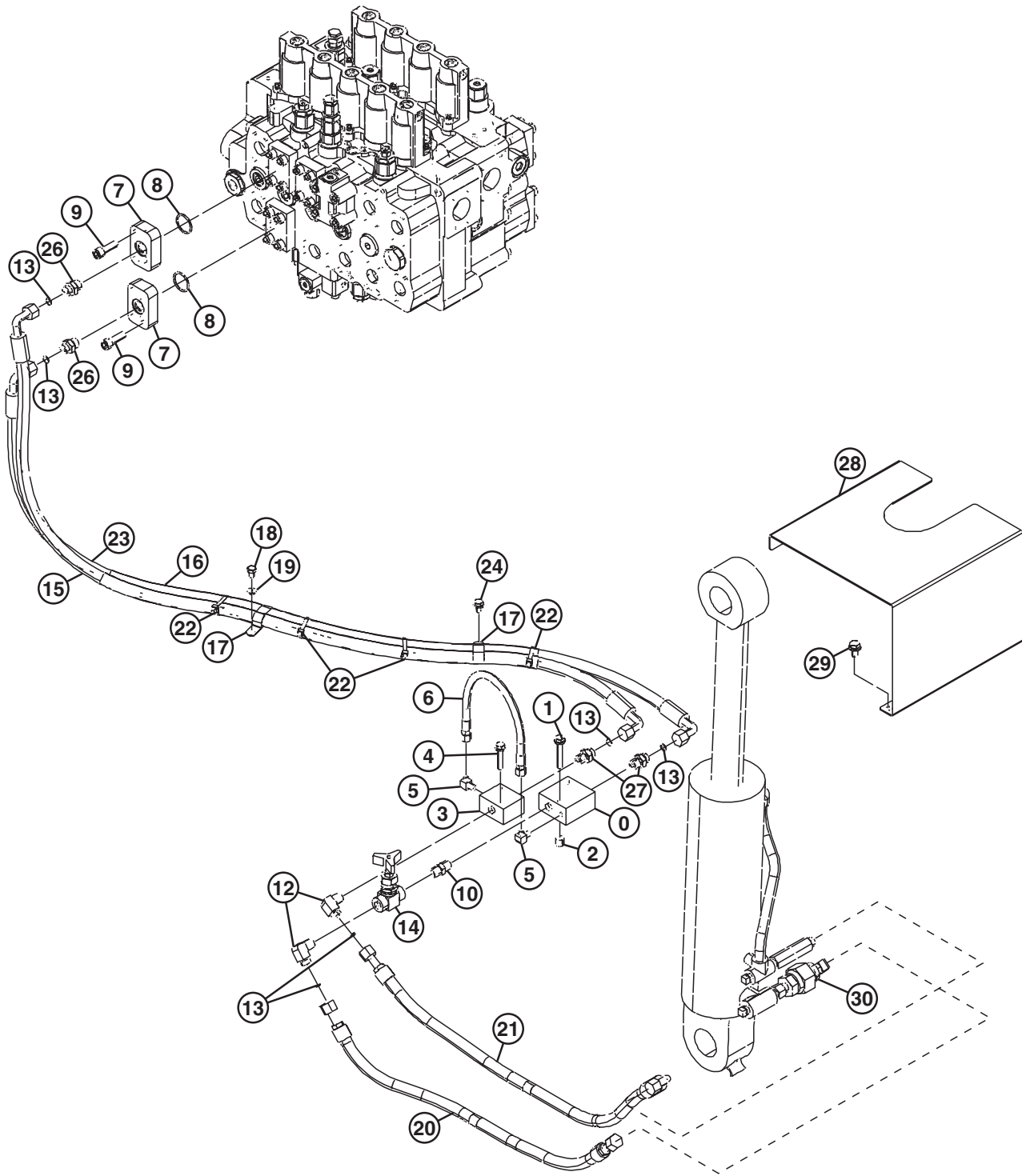
3. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)

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Hydraulic System



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Hydraulic System

0—Check Valve	6—Hydraulic Hose	16—Hose Guard (4 used)	24—Cap Screw and Washer
1—Cap Screw and Washer (2 used)	7—Flange Fitting (2 used)	17—Clamp (2 used)	26—Adapter Fitting (2 used)
2—Spacer (2 used)	8—O-Ring (2 used)	18—Cap Screw	27—Adapter Fitting (2 used)
3—Manifold	9—Cap Screw (8 used)	19—Lock Washer	28—Cover
4—Cap Screw and Washer (2 used)	10—Adapter Fitting	20—Hydraulic Hose	29—Cap Screw and Washer (3 used)
5—Elbow Fitting (2 used)	12—Elbow Fitting (2 used)	21—Hydraulic Hose	30—Slow Return Valve
	13—O-Ring (6 used)	22—Tie Band	
	14—Shutoff Valve	23—Hydraulic Hose (2 used)	

4. Remove cover (28).



CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

5. Disconnect hydraulic hose (20). Close all openings using caps and plugs.

6. Remove shutoff valve (14).

7. Repair or replace parts as necessary.

8. Install shutoff valve (14).

9. Connect hydraulic hose (20).

10. Install cover (28).

11. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

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Counterweight Check Valve Remove and Install

1. Release hydraulic circuit pressure. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

2. Push pressure release button on top of hydraulic oil tank to relieve tank pressure.

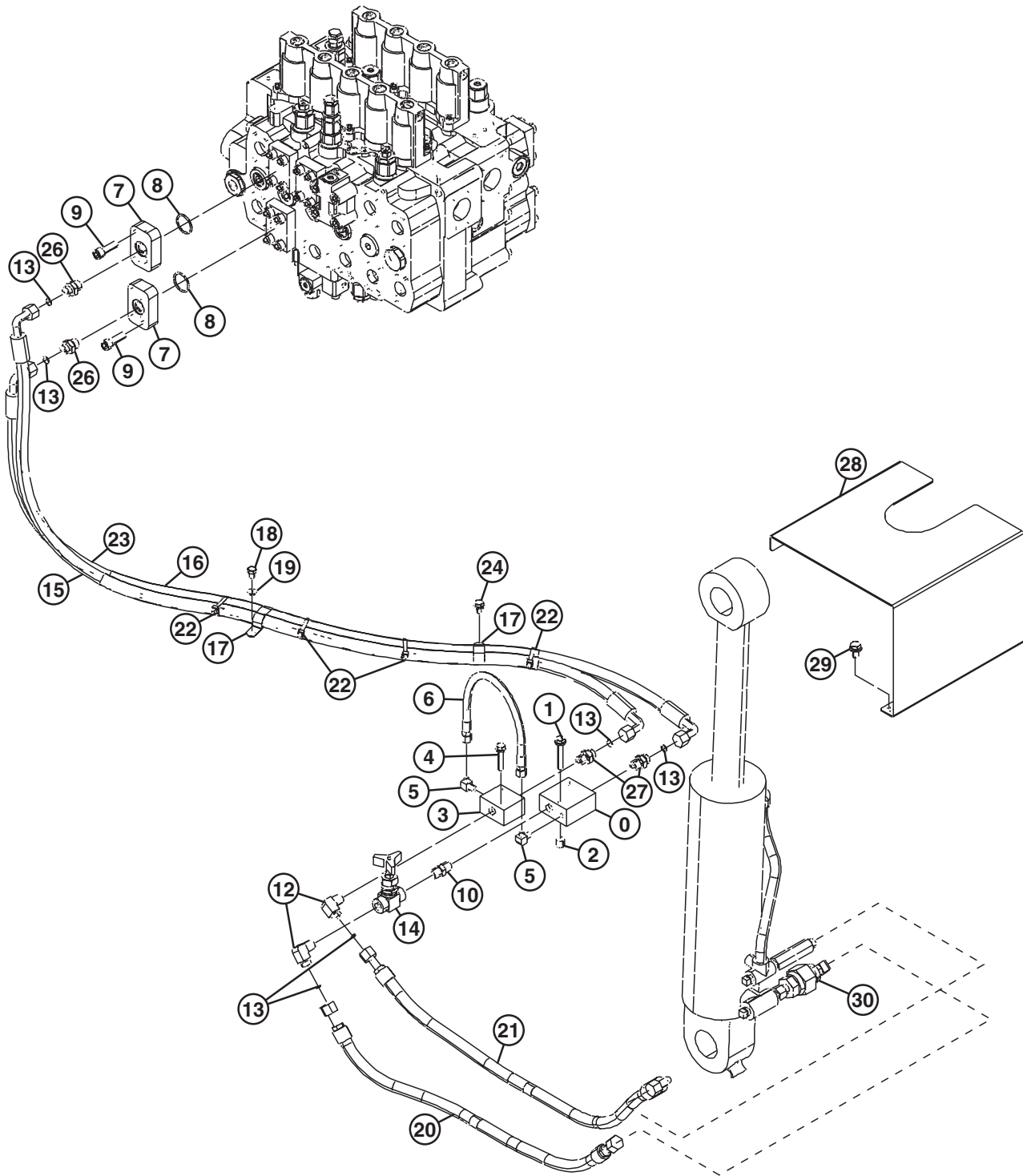
3. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)

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Hydraulic System



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Hydraulic System

0—Check Valve	6—Hydraulic Hose	15—Hydraulic Hose	23—Hydraulic Hose
1—Cap Screw and Washer (2 used)	7—Flange Fitting (2 used)	16—Hose Guard (4 used)	24—Cap Screw and Washer
2—Spacer (2 used)	8—O-Ring (2 used)	17—Clamp (2 used)	26—Adapter Fitting (2 used)
3—Manifold	9—Cap Screw (8 used)	18—Cap Screw	27—Adapter Fitting (2 used)
4—Cap Screw and Washer (2 used)	10—Adapter Fitting	19—Lock Washer	28—Cover
5—Elbow Fitting (2 used)	12—Elbow Fitting (2 used)	20—Hydraulic Hose	29—Screw and Washer (3 used)
	13—O-Ring (6 used)	21—Hydraulic Hose	30—Slow Return Valve
	14—Shutoff Valve	22—Tie Band	

4. Remove cover (28).

CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

5. Disconnect hydraulic hoses (6, 20, and 23). Close all openings with caps and plugs.

6. Remove check valve (0).

7. Repair or replace parts as necessary.

8. Install check valve (0).

9. Connect hydraulic hoses (6, 20, and 23).

10. Install cover (28).

11. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

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Control Valve Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

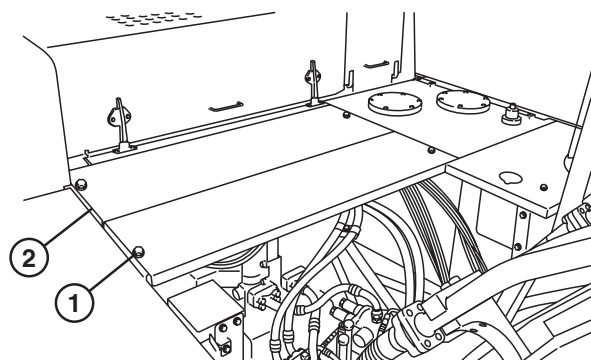
1. Push the pressure release button on top of hydraulic oil tank to relieve pressure.

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2. Remove cap screws (1).

3. Remove covers (2).

1—Cap Screw (4 used)
2—Cover (2 used)



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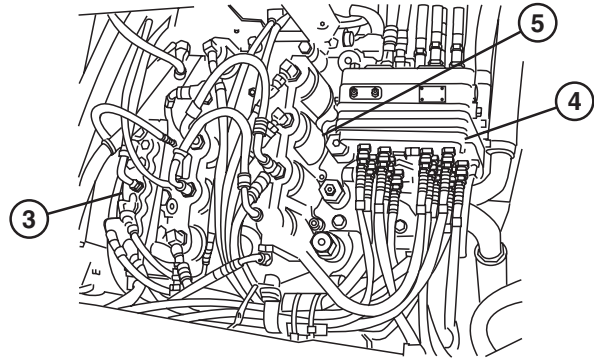
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Hydraulic System

4. Attach identification tags to all lines connected to control valve (5). See Control Valve Line Identification. (Group 9025-15.)
5. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)
6. Disconnect all lines connected to control valve (5). Close all openings using caps and plugs. See Control Valve Line Identification. (Group 9025-15.)
7. Remove cap screws connecting solenoid valve manifold (3) to control valve (5).
8. Remove cap screws connecting pilot signal manifold (4) bracket to control valve (5).
9. Move solenoid valve manifold (3) and pilot signal manifold (4) away from control valve (5).



3—Solenoid Valve Manifold
4—Pilot Signal Manifold
5—Control Valve

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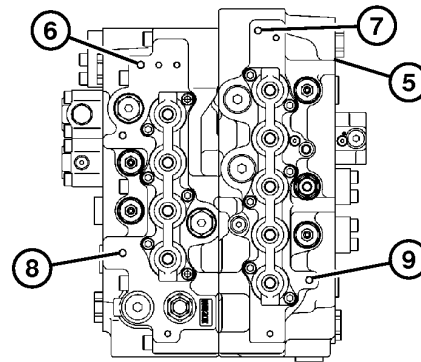
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10. Install M12-1.75 metric lifting eyebolts such as JT05550 Metric Lifting Eyebolts to tapped holes (6—9).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

11. Attach lifting device to control valve (5).

Specification	
Control Valve—Weight	400 kg approximate 880 lb approximate



5—Control Valve
6—Tapped Hole
7—Tapped Hole
8—Tapped Hole
9—Tapped Hole

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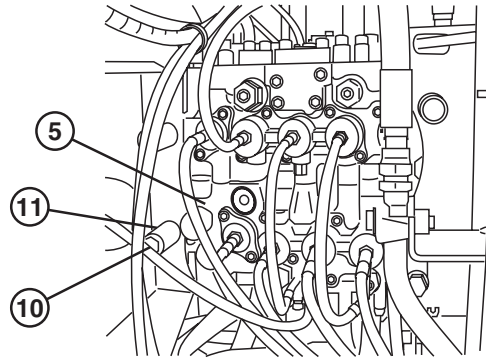
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Hydraulic System

12. Remove cap screws (10) and spacers (11).
13. Remove control valve.
14. Repair or replace parts as necessary.

- 5—Control Valve
- 10—Cap Screw (4 used)
- 11—Spacer (4 used)



TX17984.0000093 -19-02AUG06-5/9

15. Install M12-1.75 metric lifting eyebolts such as JT05550 Metric Lifting Eyebolts to tapped holes (6—9).

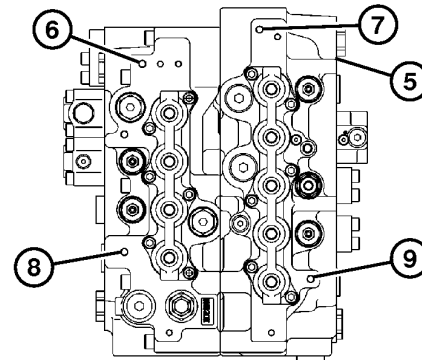
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

16. Attach lifting device to control valve (5).

Specification

Control Valve—Weight 400 kg approximate
880 lb approximate

17. Lift and align control valve (5) to frame.



- 5—Control Valve
- 6—Tapped Hole
- 7—Tapped Hole
- 8—Tapped Hole
- 9—Tapped Hole

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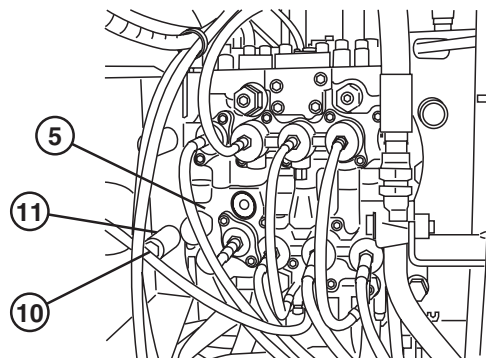
18. Apply PM38654 Thread Lock (high strength) to threads of cap screws (10).

19. Install cap screws (10) and spacers (11).

Specification

Cap Screw—Torque 400 N•m
295 lb-ft

- 5—Control Valve
- 10—Cap Screw (4 used)
- 11—Spacer (4 used)



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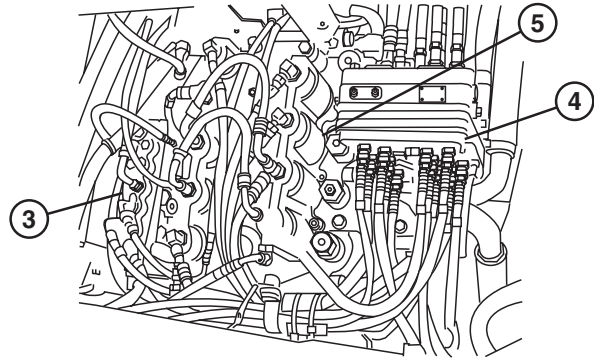
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Hydraulic System

20. Install cap screws connecting solenoid valve manifold (3) to control valve (5).
21. Install cap screws connecting pilot signal manifold (4) bracket to control valve (5).
22. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)
23. Connect all lines to control valve (5). See Control Valve Line Identification. (Group 9025-15.)



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- 3—Solenoid Valve Manifold
- 4—Pilot Signal Manifold
- 5—Control Valve

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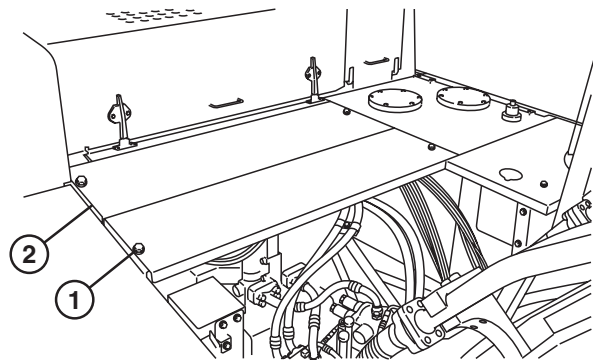
24. Install covers (2) and tighten cap screws (1).

Specification

Cap Screw—Torque..... 90 N•m
66 lb-ft

25. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)
26. Start engine and check for hydraulic oil leaks.

- 1—Cap Screw (4 used)
- 2—Cover (2 used)



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TX17984,0000093 -19-02AUG06-9/9

Control Valve Disassemble and Assemble

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

1. Connect left and right control valve housings (1 and 2) to a hoist using M12-1.75 metric lifting eyebolt such as JT05550 Metric Lifting Eyebolts and a lifting strap.

Specification

Right and Left Control Valve
 Housing—Weight..... 400 kg approximate
 880 lb approximate

See Left Control Valve (5-spool) Disassemble and Assemble for disassemble and assemble of housing components.

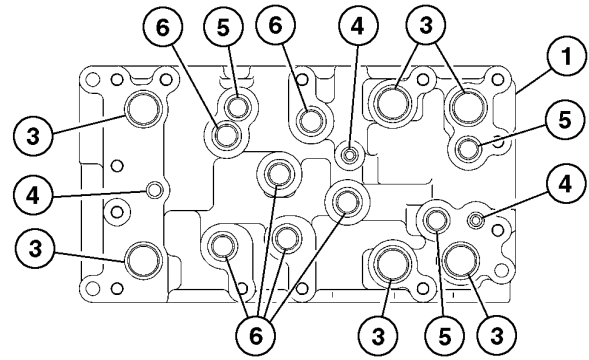
See Right Control Valve (4-spool) Disassemble and Assemble for disassemble and assemble of housing components.

2. Apply grease to O-rings (3—6) to hold them in places.
3. Tighten socket head cap screws and washers (8 and 9) to specification.

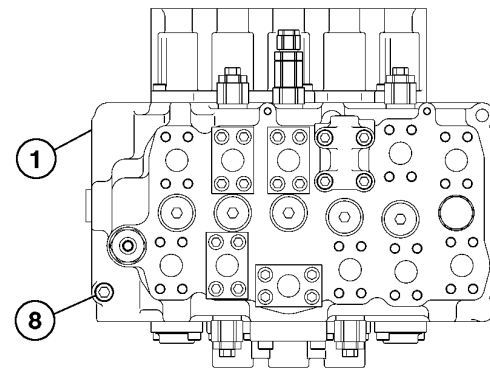
Specification

Right and Left Control Valve
 Housing Cap Screw—Torque..... 250 N•m
 184 lb-ft

- 1—Left Control Valve Housing (4-spool)
- 2—Right Control Valve Housing (5-spool)
- 3—O-Ring (6 used)
- 4—O-Ring (3 used)
- 5—O-Ring (3 used)
- 6—O-Ring (6 used)
- 8—Socket Head Cap Screw and Washer (8 used)
- 9—Socket Head Cap Screw and Washer (6 used)



O-Ring Locations



Socket Head Cap Screws and Washers

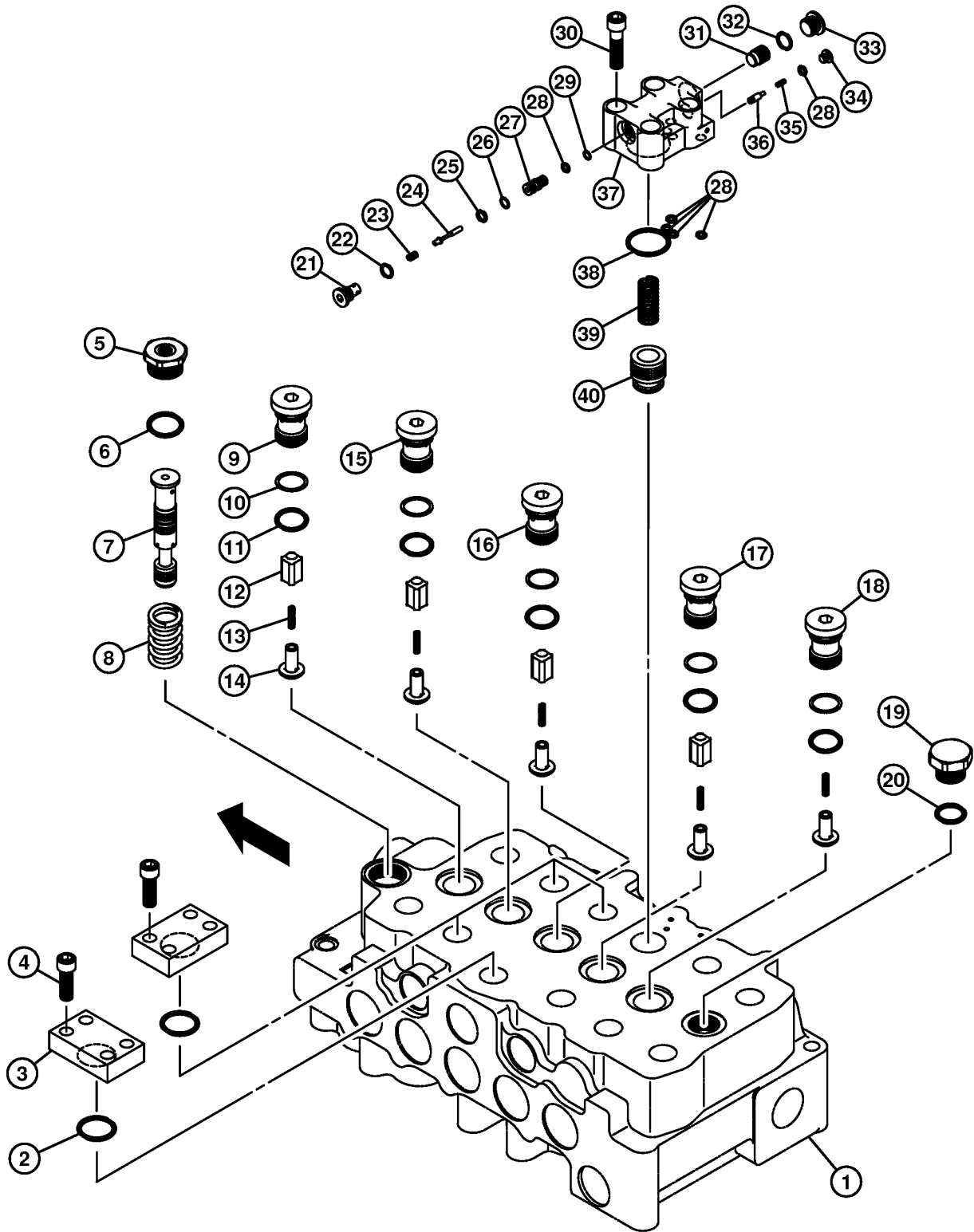
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Left Control Valve (5-Spool) Disassemble and Assemble



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TX1008976

Check Valves and Arm Reduced Leakage Valve
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TX1008976 -UN-07JUL06

Hydraulic System

- | | | | |
|-------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------|
| 1—Left Control Valve Housing (5-spool) | 10—Backup Ring (5 used) | 19—Plug | 31—Piston |
| 2—O-Ring (4 used) | 11—O-Ring (5 used) | 20—O-Ring | 32—O-Ring |
| 3—Flange (4 used) | 12—Check Valve (4 used) | 21—8 mm Plug—Arm Reduced Leakage Valve—Switch Valve | 33—30 mm Plug—Arm Reduced Leakage Valve—Piston |
| 4—Socket Head Cap Screw (16 used) | 13—Spring (5 used) | 22—O-Ring | 34—5 mm Plug—Arm Reduced Leakage Valve—Check Valve |
| 5—46 mm Plug—Bypass Shutoff Valve (bucket flow combiner) | 14—Check Valve (5 used) | 23—Spring | 35—Spring |
| 6—O-Ring | 15—14 mm Plug—Neutral Passage Check Valve (auxiliary lift check) | 24—Poppet—Arm Reduced Leakage Valve—Switch Valve | 36—Check Valve |
| 7—Spool—Bypass Shutoff Valve (bucket flow combiner) | 16—14 mm Plug—Neutral Passage Check Valve (boom 2 lift check) | 25—O-Ring | 37—Cover—Arm Reduced Leakage Valve |
| 8—Spring | 17—14 mm Plug—Neutral Passage Check Valve (arm 1 lift check) | 26—Backup Ring | 38—O-Ring |
| 9—14 mm Plug—Neutral Passage Check Valve (left travel lift check) | 18—14 mm Plug—Neutral Passage Check Valve (swing lift check) | 27—Sleeve | 39—Spring |
| | | 28—O-Ring (6 used) | 40—Poppet—Arm Reduced Leakage Valve—Check Valve |
| | | 29—Backup Ring | |
| | | 30—Socket Head Cap Screw (4 used) | |

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: It is not always necessary to remove the control valve from the machine to remove and install individual components.

1. Attach left control valve housings (5-spool) (1) to a hoist using M12-1.75 metric lifting eyebolt such as JT05550 Metric Lifting Eyebolts and a lifting strap.

Specification

Left Control Valve (5-spool)—	
Weight.....	200 kg 440 lb

2. See Control Valve Operation for locations of control valve components.

3. Push sleeve (27) from cover—arm reduced leakage valve (37) using a 10 mm (3/8 in.) roll pin punch or a 7 x 10 x 15 mm (0.276 x 0.394 x 591 mm) pipe against the smaller end of sleeve.

4. Repair or replace parts as necessary.

5. Assemble bypass shutoff valve (bucket flow combiner) (5—8)

Tighten 46 mm plug (5) to specification.

Specification

46 mm Plug—Bypass Shutoff Valve (bucket flow combiner) to Left Control Valve Housing—	
Torque.....	250 N•m 185 lb-ft

6. Assemble neutral passage check valves (lift check) (9—18).

Tighten 14 mm plugs (9 and 15—18) to specification.

Specification

Plug—Neutral Passage Check Valve (left travel lift check) to Left Control Valve Housing—	
Torque.....	350 N•m 260 lb-ft
Plug—Neutral Passage Check Valve (auxiliary lift check) to Left Control Valve Housing—	
Torque.....	350 N•m 260 lb-ft
Plug—Neutral Passage Check Valve (boom 2 lift check) to Left Control Valve Housing—	
Torque.....	350 N•m 260 lb-ft

Hydraulic System

Specification

Plug—Neutral Passage Check
Valve (arm 1 lift check) to Left
Control Valve Housing—Torque..... 350 N•m
260 lb-ft

Plug—Neutral Passage Check
Valve (swing lift check) to Left
Control Valve Housing—Torque..... 350 N•m
260 lb-ft

7. Assemble arm reduced leakage valve—switch valve
(21—40).

Tighten 8 mm plug (21) to specification.

Specification

8 mm Plug—Arm Reduced
Leakage Valve—Switch Valve
to Cover—Torque 50 N•m
37 lb-ft

Tighten 30 mm plug (33) to specification.

Specification

30 mm Plug—Arm Reduced
Leakage Valve—Piston to
Cover—Torque 60 N•m
44 lb-ft

Tighten 5 mm plug (34) to specification.

Specification

5 mm Plug—Arm Reduced
Leakage Valve—Check Valve
to Cover—Torque 20 N•m
15 lb-ft

Tighten cover—arm reduced leakage valve (37)-to-left
control valve housing (1) socket head cap screw (30)
to specification.

Specification

Cover—Arm Reduced Leakage
Valve-to-Left Control Valve
Housing Socket Head Cap
Screw—Torque 180 N•m
130 lb-ft

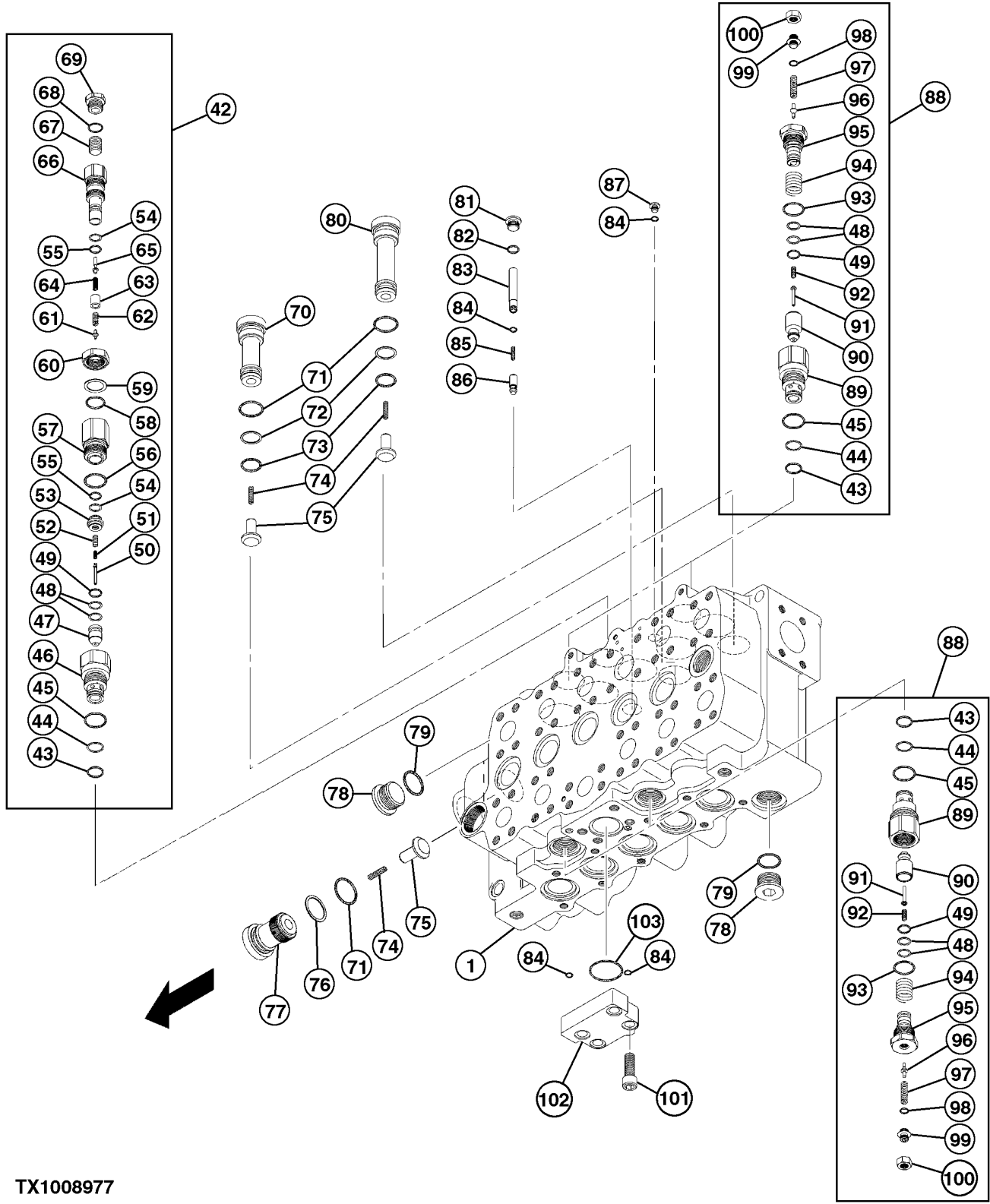
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Hydraulic System

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Hydraulic System



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|----------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------|
| 1—Left Control Valve Housing (5-spool) | 59—Ring | 76—Backup Ring | 88—Circuit Relief Valve (4 used) |
| 42—Boom Mode Relief Valve | 60—36 mm Nut | 77—14 mm Plug—Main Relief Valve Isolation Check Valve (5-spool) | 89—Sleeve (4 used) |
| 43—O-Ring (5 used) | 61—Poppet | 78—Plug (2 used) | 90—Poppet (4 used) |
| 44—Backup Ring (5 used) | 62—Spring | 79—O-Ring (2 used) | 91—Piston (4 used) |
| 45—O-Ring (5 used) | 63—Retainer | 80—14 mm Plug—Power Passage Check Valve (arm 1 in function lift check) | 92—Spring (4 used) |
| 46—Sleeve | 64—Spring | 81—8 mm Plug—Left Travel and Bucket Flow Combining Circuit Check Valve | 93—O-Ring (4 used) |
| 47—Poppet | 65—Poppet | 82—O-Ring | 94—Spring (4 used) |
| 48—Ring (10 used) | 66—Sleeve | 83—Spacer | 95—Valve Seat (4 used) |
| 49—O-Ring (5 used) | 67—Piston | 84—O-Ring (4 used) | 96—Poppet (4 used) |
| 50—Piston | 68—O-Ring | 85—Spring | 97—Spring (4 used) |
| 51—Spring | 69—27 mm Plug | 86—Check Valve | 98—O-Ring (4 used) |
| 52—Spring | 70—14 mm Plug—Power Passage Check Valve (arm 1 out function lift check) | 87—Plug | 99—Adjusting Screw (4 used) |
| 53—Valve Seat | 71—O-Ring (3 used) | | 100—Nut (4 used) |
| 54—Ring | 72—Backup Ring (2 used) | | 101—Socket Head Cap Screw (4 used) |
| 55—O-Ring (2 used) | 73—O-Ring (2 used) | | 102—Cover |
| 56—O-Ring | 74—Spring (3 used) | | 103—O-Ring |
| 57—Sleeve | 75—Check Valve (3 used) | | |
| 58—O-Ring | | | |

8. See Control Valve Operation for locations of control valve components.

Tighten the valve seat (95) to sleeve (89) to specification.

IMPORTANT: The boom mode relief valve and circuit relief valves must be checked and adjusted after assemble to ensure that the pressure settings are correct.

Specification

Circuit Relief Valve—Valve Seat-to-Sleeve—Torque	100 N•m 74 lb-ft
--------------------------------------------------------	---------------------

9. Before disassembling the boom mode relief valve (42) or the circuit relief valves (88), make a mark on the sleeve or adjusting screw and record the number of turns to remove.

Tighten the circuit relief valves (88) to left control valve housing (1) to specification. Apply tighten force to the hexagonal part of sleeve.

Specification

Circuit Relief Valve to Left Control Valve Housing—Torque	100 N•m 74 lb-ft
-----------------------------------------------------------------	---------------------

10. Repair or replace parts as necessary.

11. Assemble main relief valve isolation check valve (5-spool) (71 and 74—77).

Perform Circuit Relief Valve Test and Adjustment to check and adjust pressure setting after assembly.

Tighten 14 mm plug (77) to specification.

13. Assemble power passage check valve (arm 1 out and arm 1 in function lift check) (70—75 and 80).

Tighten 14 mm plugs (70 and 80) to specification.

Specification

14 mm Plug—Main Relief Valve Isolation Check Valve to Left Control Valve Housing (5-spool)—Torque	350 N•m 258 lb-ft
---------------------------------------------------------------------------------------------------------	----------------------

Specification

14 mm Plug—Power Passage Check Valve (arm 1 out function lift check) to Left Control Valve Housing—Torque	350 N•m 258 lb-ft
-----------------------------------------------------------------------------------------------------------------	----------------------

12. Assemble circuit relief valves (43—45, 48, 49, 88, and 89—100).

Hydraulic System

Specification

14 mm Plug—Power Passage Check Valve (arm 1 in function lift check) to Left Control Valve Housing—Torque.....	350 N•m 258 lb-ft
------------------------------------------------------------------------------------------------------------------------	----------------------

14. Assemble left travel and bucket flow combining circuit check valve (81—86).

Tighten 8 mm plug (81) to specification.

Specification

8 mm Plug—Left Travel and Bucket Flow Combining Circuit Check Valve to Left Control Valve Housing—Torque.....	50 N•m 37 lb-ft
------------------------------------------------------------------------------------------------------------------------	--------------------

15. Assemble boom mode relief valve (42—69).

Tighten 27 mm plug (69), 36 mm nut (60), and sleeve (57) to specification.

Specification

Boon Mode Relief Valve—27 mm Plug to Sleeve—Torque	50 N•m 37 lb-ft
Boom Mode Relief Valve— Sleeve-to-Sleeve 36 mm nut— Torque.....	80 N•m 59 lb-ft
Boom Mode Relief Valve— Sleeve to Sleeve—Torque.....	100 N•m 74 lb-ft

Tighten the boom mode relief valve to the left control valve housing to specification. Apply tighten force to the hexagonal part of sleeve.

Specification

Boom Mode Relief Valve to Left Control Valve Housing—Torque.....	100 N•m 74 lb-ft
---------------------------------------------------------------------	---------------------

16. Perform Boom Mode Relief Valve Test and Adjustment to check and adjust pressure setting after assembly.

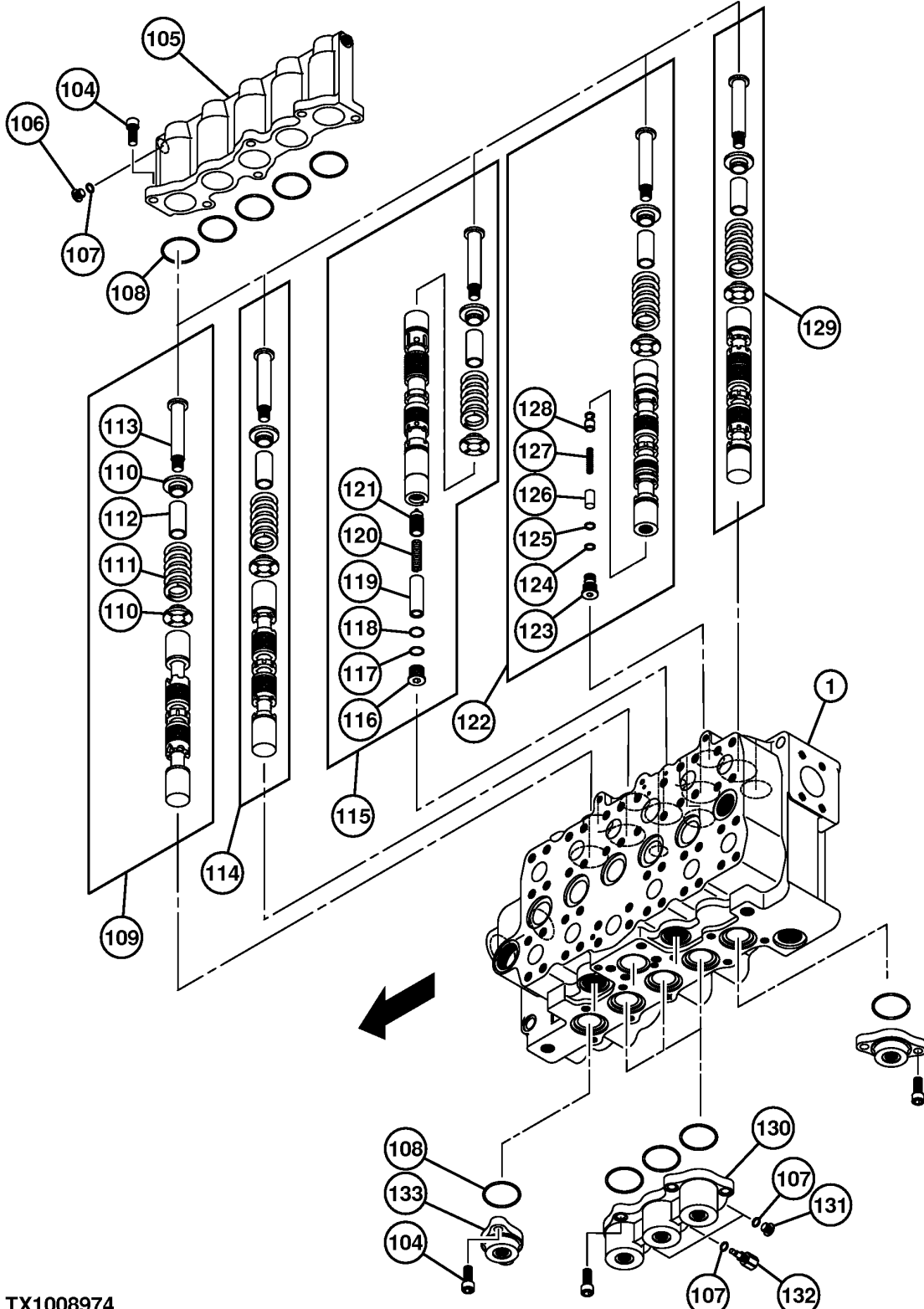
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Hydraulic System

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Hydraulic System



Left Control Valve Spools (5-spool)

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Hydraulic System

- 1—Left Control Valve Housing (5-spool)
- 104—Socket Head Cap Screw (15 used)
- 105—Cover (pilot cap)
- 106—Plug (2 used)
- 107—Packing (3 used)
- 108—O-Ring (10 used)
- 109—Left Travel Spool

- 110—Guide (10 used)
- 111—Centering Spring (5 used)
- 112—Sleeve (5 used)
- 113—Special Screw (5 used)
- 114—Auxiliary Spool
- 115—Boom 2 Spool
- 116—10 mm Plug—Boom 2 Regenerative Valve

- 117—Backup Ring
- 118—O-Ring
- 119—Spacer
- 120—Spring
- 121—Check Valve
- 122—Arm 2 Spool
- 123—8 mm Plug—Arm 1 Regenerative Valve
- 124—Backup Ring

- 125—Packing
- 126—Spacer
- 127—Spring
- 128—Check Valve
- 129—Swing Spool
- 130—Cover (pilot cap)
- 131—Plug
- 132—Special Plug
- 133—Cover (pilot cap) (2 used)

17. See Control Valve Operation for locations of control valve components.

IMPORTANT: The spools are select fitted to the bores in housing and are a different design for each function. Spools must be installed into the same bores from which they were removed for proper operation of machine.

Disassemble the spools only for repair or replacement.

18. Slowly turn the spool (109, 114, 115, 123, 122, and 129) as it is remove from the housing. Put an identification tag on each spool for location to aid assembly.

19. When disassembling a spool, hold the spool in a vise using wooden blocks to protect it. A thread lock (high-strength) is use on the threads of special screws (113).

20. Repair or replace parts as necessary.

21. Assemble the control valve spools (109, 114, 115, 122, and 129).

Clean the thread of special screw and threads in the spool.

Apply PM38654 Thread Lock (high strength) to the threads of special screws.

Tighten the special screws to specification.

Specification

Special Screw-to-Control Valve	
Spool—Torque.....	100 N•m 74 lb-ft

22. Assemble the boom 2 regenerative valve (116—121).

Tighten 10 mm plug (116) to specification.

Specification

10 mm Plug—Boom 2	
Regenerative Valve to Boom 2	
Spool—Torque.....	80 N•m 59 lb-ft

23. Assemble the arm 1 regenerative valve (123—128).

Tighten 8 mm plug (123) to specification.

Specification

8 mm Plug—Arm 1	
Regenerative Valve-to-Arm 1	
Spool—Torque.....	80 N•m 59 lb-ft

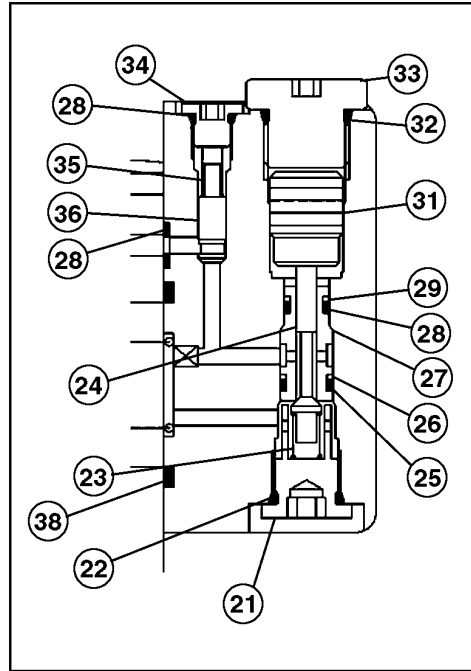
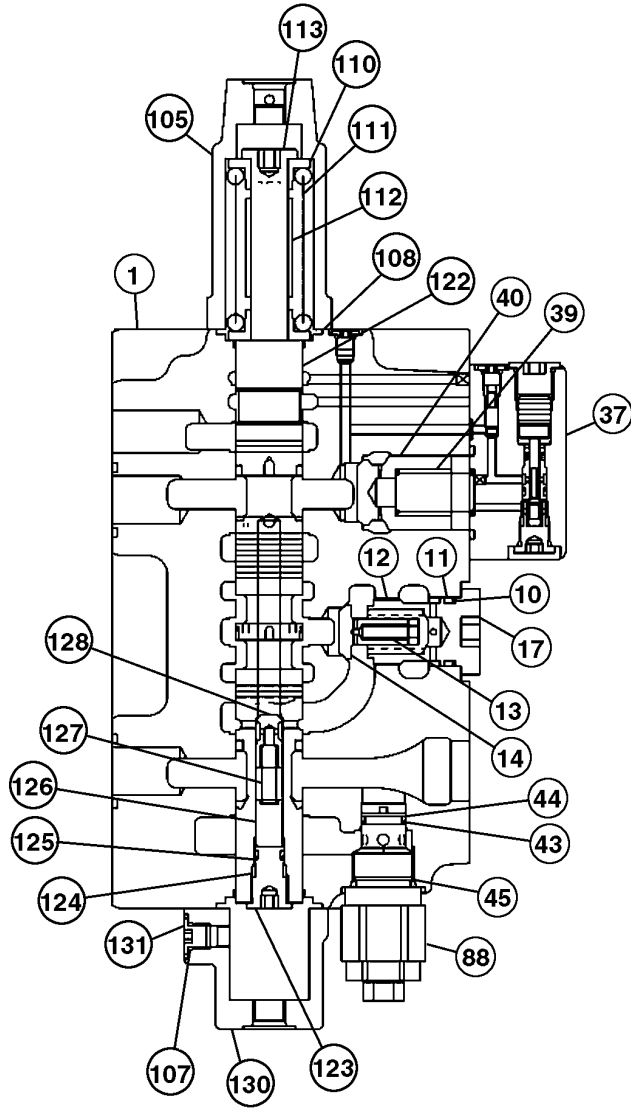
24. Install the spools (109, 114, 115, 122, and 129). The flat on end of spools must be aligned with the special plug (132).

Install the O-rings (108), and covers (pilot caps) (105, 130, and 133).

Tighten socket head cap screws (144) to specification.

Specification

Cover (Pilot Cap)-to-Left	
Control Valve Housing Socket	
Head Cap Screw—Torque	100 N•m 74 lb-ft



TX1009303

Arm 1 Spool and Arm Reduced Leakage Valve Cross Section

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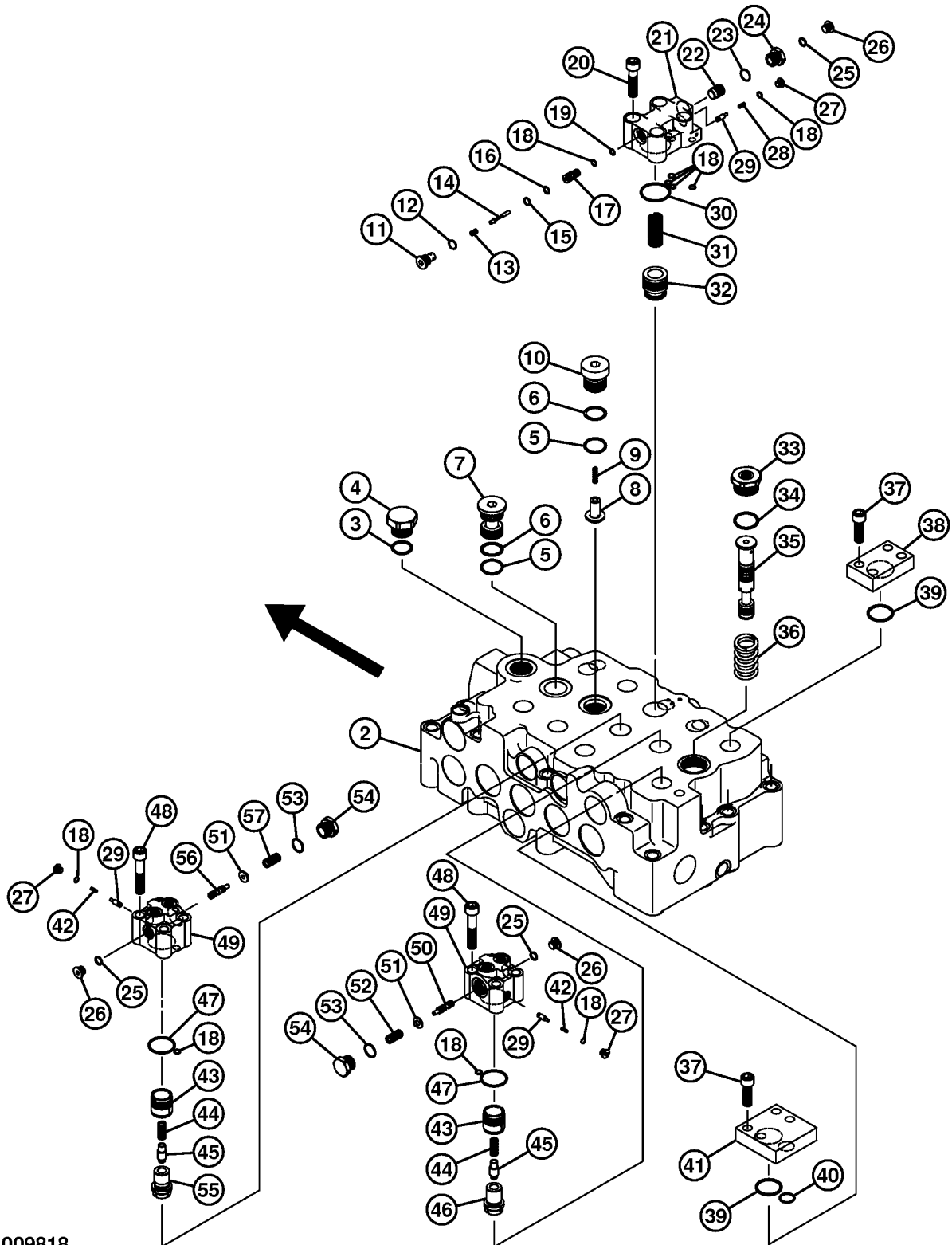
Hydraulic System

1—Left Control Valve Housing (5-spool)	25—O-Ring	39—Spring	110—Guide (2 used)
10—Backup Ring	26—Backup Ring	40—Poppet—Arm Reduced Leakage Valve—Check Valve	111—Centering Spring
11—O-Ring	27—Sleeve		112—Sleeve
12—Check Valve	28—O-Ring (6 used)	43—O-Ring	113—Special Screw
13—Spring	31—Piston	44—Backup Ring	122—Arm 2 Spool
14—Check Valve	32—O-Ring	45—O-Ring	123—8 mm Plug—Arm 1 Regenerative Valve
17—Plug—Neutral Passage Check Valve (arm 1 lift check)	33—Plug	88—Circuit Relief and Anticavitation Valve—Arm Out	124—Backup Ring
21—Plug	34—Plug		125—Packing
22—O-Ring	35—Spring	105—Cover (pilot cap)	126—Spacer
23—Spring	36—Check Valve	107—Packing	127—Spring
24—Poppet—Arm Reduced Leakage Valve—Switch Valve	37—Cover—Arm Reduced Leakage Valve	108—O-Ring	130—Cover (pilot cap)
	38—O-Ring		131—Plug

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Right Control Valve (4-Spool) Disassemble and Assemble



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TX1009818

Boom Reduced Leakage, Flow Rate, and Check Valves

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TX1009818 -JUN-17JUL06

Hydraulic System

2—Right Control Valve Housing (4-spool)	17—Sleeve	33—46 mm Plug	48—Socket Head Cap Screw (8 used)
3—O-Ring	18—O-Ring (10 used)	34—O-Ring	49—Cover—Boom and Arm Flow Rate Control Valve (2 used)
4—Plug	19—Backup Ring	35—Spool—Bypass Shutoff Valve (auxiliary flow combiner)	50—Spool—Arm Flow Rate Control Valve—Switch Valve
5—O-Ring (2 used)	20—Socket Head Cap Screw (4 used)	36—Spring	51—Guide (2 used)
6—Backup Ring (2 used)	21—Cover—Boom 1 Reduced Leakage Valve	37—M14 x 45 mm Socket Head Cap Screw	52—Spring
7—Plug	22—Piston	38—Flange	53—O-Ring (2 used)
8—Power Passage Check Valve (bucket lift check)	23—O-Ring	39—O-Ring (2 used)	54—30 mm Plug
9—Spring	24—30 mm Plug	40—O-Ring	55—Poppet—Boom Flow Rate Control Valve
10—14 mm Fitting Plug	25—Packing (3 used)	41—Flange	56—Spool—Boom Flow Rate Control Valve—Switch Valve
11—8 mm Plug	26—Plug (3 used)	42—Spring (2 used)	57—Spring
12—O-Ring	27—5 mm Plug (3 used)	43—Piston (2 used)	
13—Spring	28—Spring	44—Spring (2 used)	
14—Poppet—Boom 1 Reduced Leakage Valve—Switch Valve	29—Check Valve (3 used)	45—Check Valve (2 used)	
15—O-Ring	30—O-Ring	46—Poppet—Arm Flow Rate Control Valve	
16—Backup Ring	31—Spring	47—O-Ring (2 used)	
	32—Poppet—Boom 1 Reduced Leakage Valve—Check Valve		

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

NOTE: It is not always necessary to remove the control valve from the machine to remove and install individual components.

1. Attach right control valve housings (4-spool) (2) to a hoist using M12-1.75 metric lifting eyebolt such as JT05550 Metric Lifting Eyebolts and a lifting strap.

Specification	
Right Control Valve (4-spool)—	
Weight.....	200 kg 440 lb

2. See Control Valve Operation for locations of control valve components.

3. Push sleeve (17) from cover—boom 1 reduced leakage valve (21) using a 10 mm (3/8 in.) roll pin punch or a 7 x 10 x 15 mm (0.276 x 0.394 x 591 mm) pipe against the smaller end of sleeve.

4. Repair or replace parts as necessary.

5. Assemble bypass shutoff valve (auxiliary flow combiner) (33—36).

Tighten 46 mm plug (33) to specification.

Specification	
46 mm Plug—Bypass Shutoff Valve (auxiliary flow combiner) to Control Valve Housing—	
Torque.....	250 N•m 185 lb-ft

6. Assemble boom flow rate control valve (18, 25—27, 29, 42—45, 47—49, 51, and 53—57) and arm flow rate control valve (18, 25—27, 29, and 42—54).

Tighten 5 mm and 30 mm plugs (27 or 54) in cover—boom and arm flow rate control valve (49) to specification.

Specification	
5 mm Plug to Cover—Boom and Arm Flow Rate Control Valve—Torque.....	20 N•m 15 lb-ft
30 mm Plug to Cover—Boom and Arm Flow Rate Control Valve—Torque.....	60 N•m 44 lb-ft

Tighten cover—boom and arm flow rate control valve-to-right control valve housing cap screws (48) to specification.

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Hydraulic System

Specification

Cover—Boon and Arm Flow
Rate Control Valve-to-Right
Control Valve Housing Cap
Screw—Torque 180 N•m
130 lb-ft

7. Assemble boom 1 reduced leakage valve (11—32).

Tighten plugs (11, 24, and 27) to cover (21) to specification.

Specification

8 mm Plug to Cover—Boom 1
Reduced Leakage Valve—
Torque..... 50 N•m
37 lb-ft

30 mm Plug to Cover—Boom 1
Reduced Leakage Valve—
Torque..... 60 N•m
44 lb-ft

5 mm Plug to Cover—Boom 1
Reduced Leakage Valve—
Torque..... 20 N•m
15 lb-ft

Tighten cover-to-right control valve housing cap screws (20) to specification.

Specification

Cover—Boon 1 Reduced
Leakage Valve-to-Right Control
Valve Housing Cap Screw—
Torque..... 180 N•m
130 lb-ft

8. Assemble power passage check valve (bucket lift check) (6, 5, and 8—10).

Specification

14 mm Fitting Plug for Power
Passage Check Valve (bucket
lift check) to Right Control
Valve Housing—Torque..... 350 N•m
260 lb-ft

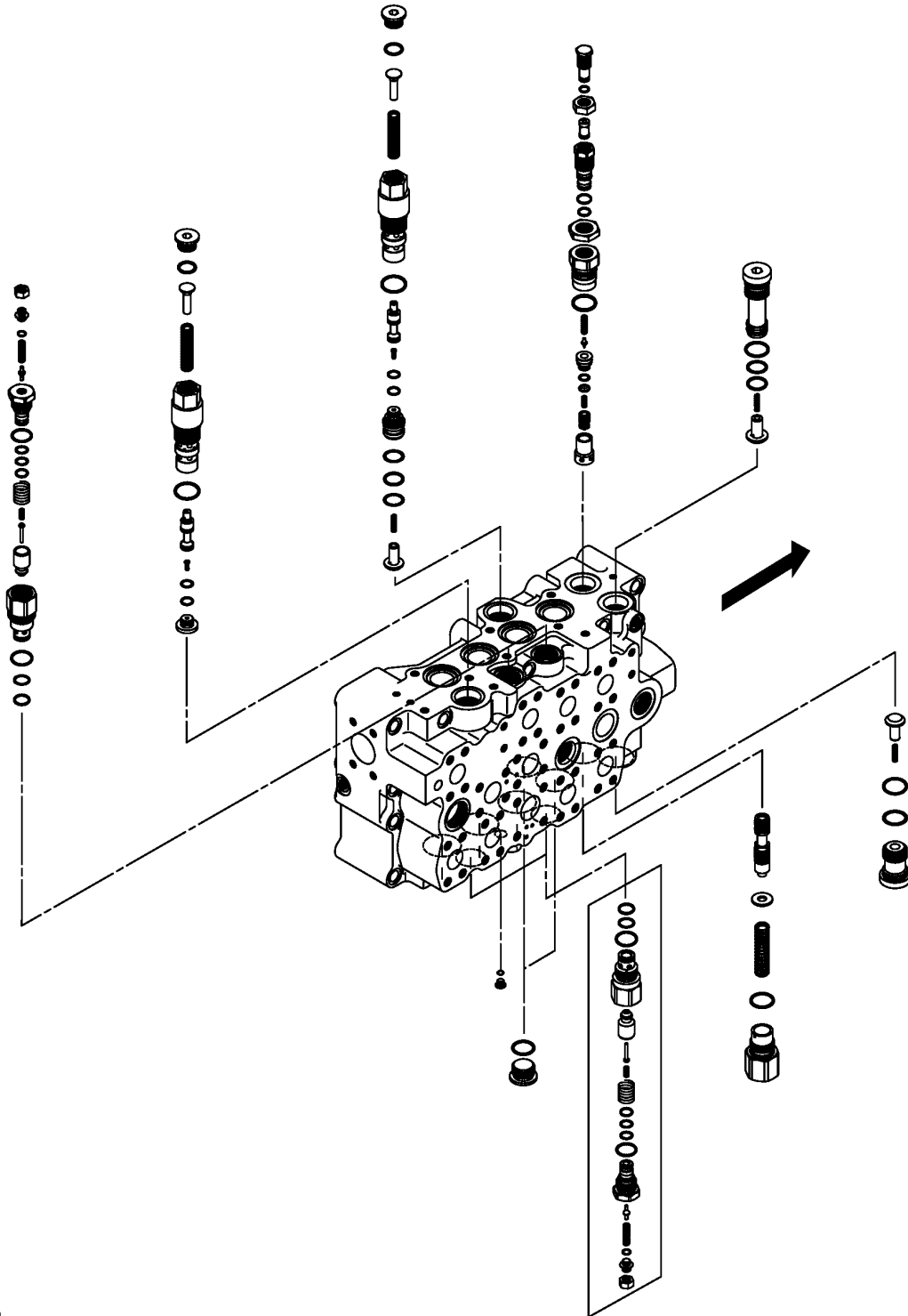
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Hydraulic System

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TX1009819

Main Relief and Power Digging, and Circuit Relief Valves

TX1009819 -UN-17JUL06

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Hydraulic System

2—Right Control Valve (4-spool) 60—Circuit Relief Valve (4 used) 61—O-Ring (4 used) 62—Backup Ring (4 used) 63—O-Ring (4 used) 64—Sleeve (4 used) 65—Poppet (4 used) 66—Piston (4 used) 67—Spring (4 used) 68—Spring (4 used) 69—O-Ring (4 used) 70—Backup Ring (8 used) 71—O-Ring (4 used) 72—Valve Seat (4 used) 73—Pilot Poppet (4 used) 74—Spring (4 used) 75—O-Ring (4 used) 76—Adjusting Screw (4 used) 77—Nut (4 used)	78—Arm Regenerative Valve—Switch Valve 79—Sleeve 80—O-Ring (2 used) 81—Backup Ring (2 used) 82—Piston (2 used) 83—Spool (2 used) 84—O-Ring (2 used) 85—Sleeve 86—Spring 87—Guide (2 used) 88—O-Ring (2 used) 89—14 mm Fitting Plug (2 used) 90—Bucket Regenerative Switch Valve 91—Check Valve (3 used) 92—Spring (3 used) 93—Backup Ring (3 used) 94—O-Ring (2 used) 95—Sleeve	96—Sleeve 97—Spring 98—Main Relief and Power Digging Valve 99—Sleeve 100—Poppet 101—Spring 102—O-Ring 103—Backup Ring 104—Valve Seat 105—Poppet 106—Spring 107—O-Ring (4 used) 108—Cap (relief valve housing) 109—41 mm Nut 110—O-Ring 111—O-Ring 112—Sleeve (second adjusting plug) 113—Orifice	114—30 mm Nut 115—O-Ring 116—Screw (first adjusting plug) 117—14 mm Plug—Main Relief Valve Isolation Check Valve 118—Backup Ring 119—14 mm Plug—Travel Flow Combiner Circuit Check Valve 120—46 mm Plug—Travel Flow Combiner Valve 121—Spring 122—Spacer 123—Spool 124—Plug 125—O-Ring 126—Plug 127—O-Ring
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

9. See Control Valve Operation for locations of control valve components.

IMPORTANT: The circuit relief and main relief and power digging valves must be checked and adjusted after assemble to ensure that the pressure settings are correct.

10. Before disassembling the circuit relief or main relief and power digging valves (60 and 98), make a mark on the adjusting plugs or adjusting screw and then record the number of turns to remove.

CAUTION: The arm regenerative valve—switch valve and bucket regenerative switch valve contains a spring under load. Prevent injury from sudden release of spring by holding the 14 mm fitting plug as it is removed.

11. Hold 14 mm fitting plug (89) as it is removed to release the force of spring (86 or 97).

12. Assemble circuit relief valves (60—77).

Tighten the valve seat (72) to sleeve (64) to specification.

Specification

Circuit Relief Valve—Valve Seat to Sleeve—Torque	100 N•m 74 lb-ft
--------------------------------------------------------	---------------------

Tighten the circuit relief valves (60) to right control valve housing (2) to specification. Apply tighten force to the hexagonal part of sleeve.

Specification

Circuit Relief Valve to Right Control Valve Housing—Torque	100 N•m 74 lb-ft
------------------------------------------------------------------	---------------------

Perform Circuit Relief Valve Test and Adjustment to check and adjust pressure setting after assembly.

13. Assemble arm regenerative valve—switch valve (78—89)

Tighten 14 mm fitting plug (89) to specification.

Specification

Arm Regenerative Valve—Switch Valve—14 mm Fitting Plug to Sleeve—Torque	180 N•m 133 lb-ft
-------------------------------------------------------------------------------	----------------------

Arm Regenerative Valve—Switch Valve to Right Control Valve Housing—Torque	180 N•m 133 lb-ft
---------------------------------------------------------------------------------	----------------------

Hydraulic System

14. Assemble bucket regenerative switch valve (90, 80—84, 87—89, and 91—97).

Tighten 14 mm fitting plug (89) to specification.

Specification

Bucket Regenerative Switch Valve—14 mm Fitting Plug to Sleeve—Torque	180 N•m 133 lb-ft
Bucket Regenerative Switch Valve to Right Control Valve Housing—Torque	180 N•m 133 lb-ft

15. Assemble travel flow combiner valve (107 and 120—123).

Tighten 46 mm plug (120) to specification.

Specification

Travel Flow Combiner Valve-to-Right Control Valve Housing 46 mm Plug—Torque	250 N•m 184 lb-ft
-----------------------------------------------------------------------------------	----------------------

16. Assemble main relief valve isolation check valve (91—94, 107, and 117).

Tighten 14 mm plug (117) to specification.

Specification

14 mm Plug—Main Relief Valve Isolation Check Valve to Right Control Valve Housing—Torque	350 N•m 285 lb-ft
------------------------------------------------------------------------------------------------	----------------------

17. Assemble travel flow combiner circuit check valve (91, 92, 107, 118, and 119).

Tighten 14 mm plug (119) to specification.

Specification

14 mm Plug—Travel Flow Combiner Circuit Check Valve to Right Control Valve Housing—Torque	350 N•m 285 lb-ft
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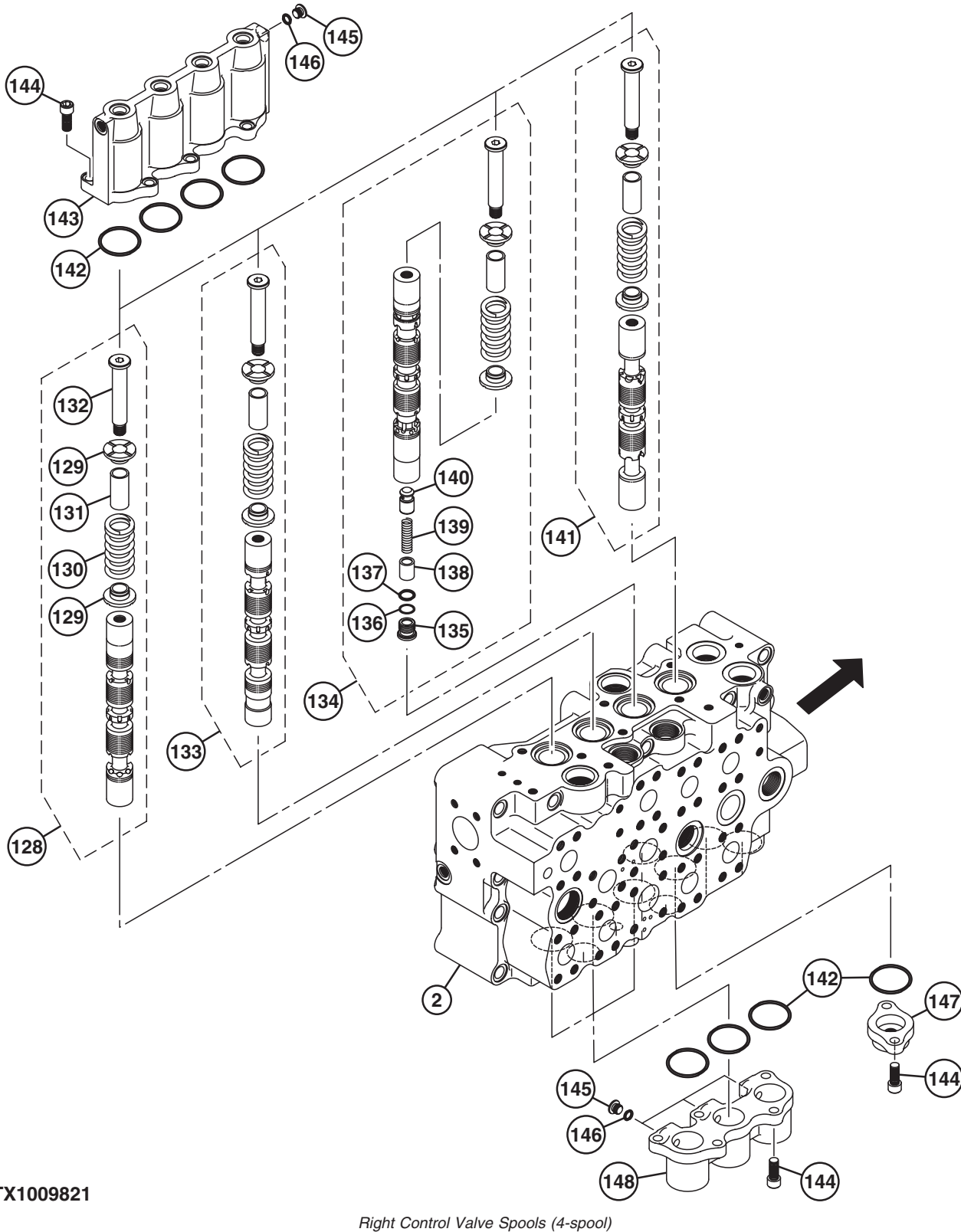
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Hydraulic System

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Hydraulic System



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TX1009821

Right Control Valve Spools (4-spool)

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TX1009821 -UN-18.JUL06

Hydraulic System

2—Right Control Valve (4-spool)	133—Boom 1 Spool	139—Spring	144—Socket Head Cap Screw (13 used)
128—Arm 2 Spool	134—Bucket Spool	140—Check Valve—Bucket Regenerative Valve	145—Plug
129—Guide (8 used)	135—10 mm Plug—Bucket Regenerative Valve	141—Right Travel Spool	146—Packing (4 used)
130—Spring (4 spring)	136—Backup Ring	142—O-Ring (8 used)	147—Cover (pilot cap)
131—Sleeve (4 used)	137—O-Ring	143—Cover (pilot cap)	148—Cover (pilot cap)
132—Special Screw (4 used)	138—Spacer		

18. See Control Valve Operation for locations of control valve components.

IMPORTANT: The spools are select fitted to the bores in housing and are a different design for each function. Spools must be installed into the same bores from which they were removed for proper operation of machine.

Disassemble the spools only for repair or replacement.

19. Slowly turn the spool (128, 133, 134, 141) as it is remove from the housing. Put an identification tag on each spool for location to aid assembly.

20. When disassembling a spool, hold the spool in a vise using wooden blocks to protect it. A thread lock (high-strength) is use on the threads of special screws (132).

21. Assemble the bucket regenerative valve (135—140).

Tighten 10 mm plug (135) to specification.

Specification

10 mm Plug—Bucket	
Regenerative Valve to Bucket	
Spool—Torque.....	80 N•m 59 lb-ft

22. Assemble the control valve spools (128—132, 133, 134, and 141).

Clean the thread of special screw (132) and threads in the spool.

Apply PM38654 Thread Lock (high strength) to the threads of special screws.

Tighten the special screws to specification.

Specification

Special Screw-to-Control Valve	
Spool—Torque.....	100 N•m 74 lb-ft

23. Install the spools (128, 133, 134, and 141).

Install the O-rings (142) and covers (pilot caps) (143, 147, and 148).

Tighten socket head cap screws (144) to specification.

Specification

Cover (Pilot Cap)-to-Right	
Control Valve Housing Socket	
Head Cap Screw—Torque	100 N•m 74 lb-ft

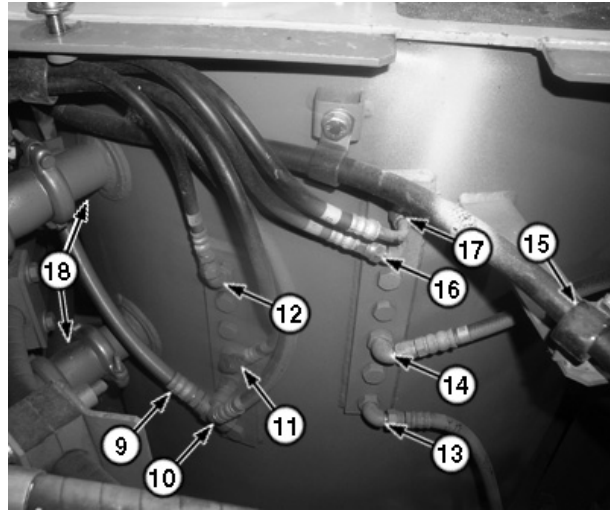
TX17984.00000E7 -19-20JUL06-8/8

Hydraulic Oil Tank Remove and Install

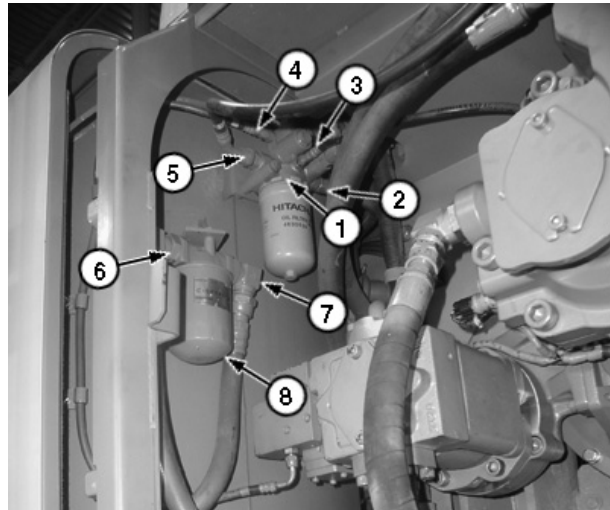
CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure by pushing hydraulic oil tank pressure release button.

1. Release pressure by pushing hydraulic oil tank pressure release button.
2. Drain hydraulic oil tank. Approximate capacity is 321 L, (85 gal).
3. Disconnect lines (9—14), 16 and 17). Close all openings using cap and plugs.
4. Remove hose clamps (15).
5. Disconnect couplings (18).

- 1—Pilot Valve Regulator and Filter
- 2—Regulator Valve-to-Pump
- 3—Test port
- 4—Regulator Pilot
- 5—Regulator Valve-to-Pump
- 6—Line Hose Filter-to-Tank
- 7—Line Drain Pumps-to-Filter
- 8—Drain Filter
- 9—Tank-to-4-Spool Side
- 10—Tank-to-4-Spool Side
- 11—Tank-to-4-Spool Side
- 12—Tank-to-4-Spool Side
- 13—Tank-to-5-Spool Side
- 14—Tank-to-5-Spool Side
- 15—Hose Clamp (2 used)
- 16—Tank-to-5-Spool Side
- 17—Tank-to-5-Spool Side
- 18—Coupling (2 used)



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TX1010268A -UN-24JUL06

Continued on next page

CP94658,0000018 -19-02AUG06-1/2

Hydraulic System

6. Remove clamps (22) at bottom and right side of tank.
7. Remove electrical connector sensor (25) from bottom of tank.
8. Remove flange (20) and pump line.
9. Remove cap screws (19 and 25).

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

Specification

Hydraulic Oil Tank—Weight 255 kg approximate
562 lb approximate

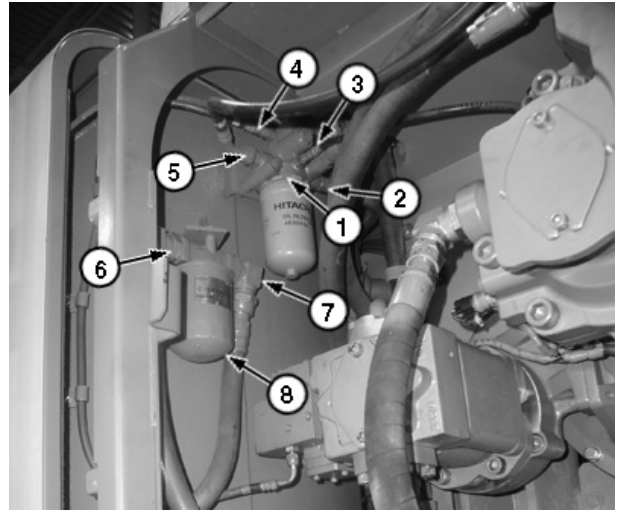
10. Remove hydraulic oil tank (21).
11. Replace parts as necessary.
12. Install oil tank.

Specification

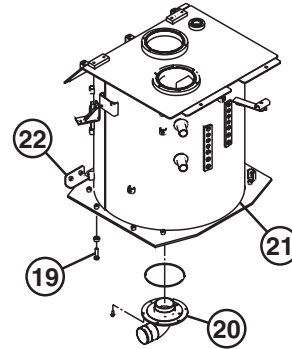
Cap Screw—Torque 205 N•m
151 lb-ft.

13. Connect lines.
14. Connect and tighten clamps.
15. Connect electrical sensors.
16. Perform Hydraulic Pump Start-up Procedure. (Group 3360.)

- 19—Cap Screw (8 used)
- 20—Flange
- 21—Hydraulic Oil Tank
- 22—Clamp (2-used)
- 25—Electrical Connector Sensor
- 26—Cap Screw



TX1010288A -UN-24JUL06



TX1010789 -UN-28JUL06

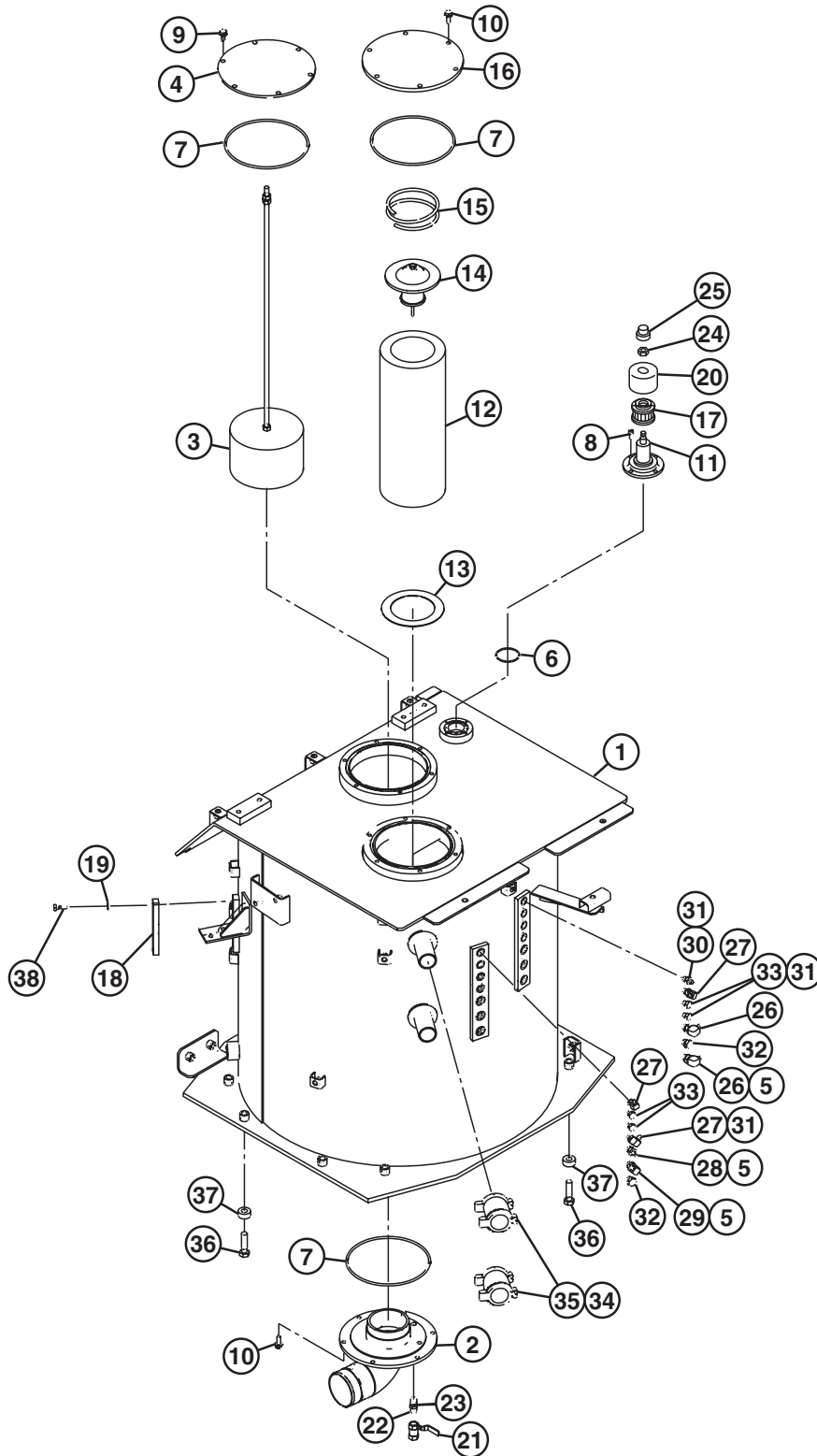


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Hydraulic Oil Tank Disassemble and Assemble



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TX1010450 -UN-24JUL06

Hydraulic System

- | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1—Hydraulic Oil Tank
2—Fitting
3—Suction Strainer
4—Cover
5—O-ring (6 used)
6—Packing
7—O-ring (3 Used)
8—Screw
9—Cap Screw (6 used)
10—Cap Screw (12 used) | 11—Housing
12—Filter Element
13—Washer (18 used)
14—Flow Control Hydraulic Valve
15—Spring
16—Cover
17—Filter Element
18—Level gauge
19—Washer (4 used) | 20—Cover
21—Hand Operated Valve
22—Adapter Fitting
23—Pipe Plug
24—Nut
25—Cap
26—Elbow Fitting
27—Elbow Fitting
28—Adapter Fitting
29—Elbow Fitting | 30—Adapter Fitting
31—Packing (8 used)
32—Pipe Plug
33—Plug
34—Seal (2 used)
35—Coupling
36—Cap Screw (8 used)
37—Spacer
38—Cap Screw (2 used) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

1. Remove covers (4 and 16).
2. Remove filter element (12 and 17).
3. Remove suction strainer (3).
4. Adjust length of rod on suction strainer (3). Tighten suction strainer nuts.
5. Install suction strainer.
6. Install filter elements.
7. Install covers. Tighten cap screws (9 and 10).

Specification

Suction Strainer Rod—Length.....	683 mm 27 in.
Suction Strainer Rod Nuts—	
Torque.....	17 N•m 153 lb-in.

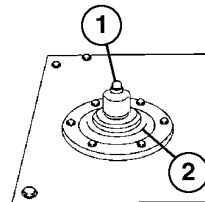
Specification

Tank Cover Cap Screws—	
Torque.....	49 N•m 36 lb-ft

TX17984.000009D -19-28JUL06-2/2

Restriction Valve Remove and Install

CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury.



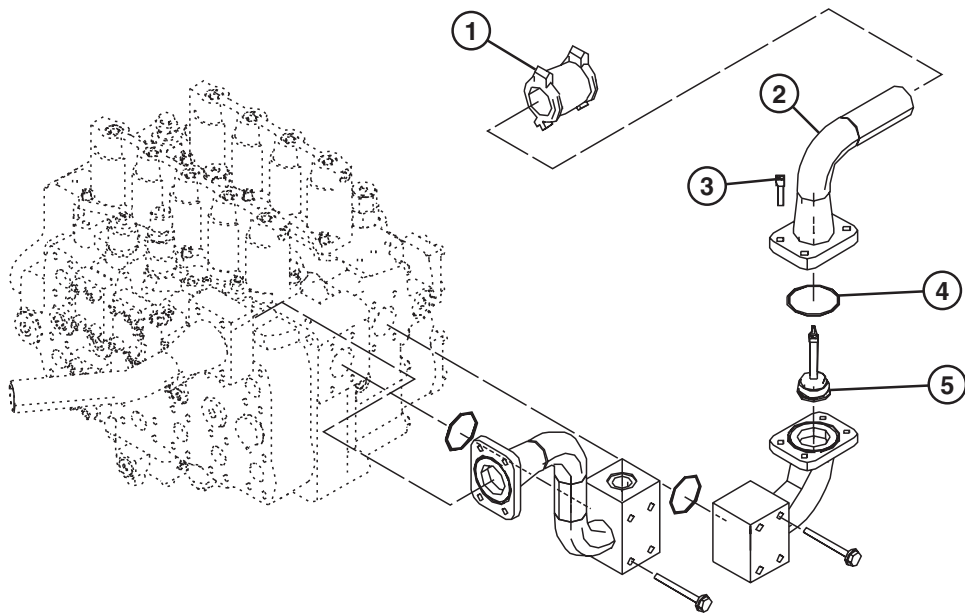
1—Hydraulic Oil Tank Pressure Release Button
 2—Hydraulic Oil Tank Cover

1. Release hydraulic oil tank pressure by pushing release button on top of hydraulic oil tank.
2. Drain hydraulic tank. Hydraulic tank capacity is 331 L (85 gal) approximate. See Change Hydraulic Tank Oil, Clean Suction Screen. (Operator's Manual.)
3. Apply vacuum to hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)

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Hydraulic System



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TX1010141

1—Coupling
2—Hydraulic Line

3—Cap Screws (4 used)

4—O-ring

5—Restriction Valve

Continued on next page

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Hydraulic System

4. Loosen coupling (1).

5. Remove hydraulic line (2).

6. Remove restriction valve (5).

7. Replace parts as necessary.

8. Install restriction valve (5).

9. Install hydraulic line (2).

10. Tighten coupling (1).

Specification

Coupling—Torque..... 10 N•m
90 lb-in.

11. Fill hydraulic system. See Change Hydraulic Tank Oil, Clean Suction Screen. (Operator's Manual.)

12. Bleed air from hydraulic system. See Bleed Air From Hydraulic System. (Operator's Manual.)

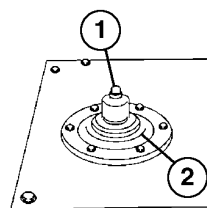
TX17984.000009E -19-02AUG06-3/3

Hydraulic Oil Cooler Bypass Valve Remove and Install



CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

1. Release hydraulic oil tank pressure by pushing release button on top of hydraulic oil tank.
2. Drain hydraulic tank. Hydraulic tank capacity is 331 L (85 gal) approximate. See Change Hydraulic Tank Oil, Clean Suction Screen. (Operator's Manual.)
3. Apply vacuum to hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)



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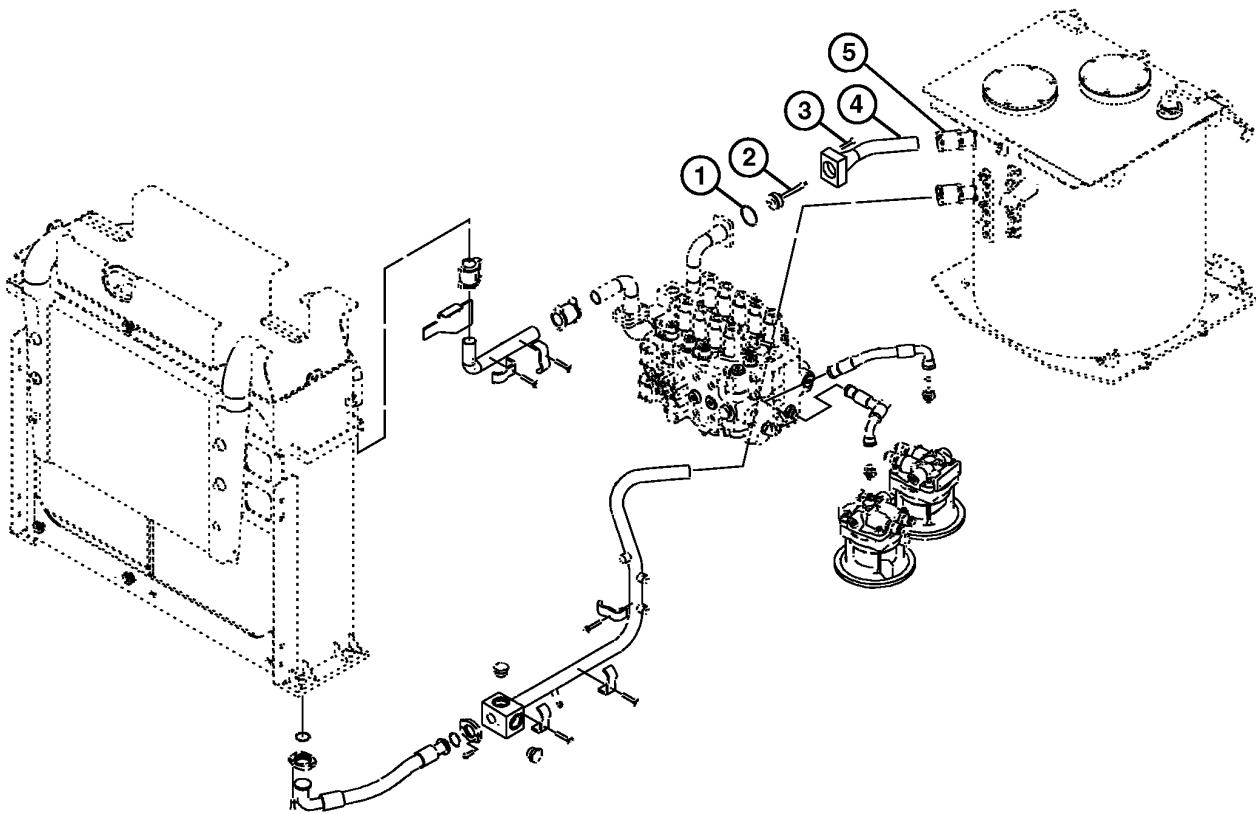
- 1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

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Hydraulic System



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Hydraulic System

1—O-ring
2—Hydraulic Oil Cooler
Bypass Valve

3—Cap Screw (4 used)

4—Hydraulic Line

5—Coupling

4. Loosen coupling (5).
5. Remove hydraulic line (4).
6. Remove hydraulic oil cooler bypass valve (2).
7. Replace parts as necessary.
8. Install hydraulic oil cooler bypass valve (2).
9. Install hydraulic line (4).

10. Tighten coupling (5).

Specification

Coupling—Torque..... 10 N•m
90 lb-in.

11. Fill hydraulic system. See Change Hydraulic Tank Oil, Clean Suction Screen. (Operator's Manual.)
12. Bleed air from hydraulic system. See Bleed Air From Hydraulic System. (Operator's Manual.)

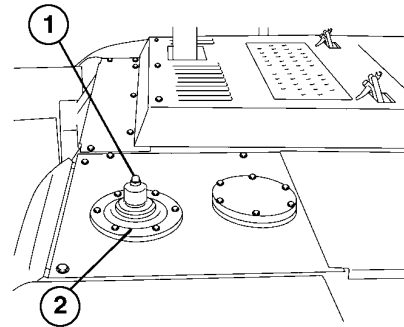
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Hydraulic Oil Cooler Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing button (1) on top of hydraulic tank.
2. Drain hydraulic oil. Approximate capacity is 322 L (85 gal).



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

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Hydraulic System

3. Remove intercooler. See Intercooler Remove and Install. (Group 0510.)
4. Remove cooler frame cover (13).
5. Remove retainers (24).
6. Remove hydraulic oil cooler inlet pipe (18). Close openings using caps and plugs.
7. Remove hydraulic oil cooler out let pipe. Close openings using caps and plugs.
8. Remove hydraulic oil cooler cap screws.

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

9. Attach hoist to hydraulic oil cooler (23).

Specification

Hydraulic Oil Cooler—Weight..... 91 kg approximate
200 lb approximate

Lift hydraulic oil cooler from machine.

10. Repair or replace parts as necessary.

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

11. Install hydraulic oil cooler (23).

Specification

Hydraulic Oil Cooler—Weight..... 91 kg approximate
200 lb approximate

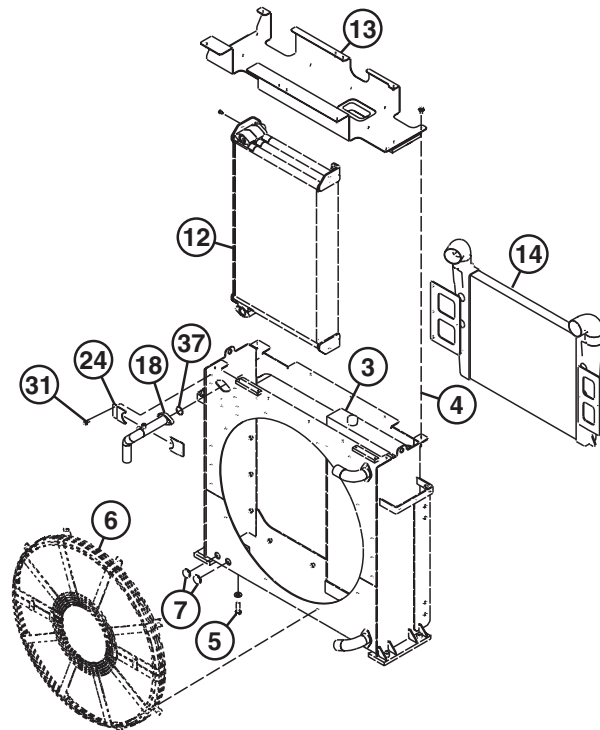
12. Install hydraulic oil cooler cap screws.

13. Install cap screws (3).

Install hydraulic oil cooler out let pipe.

14. Install hydraulic oil cooler inlet pipe (12).

15. Install retainers (9).



- 3—Radiator
- 4—Cooler Frame
- 5—Cap Screw
- 6—Fan Guard
- 7—Plug
- 12—Hydraulic Oil Cooler
- 13—Cooler Frame Cover
- 14—Intercooler
- 18—Hydraulic Oil Cooler Inlet Pipe
- 24—Retainer (2 used)
- 31—Cap Screw
- 37—O-Ring

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Hydraulic System

Install cap screw (8).

16. Install cooler frame cover (13).
17. Perform Intercooler Remove and Install. (Group 0510.)
18. Fill hydraulic oil reservoir. Approximate capacity is 322 L (85 gal).

GD61784.0000025 -19-01AUG06-3/3

Boom Cylinder Remove and Install

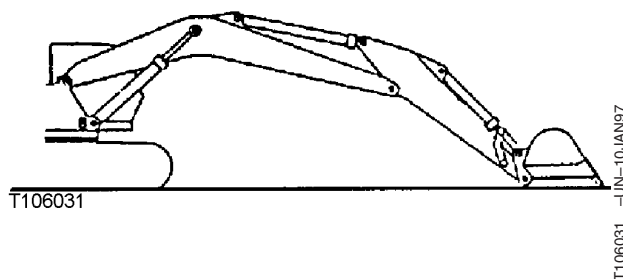
1. Park machine on a solid level surface.

MM16633.0000027 -19-15MAY08-1/6

2. Retract bucket and arm cylinders fully and lower front attachment to the ground.
3. Stop engine.
4. Release pressure in front attachment hydraulic circuit. See Hydraulic Circuit Pressure Release Procedure . (Group 3360.)

⚠ CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

5. Push the pressure release button on top of hydraulic oil tank to relieve pressure.



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6. Disconnect lubrication line (A) at rod end of cylinder.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

7. Attach boom cylinder to hoist.

Specification	
Boom Cylinder—Weight	522 kg approximate 1150 lb approximate

8. Remove parts (1—4).

9. Push pin (5) into boom to remove cylinder rod end.

10. Remove shim (B).

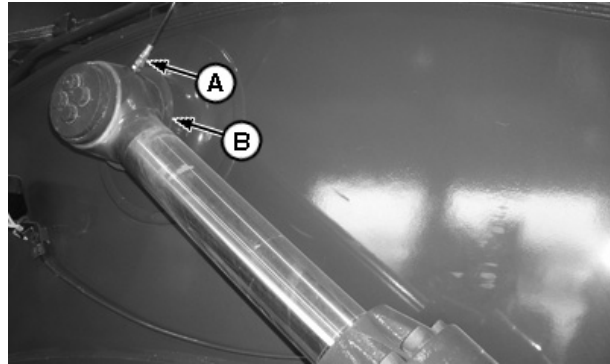
11. Lower cylinder and support cylinder on stand.

12. Start engine.

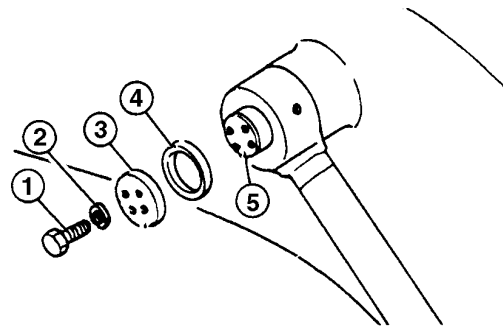
13. Retract cylinder rod fully.

14. Stop engine.

15. Release pressure in front attachment hydraulic circuit and oil tank.



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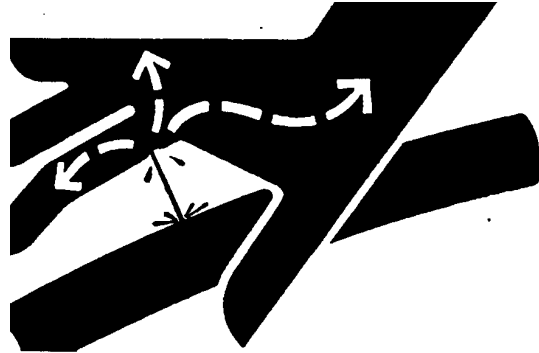
TX1010048 -UN-18JUL06

- A—Lubrication Line
- B—Shim
- 1—Cap Screw (4 used)
- 2—Washer (4 used)
- 3—Stopper
- 4—Washer
- 5—Pin

Continued on next page

MM16633,000027 -19-15MAY08-3/6

CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.



16. Disconnect hydraulic hoses (7). Close all openings using caps and plugs.
17. Remove parts (8—10).

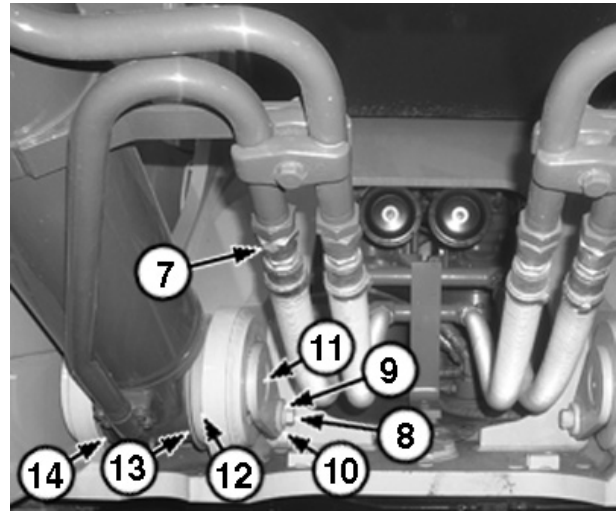
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

18. Remove pin (11).

	Specification	
Pin—Weight.....		24 kg approximate 53 lb approximate

19. Remove boom cylinder and parts (12—14).
20. Repair or replace parts as necessary.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.



21. Attach boom cylinder to hoist.

	Specification	
Boom Cylinder—Weight		522 kg approximate 1150 lb approximate

22. Lift cylinder and align cylinder head end with pin.
23. Install spacer (12).
24. Install shims (13 and 14) equally on each side of cylinder head to get minimal amount of clearance in joint.

- 7—Hydraulic Hose (2 used)
- 8—Cap Screw
- 9—Lock Washer
- 10—Washer
- 11—Pin
- 12—Spacer
- 13—Shim
- 14—Shim

X9811 -UN-23AUG88

TX1010615A -UN-26JUL06



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

25. Install pin (11) and parts (8—10).

Specification

Pin—Weight..... 24 kg approximate
53 lb approximate
Cap Screw—Torque..... 400 N•m
295 lb-ft

26. Connect hydraulic hoses (7).

Specification

Hydraulic Hose—Torque 210 N•m
155 lb-ft

27. Lift cylinder rod end.

28. Extend cylinder rod and align cylinder rod end with pin.

Continued on next page

MM16633,0000027 -19-15MAY08-5/6

Hydraulic System

29. Install shim (B).

30. Install pin (5).

31. Install parts (1—4).

Specification	
Cap Screw—Torque	400 N•m 295 lb-ft

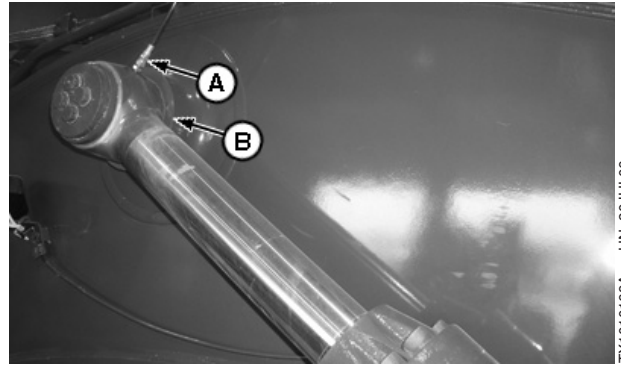
32. Install lubrication line (A).

Specification	
Lubrication Line—Torque	30 N•m 22 lb-ft

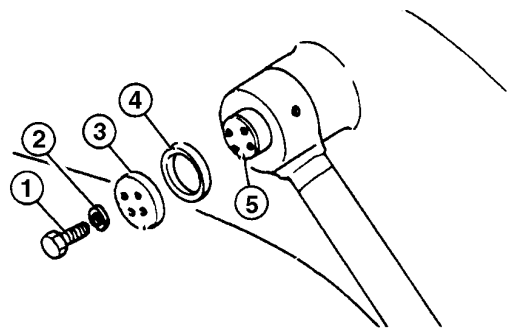
33. Lubricate all pivot joints.

34. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

35. Slowly extend and retract boom cylinders several times to bleed air from cylinder. See Hydraulic Cylinder Bleed Procedure . (Group 3360.)



TX1010169A -JUN-20JUL06



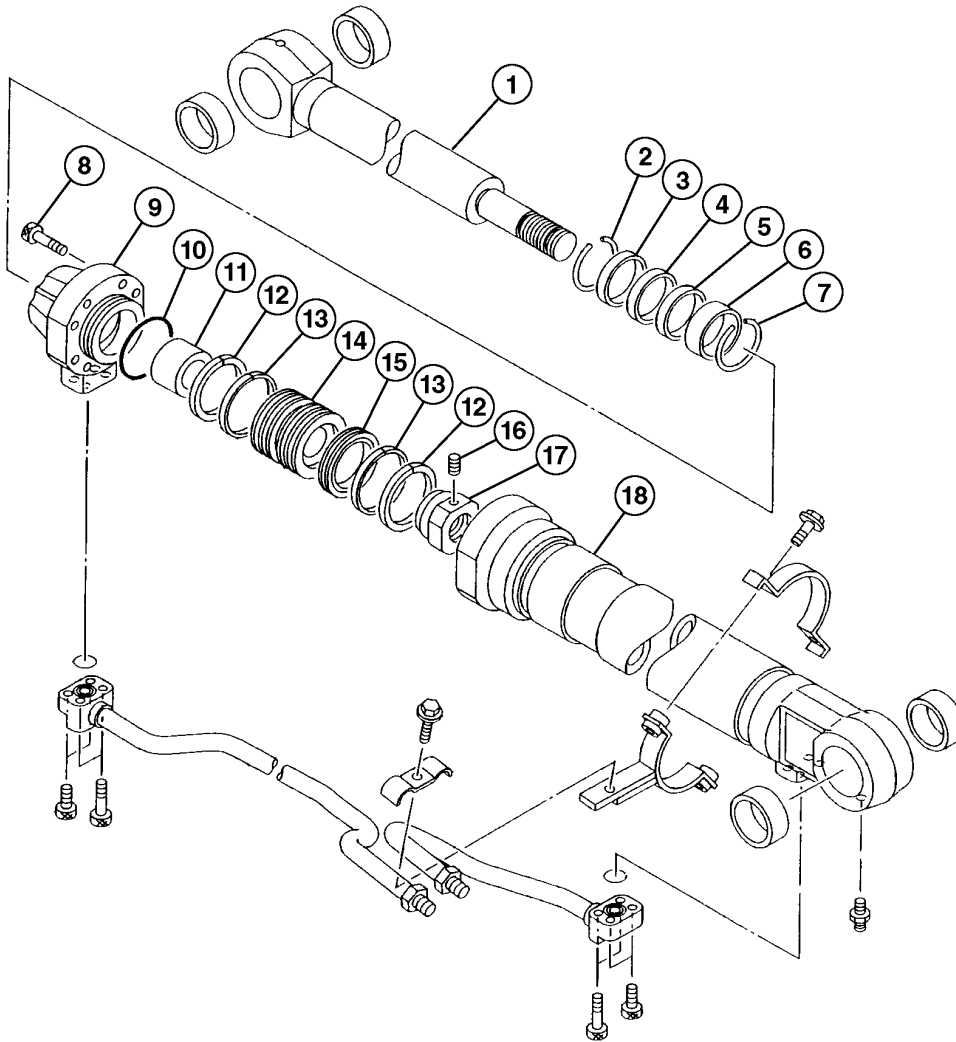
TX1010048 -JUN-18JUL06

- A—Lubrication Line
- B—Shim
- 1—Cap Screw (4 used)
- 2—Washer (4 used)
- 3—Stopper
- 4—Washer
- 5 —Pin

MM16633.0000027 -19-15MAY08-6/6

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Boom Cylinder Disassemble and Assemble



TX1011532

- | | | | |
|----------------|----------------------|-----------------------|--------------------|
| 1—Cylinder Rod | 6—Bushing | 11—Cushion Ring | 15—Seal Ring |
| 2—Snap Ring | 7—Snap Ring | 12—Ring (2 used) | 16—Set Screw |
| 3—Dust Seal | 8—Cap Screw (8 used) | 13—Wear Ring (2 used) | 17—Nut |
| 4—Seal | 9—Cylinder Rod Guide | 14—Piston | 18—Cylinder Barrel |
| 5—Ring | 10—O-Ring | | |

1. Drain hydraulic oil from cylinder.

2. Hoist cylinder onto cylinder service tool.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

Specification

Boom Cylinder—Weight 430 kg approximate
 950 lb approximate

TX1011532 - JUN-31/AUG06

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Continued on next page

MM16633,000028 -19-08NOV06-1/5

Hydraulic System

NOTE: The following cylinder service tools are recommended to disassemble and assemble cylinders on this machine:

Recommended Cylinder Service Tools—Specification

HCS-40—Maximum Torque	54 232 N•m 40,000 lb-ft
HCS-60—Maximum Torque	81 349 N•m 60,000 lb-ft
HCS-60-L—Maximum Torque	81 349 N•m 60,000 lb-ft

Contact **Tricorp USA**, Palm Beach, Florida (www.tricorpusa.com) for more information.

3. Attach cylinder to service tool.

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

IMPORTANT: Avoid damage to cylinder barrel and cylinder rod. Pull cylinder rod straight out to protect sealing surfaces.

4. Pull cylinder rod (1) straight out of cylinder barrel (18).

5. Completely extend cylinder rod (1).

6. Remove cap screw (8) from cylinder rod guide (9).

7. Remove cylinder rod guide (9) and cylinder rod (1) from cylinder barrel (18).

8. Attach cylinder rod (1) to service tool.

9. Mark cylinder rod (1) and nut (17) to aid in assembly.

10. Remove set screw (16).

11. Loosen nut (17) and remove piston (14) using ST3268 (125 mm) Special Wrench for Cylinder Piston Nut.

12. Inspect piston (14) for any damage.

13. Remove and discard seal ring (15), ring (12) and wear ring (13), from piston (14).

14. Remove packing ring (11) and cylinder rod guide (9) from cylinder rod (1).

15. Remove O-ring (10) and snap rings (2) and (7) from cylinder rod guide (9).

16. Remove dust seal (3), ring (5), seal (4), and bushing (6) using ST2671 (115 mm) Installing Bushing.

17. Inspect cylinder rod (1) and cylinder barrel (18) outside and inside for wear, scratches, and nicks that may cut or damage a seal or wear ring during assembly.

Specification

Cylinder Barrel—ID	170—170.063 mm 6.69—6.70 in.
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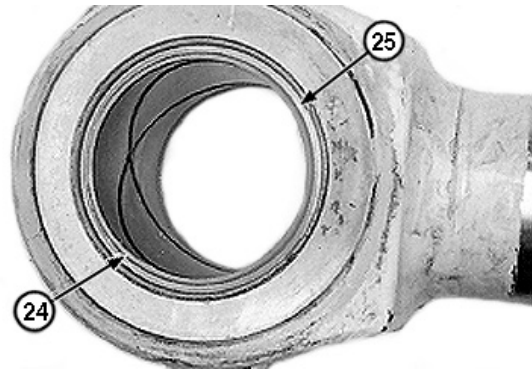
MM16633,0000028 -19-08NOV06-2/5

Hydraulic System

18. Inspect seals and bushings on both rod end and head end of cylinder for wear and damage. Perform Inspect Pins, Bushings and Bosses-Front Attachment. (Group 3340.)

Specification	
Boom Cylinder Head End Bushing—ID.....	110.05—110.25 mm 4.333—4.341 in.

Specification	
Boom Cylinder Rod End Bushing—ID.....	120.05—120.25 mm 4.726—4.734 in.



24—Bushing
25—Seal

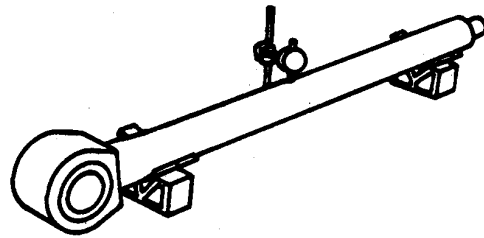
TX1012376A -UN-26SEP06

MM16633,0000028 -19-08NOV06-3/5

19. Check cylinder rod (1) for curvature using V-blocks and dial indicator.

Specification	
Boom Cylinder Rod—Curvature.....	0.125 mm /1000 mm 0.005 in. /39.37 in.

Specification	
Boom Cylinder Rod—OD After Re-plating	114.97—114.99 mm



T6585XG -UN-27OCT88

20. Install bushing (6) to cylinder rod guide (9) using ST2671 (115 mm) Installing Bushing.

21. Install ring (5), seal (4), and snap ring (7) to cylinder rod guide (9).

22. Install dust seal (3) to cylinder rod guide (9) using ST2672 Installing Dust Seal.

23. Install O-ring (10) and snap ring (2) to cylinder rod guide (9).

Continued on next page

MM16633,0000028 -19-08NOV06-4/5

24. Install new wear rings (13), seal ring (15), and rings (12) to piston (14).

25. Install cylinder rod guide (9) to cylinder rod (1).

26. Install cushion ring (11) toward the nut (17) to the cylinder rod (1) and piston (14) to cylinder rod (1).

27. Align the matching marks and tighten nut (17) using ST3268 (125 mm) Special Wrench for Cylinder Piston Nut.



12—Ring (2 used)
13—Wear Ring (2 used)
14—Piston
15—Seal Ring

Specification

Boom Cylinder Nut—Torque 14 220 N•m
10,490 lb-ft

28. Install steel ball (19) and set screw (16) to nut (17) and stake set screw (16) in two places on the outer edge with a punch and hammer.

Specification

Boom Cylinder Set Screw—
Torque 64 N•m
47 lb-ft

29. Attach cylinder barrel (18) to service tool.

30. Align cylinder rod (1) with center of cylinder barrel (18). Install the cylinder rod (1) into cylinder barrel (18).

31. Tighten cylinder rod guide (9) to cylinder barrel (18) with cap screw (8).

Specification

Boom Cylinder Rod Guide Cap
Screw—Torque..... 1230 N•m
907 lb-ft

TX1012545A -UN-28SEP06

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MM16633,0000028 -19-08NOV06-5/5

Arm Cylinder Remove and Install

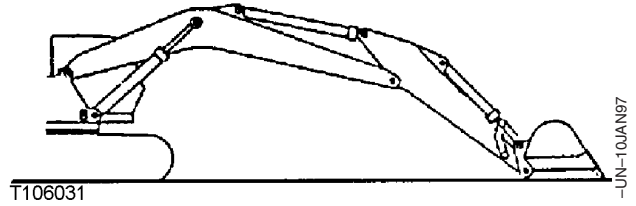
1. Park the machine on firm, level surface.

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TF44157,0000007 -19-02AUG06-1/10

Hydraulic System

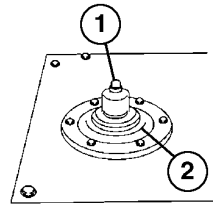
2. Retract bucket and arm cylinders. Lower front attachment onto the ground.
3. Stop engine.
4. Release the pressure in the cylinder. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)



TF44157,0000007 -19-02AUG06-2/10

CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

5. Release hydraulic oil tank pressure by pushing release button on top of hydraulic oil tank.



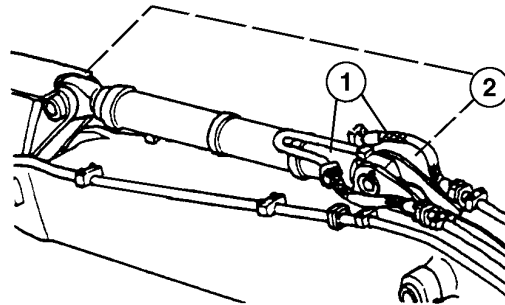
- 1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

TF44157,0000007 -19-02AUG06-3/10

CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

6. Disconnect hydraulic hoses (1). Close all openings using caps and plugs.
7. Disconnect lubrication hoses (2). Close all openings using caps and plugs.

- 1—Hydraulic Hose (2 used)
2—Lubrication Hose (2 used)



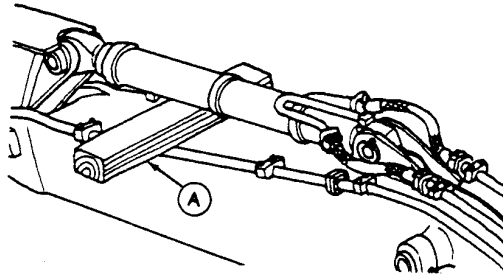
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TF44157,0000007 -19-02AUG06-4/10

Hydraulic System

8. Install wood block between arm cylinder and boom.

A—Wood Block



T7029MN -JUN-13.JUL89

TF44157,0000007 -19-02AUG06-5/10

9. Remove cap screw (B).



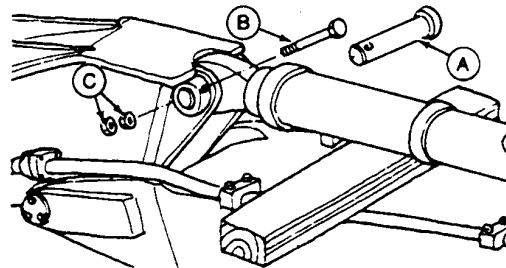
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

10. Remove arm cylinder pin (A).

Specification

Arm Cylinder Pin—Weight..... 24 kg approximate
55 lb approximate

- A—Arm Cylinder Pin
- B—Cap Screw
- C—Nut (2 used)



T7029MP -JUN-13.JUL89

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TF44157,0000007 -19-02AUG06-6/10

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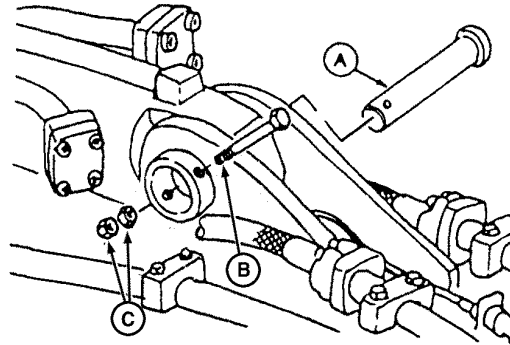
11. Remove cap screw (B).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

12. Support arm cylinder with hoist and remove arm cylinder pin (A).

	Specification	
Arm Cylinder—Weight.....		660 kg approximate 1455 lb approximate

	Specification	
Arm Cylinder Pin—Weight.....		24 kg approximate 55 lb approximate



A—Arm Cylinder Pin
B—Cap Screw
C—Nut (2 used)

T108978 -JUN-14MAY97

13. Remove arm cylinder.

14. Repair or replace arm cylinder as necessary.

15. Check pins and bushings for any wear. See Inspect Pins, Bushings and Bosses—Front Attachment. (Group 3340.)

16. Clean pins and bores.

17. Apply grease to pins and bores.

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TF44157.000007 -19-02AUG06-7/10



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

18. Support arm cylinder with hoist and install arm cylinder pin (A).

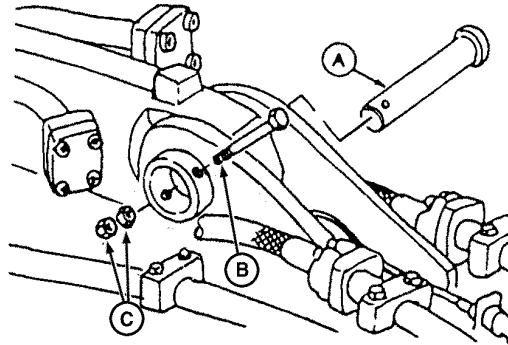
	Specification	
Arm Cylinder—Weight		660 kg approximate 1455 lb approximate

	Specification	
Arm Cylinder Pin—Weight.....		24 kg approximate 55 lb approximate

NOTE: Tighten nut against nut when installing cap screw nuts.

19. Install cap screw (B).

	Specification	
Cap Screw Nut—Torque		400 N•m 295 lb-ft



A—Arm Cylinder Pin
B—Cap Screw
C—Nut (2 used)

T108978 -JUN-14MAY97

TF44157,000007 -19-02AUG06-8/10



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

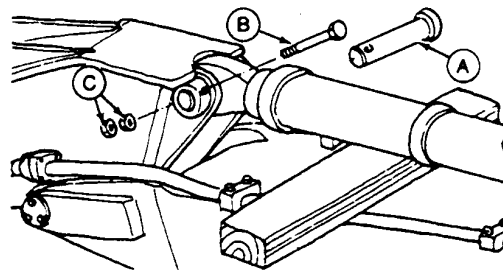
20. Align pin bore and install arm cylinder pin (A).

	Specification	
Arm Cylinder Pin—Weight.....		24 kg approximate 55 lb approximate

NOTE: Tighten nut against nut when installing cap screw nuts.

21. Install cap screw (B).

	Specification	
Cap Screw Nut—Torque		400 N•m 295 lb-ft



A—Arm Cylinder Pin
B—Cap Screw
C—Nut (2 used)

T7029MP -JUN-13JUL89

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TF44157,000007 -19-02AUG06-9/10

Hydraulic System

22. Connect hydraulic hoses (1).

Specification

Hydraulic Hose Cap Screw—	
Torque	140 N•m 103 lb-ft

23. Connect lubrication hoses (2).

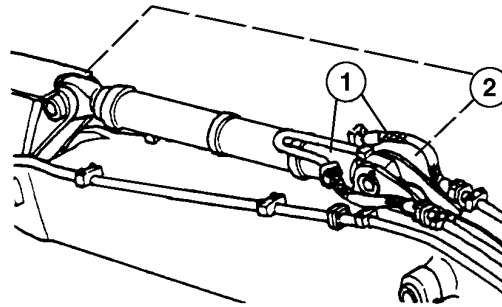
Specification

Lubrication Hose—Torque.....	29.5 N•m 22 lb-ft
------------------------------	----------------------

24. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

25. Bleed air from arm cylinder. See Hydraulic Cylinder Bleed Procedure. (Group 3360.)

26. Grease arm cylinder pin joints. See Grease Front End Pin Joints. (Operator's Manual.)

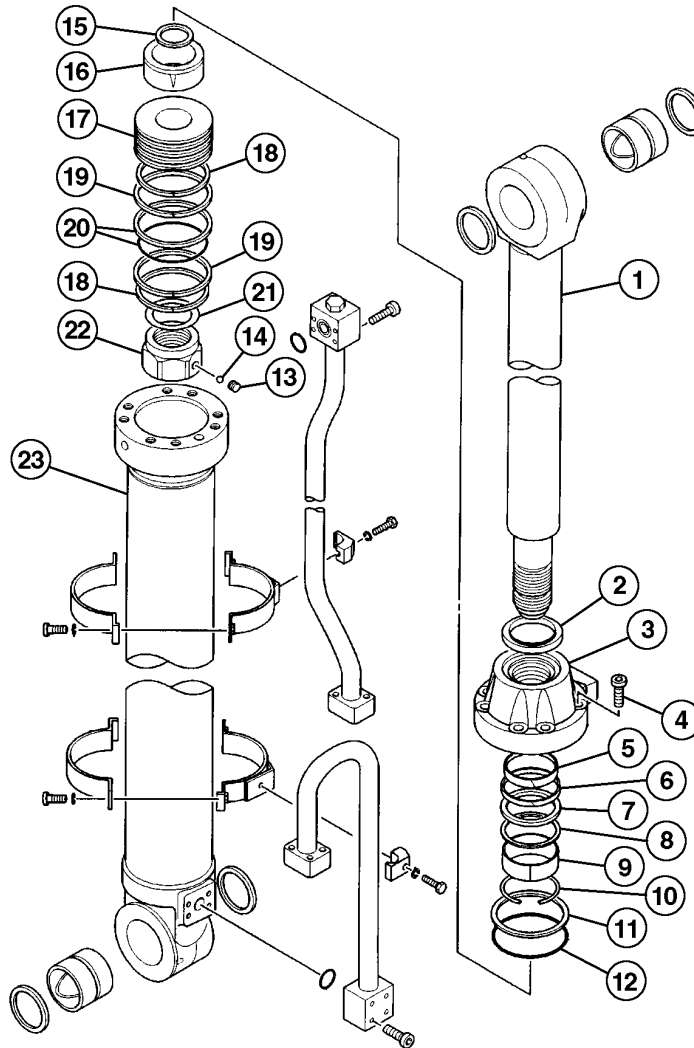


1—Hydraulic Hose (2 used)
2—Lubrication Hoses (2 used)

TX1009861 -JUN-18/JUL08

TF44157,000007 -19-02AUG06-10/10

Arm Cylinder Disassemble and Assemble



TX1011533

- | | | | |
|----------------------|----------------|------------------------|------------------------|
| 1—Cylinder Rod | 7—U-Ring | 13—Set Screw | 19—Slide Ring (2 used) |
| 2—Wiper Ring | 8—Buffer Ring | 14—Steel Ball | 20—Seal Ring |
| 3—Cylinder Rod Guide | 9—Bushing | 15—Cushion Seal | 21—Shim |
| 4—Cap Screw (8 used) | 10—Snap Ring | 16—Cushion Bearing | 22—Nut |
| 5—Slide Ring | 11—Backup Ring | 17—Piston | 23—Cylinder Barrel |
| 6—Backup Ring | 12—O-Ring | 18—Slide Ring (2 used) | |

1. Drain hydraulic oil from cylinder.

2. Hoist cylinder onto cylinder service tool.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

Specification	
Arm Cylinder—Weight	660 kg 1455 lb

TX1011533 -JUN-31AUG06

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Continued on next page

TF44157.0000008 -19-07NOV06-1/6

Hydraulic System

NOTE: The following cylinder service tools are recommended to disassemble and assemble cylinders on this machine:

Recommended Cylinder Service Tool—Specification

HCS-40—Maximum Torque	54 232 N•m
	40,000 lb-ft
HCS-60—Maximum Torque	81 349 N•m
	60,000 lb-ft
HCS-60-L—Maximum Torque	81 349 N•m
	60,000 lb-ft

Contact **Tricorp USA**, Palm Beach, Florida (www.tricorpusa.com) for more information.

3. Attach cylinder to service tool.

IMPORTANT: Avoid damage to cylinder barrel and cylinder rod. Pull cylinder rod straight out to protect sealing surfaces.

- 4. Pull cylinder rod (1) straight out of cylinder barrel (23).
- 5. Completely extend cylinder rod (1).
- 6. Remove cap screws (4) from cylinder rod guide (3).

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

7. Remove cylinder rod guide (3) together with cylinder rod (1) from cylinder barrel (23).

Specification

Arm Cylinder Rod—Weight	275 kg
	606 lb

Specification

Arm Cylinder Barrel—Weight	265 kg
	585 lb

- 8. Attach cylinder rod (1) to service tool.
- 9. Inspect cylinder rod (1) and cylinder barrel (23) outside and inside for wear, scratches, and nicks that may cut or damage a seal during assembly.

Specification

Cylinder Barrel—ID	190—190.072 mm
	7.48—7.483 in.

- 10. Mark cylinder rod (1) and nut (22) to aid in assembly.
- 11. Remove set screw (13) and steel ball (14).
- 12. Remove nut (22) and piston (17) using ST3283 (135 mm) Special Wrench for Cylinder Piston Nut.
- 13. Inspect piston (17) for wear or damage.
- 14. Remove shim (21) from cylinder rod (1).
- 15. Remove and discard slide rings (18 and 19) and seal ring (20) from piston (17).
- 16. Remove bushing (16), seal (15), and cylinder rod guide (3) from cylinder rod (1).
- 17. Remove and discard slide ring (5).
- 18. Remove wiper ring (2), backup ring (6), U-ring (7), and buffer ring (8) from cylinder rod guide (3).
- 19. Remove snap ring (10) and bushing (9) from cylinder rod guide (3).
- 20. Remove O-ring (12) and backup ring (11) from cylinder rod guide (3).

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TF44157,0000008 -19-07NOV06-2/6

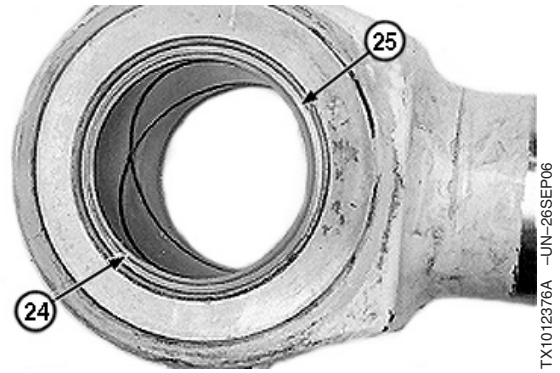
Hydraulic System

21. Inspect seals and bushings on both rod end and head end of cylinder for wear and damage Perform Inspect Pins, Bushings and Bosses-Front Attachment. (Group 3340.)

Specification

Arm Cylinder Head End Bushing—ID.....	110.05—110.25 mm 4.333—4.341 in.
Arm Cylinder Rod End Bushing—ID.....	110.05—110.25 mm 4.333—4.341 in.

24—Bushing
25—Dust Seal



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TF44157,0000008 -19-07NOV06-3/6

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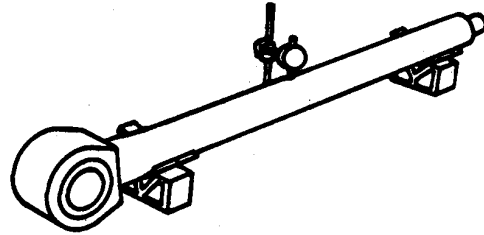
22. Check cylinder rod (1) for curvature using V-blocks and dial indicator.

Specification

Arm Cylinder Rod—Curvature..... 0.125 mm /1000 mm
0.005 in. /39.37 in.

Specification

Arm Cylinder Rod—OD After
Re-plating 129.939—130.031 mm
5.116—5.119 in.



T6585XG -JUN-27OCT88

- 23. Install bushing (9) and snap ring (10) to cylinder rod guide (3) using ST8023 (135 mm) Cylinder Head Maintenance Tool / Rod Outside Dimension 135 mm.
- 24. Install buffer ring (8) with the lip toward the cylinder head end.
- 25. Install U-ring (7) with the lip toward the cylinder head end.
- 26. Install backup ring (6) and U-ring (7) to the cylinder rod guide (3).
- 27. Install new slide ring (5) to the cylinder rod guide (3).
- 28. Install wiper ring (2) with the lip toward the rod end of cylinder to the cylinder rod guide (3) using ST8023 (135 mm) Cylinder Head Maintenance Tool / Rod Outside Dimension 135 mm.
- 29. Install O-ring (12) and backup ring (11) to cylinder rod guide (3).

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TF44157,0000008 -19-07NOV06-4/6

30. Install new seal ring (20) to piston (17) using ST2971 Seal Ring Installing Tool.
31. With their openings positioned 180 degrees apart pointing in opposite directions. Install new slide rings (18 and 19) to piston (17).
32. Attach cylinder rod (1) to service tool.
33. Install cylinder rod guide (3) to cylinder rod (1) using ST8023 (135 mm) Cylinder Head Maintenance Tool / Rod Outside Dimension 135 mm.
34. Install seal (15) to the cylinder rod (1) with slit toward the piston (17) side.
35. Install cushion bearing (16) with the chamfered side toward the cylinder rod guide (3) side.
36. Install piston (17) to cylinder rod (1).
37. Install shim (21) and nut (22) to the cylinder rod (1). Tighten nut (22) using ST3283 (135 mm) Special Wrench for Cylinder Piston Nut.



17—Piston
 18—Slide Ring (2 used)
 19—Slide Ring (2 used)
 20—Seal Ring

TX1012378A -UN-26SEP06

Specification

Arm Cylinder Nut—Torque 27 300 N•m
 20,135 lb-ft

38. Install steel ball (14) to nut (22) install set screw (13).

Specification

Arm Cylinder Nut Set Screw—
 Torque 100 N•m
 74 lb-ft

39. Stake set screw (13) in two places on the outer edge with a punch and hammer.
40. Attach cylinder barrel (23) to service tool.
41. Align cylinder rod (1) with cylinder barrel (23). Install cylinder rod (1) into cylinder barrel (23).
42. Install cylinder rod guide (3) to cylinder barrel (23) with cap screws (4).

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Hydraulic System

Specification

Arm Cylinder Rod Guide Cap

Screws—Torque..... 1560 N•m
1150 lb-ft

TF44157,000008 -19-07NOV06-6/6

Bucket Cylinder Remove and Install

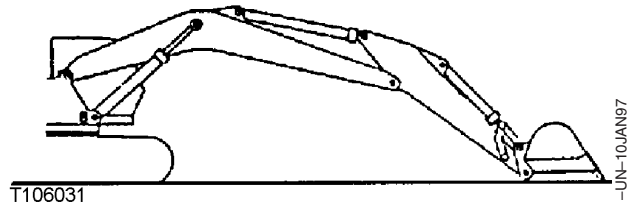
1. Park the machine on firm, level surface.

TF44157,000017 -19-02AUG06-1/9

2. Retract bucket and arm cylinders. Lower front attachment onto the ground.

3. Stop engine.

4. Release the pressure in the cylinder. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)



T106031

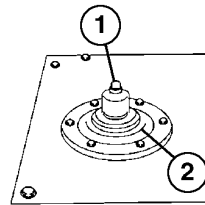
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TF44157,000017 -19-02AUG06-2/9



CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury.

5. Release hydraulic oil tank pressure by pushing release button on top of hydraulic oil tank.



TX1000859 -UN-01DEC05

1—Hydraulic Oil Tank Pressure Release Button
2—Hydraulic Oil Tank Cover

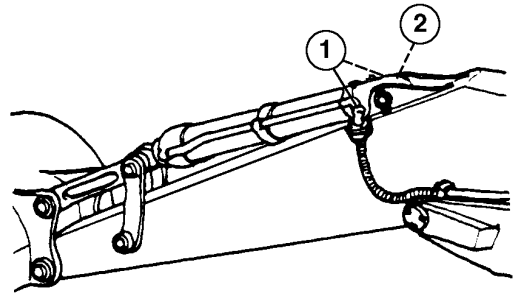
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TF44157,000017 -19-02AUG06-3/9

CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

6. Disconnect two hydraulic hoses (1). Close all openings using caps and plugs.
7. Disconnect lubrication hose (2). Close all openings using caps and plugs.

1—Hydraulic Hose (2 used)
2—Lubrication Hose

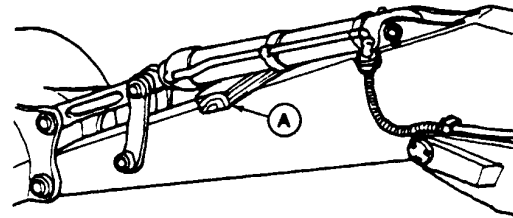


TX1009868 -JUN-18/JUL06

TF44157.0000017 -19-02AUG06-4/9

8. Install wood block between bucket cylinder and boom.

A—Wood Block



T7029MK -JUN-13/JUL89

TF44157.0000017 -19-02AUG06-5/9

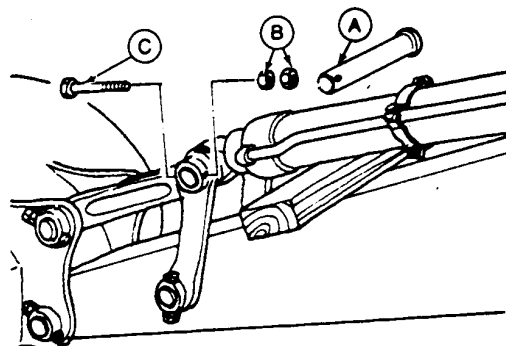
9. Remove cap screw (C).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

10. Remove bucket cylinder pin (A).

Specification
Bucket Cylinder Pin—Weight 46 kg approximate
101 lb approximate

A—Bucket Cylinder Pin
B—Nut (2 used)
C—Cap Screw



T7029ML -JUN-13/JUL89

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TF44157.0000017 -19-02AUG06-6/9

11. Remove cap screw (C).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

12. Support bucket cylinder with hoist and remove bucket pin (A).

Specification	
Bucket Cylinder—Weight.....	410 kg approximate 905 lb approximate

13. Remove bucket cylinder.

14. Repair or replace bucket cylinder as necessary.

15. Check pins and bushings for any wear. See Inspect Pins, Bushings and Bosses—Front Attachment. (Group 3340.)

16. Clean pins and bores.

17. Apply grease to pins and bores.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

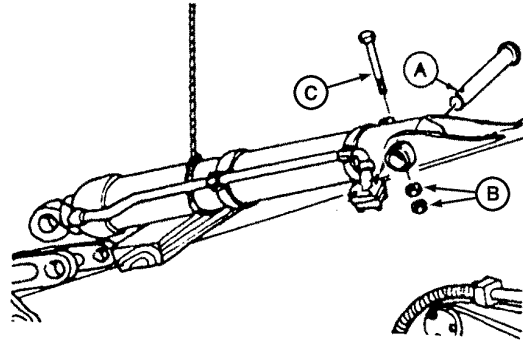
18. Support bucket cylinder with hoist and install bucket cylinder pin (A).

Specification	
Bucket Cylinder—Weight.....	410 kg approximate 905 lb approximate

NOTE: Tighten nut against nut when installing cap screw nuts.

19. Install cap screw (C).

Specification	
Cap Screw Nut—Torque	400 N•m 295 lb-ft



A—Bucket Cylinder Pin
B—Nut (2 used)
C—Cap Screw

T108977 -JUN-14MAY97

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CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

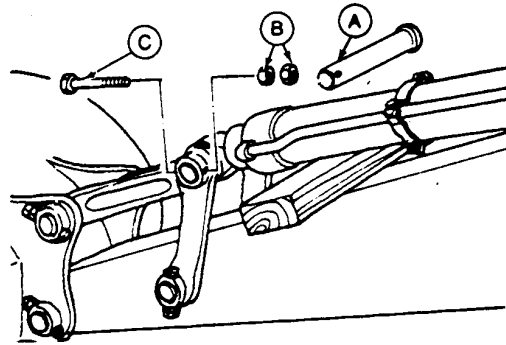
20. Align pin bore and install bucket cylinder pin (A).

Specification	
Bucket Cylinder Pin—Weight	46 kg approximate 101 lb approximate

NOTE: Tighten nut against nut when installing cap screw nuts.

21. Install cap screw (C).

Specification	
Cap Screw Nut—Torque	400 N•m 295 lb-ft



A—Bucket Cylinder Pin
B—Nut (2 used)
C—Cap Screw

T7029ML -JUN-13JUL09

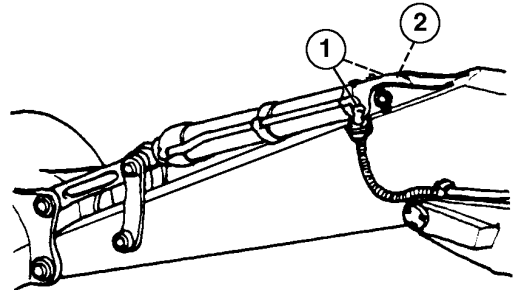
TF44157.0000017 -19-02AUG06-8/9

22. Connect hydraulic hoses (1).

Specification	
Hydraulic Hose Cap Screw—	
Torque	90 N•m 66 lb-ft

23. Connect lubrication hose (2).

Specification	
Lubrication Hose—Torque.....	29.5 N•m 22 lb-ft



1—Hydraulic Hose (2 used)
2—Lubrication Hose

TX1009868 -JUN-18JUL06

24. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

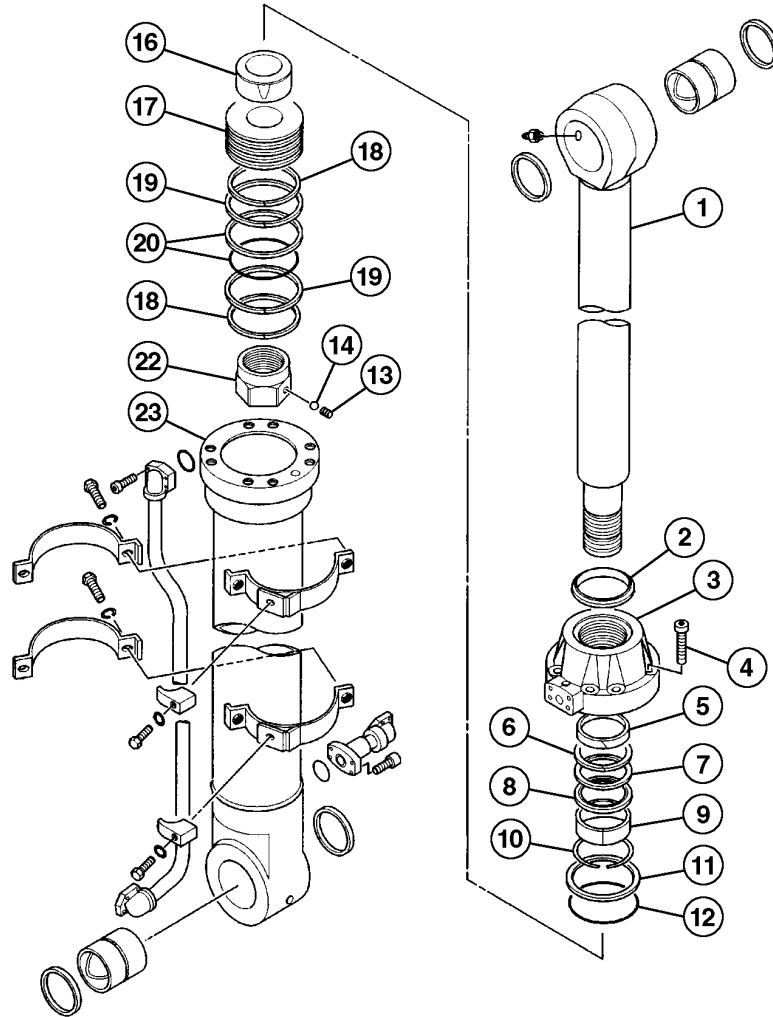
25. Bleed air from bucket cylinder. See Hydraulic Cylinder Bleed Procedure. (Group 3360.)

26. Grease bucket cylinder pin joints. See Grease Front End Pin Joints. (Operator's Manual.)

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Bucket Cylinder Disassemble and Assemble



TX1011534

- | | | | |
|----------------------|----------------|--------------------|------------------------|
| 1—Cylinder Rod | 7—U-Ring | 12—O-Ring | 18—Slide Ring (2 used) |
| 2—Wiper Ring | 8—Buffer Ring | 13—Set Screw | 19—Slide Ring (2 used) |
| 3—Cylinder Rod Guide | 9—Bushing | 14—Steel Ball | 20—Seal Ring |
| 4—Cap Screw (8 used) | 10—Snap Ring | 16—Cushion Bearing | 22—Nut |
| 5—Slide Ring | 11—Backup Ring | 17—Piston | 23—Cylinder Barrel |
| 6—Backup Ring | | | |

1. Drain hydraulic oil from cylinder.

2. Hoist cylinder onto cylinder service tool.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

Specification

Bucket Cylinder—Weight..... 410 kg
905 lb

TX1011534 - JUN-31/AUG06

Continued on next page

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Hydraulic System

NOTE: The following cylinder service tools are recommended to disassemble and assemble cylinders on this machine:

Recommended Cylinder Service Tool—Specification

HCS-40—Maximum Torque	54 232 N•m 40,000 lb-ft
HCS-60—Maximum Torque	81 349 N•m 60,000 lb-ft
HCS-60-L—Maximum Torque	81 349 N•m 60,000 lb-ft

Contact **Tricorp USA**, Palm Beach, Florida (www.tricorpusa.com) for more information.

3. Attach cylinder to service tool.
4. Completely extend cylinder rod (1).
5. Remove cap screws (4) from cylinder rod guide (3).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

IMPORTANT: Avoid damage to cylinder barrel and cylinder rod. Pull cylinder rod straight out to protect sealing surfaces.

6. Pull cylinder rod guide (3) together with cylinder rod (1) straight out from cylinder barrel (23).

Specification

Bucket Cylinder Rod—Weight	170 kg 375 lb
----------------------------------	------------------

Specification

Bucket Cylinder Barrel—Weight	170 kg 375 lb
-------------------------------------	------------------

7. Attach cylinder rod (1) to service tool.
8. Mark cylinder rod (1) and nut (22) to aid in assembly.
9. Remove set screw (13) and steel ball (14).
10. Remove nut (22) and remove piston (17) from cylinder rod (1) using ST7213 (130 mm) Special Wrench for Cylinder Piston Nut.

Specification

Bucket Cylinder Nut—Torque	20 900 N•m 15,415 lb-ft
----------------------------------	----------------------------

11. Remove and discard slide rings (18 and 19). Remove seal ring (20) from piston (17).
12. Remove cushion bearing (16) and cylinder rod guide (3) from cylinder rod (1).
13. Remove and discard slide ring (5). Remove wiper ring (2), slide ring (5), backup ring (6), U-ring (7), and buffer ring (8) from cylinder rod guide (3).
14. Remove snap ring (10) and bushing (9) from cylinder rod guide (3).
15. Remove O-ring (12) and backup ring (11) from cylinder rod guide (3).
16. Inspect cylinder rod (1) and cylinder barrel (23) outside and inside for wear, scratches, and nicks that may cut or damage a seal or wear ring during assembly.

Specification

Bucket Cylinder Barrel—ID	110—110.063 mm 4.331—4.333 in.
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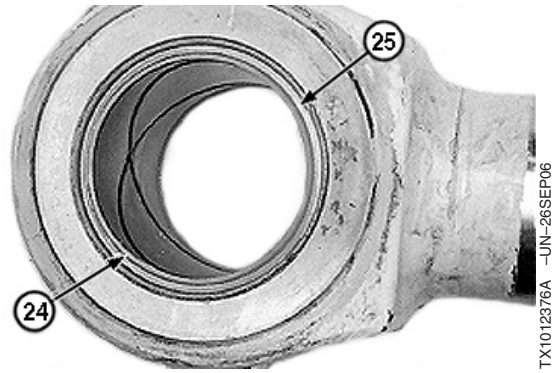
Hydraulic System

17. Inspect seals and bushings on both rod end and head end of cylinder for wear and damage. Perform Inspect Pins, Bushings and Bosses-Front Attachment. (Group 3340.)

Specification

Bucket Cylinder Head End	
Bushing—ID.....	100.05—100.25 mm 3.939—3.947 in.
Bucket Cylinder Rod End	
Bushing—ID.....	110.05—110.25 mm 4.333—4.341 in.

24—Bushing
25—Dust Seal



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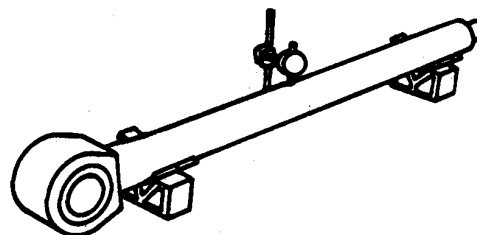
18. Check cylinder rod (1) for curvature using V-blocks and dial indicator.

Specification

Bucket Cylinder Rod—Curvature 0.125 mm /1000 mm
0.005 in. /39.37 in.

Specification

Bucket Cylinder Rod—OD After
Re-plating 119.943—120.027 mm



19. Install bushing (9) and snap ring (10) to cylinder rod guide (3) using ST8036 (120 mm) Cylinder Head Maintenance Tool / Rod Outside Dimension 120 mm.
20. Install buffer ring (8) to the cylinder rod guide (3) with the lip toward the cylinder head end.
21. Install U-ring (7) with the lip toward the cylinder head end.
22. Install backup ring (6) and U-ring (7) to the cylinder rod guide (3).
23. Install new slide ring (5) to the cylinder rod guide (3).
24. Install wiper ring (2) with the lip toward the rod end of cylinder. Install to the cylinder rod guide (3) using ST8036 (120 mm) Cylinder Head Maintenance Tool / Rod Outside Dimension 120 mm.
25. Install O-ring (12) and backup ring (11) to cylinder rod guide (3).

T6665XG -UN-27OCT88

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26. Install seal ring (20) to piston (17) using ST2970 Seal Ring Installing Tool.
27. Install new slide rings (18 and 19) to piston (17) with their slits positioned 180 degrees each pointing the opposite direction to piston (17).
28. install new seal ring (20) to piston (17) using ST2970 Seal Ring Installing Tool.
29. Attach cylinder rod (1) to service tool.
30. Install cylinder rod guide (3) to cylinder rod (1) using ST8022 Cylinder Guide Tool.
31. Install cushion bearing (16) with the chamfered side toward the cylinder rod guide (3) side to cylinder rod (1).
32. Install piston (17) to cylinder rod (1).
33. Install nut (22) to the cylinder rod (1). Tighten nut (22) using ST7213 (130 mm) Special Wrench for Cylinder Piston Nut.



17—Piston
 18—Slide Ring (2 used)
 19—Slide Ring (2 used)
 20—Seal Ring

TX1012378A -UN-26SEP06

Specification

Bucket Cylinder Nut—Torque..... 20 900 N•m
 15,415 lb-ft

34. Install steel ball (14) to nut (22) install set screw (13).

Specification

Bucket Cylinder Nut Set Screw—
 Torque 100 N•m
 74 lb-ft

35. Stake set screw (13) in two places on the outer edge with a punch and hammer.
36. Attach cylinder barrel (23) to cylinder service tool.
37. Align cylinder rod (1) with center of cylinder barrel (23). Install the cylinder rod (1) into cylinder barrel (23).
38. Install cylinder rod guide (3) to cylinder barrel (23) with cap screws (4).

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Hydraulic System

Specification

Bucket Cylinder Rod Guide Cap

Screws—Torque..... 1140 N•m
840 lb-ft

TF44157,000001A -19-08NOV06-6/6

Counterweight Cylinder Remove and Install

1. Release hydraulic circuit pressure. See Hydraulic Circuit Pressure Release Procedure. (Group 3360.)



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Relieve pressure by pushing hydraulic oil tank pressure release button.

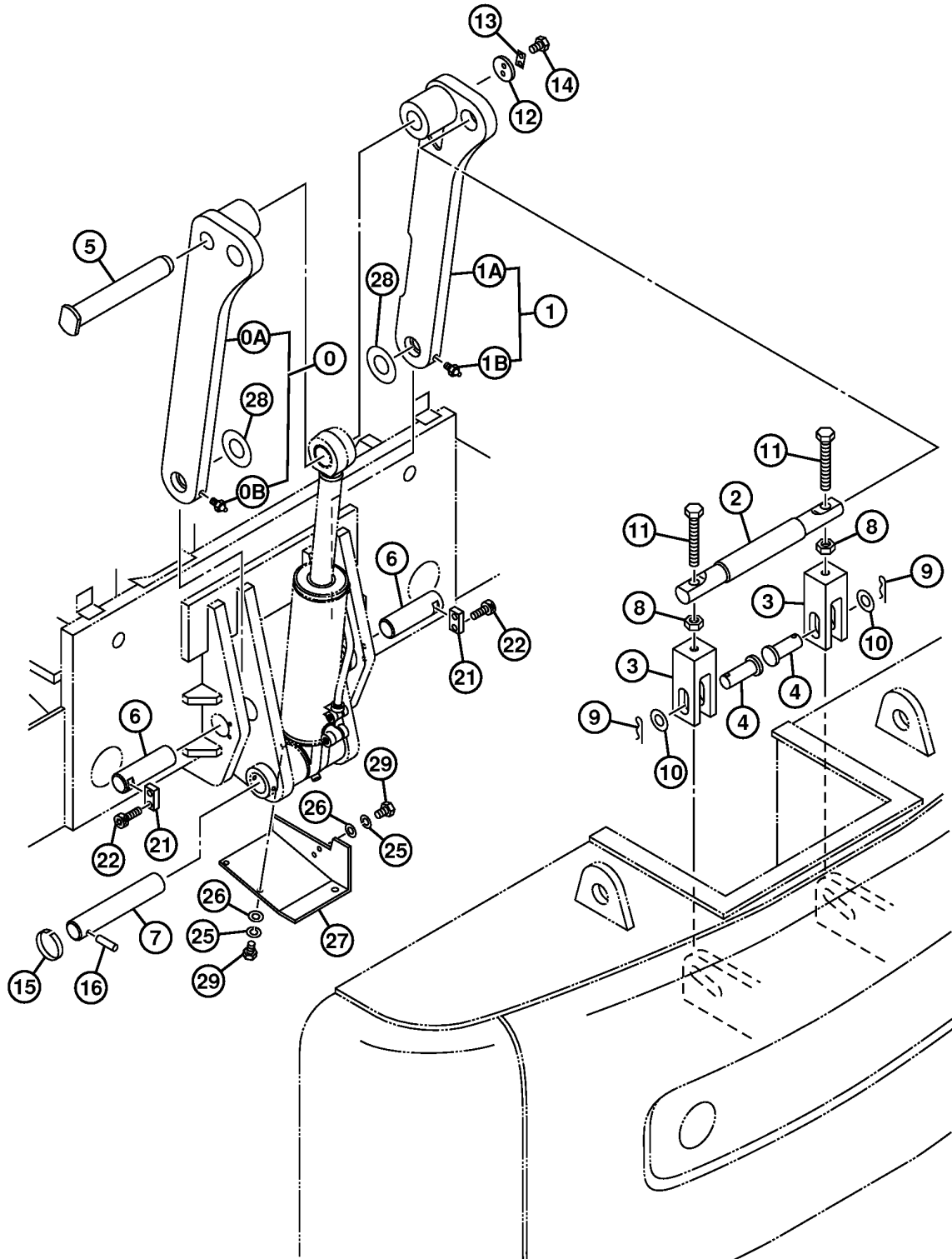
2. Push pressure release button on top of hydraulic oil tank to relieve tank pressure.

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Hydraulic System



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Hydraulic System

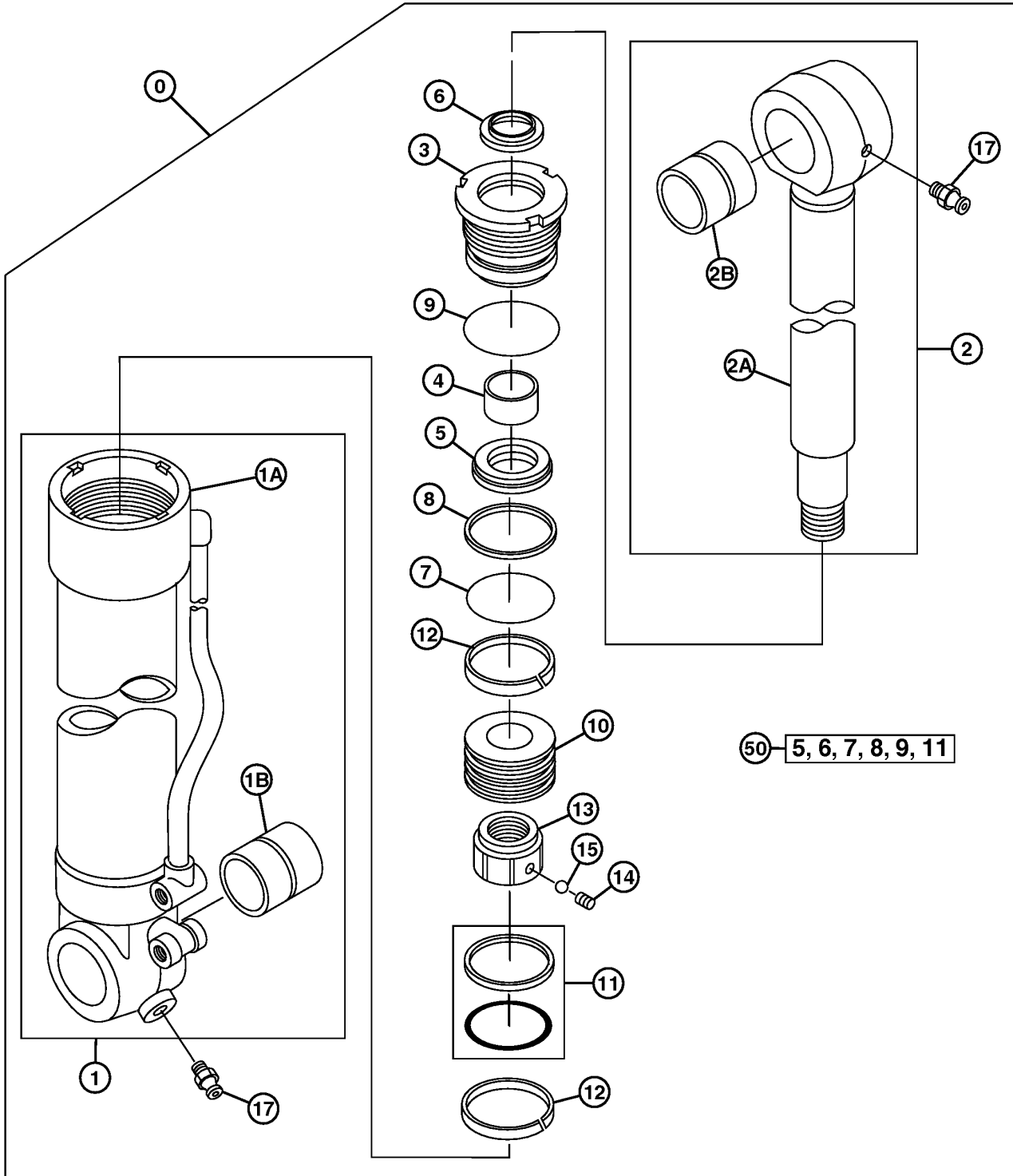
0—Link and Lubrication Fitting	4—Pin (2 used)	10—Washer (2 used)	21—Strap (2 used)
0A—Link	5—Pin	11—Cap Screw (2 used)	22—Screw (4 used)
0B—Lubrication Fitting	6—Pin (2 used)	12—Retainer	25—Lock Washer (3 used)
1—Link and Lubrication Fitting	7—Pin	13—Strap	26—Washer (3 used)
1A—Link	8—Nut (2 used)	14—Cap Screw (2 used)	27—Guard
1B—Lubrication Fitting	9—Spring Locking Pin (2 used)	15—Retainer	28—Shim (2 used)
2—Pin		16—Pin	29—Cap Screw (3 used)
3—Fork (2 used)			

3. Remove guard (27).
 4. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)
- CAUTION:** To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.
5. Disconnect hoses from cylinder. Close all openings using caps and plugs. See Counterweight Removal Hydraulic System Line Connections. (Group 9025-15.)
 6. Remove cap screws (14), strap (13), and retainer (12).
 7. Remove pin (5).
 8. Remove retainer (15), pin (16), and pin (7).
 9. Remove cylinder.
 10. Repair or replace parts as necessary.
 11. Raise cylinder into position and align bottom bore.
 12. Install pin (7), pin (16), and retainer (15).
 13. Raise cylinder rod end and align top bore.
 14. Install pin (5), retainer (12), strap (13), and cap screws (14).
 15. Attach vacuum pump to tank to apply vacuum. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)
 16. Connect hoses to cylinder. See Counterweight Removal Hydraulic System Line Connections. (Group 9025-15.)
 17. Install guard (27).
 18. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)
- IMPORTANT:** Engine must be run at slow idle to avoid fast hydraulic response when operating counterweight lifting device.
- Link assemblies must not touch counterweight while operating counterweight lifting device.**
19. Start engine. Slowly extend and retract cylinder several times to bleed air from cylinder.
 20. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)
 21. Attach link assembly to counterweight connecting links.

MM16633,000002D -19-02AUG06-3/3

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Counterweight Cylinder Disassemble and Assemble



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TX1002423

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Hydraulic System

0—Counterweight Cylinder	2A—Counterweight Cylinder	6—Seal	13—Nut
1—Counterweight Cylinder	Rod	7—O-Ring	14—Set Screw
Barrel and Bushing	2B—Bushing	8—Backup Ring	15—Ball
1A—Counterweight Cylinder	3—Counterweight Cylinder	9—O-Ring	17—Lubrication Fitting (2
Barrel	Rod Guide	10—Piston	used)
1B—Bushing	4—Bushing	11—Seal	50—Seal Kit
2—Counterweight Cylinder	5—Seal	12—Ring (2 used)	
Rod and Bushing			

Tool and torque specification information not available at time of release.

MM16633.0000039 -19-02AUG06-2/2

Hydraulic Cylinder Bleed Procedure

IMPORTANT: Trapped air suddenly compressed in a cylinder is heated and ignites the oil used for assembly causing cap seal and ring damage. Start with cylinder rod retracted and the rod end filled with clean oil. Connect the cylinder head end and lines. Operate function to slowly extend rod. Procedure will eliminate most of the air and reduce the possibility of damage.

NOTE: Bleed air at initial startup, whenever major repairs or maintenance (oil change) is done on hydraulic system, or when machine has been in storage for a period of time.

1. Run engine at slow idle.
2. Slowly operate function to move cylinder to the most horizontal position possible.
3. Slowly extend and retract cylinder several times approximately 100 mm (4 in.) from end of stroke.
4. Operate cylinder several times to full stroke.
5. Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)
6. Repeat procedure until air is removed.

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Hydraulic System

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Section 43 Swing or Pivoting System

Contents

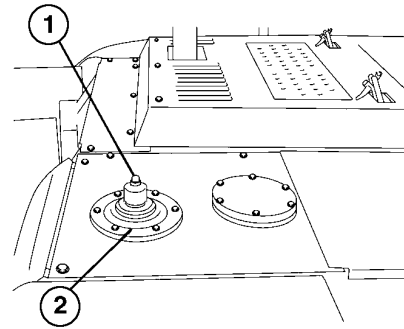
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Contents

Swing Gearbox Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing pressure release button (1) on top of hydraulic tank.
2. Drain hydraulic oil tank. Approximate capacity is 322 L (85 gal).



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

T214924 -UN-17NOV05

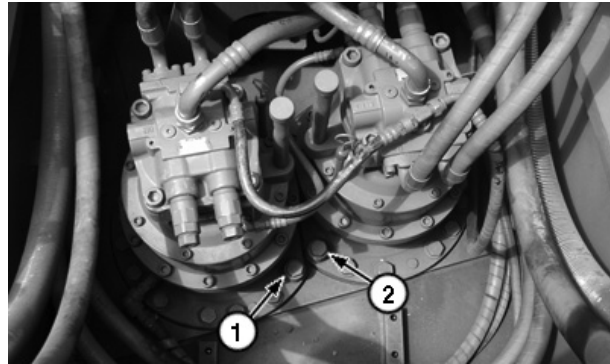
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- Attach identification tags to hydraulic fittings. Disconnect hydraulic lines, close all openings using caps and plugs.

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove cap screws (1) and spacers (2). Remove swing motor, brake, and gearbox.



TX1008856A -UN-16JUN06

Swing Gearbox

1—Cap Screw (26 used)
2—Spacer (4 used)

Specification

Swing Motor, Brake, and Gearbox—Weight 230 kg approximate
510 lb approximate

- See Swing Gearbox Disassemble and Assemble. (Group 4350.) Repair or replace parts as necessary.
- Apply PM38656 Threadlocker (High Strength) to mating surfaces of swing gearbox housing and upperstructure.
- Install swing motor, brake, and gearbox.

Specification

Swing Motor, Brake, and Gearbox—Weight 230 kg approximate
510 lb approximate

- Install spacers (2). Tighten gearbox-to-frame cap screws (1).

Specification

Gearbox-to-Frame Cap Screw—
Torque 750 N•m
555 lb-ft

- Connect hydraulic lines. See Swing Motor Line Identification. (Group 9025-15.)
- Perform Swing Gearbox Start-Up Procedure. (Group 4350.)
- Perform Swing Motor and Park Brake Start-Up Procedure. (Group 4360.)
- Fill hydraulic oil tank. See 450DLC Drain and Refill Capacities. (Operator's Manual.)

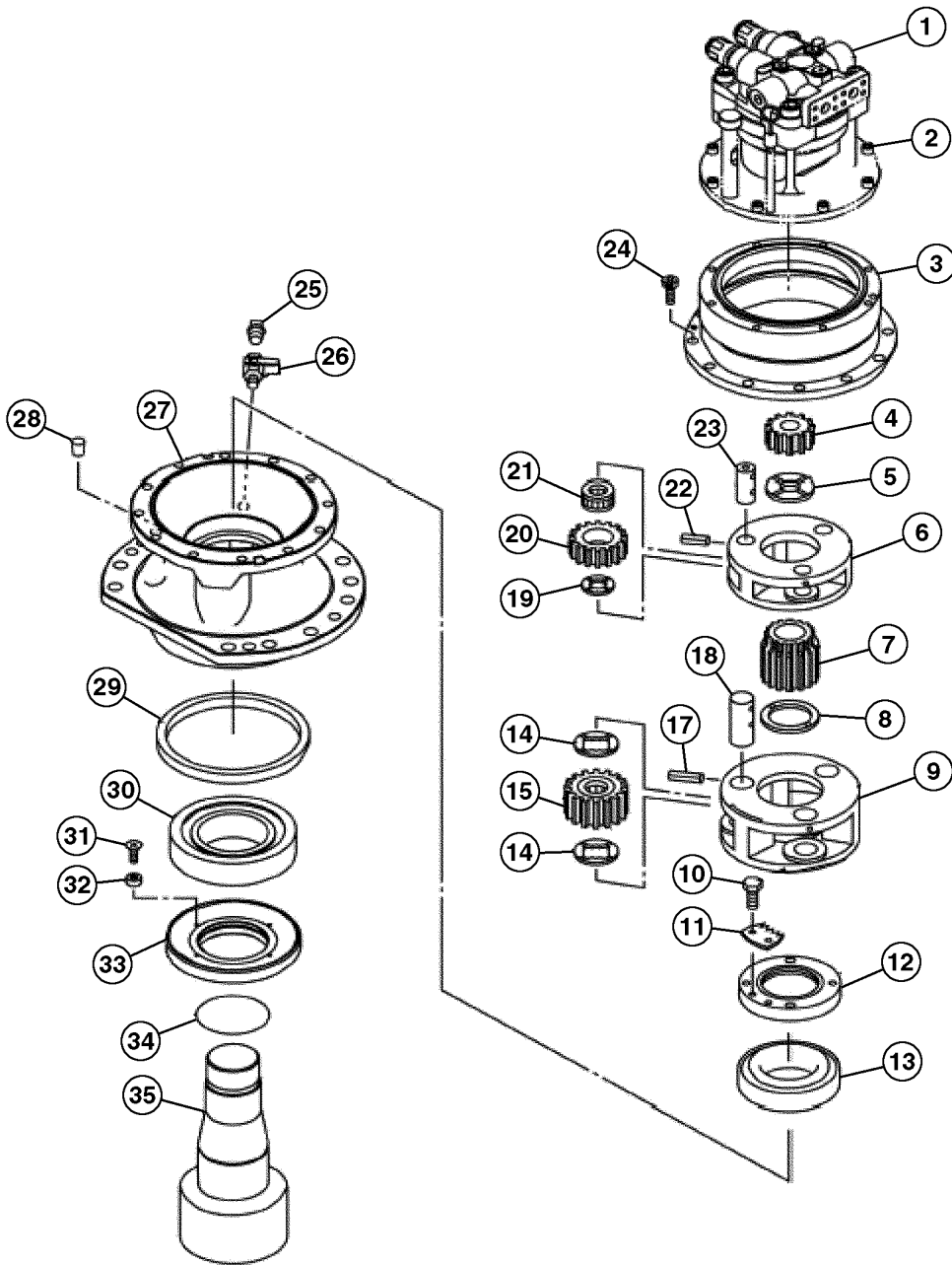
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IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.

13. Perform Pump 1 and 2 Start-Up Procedure. (Group 3360.)

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Swing Gearbox Disassemble and Assemble



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Swing Gearbox

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Mechanical Drive Elements

- 1—Swing Motor
- 2—Cap Screw (8 used)
- 3—Ring Gear
- 4—Sun Gear
- 5—Thrust Plate
- 6—Planetary Pinion Carrier
- 7—Sun Gear
- 8—Thrust Plate
- 9—Planetary Pinion Carrier

- 10—Cap Screw (2 used)
- 11—Lock Plate
- 12—Bearing Nut
- 13—Tapered Roller Bearing
- 14—Thrust Plate (3 used)
- 15—Planetary Gear (3 used)
- 16—Thrust Plate (3 used)
- 17—Spring Pin (3 used)
- 18—Pin (3 used)

- 19—Thrust Plate (3 used)
- 20—Planetary Gear (3 used)
- 21—Needle Bearing (3 used)
- 22—Spring Pin (3 used)
- 23—Pin (3 used)
- 24—Cap Screw (12 used)
- 25—Drain Plug
- 26—Drain Valve
- 27—Housing

- 28—Cork (2 used)
- 29—Oil Seal
- 30—Tapered Roller Bearing
- 31—Screw (4 used)
- 32—Magnet (4 used)
- 33—Sleeve
- 34—O-Ring
- 35—Shaft

NOTE: Disassembly and assembly of swing gearboxes are similar.

- Remove drain plug (25). Rotate drain valve (26) to drain oil from swing gearbox.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove swing motor-to-housing cap screws, remove swing motor.

Specification

Swing Motor—Weight..... 50 kg approximate
110 lb approximate

- Remove sun gear (4) from planetary pinion carrier (6).
- Remove planetary pinion carrier (6) from ring gear (3).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove cap screw (24) to remove ring gear (3).

Specification

Ring Gear—Weight..... 23 kg approximate
50 lb approximate

- Remove sun gear (7) from planetary pinion carrier (9).



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove the planetary pinion carrier from shaft (35).

Specification

Planetary Pinion Carrier—
Weight..... 23 kg approximate
51 lb approximate

- Remove spring pins (22) from planetary pinion carrier (6).
- Remove pins (23), planetary gears (20), needle bearings (21), and thrust plates (19) from planetary pinion carrier (6).
- Remove thrust plate (5) from planetary pinion carrier (6).
- Remove planetary pinion carrier (9).
- Remove spring pins (17) from planetary pinion carrier (9).

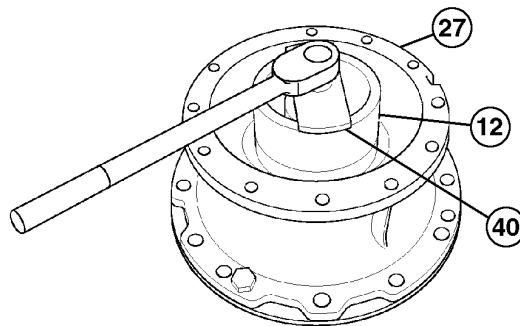
NOTE: The second stage carrier does not use needle bearings.

- Remove pins (18), planetary gears (15) and thrust washers (14) from planetary pinion carrier (9).
- Remove cap screw (10). Remove lock plate (11) from bearing nut (12).

Mechanical Drive Elements

15. Remove bearing nut (12) from shaft (35) using ST 2926 special tool or DFT1220 Swing Gearbox Nut Spanner Wrench. See DFT1220 Swing Gearbox Nut Spanner Wrench. (Group 9900.)
16. Remove tapered roller bearing (13) from housing (27) by inserting bar through oil passage in housing, and tap it out.

- 12—Bearing Nut
- 27—Housing
- 40—DFT1220 Swing Gearbox Nut Spanner Wrench



Swing Bearing Spanner Wrench

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Continued on next page

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⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 17. Remove the shaft (34) from housing (27) using a press (36).

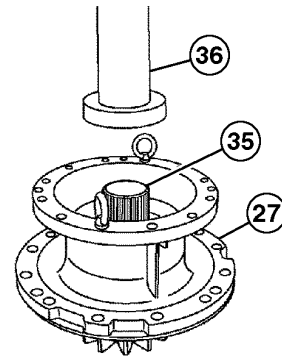
	Specification
Shaft—Weight.....	50 kg approximate 110 lb approximate

⚠ CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 18. Place shaft (35) in press.

	Specification
Shaft—Weight.....	50 kg approximate 110 lb approximate

- 19. Remove the cone of tapered roller bearing (30) and sleeve (33) from shaft (35).
- 20. Remove O-ring (34), screws (31) and magnets (32) from sleeve (33).
- 21. Remove oil seal (29) from housing (27).
- 22. Inspect and replace parts as necessary.



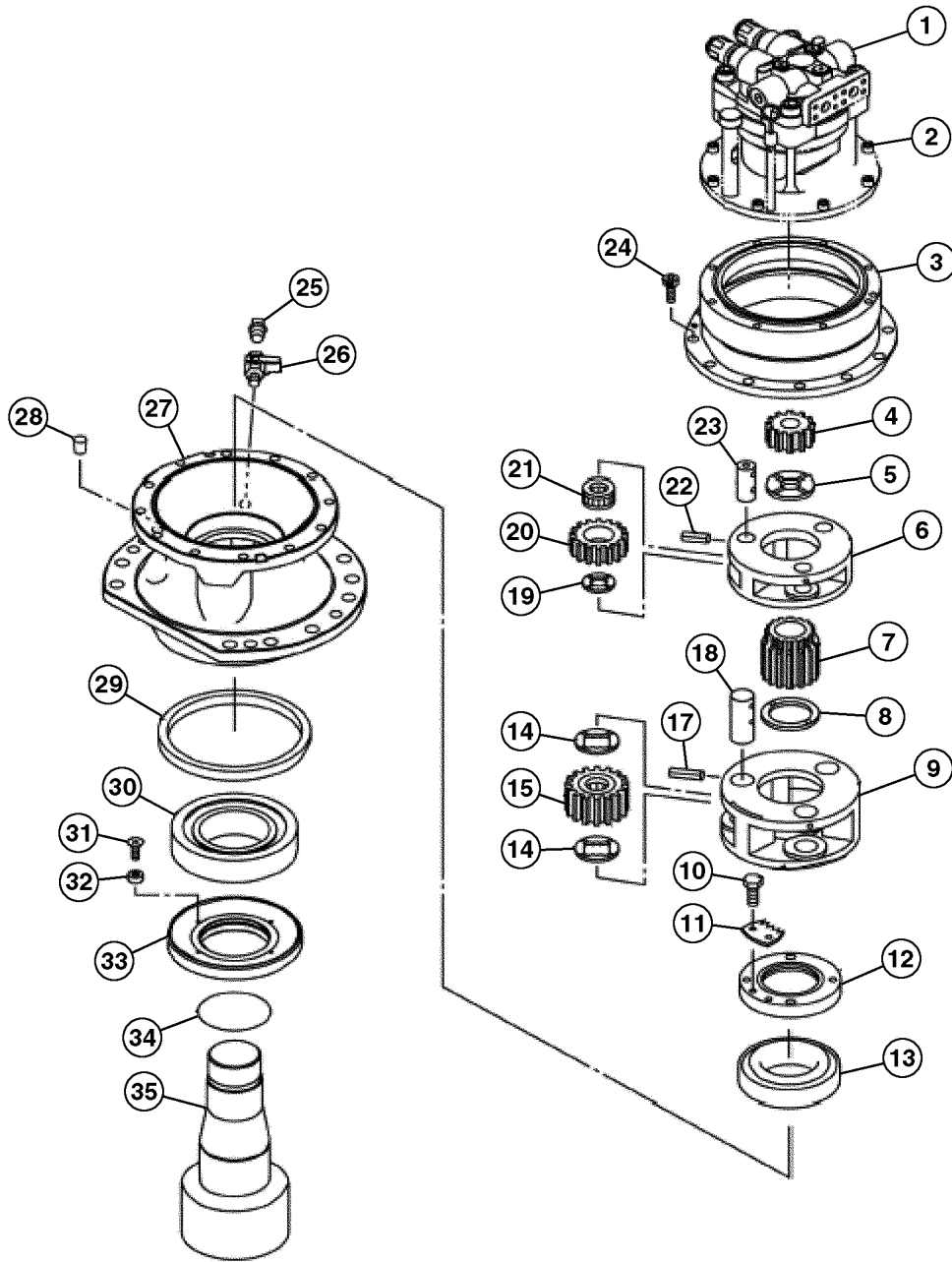
Shaft and Housing

- 27—Housing
- 35—Shaft
- 36—Press

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TX1009843

Swing Gearbox

Continued on next page

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Mechanical Drive Elements

- 1—Swing Motor
- 2—Cap Screw (8 used)
- 3—Ring Gear
- 4—Sun Gear
- 5—Thrust Plate
- 6—Planetary Pinion Carrier
- 7—Sun Gear
- 8—Thrust Plate
- 9—Planetary Pinion Carrier

- 10—Cap Screw (2 used)
- 11—Lock Plate
- 12—Bearing Nut
- 13—Tapered Roller Bearing
- 14—Thrust Plate (3 used)
- 15—Planetary Gear (3 used)
- 16—Thrust Plate (3 used)
- 17—Spring Pin (3 used)
- 18—Pin (3 used)

- 19—Thrust Plate (3 used)
- 20—Planetary Gear (3 used)
- 21—Needle Bearing (3 used)
- 22—Spring Pin (3 used)
- 23—Pin (3 used)
- 24—Cap Screw (12 used)
- 25—Drain Plug
- 26—Drain Valve
- 27—Housing

- 28—Cork (2 used)
- 29—Oil Seal
- 30—Tapered Roller Bearing
- 31—Screw (4 used)
- 32—Magnet (4 used)
- 33—Sleeve
- 34—O-Ring
- 35—Shaft

23. Apply PM37477 Threadlocker (medium strength) to screws (31). Install magnets (32) and screws to sleeve (33).

24. Install O-ring (34) to sleeve (33).

25. Install sleeve (33) and cone of roller bearing (30) to shaft (35). ST 7295 Bearing Pusher can be used with a press to install the bearing and sleeve on shaft.

26. Install cup of tapered roller bearing (30) to housing (27).

27. Apply PM38654 Threadlocker (high strength) to OD of oil seal (29) and multi-purpose grease to lip of seal.

Install oil seal into housing (27) with the lip of seal facing the motor side of housing. ST 7300 and ST 7296 Seal Install Tools may be used to install seal.

28. Install the cup of tapered roller bearing (13) to housing (27).

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

29. Lift and install housing (27) onto shaft (34).

Specification

Housing—Weight..... 70 kg approximate
130 lb approximate

30. Install cone of tapered roller bearing (13) to shaft. Tap the cone until two threads of shaft (35) for bearing nut (12) appear.

31. Install bearing nut (12) to shaft (35) to prevent shaft from falling out.

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

32. Lift and place housing (27) in a press.

Specification

Housing and Shaft—Weight..... 95 kg approximate
210 lb approximate

33. Remove bearing nut (12) from shaft (34).

34. Install tapered roller bearing (13) to housing (27). ST 2924 Bearing Pusher may be used to press bearing.

35. Apply grease to threads of bearing nut (12).

Install bearing nut to shaft (35).

Tighten bearing nut using either DFT1220 Swing Gearbox Nut Spanner Wrench or ST 2926 Spanner Wrench.

To make DFT1220 Swing Gearbox Nut Spanner Wrench tool see DFT1220 Swing Gearbox Nut Spanner Wrench. (Group 9900.)

Specification

Bearing Nut—Torque..... 490 N•m
360 lb-ft

36. Apply PM38654 Threadlocker to the threads of cap screws (10). Install lock plate (11) to bearing nut (12) with cap screws and tighten.

Mechanical Drive Elements

Specification

Lock Plate Cap Screws—
Torque..... 50 N•m
37 lb-ft

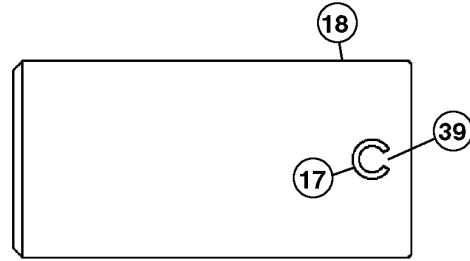
37. Install thrust plate (8) to planetary pinion carrier (9) with the oil groove facing to sun gear (7).

38. Apply grease onto the upper and lower sides of planetary gears (15). Install thrust plates (14) so the oil grooves face the planetary gear. Install planetary gears and thrust plates to planetary pinion carrier (9).

Continued on next page

TX17984,00000AB -19-02AUG06-7/9

- 39. Install spring pin (17) so the slit (39) in spring pin is to the end of the pin (18).
- 40. Install spring pin (17) into the hole of planetary pinion carrier (9).
- 41. Install thrust plate (5) to planetary pinion carrier (6) with the oil groove to sun gear (4).
- 42. Install needle bearings (21) to planetary gears (20).
- 43. Install planetary gears (20), thrust plates (19), pins (23) and spring pins (22) to first stage carrier (6).



Spring Pin

- 17—Spring Pin
- 18—Pin
- 39—Slit



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 44. Install the planetary pinion carrier (9) to the shaft (34).

Specification

Planetary Pinion Carrier—Weight 23 kg approximate
51 lb approximate

- 45. Install the sun gear (7) to the planetary pinion carrier (9) with the thinner side facing up towards the motor side.
- 46. Apply PM38654 Threadlocker to mating surfaces of ring gear (3) and housing (27).



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- 47. Install ring gear to housing. Tighten cap screws (24).

Specification

Ring Gear—Weight 23 kg approximate
50 lb approximate

Specification

Ring Gear-to-Housing Cap
Screws—Torque 205 N•m
150 lb-ft

- 48. Install the planetary pinion carrier (6) to the sun gear (7).

TX1009831 -JUN-17/JUL06


Mechanical Drive Elements

- 49. Install sun gear (4) to planetary pinion carrier (6) with the stepped side facing downward towards the thrust plate (5).
- 50. Install drain valve (26) to housing (27). Place the handle in the closed position.
- 51. Install drain plug (25) to drain valve (26).

Specification

Drain Plug—Torque..... 50 N•m
37 lb-ft

- 52. Add gear oil to swing gearbox. See 450DLC Drain and Refill Capacities. (Operator's Manual.)

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

- 53. Apply PM38655 Gasket Maker to ring gear (3) and swing motor (1) mating surfaces. Install swing motor to swing gearbox.

Specification

Swing Motor—Weight..... 50 kg approximate
110 lb approximate

- 54. Apply PM37477 Threadlocker (medium strength) to cap screws (2), and tighten to specification.

Specification

Swing Motor-to-Ring Gear Cap
Screw—Torque..... 88 N•m
65 lb-ft

TX17984,00000AB -19-02AUG06-9/9

Swing Gearbox Start-Up Procedure

IMPORTANT: Swing gearbox will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a new swing gearbox is installed or oil has been drained from the gearbox.

1. Check that drain line plug is installed.
2. Remove fill cap and add oil. See Swing Gearbox and Travel Gearbox Oils. (Operator's Manual.)
3. Install fill cap. Check oil level on dipstick. See Check Swing Gearbox Oil Level. (Operator's Manual.)

TX17984,00000AC -19-26JUL06-1/1

Upperstructure Remove and Install

1. Remove bucket from arm. See Bucket Remove and Install. (Group 3302.)
2. Remove arm from boom. See Arm Remove and Install. (Group 3340)
3. Remove boom from upperstructure. See Boom Remove and Install. (Group 3340.)
4. Remove counterweight from upperstructure. See Counterweight Remove and Install. (Group 1749.)
5. Remove cab from upperstructure. See Cab Remove and Install. (Group 1800.)
6. Remove center joint. See Center Joint Remove and Install. (Group 4360.)



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

7. Attach a suitable lifting device to upperstructure.

Specification

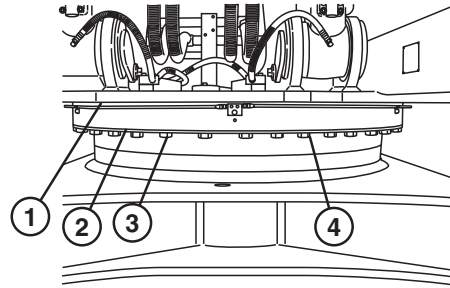
Upperstructure—Weight 10 800 kg approximate
23,800 lb approximate

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4350
13

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TX17984,00000AD -19-01AUG06-1/3

8. Remove swing bearing cap screws (3 and 4). Mark the location of the seven longer cap screws (4) so they can be put in the same location during assembly.
9. Lift upperstructure (1) off swing bearing (2) and under carriage. Support upperstructure with appropriate stands when working under.
10. Repair or replace parts as necessary.
11. Clean mating surfaces on swing bearing and upperstructure.



Swing Bearing-To-Upperstructure Cap Screws

- 1—Upperstructure
- 2—Swing Bearing
- 3—Cap Screw (29 used)
- 4—Cap Screw (7 used)

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

12. Attach a suitable lifting device to upperstructure.

Specification

Upperstructure—Weight 10 800 kg approximate
 23,800 lb approximate

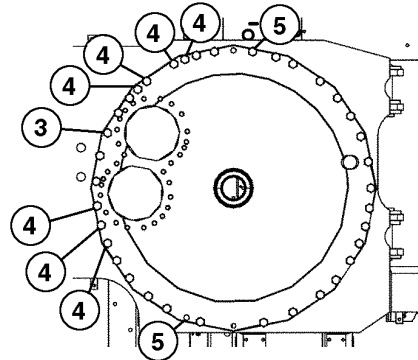
TX1009964 -UN-17JUL06

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TX17984.00000AD -19-01AUG06-2/3

13. Install upperstructure onto swing bearing aligning doll pin holes (5) on the upperstructure with the doll pins on outer race of swing bearing.
14. Apply PM38654 Threadlocker (High Strength) to cap screws (3 and 4). Install the seven longer cap screws (4) at the same location from which they were removed. Install remaining cap screws. Tighten cap screws to specification.

Specification	
Cap Screw—Torque	1950 N•m 1440 lb-ft



Swing Bearing-to-Upperstructure Cap Screw Locations

- 3—Cap Screw (29 used)
- 4—Cap Screw (7 used)
- 5—Doll Pin Hole (2 used)

15. Install center joint. See Center Joint Remove and Install. (Group 4360.)
16. Install cab to upperstructure. See Cab Remove and Install. (Group 1800.)
17. Install counterweight onto upperstructure. See Counterweight Remove and Install. (Group 1749.)
18. Install boom to upperstructure. See Boom Remove and Install. (Group 3340.)
19. Install arm onto boom. See Arm Remove and Install. (Group 3340.)
20. Install bucket to arm. See Bucket Remove and Install. (Group 3302.)

TX1009979 -JUN-17/JUL06

TX17984,00000AD -19-01AUG06-3/3

Swing Bearing Remove and Install

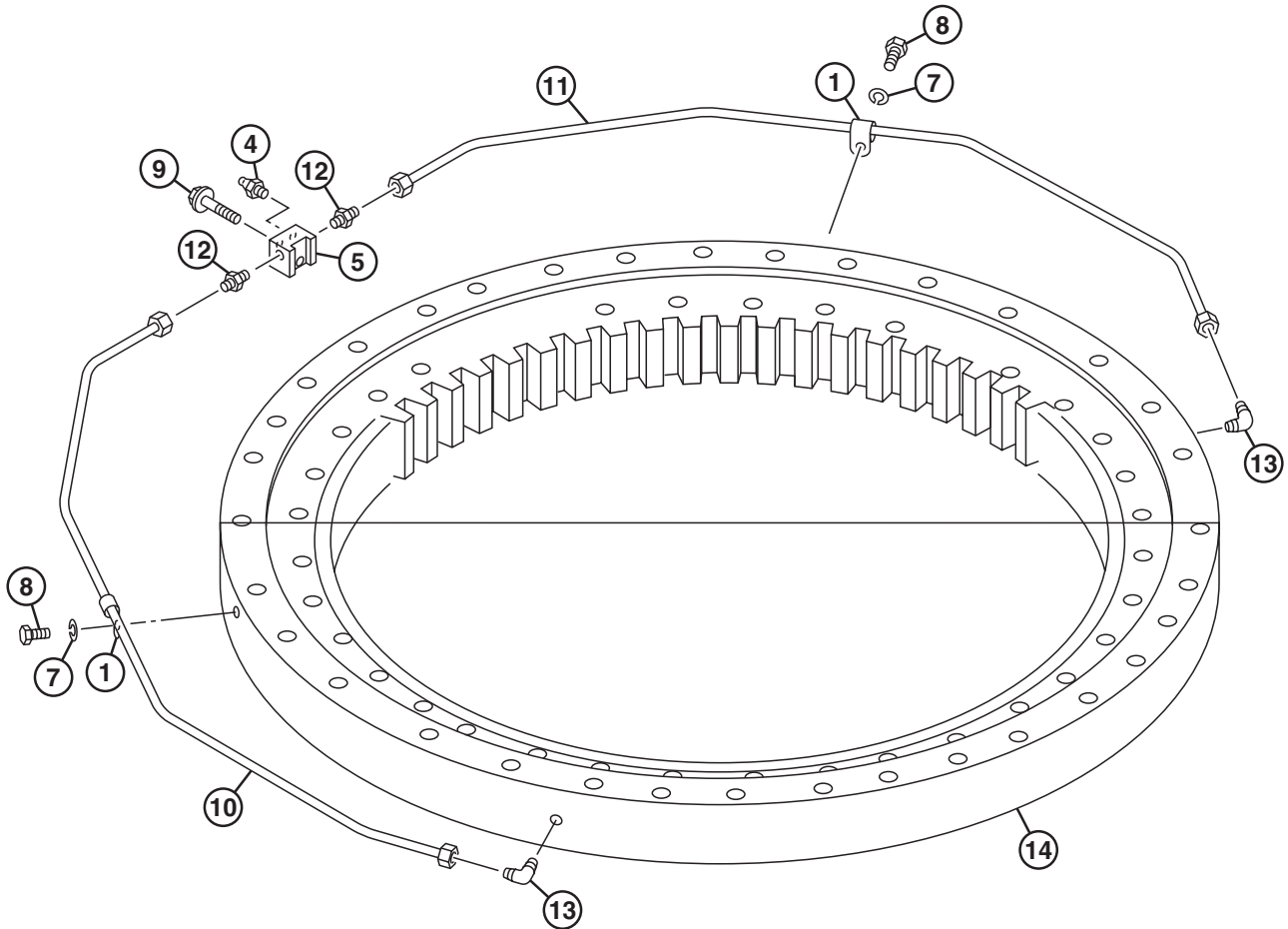
1. Remove upperstructure. See Upperstructure Remove and Install. (Group 4350.)

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4350
15

Mechanical Drive Elements



TX1009361

Swing Bearing Lubrication Lines

- | | | | |
|-----------------------|------------------------|-----------------------------|---------------------------|
| 1—Clamp (2 used) | 7—Lock Washer (2 used) | 10—Line | 13—Elbow Fitting (2 used) |
| 4—Lubrication Fitting | 8—Cap Screw (2 used) | 11—Line | 14—Swing Bearing |
| 5—Manifold | 9—Cap Screw | 12—Adapter Fitting (2 used) | |

2. Remove lubrication lines and fittings.

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TX17984,00000AE -19-01AUG06-2/4

TX1009361 -UN-25JUL06

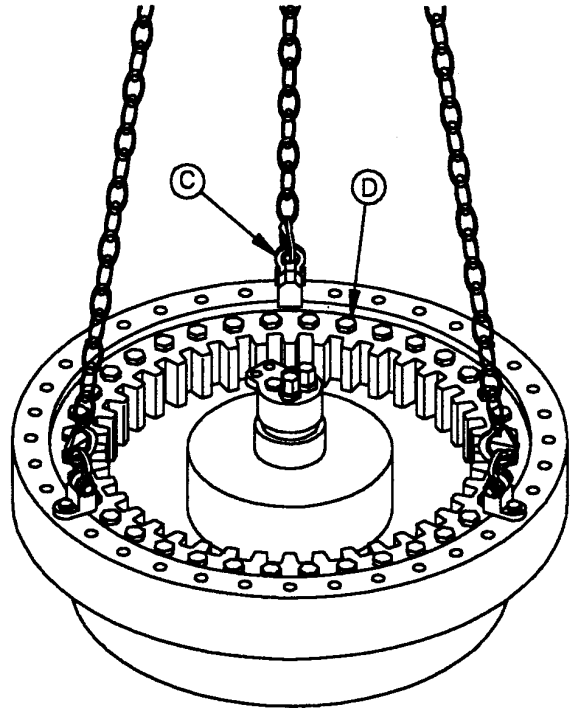
CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

3. Connect swing bearing to a hoist using lifting brackets (C) such as JT01748 Lifting Brackets.
4. Remove cap screws (D). Remove swing bearing.

Specification

Swing Bearing—Weight..... 642 kg approximate
1420 lb approximate

5. Repair or replace parts as necessary. See Swing Bearing Disassemble and Assemble. (Group 4350.)
6. Clean mating surfaces of swing bearing, upperstructure, and undercarriage.
7. Apply PM37509 Cure Primer to mating surfaces of swing bearing, upperstructure and undercarriage.
8. Apply PM38656 Threadlocker (High Strength) to mating surfaces on swing bearing, upperstructure and undercarriage.



T7720AR (CV)

C—Lifting Brackets (3 used)
D—Cap Screws (40 used)

T7720AR -UN-07MAY92

Continued on next page

TX17984,00000AE -19-01AUG06-3/4

IMPORTANT: The tooth marked with the letter “G” or “S” or equivalent is the starting and stopping point for the hardening process. The tooth and bearing loading plug must be installed on the right side of machine so the use of that part of swing bearing is minimized.

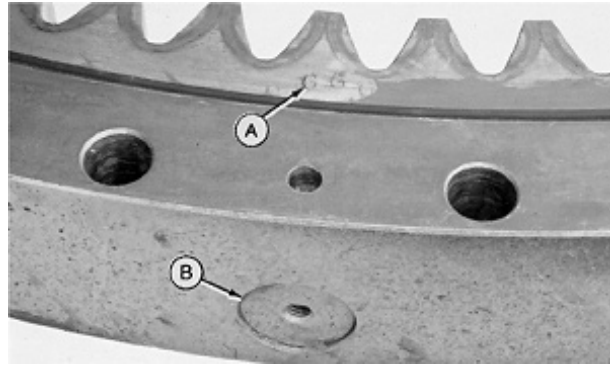
9. Install swing bearing on undercarriage so the tooth (A) marked “G” or “S” or equivalent and bearing loading plug (B) are to the right side of machine.

10. Install and tighten cap screws (D).

Specification	
Undercarriage-to-Swing Bearing	
Cap Screws—Torque	1375 N•m 1015 lb-ft

11. Install lubrication lines and fittings.

12. Apply grease to swing bearing. See Grease Swing Bearing. (Operator’s Manual.)



Tooth and Loading Plug

A—Tooth
B—Loading Plug

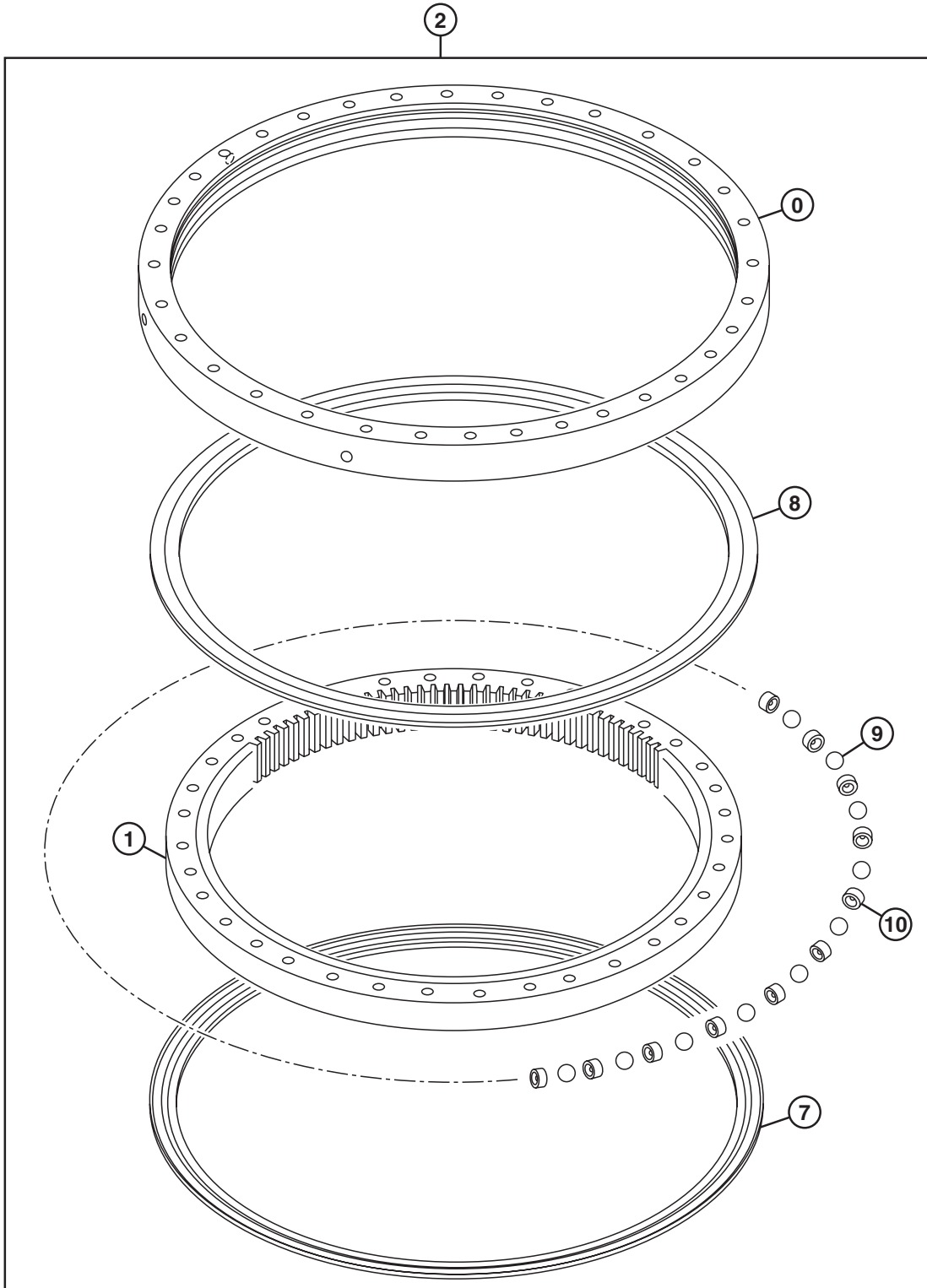
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TX17984,00000AE -19-01AUG06-4/4

Mechanical Drive Elements

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19

Swing Bearing Disassemble and Assemble



TX1009420

Swing Bearing Exploded View

Continued on next page

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Mechanical Drive Elements

0—Outer Bearing Race
1—Inner Bearing Race

2—Swing Bearing
7—Lower Seal

8—Upper Seal
9—Ball Bearing (86 used)

10—Support (86 used)



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

1. Place swing bearing (2) on clean, flat surface.

Specification

Swing Bearing—Weight..... 642 kg approximate
1420 lb approximate

Keep hoist attached to outer bearing race (0) to aid in disassembly.

2. See Swing Bearing Upper Seal Install for replacement of damaged or torn upper seal (8). (Group 4350.)

See Swing Bearing Lower Seal Install for replacement of damaged or torn lower seal (7). (Group 4350.)

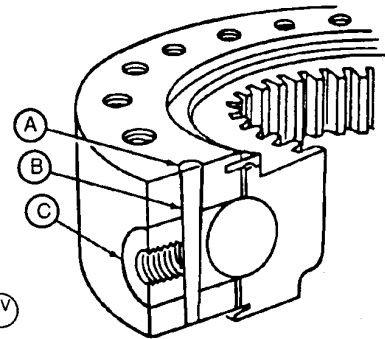
TX17984,00000AF -19-02AUG06-2/4

NOTE: Taper pin may be tack welded or crimped.

3. Grind tack weld (A) or crimp off of top of taper pin (B)
4. Drive taper pin out from the bottom side of swing bearing.
5. Remove loading plug (C) using a M10 x 1.5 pitch cap screw.

A—Tack Weld
B—Taper Pin
C—Loading Plug

T7974AA (CV)



T7974AA -JUN-30MAR93

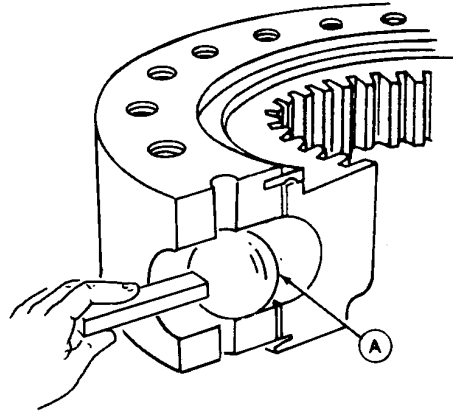
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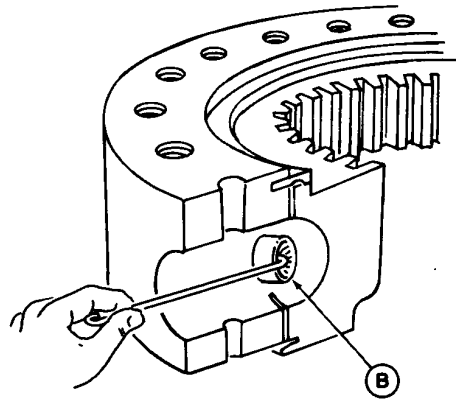
Mechanical Drive Elements

6. Remove ball bearings (A) using a magnet.
7. Remove supports (B) using a length of wire.
8. Turn inner race to remove remaining ball bearings and supports.
9. Repair or replace parts as necessary.
10. Apply grease to ball bearings and supports.
11. Starting with a ball bearing, alternately install 86 ball bearings and 86 supports through the hole. Turn inner bearing race to aid in installing ball bearings and supports.
12. Install loading plug into outer race.
13. Install taper pin even with top of swing bearing.
14. Tack weld head of taper pin to outer bearing or crimp the head of taper pin using a punch.
15. See Grease Swing Bearing. (Operator's Manual.) Add grease to swing bearing through lubrication fittings.

A—Ball Bearing
B—Support



T6876FK -UN-07MAY92



T7763AB -UN-07MAY92

TX17984,00000AF -19-02AUG06-4/4

Swing Bearing Upper Seal Install

1. Perform Upperstructure Remove and Install. (Group 4350.)
2. Remove old upper seal (A).
3. Scrape old adhesive from seal groove.

Thoroughly clean seal groove using PM37509 Cure Primer.

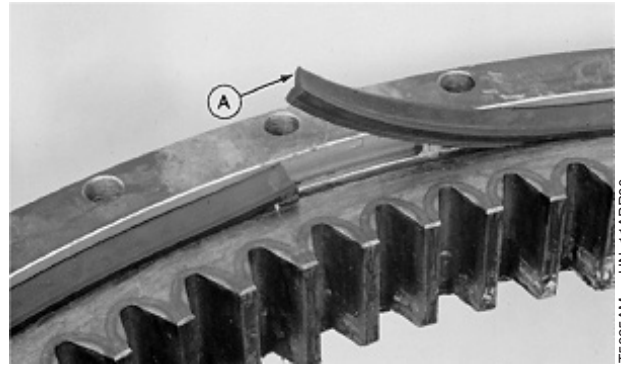
4. Apply PM37391 Gel Super Glue sparingly to seal groove.
5. Install seal with lip against outer bearing race.

Start about 76 mm (3 in.) from end of seal using a blunt instrument to force seal into groove. Push seal in direction of portion already installed to avoid stretching seal.

6. Before bringing ends of seal together, cut off excess length.
7. Apply PM37391 Gel Super Glue to both ends of seal. Push ends into seal groove making sure they come together.

IMPORTANT: To avoid pulling seal out of groove, adhesive must cure for at least 24 hours before using swing function

8. Let adhesive cure for at least 24 hours before using swing function.



A—Upper Seal

TS925AM -UN-11APR90

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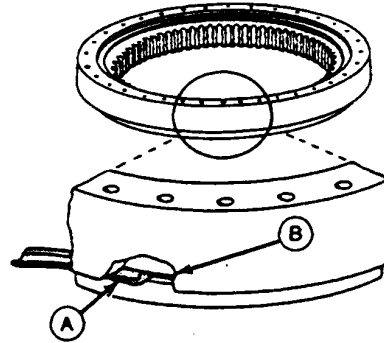
Swing Bearing Lower Seal Install

NOTE: Part of swing bearing shown cut away to show lower seal in groove.

1. Remove old seal (A).
2. Scrape old adhesive from seal groove (B). Thoroughly clean seal groove using PM37509 Cure Primer.
3. Apply PM37391 Gel Super Glue sparingly to seal groove.
4. Install seal with seal lip against outer race. Start about 76 mm (3 in.) from end of seal using blunt instrument to force seal into groove. Push seal in direction of portion already installed to avoid stretching seal.
5. Before bringing ends of seal together, cut off excess length.

IMPORTANT: To avoid pulling seal out of groove, adhesive must cure for at least 24 hours before using swing function.

6. Apply PM37391 Gel Super Glue to both ends of seal. Push ends into seal groove making sure they come together.



A—Seal
B—Seal Groove

T5936BA -JUN-17MAY89

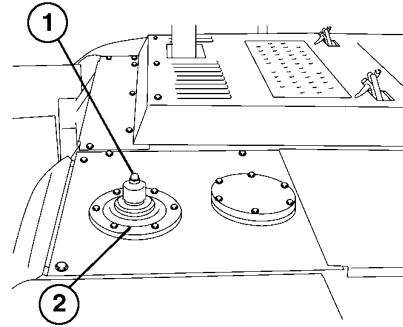
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Center Joint Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing button (1) on top of hydraulic tank.

1—Pressure Release Button
2—Hydraulic Oil Tank Cover



T214924 -UN-17NOV05

TX17984,00000B2 -19-01AUG06-1/4

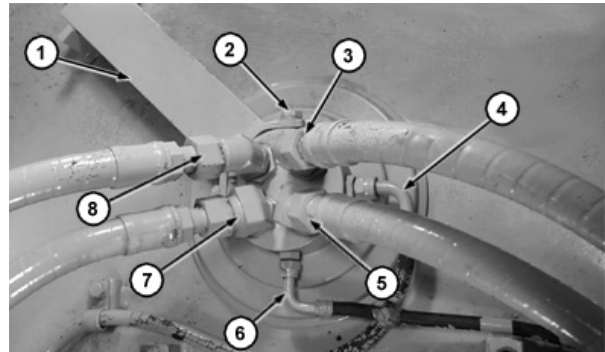
2. Attach an identification tag to the hydraulic lines and fittings of center joint to aid install procedure.
3. Disconnect hydraulic lines (3—8). Close all openings using caps and plugs.
4. Remove cap screws (2). Remove stop (1).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

5. Attach center joint to a hoist using Center Joint Lifting Tool. See Center Joint (Rotary Manifold) Lifting Tool. (Group 9900) for instructions to make tool.

Specification

Center Joint—Weight 52 kg approximate
110 lb approximate



1—Stop
2—Cap Screw (2 used)
3—Hydraulic Line
4—Hydraulic Line
5—Hydraulic Line
6—Hydraulic Line
7—Hydraulic Line
8—Hydraulic Line

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TX17984,00000B2 -19-01AUG06-2/4

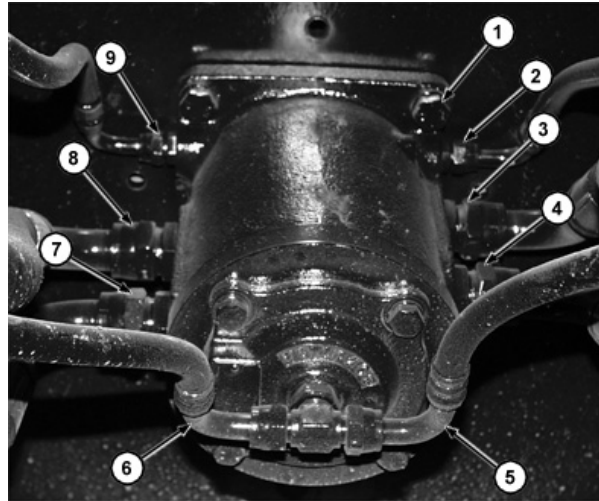
Hydraulic System

6. Attach an identification tag to the hydraulic lines of center joint to aid install procedure.
7. Disconnect hydraulic lines (2—9). Close all openings using caps and plugs.
8. Remove cap screws (1). Lower center joint.
9. Replace parts as necessary. See Center Joint Disassemble and Assemble. (Group 4360.)
10. Raise center joint into position. Tighten cap screws (1).

Specification

Center Joint Manifold-to-Frame	
Cap Screw—Torque	210 N•m 154 lb-ft

11. Connect hydraulic lines (2—9). See Travel Hydraulic System Line Connection. (Group 9025-15.)



- 1—Cap Screw (4 used)
- 2—Hydraulic Line
- 3—Hydraulic Line
- 4—Hydraulic Line
- 5—Hydraulic Line
- 6—Hydraulic Line
- 7—Hydraulic Line
- 8—Hydraulic Line
- 9—Hydraulic Line

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TX17984,00000B2 -19-01AUG06-3/4

Hydraulic System

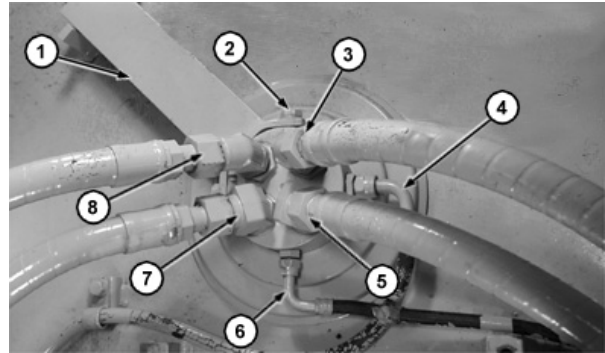
12. Connect hydraulic lines (3—8). See Travel Hydraulic System Line Connection. (Group 9025-15.)

13. Install stop (1). Tighten cap screws (2).

Specification

Center Joint Stop-to-Manifold Cap
Screw—Torque..... 140 N•m
101 lb-ft

- 1—Stop
- 2—Cap Screw (2 used)
- 3—Hydraulic Line
- 4—Hydraulic Line
- 5—Hydraulic Line
- 6—Hydraulic Line
- 7—Hydraulic Line
- 8—Hydraulic Line

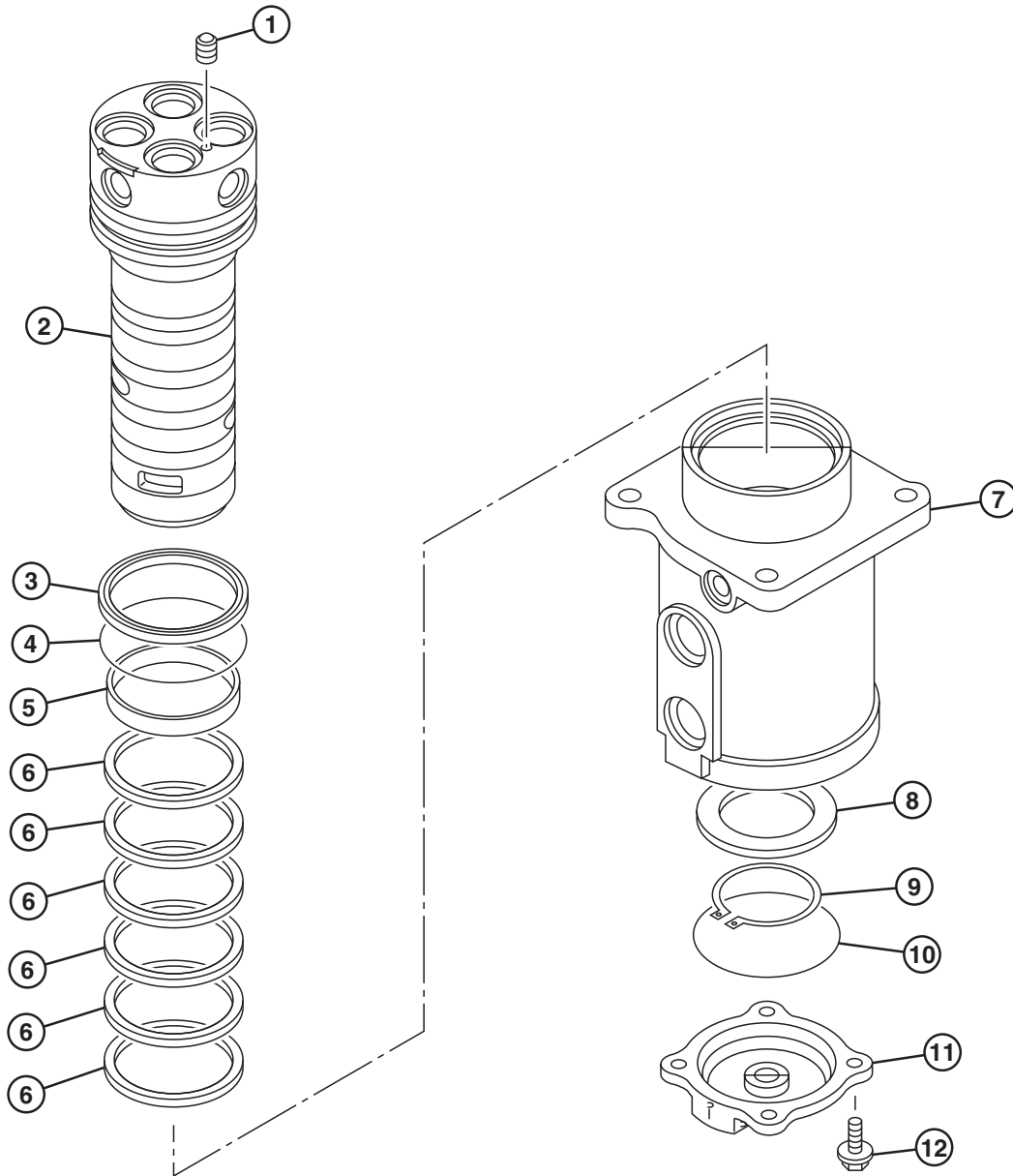


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TX17984.00000B2 -19-01AUG06-4/4

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3

Center Joint Disassemble and Assemble



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4

TX1009610

Center Joint Exploded View
Continued on next page

TX17984,00000B3 -19-27JUL06-1/4

TX1009610 -UN-14/JUL06

Hydraulic System

- 1—Plug
- 2—Spindle
- 3—Dust Seal

- 4—O-Ring
- 5—Bushing
- 6—Oil Seal (6 used)

- 7—Body
- 8—Ring
- 9—Snap Ring

- 10—O-Ring
- 11—Cover
- 12—Cap Screw (4 used)



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

1. Place center joint on a flat clean work area.

Specification

Center Joint—Weight..... 52 kg approximate
110 lb approximate

2. Remove cap screws (12).
3. Remove cover (11) from body (7).
4. Remove O-ring (10), snap ring (9) and ring (8) from body.
5. Remove the body from the spindle (2) using pullers and adapters from a puller set.



CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

6. Tighten center bolt of puller to remove body from spindle.

Specification

Spindle—Weight 22 kg approximate
50 lb approximate
Body—Weight..... 29 kg approximate
60 lb approximate

7. Remove oil seals (6) from body.
8. Remove dust seal (3) and O-ring (4) from body.
9. Inspect body and spindle for wear and damage.

Sliding surfaces with seals that are heavily damaged by seizure or foreign matter should be

replaced. Sliding surfaces with seals that are scored and less than specification, repair the surface.

Specification

Body and Spindle Sliding
Clearance—Depth 0.1 mm
0.004 in.

Inspect the sliding surfaces of body and spindle with ring (8). Surfaces that are worn or have scores but are less than allowable specification, repair. Surfaces scored or worn more than allowable specification, replace.

Specification

Body, Spindle Sliding Surface
With Ring—Depth 0.5 mm
0.02 in.

10. Inspect cover (11) sliding surface with ring (8). If worn or scored and damage is less than specification, repair. If worn or scored more than specification, replace.

Specification

Cover to Ring Wear—Depth..... 0.5 mm
0.02 in.

11. Replace bushing (5) if damaged or wear over specification is found within 180° of bushing.

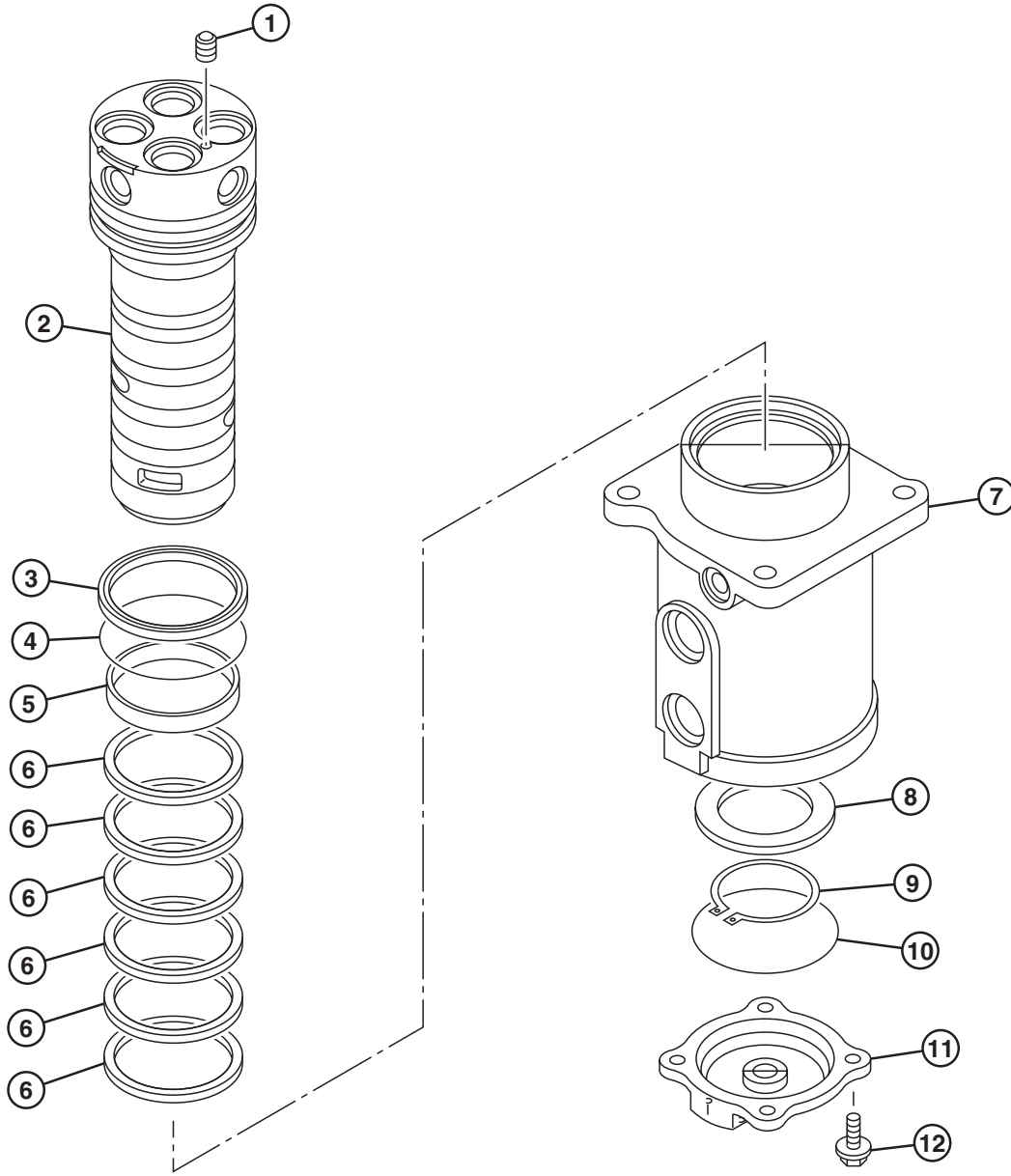
Specification

Bushing Wear—Thickness 0.2 mm
0.008 in.

IMPORTANT: When welding, cover the seal surface to prevent from weld spatter.

Remove bushing by welding on bushing inner diameter in four places at 90°. Let bushing cool and shrink, remove from body.

Hydraulic System



Center Joint Exploded View

TX1009610

Continued on next page

TX17984,00000B3 -19-27JUL06-3/4

TX1009610 -UN-14JUL06

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6

Hydraulic System

- 1—Plug
- 2—Spindle
- 3—Dust Seal

- 4—O-Ring
- 5—Bushing
- 6—Oil Seal (6 used)

- 7—Body
- 8—Ring
- 9—Snap Ring

- 10—O-Ring
- 11—Cover
- 12—Cap Screw (4 used)

12. Clean body and new bushing. Apply grease to body and new bushing.

13. Install bushing into body using the ST 2670 Pushing Tool or disks from JT01800 Bushing, Bearing, and Seal Driver Set and a press.

14. Install dust seal and O-ring (4).

Apply grease to lip of dust seal and O-ring in body.

15. Install oil seals to body.

 **CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.**

16. Place spindle with its upside down.

Install two M12 x 1.75 mm eyebolts into the body.

Lift and place body.

Specification

Spindle—Weight 22 kg approximate
50 lb approximate

Body—Weight 29 kg approximate
60 lb approximate

17. Install the body onto spindle by tapping the circumference of body evenly.

18. Install snap ring to spindle.

19. Install O-ring (10) to body.

20. Install cover to body.

21. Tighten cap screws (12) to specification.

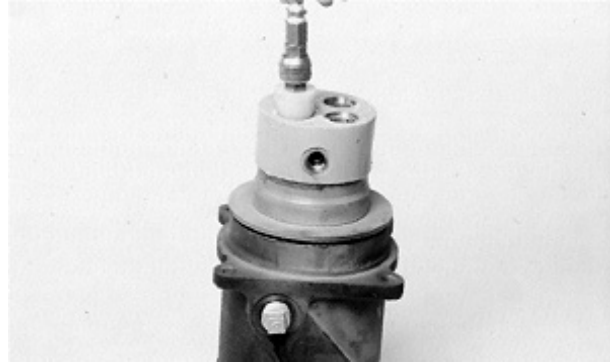
Specification

Cover to Body Cap Screws—
Torque 88 N•m
65 lb-ft

TX17984.00000B3 -19-27JUL06-4/4

Center Joint Air Test

1. Install a plug in one port.
2. Apply air pressure using JDG185 Air Test Plug and regulated air pressure through the other port in that passage.
3. Listen for air leaks at ports on either side of pressurized port.
4. See Center Joint Disassemble and Assemble. (Group 4360.) If center joint fails air test.



T6557 JB -JUN-01NOV88

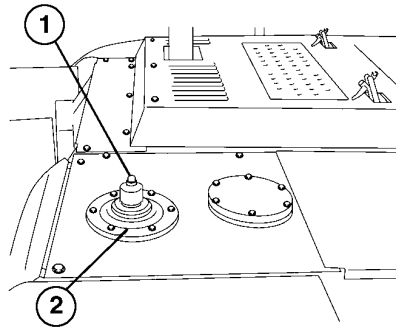
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Swing Motor and Park Brake Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing button on top of hydraulic tank.
2. Drain hydraulic oil tank. Approximate capacity is 322 L (85 gal).



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

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Continued on next page

TX17984,0000B5 -19-01AUG06-1/2

- For left swing motor disconnect lines (1, 5, 6, 8, and 9). For right swing motor disconnect lines (2, 3, 4, 7 and 11.) Install caps and plugs to hydraulic lines and swing motor fittings.

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

- Remove cap screws (10 or 12) to remove swing motor and brake.

Specification

Swing Motor and Park Brake—	
Weight.....	50 kg approximate 110 lb approximate

- See Swing Motor and Park Brake Disassemble and Assemble. (Group 4360.) If repairs are necessary.
- Install swing motor and park brake. Tighten cap screws (10 or 12).

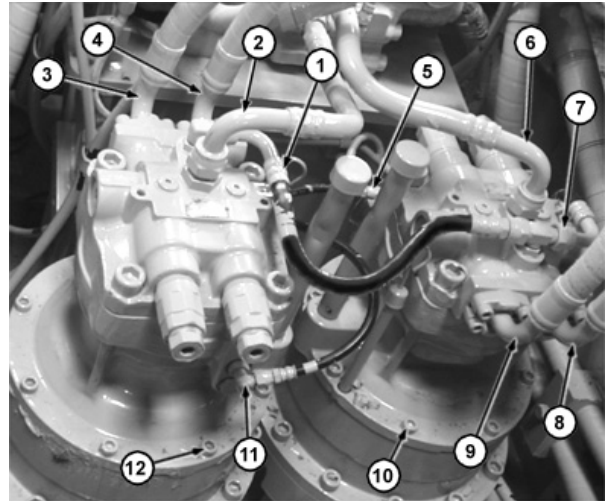
Specification

Swing Motor and Park Brake	
Cover-to-Housing Cap Screw—	
Torque	88 N•m 65 lb-ft

- Connect hydraulic lines. See Swing Motor Line Identification. (Group 9025-15.)
- Perform Swing Motor and Park Brake Start-Up Procedure. (Group 4360.)
- Fill hydraulic oil tank. See 450DLC Drain and Refill Capacities. (Operator's Manual.)

IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.

- Perform Pump 1 and 2 Start-Up Procedure. (Group 3360.)
- Check hydraulic oil level. See Check Hydraulic Oil Level. (Operator's Manual.)

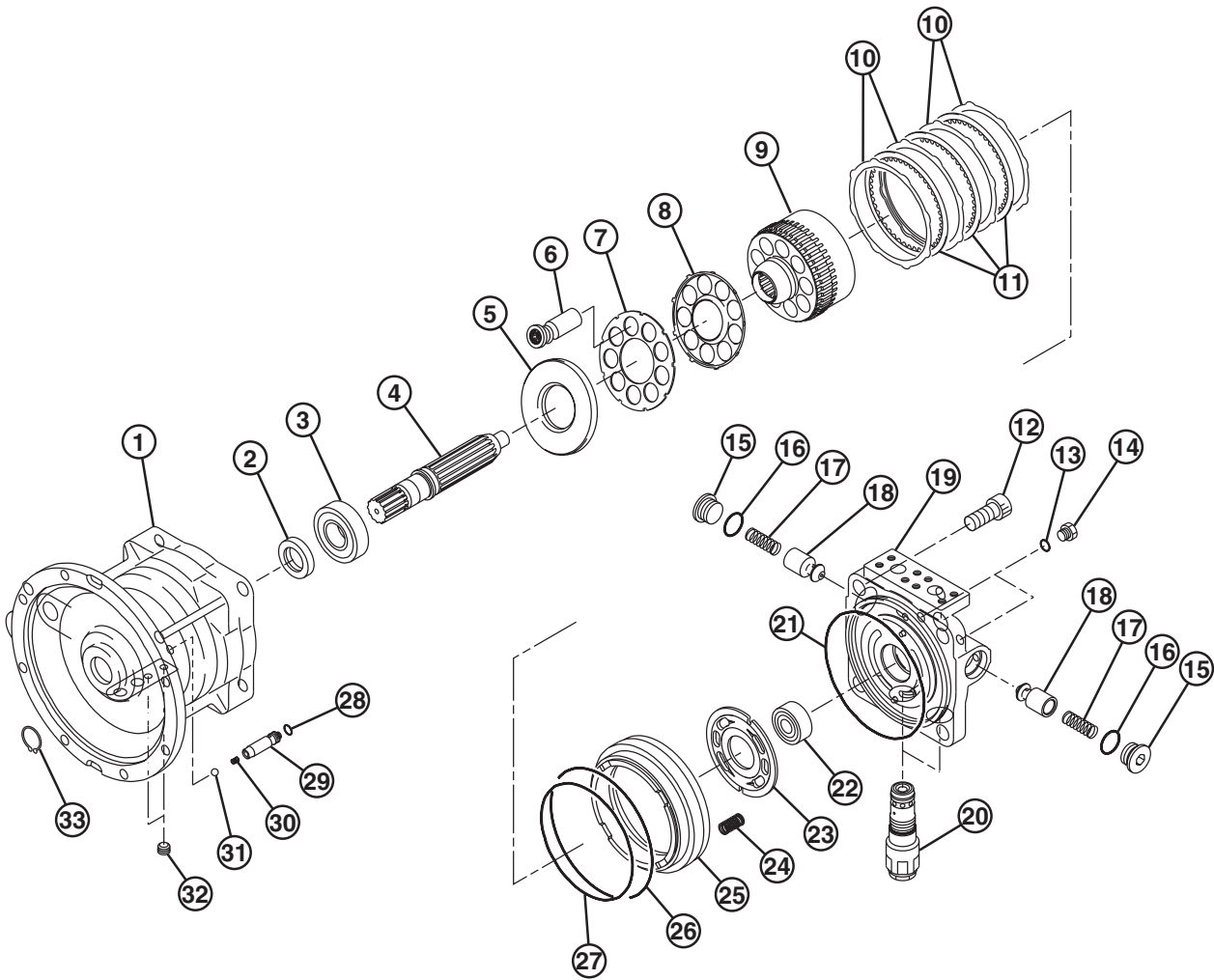


View Looking Toward Rear

- 1—Right Swing Motor DB Port-to-Left Swing Motor DB Port
- 2—Right Swing Motor-to-Main Control Valve 5-Spool Side Bottom Front Port
- 3—Right Swing Motor A Port-to-Left Manifold Block A Top Port
- 4—Right Swing Motor B Port-to-Right Manifold Block B Top Port
- 5—Left Swing Motor Rear-to-Signal Control Valve Manifold SH Port
- 6—Left Swing Motor-to-Main Control Valve 5-Spool Side Top Front Port
- 7—Left Swing Motor-to-DB Port-to-Hydraulic Oil Tank Top Front Cargo Port
- 8—Left Swing Motor A Port-to-Left Manifold Block A Bottom Port
- 9—Left Swing Motor B Port-to-Right Manifold Block B Bottom Port
- 10—Cap Screw (8 used)
- 11—Right Swing Motor Front Port-to-Left Swing Motor Rear Port
- 12—Cap Screw (8 used)

T139536B -UN-30APR01

Swing Motor and Park Brake Disassemble and Assemble



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4360
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T142065

T142065 -UN-22JUN01

Continued on next page

TX17984,00000EE -19-02AUG06-1/7

Hydraulic System

1—Case	10—Plate (4 used)	19—Valve Casing	27—O-Ring
2—Oil Seal	11—Friction Plate (3 used)	20—Relief Valve (2 used)	28—O-Ring
3—Bearing	12—Cap Screw (4 used)	21—O-Ring	29—Piston
4—Shaft	13—O-Ring (2 used)	22—Bearing	30—Spring
5—Shoe Plate	14—Plug (2 used)	23—Valve Plate	31—Ball
6—Plunger (9 used)	15—Plug (2 used)	24—Spring (24 used)	32—Plug (2 used)
7—Plate	16—O-Ring (2 used)	25—Brake Piston	33—Snap Ring
8—Retainer	17—Spring (2 used)	26—O-Ring	34—Port B
9—Rotor	18—Poppet (2 used)		

1. Drain oil from swing motor. Approximate capacity is 1.5 L (1.6 qt).

CAUTION: Prevent possible crushing injury from heavy component. Use appropriate lifting device.

2. Place swing motor on clean, flat surface.

Specification

Swing Motor and Brake—

Weight..... 50 kg approximate
110 lb approximate

3. Remove relief valves (20), plugs (15), springs (17), and poppets (18) from valve casing (19).

4. Remove valve casing from case (1). Valve plate (23) may be removed with valve casing.

5. Remove valve plate and springs (24) from rotor (9).

6. Remove brake piston (25).

7. Remove O-rings (26 and 27) from case.

8. Remove rotor (9), retainer (8), plate (7), and plungers (6) from shaft (4).

9. Remove plates (10) and friction plates (11).

10. Remove shoe plate (5) from case.

11. Remove snap ring (33) and shaft (4).

12. Remove oil seal (2) and cup of bearing (3).

13. Remove cone of bearing (3) from shaft (4).

IMPORTANT: Filter and orifice are mounted inside of piston. Unless clogged or deformed, do not disassemble. Do so only when absolutely needed. If the inner parts need to be replaced, replace them as an assembly.

14. Remove piston (29), O-ring (28), spring (30) and ball (31)

15. Inspect and replace parts as necessary.

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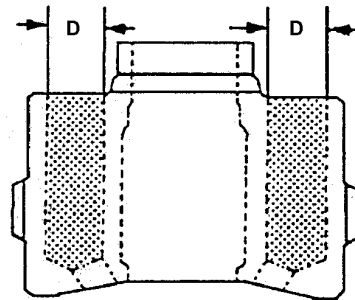
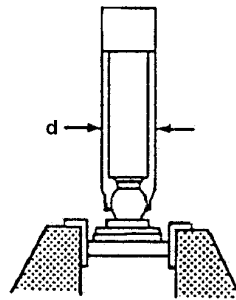
TX17984,00000EE -19-02AUG06-27

Hydraulic System

16. Measure clearance between outer diameter of plunger and inner bore of cylinder.

Specification

Plunger-to-Cylinder Clearance—	
Clearance	0.027 mm new
	0.052 mm maximum used
	0.0011 in. new
	0.0020 in. maximum used



T142067

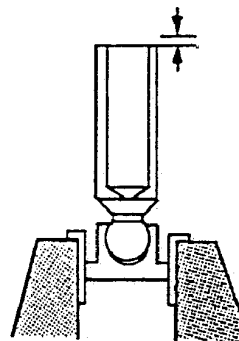
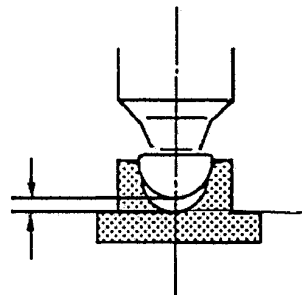
T142067 -UN-22JUN01

TX17984,00000EE -19-02AUG06-3/7

17. Measure clearance between plunger and shoe.

Specification

Plunger-to-Shoe—Clearance.....	0.0 mm new
	0.3 mm maximum used
	0.0 in. new
	0.0118 in. maximum used



T142069

T142069 -UN-22JUN01

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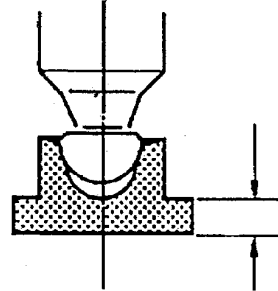
TX17984,00000EE -19-02AUG06-4/7

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Hydraulic System

18. Measure thickness of shoe.

	Specification
Shoe—Thickness.....	5.5 mm new
	5.3 mm minimum
	0.22 in. new
	0.21 in. minimum



T142072

T142072 -UN-22JUN01

Continued on next page

TX17984,00000EE -19-02AUG06-5/7

Hydraulic System

19. Measure thickness of friction plate.

Specification

Friction Plate—Thickness..... 2.0 mm new
1.8 mm minimum
0.08 in. new
0.07 in. minimum

20. Install cones of bearings (3 and 22) to shaft (4) using press.

21. Install oil seal (2) to case.

22. Install cup of bearing (3) to case.

23. Wrap tape around splines of shaft in order not to damage oil seal when installing. Install shaft and snapping to case.

24. Install shoe plate (5) to case with the chamfered side toward case.

25. Install retainer (8) to plunger (6) with the notch on retainer facing the shoe plate (5) side.

26. Align the notch and install retainer (8) to plate (7). Install plungers (6).

27. Install the plungers (6) to rotor (9).

28. Set casing horizontally. Install the rotor (9) to shaft (4).

29. Set the case vertically.

30. Starting with a plate (10), alternately install plates and friction plates (11) to case and rotor (9) aligning the 4 notches on the outer side of friction plates and on the spline side of plates respectively.

31. Install O-rings (26 and 27) to case.

32. Align the matching mark and install brake piston (25) into case.

33. Install springs (24) to brake piston (25).

34. Install ball (31), spring (30) and piston (29) to case.



T142073

T142073 -JUN-22JUN01

Hydraulic System

35. Install the cup part of bearing (22) to valve casing (19).
36. Install O-ring (21) to valve casing. Apply petroleum jelly to plate (23). Install plate to valve casing with the notch on port facing to the rotor (9).
37. Apply petroleum jelly to needle part of bearing (22).
38. Install valve casing to case. Tighten cap screws (12).

Specification

Valve Casing Cap Screw—
Torque 430 N•m
320 lb-ft

39. Install poppet (18) and spring (17). Tighten plug (15) with O-ring (16) attached.

Specification

Poppet Plug—Torque 330 N•m
245 lb-ft

40. Install relief valves (20) into valve casing.

Specification

Swing Motor Relief Valve—
Torque 175 N•m
130 lb-ft

41. Add oil. See Hydraulic Oil. (Operator's Manual.)

TX17984,00000EE -19-02AUG06-7/7

Swing Motor and Park Brake Start-Up Procedure

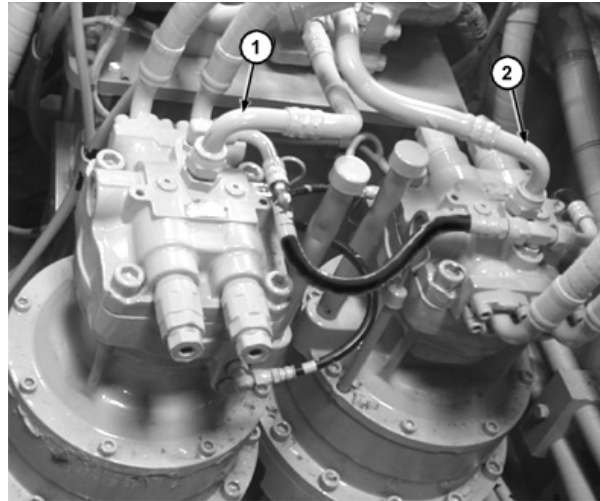
IMPORTANT: Swing motor will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a new swing motor is installed or oil has been drained from the motor.

Procedure is to ensure the swing motor is filled with oil.

1. Disconnect swing motor hydraulic line (1 or 2).
2. Fill motor with hydraulic oil through port until oil reaches level of port. See Hydraulic Oil. (Operator's Manual.)

NOTE: Air must be allowed to escape from the swing motor while filling.

3. Connect hydraulic line (1 or 2).



1—Right Swing Motor-to-Main Control Valve
5-Spool Side Bottom Front Port
2—Left Swing Motor-to-Main Control Valve
5-Spool Side Top Front Port

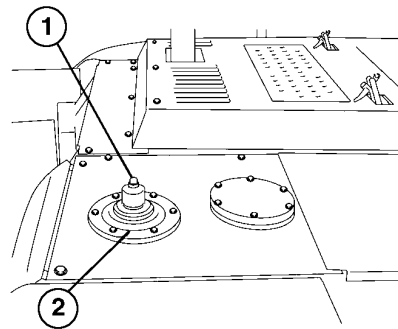
T139536C -UN-30APR01

TX17984,00000B9 -19-01AUG06-1/1

Swing Motor Crossover Relief Valve Remove and Install

CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing pressure release button (1) on top of hydraulic tank.
2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

T214924 -UN-17NOV05

Continued on next page

TX17984,00000EF -19-01AUG06-1/2

Hydraulic System

3. Remove crossover relief valve (1).

NOTE: Crossover relief valves are not repairable.
Replace only.

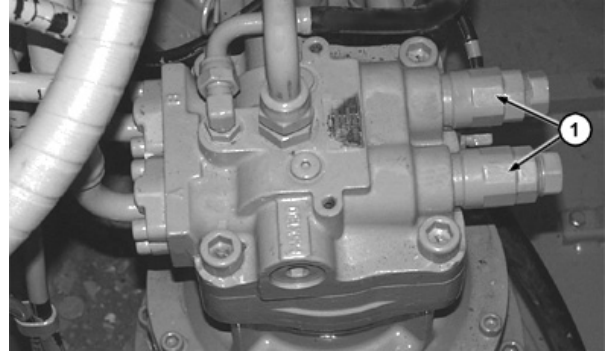
4. Install crossover relief valve (1).

Specification

Crossover Relief Valve—Torque..... 175 N•m
130 lb-ft

5. Perform Swing Motor Crossover Relief Valve Test and Adjustment. (Group 9025-25.)

1—Crossover Relief Valve (4 used)



T139531B -UN-30APR01

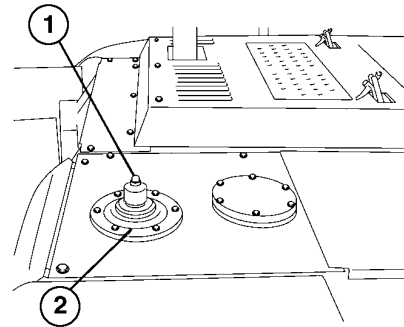
TX17984,00000EF -19-01AUG06-2/2

Swing Motor Make-Up Check Valve Remove and Install



CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Relieve pressure by pushing pressure release button.

1. Release hydraulic oil tank pressure by pushing pressure release button (1) on top of hydraulic tank.
2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. See Apply Vacuum to Hydraulic Oil Tank. (Group 3360.)



1—Pressure Release Button
2—Hydraulic Oil Tank Cover

T214924 -UN-17NOV05

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TX17984,00000F0 -19-03AUG06-1/2

Hydraulic System

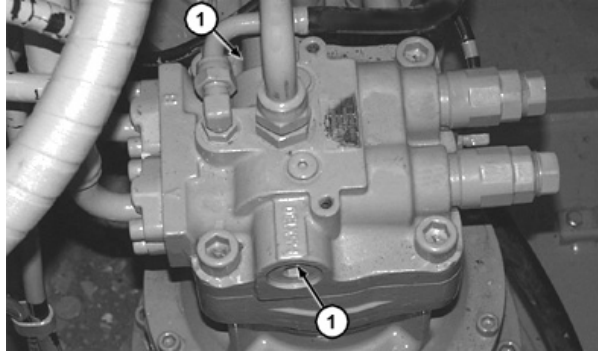
NOTE: Swing motor make-up check valves can be removed with swing motor on machine.

3. Remove swing motor make-up check valve (1).
4. Replace parts as needed.
5. Install swing motor make-up check valve (1).

Specification

Swing Motor Make-Up Check Valve Plugs—Torque.....	330 N•m 245 lb-ft
---------------------------------------------------	----------------------

1—Swing Motor Make-Up Check Valve (4 used)



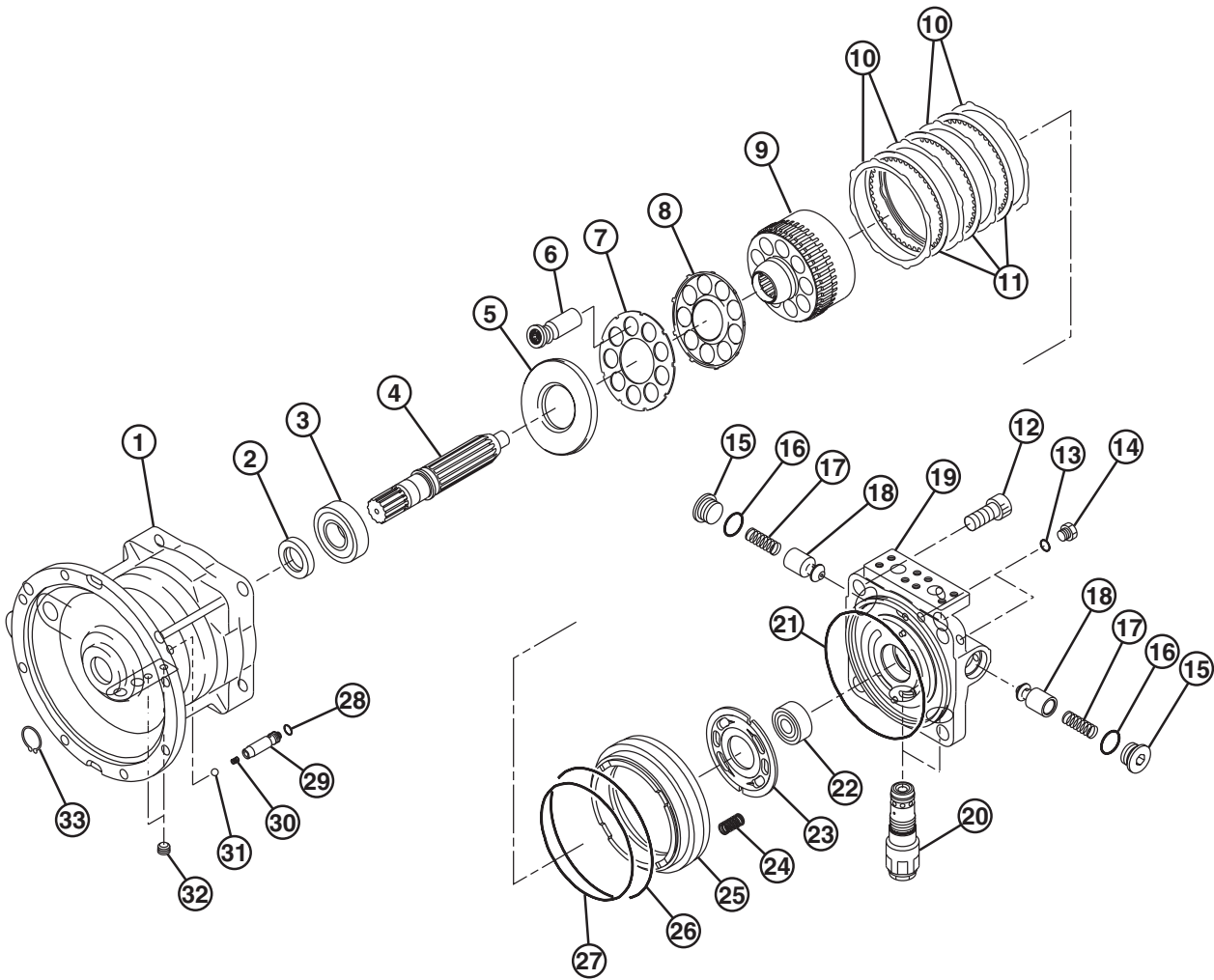
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Hydraulic System

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4360
19

Swing Park Release Valve Remove and Install



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4360
20

T142065

T142065 -UN-22JUN01

Continued on next page

TX17984.00000BD -19-02AUG06-1/2

Hydraulic System

1—Case	10—Plate (4 used)	19—Valve Casing	27—O-Ring
2—Oil Seal	11—Friction Plate (3 used)	20—Relief Valve (2 used)	28—O-Ring
3—Bearing	12—Cap Screw (4 used)	21—O-Ring	29—Piston
4—Shaft	13—O-Ring (2 used)	22—Bearing	30—Spring
5—Shoe Plate	14—Plug (2 used)	23—Valve Plate	31—Ball
6—Plunger (9 used)	15—Plug (2 used)	24—Spring (24 used)	32—Plug (2 used)
7—Plate	16—O-Ring (2 used)	25—Brake Piston	33—Snap Ring
8—Retainer	17—Spring (2 used)	26—O-Ring	34—Port B
9—Rotor	18—Poppet (2 used)		

1. Remove swing motor. See Swing Motor and Park Brake Remove and Install. (Group 4360.)
2. Remove valve casing (19) from swing motor. See Swing Motor and Park Brake Disassemble and Assemble. (Group 4360.)
- IMPORTANT: The filter and orifice are installed to piston. Replace as an assembly.**
3. Remove piston (29) from case (1) by using a pair of pliers. Remove spring (30) and ball (31) from case.
4. Remove O-ring (28) from case.
5. Inspect swing park release valve parts and ball seat in case.
6. Repair or replace parts as needed.
7. Install O-ring in casing.
8. Install ball, spring and piston in case.
9. Install valve casing to swing motor. See Swing Motor and Park Brake Disassemble and Assemble. (Group 4360.)

TX17984,00000BD -19-02AUG06-2/2

Hydraulic System

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Section 99 Dealer Fabricated Tools

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DFT1220 Swing Gearbox Nut Spanner Wrench	99-9900-10
DFRW20 Compressor Holding Fixture.	99-9900-11

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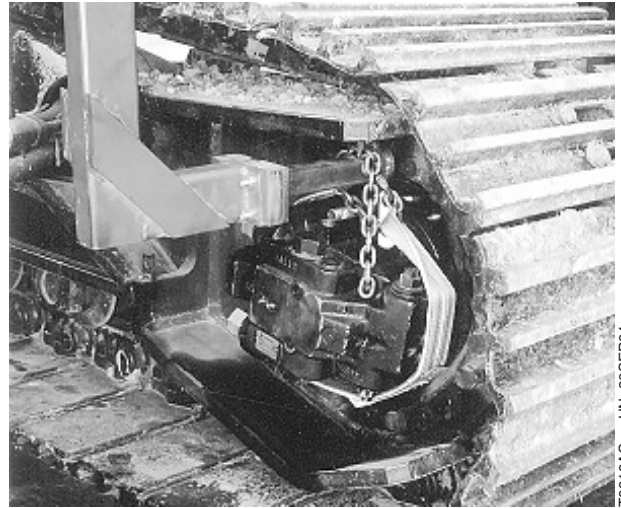
DF1063 Lift Bracket

Tool is the same as used on other machines. Only the lift bracket of the tool is used for this machine with adapter DFT1130.

Lift Bracket is used to remove and install travel motor.

Material required:

- 38.1 x 76.2 x 0.48 mm (1-1/2 x 3 x 3/16 in.) Square Tube
- 1.3 mm (1/2 in.) 1020 Steel Plate
- 1 x 38.1 mm (3/8 x 1-1/2 in.) Cap Screw and Nut (4 used)



T8318AC -JUN-20SEP94

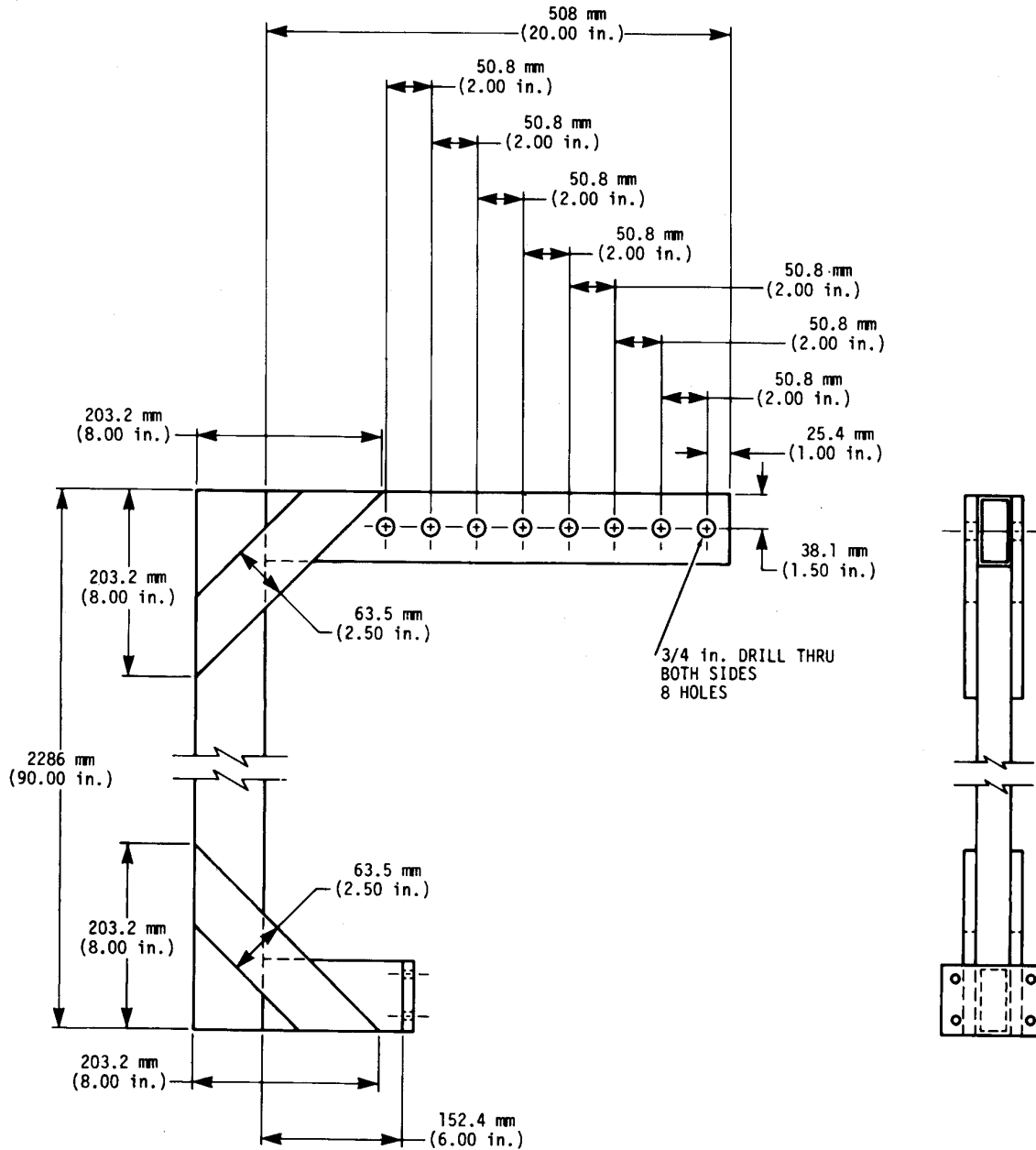
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MD46667,00000C8 -19-01AUG06-1/2

Dealer Fabricated Tools

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T7247BW -19-25APR90

Dealer Fabricated Tools

Lifting bracket is used to remove and install fan drive pump.

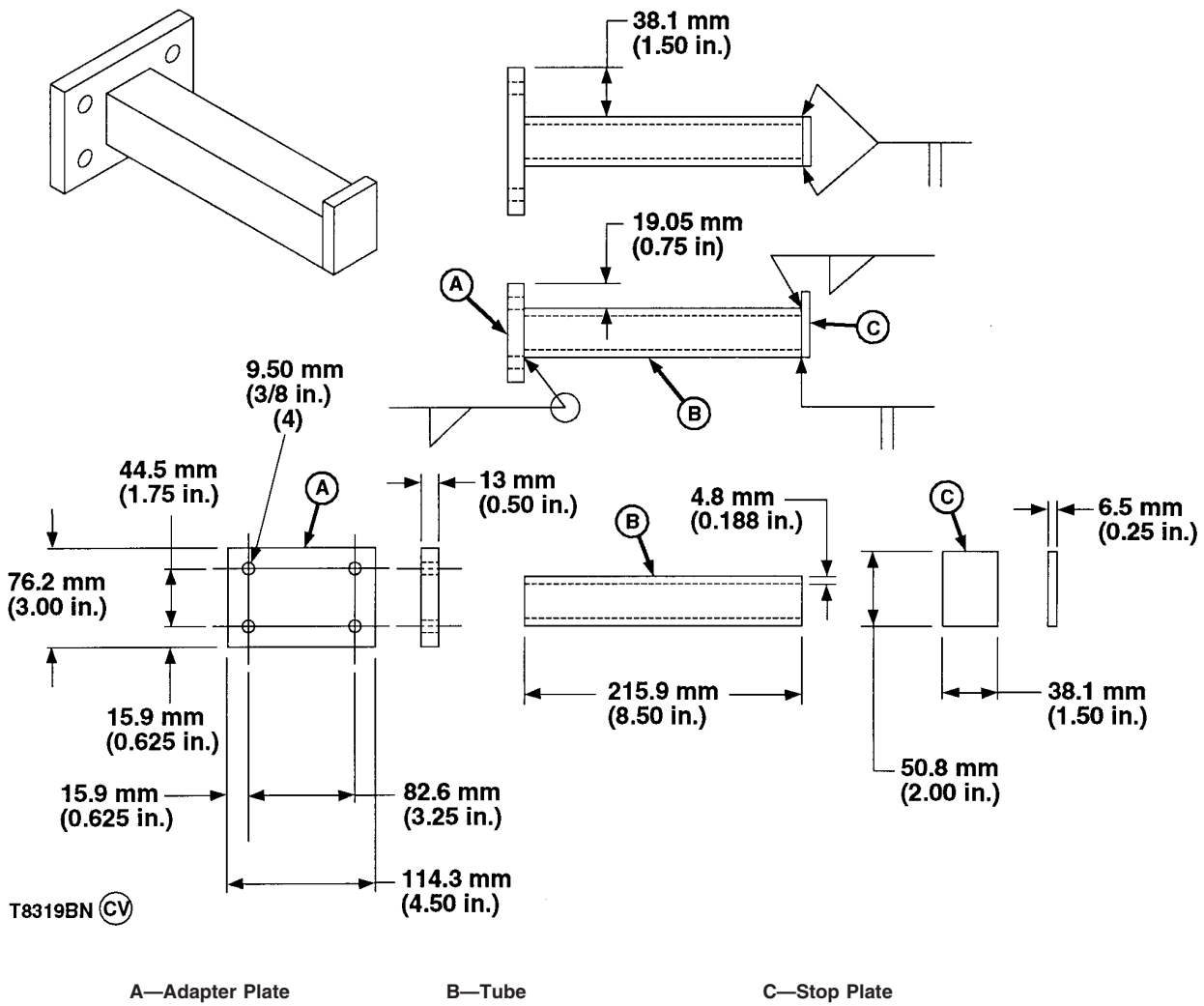
- 50 x 50 mm (2 x 2 in.) 1020 Steel Bar Stock
- 20 x 50 mm (0.75 x 2 in.) 1020 Steel Plate
- 7018 Electrodes for welding

Material required:

TX04577,0000114 -19-01AUG06-2/2

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DFT1130 Adapter



Adapter is used with DF1063 Lift Bracket to remove and install travel motor.

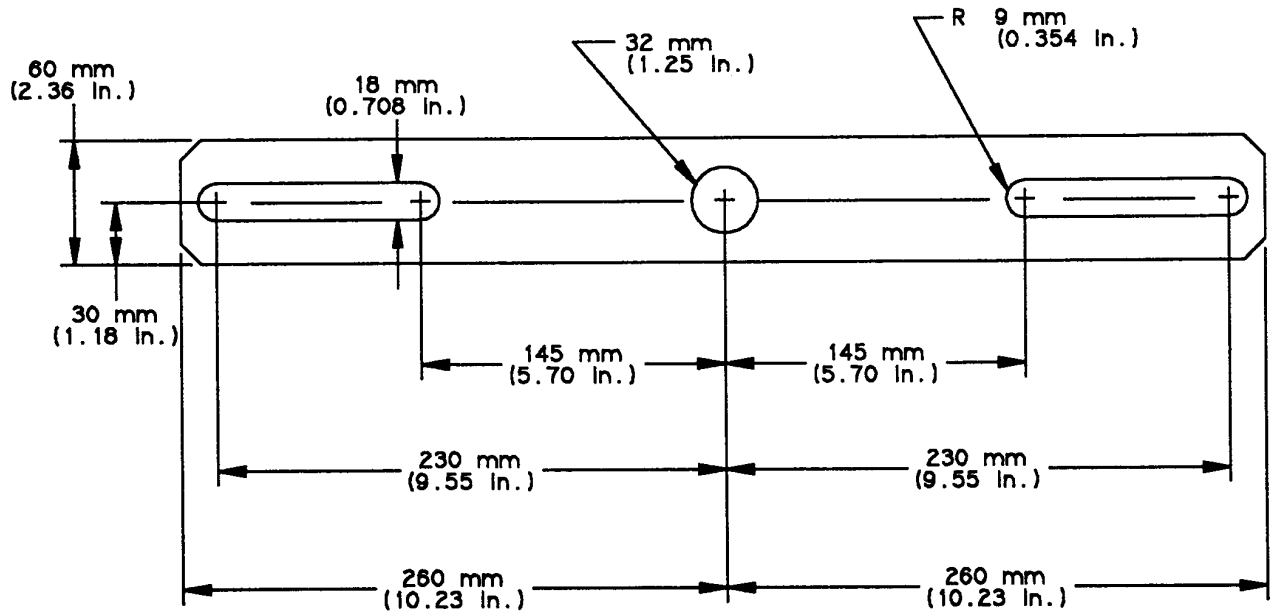
- 1.3 mm (1/2 in.) 1020 Steel Plate (A)
- 38.1 mm x 38.1 mm x .48 mm (1-1/2 in. x 1-1/2 in. x 3/16 in.) Square Tube (B)
- .6 mm (1/4 in.) 1020 Steel Plate (C)

Material required:

T8319BN -UN-20SEP04

MD46667,00000CD -19-12MAY06-1/1

DFT1109 Holding Bar



T7690AA ©

Holding Bar is used with the DFT1036A Propel Gearbox Nut Wrench as a guide when loosening the hub-to-housing nut in the travel gearbox.

Material required:

- 16 mm (5/8 in.) Flat Bar Stock

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T7690AA -JUN-27FEB92

Center Joint (Rotary Manifold) Lifting Tool

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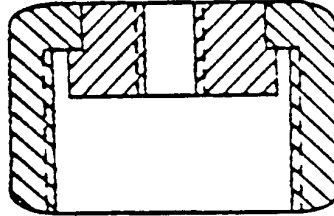
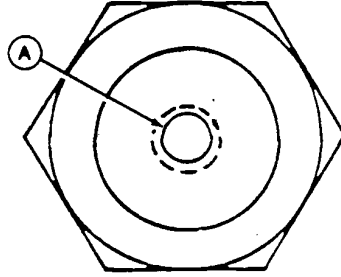
Tool is used to remove and install center joint.

Drill and tap the center of 38H1419 Cap Assembly for M16 x 2 threads (A).

Material required:

- 38H1419 Cap Assembly (—16)
- JT05551 Metric Lifting Eyebolt (M16 x 2)

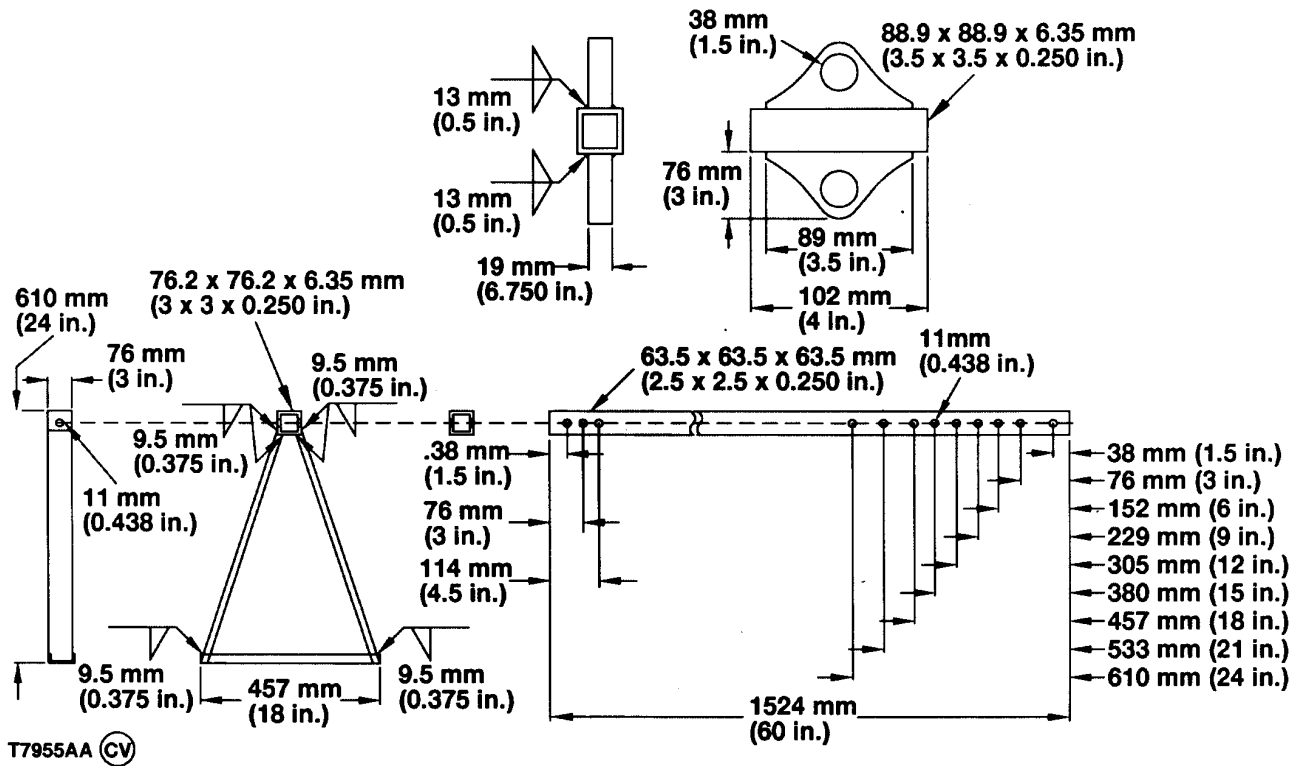
A—Drilled and Tapped hole Location



T6641DO -UN-24OCT88

TP97644.0000003 -19-27JUL06-1/1

DFT1119 Pump Support



Pump support is used with a hand hoist to support a pump(s) when an engine is removed.

Two end stands are needed.

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TP97644,0000021 -19-25JUL06-1/2

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T7955AA -UN-23A-PR83

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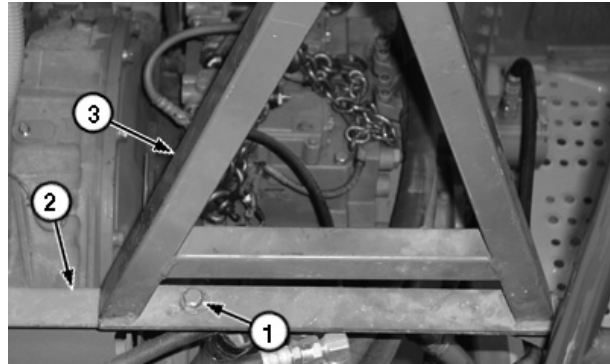
CAUTION: Failure to use a cap screw to secure end stand base could result in the stand falling off the machine.

Drill a hole in the base of end stands as needed so that a cap screw (1) can be installed in an existing threaded hole in sheet metal brace (2). Install cap screw to secure pump support to sheet metal brace.

Drill the holes through the square steel tubing so they are centered.

Material required:

- C3 x 5 Steel Channel
- 88.9 x 88.9 x 6.35 mm (3.5 x 3.5 x 0.250 in.) Square Steel Tubing
- 76.2 x 76.2 x 6.35 mm (3 x 3 x 0.250 in.) Square Steel Tubing
- 63.5 x 63.5 x 6.35 mm (2.5 x 2.5 x 0.250 in.) Square Steel Tubing
- 19 mm (3/4 in.) Flat Bar Stock
- M10 x 89 mm or 3/8 x 3-1/2 in. D Grade (SAE Grade 5) Cap Screw (2 used)
- M10 or 3/8 in. D Grade (SAE Grade 5) Nut (2 used)



TX1010050A -UN-17JUL06

Cap Screw Location Example

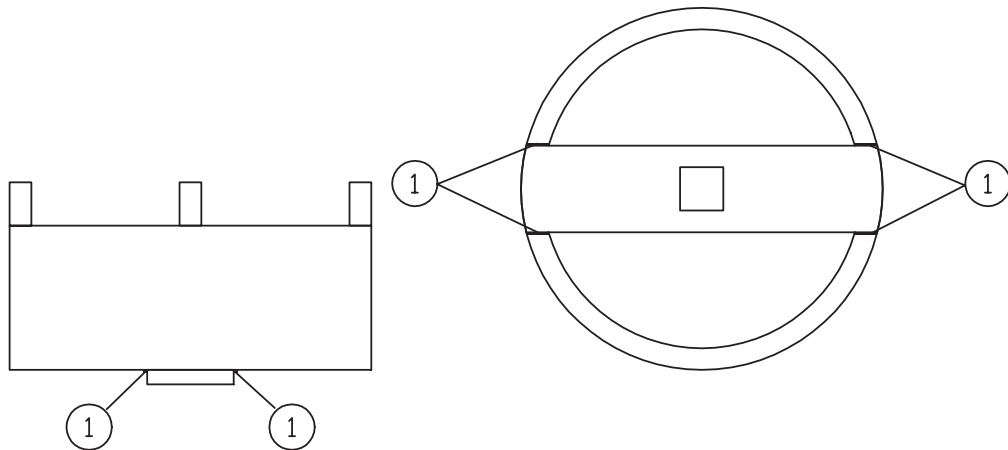
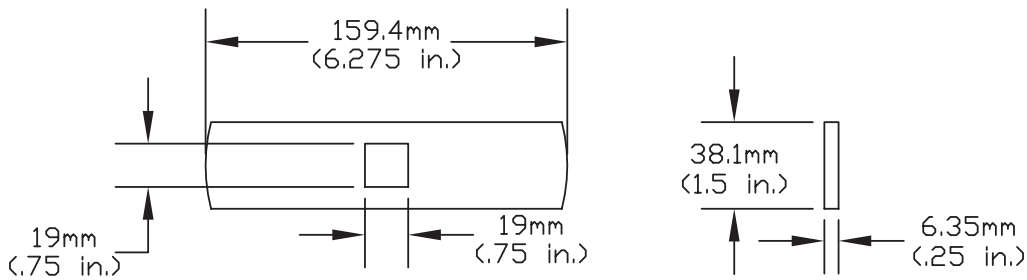
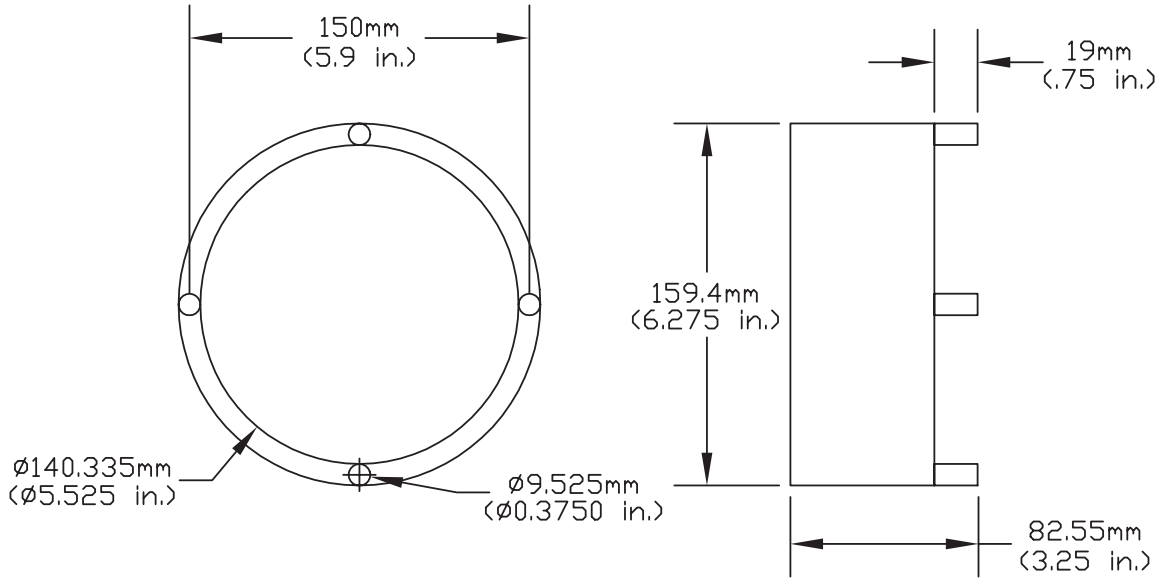
- 1—Cap Screw
- 2—Sheet Metal Brace
- 3—End Stand

Dealer Fabricated Tools

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DFT1220 Swing Gearbox Nut Spanner Wrench

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T143704

T143704 -UN-17JUL01

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Dealer Fabricated Tools

1—Weld (4 Places)

Material required:

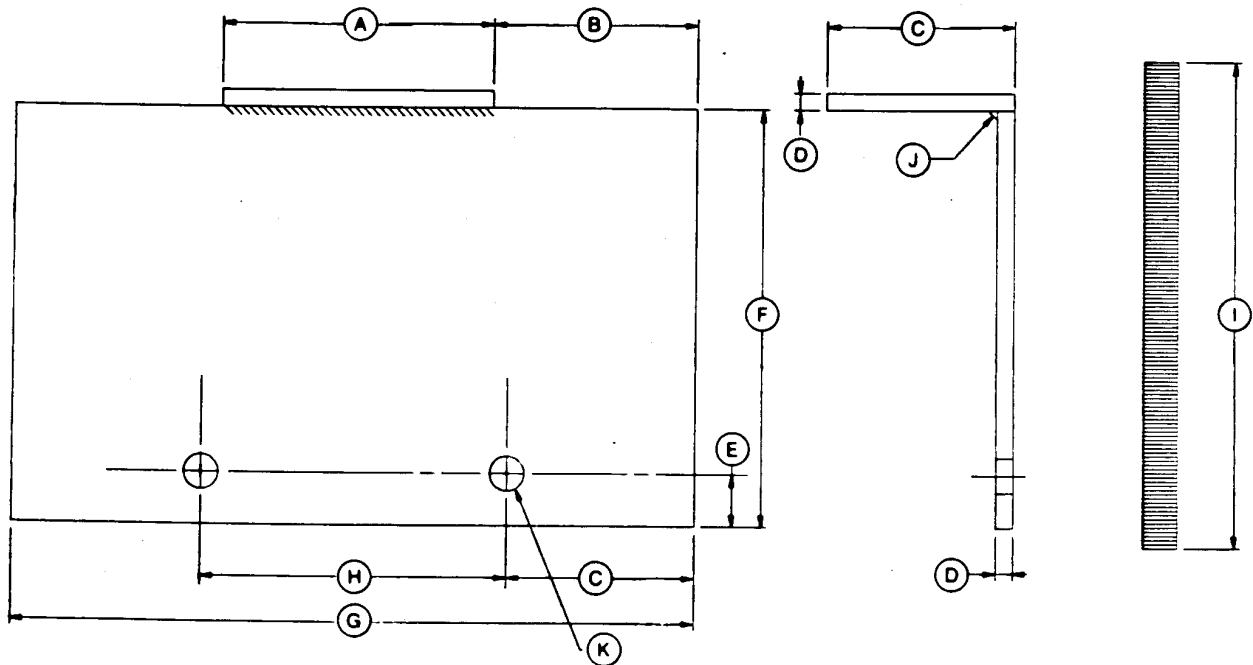
- 159.4 x 82.5 mm (6.275 x 3.25 in.) Steel Tubing

- 159.4 x 38.1 x 6.35 mm (6.65 x 1.5 x 0.25 in.) Plate Steel

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OUOE047.000000E -19-27JUL06-2/2

DFRW20 Compressor Holding Fixture



- A—102 mm (4 in.)
- B—76 mm (3 in.)
- C—70 mm (2.75 in.)

- D—6.4 mm (0.25 in.)
- E—19 mm (0.75 in.)
- F—152 mm (6 in.)

- G—254 mm (10 in.)
- H—114 mm (4.5 in.)
- I—178 mm (7 in.)

- J—Fillet Weld
- K—Two Holes

Material required:

- 2—Steel Plates (4 x 2.75 in.) and (10 x 6 in.)
- 2—Threaded Steel Rods (0.5 x 7 in.)

- 4—Matching Lock Washers and Nuts

Tool is used to hold air conditioning compressor during assembly and disassembly.

RW13619 -UN-20SEP89

OUT3035.0000041 -19-28JUN06-1/1

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