COMPANY POLICY

Company policy, which is one of continuous improvement, reserves the right to make changes in design and specification at any time without notice and without obligation to modify units previously built.

All data given in this book is subject to production variations. Dimensions and weights are approximate only and the illustrations do not necessarily show tractors in standard condition. For exact information about any particular machine please consult your Dealer.

PARTS AND ACCESSORIES

Genuine parts and accessories have been specifically designed for these machines.

We would like to point out that ‘‘non-genuine” parts and accessories have NOT been examined and released by the Company. The installation and or use of such products could have negative effects upon the design characteristics of your machine and thereby affect its safety. The Company is not liable for any damage caused by the use of ‘‘non-genuine” parts and accessories.

MODEL CODES

The complete range of Backhoe Loaders described in this manual are identified below :

	EUR							NA			
	LB 90.B	LB 95.B	LB 110.B	LB 115.B 4WS	580 SR	590 SR	695 SM / 695 SR	LB 75.B	LB 90.B / LB 95.B	LB 110.B	LB 115.B 4WS
Moteur 95HP FAGE0454C	X	X			X			X			
Moteur 110HP FAGE0484G			X	X		X	X		X	X	X
PowerShuttle	X	X	X		X	X		X	X	X	
PowerShift			X	X	X	X	X			X	X
Cab	X	X	X	X			X	X	X	X	X
Euro. cab			X	X	X	X	X				
ROPS	X				X			X	X	X	
Central Pivot			X	X			X	X	X	X	X
Side Shift	X	X	X	X	X	X	X				
2 WD					X			X			
4 WD	X	X	X	X	X	X	X	X	X	X	X
4 WS				X			X				X
Mechanical control	X	X	X	X	X	X	X	X	X	X	X
Pilot control	X	X	X	X	X	X	X	X	X	X	X

The vehicles listed above may not be available in all countries or markets, therefore for the latest information consult your local authorised dealer.

CONTENTS

SECTION 00 - HEALTH, SAFETY, MAINTENANCE

CHAPTER 1 - General

SECTION 10 - ENGINE

CHAPTER 1 - Injection pump

SECTION 17 - TORQUE CONVERTOR

CHAPTER 1 - With Powershuttle Transmission

CHAPTER 2 - With Powershift Transmission

SECTION 21 - TRANSMISSIONS

CHAPTER 1 - 4x4 Compact Shuttle

CHAPTER 2 - Powershift Introduction

CHAPTER 3 - Powershift Operating Lever

CHAPTER 4 - Powershift Overhaul (includes 4 Wheel Steer)

SECTION 25 - FRONT AXLES

CHAPTER 1 - Front Axle for 2 and 4 Wheel Drive Only

CHAPTER 2 - Front Axle for 4 Wheel Steer Only

CHAPTER 3 - Front Axle

CHAPTER 7 - Front Axle

CHAPTER 10 - Front Axle

SECTION 27 - REAR AXLES

CHAPTER 1 - Rear Axle with Foot Operated Diff Lock for 2 and 4 Wheel Drive Only

CHAPTER 2 - Rear Axle with Electrically Operated Diff Lock for 2 and 4 Wheel Drive Only

CHAPTER 3 - Rear Axle for 4 Wheel Steer Only

CHAPTER 4 - Rear Axle

SECTION 33 - BRAKE SYSTEMS

CHAPTER 1 - Brakes for 2 and 4 Wheel Drive Only

CHAPTER 2 - Brakes for 4 Wheel Steer Only

SECTION 35 - HYDRAULIC SYSTEMS

CHAPTER 1 - Hydraulic Circuits and Components for HUSCO Only

CHAPTER 2 - Fault Finding, Pressure and Flow Testing for HUSCO Only

CHAPTER 3 - Hydraulic Circuits and Components for REXROTH

CHAPTER 4 - Fault Finding, Pressure and Flow Testing for REXROTH Only

CHAPTER 5 - Control Valves for REXROTH with Mechanical or Hydraulic Control

CHAPTER 6 - Swing System and Hydraulic Cylinders

CHAPTER 7 - Hydraulic Pump

CHAPTER 8 - Rexroth Control Blocks

SECTION 39 - VEHICLE CHASSIS

CHAPTER 1 - CHASSIS COMPONENTS

SECTION 41 - STEERING SYSTEMS

CHAPTER 1 - Steering for 2 and 4 Wheel Drive Only

CHAPTER 2 - Steering for 4 Wheel Steer Only

SECTION 50 - CAB HEATING AND AIR CONDITIONING

CHAPTER 1 - Cab Heating

CHAPTER 2 - Cab Air Conditioning

SECTION 55 - ELECTRICAL SYSTEM

CHAPTER 1 - System General

CHAPTER 2.1 - Powershuttle Wiring Diagrams (N/A and Europeen Model)

CHAPTER 2.2 - Powershift Wiring Diagrams (N/A and Europeen Model)

CHAPTER 2.3 - Powershift 4 WS Wiring Diagrams (N/A and Europeen Model)

CHAPTER 2.4 - ROPS Wiring Diagrams (N/A and Europeen Model)

CHAPTER 3 - Starter Motor 2.7kW

CHAPTER 4 - Alternator 90A

CHAPTER 5 - Battery

CHAPTER 6 - Service Diagnostics, Calibration and Immobiliser

CHAPTER 7 - Component Testing

SECTION 82 - LOADER

CHAPTER 1 - Loader Frame, Controls and Buckets for 2 and 4 Wheel Drive Only

CHAPTER 2 - Loader Frame, Controls and Buckets for 4 Wheel Steer Only

SECTION 84 - BACKHOE

CHAPTER 1 - Backhoe, Boom and Dipperstick assembly

Description **Page**

SECTION 00 – MAINTENANCE

Chapter 1 – General Instructions

IMPORTANT NOTICE

All maintenance and repair operations described in this manual should be carried out exclusively by authorised workshops. All instructions detailed should be carefully observed and special equipment indicated should be used if necessary.
Everyone who carries out service operations described without carefully observing these prescriptions will be directly responsible of deriving damages.

SHIMMING

At each adjustment, select adjusting shims, measure them individually using a micrometer and then sum up recorded values. Do not rely on measuring the whole shimming set, which may be incorrect, or on rated value indicated for each shim.

ROTATING SHAFT SEALS

To correctly install rotating shaft seals, observe the following instructions:

- Let the seal soak into the same oil as it will seal for at least half an hour before mounting;
- Thoroughly clean the shaft and ensure that the shaft working surface is not damaged;
- Place the sealing lip towards the fluid. In case of a hydrodynamic lip, consider the shaft rotation direction and orient grooves in order that they deviate the fluid towards the inner side of the seal;
- Coat the sealing lip with a thin layer of lubricant (oil rather than grease) and fill with grease the gap between the sealing lip and the dust lip of double lip seals;
- Insert the seal into its seat and press it down using a flat punch. Do no tap the seal with a hammer or a drift;
- Take care to insert the seal perpendicularly to its seat while you are pressing it. Once the seal is settled, ensure that it contacts the thrust element if required.;
- To prevent damaging the sealing lip against the shaft, place a suitable protection during installation.

‘O’ RINGS

Lubricate the ‘O’ rings before inserting them into their seats. This will prevent the ‘O’ rings from rolling over and twine during mounting which will jeopardise sealing.

SEALERS

Apply FLEXIBLE GASKET SEALANT 82995770 or a suitable equivalent, over the mating surfaces marked with an X.
Before applying the sealer, prepare the surface as follows:

- remove possible scales using a metal brush;
- thoroughly degrease the surfaces using DEGREASER 82995779, or a suitable equivalent.

BEARINGS

It is advisable to heat the bearings to 80 to 90°C before mounting them on their shafts and cool them down before inserting them into their seats with external tapping.

SPRING PINS

When mounting split socket spring pins, ensure that the pin notch is oriented in the direction of the effort to stress the pin.
Spiral spring pins should not be oriented during installation.

NOTES FOR SPARE PARTS

USE EXCLUSIVELY **GENUINE SPARE PARTS**

Only genuine parts guarantee same quality, life, safety as original components as they are the same as mounted in production.
Only the **genuine spare parts** can offer this guarantee.
All spare parts orders should be complete with the following data:

- Machine model (commercial name) and frame number;
- engine type and number;
- part number of the ordered part, which can be found on the “Microfiches” or the “Spare Parts Catalogue”, which is the base for order processing.

NOTES FOR EQUIPMENT

Equipment which proposes and shows in this manual are as follows:

- studied and designed expressly for use on company machines;
- necessary to make a reliable repair;
- accurately built and strictly tested to offer efficient and long-lasting working means.
- we also remind the Repair Personnel that having these equipment means:
- work in optimal technical conditions;
- obtain best results;
- save time and effort;
- work more safely.

NOTICES

Wear limits indicated for some details should be intended as advised, but not binding values. The words “front”, “rear”, “right hand”, and “left hand” referred to the different parts should be intended as seen from the operator’s seat oriented to the normal sense of movement of the Machine.

HOW TO MOVE THE MACHINE WITH THE BATTERY REMOVED

Cables from the external power supply should be connected exclusively to the respective terminals of the Machine positive and negative cables using pliers in good condition which allow proper and steady contact.
Disconnect all services (lights, wind-shield wipers, etc.) before starting the Machine.
If it is necessary to check the Machine electrical system, check it only with the power supply connected. At check end, disconnect all services and switch the power supply off before disconnecting the cables.

SAFETY RULES

PAY ATTENTION TO THIS SYMBOL

This warning symbol points out important messages involving personal safety. Carefully read the safety rules contained herein and follow advised precautions to avoid potential hazards and safeguard your safety and personal integrity.
In this manual you will find this symbol together with the following key-words:

WARNING (ATTENZIONE) *- it gives warning about improper repair operations and deriving potential consequences affecting the service technician's personal safety.*

DANGER (PERICOLO) *- it gives specific warning about potential dangers for personal safety of the operator or other persons directly or indirectly involved.*

TO PREVENT ACCIDENTS

Most accidents and personal injuries taking place in workshops are due from non-observance of some simple and essential prudential rule and safety precautions. For this reason, IN MOST CASES THEY CAN BE AVOIDED. It suffices to foresee possible causes and act consequently with necessary caution and care.

The possibility that an accident might occur with any type of machines should not be disregarded, no matter how well the machine in question was designed and built.

A wise and careful service technician is the best precautions against accidents.

Careful observance of this only basic precaution would be enough to avoid many severe accidents.

DANGER: Never carry out any cleaning, lubrication or maintenance operations when the engine is running.

SAFETY RULES

- Carefully follow specified repair and maintenance procedures.
- Do not wear rings, wristwatches, jewels, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could get hold into moving parts. We advise to use approved safety clothing such as anti-slipping footwear, gloves, safety goggles, helmets, etc.
- Never carry out any repair on the machine if someone is sitting on the operator's seat, except if they are certified operators to assist in the operation to be carried out.
- Never operate the machine or use attachments from a place other than sitting at the operator's seat.
- Never carry out any operation on the machine when the engine is running, except when specifically indicated.
- Stop the engine and ensure that all pressure is relieved from hydraulic circuits before removing caps, covers, valves, etc.
- All repair and maintenance operations should be carried out with the greatest care and attention.
- Service stairs and platforms used in a workshop or in the field should be built in compliance with the safety rules in force.
- Disconnect the batteries and label all controls to warn that the Machine is being serviced. Block the machine and all equipment which should be raised.
- Never check or fill fuel tanks and accumulator batteries, nor use starting liquid if you are smoking or near open flames as such fluids are flammable.
- Brakes are inoperative when they are manually released for maintenance purposes. In such cases, the machine should be kept constantly under control using blocks or similar devices.
- The fuel filling gun should remain always in contact with the filler neck. Maintain this contact until the fuel stops flowing into the tank to avoid possible sparks due to static electricity buildup.
- Use exclusively specified towing points for towing the Machine. Connect parts carefully. Ensure that foreseen pins and/or locks are steadily fixed before applying traction. Do not stop near towing bars, cables or chains working under load.
- To transfer a failed Machine, use a trailer or a low loading platform trolley if available.
- To load and unload the machine from the transportation mean, select a flat area providing a firm support to the trailer or truck wheels. Firmly tie the machine to the truck or trailer platform and block wheels as required by the forwarder.
- For electrical heaters, battery-chargers and similar equipment use exclusive auxiliary power supplies with a efficient ground to avoid electrical shock hazard.

- Always use lifting equipment and similar of appropriate capacity to lift or move heavy components.
- Pay special attention to bystanders.
- Never pour gasoline or diesel oil into open, wide and low containers.
- Never use gasoline, diesel oil or other flammable liquids as cleaning agents. Use non-flammable non-toxic proprietary solvents.
- Wear protection goggles with side guards when cleaning parts using compressed air.
- Do not exceed a pressure of 2.1 bar, in accordance with local regulations.
- Do not run the engine in a closed building without proper ventilation.
- Do not smoke, use open flames, cause sparks in the nearby area when filling fuel or handling highly flammable liquids.
- Do not use flames as light sources when working on a machine or checking for leaks.
- Move with caution when working under a Machine, and also on or near a Machine. Wear proper safety accessories: helmets, goggles and special footwear.
- During checks which should be carried out with the engine running, ask an assistant to seat at the operator's seat and keep the service technician under visual control at any moment.
- In case of operations outside the workshop, drive the Machine to a flat area and block it. If working on an incline cannot be avoided, first block the Machine carefully. Move it to a flat area as soon as possible with a certain extent of safety.
- Ruined or plied cables and chains are unreliable. Do not use them for lifting or trailing. Always handle them wearing gloves of proper thickness.
- Chains should always be safely fastened. Ensure that fastening device is strong enough to hold the load foreseen. No persons should stop near the fastening point, trailing chains or cables.
- The working area should be always kept CLEAN and DRY. Immediately clean any spillage of water or oil.
- Do not pile up grease or oil soaked rags, as they constitute a great fire hazard. Always place them into a metal container.
  Before starting the Machine or its attachments, check, adjust and block the operator's seat. Also ensure that there are no persons within the Machine or attachment operating range.
- Do not keep into your pockets any object which might fall unobserved into the Machine's inner compartments.
- Whenever there is the possibility of being reached by ejected metal parts or similar, use protection eye mask or goggles with side guards, helmets, special footwear and heavy gloves.
- Wear suitable protection such as tinted eye protection, helmets, special clothing, gloves and footwear whenever it is necessary to carry out welding procedures. All persons standing in the vicinity of the welding process should wear tinted eye protection. NEVER LOOK AT THE WELDING ARC IF YOUR EYES ARE NOT SUITABLY PROTECTED.
- Metal cables with the use get frayed. Always wear adequate protections (heavy gloves, eye protection, etc.)
- Handle all parts with the greatest caution. Keep your hands and fingers far from gaps, moving gears and similar. Always use approved protective equipment, such as eye protection, heavy gloves and protective footwear.

START UP

- Never run the engine in confined spaces which are not equipped with adequate ventilation for exhaust gas extraction.
- Never bring your head, body, arms, legs, feet, hands, fingers near fans or rotating belts.

ENGINE

- Always loosen the radiator cap very slowly before removing it to allow pressure in the system to dissipate. Coolant should be topped up only when the engine is stopped or idle if hot.
- Do not fill up fuel tank when the engine is running, mainly if it is hot, to avoid ignition of fires in case of fuel spilling.
- Never check or adjust the fan belt tension when the engine is running.
  Never adjust the fuel injection pump when the Machine is moving.
- Never lubricate the Machine when the engine is running.

ELECTRICAL SYSTEMS

- If it is necessary to use auxiliary batteries, cables must be connected at both sides as follows: (+) to (+) and (–) to (–). Avoid short–circuiting the terminals. GAS RELEASED FROM BATTERIES IS HIGHLY FLAMMABLE. During charging, leave the battery compartment uncovered to improve ventilation. Avoid checking the battery charge by means of “jumpers” made by placing metallic objects across the terminals. Avoid sparks or flames near the battery area. Do no smoke to prevent explosion hazards.
- Prior to any service, check for fuel or coolant leaks. Remove these leaks before going on with the work.
- Do not charge batteries in confined spaces. Ensure that ventilation is appropriate to prevent accidental explosion hazard due to build–up of gasses relieved during charging.
- Always disconnect the batteries before performing any type of service on the electrical system.

HYDRAULIC SYSTEMS

- Some fluid slowly coming out from a very small port can be almost invisible and be strong enough to penetrate the skin. For this reason, NEVER USE YOUR HANDS TO CHECK FOR LEAKS, but use a piece of cardboard or a piece of wood to this purpose. If any fluid is injected into the skin, seek medical aid immediately. Lack of immediate medical attention, serious infections or dermatosis may result.
- Always take system pressure readings using the appropriate gauges.

WHEELS AND TYRES

- Check that the tyres are correctly inflated at the pressure specified by the manufacturer. Periodically check possible damages to the rims and tyres.
- Keep off and stay at the tyre side when correcting the inflation pressure.
- Check the pressure only when the Machine is unloaded and tyres are cold to avoid wrong readings due to over–pressure. Do not reuse parts of recovered wheels as improper welding, brazing or heating may weaken the wheel and make it fail.
- Never cut, nor weld a rim with the inflated tyre assembled.
- To remove the wheels, block both front and rear Machine wheels. Raise the Machine and install safe and stable supports under the Machine in accordance with regulations in force.
- Deflate the tyre before removing any object caught into the tyre tread.
- Never inflate tyres using flammable gases as they may originate explosions and cause injuries to bystanders.

REMOVAL AND INSTALLATION

- Lift and handle all heavy components using lifting equipment of adequate capacity. Ensure that parts are supported by appropriate slings and hooks. Use lifting eyes provided to this purpose. Take care of the persons near the loads to be lifted.
- Handle all parts with great care. Do not place your hands or fingers between two parts. Wear approved protective clothing such as safety goggles, gloves and footwear.
- Do not twine chains or metal cables. Always wear protection gloves to handle cables or chains.

IMPORTANT ECOLOGICAL CONSIDERATIONS

The following are recommendations which may be of assistance:

- Become acquainted with and ensure that you understand the relative legislation applicable to your country.
- Where no legislation exists, obtain information from suppliers of oils, fuels, antifreeze, cleaning agents, etc., with regard to their effect on man and nature and how to safely store, use and dispose of these substances.

HELPFUL HINTS

1. Avoid filling tanks using jerry cans or inappropriate pressurised fuel delivery systems which may cause considerable spillage.
2. In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of them contain substances which can be harmful to your health.
3. Modern oils contain additives. Do not burn contaminated fuels and/or waste oils in ordinary heating systems.
4. Avoid spillage when draining off used engine coolant mixtures, engine, gearbox and hydraulic oils, brake fluids, etc. Do not mix drained brake fluids or fuels with lubricants. Store them safely until they can be disposed of in a proper way to comply with local legislation and available resources.
5. Modern coolant mixtures, i.e. antifreeze and other additives, should be replaced every two years. They should not be allowed to get into the soil but should be collected and disposed of safely.
6. Do not open the Air–Conditioning system yourself. It may contain gasses which should not be released into the atmosphere. Your air conditioning specialist has a special equipment for discharging and charging the system.
7. Repair any leaks or defects in the engine cooling or hydraulic system immediately.
8. Do not increase the pressure in a pressurised circuit as this may lead to a catastrophic failure of the system components.
9. Protect hoses during welding as penetrating weld splatter may burn a hole or weaken them, causing the loss of oils, coolant, etc.

SERVICE TECHNIQUES

GENERAL

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to 'O' rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also that they do not risk the personal safety of the user.

Replace 'O' rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or 'O' rings, regardless of condition. Always lubricate new seals and 'O' rings with hydraulic oil before installation.

When replacing component parts, use the correct tool for the job.

HOSES AND TUBES

Always replace hoses and tubes if the cone end or the end connections on the hose are damaged.

When installing a new hose, loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

After hose replacement to a moving component, check that the hose does not foul by moving the component through the complete range of travel.

Be sure any hose which has been installed is not kinked or twisted.

Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swagged position have failed and will ultimately separate completely.

A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.

Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimate hose failure.

Free-moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

'O' RING FLAT FACE SEAL FITTINGS

When repairing 'O' ring face seal connectors, the following procedures should be observed.

WARNING

NEVER DISCONNECT OR TIGHTEN A HOSE OR TUBE THAT IS UNDER PRESSURE. IF IN DOUBT, ACTUATE THE OPERATING LEVERS SEVERAL TIMES WITH THE ENGINE SWITCHED OFF PRIOR TO DISCONNECTING A HOSE OR TUBE.

1. Release the fittings and separate the hose or tube assembly, then remove and discard the 'O' ring seal from the fitting.
2. Dip a new 'O' ring seal into clean hydraulic oil prior to installation. Install a new 'O' ring into the fitting and, if necessary, retain in position using petroleum jelly.
3. Assemble the new hose or tube assembly and tighten the fitting finger tight, while holding the tube or hose assembly to prevent it from turning.
4. Use two suitable wrenches and tighten the fitting to the specified torque according to the size of the fitting. Refer to the following torque chart.

NOTE: *To ensure a leak-free joint is obtained, it is important that the fittings are not over or under torqued.*

‘O’ RING FLAT FACE SEAL FITTING TORQUE VALUES

Nominal O.D (in.)	Nominal Tube (mm)	Dash Size	Thread Size In.	Swivel Nut Torque lbf. Ft	Swivel Nut Torque Nm
0.250	6.35	-4	9/16-18	12	16
0.375	9.52	-6	11/16-16	18	24
0.500	12.70	-8	13/16-16	37	50
0.625	15.88	-10	1-14	51	69
0.750	19.05	-12	1 3/16-12	75	102
0.875	22.22	-14	1 3/16-12	75	102
1.000	25.40	-16	1 7/16-12	105	142
1.250	31.75	-20	1 11/16-12	140	190
1.500	38.10	-24	2-12	160	217

SEALER SPECIFICATIONS

The following sealers should be used as directed in the manual:

SEALERS	PART NUMBER	TRADE DESCRIPTION
Anaerobic sealer	82995770/1	LOCTITE GASKET ELIMINATOR 518
RTV silicone sealer	82995775/6	LOCTITE SUPERFLEX 593, 595 or 596 LOCTITE ULTRA BLUE 587 DOW CORNING SILASTIC 732 GENERAL ELECTRIC RTV 103 OR 108
Pipe sealant	82995768	PST 592 PIPE SEALANT WITH TEFLON
Thread-locking compound	82995773	LOCTITE 271 THREADLOCKER/SEALANT (red)

HARDWARE TORQUE VALUES

Check the tightness of hardware periodically.

Use the following charts to determine the correct torque when checking, adjusting or replacing hardware on the Backhoe Loader.

IMPORTANT: *DO NOT use the values listed in the charts if a different torque value or tightening procedure is specified in this manual for a specific application. Torque values listed are for general use only.*

Make sure fastener threads are clean and not damaged.

NOTE: *A torque wrench is necessary to properly torque hardware.*

MINIMUM HARDWARE TIGHTENING TORQUES

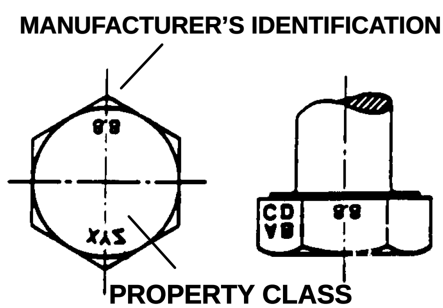
IN FOOT POUNDS – LBF. FT (NEWTON-METRES – Nm)
FOR NORMAL ASSEMBLY APPLICATIONS

METRIC HARDWARE AND LOCKNUTS

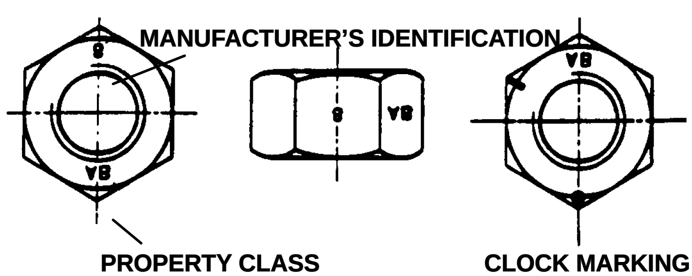
NOMINAL SIZE	CLASS 5.8		CLASS 8.8		CLASS 10.9		LOCKNUT CL.8 W/CL8.8 BOLT
	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr	
M4	15* (1.7)	19* (2.2)	23* (2.6)	30* (3.4)	33* (3.7)	42* (4.8)	16* (1.8)
M6	51* (5.8)	67* (7.6)	79* (8.9)	102* (12)	115* (13)	150* (17)	56* (6.3)
M8	124* (14)	159* (18)	195* (22)	248* (28)	274* (31)	354* (40)	133* (15)
M10	21 (28)	27 (36)	32 (43)	41 (56)	45 (61)	58 (79)	22 (30)
M12	36 (49)	46 (63)	55 (75)	72 (97)	79 (107)	102 (138)	39 (53)
M16	89 (121)	117 (158)	137 (186)	177 (240)	196 (266)	254 (344)	97 (131)
M20	175 (237)	226 (307)	277 (375)	358 (485)	383 (519)	495 (671)	195 (265)
M24	303 (411)	392 (531)	478 (648)	619 (839)	662 (897)	855 (1160)	338 (458)

NOTE: Torque values shown with * are inch pounds.

IDENTIFICATION
HEX CAP SCREW AND CARRIAGE BOLTS
CLASSES 5.6 AND UP



HEX NUTS AND LOCKNUTS
CLASSES 05 AND UP



MINIMUM HARDWARE TIGHTENING TORQUES

IN FOOT POUNDS – LBF. FT (NEWTON-METRES – Nm)
FOR NORMAL ASSEMBLY APPLICATIONS

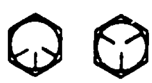
INCH HARDWARE AND LOCKNUTS

	SAE GRADE 2		SAE GRADE 5		SAE GRADE 8		LOCKNUTS		
NOMINAL SIZE	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	GR.B w/GR5 BOLT	GR.C w/GR8 BOLT	NOMINAL SIZE
1/4	55* (6.2)	72* (8.1)	86* (9.7)	112* (13)	121* (14)	157* (18)	61* (6.9)	86* (9.8)	1/4
5/16	115* (13)	149* (17)	178* (20)	229* (26)	250* (28)	324* (37)	125* (14)	176* (20)	5/16
3/8	17 (23)	22 (30)	26 (35)	34 (46)	37 (50)	48 (65)	19 (26)	26 (35)	3/8
7/16	27 (37)	35 (47)	42 (57)	54 (73)	59 (80)	77 (104)	30 (41)	42 (57)	7/16
1/2	42 (57)	54 (73)	64 (87)	83 (113)	91 (123)	117 (159)	45 (61)	64 (88)	1/2
9/16	60 (81)	77 (104)	92 (125)	120 (163)	130 (176)	169 (229)	65 (88)	92 (125)	9/16
5/8	83 (112)	107 (145)	128 (174)	165 (224)	180 (244)	233 (316)	90 (122)	127 (172)	5/8
3/4	146 (198)	189 (256)	226 (306)	293 (397)	319 (432)	413 (560)	160 (217)	226 (306)	3/4
7/8	142 (193)	183 (248)	365 (495)	473 (641)	515 (698)	667 (904)	258 (350)	364 (494)	7/8
1	213 (289)	275 (373)	547 (742)	708 (960)	773 (1048)	1000 (1356)	386 (523)	545 (739)	1

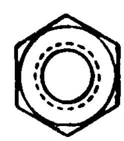
NOTE: Torque values shown with * are inch pounds.

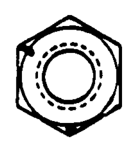
IDENTIFICATION
CAP SCREWS AND CARRIAGE BOLTS

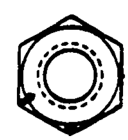

SAE GRADE 2


SAE GRADE 5

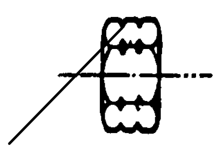

SAE GRADE 8


REGULAR NUTS


SAE GRADE 5
HEX NUTS


SAE GRADE 8
HEX NUTS

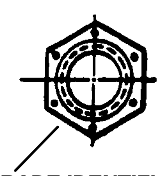
LOCKNUTS


GRADE IDENTIFICATION

GRADE A NO NOTCHES

GRADE B ONE CIRCUMFERENTIAL NOTCH

GRADE C TWO CIRCUMFERENTIAL NOTCHES

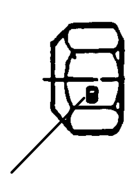

GRADE IDENTIFICATION

GRADE A NO MARKS

GRADE B THREE MARKS

GRADE C SIX MARKS

MARKS NEED NOT BE LOCATED AT CORNERS


GRADE A NO MARK
GRADE B LETTER B
GRADE C LETTER C

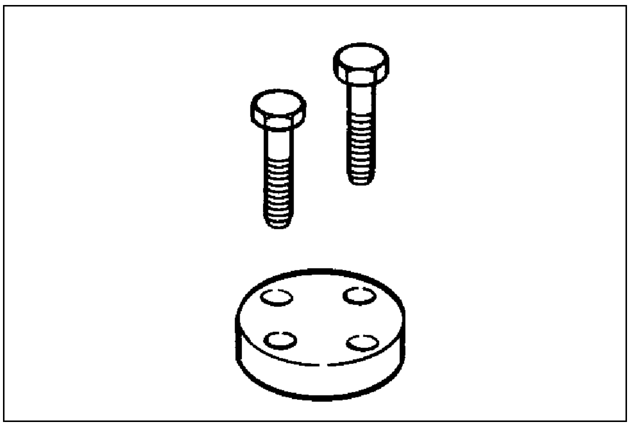
GRADE IDENTIFICATION

SECTION 10 - ENGINE

Chapter 1 - Injection pump

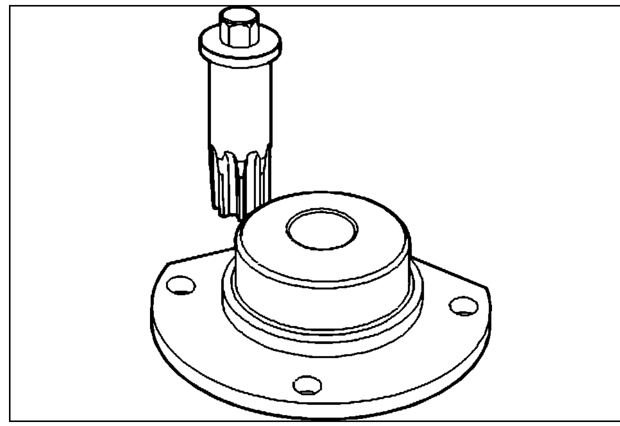
TABLE OF CONTENTS

SPECIAL TOOLS



BC04A194

CAS 1691A GEAR PULLER.



BC04A195

380000988

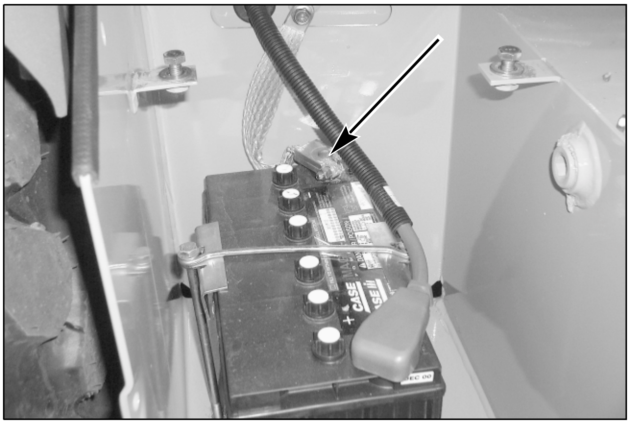
ENGINE TURNING TOOL

REMOVAL

STEP 1

Secure loader in raised position, (see Operator Manual), and stop engine.

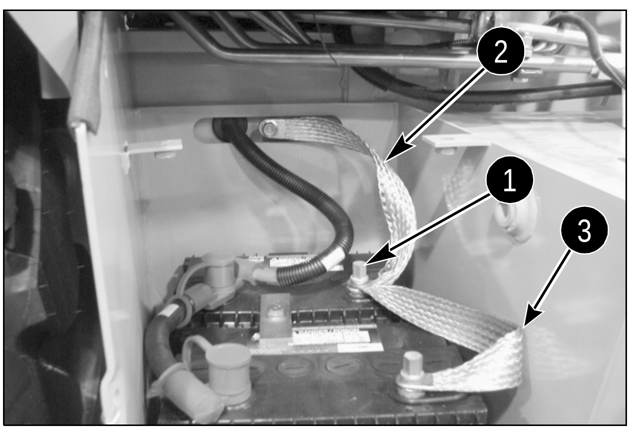
STEP 2



BD01B353

Remove the battery cover from the right step. If the machine has only one battery, disconnect the negative battery cable from the battery, (See Operator Manual).

STEP 3



BD01B352

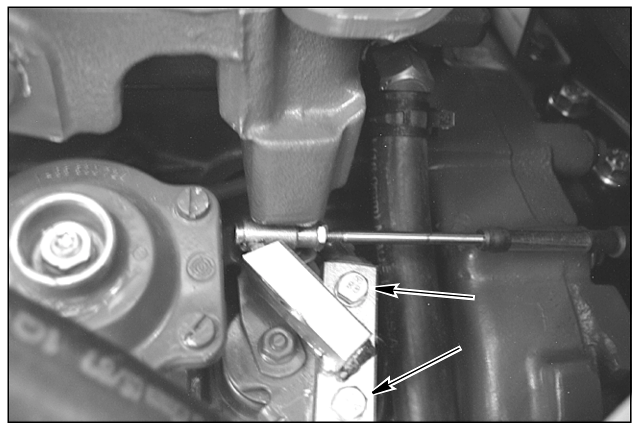
If the machine has two batteries, remove the terminal nut **(1)**. Remove the negative battery cable **(2)** from the terminal and move the negative battery cable away from the battery. Make sure the jumper cable **(3)** is installed on the terminal and start the terminal nut **(2)** onto the terminal.

STEP 4

BD04A029

Loosen jam nut for throttle cable.

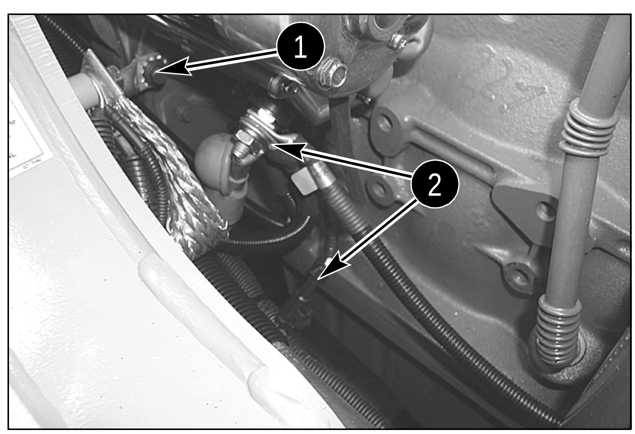
STEP 5



BS03K002

Remove the two throttle arm mounting bolts, move the throttle cable out of the mounting bracket.

STEP 6



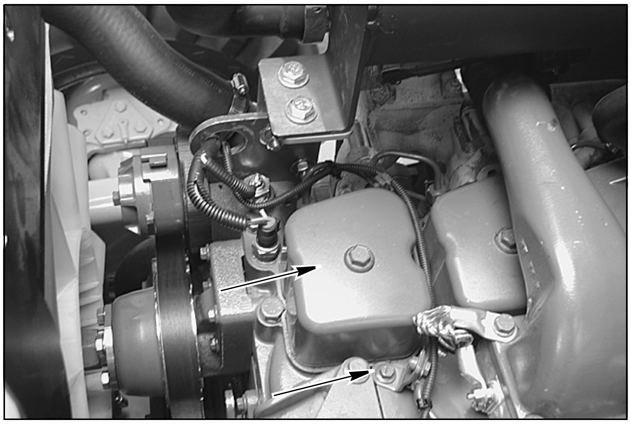
BS03K005

Disconnect the ground strap **(1)**. Disconnect the wires **(2)** from the starter.

STEP 7

Remove the starter from the engine and install 380000988 engine turning tool.

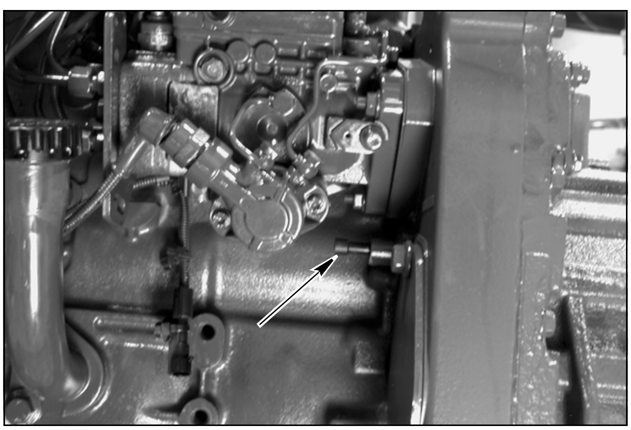
STEP 8



BD04A014

Remove the front rocker arm cover and injector line retaining bracket mounting bolt. Using engine turning tool turn engine in direction of running rotation until push rods can be turned freely.

STEP 9



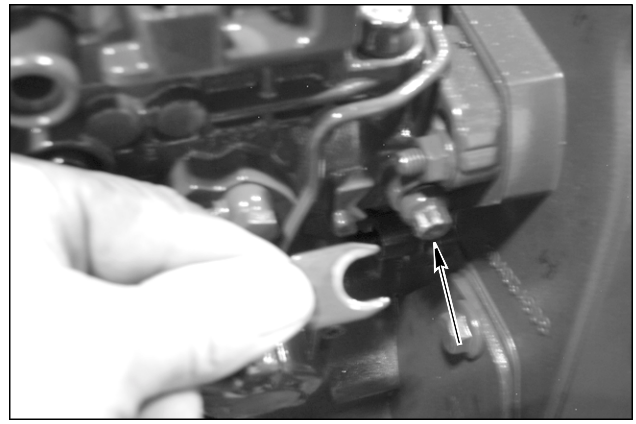
BD04A015

Have an assistant continue to turn the engine with turning tool while pressing in on lock pin located just below injector pump.

STEP 10

Once the lock pin has engaged continue to turn with light pressure on turning tool until engine has completely stopped rotating.

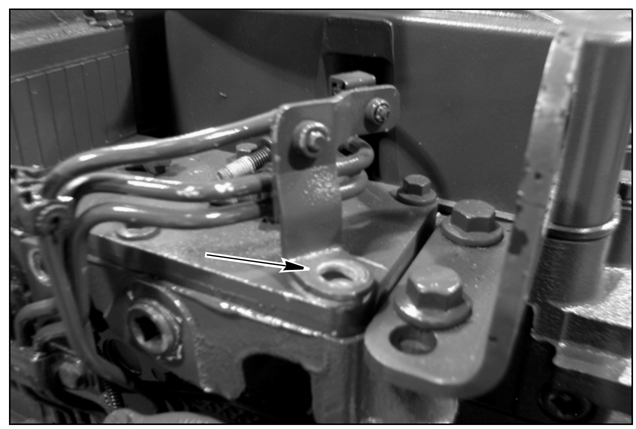
STEP 11



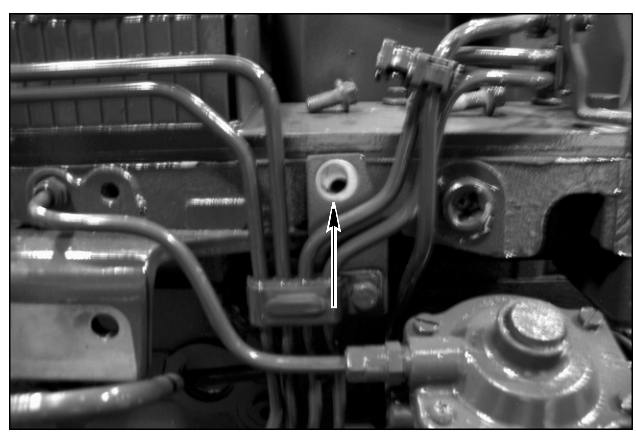
BD04A016

Loosen injector pump locking bolt and remove the slotted plate, tighten the locking bolt to 20 to 24 lb-ft (27 to 33 Nm).

STEP 12



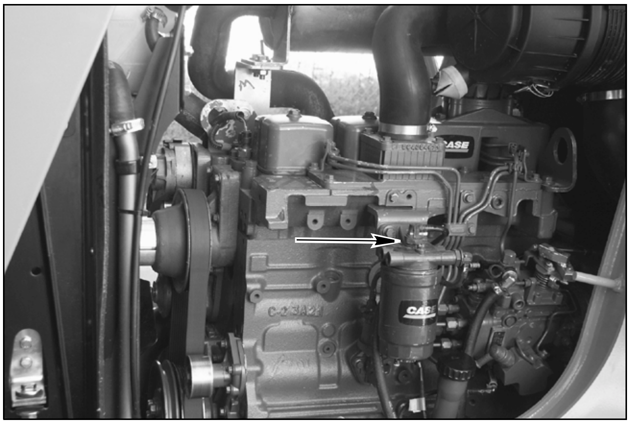
BD04A017



BD04A019

Remove the injector line retaining bracket mounting bolts.

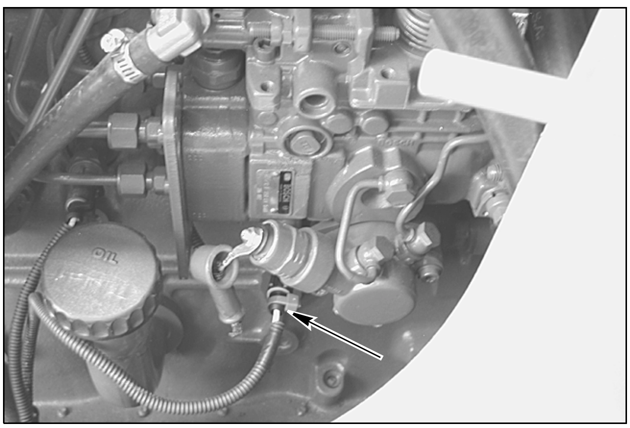
STEP 13



BD03K068

Remove fuel filter and mounting bracket from engine.

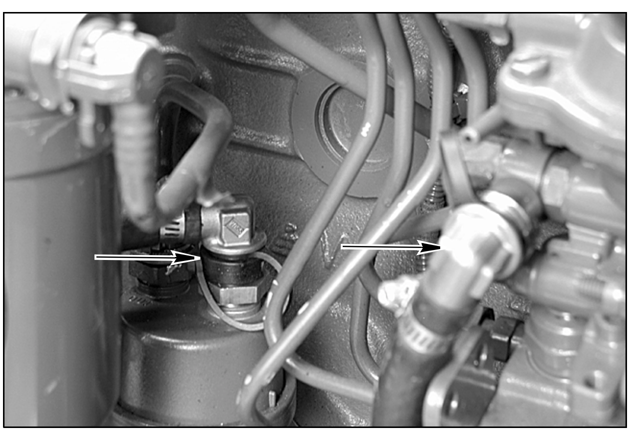
STEP 14



BS03K009

Disconnect the power lead to the injector pump.

STEP 15



BS03K010

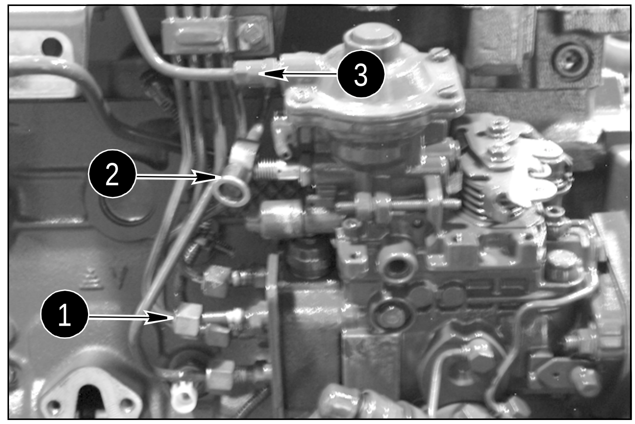
Disconnect the fuel inlet line from the fuel pump and fuel return line from the injector pump. Cover line and fitting to keep foreign material from entering the fuel system.

STEP 16

Remove the mechanical fuel pump and engine oil filler tube from the engine.

NOTE: *In the following photos the engine is shown removed from the machine, this is for clarity only, it is not required to remove the engine.*

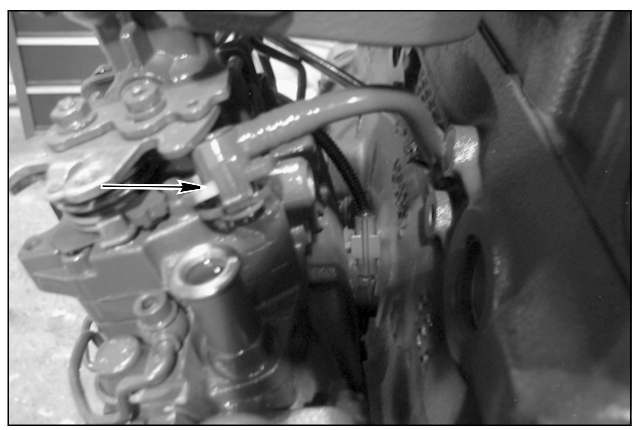
STEP 17



BD04A020

Loosen fuel injector lines **(1)**, disconnect fuel return line **(2)**, and boost line **(3)** at the pump. Cover lines and fittings to keep foreign material from entering the fuel system.

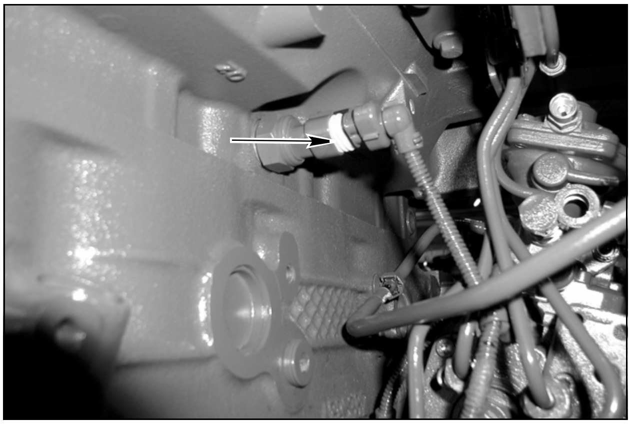
STEP 18



BD04A021

Disconnect fuel feed line from injector pump. Cover line and fitting to keep foreign material from entering the fuel system.

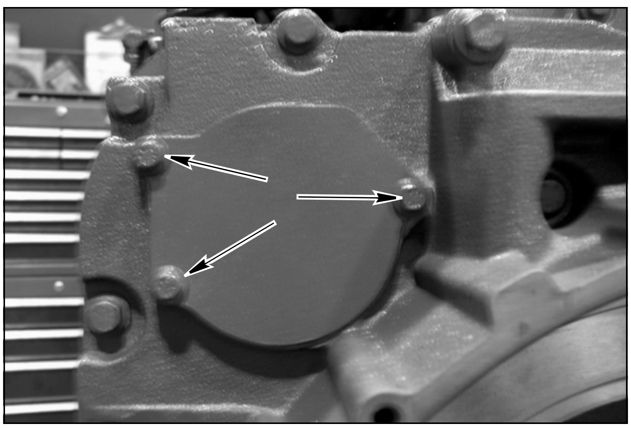
STEP 19



BD04A022

Disconnect temperature sensor.

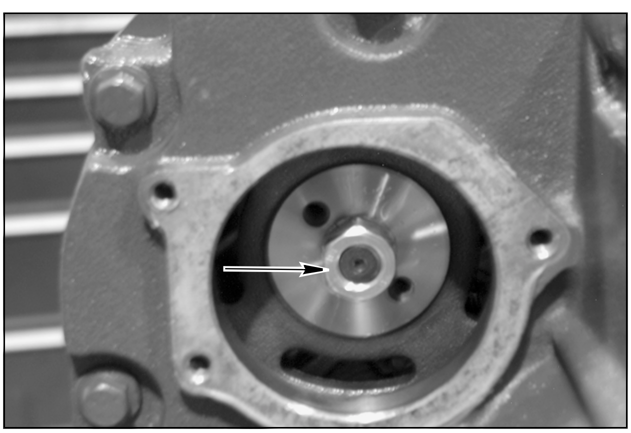
STEP 20



BD04A023

Reaching through the inlet hole in the frame, remove the three plate retaining bolts, remove the plate.

STEP 21

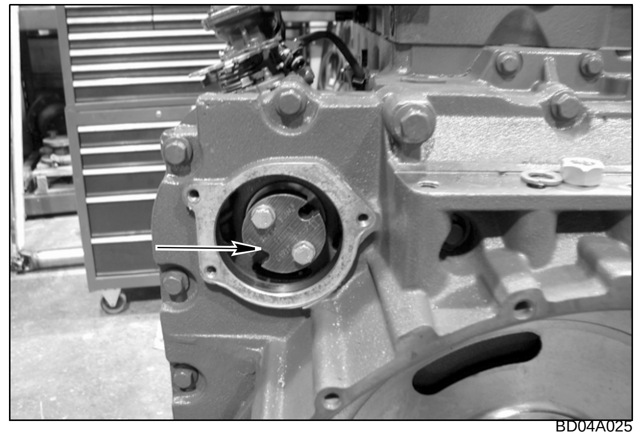


BD04A024

Loosen and remove nut and washer.

WARNING: *Use caution when removing nut and washer they can be dropped inside of the engine, engine will have to be disassembled to remove the nut or washer.*

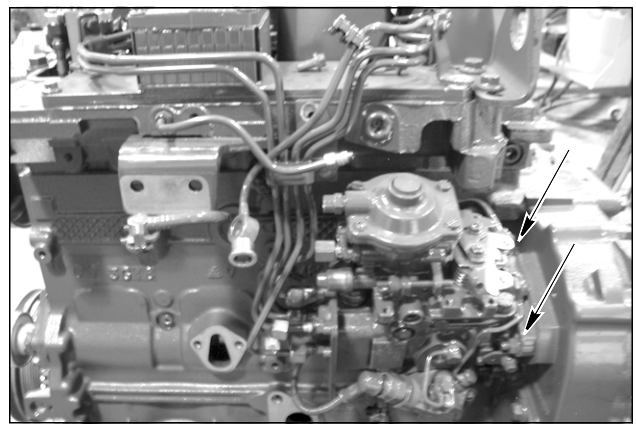
STEP 22



BD04A025

Install gear puller and tighten bolts until gear is loose.

STEP 23

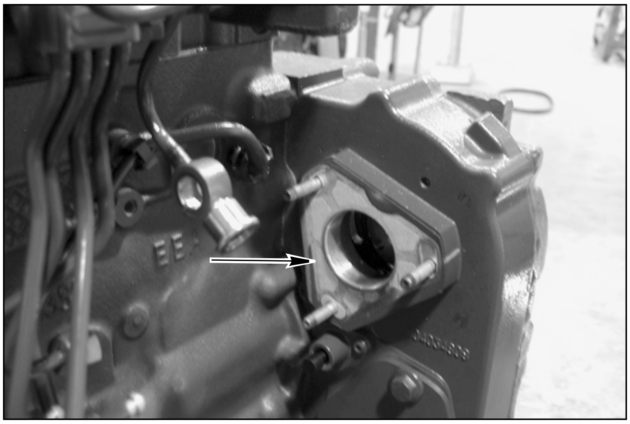


BD04A018

Remove the three mounting nuts from the studs, two are located at arrows, one is located at the bottom of the pump. Remove the pump from the engine

INSTALLATION

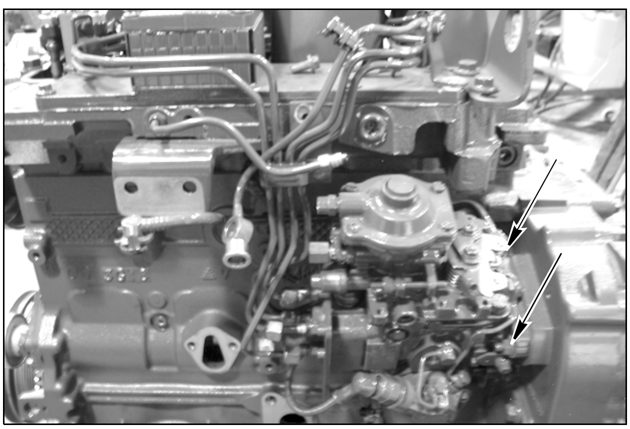
STEP 24



BD04A026

Replace gasket on pump mounting flange.

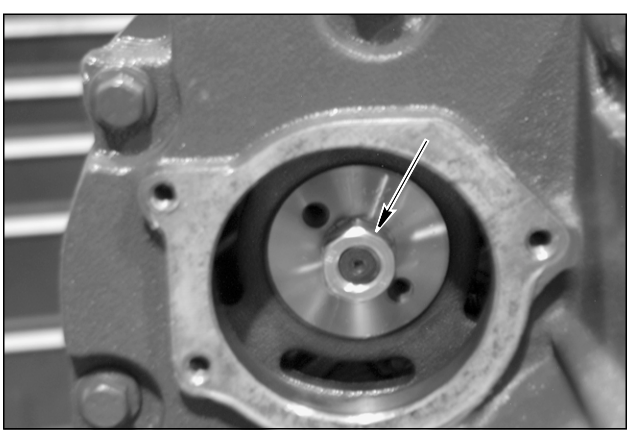
STEP 25



BD04A018

Install pump and tighten the three mounting nuts.

STEP 26

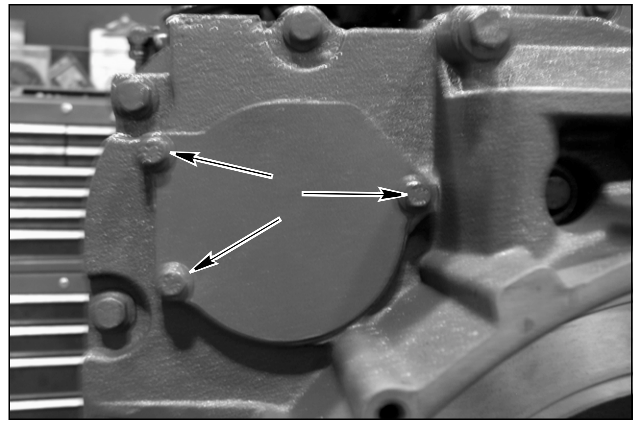


BD04A024

Install lock washer and nut, torque nut to 66 to 70 lb-ft (90 to 95 Nm).

WARNING: *Use caution when installing nut and washer they can be dropped inside of the engine.*

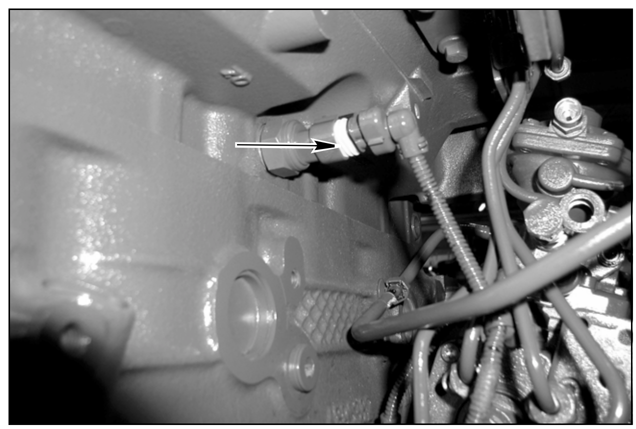
STEP 27



BD04A023

Apply Loctite 5205 to the surface of the cover plate, install cover plate and mounting bolts, tighten bolts.

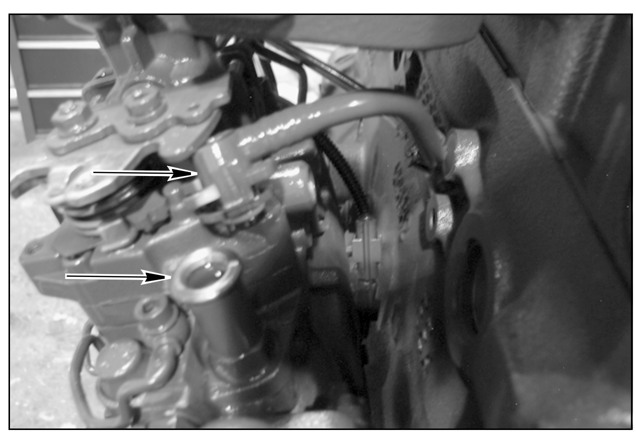
STEP 28



BD04A022

Connect wire to temperature sensor.

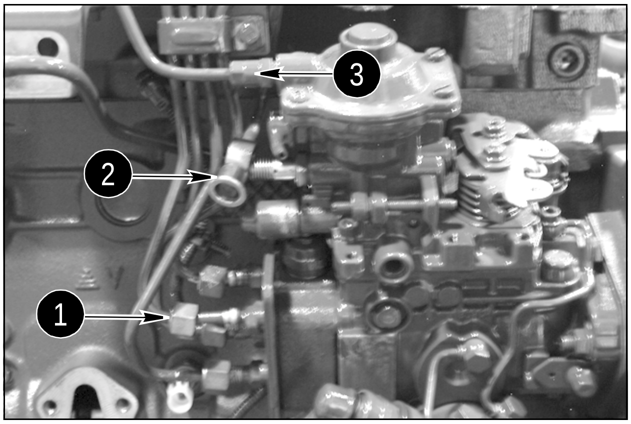
STEP 29



BD04A021

Connect the fuel feed line to the injector pump.

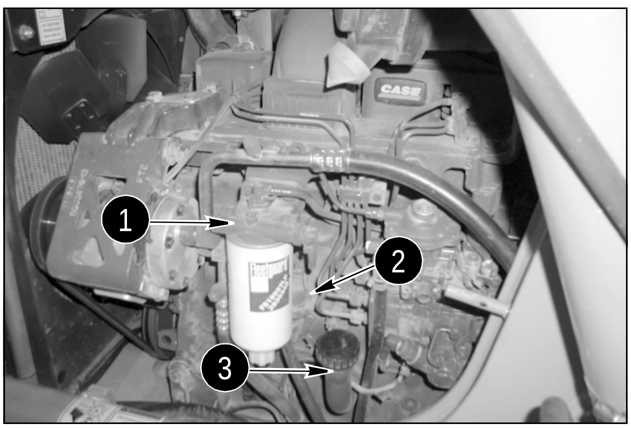
STEP 30



BD04A020

Remove covers from lines and fittings. Connect fuel injector lines **(1)**, connect fuel return line **(2)**, and boost line **(3)** to the pump.

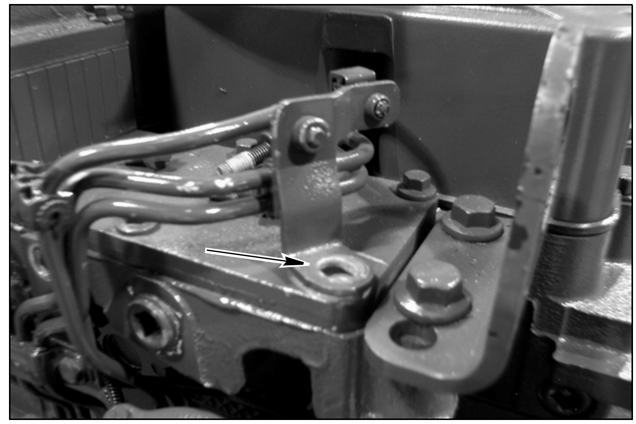
STEP 31

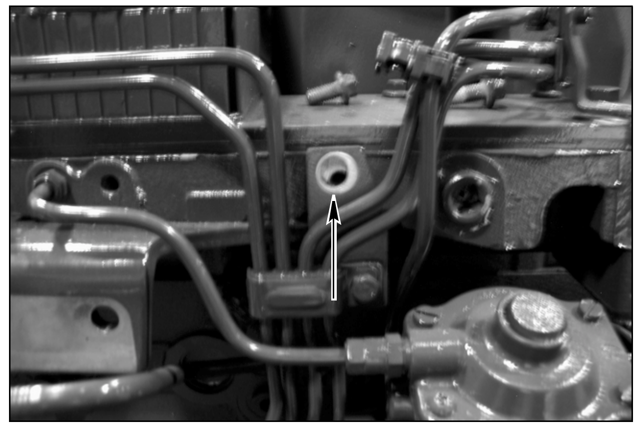


BD04A030

Install oil filler tube **(3)**, mechanical fuel pump **(2)**, and fuel filter **(1)** on the engine.

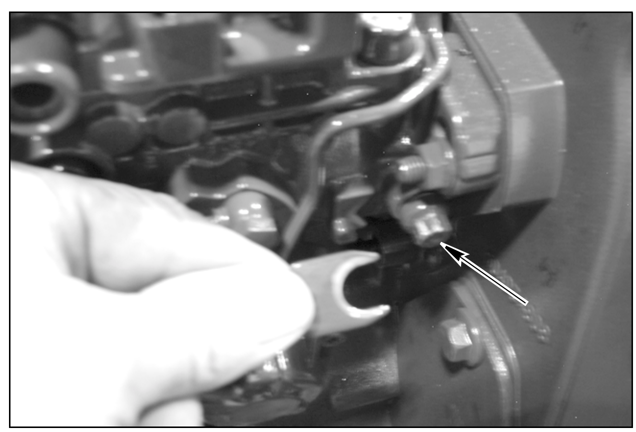
STEP 32


BD04A017


BD04A019

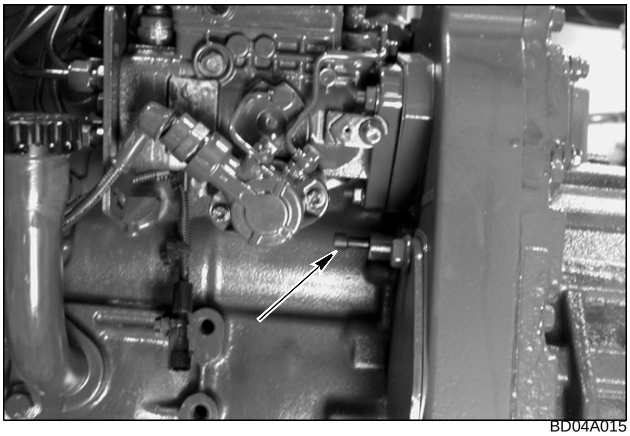
Install the injector line retaining bracket mounting bolts.

STEP 33


BD04A016

Loosen injector pump locking bolt and install the slotted plate, tighten the locking bolt to 9 to 10 lb-ft (12 to 14 Nm).

STEP 34



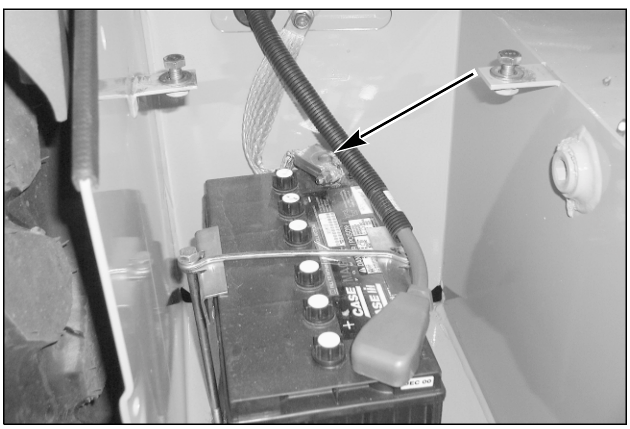
BD04A015

Make sure locking pin is disengaged from gear.

STEP 35

Remove the engine turning tool and install the starter.

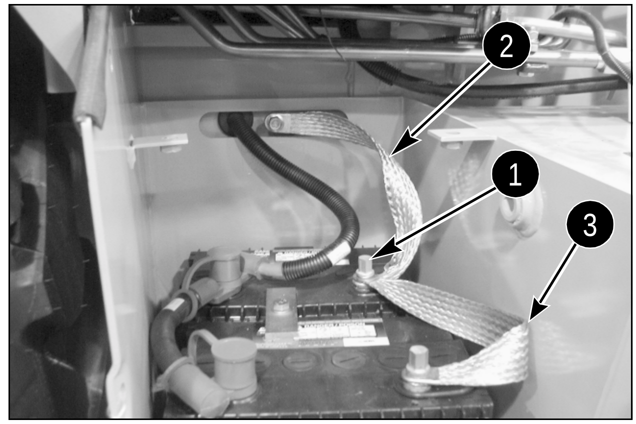
STEP 36



BD01B353

If the machine has only one battery, connect the negative battery cable to the battery. Install the battery cover.

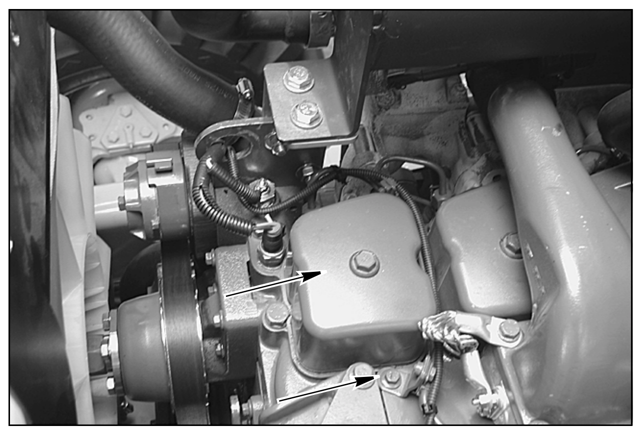
STEP 37



BD01B352

Install grounding cable **(2)** onto the terminal. Install the jumper cable **(3)** on the terminal and start the terminal nut **(1)** onto the terminal. Tighten the terminal nut.

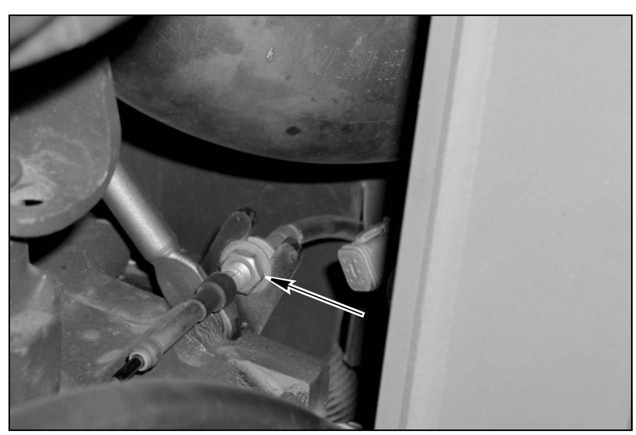
STEP 38



BD04A014

Install the front rocker arm cover and injector line retaining bracket mounting bolt.

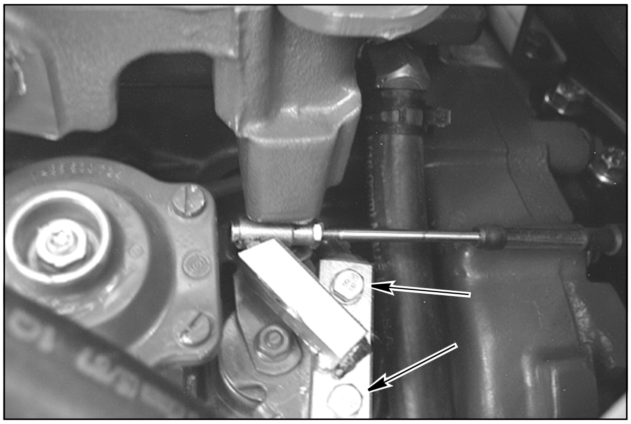
STEP 39



BD04A029

Install the throttle cable into the bracket and tighten the jam nut.

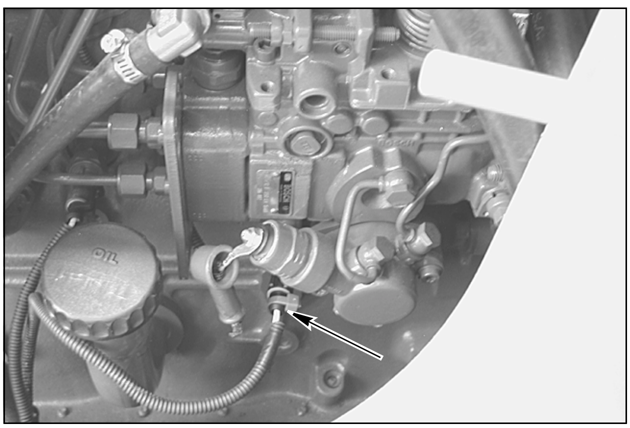
STEP 40



BS03K002

Install and thighten the two throttle arm mounting bolts.

STEP 41



BS03K009

Connect the power lead to the injector pump.

STEP 42

Actuate the lever on the mechanical fuel pump to prime the fuel system.

STEP 43

Start the machine and check for fuel leaks, check and adjust throttle linkage as needed.

SECTION 17 – TORQUE CONVERTOR

Chapter 1 – With Powershuttle Transmission

CONTENT

SPECIFICATIONS

Engine Stall Speeds

Power Shuttle Transmission .... 2009–2065 revs/min

Hydraulic Tests

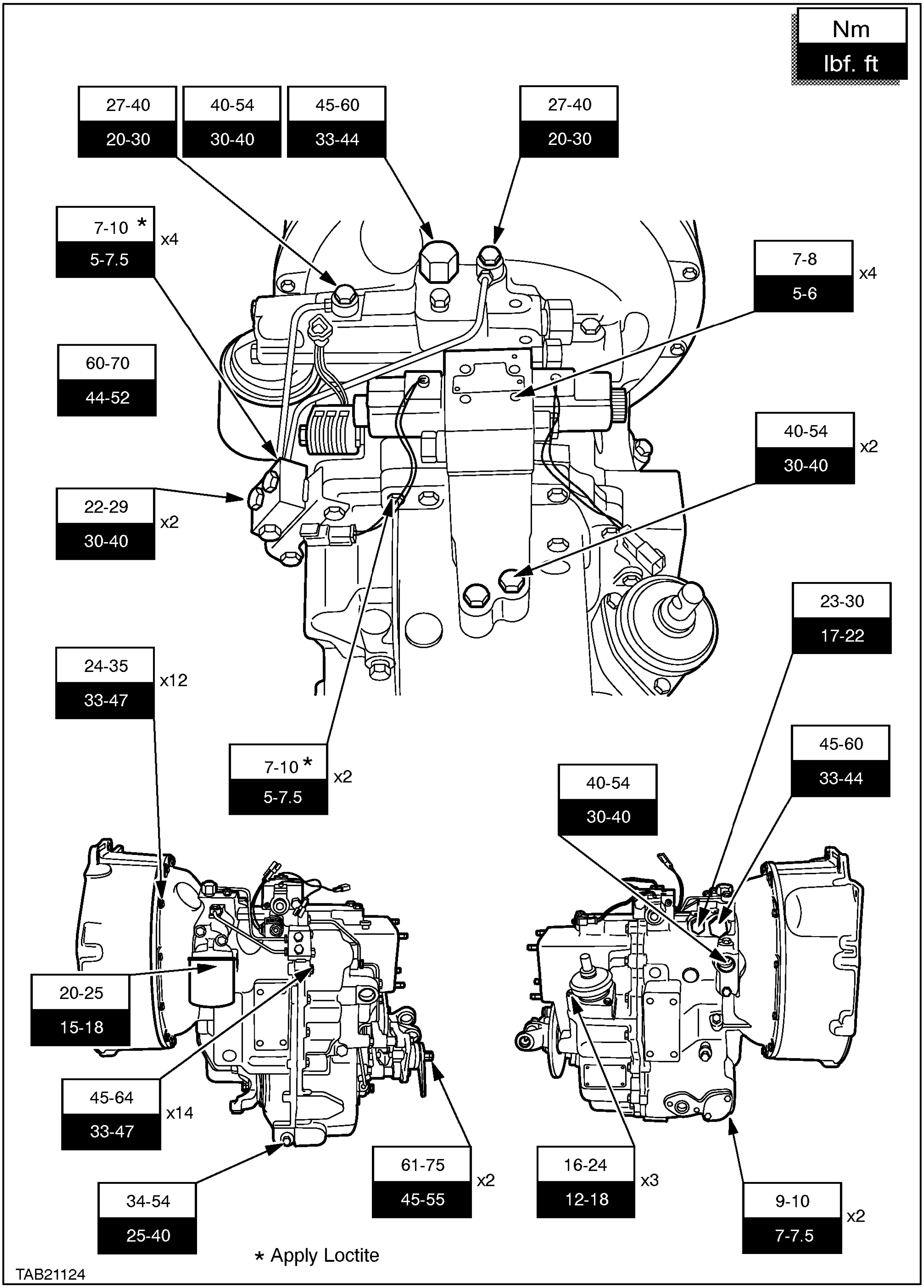
Tachometer Setting .... 2000 revs/min
Test temperature, oil .... 80–85°C (176–185°F)
Cold Start Valve (For reference only) .... 26 bar (377 psi)
System Pressure Test .... 13.7–15.2 bar (198–220 psi)
Torque Converter .... 7–11 bar (101–159 psi)

Sealant

Gasket sealant 82995774
Thread sealant 82995768

TORQUE SPECIFICATIONS

Item Description	N·m	ft. lbs.
Cooler return pipe union	49-78	36-58
Cooler return pipe elbow	49-78	36-58
Stator support retaining bolt	26	19
Flywheel to flex plate	43	32
Flex plate to converter	43	32


Nm
lbf. ft
27-40
20-30
40-54
30-40
45-60
33-44
27-40
20-30
7-10 *
5-7.5
x4
7-8
5-6
x4
60-70
44-52
40-54
30-40
x2
22-29
30-40
x2
23-30
17-22
24-35
33-47
x12
7-10 *
5-7.5
x2
45-60
33-44
40-54
30-40
20-25
15-18
45-64
33-47
x14
61-75
45-55
x2
16-24
12-18
x3
34-54
25-40
9-10
7-7.5
x2
* Apply Loctite
TAB21124

1

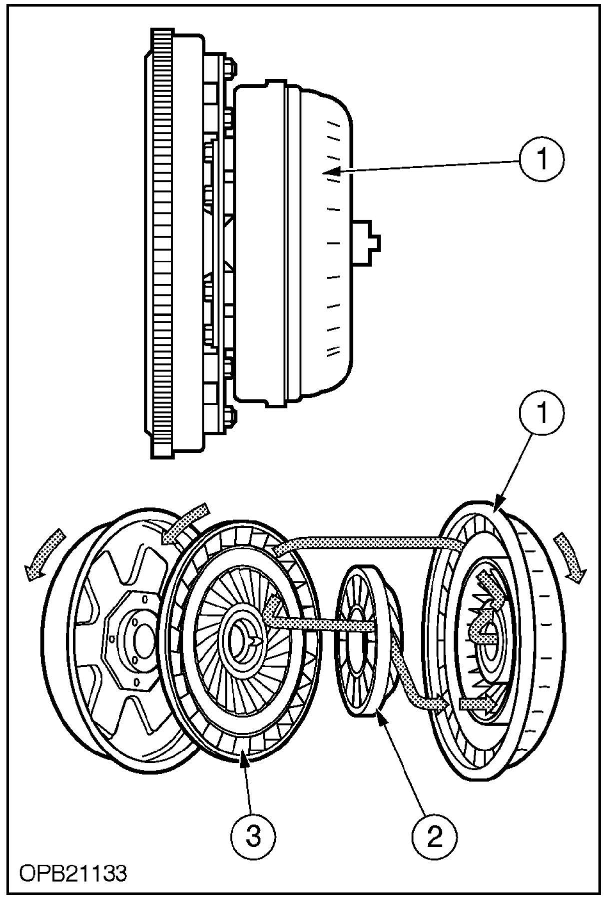
DESCRIPTION AND OPERATION

The main parts of the torque converter (1) are the impeller (pump), the turbine, the stator and the front and rear covers. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.

The turbine (2), splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator (3) to rotate only in the same direction as the impeller (1). All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, welded together, form the housing.

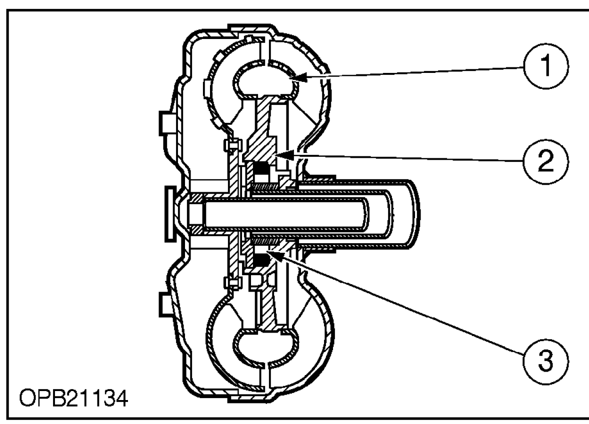
The stator (3), is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing.

When the engine is running, the oil in the converter flows from the impeller (1) to the turbine (2) and back to the impeller through the stator (3). This flow produces a maximum torque increase. When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.



2

When the turbine (1) is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades (2). The action of the oil on the rear face of the stator unlocks the one-way clutch (3), permitting the stator to rotate in the same direction as the turbine and impeller. Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine.



3

FAULT FINDING

IMPORTANT: *When effecting a repair the cause of the problem must be investigated and corrected to avoid repeat failures.*

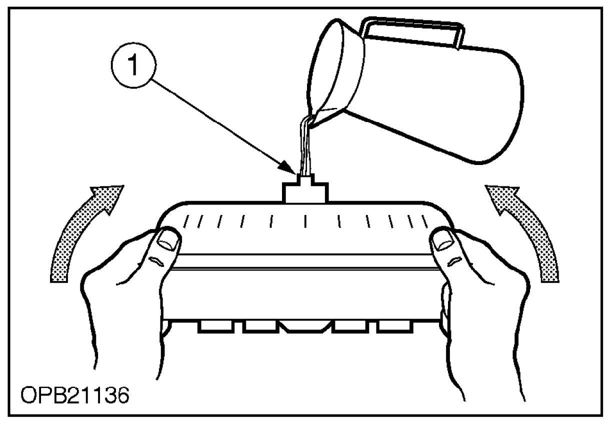
The following table lists problems and their possible causes with recommended remedial action.

PROBLEM	POSSIBLE CAUSES	CORRECTION
1. Low stall speed	Hydraulic clutch not releasing.	Replace Torque Convertor
	Stator support broken.	Replace Torque Convertor
	Defective torque converter.	Replace Torque Convertor
	Low engine power.	Check and correct output
2. High stall speed	Hydraulic clutch not applying or is slipping.	Replace
	Low line pressure.	Check pump output
	Sealing rings on rear input shaft broken.	Replace seals
	Defective torque converter.	Replace Torque Convertor

OVERHAUL

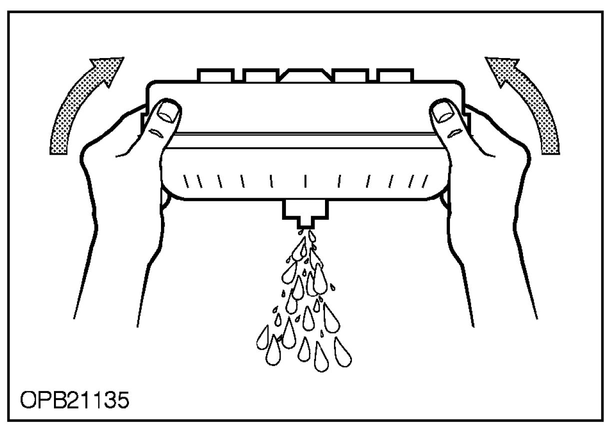
NOTE: *To remove the torque convertor refer to the transmission section 21 000 for disassembly procedure.*

The torque converter, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test, is cleaning and visual inspection. A commercial torque converter cleaner may be used to clean the converter. However, if a commercial cleaner is not available, the converter should be cleaned as outlined below.



4

1. Drain as much oil as possible from the hub of the converter by tilting the converter in all directions.
2. Fill the converter about half full, through the hub (1), with paraffin base solvent or any cleaning solvent specified for cleaning transmissions.
3. Plug the opening in the hub, then circulate the solvent inside the converter by rotating and shaking.
4. Drain the solvent from the converter.
5. Repeat Steps 1 to 4, as required, until the solvent that is drained from the converter is clean.



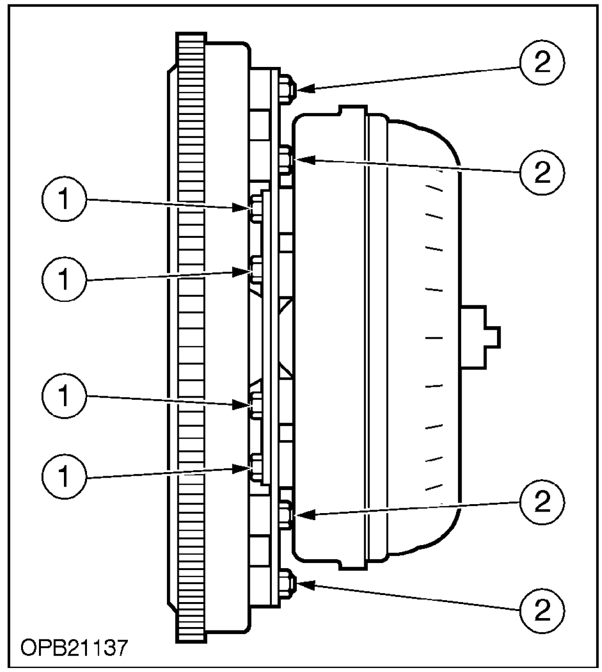
5

INSPECTION

Inspect the splines on the converter hub for wear or damage and the weld joints for cracks. If the hub is worn or damaged and/or the weld joints cracked, a new converter must be installed. A new drive plate should also be installed if it is warped.

RE-ASSEMBLY

1. Secure the drive plate to the torque converter, with the attaching bolts and flat washers (1) . Tighten bolts to 41 Nm (30 lbf ft).
2. Prior to fitting the transmission place the torque convertor carefully over the transmission shaft and into the transmission housing.
3. With the transmission bolted to the engine secure the drive plate to the flywheel accessed through the starter motor aperture, with the attaching bolts and washers (2). Tighten bolts to 41 Nm (30 lbf ft).



6

STALL TEST

The purpose of this test is to determine if the torque converter and hydraulic clutch assemblies are operating satisfactorily. For the test to be conclusive, the transmission hydraulic pump and pressure regulating valve must be operating correctly. They can be checked by performing the “Line Pressure Test”. The engine and brakes must also be in good working order.

1. Check the coolant level in the radiator and the oil level in the transmission. If low, add fluid as required to bring to the proper level.
2. With the gearshift lever and the shuttle lever in neutral, start the engine and run at 800-1000 revs/min until the transmission temperature reaches 85° - 95° F (29° - 35° C).
3. Lock the brakes and shift into fourth gear, increase engine speed to approximately 900 revs/min, then shift the power reversing lever to the forward position. This will position the control valve so as to direct high pressure oil to the front clutch.

4. Ensure the brakes are firmly locked so the unit will not move, gradually depress the foot accelerator and note the maximum engine speed obtained. Move the power reversing lever to the neutral position. The stall speed should be:

STALL SPEED:
Engine 95 HP T . . . . xxxx revs/min
Engine 110 HP TAA . . . . xxxx revs/min

IMPORTANT: *To prevent the transmission from overheating, do not allow the engine to operate at wide open throttle for more than fifteen seconds.*

5. Allow the transmission oil to cool to 29°-35° C (85°-95° F). Check the rear hydraulic clutch by repeating Steps 3 and 4, but with the power reversing lever in the rearward position. Again, cool the transmission oil by allowing the engine to run at approximately 1000 revs/min for one minute.
6. The engine speed noted in Step 4 (stall speed) for both the front and rear clutch assemblies should be within 150 revs/min of each other. If the stall speed is not within these limits, refer to the diagnosis guide for possible causes.
7. With the gearshift lever and power reversing lever in neutral, set the engine speed at 600-800 revs/min, then shift into any gear ratio. If the gears clash, either the front or rear hydraulic clutch assembly is transmitting power, even though the power reversing lever is in neutral.

NOTE: *If the unit creeps forward and the gears clash, the front clutch is at fault. The rear clutch is at fault if the unit creeps backward. If the unit does not creep and the gears still clash, use the stabilizers to raise the rear wheels off the ground, move the power reversing lever to neutral and shift into first gear. Check the rear wheels for rotational direction - if the wheel rotate rearward, then the rear clutch is at fault.*

SECTION 17 – TORQUE CONVERTOR

Chapter 2 – With Powershift Transmission

CONTENT

SPECIFICATIONS

Engine Stall Speeds

110 HP . . . . xxxx – xxxx revs/min

Torque Convertor Ratio

Ratio . . . . 2.38 : 1

Lubricant

See Operator’s Manual

Hydraulic Tests

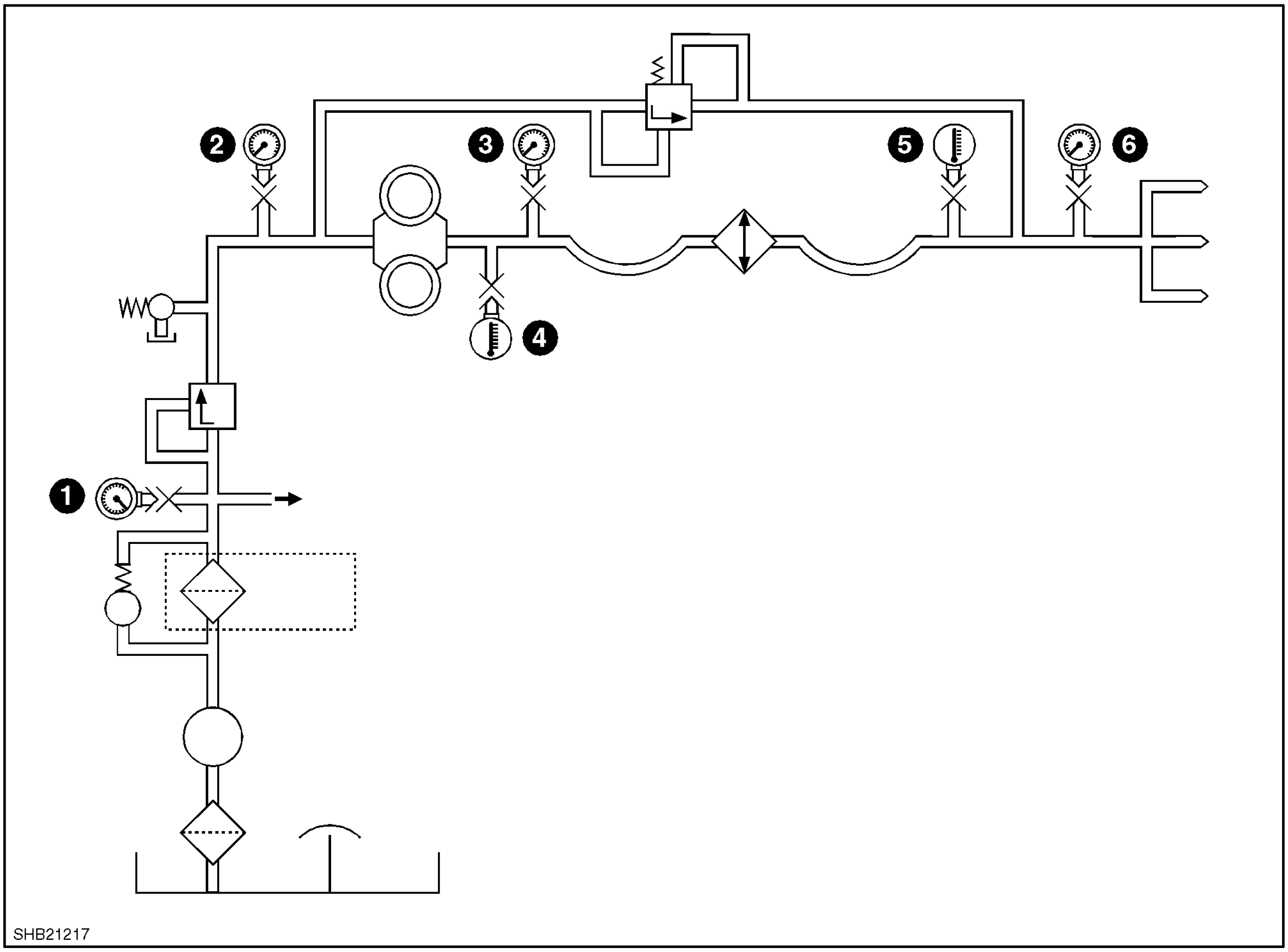
Tachometer Setting . . . . 2200 revs/min
Test temperature, oil . . . . 82–93°C (180–200°F)
Torque Converter relief valve . . . . 10 bar (101–159 psi)
Oil temperature converter out,
Normal operating range . . . . 80–90°C (175–193°F)
Maximum temperature . . . . 120°C (284°F)

Sealant

Gasket sealant 82995774
Thread sealant 82995768

TORQUE SPECIFICATIONS

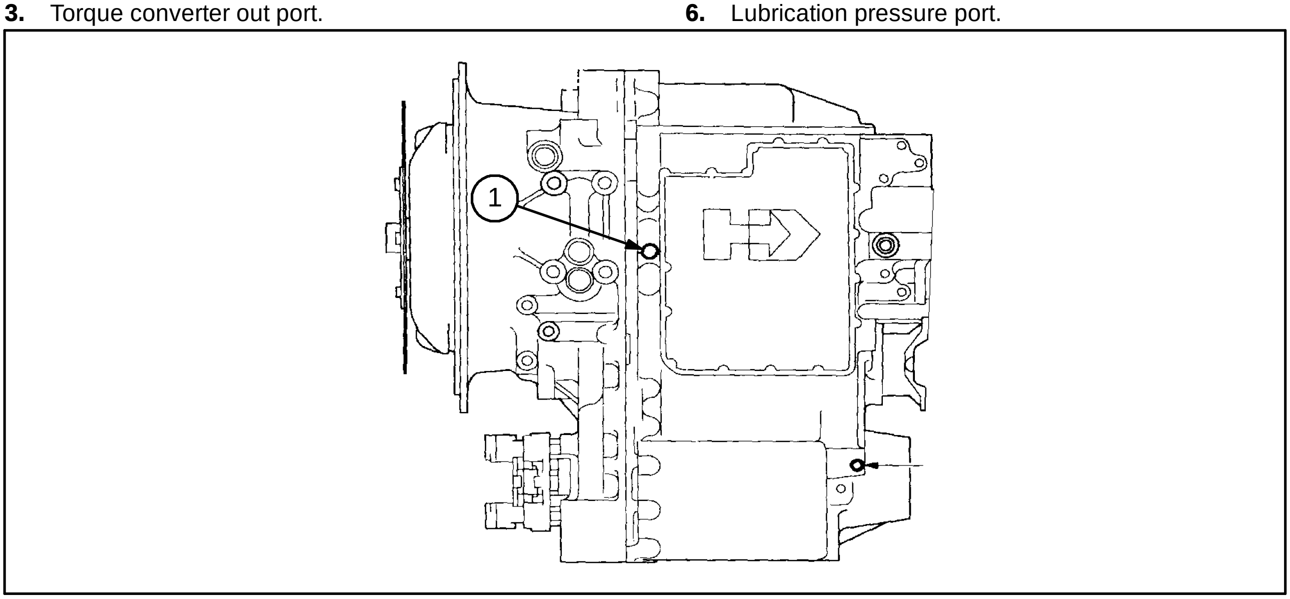
Item Description	N·m	ft. lbs.
Cooler return pipe union	49-78	36-58
Cooler return pipe elbow	49-78	36-58
Stator support retaining bolt	26	19
Flywheel to flex plate	43	32
Flex plate to converter	43	32



1

Torque converter and lubrication pressure test ports.

1. System pressure port.
2. Torque converter in port.
3. Torque converter out port.
4. Oil temperature converter out port.
5. Oil temperature cooler out port.
6. Lubrication pressure port.



2

Left Hand Side View

1. Pressure test port Convertor in 5–11 bar (73–159 psi)

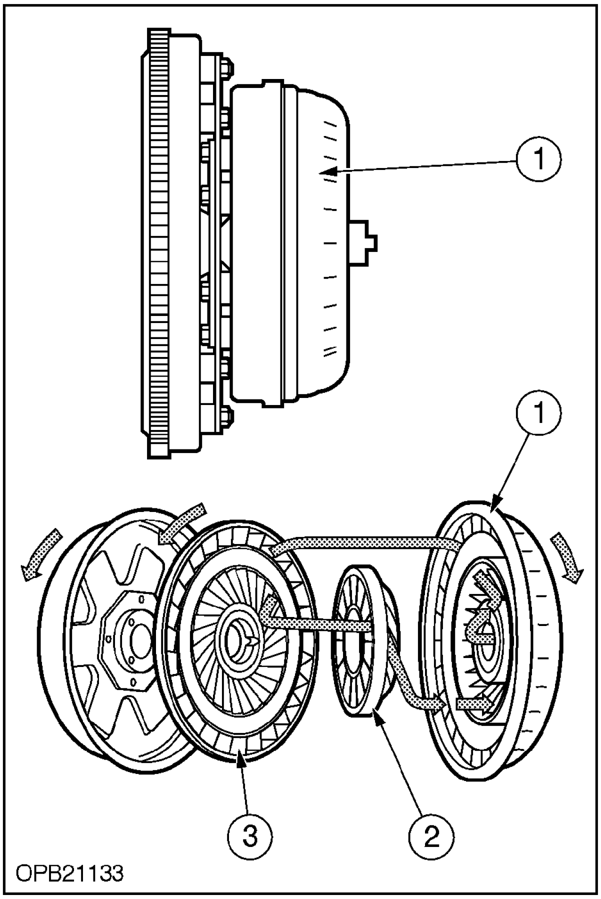
DESCRIPTION AND OPERATION

The main parts of the torque converter (1) are the impeller (pump), the turbine, the stator and the front and rear covers. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.

The turbine (2), splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator (3) to rotate only in the same direction as the impeller (1). All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, welded together, form the housing.

The stator (3), is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing.

When the engine is running, the oil in the converter flows from the impeller (1) to the turbine (2) and back to the impeller through the stator (3). This flow produces a maximum torque increase. When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.



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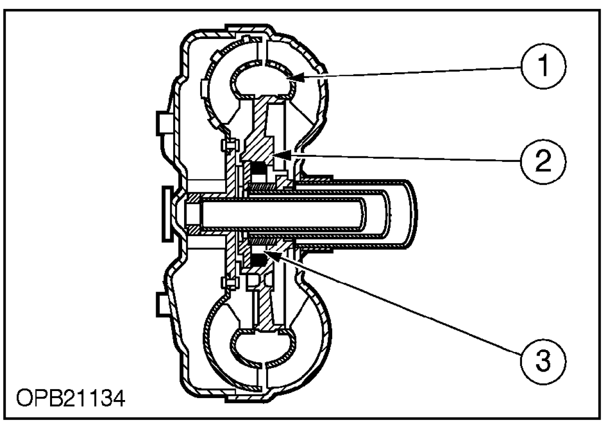
When the turbine (1) is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades (2). The action of the oil on the rear face of the stator unlocks the one-way clutch (3), permitting the stator to rotate in the same direction as the turbine and impeller. Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine.



4

FAULT FINDING

IMPORTANT: *When effecting a repair the cause of the problem must be investigated and corrected to avoid repeat failures.*

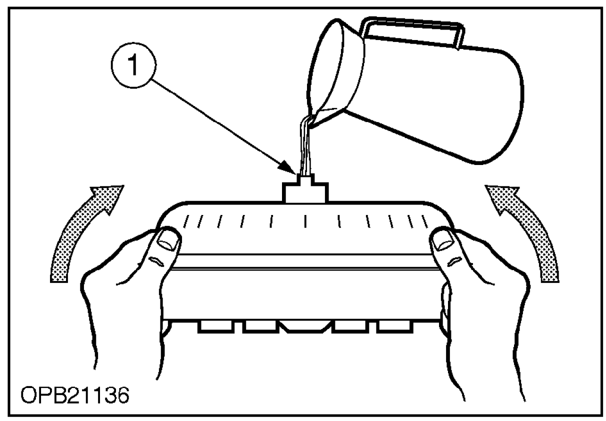
The following table lists problems and their possible causes with recommended remedial action.

PROBLEM	POSSIBLE CAUSES	CORRECTION
1. Low stall speed	Hydraulic clutch not releasing.	Replace Torque Convertor
	Stator support broken.	Replace Torque Convertor
	Defective torque converter.	Replace Torque Convertor
	Low engine power.	Check and correct output
2. High stall speed	Hydraulic clutch not applying or is slipping.	Replace
	Low line pressure.	Check pump output
	Sealing rings on rear input shaft broken.	Replace seals
	Defective torque converter.	Replace Torque Convertor

OVERHAUL

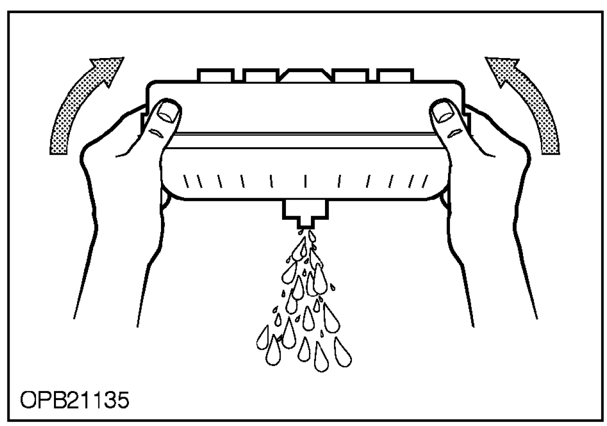
NOTE: *To remove the torque convertor refer to the transmission section 21 000 for disassembly procedure.*

The torque converter, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test, is cleaning and visual inspection. A commercial torque converter cleaner may be used to clean the converter. However, if a commercial cleaner is not available, the converter should be cleaned as outlined below.



5

1. Drain as much oil as possible from the hub of the converter by tilting the converter in all directions.
2. Fill the converter about half full, through the hub (1), with paraffin base solvent or any cleaning solvent specified for cleaning transmissions.
3. Plug the opening in the hub, then circulate the solvent inside the converter by rotating and shaking.
4. Drain the solvent from the converter.
5. Repeat Steps 1 to 4, as required, until the solvent that is drained from the converter is clean.



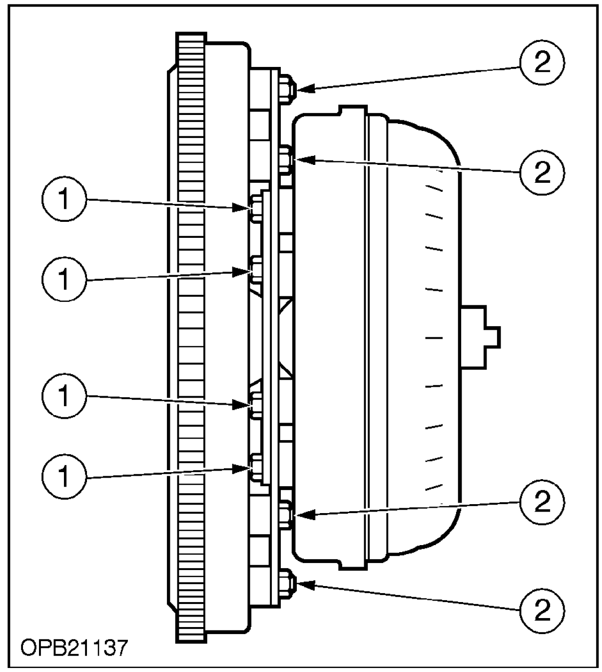
6

INSPECTION

Inspect the splines on the converter hub for wear or damage and the weld joints for cracks. If the hub is worn or damaged and/or the weld joints cracked, a new converter must be installed. A new drive plate should also be installed if it is warped.

RE-ASSEMBLY

1. Secure the drive plate to the torque converter, with the attaching bolts and flat washers (1) . Tighten bolts to 41 Nm (30 lbf ft).
2. Prior to fitting the transmission place the torque convertor carefully over the transmission shaft and into the transmission housing.
3. With the transmission bolted to the engine secure the drive plate to the flywheel accessed through the starter motor aperture, with the attaching bolts and washers (2). Tighten bolts to 41 Nm (30 lbf ft).



7

STALL TEST

The purpose of this test is to determine if the torque converter and hydraulic clutch assemblies are operating satisfactorily. For the test to be conclusive, the transmission hydraulic pump and pressure regulating valve must be operating correctly. They can be checked by performing the “Line Pressure Test”. The engine and brakes must also be in good working order.

1. Check the coolant level in the radiator and the oil level in the transmission. If low, add fluid as required to bring to the proper level.
2. With the gearshift lever and the shuttle lever in neutral, start the engine and run at 800-1000 revs/min until the transmission temperature reaches 85° - 95° F (29° - 35° C).
3. Lock the brakes and shift into fourth gear, increase engine speed to approximately 900 revs/min, then shift the power reversing lever to the forward position. This will position the control valve so as to direct high pressure oil to the front clutch.

4. Ensure the brakes are firmly locked so the unit will not move, gradually depress the foot accelerator and note the maximum engine speed obtained. Move the power reversing lever to the neutral position. The stall speed should be:

STALL TORQUE:
Power Shift Transmission Models .... xxxx revs/min

IMPORTANT: *To prevent the transmission from overheating, do not allow the engine to operate at wide open throttle for more than fifteen seconds.*

5. Allow the transmission oil to cool to 29°-35° C (85°-95° F). Check the rear hydraulic clutch by repeating Steps 3 and 4, but with the power reversing lever in the rearward position. Again, cool the transmission oil by allowing the engine to run at approximately 1000 revs/min for one minute.
6. The engine speed noted in Step 4 (stall speed) for both the front and rear clutch assemblies should be within 150 revs/min of each other. If the stall speed is not within these limits, refer to the diagnosis guide for possible causes.
7. With the gearshift lever and power reversing lever in neutral, set the engine speed at 600-800 revs/min, then shift into any gear ratio. If the gears clash, either the front or rear hydraulic clutch assembly is transmitting power, even though the power reversing lever is in neutral.

NOTE: *If the unit creeps forward and the gears clash, the front clutch is at fault. The rear clutch is at fault if the unit creeps backward. If the unit does not creep and the gears still clash, use the stabilizers to raise the rear wheels off the ground, move the power reversing lever to neutral and shift into first gear. Check the rear wheels for rotational direction - if the wheel rotate rearward, then the rear clutch is at fault.*

SECTION 21 – TRANSMISSIONS

Chapter 1 – 4X4 Compact Shuttle

CONTENT

SPECIFICATIONS

Stall Speeds

95 hp . . . . xxxx – xxxx revs/min
110 hp . . . . xxxx – xxxx revs/min

Torque Convertor Ratio

Ratio . . . . 2.34 : 1

Gear Ratios

Synchronized 4x4 Transmission	Forward 1st 4.824:1	Reverse 1st 4.020:1
	Forward 2nd 2.998:1	Reverse 2nd 2.498:1
	Forward 3rd 1.408:1	Reverse 3rd 1.173:1
	Forward 4th 0.792:1	Reverse 4th 0.660:1

Lubricant

See Operator's Manual

Sealant

Gasket sealant 82995774
Thread sealant 82995768

Cold Start By–pass Valve Spring

Free length . . . . 53.4mm $^{+}/-$ 0.96mm (2.10in $^{+}/-$ 0.038in)

Fwd Clutch Spring

Free length 76.6mm (3.017in)

Clutch Piston Spring

Free length 75.9mm (2.99inin)

Detent Spring

Free length (Approximately) 42.06mm (1.656in)

End Float

Input forward Primary Shaft 0.0508–0.41mm (0.002–0.016in)
Input reverse Primary Shaft 0.0508–0.41mm (0.002–0.016in)
Output shaft . . . . 1st Gear– 0.33–0.508mm (0.013–0.020in)
. . . . 2nd Gear– 0.35–0.558mm (0.014–0.022in)
. . . . 3rd Gear– 0.38–0.838mm (0.015–0.033in)
. . . . 4th Gear– 0.20–0.558mm (0.008–0.022in)
Four Wheel Drive Shaft 0.050–0.28mm (0.002–0.011in)
Bearing End Floats 0.025–0.076mm (0.001–0.003in)
Bearing End Float Shims available 0.050/0.076/0.127/0.177/0.381/0.508mm
. . . . (0.002/0.003/0.005/0.007/0.015/0.020in)

Hydraulic Tests

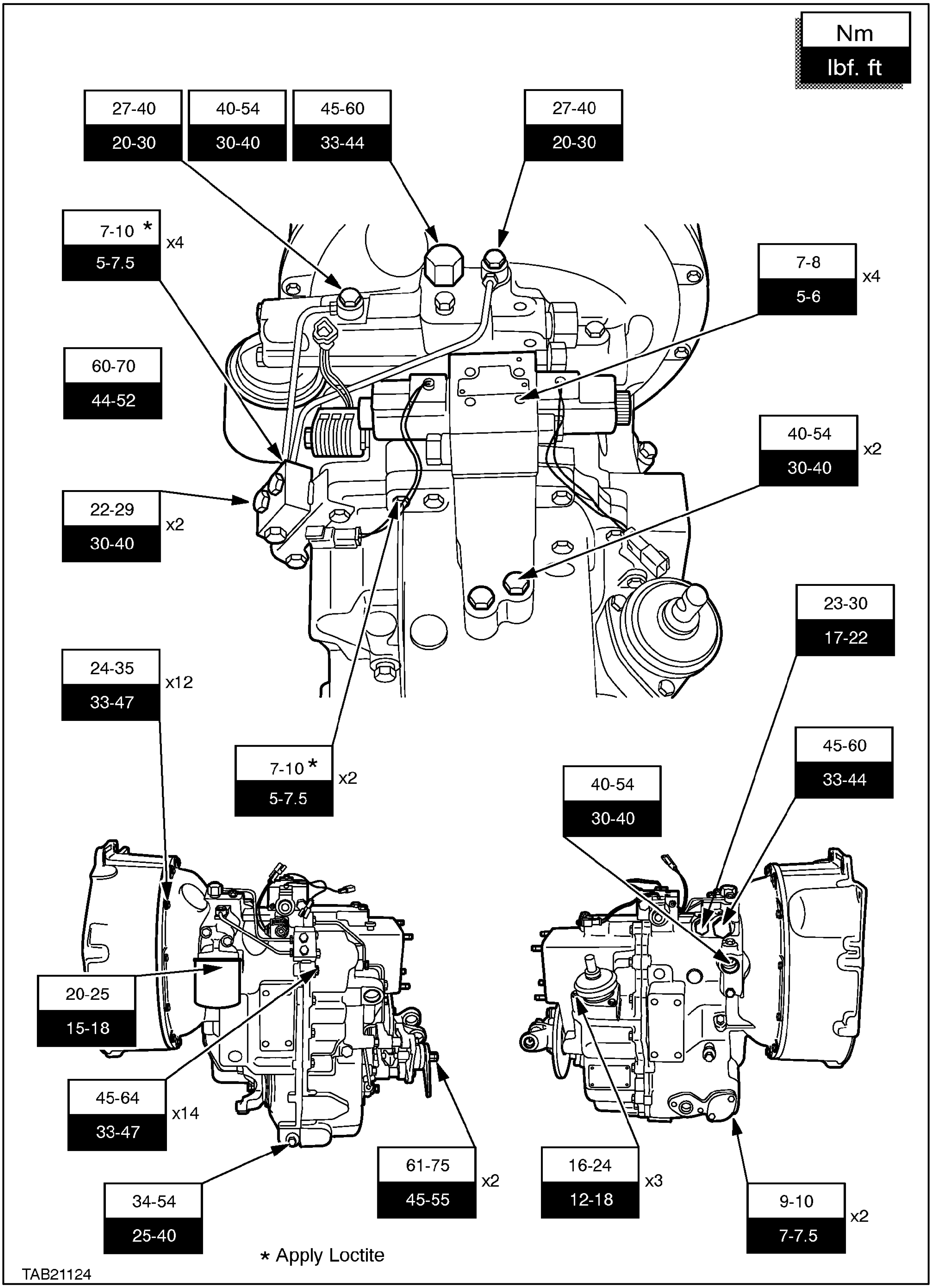
Tachometer Setting . . . . 2000 revs/min
Test temperature, oil . . . . 80–85°C (176–185°F)
Cold Start Valve (For reference only) . . . . 26 bar (377 psi)
System Pressure Test . . . . 13.7–15.2 bar (198–220 psi)
Torque Converter . . . . 7–11 bar (101–159 psi)
Reverse Clutch . . . . 13.7–15.2 bar (198–220 psi)
Forward Clutch . . . . 13.7–15.2 bar (198–220 psi)
Four Wheel Drive Drive Supply . . . . 13.7–15.2 bar (198–220 psi)

Cooler Flow Test

Oil temperature 80–85°C (176–185°F)	Revs/min	Oil Flow Litres/min (gallons/min)
. . . .	700	12.5 litres (3.3 US. gals)
. . . .	1000	18.2 litres (4.8 US. gals)
. . . .	1500	22.1 litres (5.8 US. gals)
. . . .	2000	24.0 litres (6.3 US. gals)
. . . .	2200	24.5 litres (6.5 US. gals)
. . . .	2500	25.0 litres (6.6 US. gals)

TORQUE SPECIFICATIONS

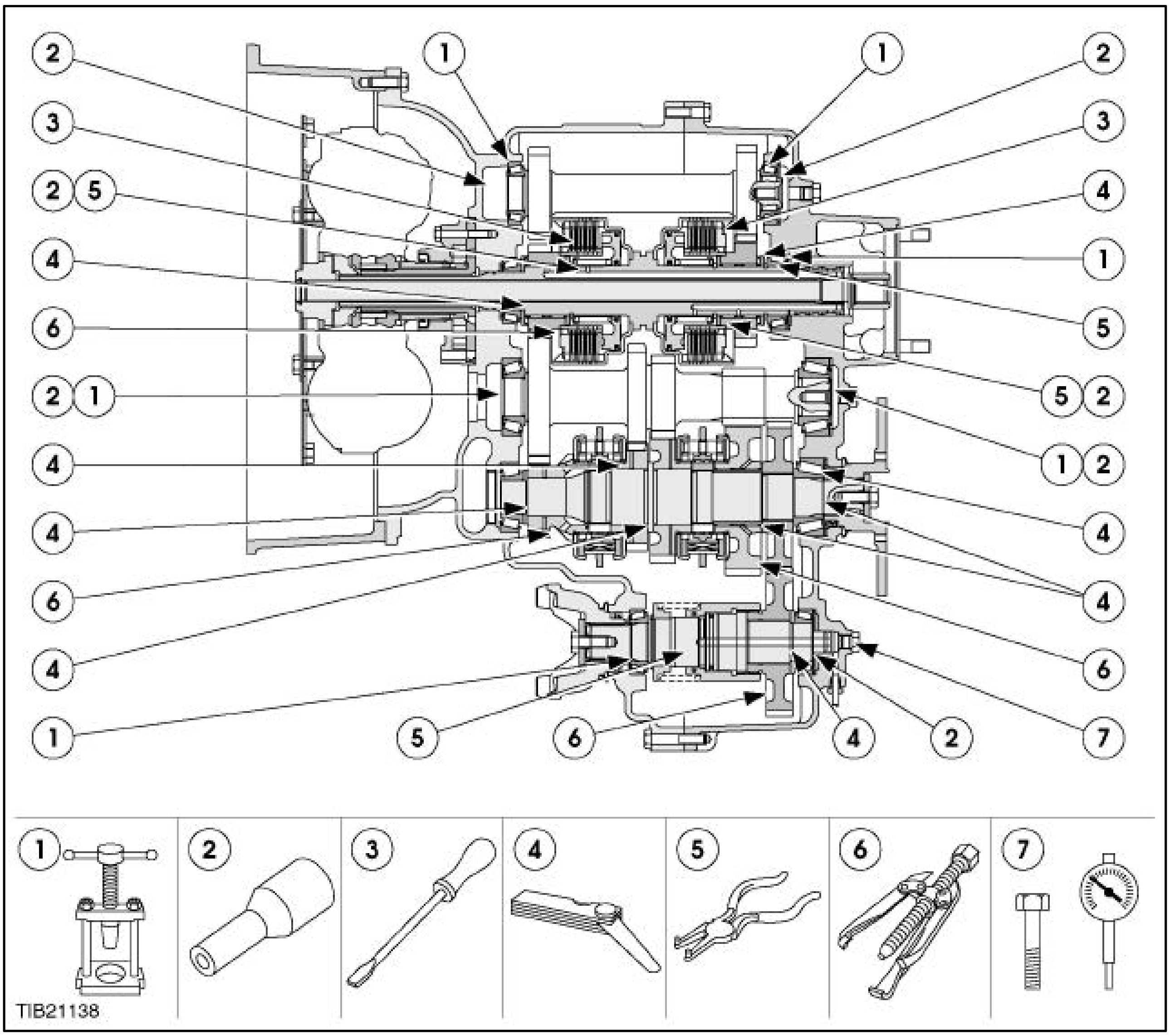
Item Description	N·m	ft. lbs.
Cooler return pipe union	49-78	36-58
Cooler return pipe elbow	49-78	36-58
Stator support retaining bolt	26	19
Flywheel to flex plate	43	32
Flex plate to converter	43	32


Nm
lbf. ft
27-40
20-30
40-54
30-40
45-60
33-44
27-40
20-30
7-10 *
5-7.5
x4
7-8
5-6
x4
60-70
44-52
40-54
30-40
x2
22-29
30-40
x2
23-30
17-22
24-35
33-47
x12
7-10 *
5-7.5
x2
45-60
33-44
40-54
30-40
20-25
15-18
45-64
33-47
x14
61-75
45-55
x2
16-24
12-18
x3
34-54
25-40
9-10
7-7.5
x2
* Apply Loctite
TAB21124

1

SPECIAL TOOLS

DESCRIPTION	APPLICATION
Bearing Cone Drift 40mm	Counter Shaft, Rear Main Shaft and 4WD Bearing
Bearing Cone Drift 35mm	Reverse Idler and Front Main Shaft Bearing
Bearing Cone Drift 40mm	Front Input Shaft Bearing
Bearing Cone Drift 50mm	Rear Input Shaft Bearing
Slide Hammer	Bearing cone removal
Bush Insertion Tool 22mm	Pump rod Insertion Tool
Welch Plug Drift	Shim Adjustment Cover
Oil Seal Drift	Pump Seal
*Spring Compressor	Main Clutches Tool no 380000679
Spring Compressor	Detent Ball Spring
Circlip Pliers .	Where applicable
Feeler Gauges	Where applicable
*Dial Indicator Bolt	Shaft end float Tool no 380000700



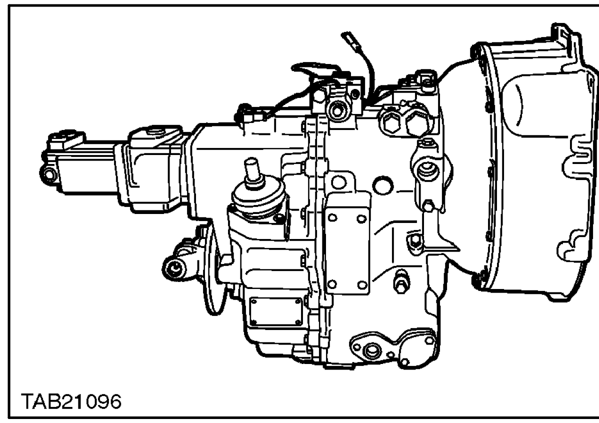
2

DESCRIPTION AND OPERATION

The transmission consists of a torque converter, an internal rotor-type hydraulic pump, an oil distributor, a solenoid control valve assembly, two hydraulically operated clutches, a 4-speed synchromesh gear-train, transmission case and oil cooler tubes.

GEAR RATIOS Synchronized 4x4 Transmission

Forward 1st – 4.824:1 . Reverse 1st – 4.020:1
Forward 2nd – 2.998:1 . Reverse 2nd – 2.498:1
Forward 3rd –1.408:1 . Reverse 3rd – 1.173:1
Forward 4th – 0.792:1 . Reverse 4th – 0.660:1

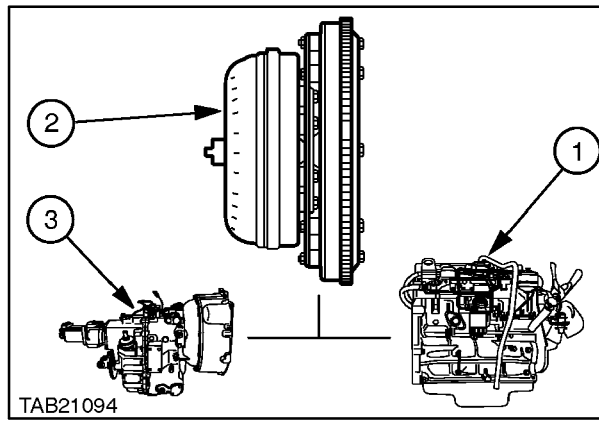


3

NOTE: *A conventional clutch is not used with this transmission.*

The transmission case serves as an oil reservoir for the torque converter and hydraulic clutch assemblies.

The gearbox receives power from the engine (1) by a fluid coupling in the torque converter (2) and hydraulic clutch assemblies in the transmission (3).



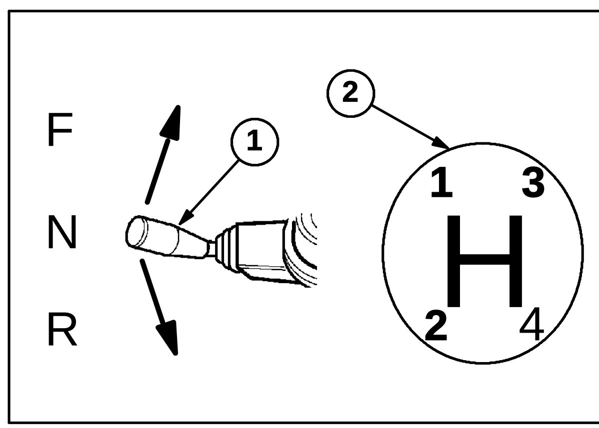
4

TRANSMISSION CONTROL (Op 21 136)

The front clutch provides power for forward travel and the rear clutch power for reverse travel. Engagement of the front and rear clutch is controlled by the operator through the movement of the hand operated power reversing lever (1).

The gearshift lever (2) is used to select any one of four speeds through an ‘H’ pattern synchronized gear shift.

In any gear ratio the operator need only move the shuttle lever to change direction of travel, forward or reverse.



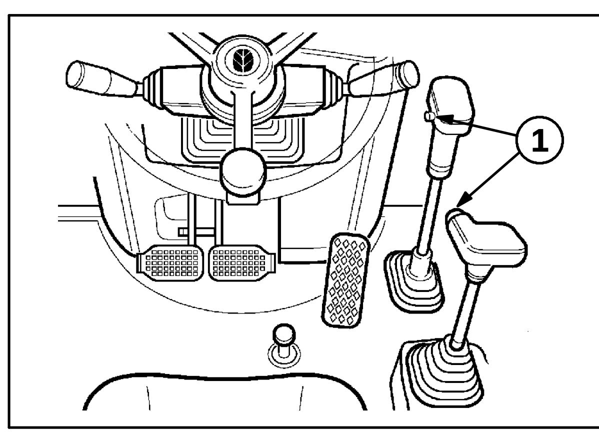
5

Transmission disconnect switches (Op 21 136)

Two finger operated button type switches (1) are provided. One on the gearshift lever knob, primarily to change gear ratios and the second on the loader control lever knob for use during loader operations.

However, as a clutch is not used between the engine and the transmission, the power flow from the engine to the transmission must be interrupted to shift from one gear ratio to another. This is accomplished by using a transmission disconnect switch on the gear lever.

Easy gear changes may be made with the fully synchronized gearbox, simply by depressing the transmission disconnect button on the gearshift lever while moving the lever from one ratio to another.



6

TORQUE CONVERTER (OP 17 110)

NOTE: *The torque converter is a sealed unit and can not be serviced as individual parts.*

The torque converter is the connection between the engine and the transmission and is hydraulically actuated.

The main parts of the torque converter are the impeller, the turbine, the stator and the front and rear covers. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.

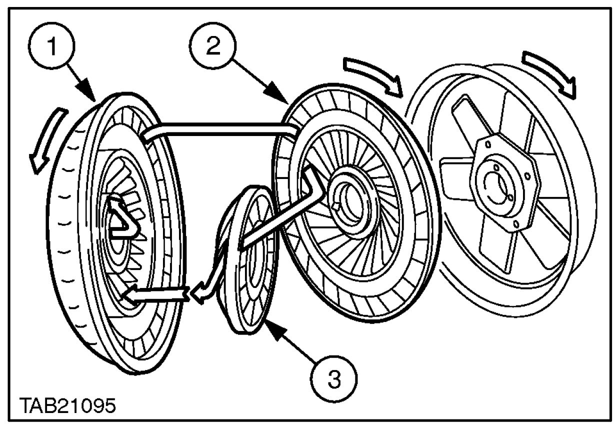
The stator, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing.

The turbine (2), splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator (3) to rotate only in the same direction as the impeller (1). All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, welded together, form the housing.

When the engine is running, the oil in the converter flows from the impeller (1) to the turbine (2) and back to the impeller through the stator (3). This flow produces a maximum torque increase. When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.

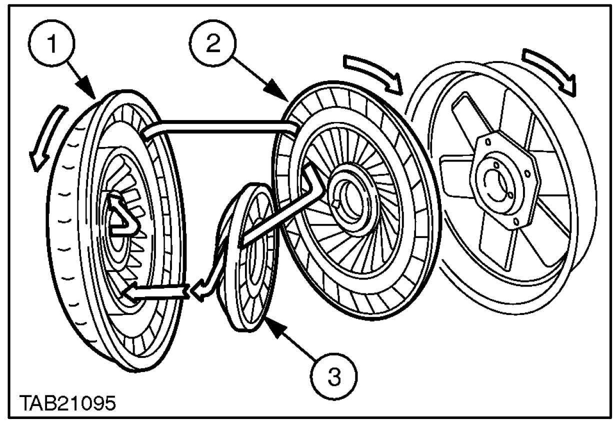
When the turbine is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades (3). The action of the oil on the rear face of the stator unlocks the one-way clutch, permitting the stator to rotate in the same direction as the turbine (2) and impeller (1). Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine.

To achieve optimum operation the engine performance, transmission ratios, hydraulic power delivery and converter torque multiplication are all “Matched” to provide the necessary vehicle drive torque when required.



7

When the turbine is rotating less than nine tenths impeller speed (1), the converter is multiplying torque through the action of the stator (3). This action, produced by oil acting on the front face of the stator blades, tends to rotate the stator in the opposite direction of the impeller (1) and turbine (2). However, the one-way clutch prevents this opposite rotation and allows the stator to direct oil back to the impeller, thereby producing torque multiplication. Maximum torque multiplication is achieved when the impeller is driven at stall speed and the turbine is stationary

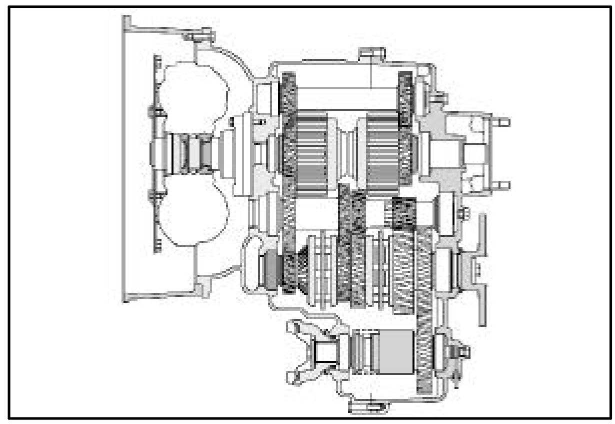


8

GEAR TRAIN (Op. 21 146)

The front and rear cases of the transmission sandwich a series of parallel shafts which support the helically cut gears, between tapered roller bearings.

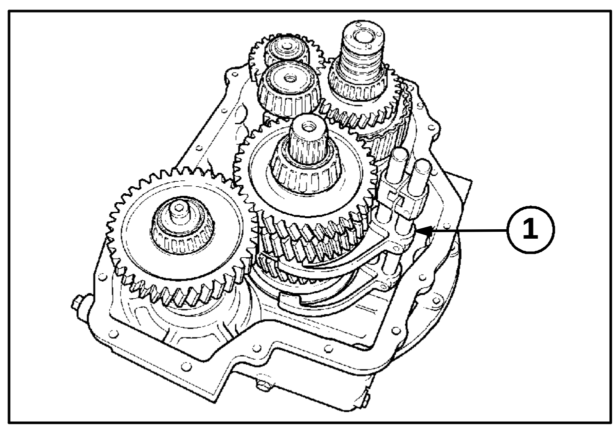
Polymer lip seals on the hydraulic pump output and FWD shafts prevent leakage from the sump. A breather at the top of the filler tube prevents pressure damage to the seals.


9

GEAR SHIFT MECHANISM (Op. 21 136)

A mechanical arrangement of shift rails, forks and synchronisers allows static or rolling engagement of any of the 4 transmission ratios from a standard H gate pattern lever.

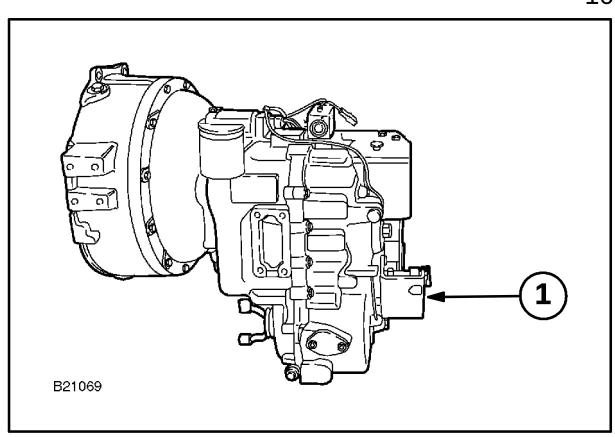
The synchronisers prevent engagement of the selected gear until its shaft speed is synchronised with that of the output shaft. A detent interlock system prevents gear jumpout and the simultaneous engagement of 2 gears.



10

PARKING BRAKE (Op. 21 136)

At the rear of the transmission and on the output coupling a cast iron disc acts as the mounting flange and parking brake. The disc runs in a mechanical calliper which reacts through a bracket connected to the transmission rear housing. The calliper has replaceable friction pads and is manually adjustable as the pads wear



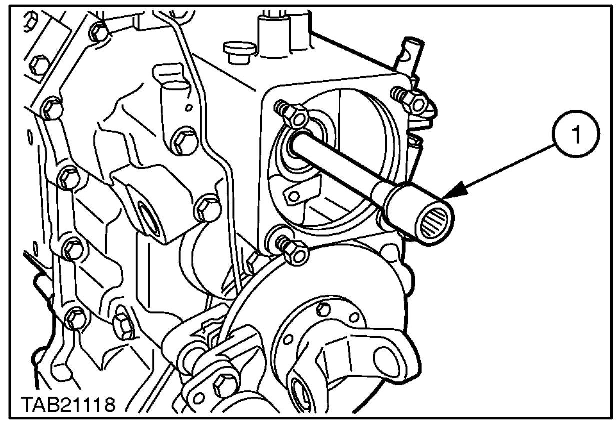
11

CO-AXIAL DRIVE VEHICLE HYDRAULIC PUMP (Op. 21 146)

A solid shaft connects the flywheel (via the torque converter impeller) to the vehicle hydraulic pump input shaft.

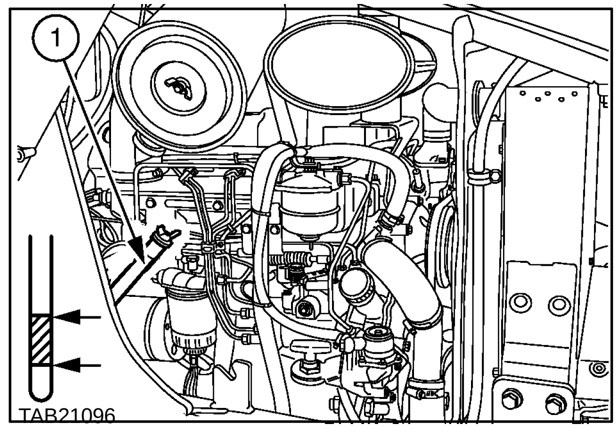
The pump drive shaft passes through the tubular input shaft and is supported at the rear by a bush. Accordingly, the main pump will run at engine speed regardless of the ratio or direction of the transmission.

An integral strainer in the transmission sump and spin on filter mounted to the left of the transmission at the top ensure that the oil remains clean between service intervals.



12

The dipstick/oil filler tube (1) is used for monitoring and maintenance of the oil level, in the transmission.



13

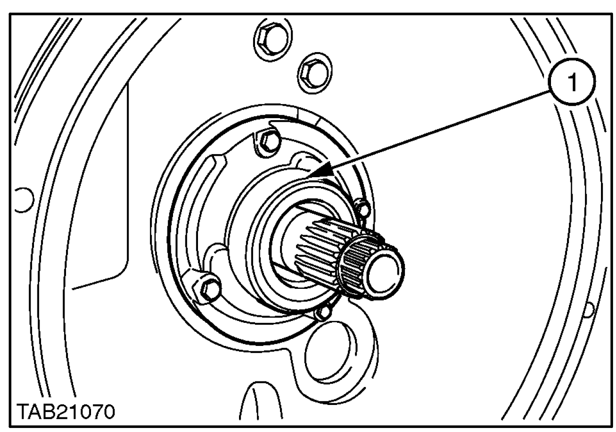
TRANSMISSION HYDRAULIC PUMP OIL SUPPLY (OP. 21 102)

The transmission case serves as an oil reservoir for the torque converter and clutch assemblies.

An integral hydraulic oil pump situated in the bell draws oil from the transmission sump to provide a pressurised flow which is continuously cooled by an external cooler.

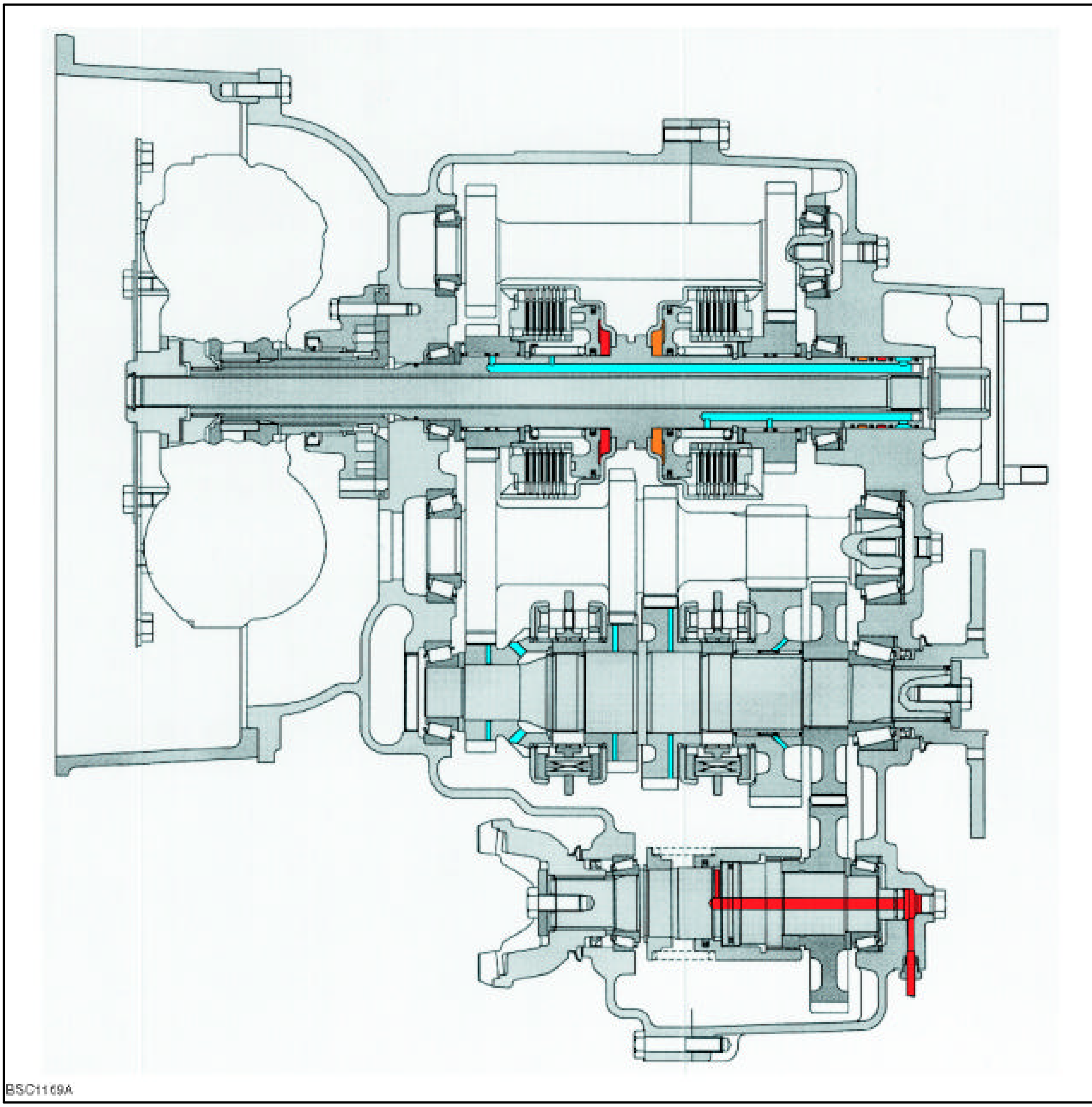
Oil is picked up from the sump, via an internal strainer, through the inlet section of the pump plate by the action of the rotors, and is forced through the outlet section of the pump plate through the spin on pressure filter to the oil distributor.

A temperature sender provides a signal to the instrument panel warning light should the transmission oil become to hot.



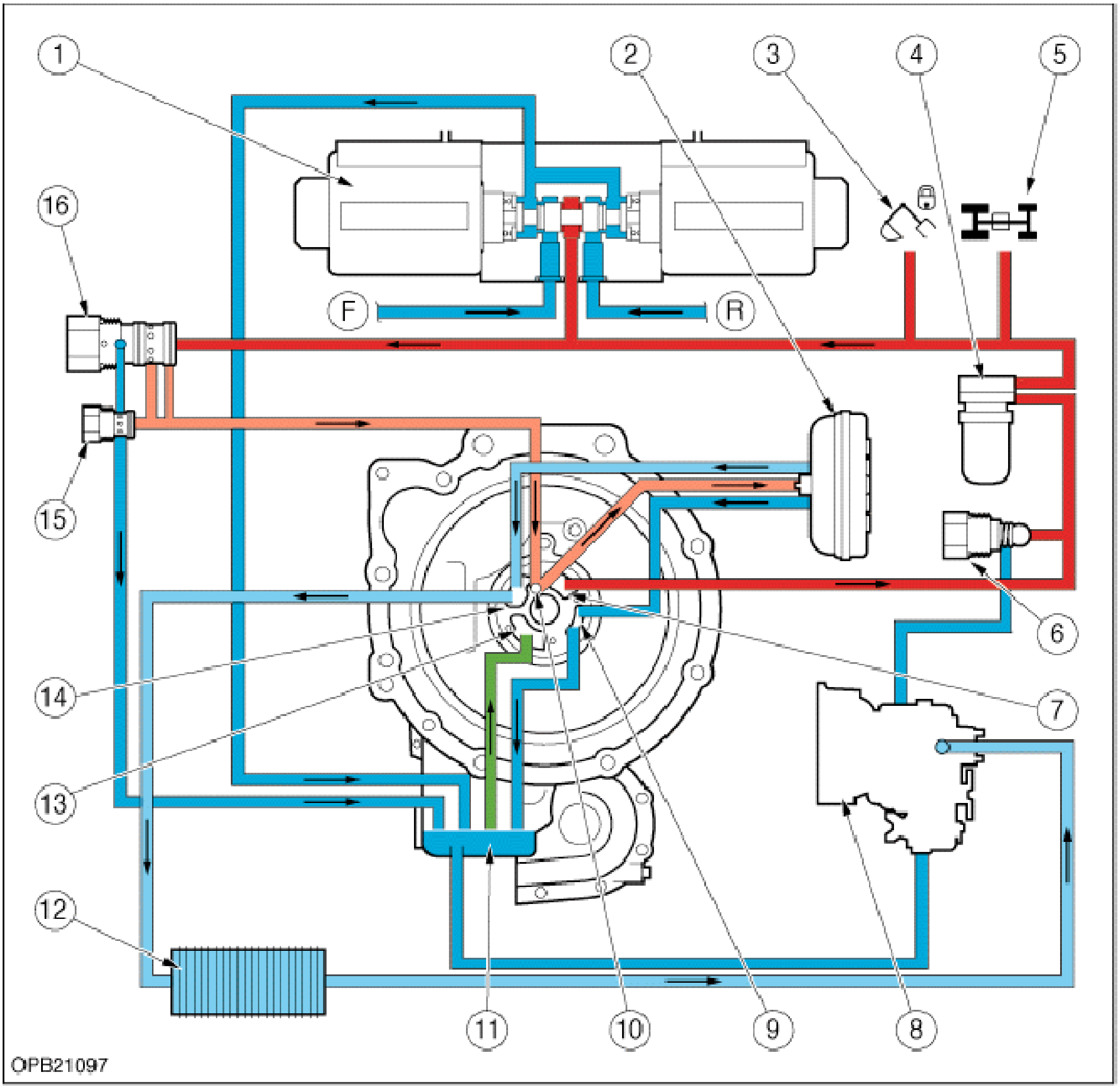
14

TRANSMISSION OIL FLOW AND SUPPLY



15

Pressure Oil	Lubrication
Disengaged	

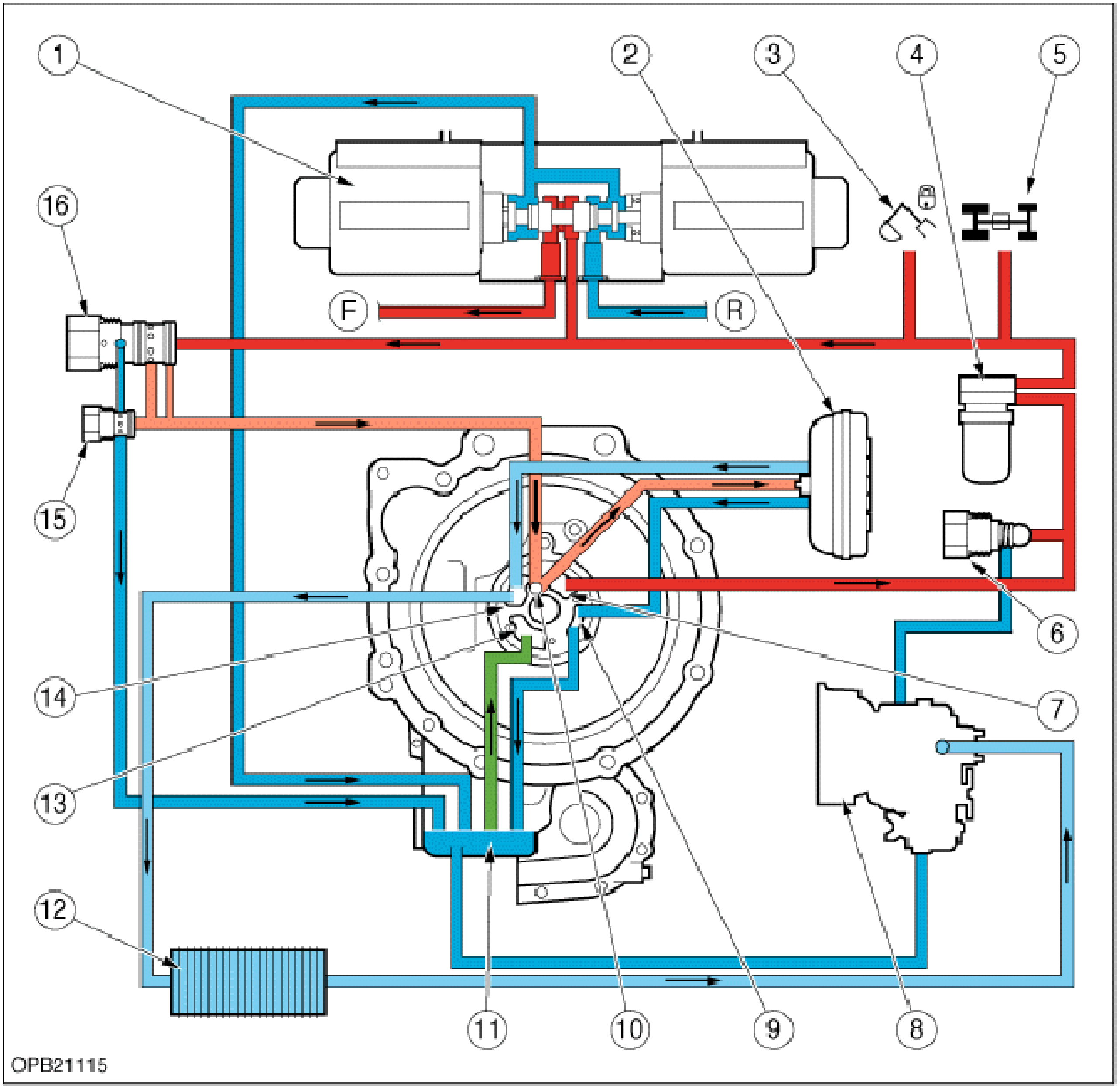


OIL FLOW AND SUPPLY IN NEUTRAL POSITION 16

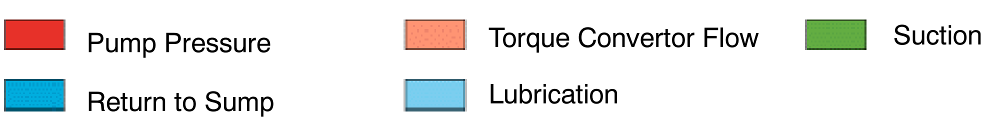
Pump Pressure	Torque Convertor Flow	Suction
Return to Sump	Lubrication	

21-10

1. Forward/reverse solenoid valve.
2. Torque converter.
3. Boom lock (if equipped).
4. Filter.
5. FWD clutch pack.
6. Cold start valve.
7. Oil pump OUT.
8. Transmission housing.
9. Oil pump recirculate.
10. Converter IN.
11. Sump.
12. Oil cooler.
13. Oil pump IN
14. Pump.
15. Regulating valve torque converter pressure.
16. System pressure sequencing.

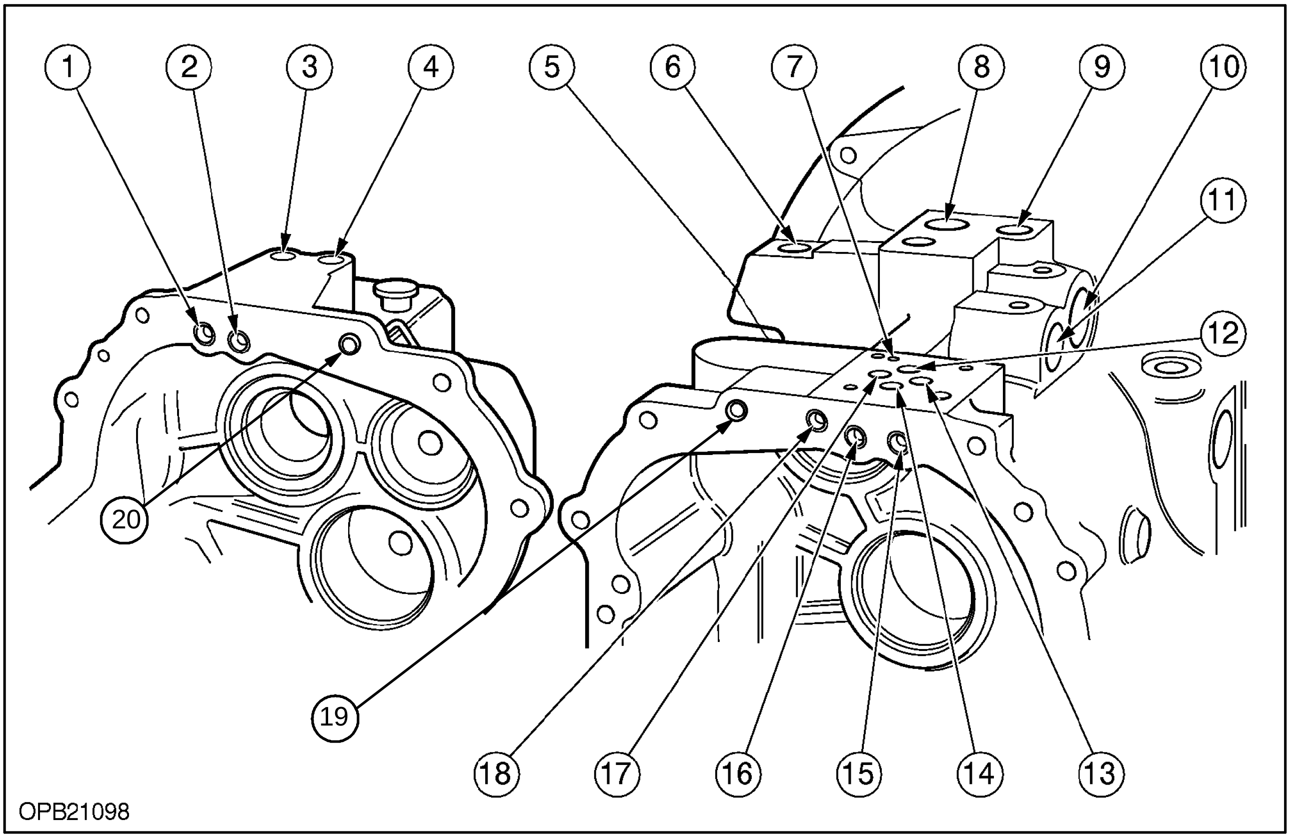


OIL FLOW AND SUPPLY IN FORWARD POSITION 17



1. Forward/reverse solenoid valve.
2. Torque converter.
3. Boom lock (if equipped).
4. Filter.
5. FWD clutch pack.
6. Cold start valve.
7. Oil pump OUT.
8. Transmission housing.
9. Oil pump recirculate.
10. Converter IN.
11. Sump.
12. Oil cooler.
13. Oil pump IN.
14. Pump.
15. Regulating valve torque converter pressure.
16. System pressure sequencing.

TRANSMISSION OIL SUPPLY PORTS



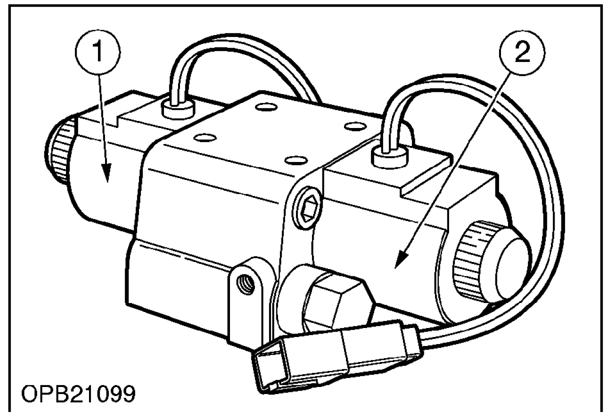
18

Viewed From Front and Rear Housings

1. Oil supply port to Reverse clutch pack, rear casing.
2. Oil supply port to forward clutch pack, rear casing.
3. Oil supply port to pressure test reverse clutch pack.
4. Oil supply port too pressure test forward clutch pack.
5. Front Wheel Drive Solenoid.
6. System pressure test point, connected to test block.
7. Locating Dowel
8. Cold start oil pressure protection valve.
9. Torque convertor pressure test point, connected to test block.
10. System pressure sequencing valve.
11. Torque convertor pressure regulating valve.
12. Oil supply from pump to solenoid valve pack.
13. Oil supply port to Reverse clutch pack, front casing.
14. Oil port to reservoir (dump) from solenoid.
15. Oil supply port to Reverse clutch pack, front casing.
16. Oil supply port to forward clutch pack, front casing.
17. Oil supply port to forward clutch pack, front casing.
18. Manufacturing drilling only.
19. FWD oil supply port (front casing)
20. FWD oil supply port (rear casing)

TRANSMISSION OIL FLOW THROUGH SOLENOID VALVE

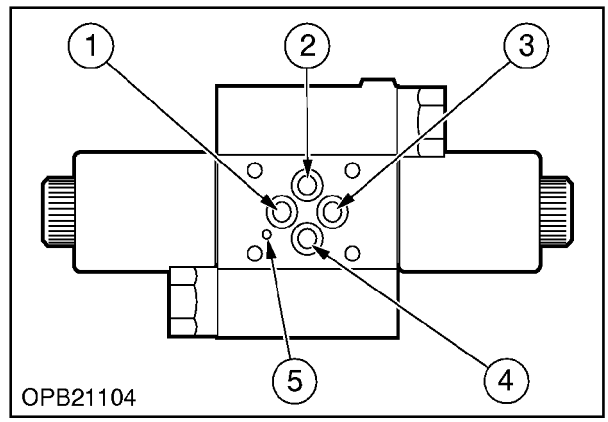
The solenoid valves forward (1) or reverse (2) fitted at the top of the transmission housing controls the oil flow to the forward/reverse clutch packs in the transmission.



19

On the underside of the solenoid valve are the 4 ports for directional oil flow to and from the solenoid valve.

1. Oil supply from the valve to the forward clutch pack.
2. Return oil to reservoir
3. Oil supply from the valve to the reverse clutch pack.
4. Oil supply from the pump into the valve.
5. Locating Pin



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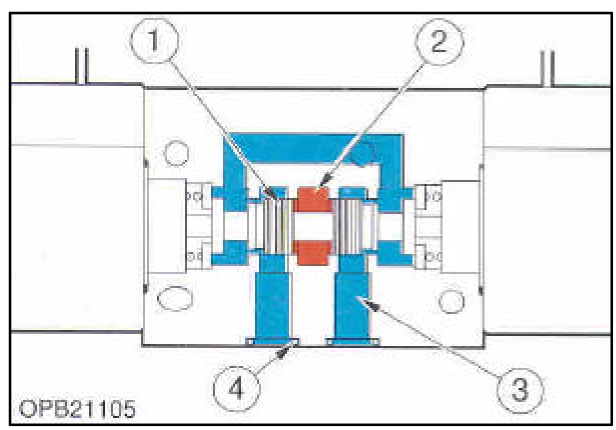
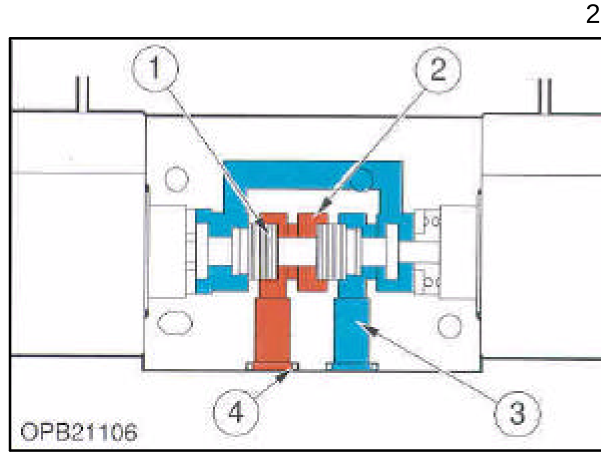
When the shuttle lever in the cab is in neutral position the solenoid valve spool (1) will be static and oil (2) will not flow into either reverse (3) or forward (4) clutch pack oil gallery.



21

When forward direction is selected on the the shuttle lever the solenoid valve spool (1) will move to the left (as shown) and the oil (2) will flow into the forward clutch pack oil gallery (4)

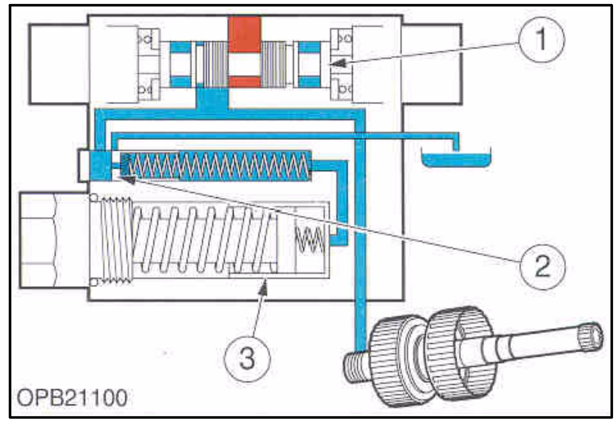
When reverse direction is selected on the the shuttle lever the solenoid valve spool (1) will move to the right (not shown) and the oil (2) will flow into the reverse clutch pack oil gallery (3).



22

OIL FLOW SOLENOID CONTROL VALVE OPERATION (FORWARD DRIVE ONLY SHOWN)

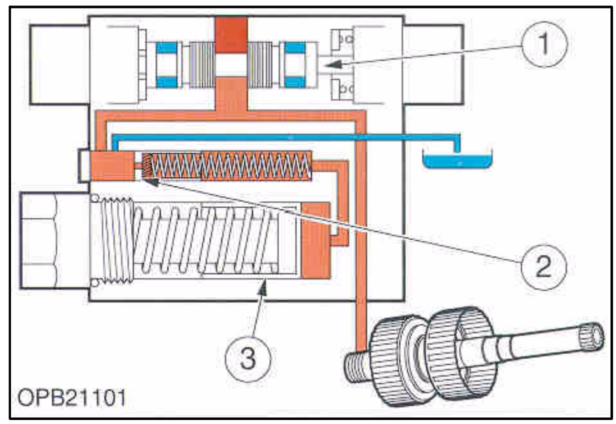
The solenoid valve when in neutral position dead heads the oil flow at the spool (1) from the supply port and no oil is allowed to pass through the valve. Therefore the oil in the galleries beyond the spool at the fill time metering valve (2) remains static.



23

Selection of the forward / reverse shuttle lever in the cab directs a current flow to the forward or reverse solenoid and the spool (1) will move in the direction selected, reverse shown. The oil then flows past the spool to the clutch pack and applies pressure to the fill time metering valve (2), a small bore allows oil to flow into the clutch feathering valve.

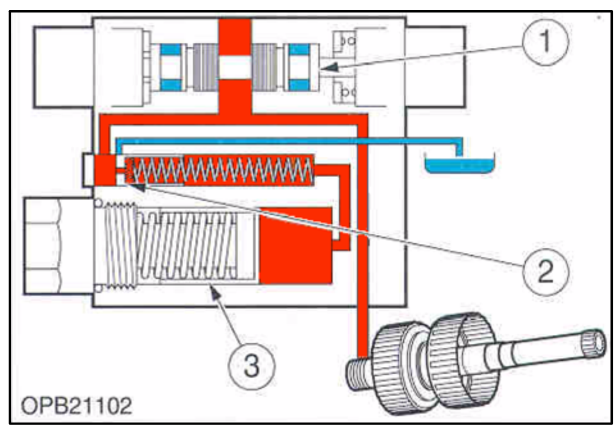
When valve (2) moves it partially uncovers a port to the reservoir and also opens the control orifice within the valve. Therefore a precisely metered flow of oil is fed to the pressure regulating (feathering) piston (3). As this piston is pushed back against its spring the pressure at the clutch builds up gradually to give a smooth jerk free clutch engagement.



24

When the piston reaches the end of its travel, clutch pressure quickly builds up to full system pressure either side of valve (2) so the the light spring pushes the valve covering the port to the reservoir.

The oil is dead headed at system pressure at the clutch so ensuring full torque can be transmitted by the clutch.



25

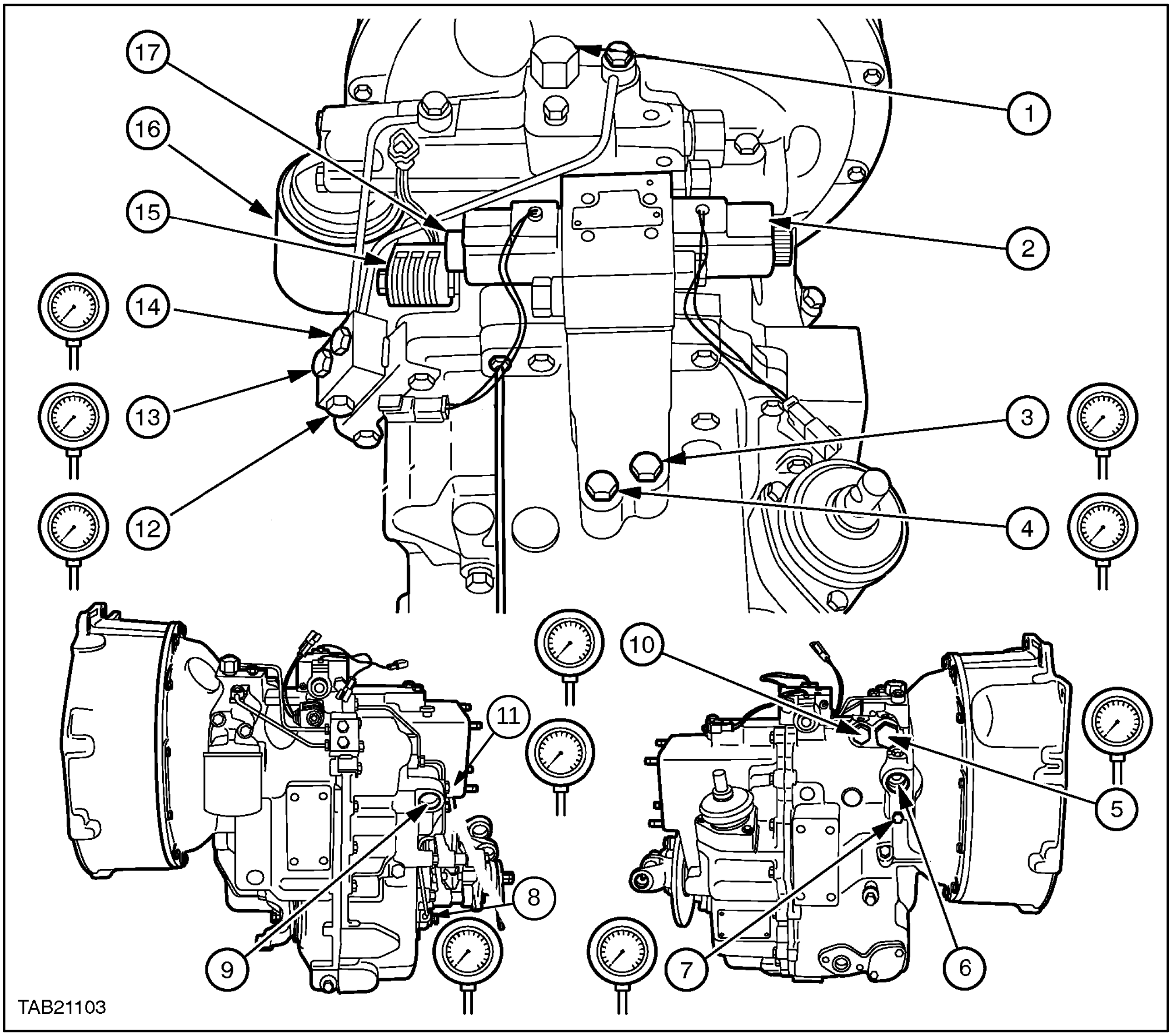
NOTE: *The control valve also includes a pressure regulating (feathering) valve and a fill time metering valve for the reverse clutch pack.*

= Regulated Pressure Oil

= Return Oil

= Pressure Oil

TRANSMISSION HYDRAULIC VALVES AND PRESSURE TEST POINTS (OP. 21 102)



26

NOTE: *All pressure test ports are $^{9}/_{16}$ in UNF thread size*

1. **Cold Start oil pressure relief valve**
   26 bar (377 psi) reference only
2. **Forward Solenoid valve**
   13.7-15.2 bar (198-220 psi)
3. **Test port for reverse clutch pack**
   13.7-15.2 bar (198-220 psi)
4. **Test port for forward clutch pack**
   13.7-15.2 bar (198-220 psi)
5. **System pressure sequencing valve**
   13.7-15.2 bar (198-220 psi)
6. **Oil flow OUT to cooler**
7. **Oil OUT to cooler, test port**
   6.5 bar (94 psi)
8. **Front Wheel Drive test point**
   13.7-15.2 bar (198-220 psi)
9. **Oil flow IN from cooler**
10. **Torque convertor pressure regulating valve**
    7-11 bar (101-159 psi)
11. **Oil in from cooler, test port**
    3.5 bar (50 psi)
12. **Backhoe Boom Lock supply**
    13.7-15.2 bar (198-220 psi)
13. **System pressure test point**
    13.7-15.2 bar (198-220 psi)
14. **Convertor pressure oil test port**
    7-11 bar (101-159 psi)
15. **Front Wheel Drive Solenoid**
    13.7-15.2 bar (198-220 psi)
16. **System Oil Filter**
17. **Reverse Solenoid valve**
    13.7-15.2 bar (198-220 psi)

TRANSMISSION POWER FLOWS (Op. 21 102)

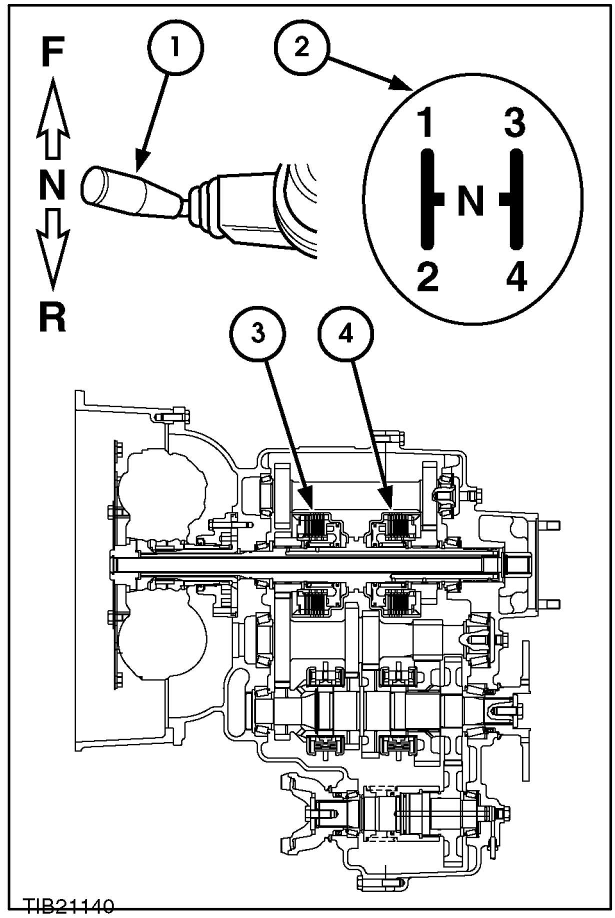
When neutral is selected on the shuttle lever (1), the transmission forward (3) and reverse hydraulic clutch packs or (4) are free to rotate and hence there is no drive in the transmission.

With Forward or Reverse selected on the shuttle lever (1) power will be directed through the clutch packs (3) or (4) to the gear train and selection of gear on lever (2) will result in engagement of gears to the output shafts.

Power for all four forward gear ratios is transmitted from the front hydraulic clutch (3) on the input shaft. The input shaft then transmits power to the countershaft forward gear and the countershaft in turn transmits power to the output shaft.

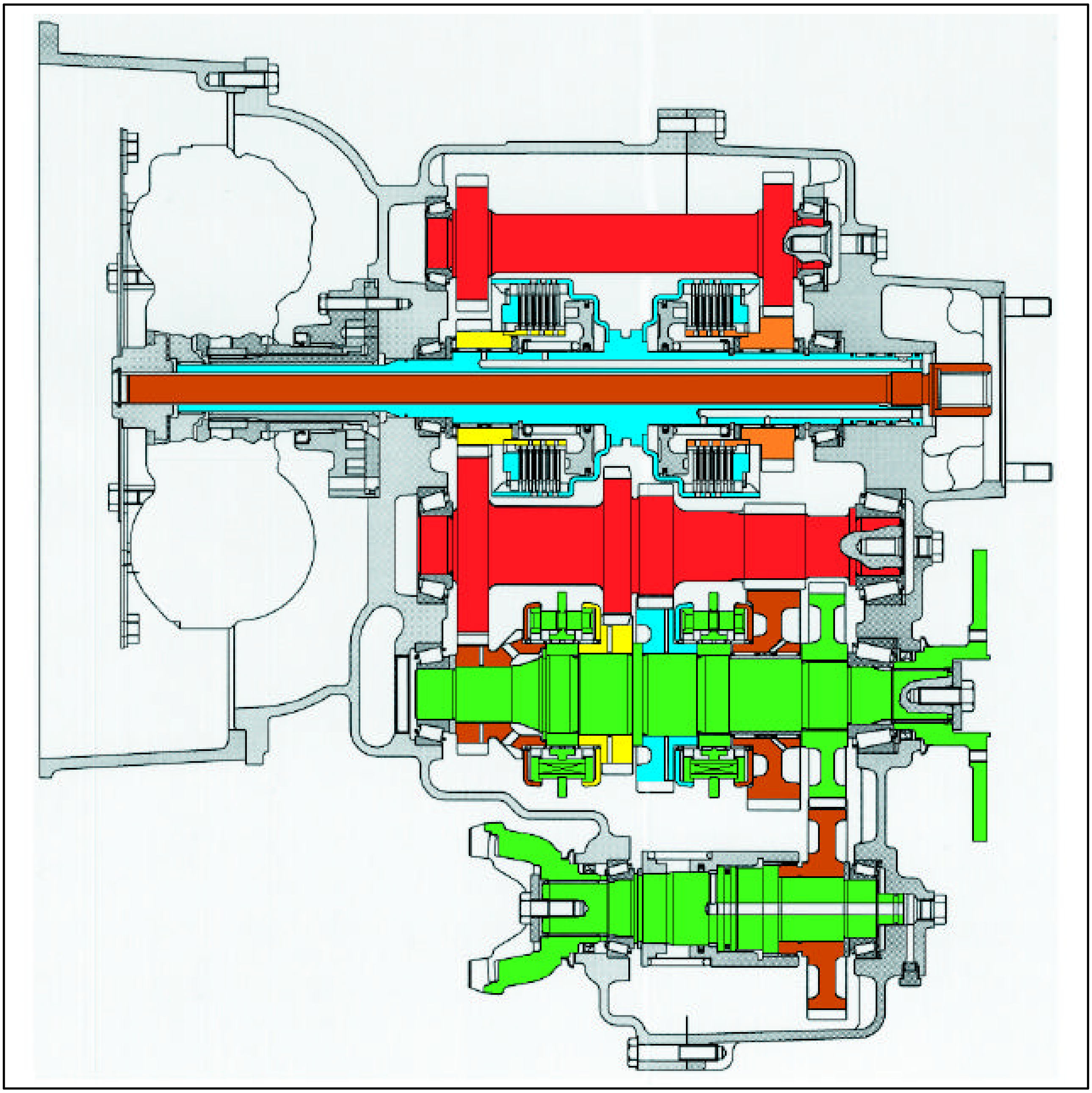
Power flow for all four reverse gear ratios is the same as for all four forward gear ratios except that the rear clutch (4) is engaged to transmit power to the reverse idler gear. The reverse idler gear in turn transmits power to the gear on the countershaft and in turn transmits power to the output shaft .

Because power is being transmitted through the reverse idler gear, the countershaft and output shaft will rotate in the opposite direction as for forward gear ratios. The rear input shaft will also rotate in the opposite direction.



27

TRANSMISSION POWER FLOW



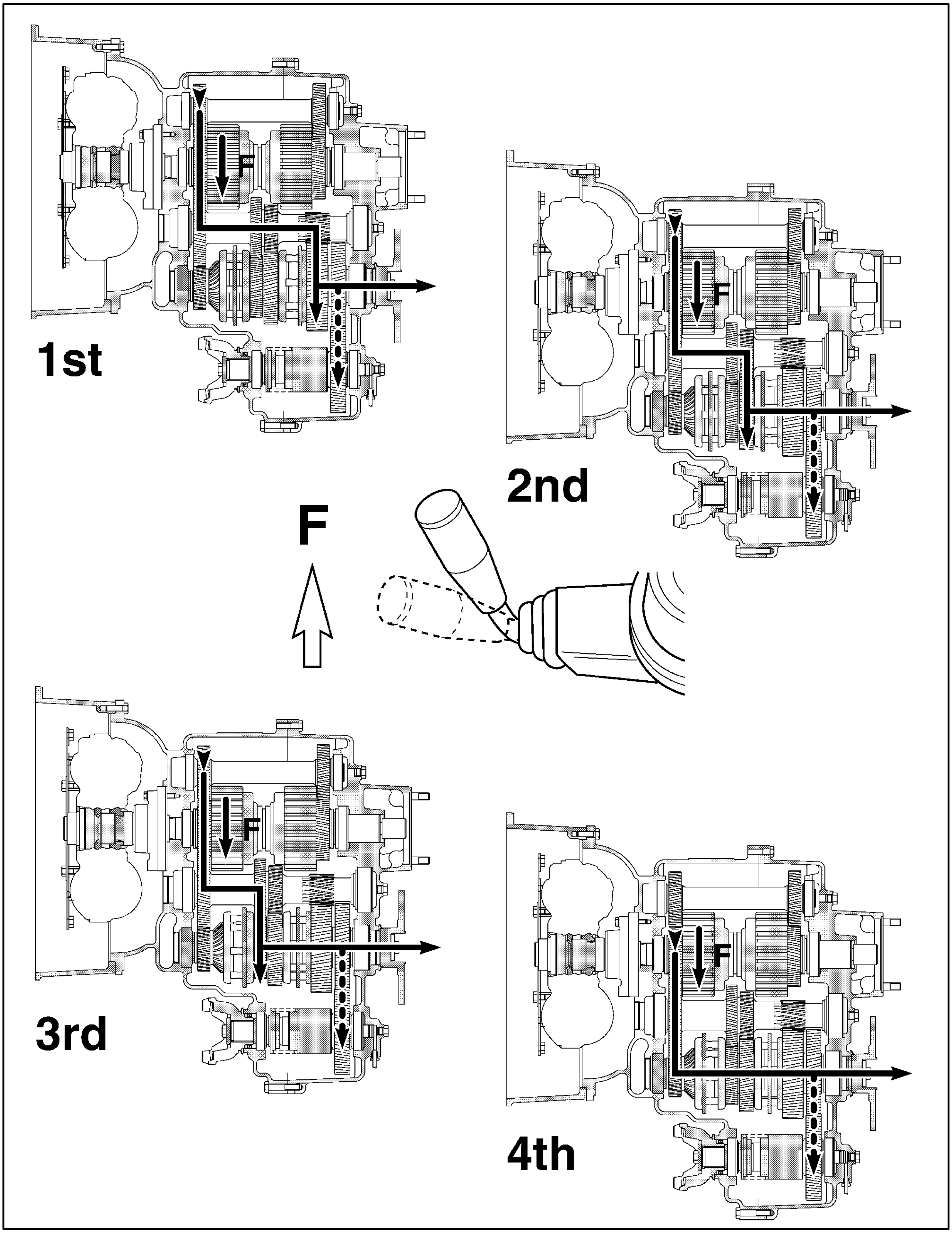
28

Input

Output

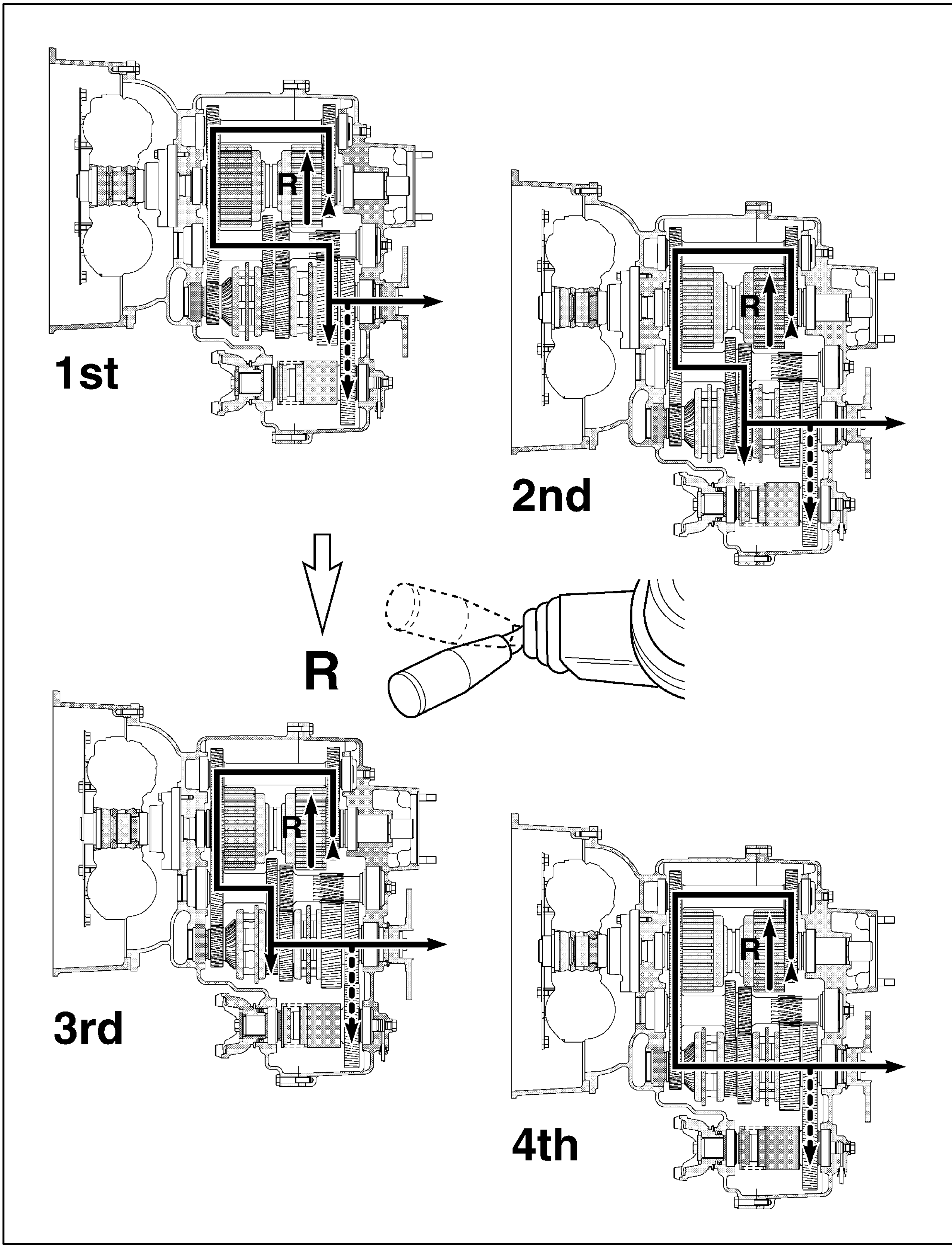
Intermediate

TRANSMISSION POWER FLOWS (FOUR WHEEL DRIVE VERSION SHOWN)



29

TRANSMISSION POWER FLOWS (FOUR WHEEL DRIVE VERSION SHOWN)



30

FAULT FINDING

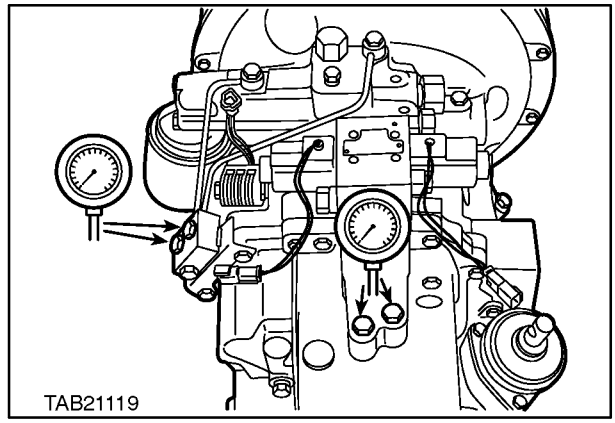
IMPORTANT: *If a malfunction of the transmission is suspected, a systematic checking procedure should be followed in order to assist in determining the problem. When effecting a repair ensure the problem is corrected to avoid repeat failures.*

The following table lists problems and their possible causes with recommended remedial action.

To assist in the diagnosis of suspected hydraulic system failures, test ports have been included in the transmission housing. The locations Shown in figure 26.

Each port accepts a 9/16in UNF ‘O’ ring connection. A gauge is required that is capable of measuring to 20 bar (290 lbs in^2).

Pressure checks are essential as a failure in the hydraulic system can be difficult to trace once the transmission is stripped down on a bench. All pressure checks should be carried out with the transmission in neutral gear, engine speed set at 2000 revs/min with oil temperature at 80–85°C (176–185°F).
The temperature can be raised by working the machine or following the stall procedure as follows



31

STALL PROCEDURE

Apply the brakes and block wheels. Place the transmission in 4th gear and select forward. With the engine running, gently increase speed to around half throttle and hold until oil temperature reaches the operating range. Do not stall for more than 30 seconds. Select neutral for 15 seconds then repeat to reach the temperature range.

Having achieved temperature, gently increase engine speed to full throttle. Record engine speed. Repeat this test in reverse. Engine speed should be:

STALL SPEED:
Power Shuttle Transmission Model 75.B (N/America only) .... xxxx revs/min
Power Shuttle Transmission Models 95.B,110.B (N/America only) .... xxxx revs/min

Power Shuttle Transmission Models 90.B, 95.B (Outside of N/America) ...... xxxx revs/min
Power Shuttle Transmission Models 110.B (Outside of N/America) .... xxxx revs/min

FAULT FINDING

PROBLEM	POSSIBLE CAUSES	CORRECTION
Low pump pressure reading	1. Low or no oil	1. Check on dipstick and top up
	2. Pump or pump seal failure	2. Remove converter housing inspection plate and check for leaks. Dismantle and replace pump or seals.
	3. Regulator valve stuck open	3. Inspect regulator cartridge
	4. Blockage at strainer or between filter and pump	4. Drain and flush the transmission, clean strainer, replace filter
	5. Damaged convertor splines	5. Repair
	6. Cold start valve stuck open	6. Remove and clean
High pump pressure reading	1. Test performed at low oil temperature	1. Retest at 80–85°C
	2. Sticking regulator valve	2. Inspect regulator cartridge
Low converter inlet pressure reading	1. Converter relief valve failure	1. Inspect converter relief valve
	2. Leak in converter, cooling or cooler hoses	2. Remove converter housing inspection plate and check for leaks. Inspect the cooler
High converter inlet pressure reading	1. Relief valve sticking	1. Inspect converter relief valve
	2. Low Oil Temperature	2. Raise Temperature
Low or no clutch pressure reading – Forward or Reverse	1. Wiring fault	1. Check voltage at directional valve. Check that the resistance across each coil is close to 5.0 ohms
	2. Sticking directional valve	2. Inspect directional valve
	3. Leakage at input shaft or clutch piston seals	3. Dismantle and examine
Low or no FWD pressure reading	1. Wiring fault	1. Check voltage at FWD valve. Check that the resistance across each coil is close to 7.0 ohms
	2. Sticking FWD valve	2. Inspect FWD valve
	3. Damage to FWD supply tube	3. Inspect tube for corrosion or restrictions
	4. Leakage at FWD shaft or clutch piston seals	4. Dismantle and examine

FAULT FINDING

PROBLEM	POSSIBLE CAUSES	CORRECTION
High oil temperature (frequent warnings from temperature light)	1. Restrictions in cooler	1. Back flush cooler and clean hoses
	2. Binding foot or parking brake	2. Inspect and adjust brakes
	3. Excessive stall operation	3. Change work cycles to avoid stall for more than 30 seconds
	4. Worn or slipping clutch plates	4. Dismantle and replace
	5. Worn transmission bearings	5. Dismantle and replace
	6. Temperature sensor	6. Check
	7. Oil cooler air flow restricted	7. Clean
Stall test inconclusive	1. Low stall speed	Hydraulic clutch not releasing. Stator support broken. Defective torque converter. Low engine power.
	2. High stall speed	Hydraulic clutch not applying or is slipping. Low line pressure. Sealing rings on rear input shaft broken. Defective torque converter.

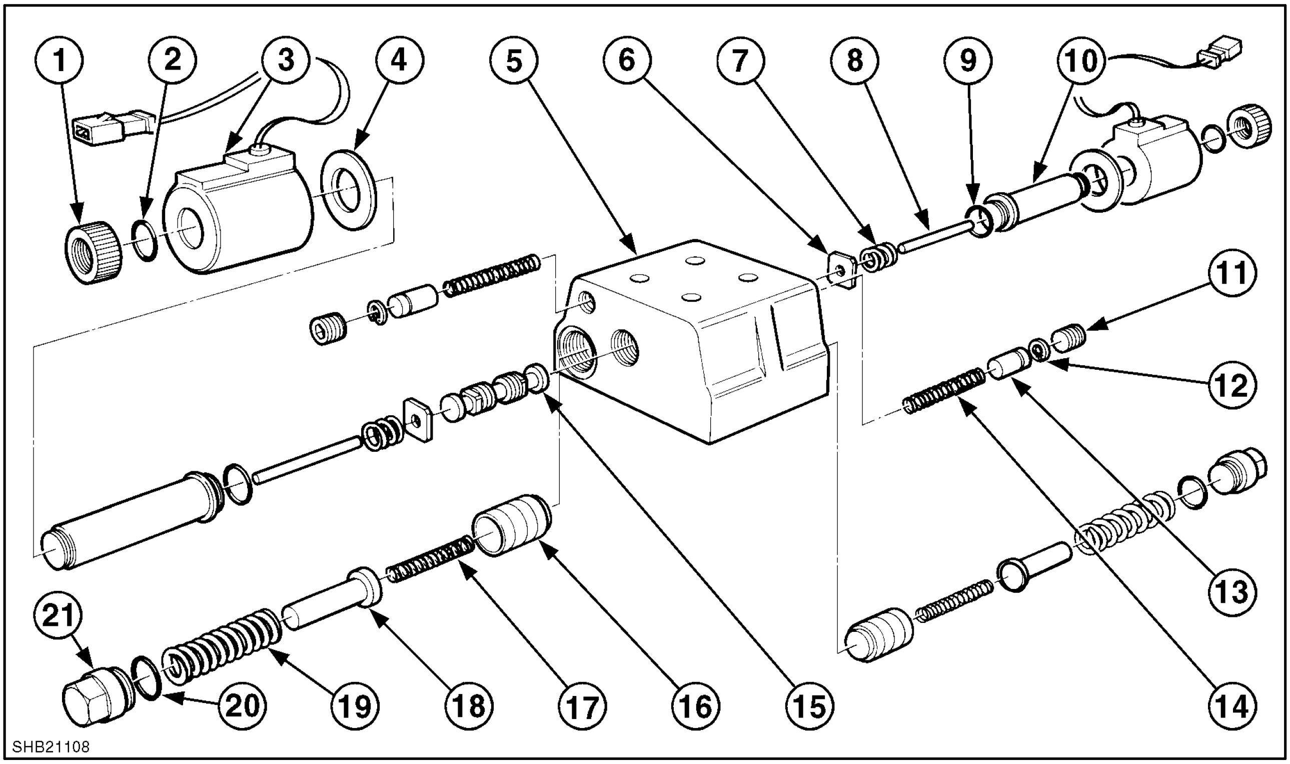
FAULT FINDING – MECHANICAL SYSTEM CHECKS

PROBLEM	POSSIBLE CAUSES	CORRECTION
Noise in neutral	1. Worn or damaged primary or reverse idler gears	1. Dismantle and renew
	2. Worn bearings	2. Dismantle and renew
Noise in gear	1. Worn or damaged countershaft or drive gears	1. Dismantle and renew
	2. Worn bearings	2. Dismantle and renew
Noise in FWD	1. Worn or damaged FWD clutch plates gears or bearings	1. Dismantle and renew
	2. Worn bearings	2. Dismantle and renew

FAULT FINDING

PROBLEM	POSSIBLE CAUSES	CORRECTION
Gear selection – Hard shifting	1. Worn or bent shift rods	1. Dismantle and renew
	2. Worn or chipped dog teeth on drive gears	2. Dismantle and renew
	3. Worn synchronizer cones or cups	3. Dismantle and renew
	4. Broken or missing detent spring or ball	4. Dismantle and renew
	5. Residual clutch pressure (clutch supply fault)	5. Dismantle and renew
	6. Corrosion at stud lever (boot damaged)	6. Dismantle and renew
	7. Clutch plates distorted	7.Replace
Gear jump out	1. Worn detent notches on shift rail	1. Dismantle and renew
	2. Worn or broken synchronizer cones or cups	2. Dismantle and renew
	3. Worn or loose shift forks	3. Dismantle and renew
Main vehicle pump no power	1. Main pump Failure	1. Dismantle and renew
	2. Fractured transmission drive rod	2. Dismantle and renew
	3. Failed splines on converter, drive rod or pump	3. Dismantle and renew
Erratic or noisy response from main pump	1. Main pump Failure	1. Dismantle and renew
	2. Out of balance transmission drive rod	2. Dismantle and renew
	3. Worn drive rod support bush	3. Dismantle and renew

FORWARD / REVERSE CONTROL SOLENOID VALVE (OP. 21 136)



32

Shuttle Valve Disassembled

1. Solenoid Retainer
2. Dirt Seal
3. Solenoid
4. Washer
5. Solenoid Body
6. Guide
7. Spring
8. Solenoid Pin
9. Seal
10. Support Body Solenoid
11. End Cap *
12. Circlip *
13. Clutch fill metering valve *
14. Spring *
15. Spool
16. Piston Clutch fill
17. Spring
18. Retainer
19. Spring
20. Seal
21. End Plug

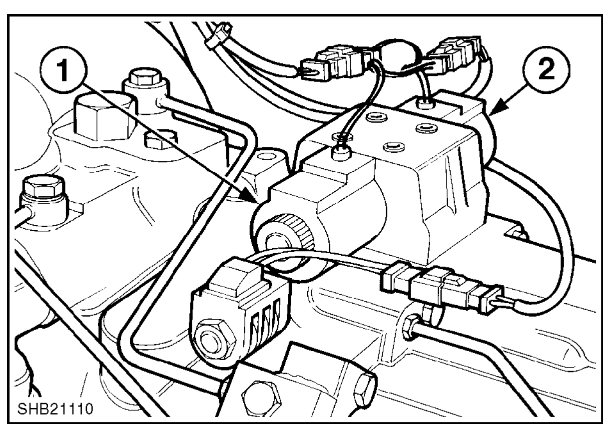
NOTE: **These items are not serviceable other than for cleaning*

SOLENOID VALVE – DISASSEMBLY

Mounted on the top of the transmission is the shuttle solenoid valve of which is controlled by the forward (2) and reverse (1) solenoids. Remove the 4 attaching bolts and remove from the transmission.

Removal of the retaining ring and 'O' ring on the end of each of the coil blocks allows removal of the coils from the solenoid assembly.

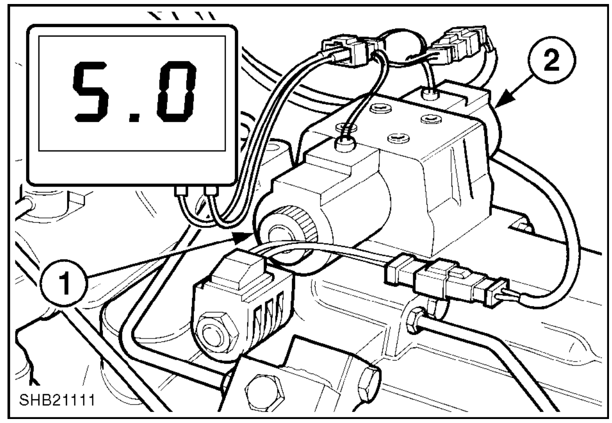
Anti clockwise rotation of the solenoid sleeve disassembles the sleeve from the body and allows removal of the plungers, springs, spool supports and spool. Clean and inspect parts for wear or scoring on the friction areas, replace if in doubt. Fit new 'O' rings before re–assembly.



33

RESISTANCE CHECKING OF COILS

Condition of the coils (1) and (2) can be checked by the resistance of the coil field measured at the connector which in good condition should read 5 ohms. If the reading is zero then a short circuit in the coil has occurred and a new one will be required.



34

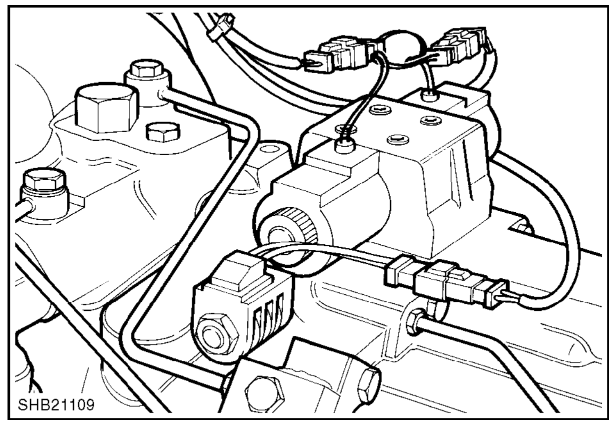
Re-assembly

Before re-assembly ensure the valve body is clean and new ‘O’ rings are placed on the transmission mounting face. Re-assemble in reverse order but observe the following:

The Coils must align with the pins on the body before tightening the coil retaining rings, ensure the ‘O’ rings are fitted.

Assembly of the valve onto the transmission must align with the locating pin to ensure correct alignment of oil feed ports and correct forward / reverse shuttle operation.

Re-assemble the attaching bolts and torque to 20-27 Nm (15-20 lbf ft)



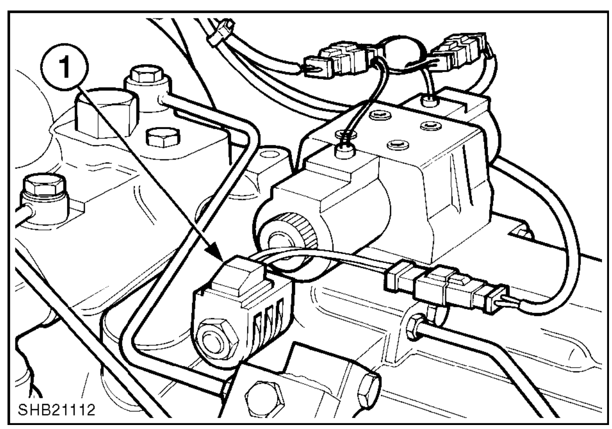
35

FOUR WHEEL DRIVE SOLENOID VALVE (OP. 21 136) DISASSEMBLY

Mounted to the left of the transmission is the FWD solenoid valve (1). Remove the attaching bolt and withdraw from the transmission.

The solenoid when removed consists of a coil surrounding a spring and plunger

Condition of the coil can be checked by the resistance of the coil field measured at the connector which in good condition should read 7 ohms. If the reading is zero then a short circuit in the coil has occurred and a new one will be required.

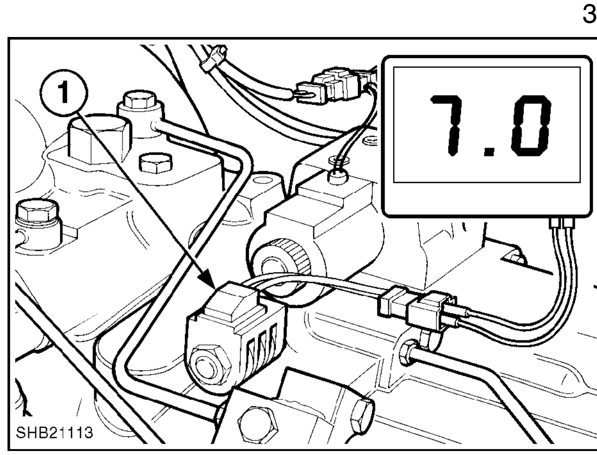


36

Prior to re-assembly ensure all parts are clean and checked for free movement

Re-assembly

Replace the spring then the spool valve and secure the solenoid to a torque of 34-54Nm (25-40 lbf ft)

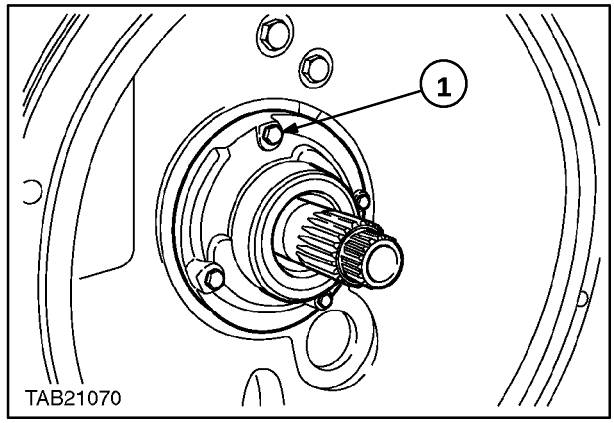


37

OIL PUMP DISASSEMBLY (Op. 21 102)

NOTE: *The oil pump can only be removed when the transmission is separated from the engine. Disassembly of the oil pump is not generally recommended since individual components are matched and are non serviceable. However it may be dismantled for cleaning purposes.*

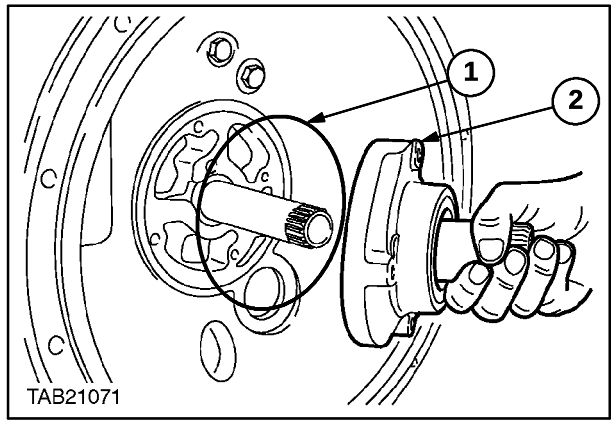
1. Place the transmission in an horizontal position and remove the 4 attaching bolts (1) from the oil pump body.



38

2. The 'O' ring (1) behind the pump body must be replaced with new before re–assembly of the pump.

3. Carefully separate the oil pump components and clean, inspect the components for wear. If in any doubt replace the pump.

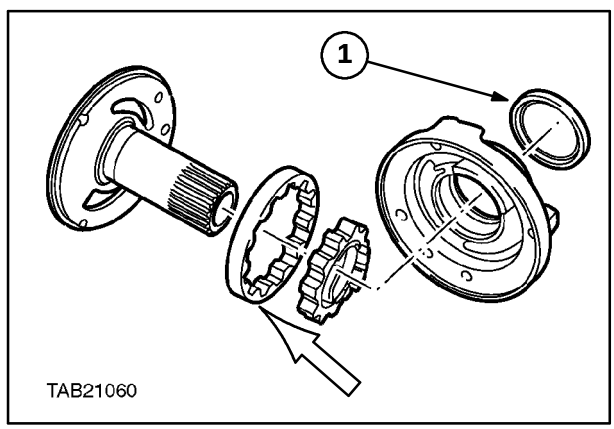


39

IMPORTANT: *A worn oil pump will reduce the efficiency of the transmission and the machine if not corrected.*

4. A single lipped seal (1) is incorporated in the front oil pump housing and should be changed when ever a complete teardown has taken place. Push out the old seal and replace with new, grease outer seal and push in ensuring it is fully seated into the housing.

Re–assemble the pump in reverse order, fit new seals and copper washers under the bolt heads and torque the retaining bolts to 20–27 Nm (15–20 lbf ft)

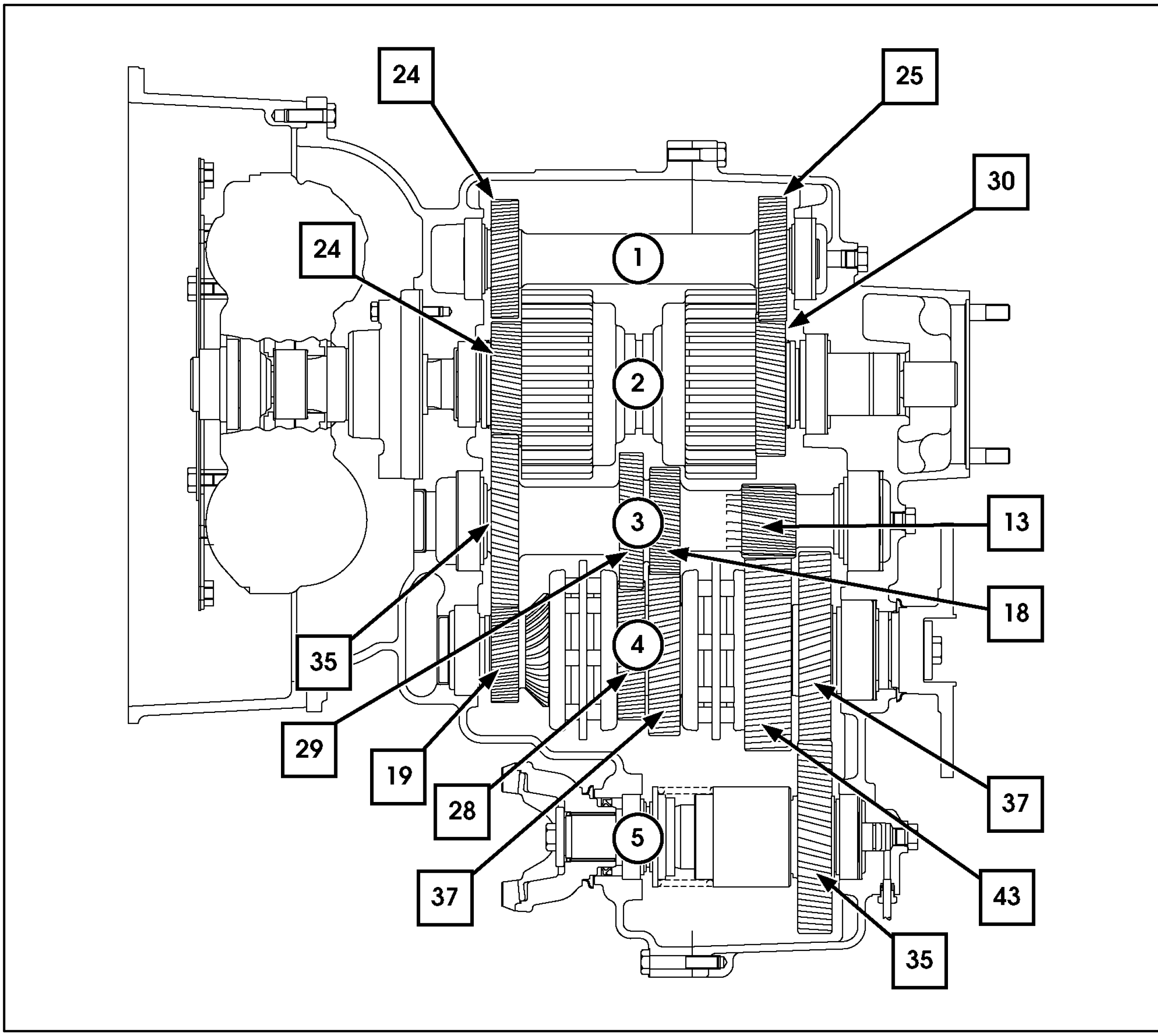


40

IMPORTANT: *Ensure the pump outer ring face with chamfer enters the pump body first.*

TRANSMISSION OVERVIEW

IMPORTANT: *Before commencing any dismantling procedure it is essential to thoroughly clean the transmission and work area.*



41

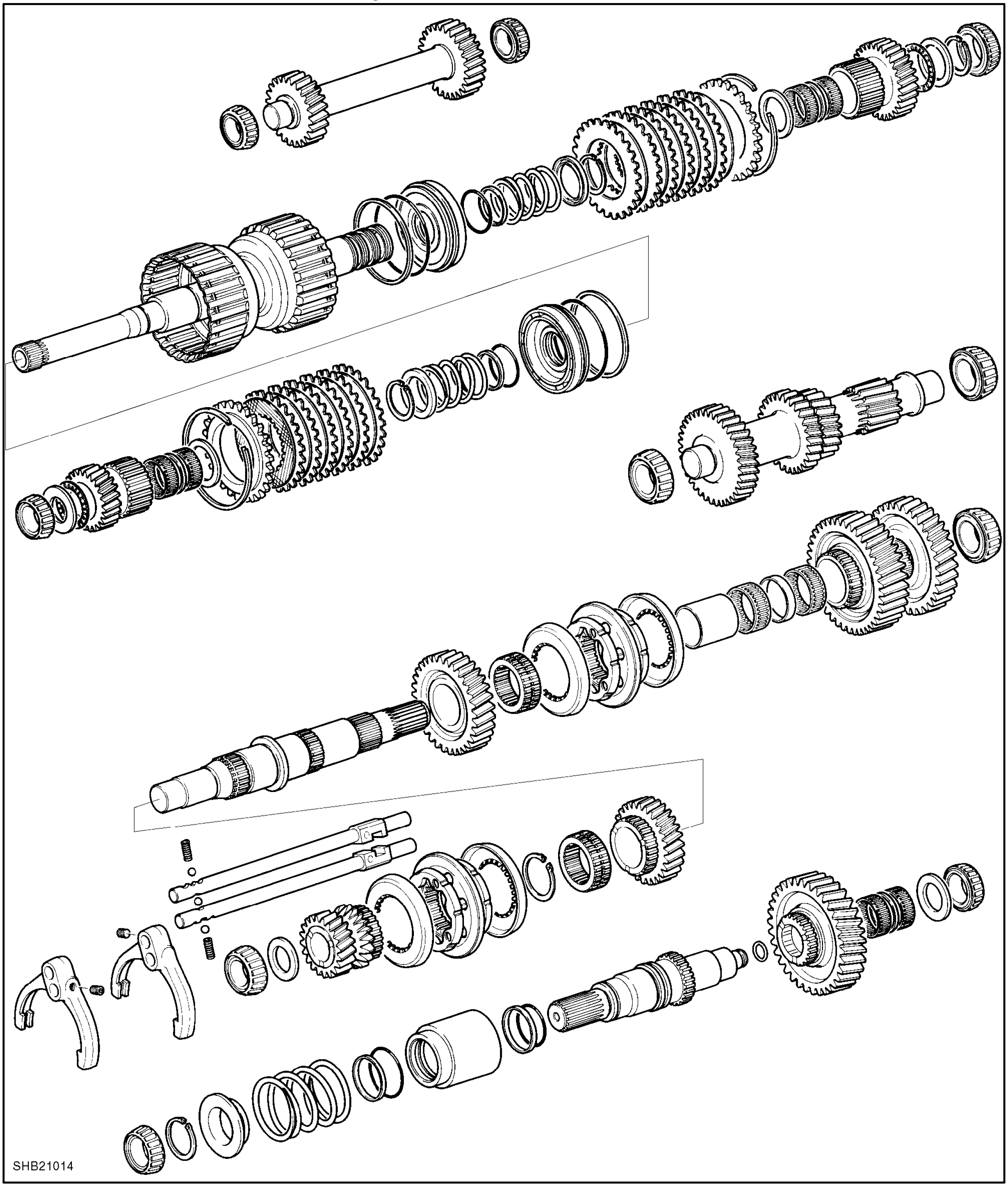
4X4 POWER SHUTTLE (FWD VERSION SHOWN)

1. REVERSE IDLER SHAFT - Gear Teeth = 24 and 25
2. INPUT OR PRIMARY SHAFT - Gear Teeth = 24 and 30
3. COUNTER SHAFT - Gear Teeth = 35 29 18 and 13
4. OUTPUT SHAFT - Gear Teeth = 19 - 4th ratio, 28 - 3rd ratio, 37 - 2nd ratio, 43 - 1st ratio and 37 FWD output
5. FOUR WHEEL DRIVE - Gear Teeth = 35

☐ Number of Gear Teeth

TRANSMISSION OVERHAUL

IMPORTANT: *Before commencing any dismantling procedure it is essential to thoroughly clean the transmission and work area. If new clutch friction discs are to be installed it will be necessary to soak the discs in clean new oil for a minimum of 3 hours before fitting.*



42

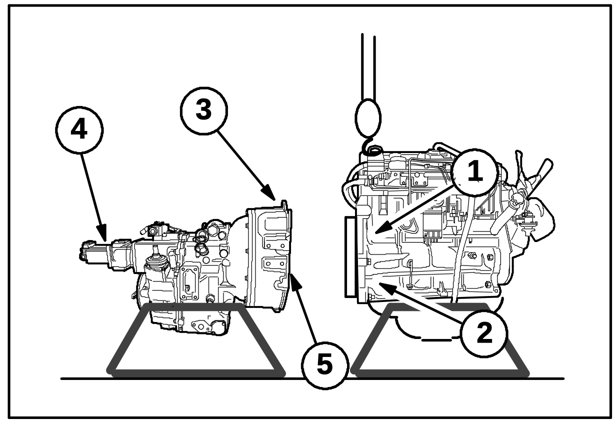
4x4 Power Shuttle

Remove the transmission and engine as a complete unit from the vehicle and place on a suitable stand for disassembly.

NOTE: *Prior to disassembly drain the oils into suitable containers for disposal.*

Prior to separating the transmission from the engine

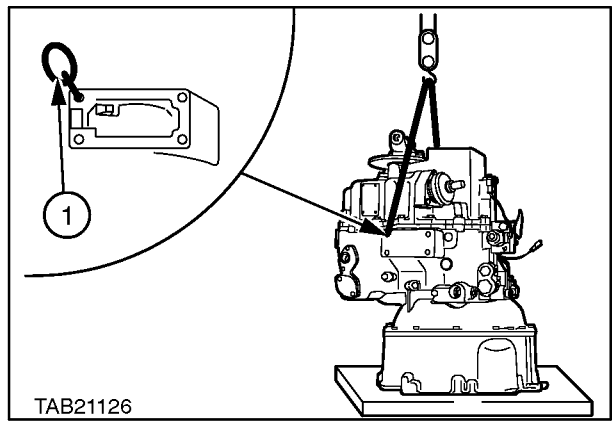
Remove the starter motor (1)
Engine timing tab (2)
Torque convertor backplate attaching bolts through the starter motor aperture (1)
Bell housing attachment bolts (3)



43

IMPORTANT: *Prior to positioning the transmission vertically remove the vehicle system oil pump (4) and torque converter unit (5) from the transmission bell housing*

Using eye bolts (1), 1 per side capable of lifting a weight of 250 kgs (550 lbs) hoist the transmission vertically and place in a safe, clean and suitable workshop environment.



44

NOTE: *To aid disassembly use the hand brake to lock the shafts, to enable both the FWD coupling and the disc bolts to be removed.*

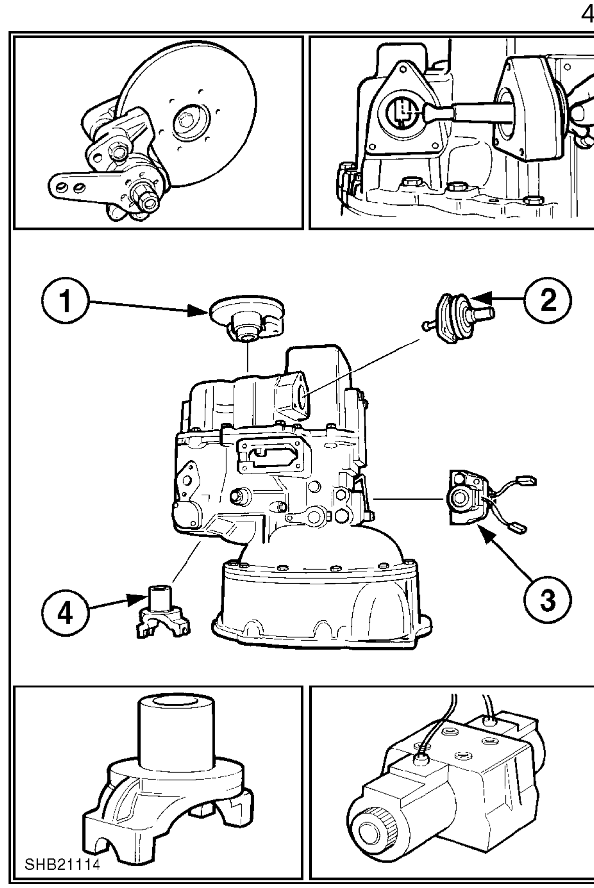
Loosen and remove the Four Wheel Drive coupling where fitted (4).

Remove the transmission handbrake, loosen and withdraw the output coupling and disc (1).

Remove the gear shift attaching bolts and withdraw the gear lever (2).

Loosen and remove the control valve and oil filter assembly, gaskets and adapters (3) if required.

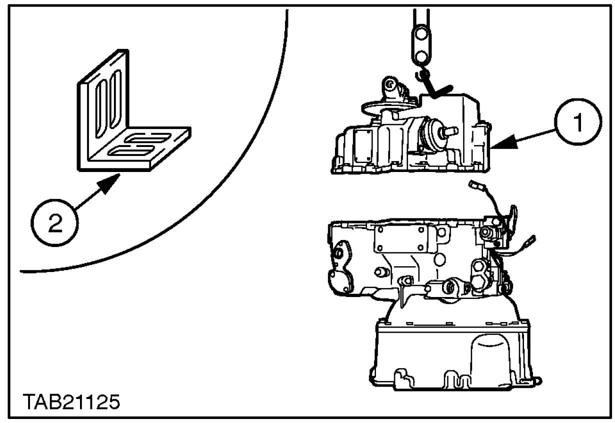
Remove all pipes and connectors that may be easily damaged or interfere with the disassembly.



45

Remove the rear cover bolts (1) and using a right angled bracket (2) attached to the center boss on the cover, lift the cover clear of the transmission.

CAUTION: *The bearing cup and cones may become dislodged when the rear cover is removed from the transmission. Ensure the the rear cover is shimmed correctly upon re-assembly.*

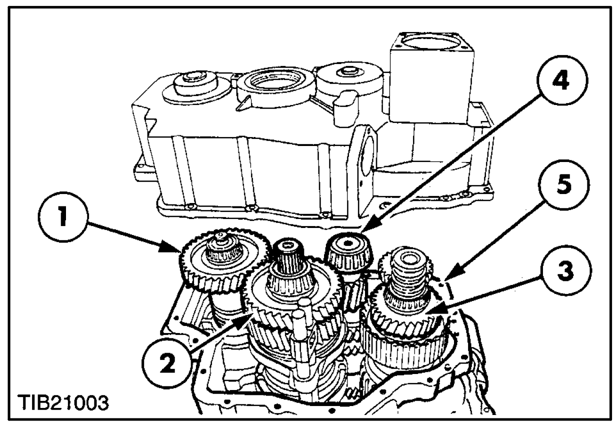


46

GEAR TRAIN REMOVAL

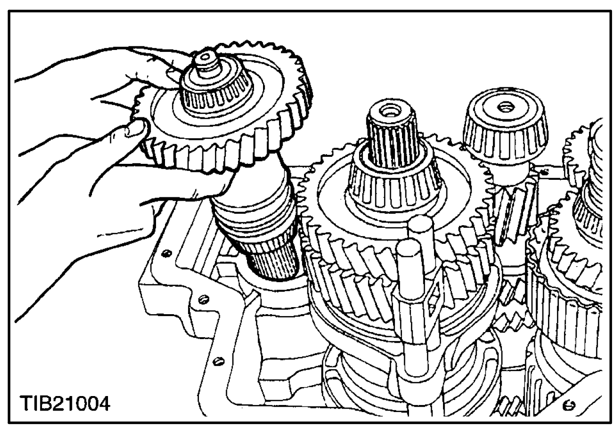
Disassemble the gear train in the following order:

1. Four Wheel Drive Shaft (Where fitted)
2. Output Shaft
3. Input Shaft
4. Counter Shaft
5. Reverse Idler Shaft



47

1. Lift out the FWD shaft assembly where fitted.



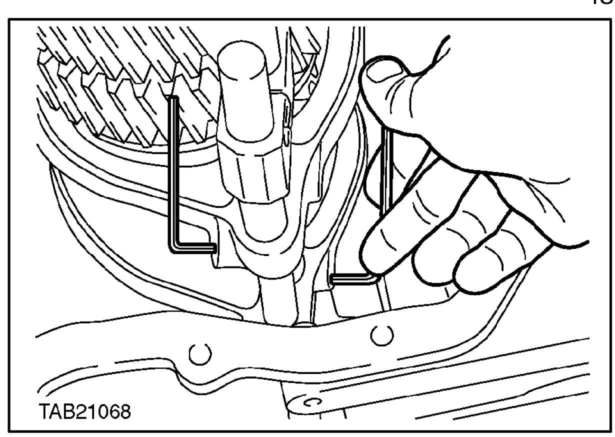
48

2. Remove the gear shift detent retaining bolt and remove the outer spring and ball, replace bolt before remove rails.

NOTE: *The inner rail detent balls and springs will no longer be captive in position when the rails are removed and may fly out with some force.*

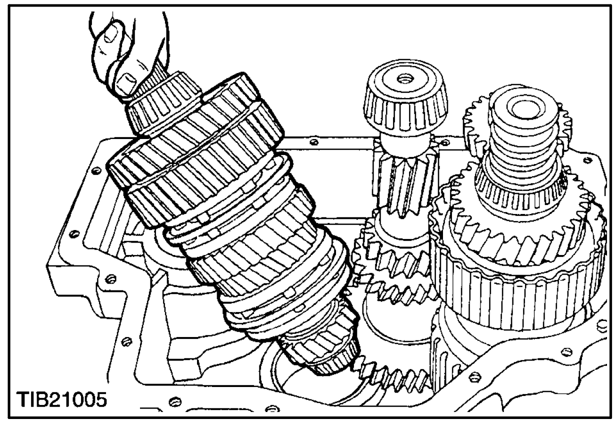
3. Using a right angled hexagonal key loosen the selector forks on the rail. Angle the output shaft and lift out the gear selector forks and rails.

Place all of the springs and balls to one side.



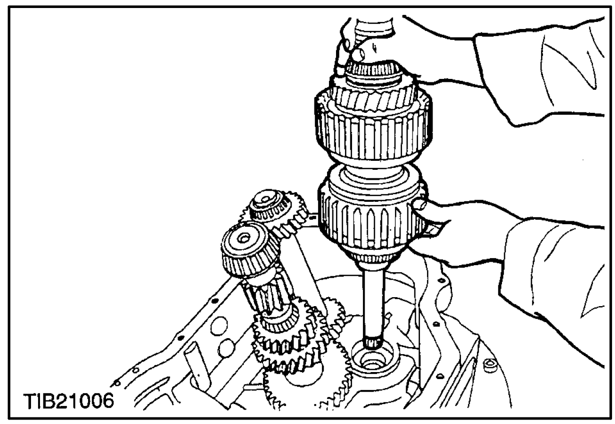
49

4. With the shift rails removed lift out the output shaft and place on a clean bench for inspection



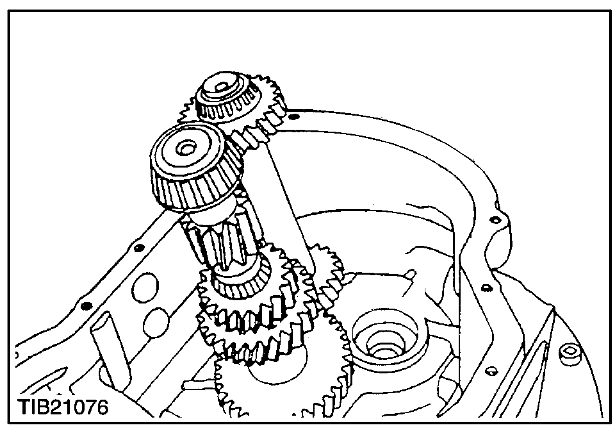
50

5. With the counter shaft and reverse idler shaft held to one side remove the input shaft and place on a bench for inspection.



51

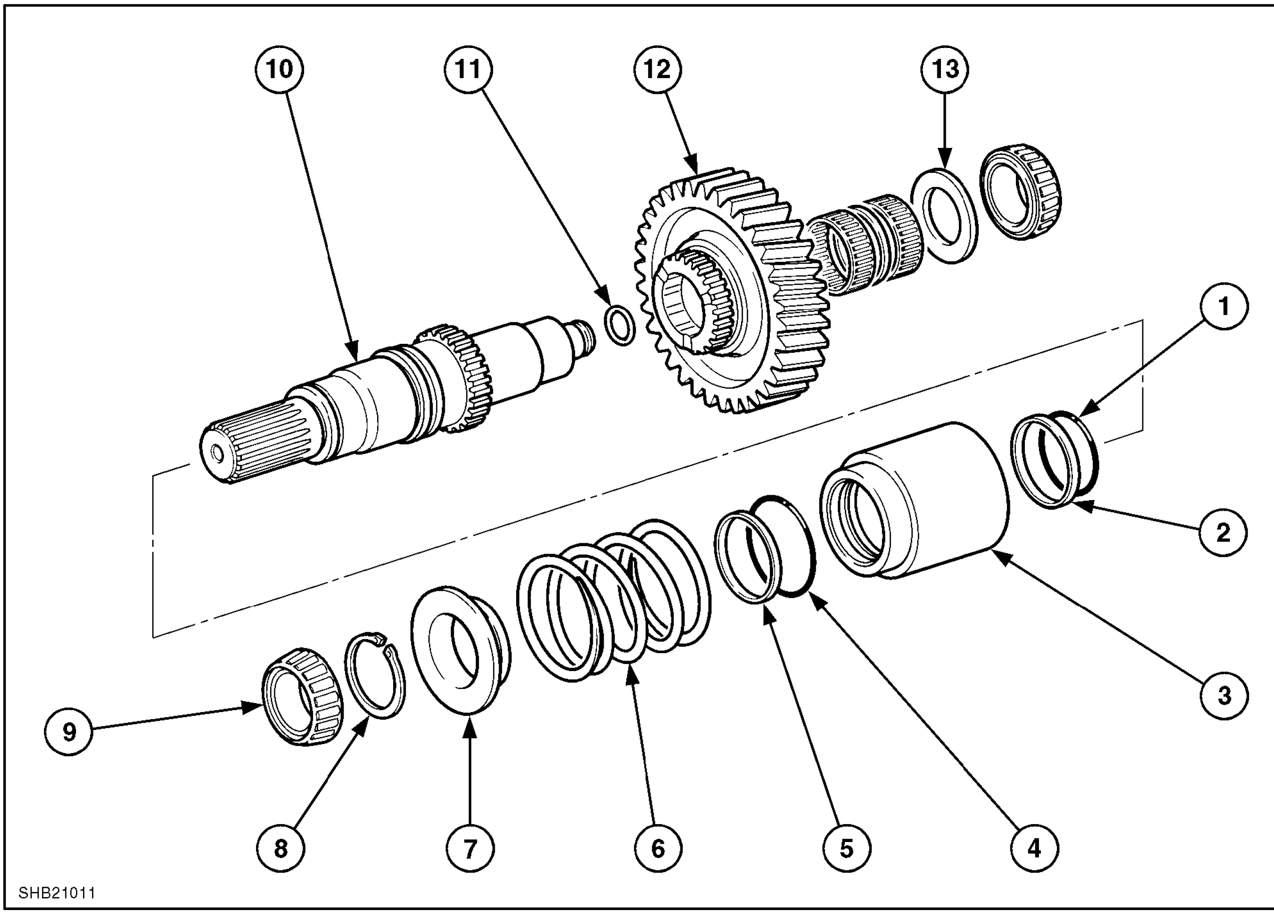
6. Remove the counter shaft and reverse idler shaft and place on a bench for inspection



52

Before attempting any disassembly of the gear train ensure all the components are clean and inspect for signs of wear, scoring, or chipping of the gear teeth or wear on related components.

FOUR WHEEL DRIVE OUTPUT SHAFT – DISASSEMBLY



53

Four Wheel Drive Output Shaft

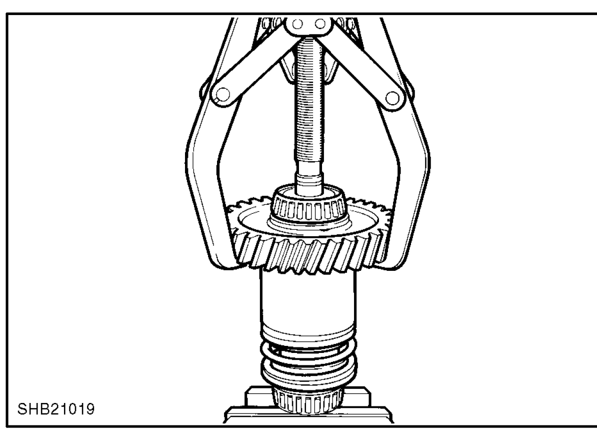
1. 'O' ring
2. Sealing Ring
3. Piston Body
4. 'O' ring
5. Sealing Ring
6. Spring
7. End Plate
8. Circlip
9. Bearing 2x places
10. 4WD Shaft
11. 'O' ring
12. Output Gear
13. Thrust Washer

FWD DRIVE SHAFT DISASSEMBLY

IMPORTANT: *When using a bearing puller be very careful to ensure it does not touch the tip of the gear teeth as they may become chipped or broken.*

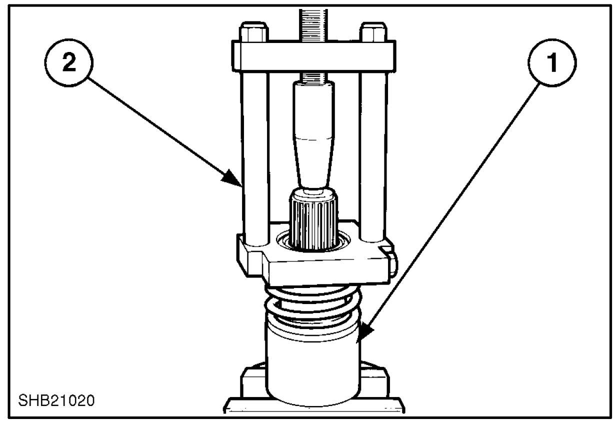
1. Remove the old seal from the gear end of the FWD shaft and place the shaft vertically (hold in a soft jaw vice). Using a three legged puller under the face of the gear and pull the gear and bearing carefully from the shaft.

Inspect the shaft for scoring or wear patterns that may be evident and check the gear thrust washer and bearing.



54

2. Invert the shaft and place vertically (hold in a soft jaw vice) with the splined shaft uppermost. Using a bearing puller (2) positioned under the rear face of the bearing withdraw the bearing from the shaft (1).



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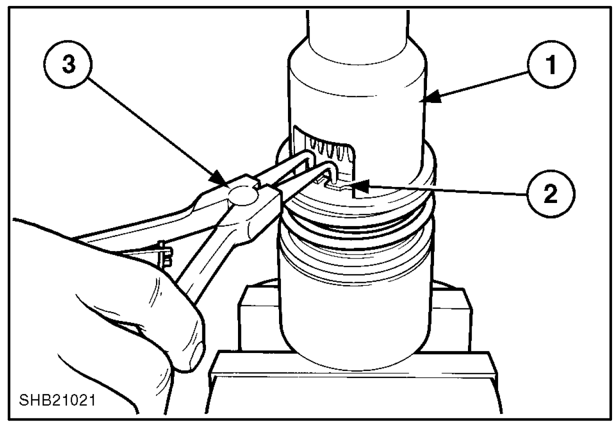
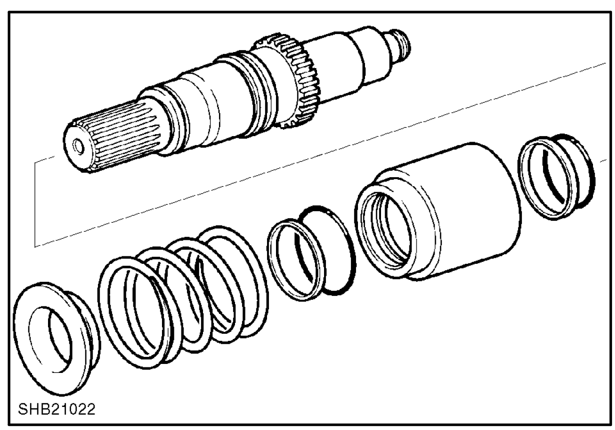
3. Compress the clutch spring (1) sufficiently to allow the release of the retaining circlip (2). Using circlip pliers (3) remove the circlip and carefully release the spring tension.



56

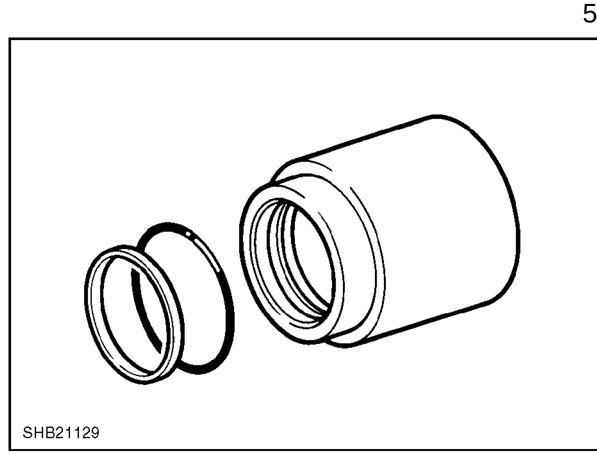
4. Disassemble the washer, spring, drive clutch and seals from the shaft and inspect for damage, scoring or wear marks that may be apparent, replace suspect parts as necessary.



57

PISTON SEALS

5. With the piston completely disassembled discard the old ‘O’ ring and sealing ring and replace with new. Place the new ‘O’ ring and seal in position into the piston.

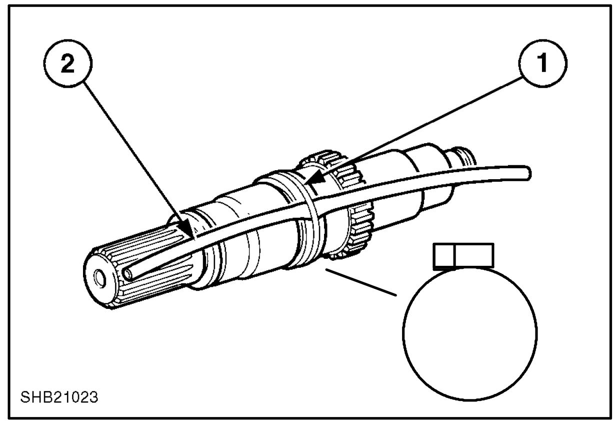


58

RE–ASSEMBLY OF SHAFT

IMPORTANT: *Where new parts are fitted ensure a coating of new transmission oil is liberally applied to all mating surfaces before re–assembly.*

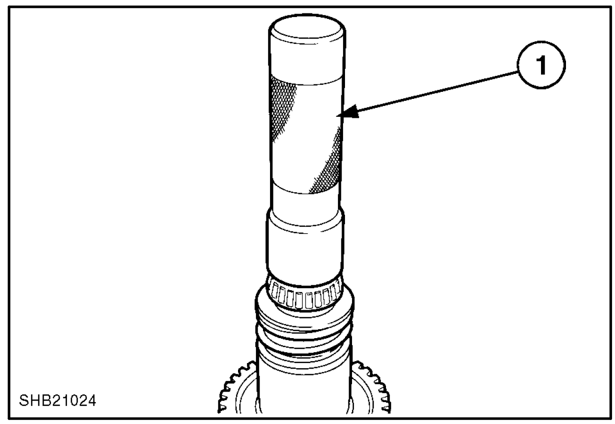
1. Prior to re–assembly ensure a new clutch seal is fitted onto the shaft. Place the seal (1) in warm water prior to fitting, when pliable carefully seat the seal in the groove on one side of the shaft and pull the seal onto the shaft around the circumference. Use a pliable PVC tube (2) or similar material that will not damage the seal.



59

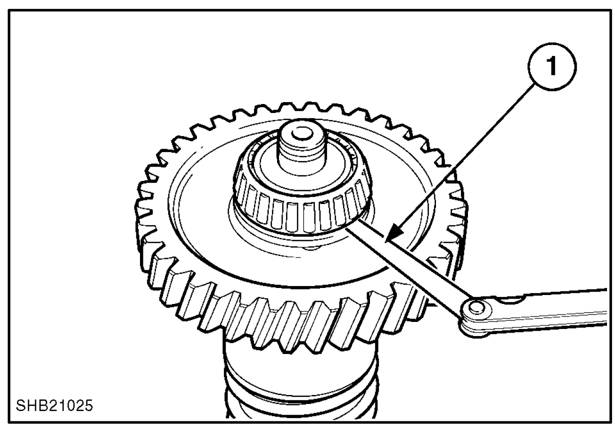
To size the seal in position place a band of tape over the seal, a jubilee clip can then be placed over the tape to compress the seal fully into the groove prior to fitting the FWD piston.

2. Re–assemble the clutch housing along with spring, washer and apply pressure as in, Figure 15, and refit the circlip. Using a 40mm bearing tool (1) refit the bearing onto the shaft.



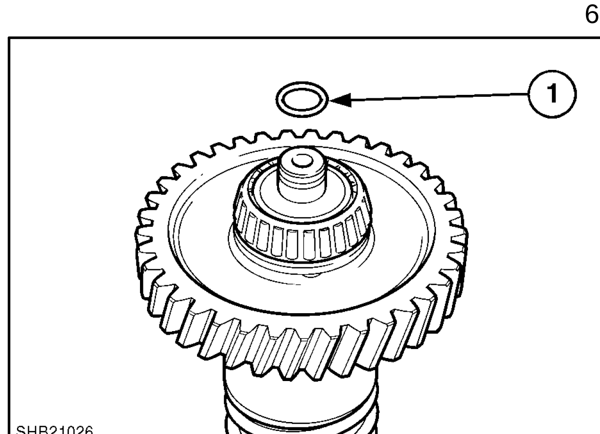
60

3. Ensure when the bearing is seated an end float of gear to washer 0.05–0.28mm (0.002– 0.011 in) is maintained between the thrust washer and gear (1).



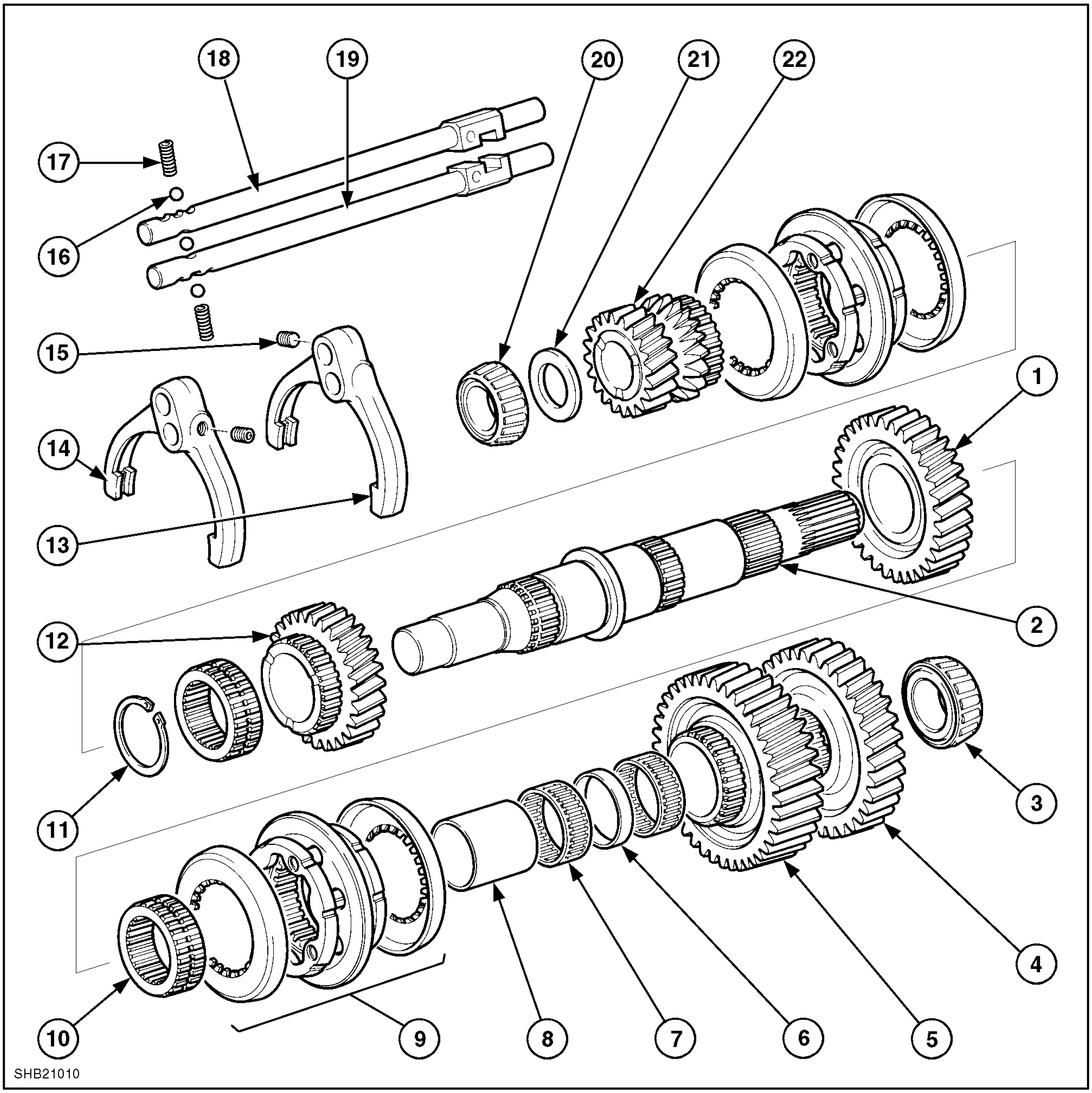
61

4. Fit a new oil seal (1) to the end of the shaft, gear end.



62

OUTPUT SHAFT – DISASSEMBLY



63

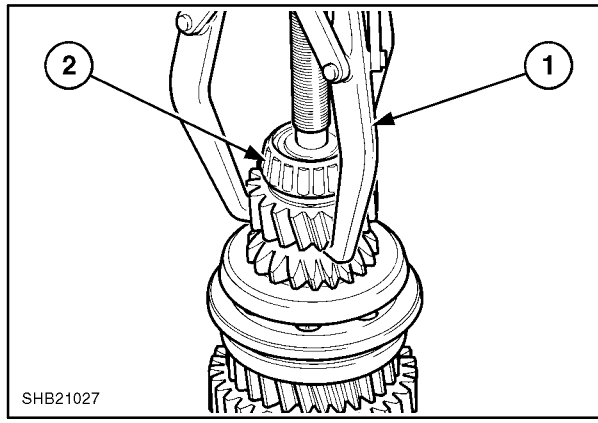
Output Shaft

1. 2nd GEAR
2. Ouput Shaft
3. Bearing
4. Out put Gear to 4WD Shaft
5. 1st GEAR
6. Spacer
7. Bearing 2 places
8. Sleeve
9. Bulk Pin Synchronizer 2 places
10. Synchronizer Hub 2 places
11. Circlip
12. 3rd GEAR
13. Gear Selection Fork 'Lower'
14. Gear Selection Fork 'Upper'
15. Fork Locking Allen Key
16. Detent Ball
17. Detent Spring
18. Gear Selection Rail
19. Gear Selection Rail
20. Bearing
21. Thrust Washer
22. 4th GEAR

OUTPUT SHAFT DISASSEMBLY (FRONT SUPPORT END)

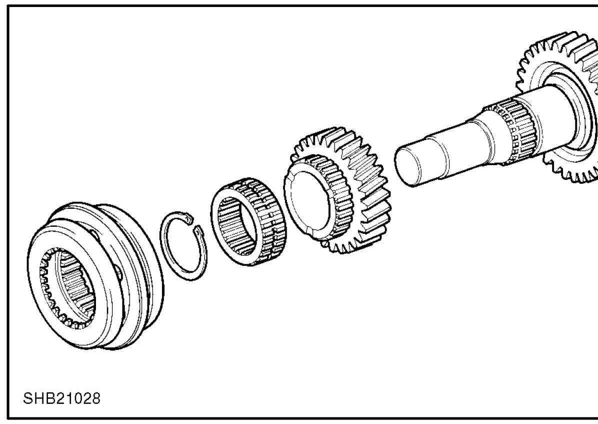
IMPORTANT: *When using a bearing puller be very careful to ensure it does not touch the tip of the gear teeth as they may become chipped or broken.*

1. Place the shaft vertically and (hold in a soft jaw vice). Using a three legged puller (1) under the face of the front gear and pull the gear and bearing carefully from the shaft.



64

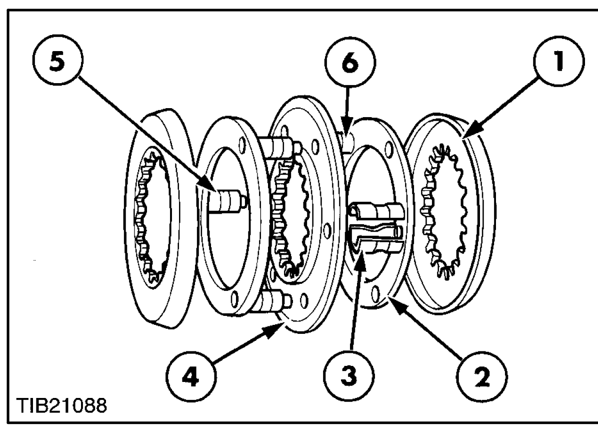
2. With the bearing, washer and 4th gear removed, withdraw the baulk ring synchroniser, circlip, hub sleeve and 3rd gear. Inspect all parts for scoring wear marks and discolouration, replace suspect parts as necessary.
3. The baulk pin synchronizer assembly can be disassembled for inspection for wear patterns or scoring and for cracking of the outer cones, if in any doubt replace with 'new'.



65

The baulk pin synchroniser assembly consists of a sliding clutch mounted on and splined to the appropriate transmission shaft, with a friction synchronising inner cone located on each side. The inner cones are mounted on three locking pins which pass through holes on the sliding clutch.

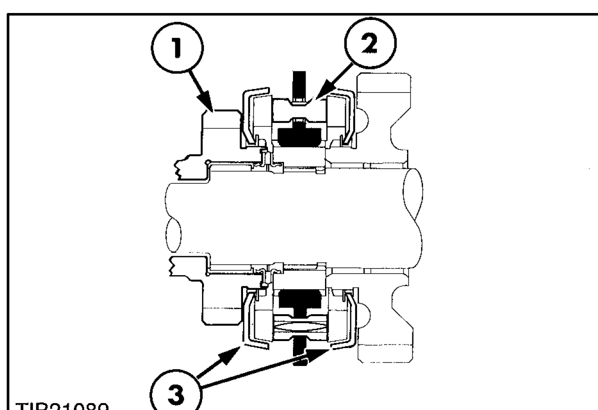
1. Outer Cone
2. Inner Friction Cone
3. Baulk Pin Assembly
4. Sliding Clutch
5. Locking Pin
6. Baulk Pin



66

The baulk pin synchroniser ensures the shaft speed and the gear speed is equal before allowing the sliding coupling to positively engage the shaft to the gear.

1. Gear
2. Locking Pins
3. Outer Cone

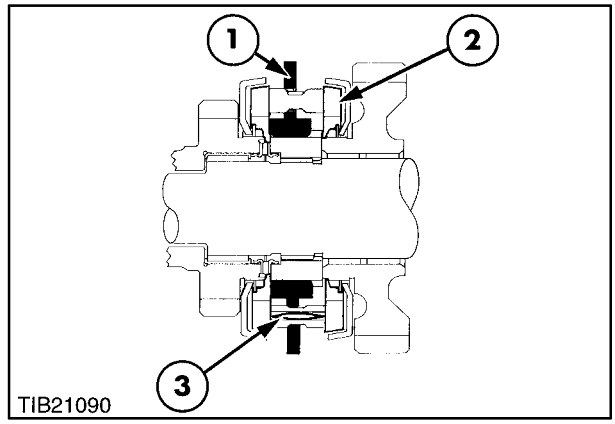


67

As the sliding clutch moves, the inner friction cone comes into contact with the outer cone allowing the shaft speed and gear speed to become equal.

The three locking pins prevent the sliding clutch from positively engaging the shaft to the gear. This is achieved by the notches around the locking pins contacting the edges of the three holes in the sliding clutch.

1. **Sliding Clutch**
2. **Inner Friction Cone**
3. **Leaf Springs**

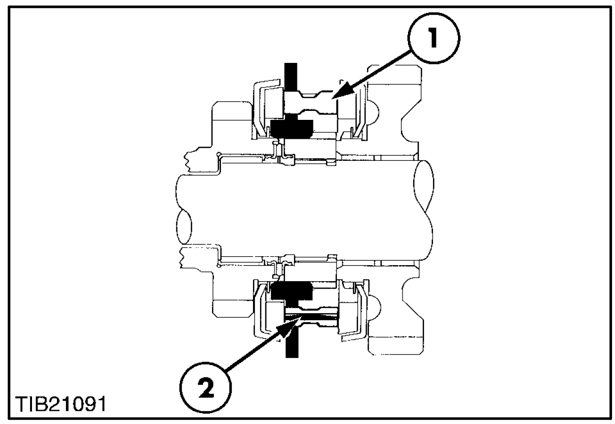


68

When the gear and shaft speeds are equal the locking pins become free and move to the centre of the holes in the sliding clutch allowing the sliding clutch to move connecting the shaft to the gear selected.

The three split sleeves are expanded by the inner leaf springs, positively locking the sliding clutch into position.

1. **Locking Pin**
2. **Leaf Spring**

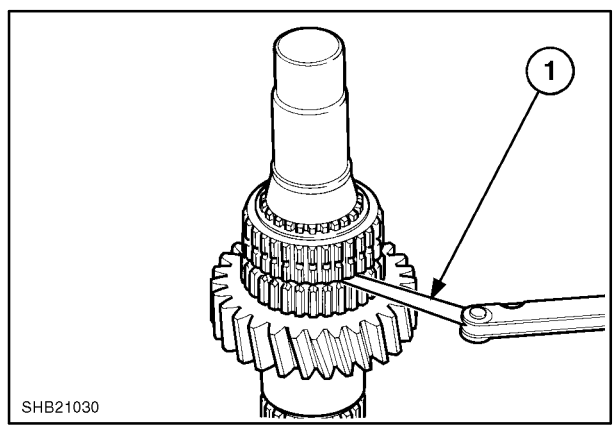


69

OUTPUT SHAFT RE-ASSEMBLY (FRONT SUPPORT END)

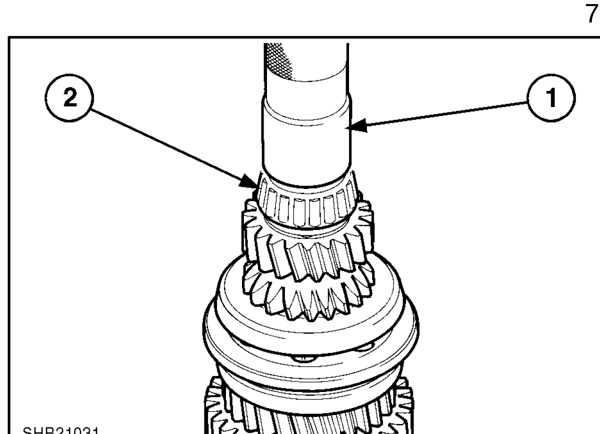
With the shaft supported vertically re-assembly is in reverse order of disassembly, however ensure all parts are liberally coated in clean transmission oil before fitting.

1. Refit the 3rd gear to the shoulder, place the hub-sleeve in position and refit the circlip. Ensure a minimum freeplay of 0.38–0.83mm (0.015–0.033in) is maintained to enable 3rd gear to rotate freely. Continue to refit the synchronizer, 4th gear, washer and bearing.



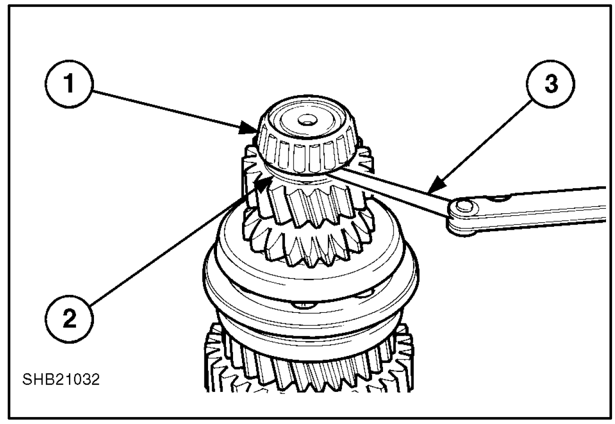
70

2. To refit the bearing use a 35mm bearing tool and press the head of the tool until the bearing is seated onto the washer.



71

3. When the bearing is fully seated ensure the clearance between the 4th gear to washer is between 0.05-0.56mm (0.008-022 in).

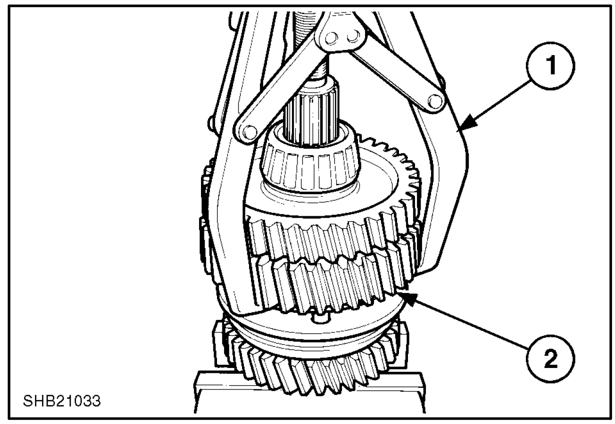


72

OUTPUT SHAFT DISASSEMBLY (REAR OUTPUT SHAFT END)

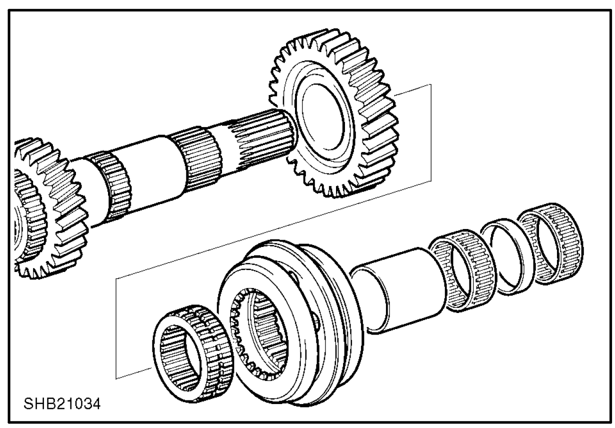
IMPORTANT: *When using a bearing puller be very careful to ensure it does not touch the tip of the gear teeth as they may become chipped or broken.*

1. Support the shaft vertically (front support end) in a soft jawed vice and attach a 3 legged puller to the underside of the 1st gear, Remove the bearing, output gear and 1st gear from the shaft.



73

2. With the 1st gear removed withdraw the needle bearing, spacer, 2nd needle bearing, sleeve, bulk ring synchronizer, hub sleeve and 2nd gear. Inspect for scoring wear marks and or discolouration, replace suspect parts as necessary.

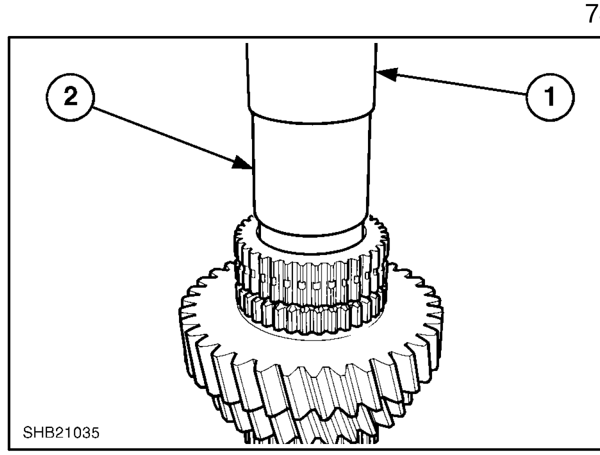


74

OUTPUT SHAFT RE-ASSEMBLY (REAR OUTPUT SHAFT END)

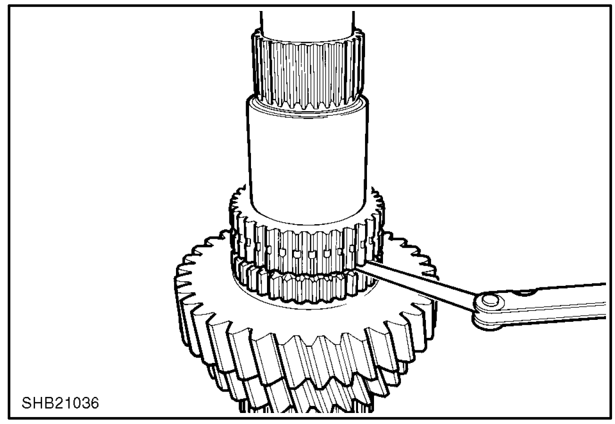
With the shaft supported vertically re-assembly is in reverse order of disassembly, ensure all parts are liberally coated in clean transmission oil before fitting.

3. Refit the 2nd gear to the shaft, along with the hub sleeve. Fit the spacer onto the shaft and using a sleeve tool press the sleeve down to the shoulder.



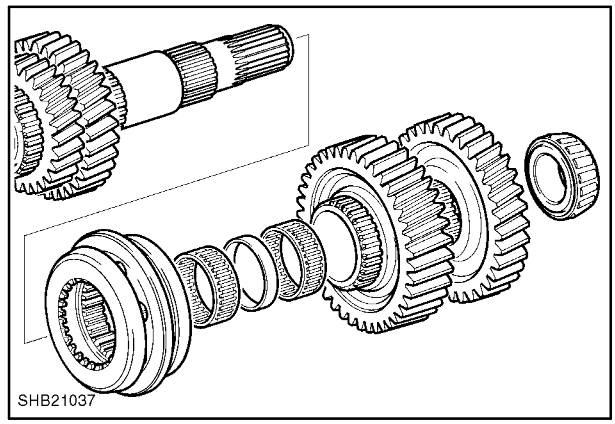
75

4. With the sleeve fully seated ensure the freeplay between the 2nd gear and hub sleeve is a minimum of 0.35–0.56mm (0.014–0.022in) to allow free rotation of the 2nd gear.



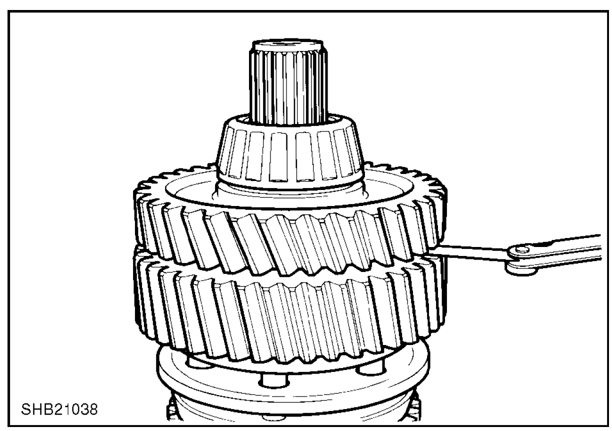
76

5. Refit the needle bearing, spacer, 2nd needle bearing, synchronizer assembly, 1st gear, output gear and washer prior to fitting the bearing.



77

6. Refit the bearing, when fully seated ensure the freeplay between the gears is at least 0.33–0.58 mm (0.013–0.020in) to allow free rotation of the 1st and output gears.

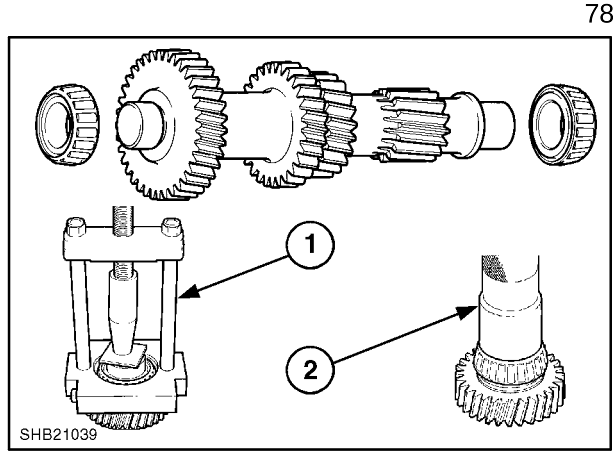


78

COUNTERSHAFT – Disassembly

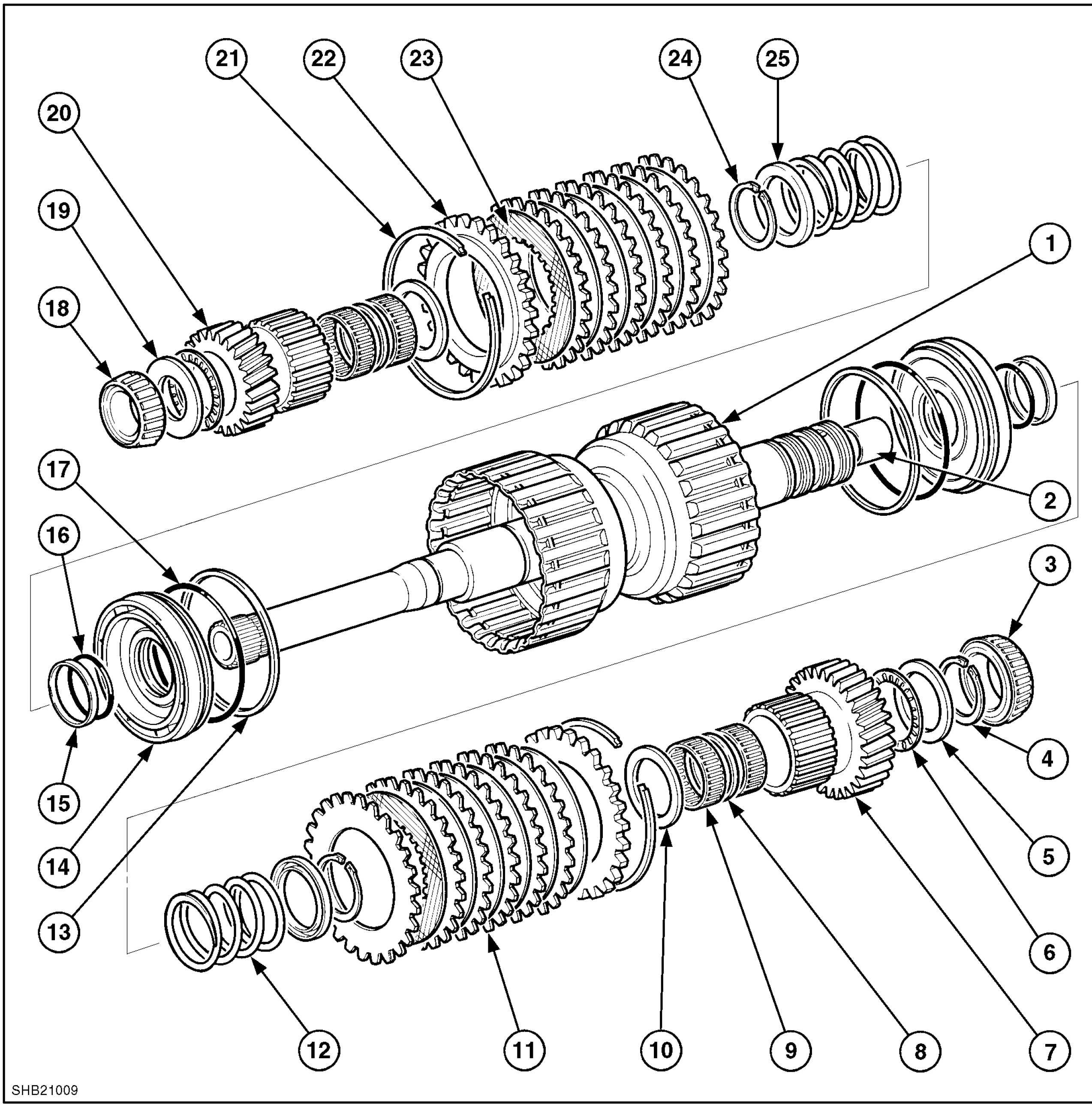
1. The counter shaft support bearings can be removed by using a suitable puller. Inspect for scoring wear marks and or discolouration, replace suspect parts as necessary.

2. To refit the bearings use a 40mm press tool



79

INPUT SHAFT – DISASSEMBLY



80

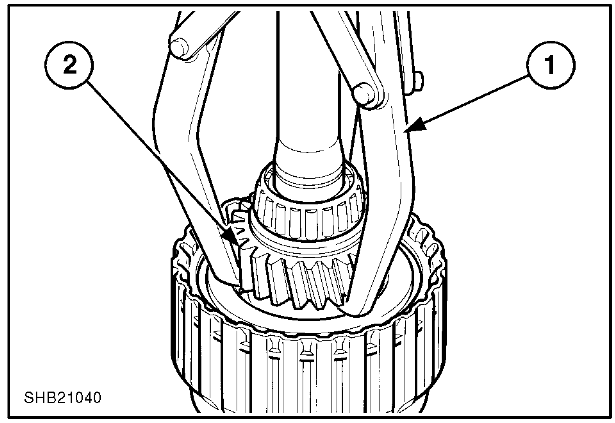
Input Shaft

1. Input Shaft / Housing Assembly
2. Bearing – Oil pump drive shaft
3. Roller Bearing
4. Circlip
5. Thrust Washer
6. Thrust Bearing
7. Gear / Clutch Hub
8. Bearing Spacer
9. Bearing
10. Thrust Washer
11. Clutch Plates (6 per clutch)
12. Spring
13. Piston Outer Seal
14. Piston
15. Piston Seal Inner
16. Piston ‘O’ ring Inner
17. Piston ‘O’ ring Outer
18. Roller Bearing
19. Thrust Washer
20. Gear Hub
21. Clutch Pack Retaining Circlip
22. Clutch Pack Retaining Plate
23. Friction Disc (x6 Each Clutch)
24. Circlip
25. Spring Retainer

INPUT SHAFT DISASSEMBLY (FRONT SUPPORT END)

IMPORTANT: *When using a bearing puller be very careful to ensure it does not touch the tip of the gear teeth as they may become chipped or broken.*

1. Support the shaft vertically (rear support end) in a soft jawed vice and remove the sealing ring. Attach a 3 legged puller (1), to the underside of the forward primary gear (2) and remove the gear hub, needle bearings and spacer, thrust washer, and bearing from the shaft.

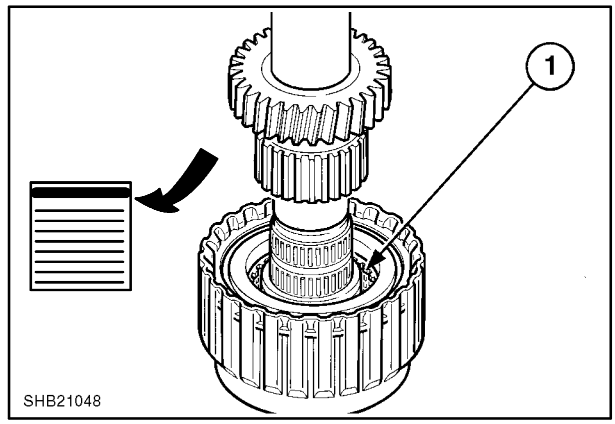


81

NOTE: *Prior to removal of the snap ring the wear factor of the clutch plates should can be checked. Measure the distance between the face of the top plate to to underside of retainer, approx. dimensions:*

When new Approx. 2.22-4.93mm (0.08-0.19in)
When run in Approx. 5.64-8.35mm (0.22-0.32in)

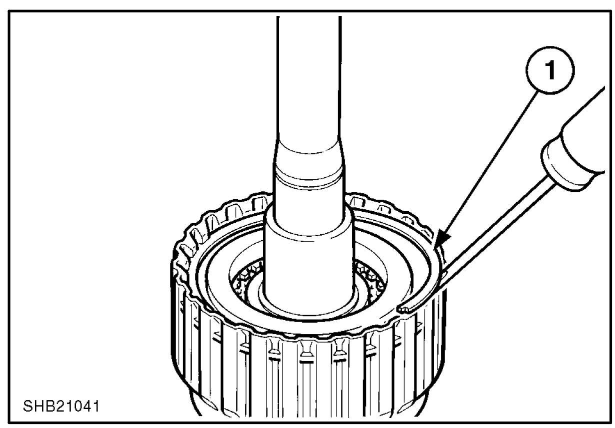
Anything exceeding or close to 8.35mm should be considered as worn and replaced with new.



82

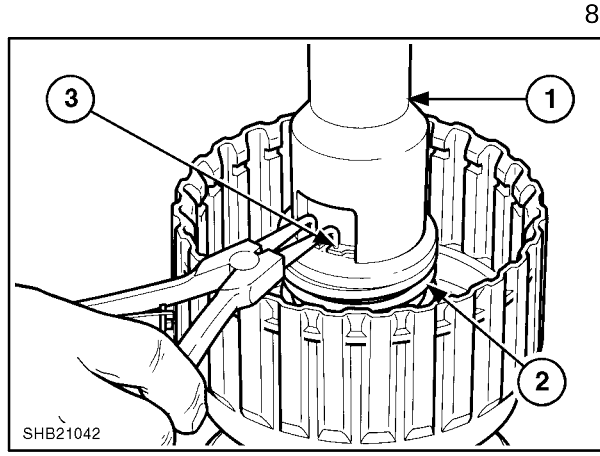
2. Release the snap ring (1), retaining the clutch pack drive rings and remove from the clutch housing.

The discs must be flat and not discoloured in any way, if in doubt renew the discs.



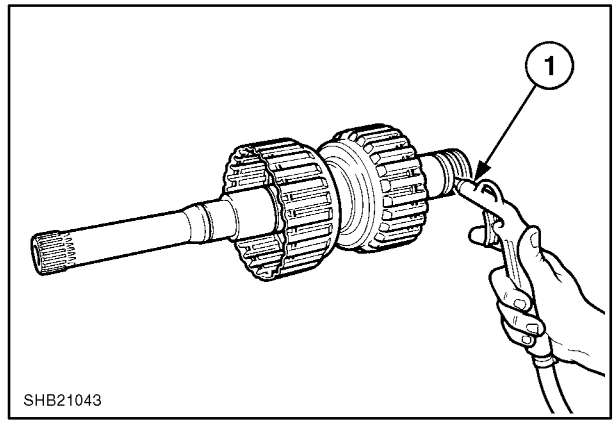
83

3. Using a press and tool NH 21 102 (1), compress the clutch piston spring (2) to enable release of the circlip (3). Carefully release the press pressure on the spring. Remove the circlip, washer and spring.



84

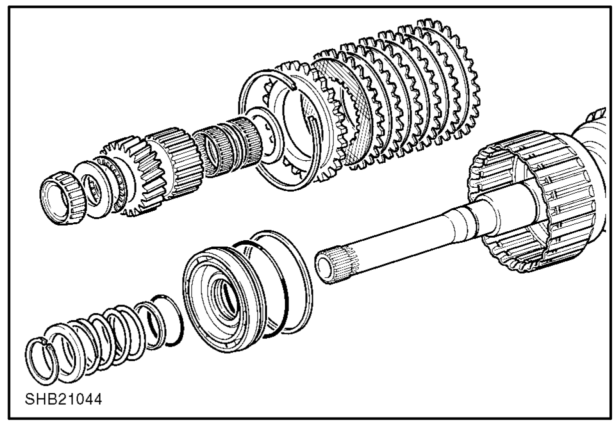
4. To remove the piston blank off the oil feed holes that are not required and carefully apply air pressure to the forward clutch oil feed hole (1) in the middle ring sufficiently to push the piston out against seal resistance.



85

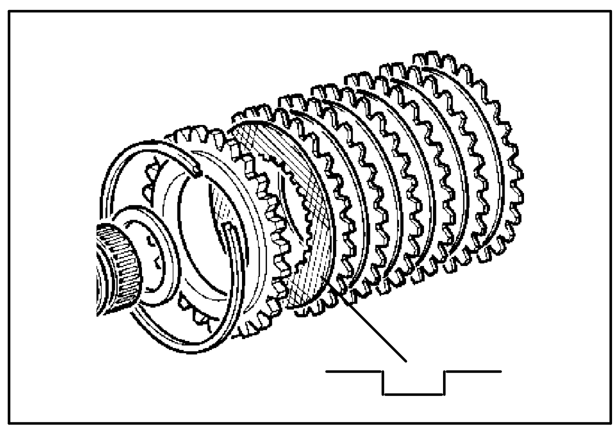
5. The piston seals should be removed and discarded prior to re-assembly.

Inspect all parts for scoring wear marks and or discolouration, replace suspect parts as necessary.



86

NOTE: *The grove depth on the friction disc when new is 0.38mm (0.014in) and is acceptable down to 0.10mm (0.004in). However any depth close to or below 0.10mm (0.004in) when a teardown has taken place should be considered as worn and replaced with new.*

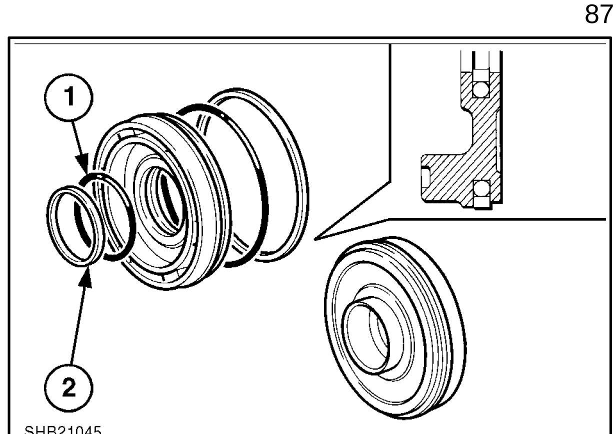


87

INPUT SHAFT RE-ASSEMBLY (FRONT SUPPORT END)

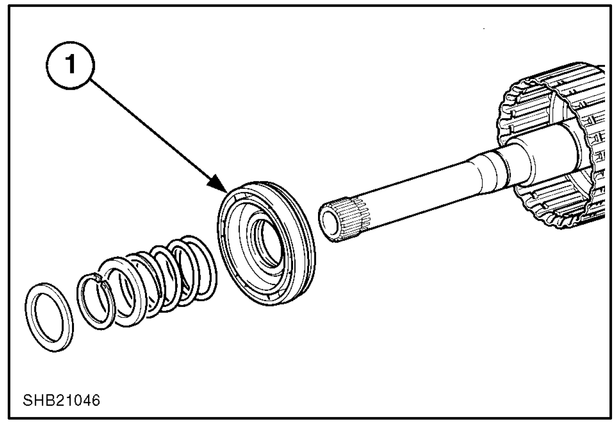
With the shaft supported vertically (in a soft jawed vice), re-assembly is in reverse order of disassembly, ensure all metallic parts are liberally coated in clean transmission oil before fitting.

6. The internal and external piston seals require replacing, before assembly, soak seals in luke warm water prior to fitting. Carefully refit the inner 'O'- ring and then the gland seal. The outer 'O'- ring can now be fitted along with the outer gland seal.



88

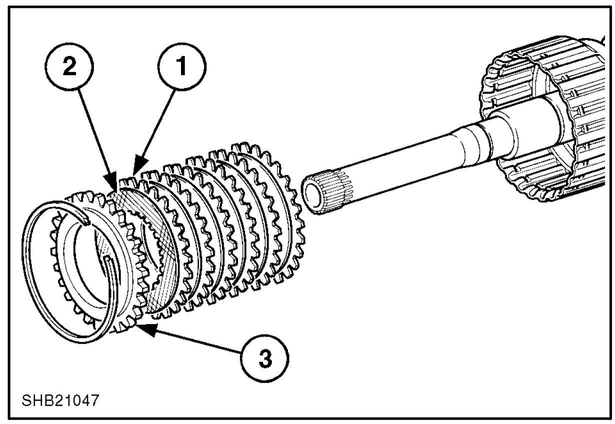
7. Lubricate the piston seal and carefully place the piston back into the clutch housing until fully seated. Re–assemble the piston spring, washer and compress using tool no #**380000679** sufficiently to allow refitting of the circlip and place the thrust washer in position.



89

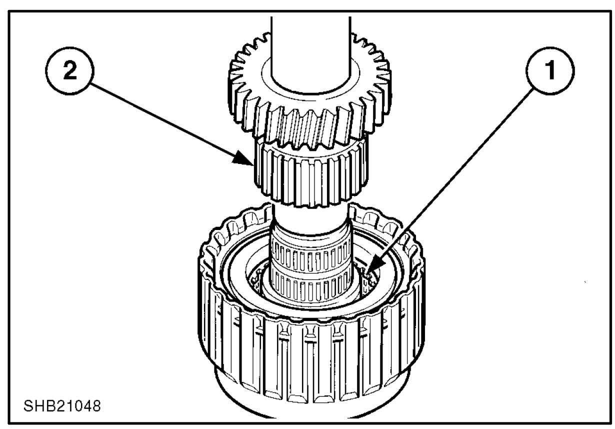
IMPORTANT: *Soak new clutch friction discs in clean new oil for a minimum of 3 hours*

8. Continue to refit the clutch discs (6 thin steel with 1 thick retaining plate) and (6 friction plates) back into the hub, steel first, followed by friction and then repeat steel, friction. The final steel plate to be fitted is the thicker retaining plate that the snap ring seats onto. Refit the snap ring into the groove of the clutch hub.



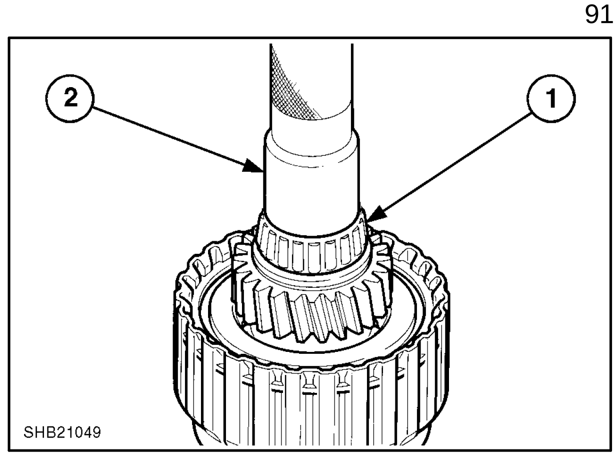
90

9. Once the gear is assembled into the clutch plates the needle bearings and spacer can be assembled into the bore of the gear without removing it from the clutch drum.



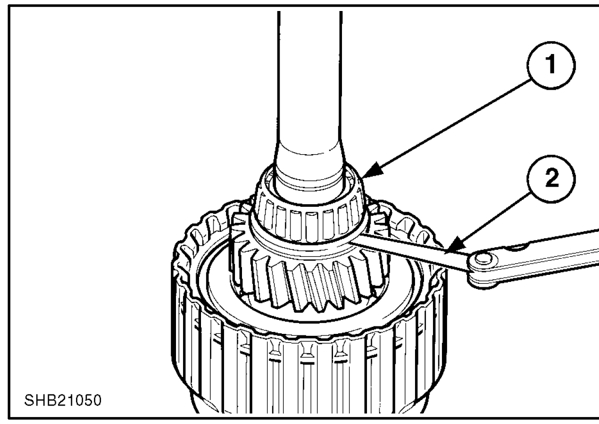
91

10. Place the thrust bearing (1) on the gear face with the thrust washer and refit the bearing using a press and tool #**380000712** (2).



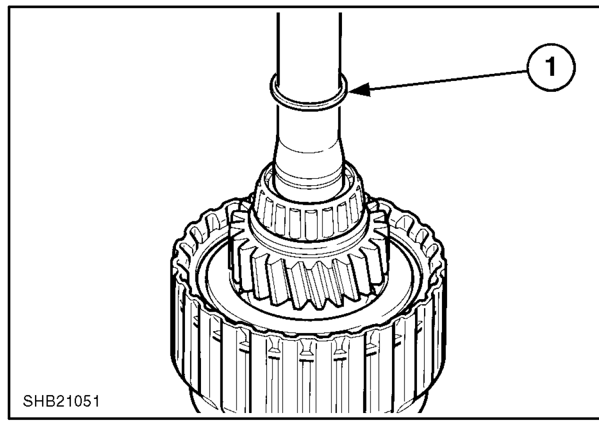
92

11. With the bearing (1) fully seated ensure a free-play of at least 0.0508–0.40mm (0.002–0.016in) exists between the thrust washer and gear (2).



93

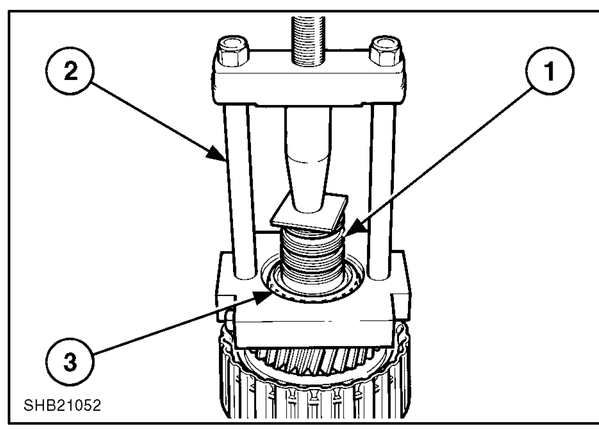
12. Fit a new sealing ring onto the shaft above the bearing (1).



94

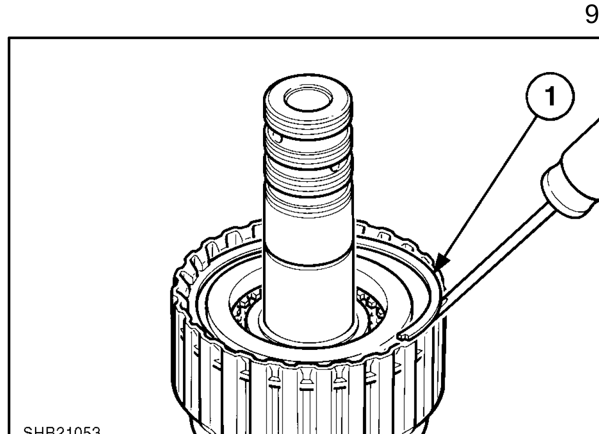
INPUT SHAFT DISASSEMBLY (REAR SUPPORT END)

13. Support the shaft vertically (front support end) in a soft jawed vice and remove the sealing rings (1). Attach puller (2) to the underside of the bearing (3) and remove. Remove the circlip which allows the removal of the thrust washer, thrust bearing, gear/hub, needle bearings with spacer.



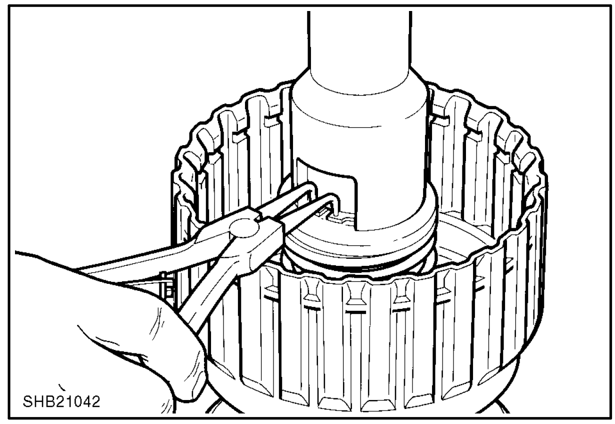
95

14. Release the snap ring (1) retaining the clutch pack drive discs and remove from the clutch housing.



96

15. Using a press and tool # **380000679** compress the clutch piston spring to enable release of the circlip. Carefully release the press pressure on the spring. Remove the circlip, washer and spring.

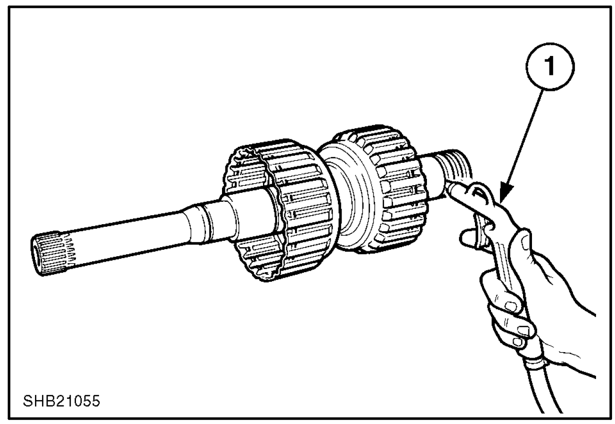


97

IMPORTANT: *When using compressed air always wear safety goggles.*

16. To remove the piston blank off the oil feed holes that are not required and carefully apply air pressure to the forward clutch oil feed hole (1) in the third ring, sufficiently to push the piston out against seal resistance.

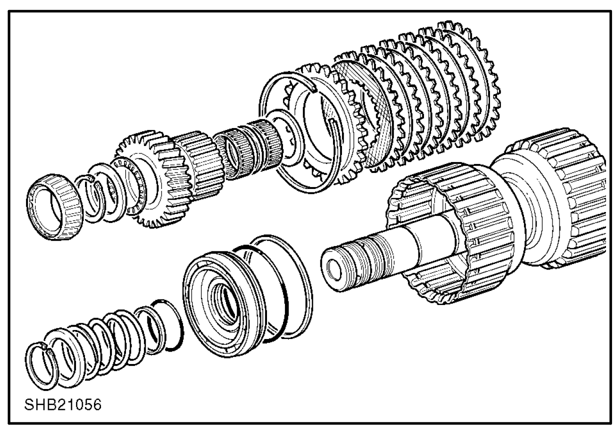
    The piston can also be removed by using a hooked tool applied carefully to the land at the rear of the piston



98

17. The piston seals should be removed and discarded prior to re-assembly, refit new ones.

Inspect all parts for scoring wear marks and or discolouration, replace suspect parts as necessary.

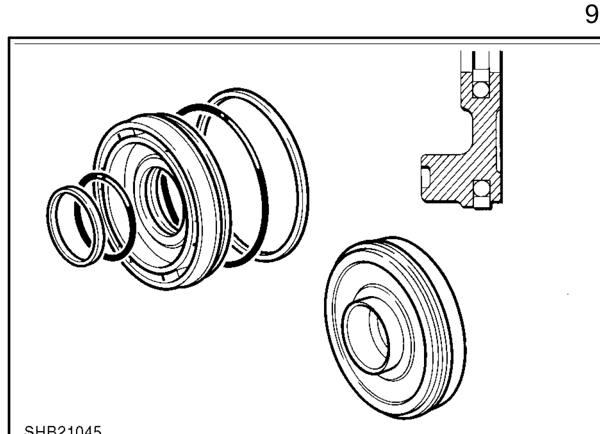


99

INPUT SHAFT RE-ASSEMBLY (REAR SUPPORT END)

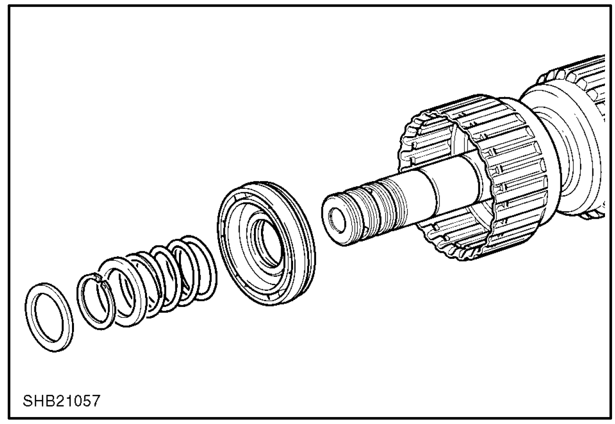
With the shaft supported vertically (in a soft jawed vice), re-assembly is in reverse order of disassembly, ensure all metallic parts are liberally coated in clean transmission oil before fitting.

1. The piston seals require replacing, before assembly, soak seals in luke warm water prior to fitting. Carefully refit the inner 'O' ring and then the gland seal. The outer 'O' ring can now be fitted along with the outer gland seal.



100

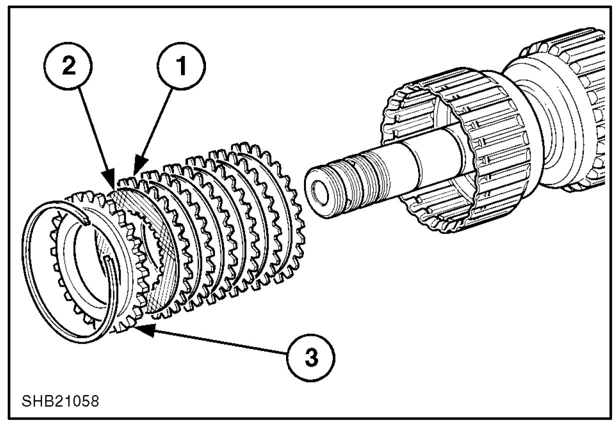
2. Lubricate the piston seal and carefully place the piston back into the clutch housing until fully seated. Re-assemble the piston spring, washer and compress sufficiently using tool **380000679** to allow refitting of the circlip and place the thrust washer in position.



101

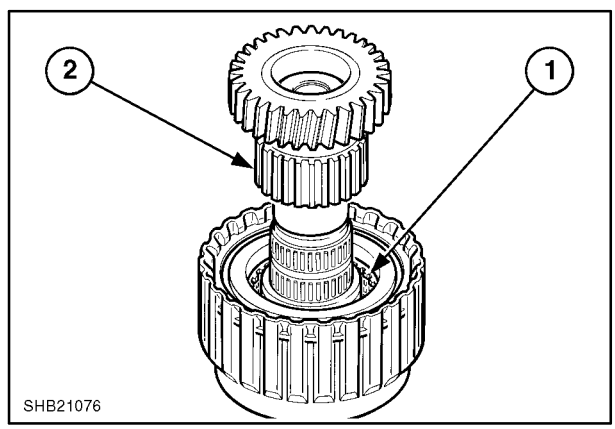
IMPORTANT: *Soak new clutch discs in clean new oil for a minimum of 3 hours*

3. Continue to refit the clutch discs (6 thin steel with 1 thick pressure plate) and (6 friction plates) back into the hub, steel first, followed by friction and then repeat steel, friction. The final steel plate to be fitted is the thicker retaining plate that the snap ring seats onto. Refit the snap ring into the groove of the clutch hub.



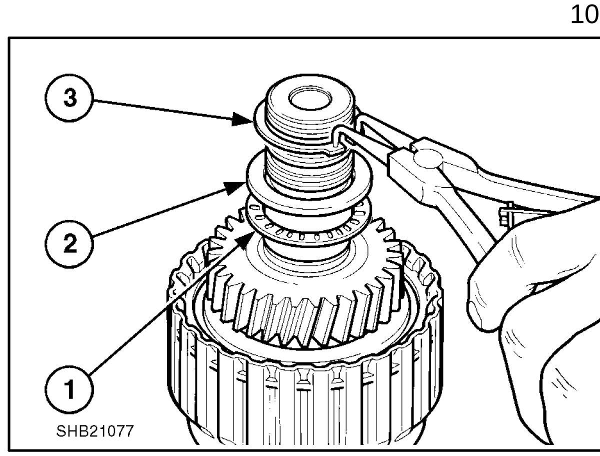
102

4. Once the gear is assembled into the clutch plates the needle bearings and spacer can be assembled into the bore of the gear without removing it from the clutch drum.



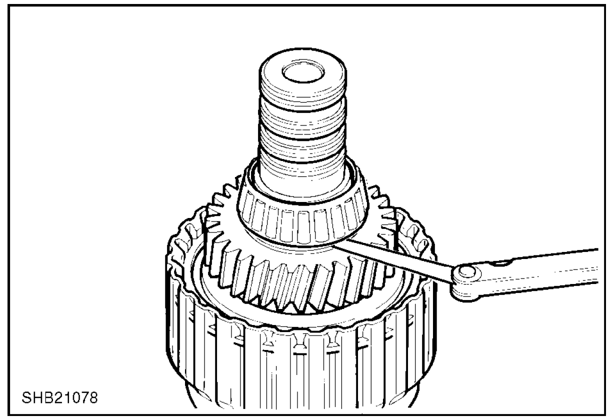
103

5. Refit the thrust bearing (1), thrust washer (2) and circlip (3).



104

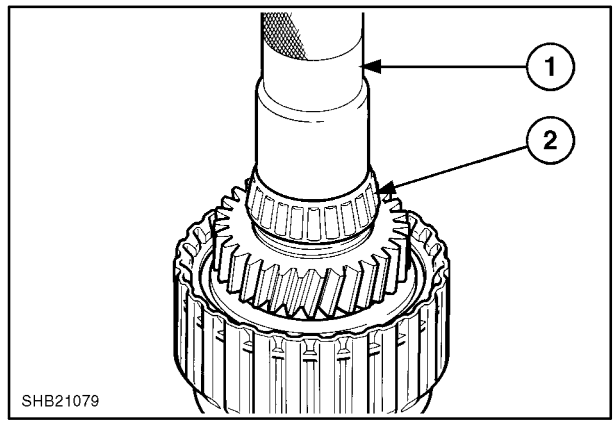
6. With the circlip seated in position ensure that a freeplay of 0.05-0.40mm (0.002-0.016in) exists between the gear and thrust washer with the bearing fully seated.



105

7. Using a suitable press and 50mm tool refit the bearing onto the shaft.

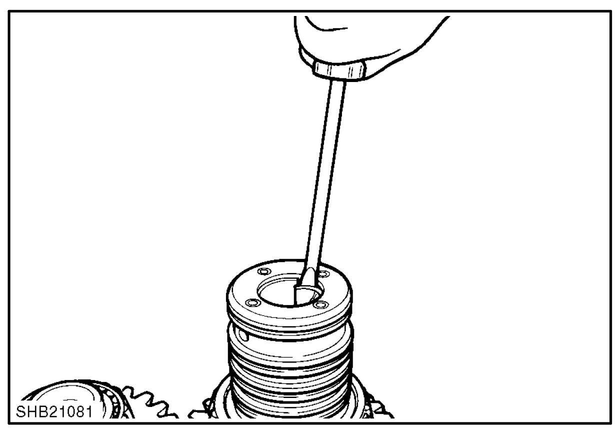
NOTE: *New seals must be fitted, however do not fit the seals until the rear cover shimming procedure is completed, as the seals may be damaged when the cover is fitted and removed during the shimming procedure.*



106

OIL PUMP DRIVE SHAFT SUPPORT BEARING

1. Remove the soft bearing from the bore of the shaft and discard. Ensure the bore is clean and free of all residues.



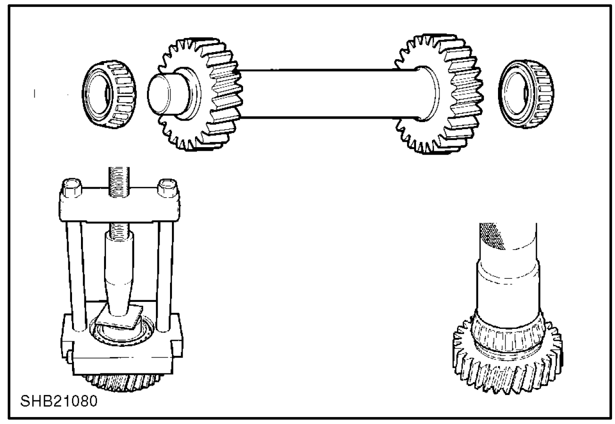
107

2. Fit a new bearing into the shaft using a small drift and tap gently into the bore until it is flush with the end face of the shaft.

108

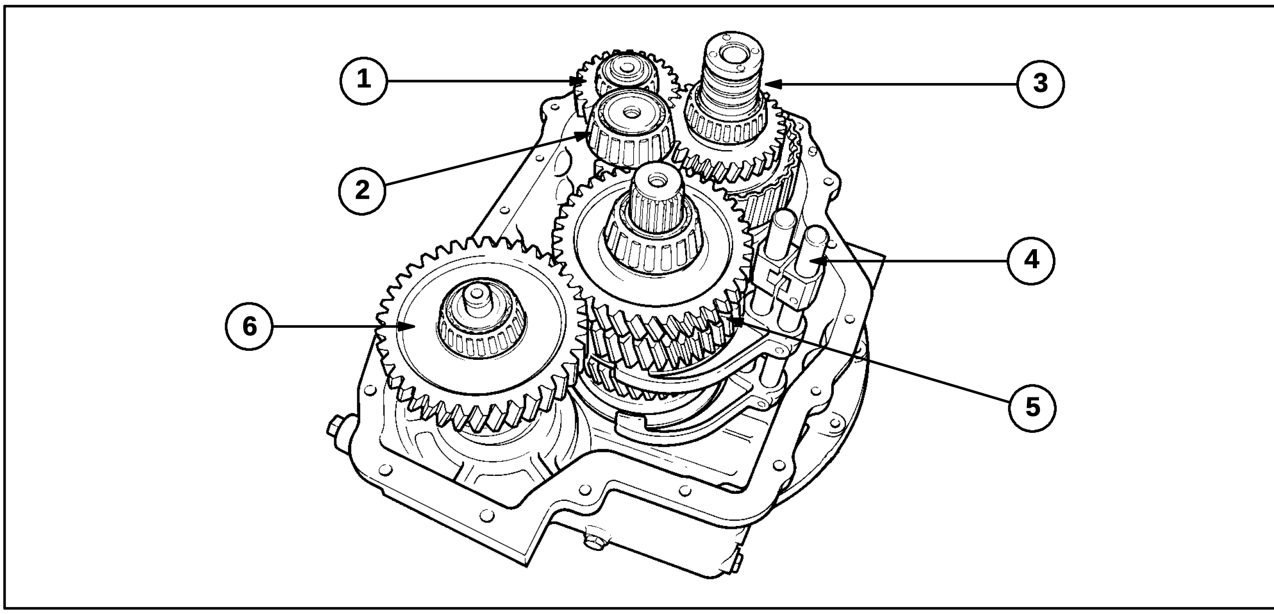
REVERSE IDLER SHAFT- DISASSEMBLY

1. The idler shaft support bearings can be removed by using a bearing puller. Inspect for scoring wear marks and or discolouration, replace suspect parts as necessary.
2. To refit the bearings use a press and 35mm tool



109

GEAR TRAIN RE-ASSEMBLY



110

Gear train Re-assembly

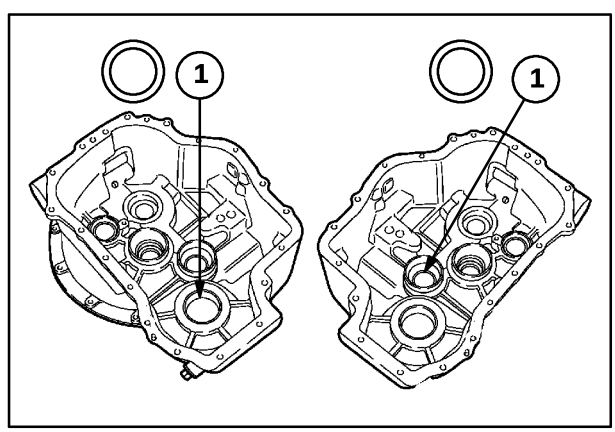
1. Reverse Idler Shaft
2. Counter Shaft
3. Input or Primary Shaft
4. Gear Selection Shafts and Forks
5. Output Gear Shaft
6. Front Wheel Drive Shaft (where fitted)

Transmission Re-assembly

IMPORTANT: *Prior to re-assembly of the transmission ensure all parts are clean and oiled.*

Where Four Wheel Drive is fitted change the lipped oil seal (1) in the front cover while it is disassembled. Push out the old seal and push in a new seal to seat on the shoulder.

Change the double lipped oil seal in the rear cover on the output shaft (2) while it is disassembled. Push out the old seal and push in a new seal to seat on the shoulder and fill the cavity between the seal double lips with a silicone grease.

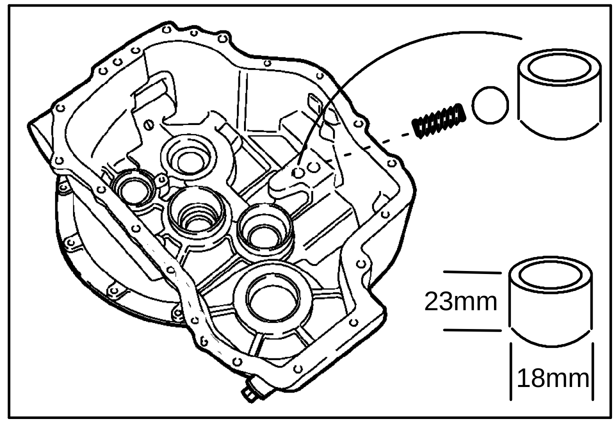


111

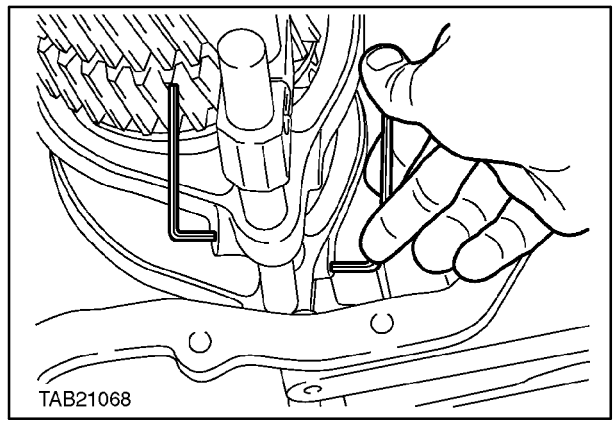
3. Place in the front cover the inner detent spring and ball and retain by using a small piece of tube 18mm (0.709 in) diameter by 23mm (0.906 in) long in lieu of the gear shift rail.
4. Re-assemble the gear train in the following order:
   D Counter Shaft
   D Reverse Idler Shaft
   D Input shaft (hold counter/idler shaft to one side)
   D Output Shaft
   D Gear Shift 1st rail and fork (push out tube). Fit intermediate ball, 2nd rail and fork, ball and spring and detent retaining plug, torque plug to 41 - 54 Nm (30-40 lbf ft).
   D Four Wheel Drive Shaft where fitted

With the detent spring and balls in position fit the retaining bolt and torque to 40-54Nm (30-40 lbs ft)

With the gear train set in neutral position torque the shift fork hexagonal head screws to 8 -16 Nm (6-12 lbf ft)



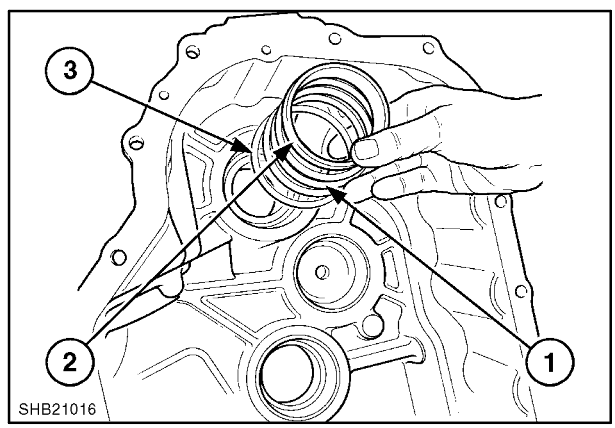
112



113

Gear Train End float - Shimming Procedure

The purpose of this procedure is to create an end float of 0.025-0.076mm (0.001-0.003in) on each of the gear shafts, this is achieved by adding or deleting the shims (1) between the shaft bearing cone (2) and spacer (3) in the rear cover on each shaft assembly. To determine end float the rear cover is seated on the transmission and securing with four bolts evenly spread around the cover, checking the end float of each shaft in turn.

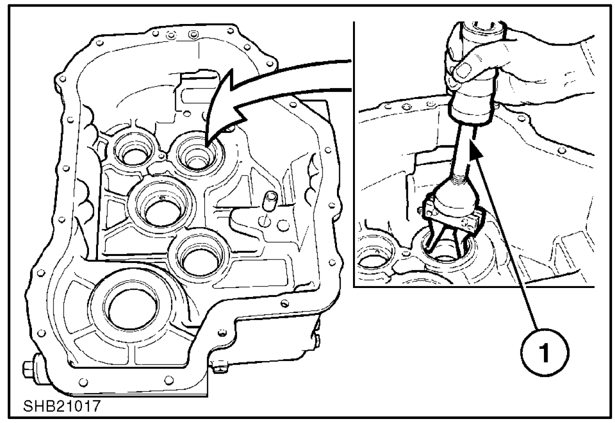


114

IMPORTANT: *The mating faces of the front and rear transmission cases must be scraped clean and free of dirt and gasket material. Any residue remaining on theses faces may affect the endfloat shimming procedure when the cases are bolted together.*

Before attempting to check the end float in any shaft assemblies they must be rotated several times to allow the taper bearing rollers to settle in tracks.

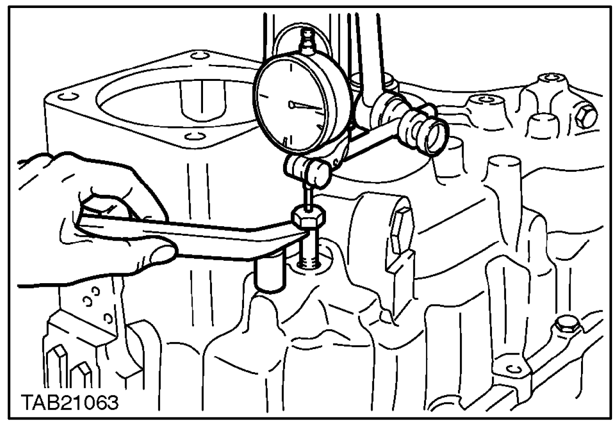
Removal of the bearing cones is achieved by use of a removal tool (1). When a new bearing cone is to be fitted fit the spacer first (but less the shims) and then fit the cone (gently tapping the cone into the counter bore).
However if the old bearing and cone is to remain in the transmission, leave the old cones installed until the end float is checked and then remove and adjust shims between the spacer and cone as required.



115

5. REVERSE IDLER GEAR SHAFT – Place Tool **380000700** in the end of the shaft through the rear cover and position a dial indicator onto the bolt head.

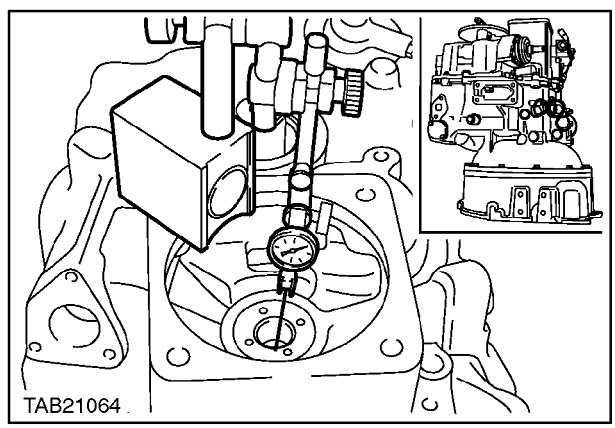
   Using a small block and lever gently lift the shaft up (do not use excessive force) and record the reading. If the result is not to the specification of 0.025–0.076mm (0.001–0.003in) it will be necessary to add or delete the shims accordingly beneath the bearing cone in the rear cover.



116

6. INPUT SHAFT – This shaft can raised by placing a lever and block below the transmission and levering the input end of the shaft where it protrudes into the bell housing. Alteratively it can be raised by placing the lever through the side casing access aperture and levering between the clutch housings.

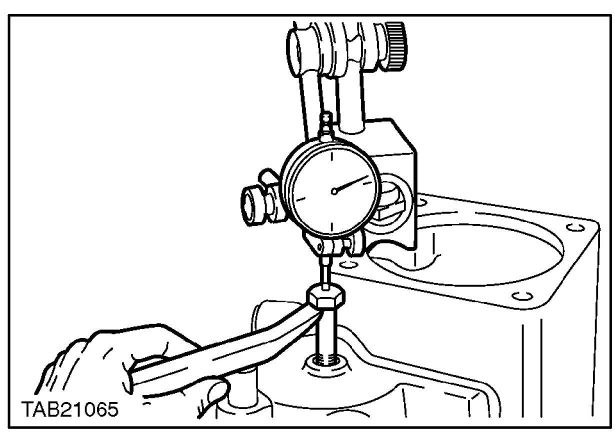
   Position a dial indicator so the indicator rests on the rear face of the shaft and gently lift the shaft up (do not use excessive force) and record the reading. If the result is not to the specification of 0.025–0.076mm (0.001–0.003in) it will be necessary to add or delete the shims accordingly beneath the bearing cone in the rear cover.



117

7. COUNTER SHAFT – Place Tool NH 21 103 in the end of the shaft through the rear cover and position a dial indicator onto the bolt head.

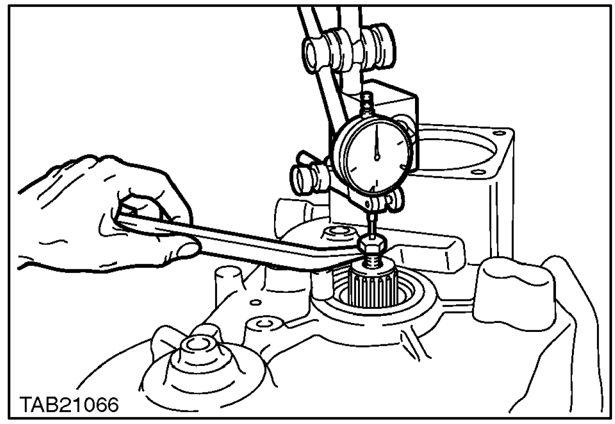
   Using a small block and lever gently lift the shaft up (do not use excessive force) and record the reading. If the result is not to the specification of 0.025–0.076mm (0.001–0.003in) it will be necessary to add or delete the shims accordingly beneath the bearing cone in the rear cover.



118

8. OUTPUT SHAFT – Place Tool **380000700** in the end of the shaft through the rear cover and position a dial indicator onto the bolt head.

   Using a small block and lever gently lift the shaft up (do not use excessive force) and record the reading. If the result is not to the specification of 0.025–0.076mm (0.001–0.003in) it will be necessary to add or delete the shims accordingly beneath the bearing cone in the rear cover.

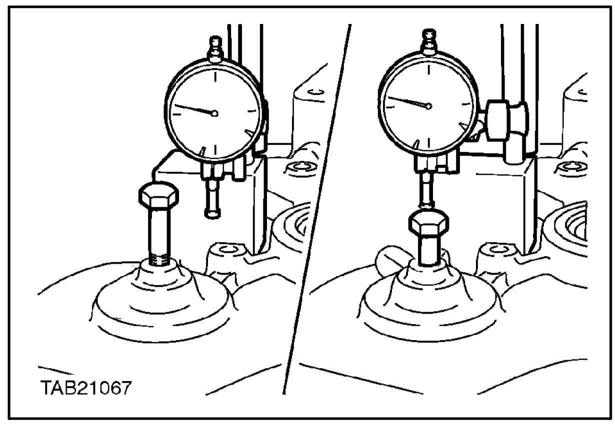


119

9. FOUR WHEEL DRIVE SHAFT – It will be necessary to place the tool **380000700** into the bolt hole on the rear cover before positioning the dial indicator

   This shaft can be raised by placing a lever and block below the transmission and levering the output end of the shaft where it protrudes from the transmission.

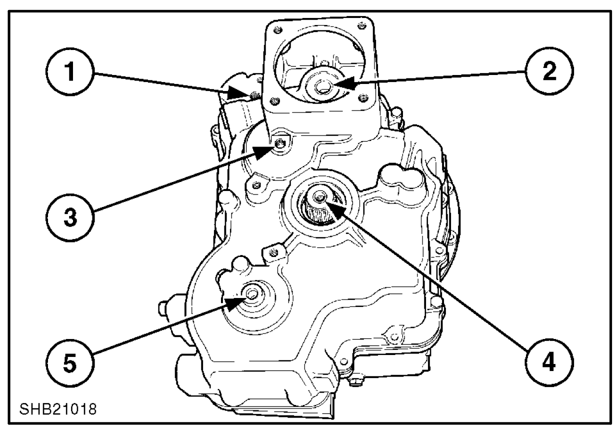
   Gently lift the shaft up (do not use excessive force) and record the reading. If the result is not to the specification of 0.025–0.076mm (0.001–0.003in) it will be necessary to add or delete the shims accordingly beneath the bearing cone in the rear cover.



120

Upon completion of recording the results lift the rear cover off and add or delete shims beneath the cones on the relative shafts to achieve the required end floats.

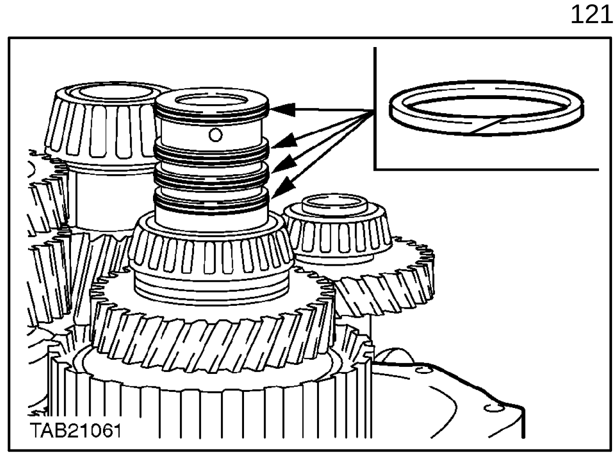
Refit the rear cover with 4 bolts evenly spread around the cover and recheck end float through steps 1 to 5. When all correct end floats are achieved, proceed to rear cover attachment.



121

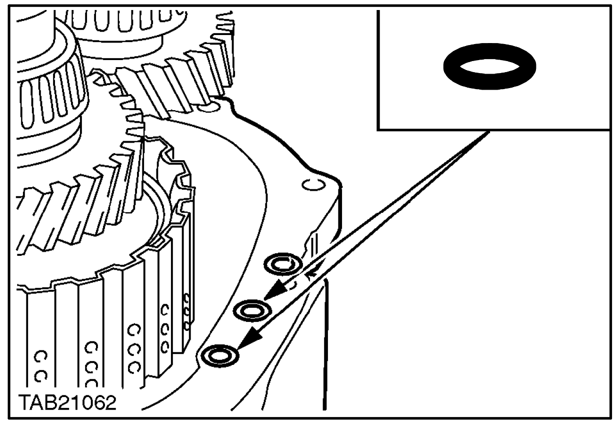
REAR COVER ATTACHMENT

Lift the rear cover and fit new seals to the end of the input shaft.



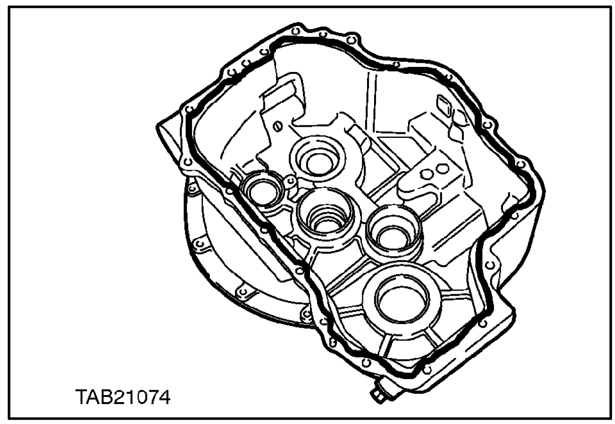
122

Replace the 'O' rings on the oil feed supply ports



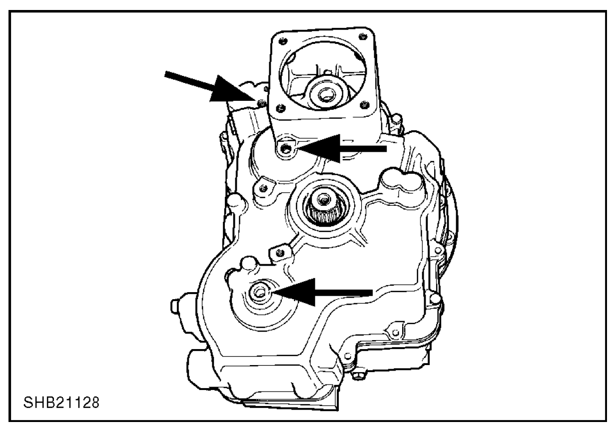
123

Apply a 2mm wide band of sealer 82995770 to the mating face of the front cover and carefully lower the rear cover. Torque the cover bolts 45 – 64 Nm (33–47 lbf ft), working out from the middle of the cover, alternating each side of the cover, to the top and bottom of the transmission.



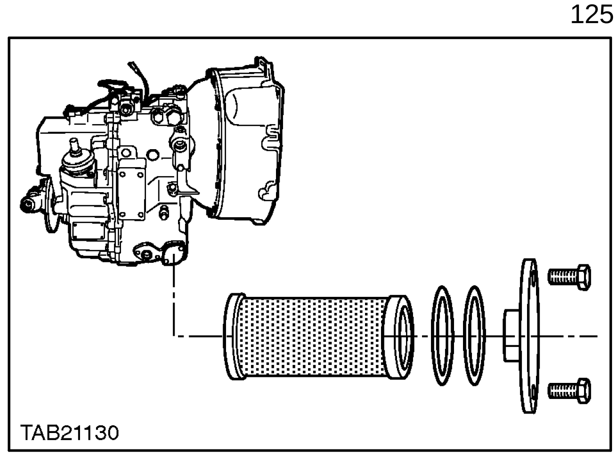
124

Replace the 3 off, shaft end bolts and torque to 45–64Nm (33–47 lbf ft).



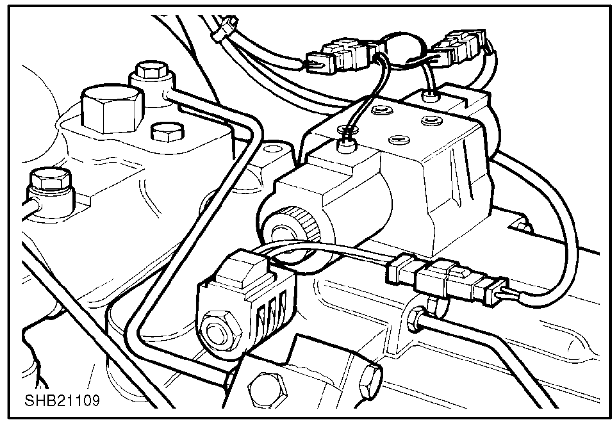
125

Replace oil drain plug torque to 34–54Nm (25–40 lbf ft)



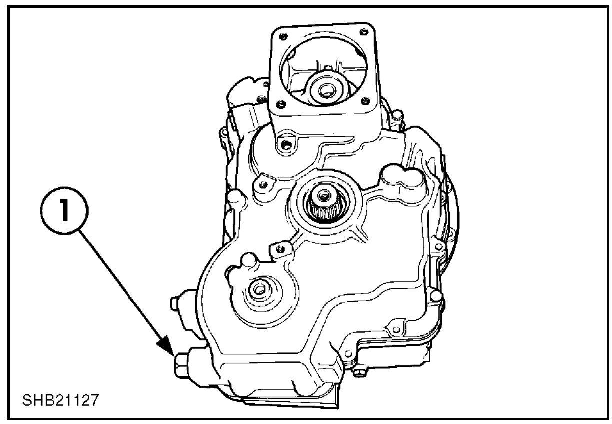
126

Control valve clean the mating faces and apply sealer to joint face on the transmission and torque bolts to 45–64Nm (33–47 lbf ft).

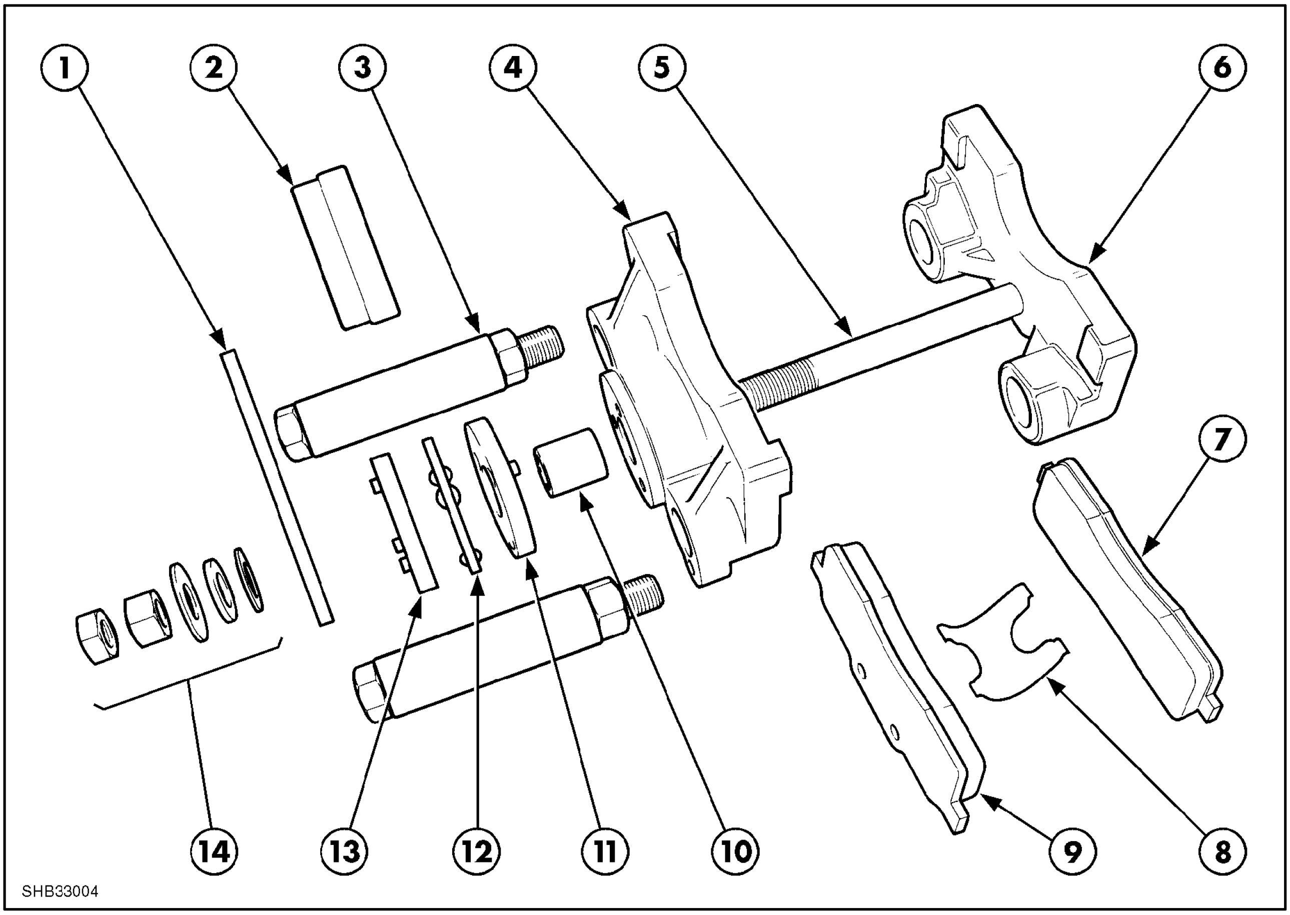


127

Replace oil drain plug torque to 34–54Nm (25–40 lbf ft)



128



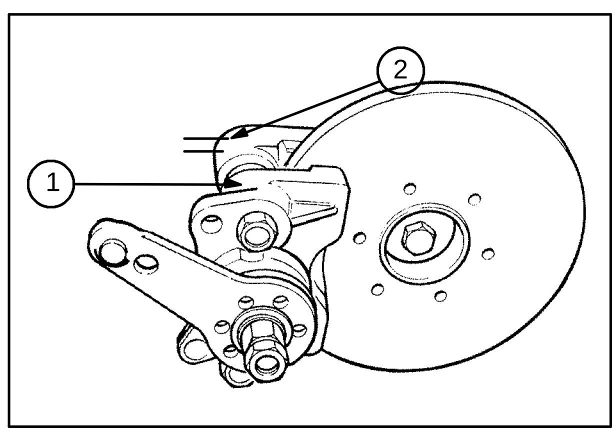
129

Brake Disc and Caliper Assembly

1. Lever
2. Cover
3. Fixing Bolt
4. Outer Caliper
5. Bolt
6. Inner Caliper
7. Inner Friction Pad
8. Fixing Spring
9. Outer Friction Pad
10. Spacer
11. Actuator Plate
12. Balls and Retainer Plate
13. Actuator Plate
14. Adjusting Nuts and washers

The transmission parking brake is fitted to all models and incorporates two free floating friction pads.

If the brake assembly is fully dismantled upon re-assembly the caliper fixing bolt spacer (1) must maintain a gap of 0.76mm (0.030in) to the transmission body (2).

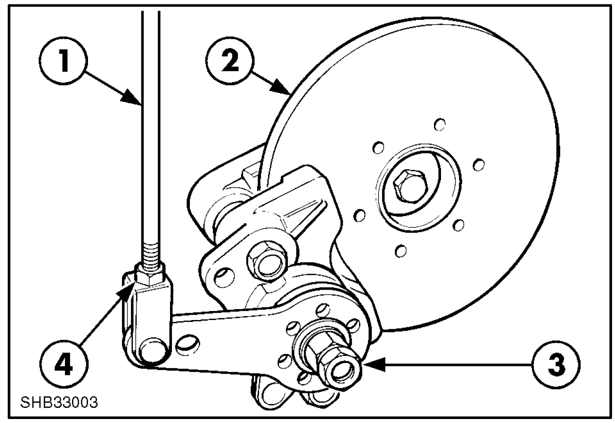


130

When operated by the cable (1) from the cab the eccentric cam forces the friction pads against the disc (2), effecting a braking action on the output shaft from the transmission, locking the drive shaft to the rear axle and front axle when Four Wheel Drive is fitted

Adjustment of the brake assembly is by tightening the inner nut (3) which effectively pushes the pads onto the disc. Once the disc is contacted by the pads the nut should be loosened 1/2 a turn and the outer locknut (3) tightened off.

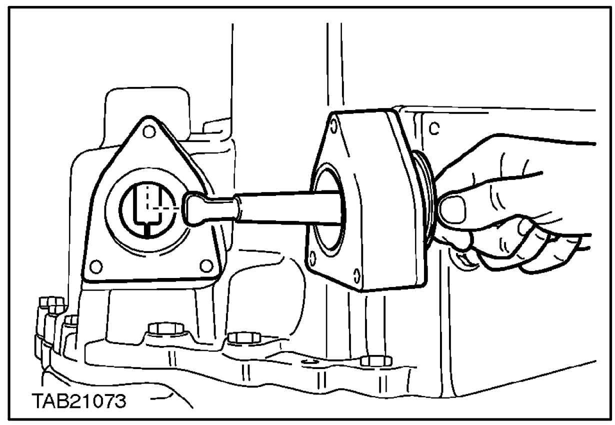
Inspect the brake pad and disc for signs of wear before re–assembly and replace as required pads or the disc if heavily scored



131

GEAR SHIFT SELECTOR ASSEMBLY

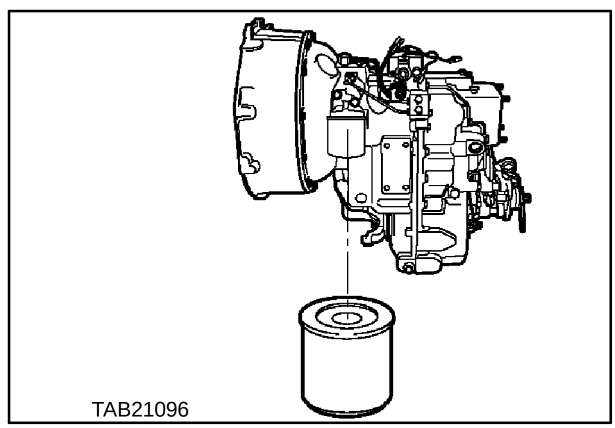
Refit the gear shift lever and spacer and torque the bolts to 16.2–24.4Nm (12–18 lbs ft).



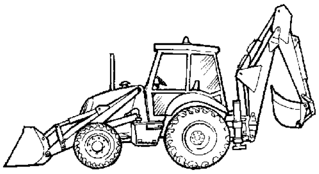
132

SPIN ON OIL FILTER

Replace the spin on filter with a new one and hand tighten the filter plus 3/4 of a turn or as instructed on the filter body.



133



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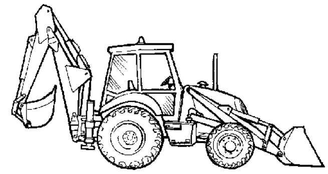


SECTION 21 – TRANSMISSIONS

Chapter 2 – Powershift Introduction

CONTENT

SPECIFICATIONS

STALL SPEED

110hp Turbocharger . . . . xxxx – xxxx revs/min

TORQUE CONVERTER RATIO

Ratio. . . . . 2.54 : 1

GEAR RATIOS

Power shift 4x2 Transmission

LUBRICANT

See Operator’s Manual

TORQUES

Engine / transmission retaining bolts and nuts	95 Nm (70 lbf ft)
Engine coolant expansion tank retaining bolts	25 Nm (18 lbf ft)
Engine / transmission mounting bolts	95 Nm (70 lbf ft)
Hydraulic pump pipe connection (small)	35 Nm (26 lbf ft)
Hydraulic pump pipe connection (large)	120 Nm (86 lbf ft)
Power steering outlet to tank	55 Nm (41 lbf ft)
Hydraulic oil cooler to coolant radiator bolts	25 Nm (18 lbf ft)
Hose transport lock valve to gearbox	15 Nm (11 lbf ft)
Hose transport lock valve to gearbox dipstick pipe	15 Nm (11 lbf ft)
Spicer universal couplings rear and front (when FWD fitted)	38 Nm (28 lbf ft)

SPECIAL TOOLS

Engine / Transmission Lifting Bracket	297389

DESCRIPTION AND OPERATION

The transmission consists of a torque converter, an internal gerotor–type hydraulic pump, a solenoid control valve assembly, three speed / directional clutches, two range clutches and one four wheel drive clutch. A parking brake is also fitted to the transmission.

TRANSMISSION CONTROL

The transmission is operated via a control lever mounted on the left hand side of the steering column. This includes the processor which monitors and controls the clutch engagement. Directional changes are made by moving the lever forward and backwards, gears are selected by twisting the lever anti clock wise for a higher gear, and clock wise for a lower gear. The lever must always be twisted after a direction is selected if the lever has been in neutral for longer than 3 seconds.

Kick down from 2nd to 1st is achieved by depressing the button on the end of the control lever. This will only operate when the transmission is in 2nd gear.

Transmission disconnect is operated by depressing the red button on the loader lever, once the button is released the transmission will drive.

NOTE: *For full instructions on the operation of the power shift transmission refer to the operators manual.*

TORQUE CONVERTER

NOTE: *The torque converter is a sealed unit and can not be serviced as individual parts.*

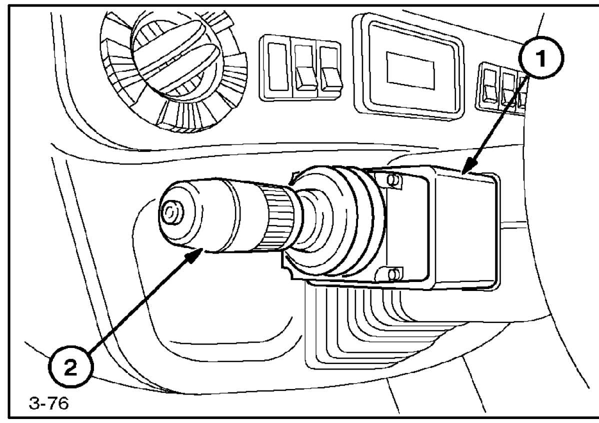
The torque converter which is a fluid coupling transmits drive from the engine to the transmission.

Attachment of the torque convertor to the flywheel is through a flexi–plate using bolts (1) to convertor and (2) bolts to flywheel.

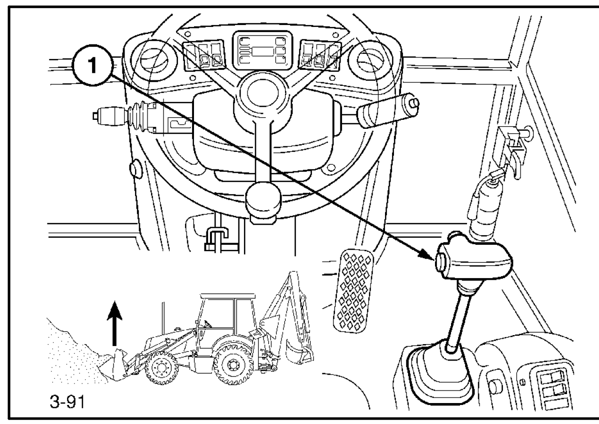
The main parts of the torque converter are the impeller, the turbine, the stator and the front and rear covers. The impeller is integrated with the rear cover which is driven by the engine flywheel by means of a drive plate.

The torque converter must be full of oil to operate correctly. The oil must flow constantly through the converter to the oil cooler to prevent over heating.

When the engine is running the impeller pumps oil to the turbine this oil acts on the turbine and flows on to the stator which is fixed. As the flow increases the turbine starts to rotate at this point we get maximum torque increase. As the turbine speed increases the torque multiplication gradually decreases. When the turbine rotates at the same speed as the impeller oil now acts on the rear face of the stator blade. This unlocks the one–way clutch, permitting the stator to rotate in the same direction.



1



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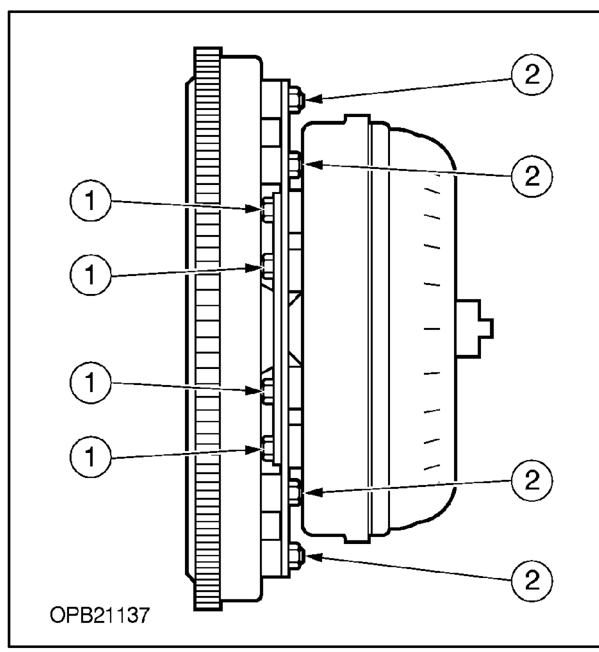
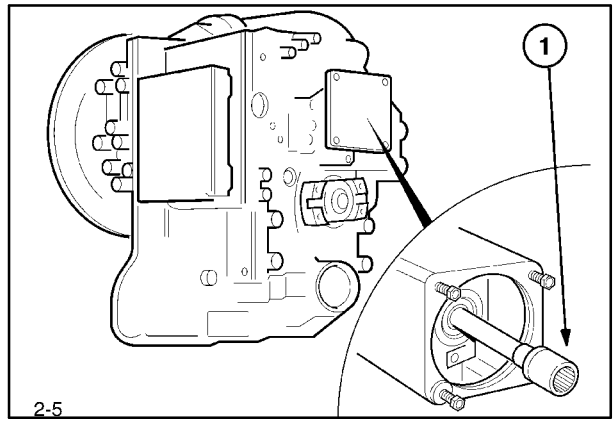


3

BACKHOE HYDRAULIC PUMP DRIVE.

A solid shaft connects the engine (via the torque converter impeller) to the main hydraulic pump input shaft. The pumps are mounted on the rear of the transmission the drive shaft passes through the centre of the transmission input shaft.



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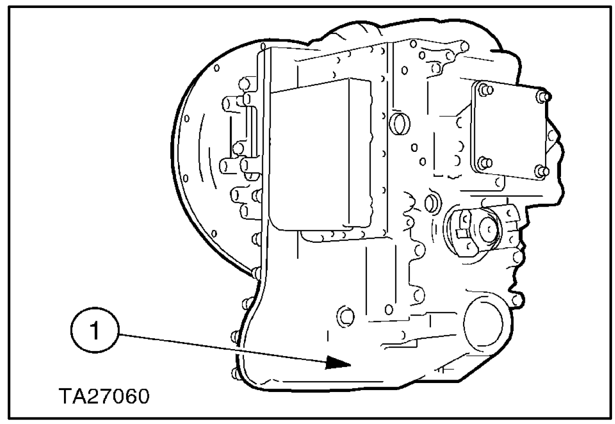
TRANSMISSION HYDRAULIC SYSTEM.

The transmission case (1) serves as an oil reservoir for the hydraulic pump which supplies oil to the system.

The dipstick/oil filler tube is located on the right hand side of the engine and can be accessed by removing the side panel.

An integral strainer in the transmission sump and a spin on oil filter mounted on the right hand side of the transmission, ensure that the components life is extended due to good oil filtration.

The hydraulic gerotor oil pump is located in the bell housing. Drive is taken via two drive tangs on the torque converter housing.



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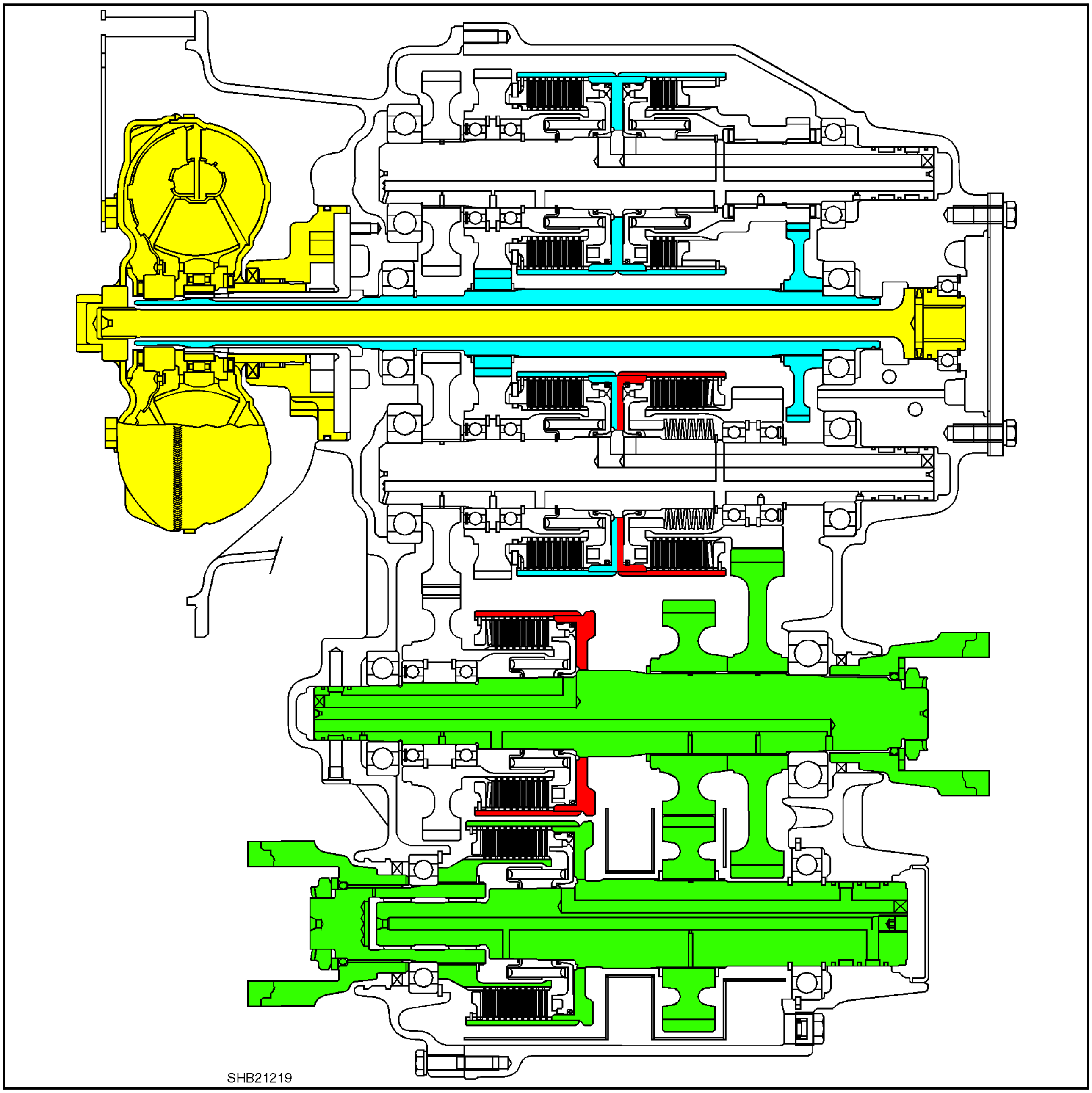
TRANSMISSION ASSEMBLY

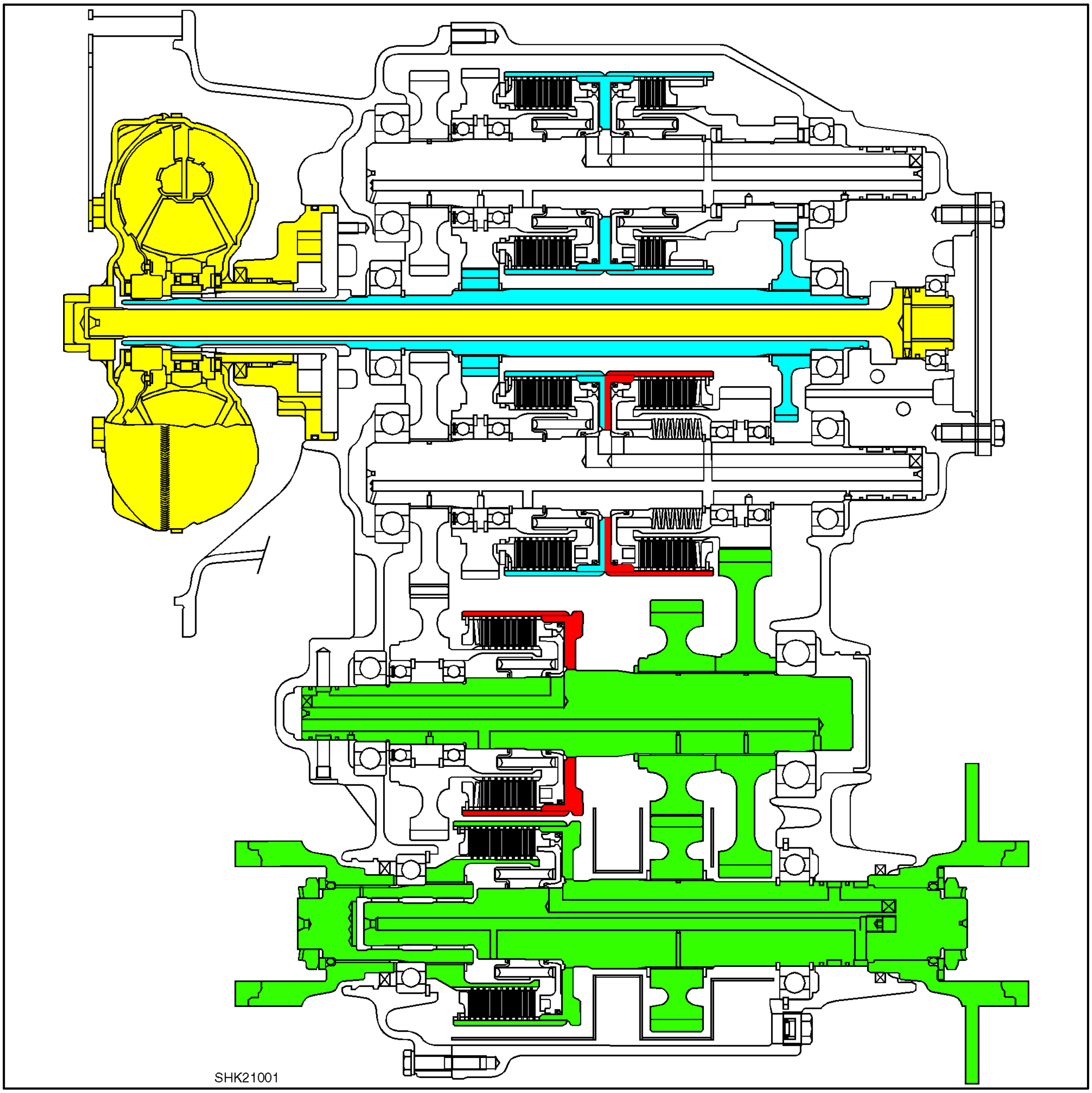
Basically the transmission is composed of five main assemblies:



6

4 Wheel Drive Transmission – 2 Wheel Steer

Converter and pump drive section	Range clutches
Input or directional clutches	Output section



7

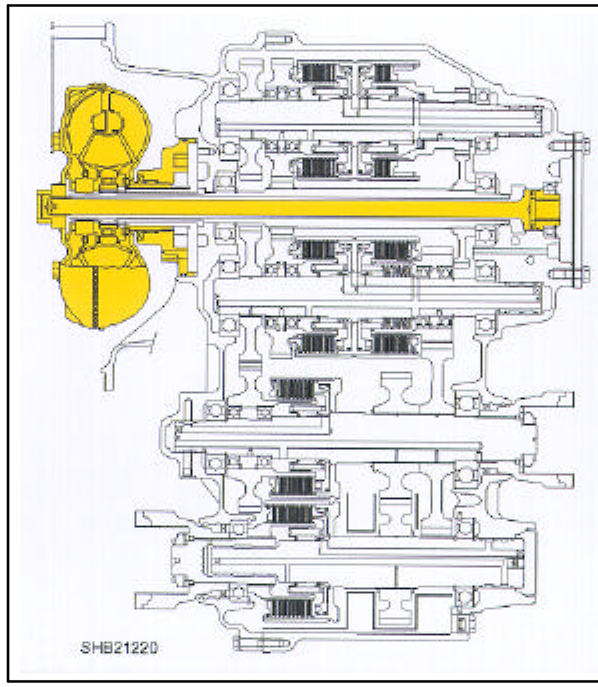
4 Wheel Drive Transmission – 4 Wheel Steer

(yellow)	Converter and pump drive section	(red)	Range clutches
(cyan)	Input or directional clutches	(green)	Output section

Converter And Pump Drive Section

Engine power is transmitted from the engine fly wheel to the impeller through the impeller cover. The rear of impeller cover has two drive tangs, which drives the transmission hydraulic pump.

The main Backhoe loader hydraulic pumps are mounted on the rear of the transmission. Drive is taken from inside the impeller cover, where a shaft takes the drive through the centre of the input shaft.



8

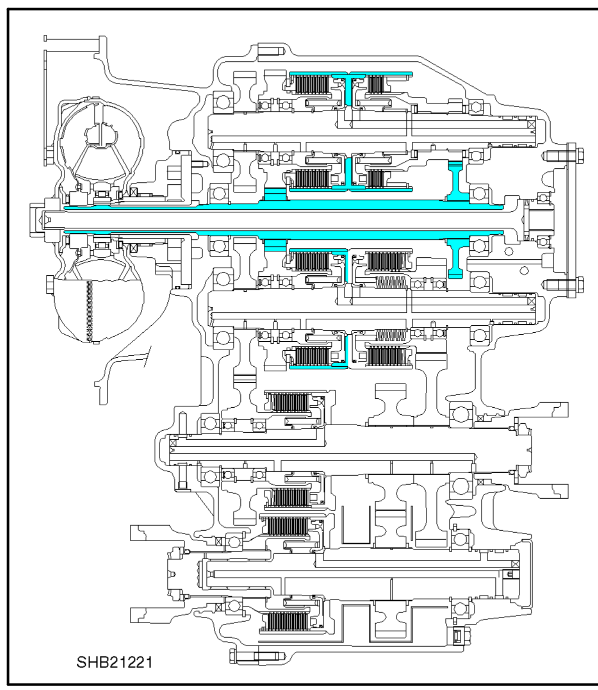
The converter and pump drive section

The Input Shaft And Directional Clutches

The turbine shaft driven from the turbine transmits power to the forward low, high or reverse clutches.

The clutch packs consists of housing, piston steel disc and then friction disc and so on. Each clutch pack has a different number of discs.

The clutches are pressure engaged, spring disengaged. The forward high, low and reverse clutch pack engagement is modulated by an electronic controlled valve.



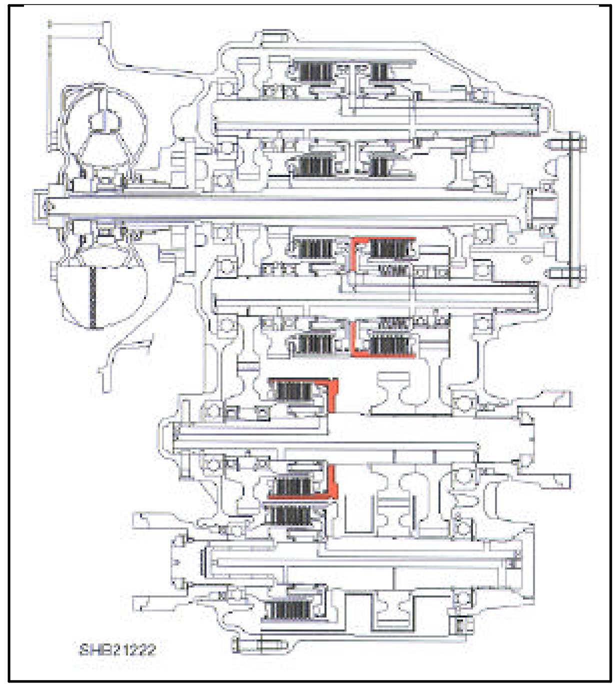
9

The input or directional clutches

The Range Clutches

Once a directional clutch is engaged power is transmitted to the range clutches (1st or 2nd). Operation and actuation of the clutch is similar to the directional clutches.

The engagement of these clutches are modulated, by means of a restriction valve fitted in the control valve which is controlled electronically, which limits oil flow to the clutch during shift. A Belleville plate is fitted in the clutch pack, this also regulates the build up of clamp force on the clutch plate.



10

The range clutches

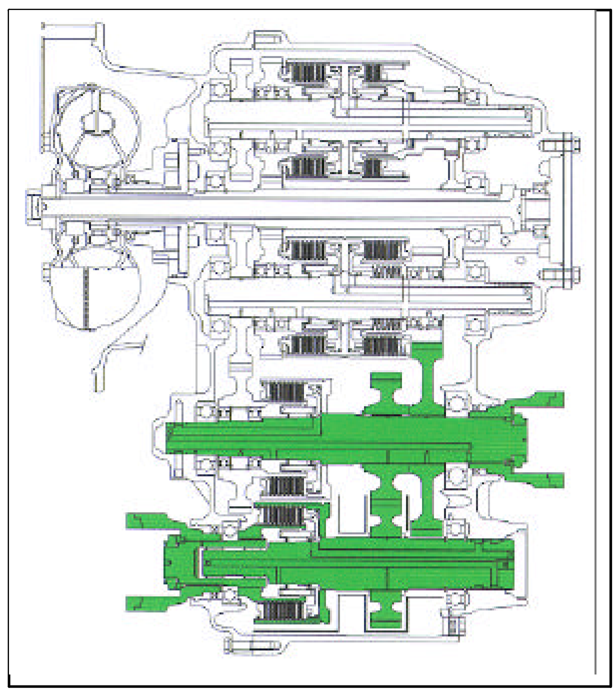
The Output Section

With the range clutch engaged power is finally transmitted to the output shafts.

The rear output is opposite to engine rotation, the front output rotation is the same as engine rotation when forward gear is selected.

The ratio from the front to the rear output is 0.951:1.

The front output is controlled by a clutch which is hydraulically engaged and spring disengaged. There is no modulation on the 4WD clutch. With no electrical signal to the control valve the clutch is engaged.

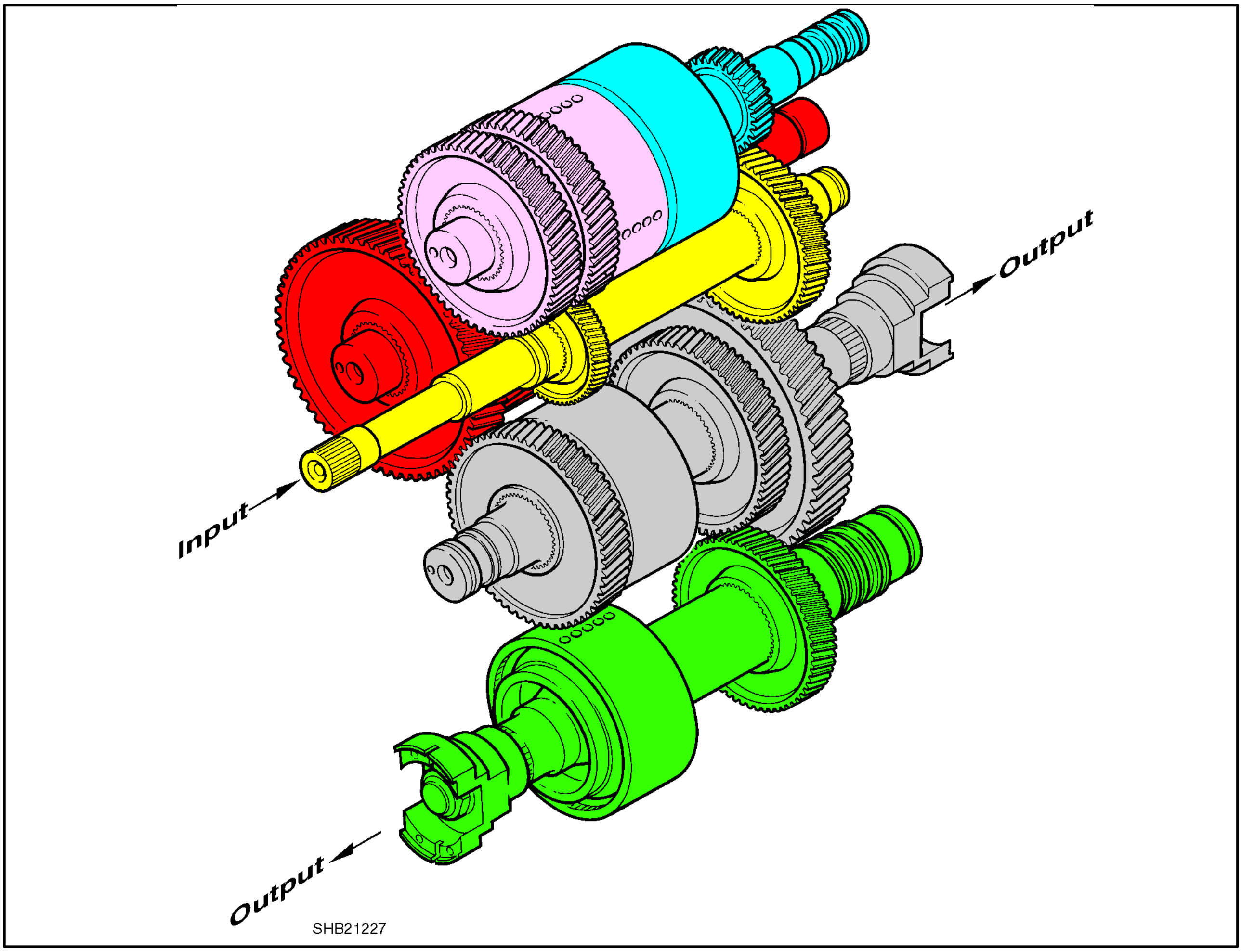


11

The output section

Transmission gear	Activated solenoids	Activated clutches
Forward 4	Forward	Forward high, 2nd
Forward 3	Forward, 2nd/1st	Forward high, 1st
Forward 2	Forward, Forward Hi/Low	Forward low, 2nd
Forward 1	Forward, Forward Hi/Low 1st/2nd	Forward low, 1st
Reverse 1	Reverse, 2nd/1st	Reverse, 1st
Reverse 2	Reverse	Reverse, 2nd
Four wheel drive off	Four wheel drive	None
Four wheel drive on	None	Four wheel drive

GEAR AND CLUTCH LAY-OUT



12

Forward Low

Forward High

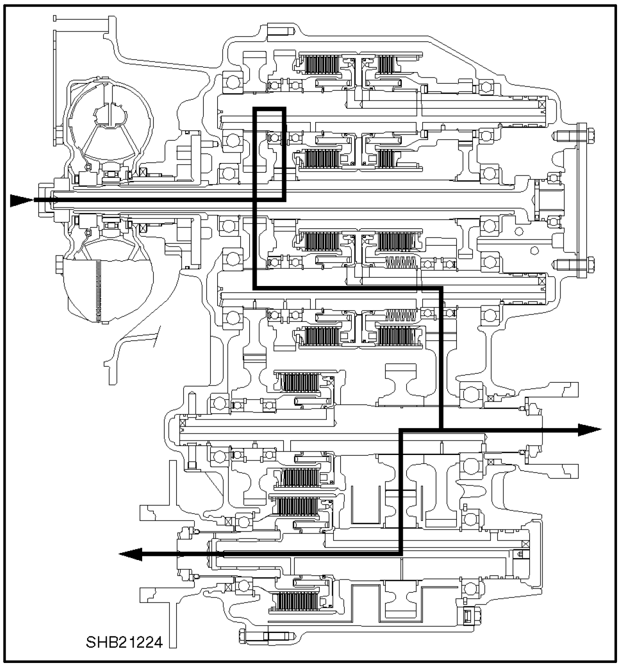
Reverse and 1st

Input

2nd

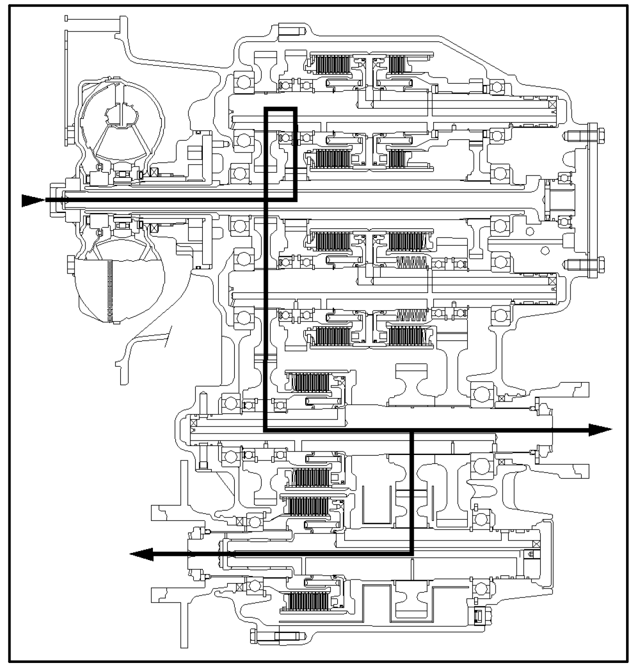
Disconnect

POWER FLOWS



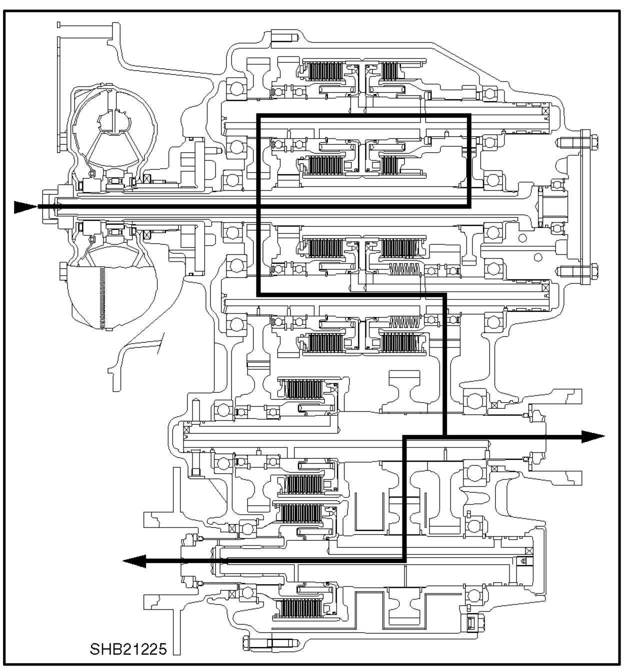
1ST SPEED FORWARD

1



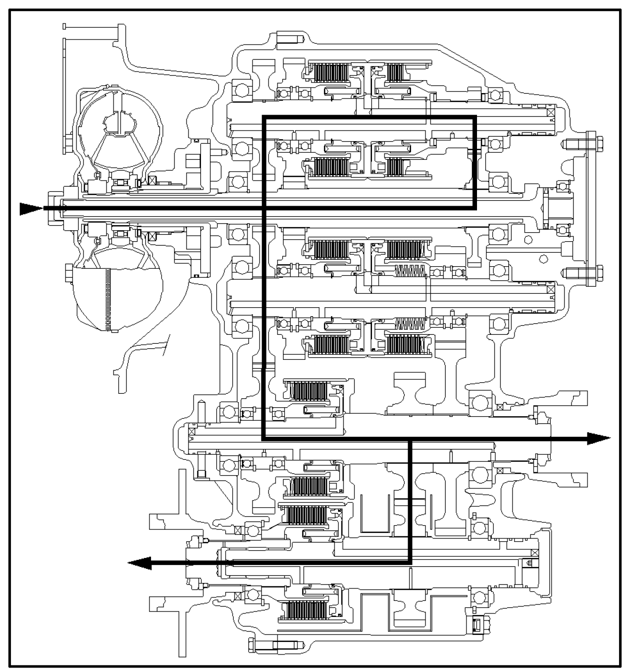
2ND SPEED FORWARD

2



3RD SPEED FORWARD

3

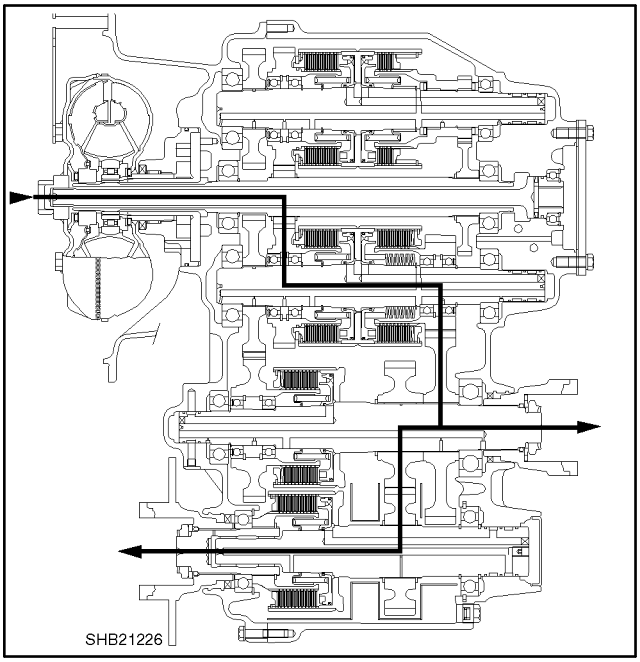


4TH SPEED FORWARD

4

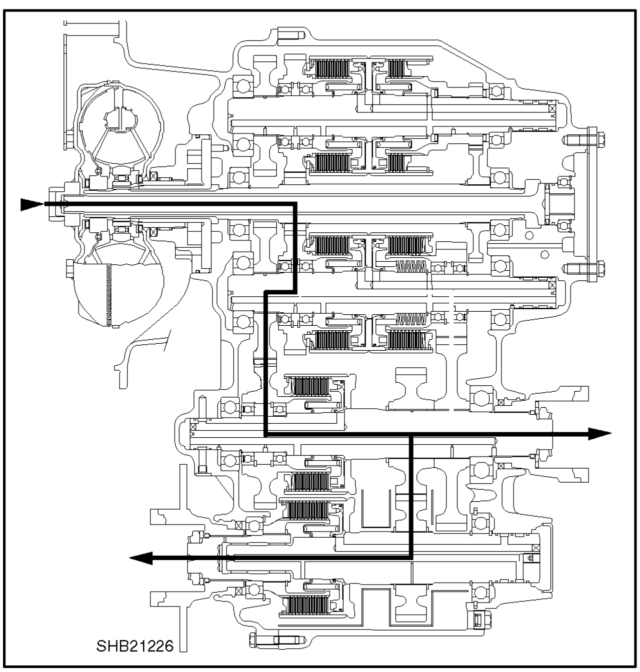
13

POWER FLOWS



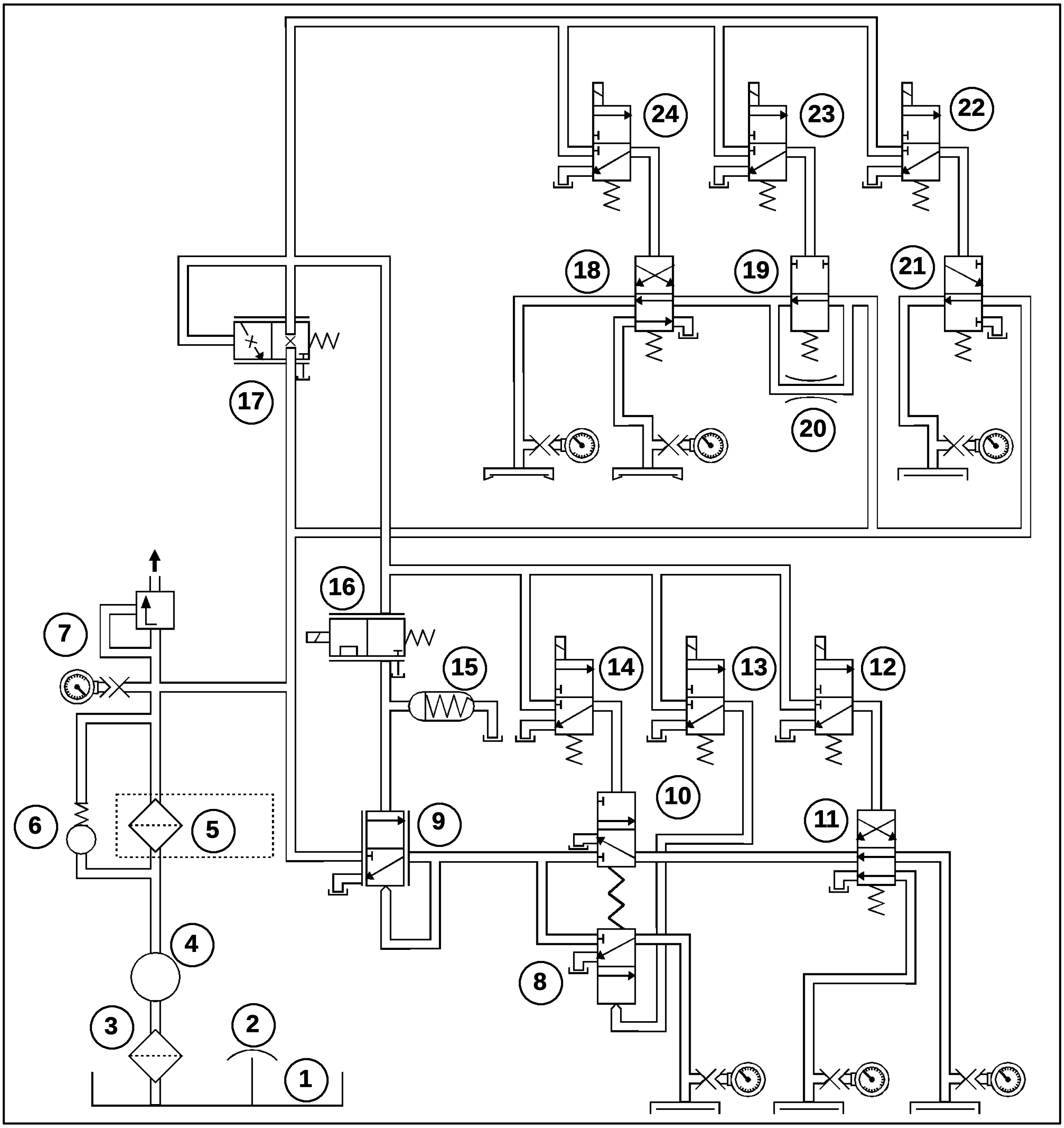
1ST SPEED REVERSE 5

14



2ND SPEED REVERSE 6

15



16

Operating Valves and Solenoids.

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Gerotor oil pump.
5. Pressure oil filter.
6. Filter by pass valve 4.3 bar (62.4 psi).
7. System pressure regulating valve 20 bar (290 psi) – Oil to converter circuit..
8. Neutral reverse shift spool.
9. Pressure booster 0 – 20 bar(0 –292 psi).
10. Neutral forward solenoid.
11. High / low shift spool.
12. High / low solenoid.
13. Neutral reverse solenoid.
14. 1st gear clutch.
15. Accumulator.
16. Electronic modulation valve 0–5.5 bar(0 – 80 psi).
17. Pressure reducing valve 5.5 bar (80 psi).
18. 2nd / 1st shift spool.
19. Range modulation spool.
20. Range modulation restriction.
21. Four wheel drive shift spool.
22. Four wheel drive solenoid.
23. Range modulation solenoid.
24. 2nd / 1st Solenoid.

Hydraulic Oil Flows

Oil flows to the pressure regulating valve, maintaining system pressure to the control valve and clutches at 20 bar (292 psi).

Excess oil flow is bleed off to the converter circuit which is protected by a 10 bar (145 psi) safety valve.

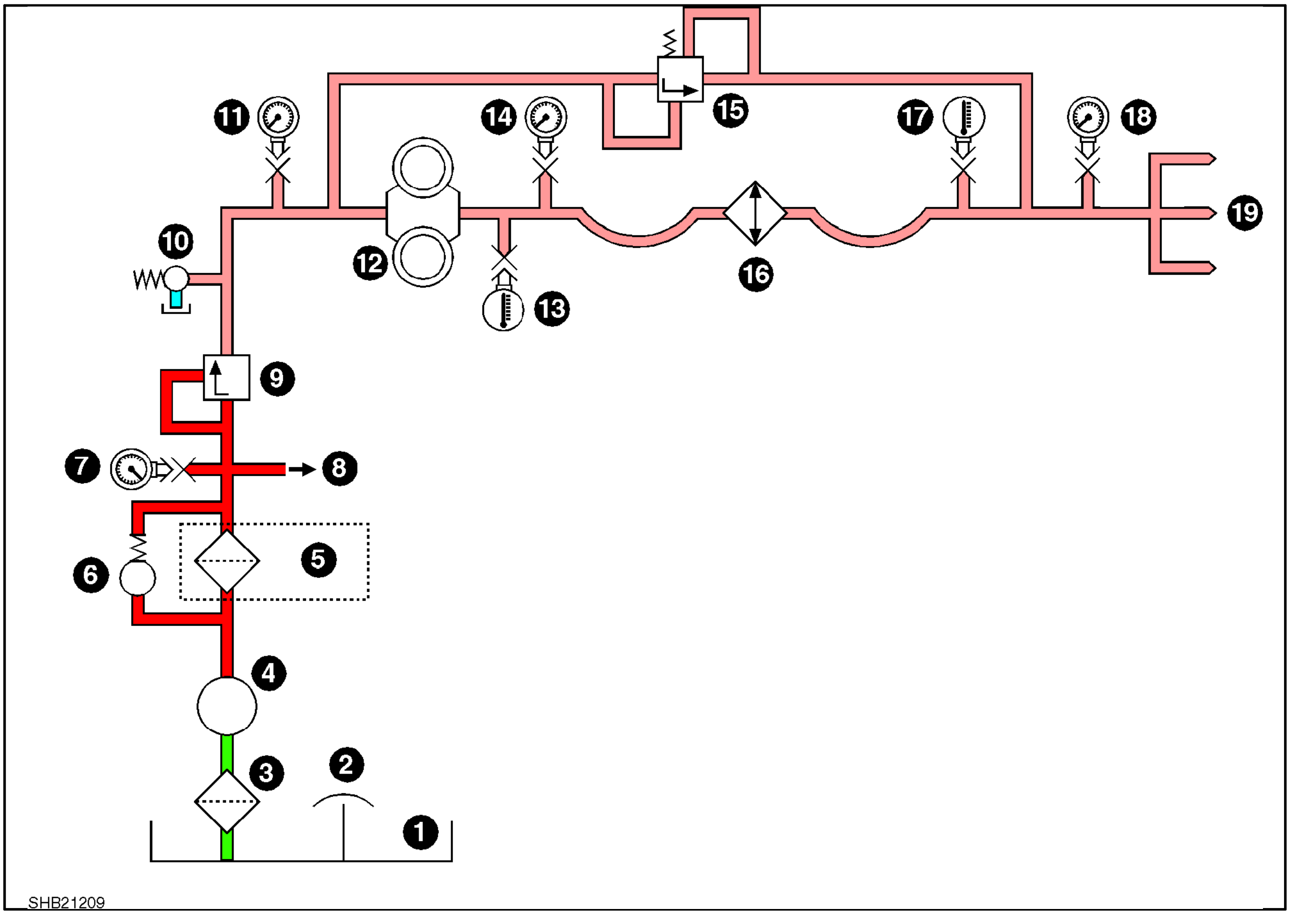
Oil enters the converter through the converter blade cavity and exits in the passage between the turbine shaft and pump drive. Oil then flow to the external cooler.

Across the converter and oil cooler circuit a by pass valve is fitted if the pressure difference is more than 4 bar (58 psi) the valve will open. Directing excess oil to the lubrication circuit. This protects the system during start up from cold oil or at high revs/min.

After leaving the cooler the oil is directed via a single fitting on the rear of the transmission to a series of tubes and passages, to lubricate and cool the transmission bearings and clutches.

Oil is drawn up from the sump, via an internal strainer, through the inlet port of the hydraulic pump. Oil is pumped out to the pressure filter. Across the oil filter is a filter by pass valve which will open if the pressure difference becomes higher than 4.3 bar (62.5 psi).

Oil then drains back by gravity to the transmission sump.



17

Torque converter and cooler circuit

Suction Oil

High Pressure Oil

Return to Reservoir

Torque Converter and Lubrication Oil

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Gerotor oil pump.
5. Pressure oil filter.
6. Filter by–pass valve. 4.3 bar (62.5 psi).
7. System pressure test port 20 bar (292 psi).
8. Oil flow to control valve.
9. System pressure regulating valve 20 bar (292 psi)
10. Converter circuit safety valve 10 bar (145 psi).
11. Converter system pressure test port 5 bar (73 psi).
12. Torque converter.
13. Converter oil temperature port.
14. Oil cooler pressure test port.
15. Converter pressure by pass valve 4 bar (58 psi).
16. Oil cooler.
17. Oil temperature port after cooler.
18. Lubrication pressure port.
19. Lubrication galleries.

TRANSMISSION CONTROL VALVE

When the unit has no electrical power it will default to Neutral, 2nd gear with four wheel drive engaged (if clutch pressure is active 20 bar (290 psi).

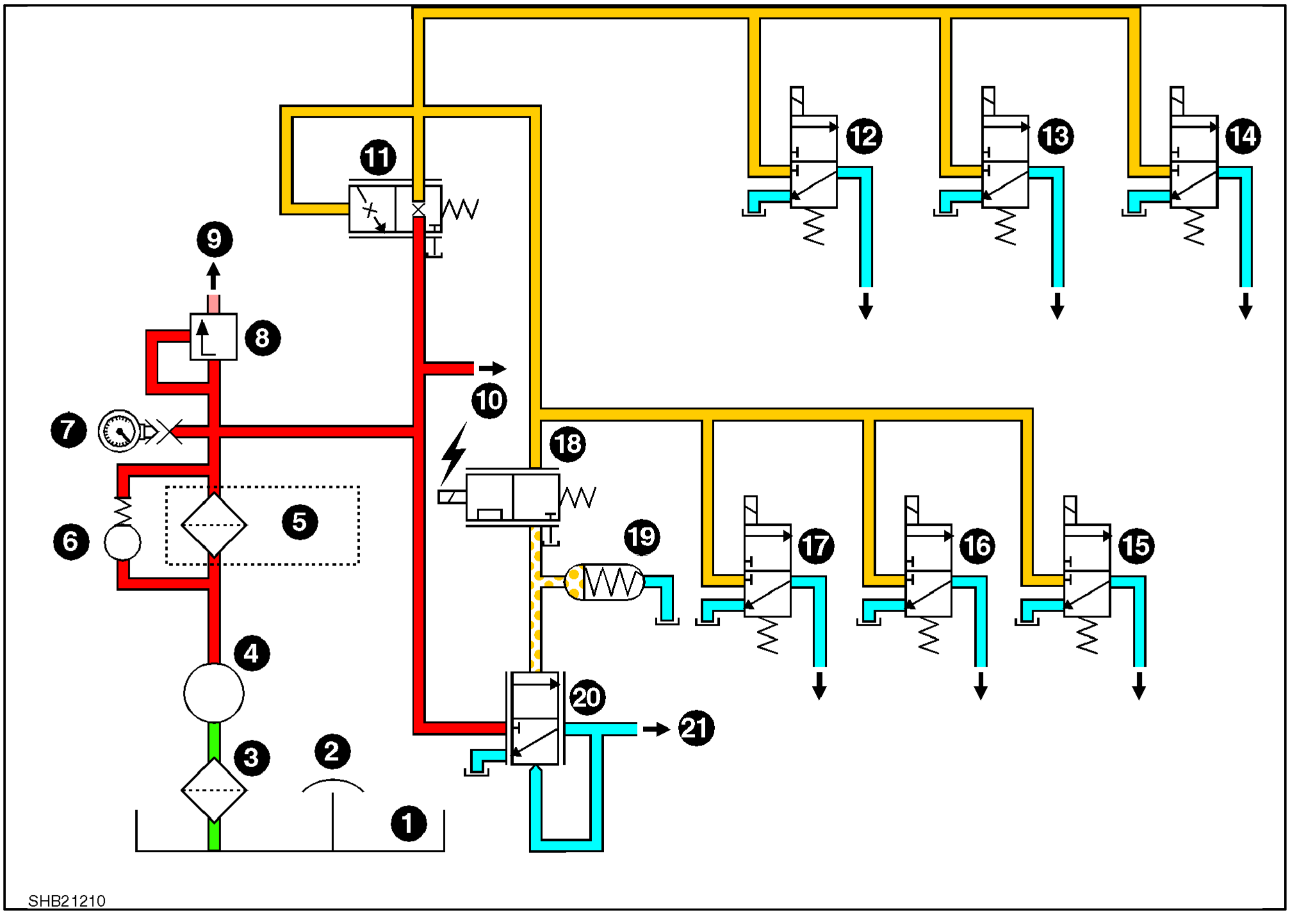
The control valve consists of 6 low pressure solenoids, 6 shift spools, a pressure reducer, an electronic controlled modulation valve, an accumulator, a pressure booster, a speed/temperature sensor and torque convertor bypass valve.

Transmission gear	Activated solenoids	Activated clutches
Forward 4	Forward	Forward high, 2nd
Forward 3	Forward, 2nd/1st	Forward high, 1st
Forward 2	Forward, Forward Hi/Low	Forward low, 2nd
Forward 1	Forward, Forward Hi/Low 1st/2nd	Forward low, 1st
Reverse 1	Reverse, 2nd/1st	Reverse, 1st
Reverse 2	Reverse	Reverse, 2nd
Four wheel drive off	Four wheel drive	None
Four wheel drive on	None	Four wheel drive

PILOT PRESSURE CIRCUIT.

Pressure oil from the system regulating valve flows to the pressure reducing valve. The pressure drops to 5.5 bar (80 psi). This oil flows to the 6 solenoids. Oil also supplies the modulation valve.

At start up none of the solenoids are energised. There is no pilot oil pressure supplied to the shift spools.



18

Servo pilot pressure circuit

- Suction Oil
- High Pressure Oil
- Torque Converter and Lubrication Oil
- Return to Reservoir
- Pilot Pressure
- Modulated Pilot Oil

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Pressure filter.
5. Gerotor oil pump.
6. Filter by pass valve 4.3 bar (62.5 psi).
7. System pressure test port 20 bar (292 psi).
8. System pressure regulating valve 20 bar (292 psi).
9. Oil flow to converter.
10. Oil flow to shift spools.
11. Pressure reducing valve 5.5 bar (80 psi).
12. 2nd / 1st Solenoid.
13. Range modulation solenoid.
14. Four wheel drive solenoid.
15. High / Low solenoid.
16. Neutral reverse solenoid.
17. Neutral forward solenoid.
18. Electronic modulation valve 0 – 5.5 bar (0 –80 psi)
19. Accumulator.
20. Pressure booster 0 – 20 bar (0 – 292 psi).
21. Modulated pressure to shift spools 0 – 20 bar (0 – 292 psi).

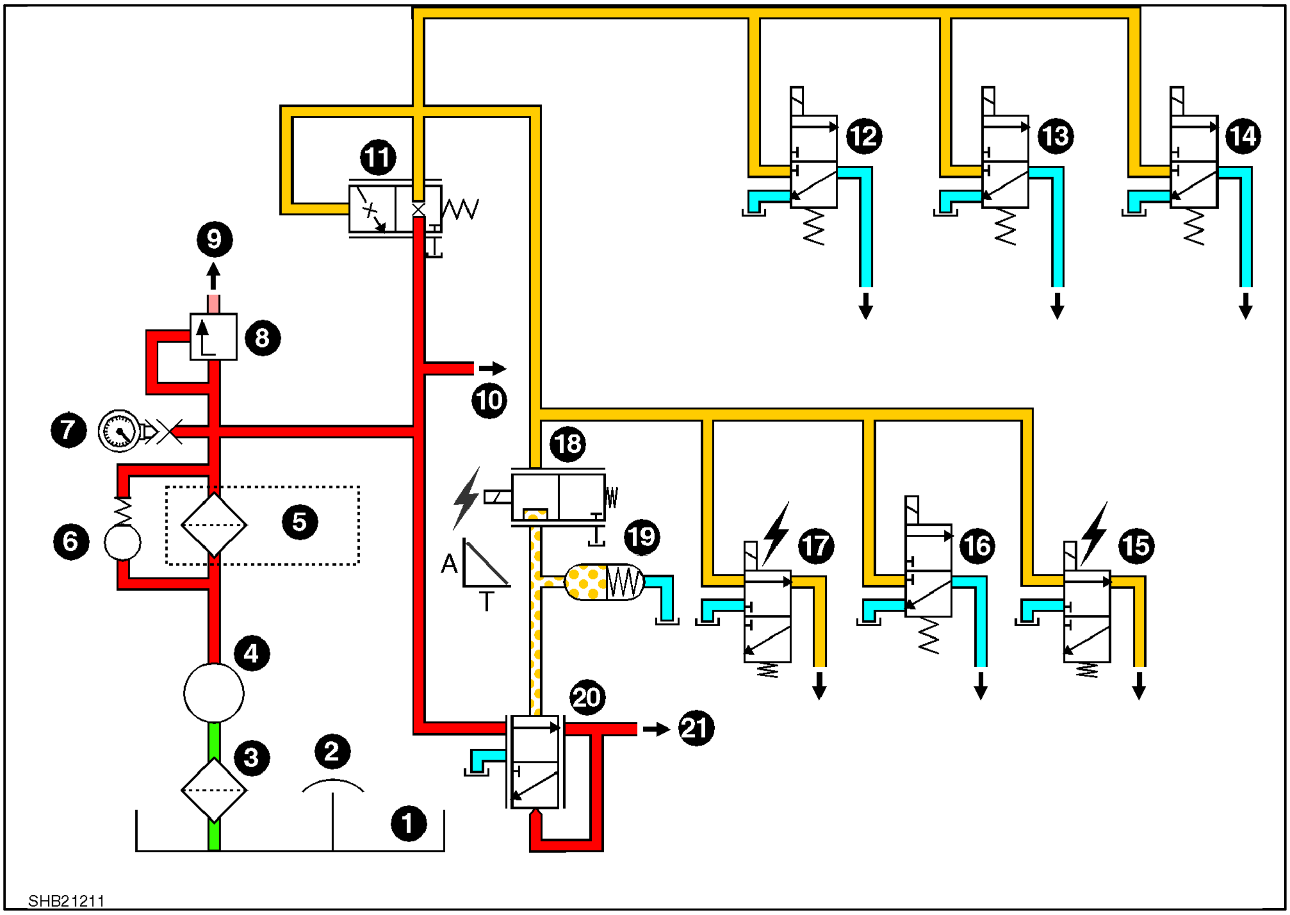
SERVO CONTROL FORWARD SECOND GEAR FOUR WHEEL DRIVE ENGAGED.

System pressure is reduced to 5.5 bar (80 psi) by the pressure reducer this oil then supplies the 6 solenoids and electronic modulation valve.

When the powershift lever is moved forward and twisted anti clock wise an electrical signal is sent to:–

1. The high low solenoid which energises allowing pilot oil to flow to the shift spool.
2. The neutral forward solenoid which energises allowing pilot oil to flow to the shift spool.
3. The powershift lever will then reduce the current to the modulation valve which gives an out put pressure curve from 0 to 5.5 bar (0 to 80 psi) to the pressure booster valve.
4. The modulation pressure curve is multiplied by 4 in the pressure booster so that a curve of 0 – 20 bar (0 – 292 psi) is available for the directional clutches.

Between the modulation valve and the booster is accumulator to dampen any hydraulic vibration.



19

Servo control forward second gear, four wheel drive engaged.

Suction Oil	Return to Reservoir
High Pressure Oil	Pilot Pressure
Torque Converter and Lubrication Oil	Modulated Pilot Oil

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Pressure filter. 20 bar (292 psi).
5. Gerotor oil pump.
6. Filter by pass valve 4.3 bar (62.4 psi)
7. System pressure test port
8. System pressure regulating valve 20 bar (292 psi).
9. Oil flow to converter.
10. Oil flow to shift spools 0 – 20 bar (0 – 292 psi).
11. Pressure reducing valve 5.5 bar (80 psi).
12. 2nd / 1st Solenoid.
13. Range modulation solenoid.
14. Four wheel drive solenoid.
15. High / Low solenoid.
16. Neutral reverse solenoid.
17. Neutral forward solenoid.
18. Electronic modulation valve 0 – 5.5 bar (0 – 80 psi)
19. Accumulator.
20. Pressure booster 0 – 20 bar (0 – 292 psi).
21. Modulated pressure to shift spools

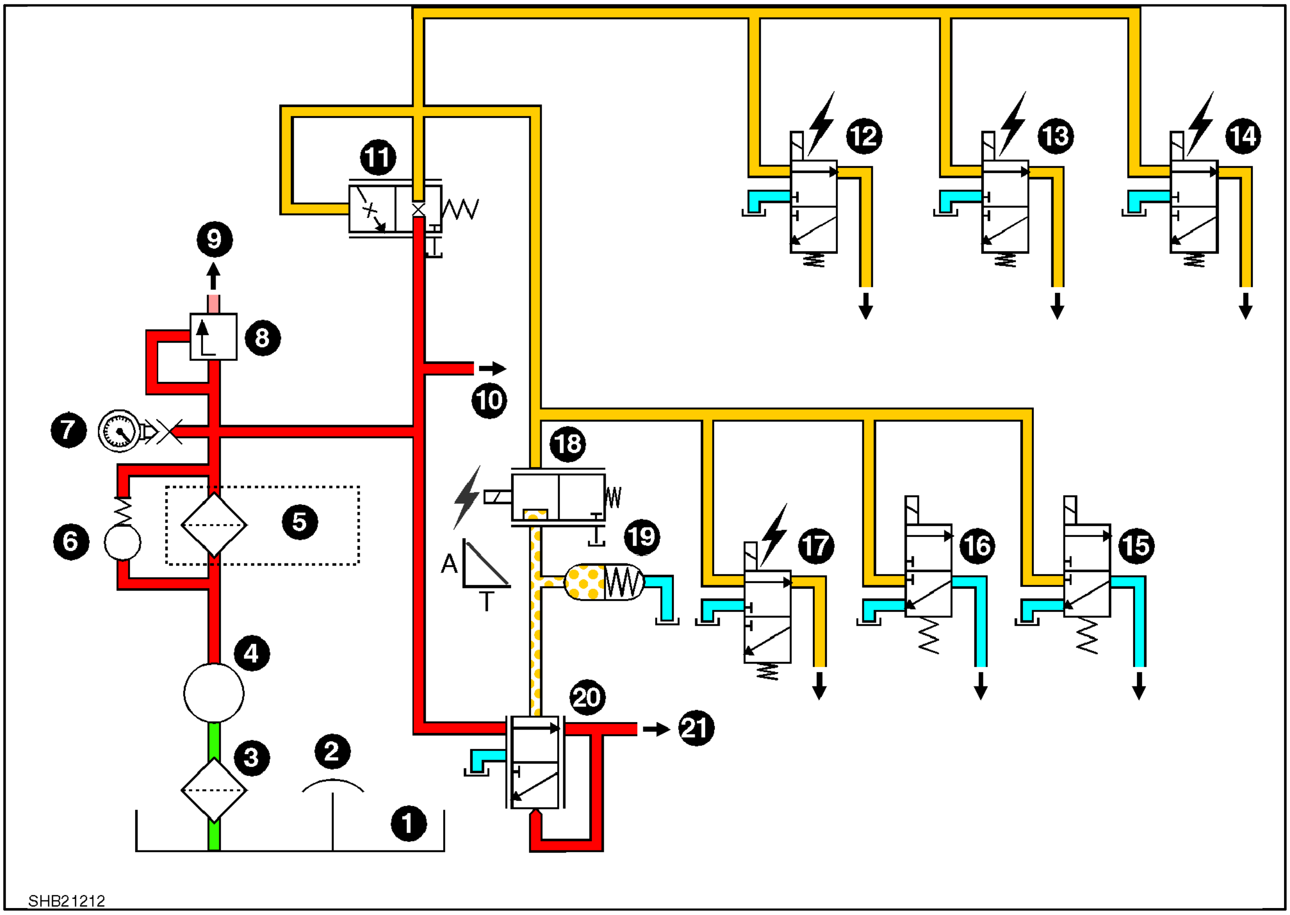
CONTROL FORWARD THIRD GEAR FOUR WHEEL DRIVE DISENGAGED.

System pressure is reduced to 5.5 bar (80 psi) by the pressure reducer this oil then supplies the 6 solenoids and electronic modulation valve.

When the powershift lever is moved forward and twisted anti clock wise an electrical signal is sent to:–

1. The range modulation solenoid sending pilot pressure to the spool.
2. The 1st 2nd solenoid sending pilot pressure to the spool.
3. Once the 3rd gear has been engaged the range modulation solenoid will be de–energised
4. The high/low solenoid prevents pilot oil to flow to the shift spool.
5. The neutral forward solenoid allowing pilot oil to flow to the shift spool.
6. The powershift electronics will then reduce the current to the modulation valve which gives an out put pressure curve from 0 – 5.5 bar (0 to 80 psi) to the pressure booster valve.
7. The modulation pressure curve is multiplied by 4 in the pressure booster so that a curve of 0 – 20 bar (0 – 292 psi) is available for the directional clutch.

   Between the modulation valve and the booster is accumulator to dampen any hydraulic vibration.
8. The four wheel drive solenoid supplies pilot oil to the shift spool



20

Servo control forward third gear, four wheel drive disengaged.

Suction Oil

High Pressure Oil

Torque Converter and Lubrication Oil

Return to Reservoir

Pilot Pressure

Modulated Pilot Oil

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Pressure filter.
5. Gerotor oil pump.
6. Filter by pass valve 4.3 bar (62.4 psi).
7. System pressure test port 20 bar (292 psi).
8. System pressure regulating valve20 bar (297 psi).
9. Oil flow to converter.
10. Oil flow to shift spools.
11. Pressure reducing valve 5.5 bar (80 psi).
12. 2nd / 1st Solenoid.
13. Range modulation solenoid.
14. Four wheel drive solenoid.
15. High / Low solenoid.
16. Neutral reverse solenoid.
17. Neutral forward solenoid.
18. Electronic modulation valve 0 – 5.5 bar (0 –80 psi)
19. Accumulator.
20. Pressure booster 0 – 20 bar (0 – 292 psi).
21. Modulated pressure to shift spools 0 – 20 bar (0 – 292 psi).

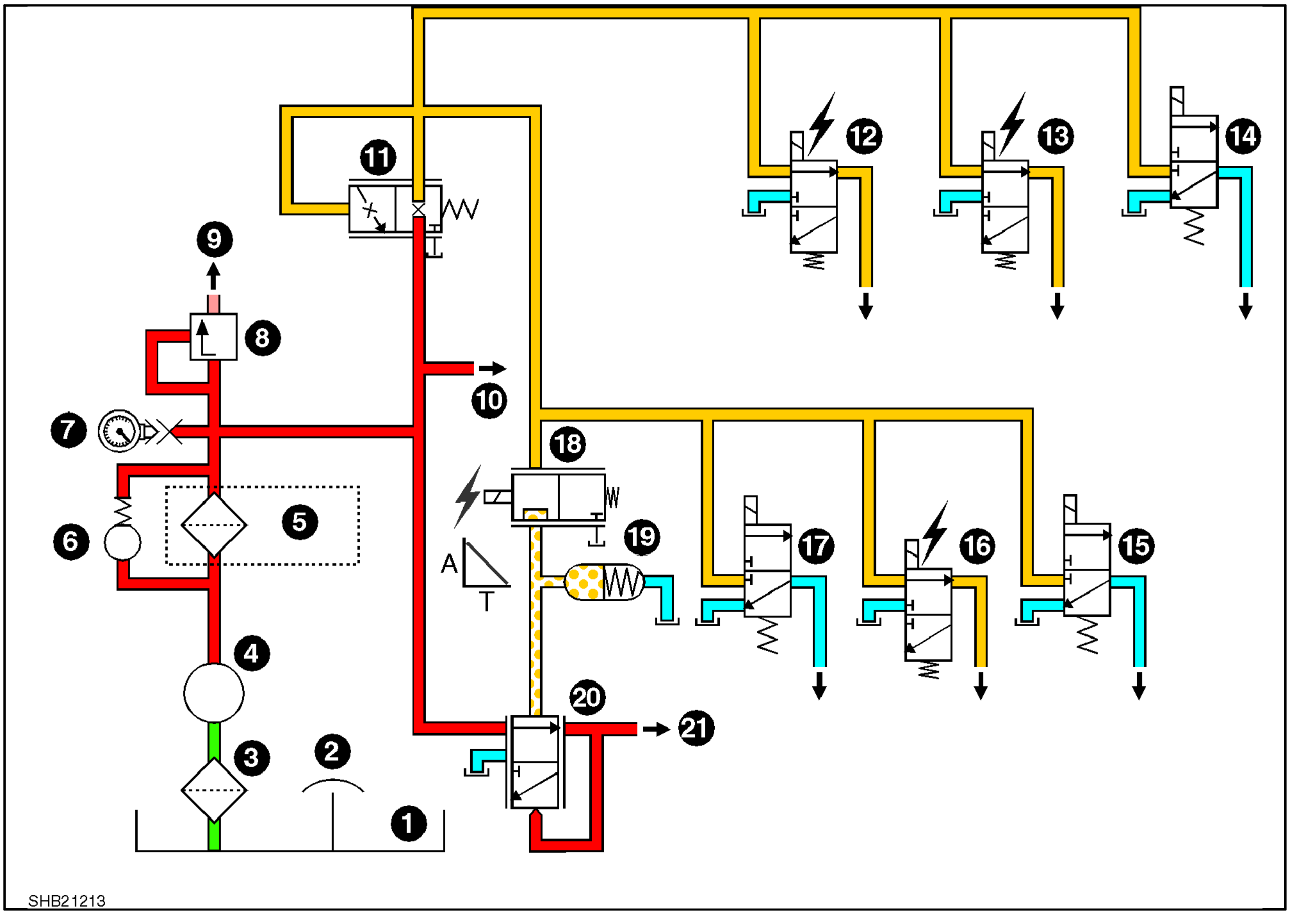
SERVO CONTROL REVERSE FIRST GEAR FOUR WHEEL DRIVE ENGAGED.

System pressure is reduced to 5.5 bar (80 psi) by the pressure reducer this oil then supplies the 6 solenoids and electronic modulation valve.

When the powershift lever is moved rearward and twisted clock wise a electrical signal is sent to:–

1. The range modulation solenoid sending pilot pressure to the spool.
2. The 1st 2nd solenoid sending pilot pressure to the spool.
3. Once the 1st gear has been engaged the range modulation solenoid will be de–energised
4. The low/high solenoid sends pilot oil to the shift spool.
5. The neutral reverse solenoid allowing pilot oil to flow to the shift spool.
6. The powershift lever microprocessor will then reduce the current to the modulation valve which gives an out put pressure curve from 0–5.5 bar (0–80 psi) to the pressure booster valve.
7. The modulation pressure curve is multiplied by 4 in the pressure booster so that a curve of 0 – 20 bar (0 – 292 psi) is available for the directional clutches.

Between the modulation valve and the booster is accumulator to dampen any hydraulic vibration.



21

Servo control reverse first gear, four wheel drive engaged.

Suction Oil

Return to Reservoir

High Pressure Oil

Pilot Pressure

Torque Converter and Lubrication Oil

Modulated Pilot Oil

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Pressure filter.
5. Gerotor oil pump.
6. Filter by pass valve 4.3 bar (62.4 psi)
7. System pressure test port 20 bar (292 psi).
8. System pressure regulating valve 20 bar (292 psi).
9. Oil flow to converter.
10. Oil flow to shift spools.
11. Pressure reducing valve 5.5 bar (80 psi).
12. 2nd / 1st Solenoid.
13. Range modulation solenoid.
14. Four wheel drive solenoid.
15. High / Low solenoid.
16. Neutral reverse solenoid.
17. Neutral forward solenoid.
18. Electronic modulation valve 0 – 5.5 bar(0 – 80 psi)
19. Accumulator.
20. Pressure booster 0 – 20 bar (0 – 292 psi).
21. Modulated pressure to shift spools 0 – 20 bar (0 – 292 psi).

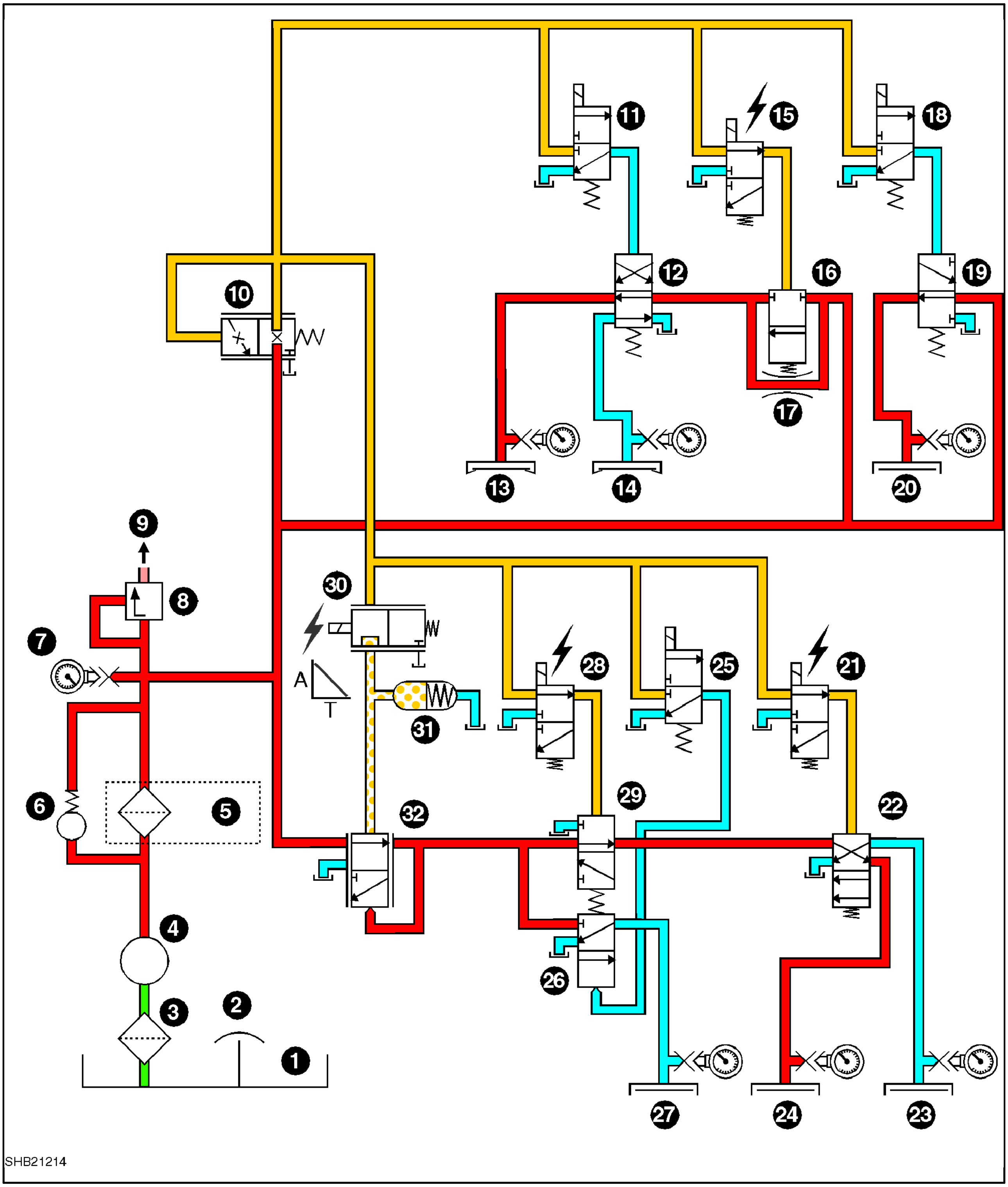
CONTROL VALVE OPERATION FORWARD, SECOND GEAR WITH FOUR WHEEL DRIVE ENGAGED.

Pressure oil from the system regulating valve flows to the pressure reducing valve. The pressure drops to 5.5 bar (80 psi). This oil flows to the 6 solenoids. Oil also supplies the modulation valve.

When the powershift lever lever is moved forward and twisted anti clock wise a electrical signal is sent to:–

1. Oil flows from the system pressure regulating valve at 20 bar through the four wheel drive spool to engage the 4WD clutch.
2. System pressure also flows through the range modulation valve, then through the 1st 2nd spool to engage the 2nd gear clutch.
3. The high low solenoid which energises allowing pilot oil to flow to the shift spool. this will allow oil to flow to the low clutch.
4. The neutral forward solenoid which energises allows pilot pressure to flow to the shift spool this will allow oil to flow on to the forward low shift spool.
5. The modulation valve has a reducing current from the microprocessor, pilot pressure gradually increases acting on the boost valve and it multiplies pilot pressure.
6. The oil from the boost valve is modulated allowing a steady increase of pressure to act on the forward low clutch pack which gradually takes up drive until clutch pressure reaches 20 bar (292 psi).

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Gerotor oil pump.
5. Pressure oil filter.
6. Filter by pass valve 4.3 bar (62.4 psi).
7. System pressure test port.
8. System pressure regulating valve20 bar (290 psi).
9. Oil to converter circuit.
10. Pressure reducing valve 5.5 bar (80 psi).
11. 2nd / 1st Solenoid.
12. 2nd / 1st shift spool.
13. 2nd gear clutch.
14. 1st gear clutch.
15. Range modulation solenoid.
16. Range modulation spool.
17. Range modulation restriction.
18. Four wheel drive solenoid.
19. Four wheel drive shift spool.
20. Four wheel drive clutch.
21. High / low solenoid.
22. High / low shift spool.
23. Forward high clutch.
24. Forward low clutch.
25. Neutral reverse solenoid.
26. Neutral reverse shift spool.
27. Reverse clutch.
28. Neutral forward solenoid.
29. Neutral forward shift spool.
30. Electronic modulation valve 0 – 5.5 bar (0 – 80 psi).
31. Accumulator.
32. Pressure booster 0 – 20 bar(0 –292 psi).



22

Control valve operation forward second gear with four wheel drive engaged.

(green)	Suction Oil	(cyan)	Return to Reservoir
(red)	High Pressure Oil	(yellow)	Pilot Pressure
(pink)	Torque Converter and Lubrication Oil	(white)	Modulated Pilot Oil

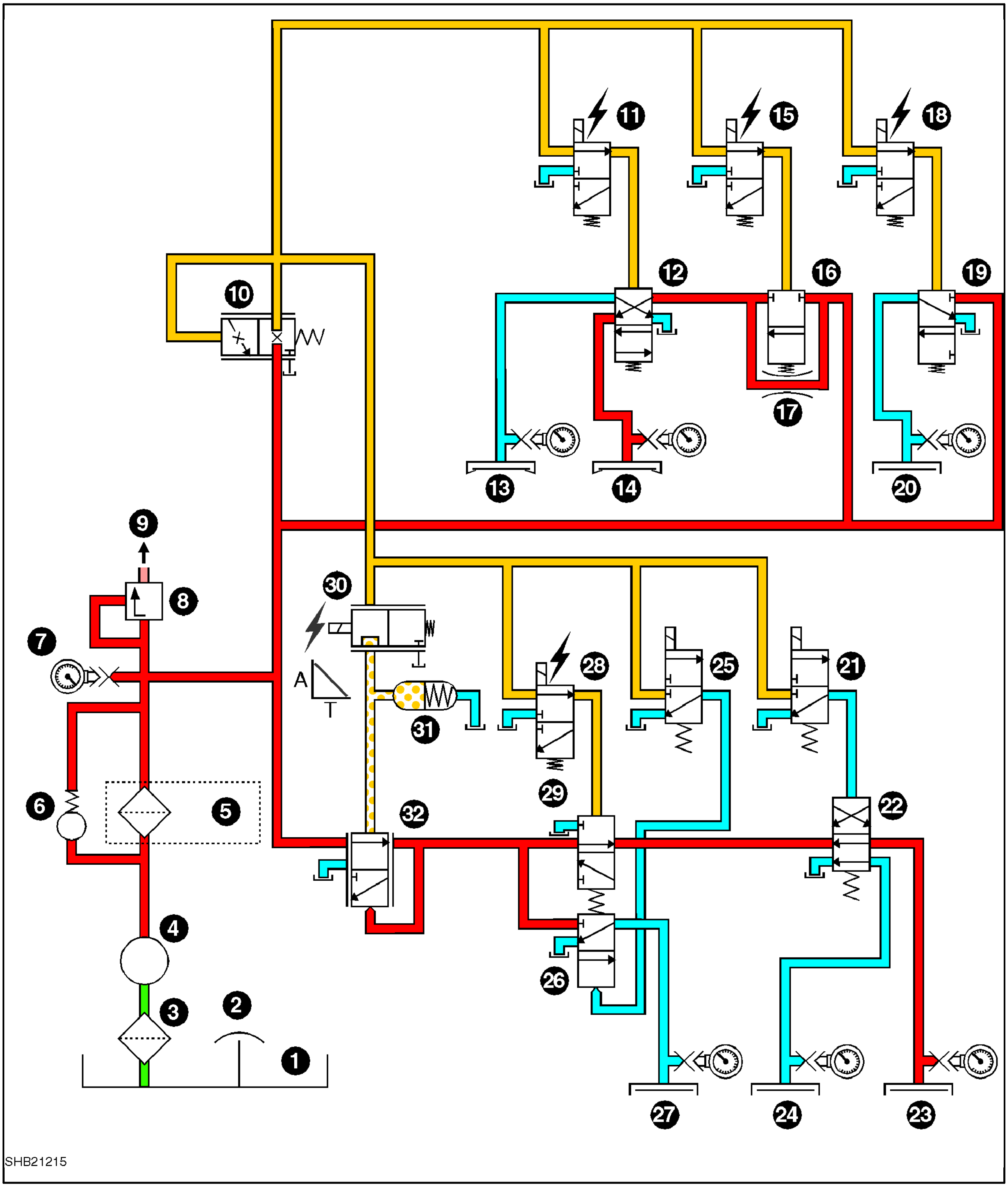
CONTROL VALVE OPERATION FORWARD, THIRD GEAR WITH FOUR WHEEL DRIVE DISENGAGED.

Pressure oil from the system regulating valve flows to the pressure reducing valve. The pressure drops to 5.5 bar (80 psi). This oil flows to the 6 solenoids. Oil also supplies the modulation valve.

When the powershift lever is moved forward and twisted anti clock wise and the 4WD is switched off a electrical signal is sent to:–

1. The 4WD solenoid, sending pilot pressure to the shift spool. This will move the spool preventing oil flowing to the clutch disengaging 4WD.
2. The range modulation solenoid allowing pilot oil to the range modulation valve, which restricting oil flow to the 1st 2nd shift spool.
3. The 1st 2nd solenoid, sending pilot pressure to the 1st 2nd shift spool which directs oil to the 1st clutch.
4. Once the 1st gear clutch is engaged the range solenoid is de–energised and full flow will go to the 1st gear clutch.
5. The neutral forward solenoid which energises allows pilot pressure to flow to the shift spool this will allow oil to flow on to the forward high shift spool.
6. The modulation valve has a reducing current from the microprocessor, pilot pressure gradually increases acting on the boost valve and it multiplies pilot pressure by 4. The oil from the boost valve is modulated allowing a steady increase of pressure to act on the forward high clutch pack which gradually takes up drive until clutch pressure reaches 20 bar (292 psi).

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Gerotor oil pump.
5. Pressure oil filter.
6. Filter by pass valve 4.3 bar (62.4 psi).
7. System pressure test port.
8. System pressure regulating valve 20 bar (290 psi).
9. Oil to converter circuit.
10. Pressure reducing valve 5.5 bar (80 psi).
11. 2nd / 1st Solenoid.
12. 2nd / 1st shift spool.
13. 2nd gear clutch.
14. 1st gear clutch.
15. Range modulation solenoid.
16. Range modulation spool.
17. Range modulation restriction.
18. Four wheel drive solenoid.
19. Four wheel drive shift spool.
20. Four wheel drive clutch.
21. High / low solenoid.
22. High / low shift spool.
23. Forward high clutch.
24. Forward low clutch.
25. Neutral reverse solenoid.
26. Neutral reverse shift spool.
27. Reverse clutch.
28. Neutral forward solenoid.
29. Neutral forward shift spool.
30. Electronic modulation valve 0 – 5.5 bar (0 – 80 psi).
31. Accumulator.
32. Pressure booster 0 – 20 bar(0 –292 psi).



23

Control valve operation forward third gear with four wheel drive disengaged.

Suction Oil	Return to Reservoir
High Pressure Oil	Pilot Pressure
Torque Converter and Lubrication Oil	Modulated Pilot Oil

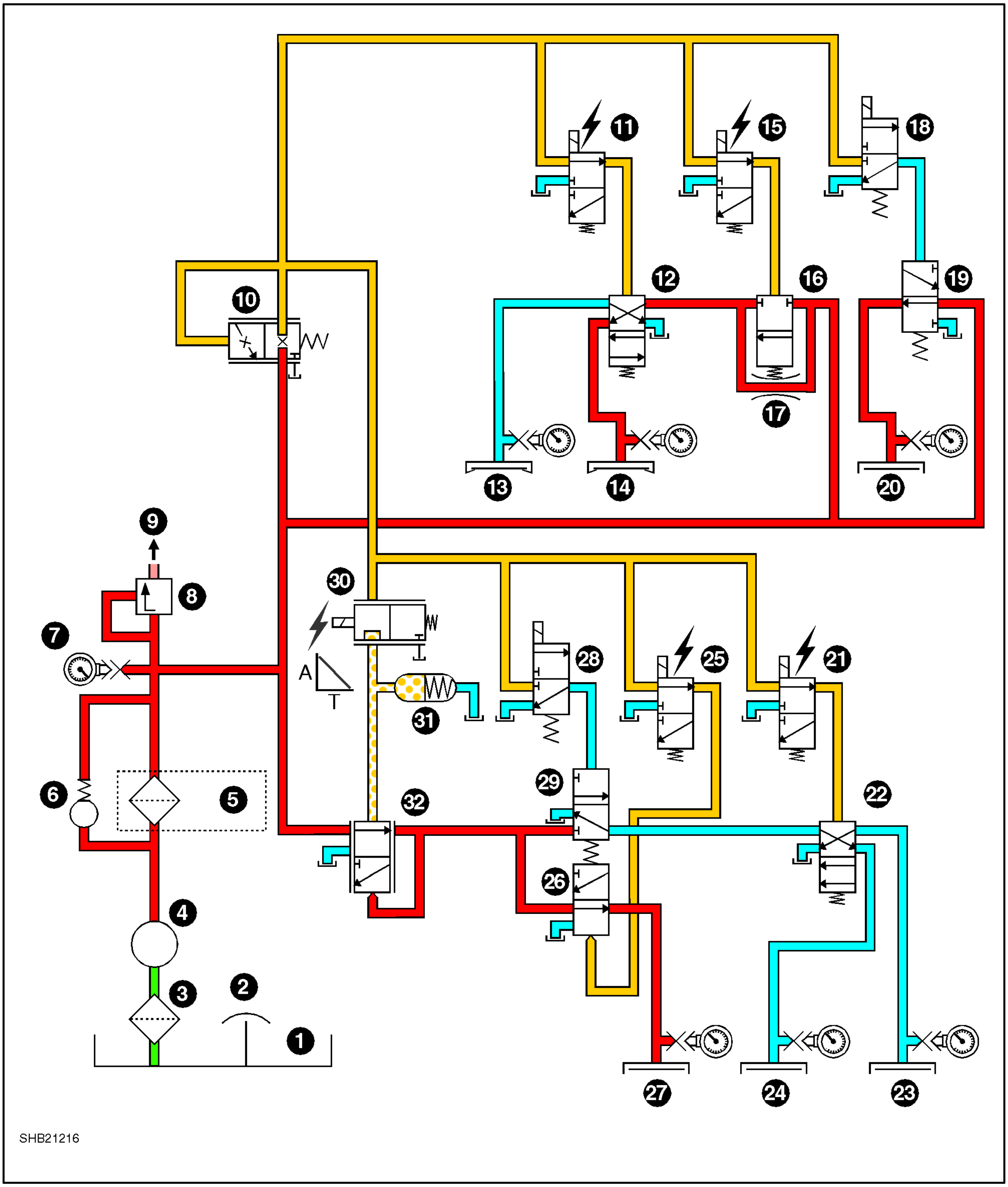
CONTROL VALVE OPERATION REVERSE, FIRST GEAR WITH FOUR WHEEL DRIVE ENGAGED.

Pressure oil from the system regulating valve flows to the pressure reducing valve. The pressure drops to 5.5 bar (80 psi). This oil flows to the 6 solenoids. Oil also supplies the modulation valve.

When the powershift lever is moved rearward, kick-down button is depressed and the 4WD is switched off a electrical signal is sent to:-

1. The range modulation solenoid allowing pilot oil to the range modulation valve, which restricting oil flow to the 1st 2nd shift spool.
2. The 1st 2nd solenoid, sending pilot pressure to the 1st 2nd shift spool which directs oil to the 1st clutch.
3. Once the 1st gear clutch is engaged the range solenoid is de-energised and full flow will go to the 1st gear clutch.
4. The neutral reverse solenoid which energises allows pilot pressure to flow to the shift spool this will allow oil to flow on to the reverse shift spool.
5. The modulation valve has a reducing current from the microprocessor, pilot pressure gradually increases acting on the boost valve and it multiplies pilot pressure.
6. The oil from the boost valve is modulated allowing a steady increase of pressure to act on the reverse clutch pack which gradually takes up drive until clutch pressure reaches 20 bar (292 psi).

1. Transmission sump.
2. Transmission breather.
3. Suction strainer.
4. Gerotor oil pump.
5. Pressure oil filter.
6. Filter by pass valve 4.3 bar (62.4 psi).
7. System pressure test port.
8. System pressure regulating valve 20 bar (290 psi).
9. Oil to converter circuit.
10. Pressure reducing valve 5.5 bar (80 psi).
11. 2nd / 1st Solenoid.
12. 2nd / 1st shift spool.
13. 2nd gear clutch.
14. 1st gear clutch.
15. Range modulation solenoid.
16. Range modulation spool.
17. Four wheel drive solenoid.
18. Range modulation restriction.
19. Four wheel drive shift spool.
20. Four wheel drive clutch.
21. High / low solenoid.
22. High / low shift spool.
23. Forward high clutch.
24. Forward low clutch.
25. Neutral reverse solenoid.
26. Neutral reverse shift spool.
27. Reverse clutch.
28. Neutral forward solenoid.
29. Neutral forward shift spool.
30. Electronic modulation valve 0 - 5.5 bar (0 - 80 psi).
31. Accumulator.
32. Pressure booster 0 - 20 bar (0 -292 psi).



24

Control valve operation reverse first gear with four wheel drive engaged.

Suction Oil

Return to Reservoir

High Pressure Oil

Pilot Pressure

Torque Converter and Lubrication Oil

Modulated Pilot Oil

PRESSURE TESTING TORQUE CONVERTER AND COOLER CIRCUIT.

All pressure and flow testing should be measured with an oil temperature of 82–93 degrees Celsius (180 – 200 F). For operating speed refer to each test.

Port 1 System pressure.

– Engine set to 750 revs/min minimum pressure15 bar (218 psi).

– Engine set to 2200 revs/min 19.6 – 23.1 bar (290 – 333 psi).

Port 2 Torque converter in.

– Engine set to 2200 revs/min oil pressure range 5 – 11 bar (73 – 159 psi).

Port 3 Torque converter out.

– Engine speed 2000 revs/min minimum pressure 2 bar (29 psi).

– Engine speed 2200 revs/min maximum pressure 5 bar (73 psi).

Port 4 Oil temperature converter out.

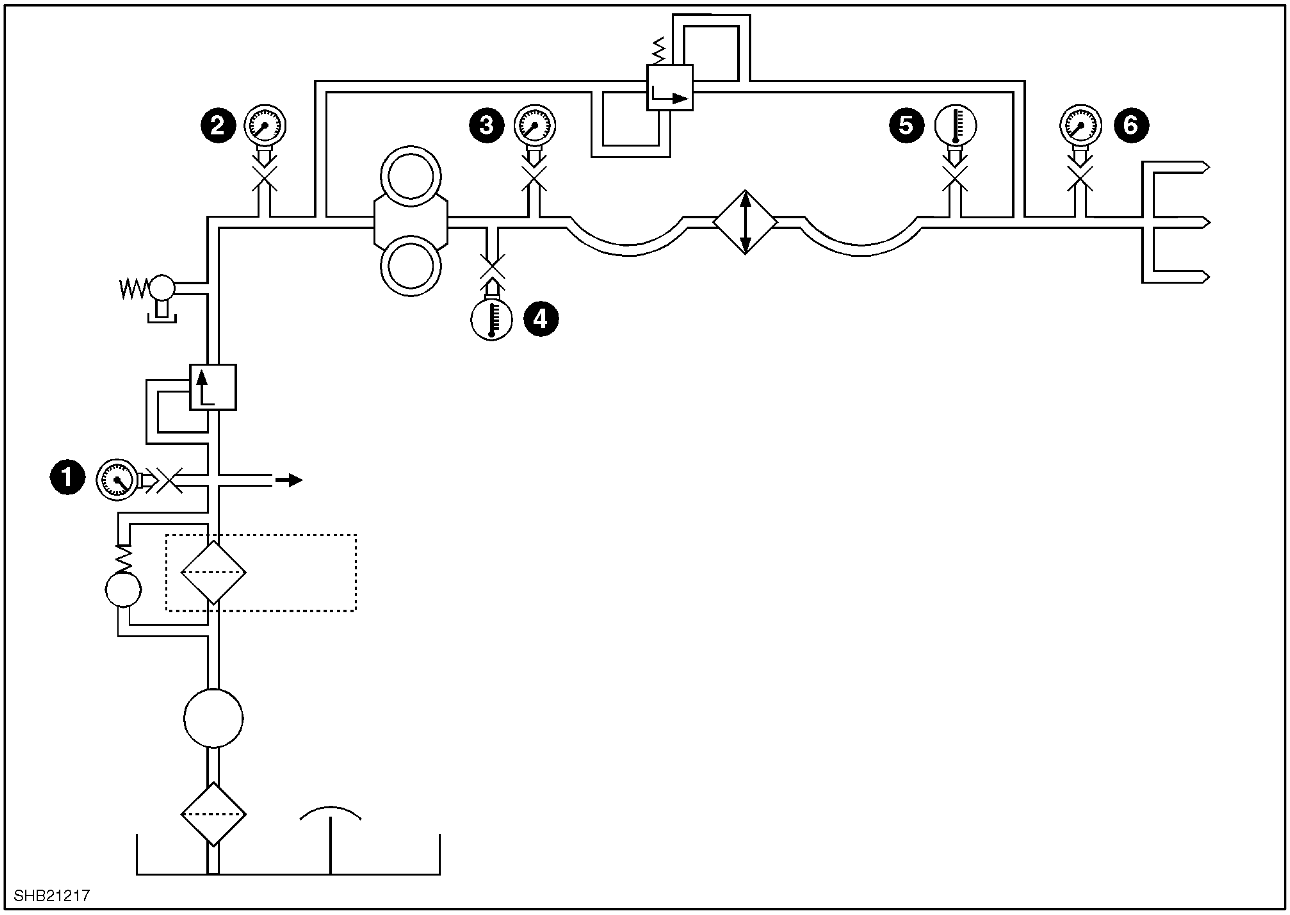
– Normal operating temperature 80 – 90 degrees Celsius. Maximum temperature 120 degrees Celsius (284 F).

Port 5 Oil temperature cooler out.

– T.B.A

Port 6 Lubrication pressure

– Engine speed 2000 revs/min pressure range 0.8 – 2.0 bar (11.6 – 29 psi).



25

Torque converter and lubrication pressure test ports.

1. System pressure port.
2. Torque converter in port.
3. Torque converter out port
4. Oil temperature converter out port.
5. Oil temperature cooler out port.
6. Lubrication pressure port.

PRESSURE TESTING CLUTCH AND HIGH PRESSURE CIRCUIT.

Port 1 System pressure.

– Engine set to 750 revs/min minimum pressure 15 bar (218 psi).

–Engine set to 2200 revs/min 19.6 – 23.1 bar (290 – 333 psi).

Port 2 2nd clutch.

– Engine set to 2200 revs/min pressure range clutch activated 18.1 – 21.5 bar (262 – 312 psi). Clutch released 0 – 0.2 bar (0 – 3 psi).

Port 3 1st clutch.

– Engine set to 2200 revs/min pressure range clutch activated 18.1 – 21.5 bar (262 – 312 psi). Clutch released 0 – 0.2 bar (0 – 3 psi).

Port 4 Four wheel drive clutch.

– Engine set to 2200 revs/min pressure range clutch activated 18.1 – 21.5 bar (262 – 312 psi). Clutch released 0 – 0.2 bar (0 – 3 psi).

Port 5 Forward high clutch.

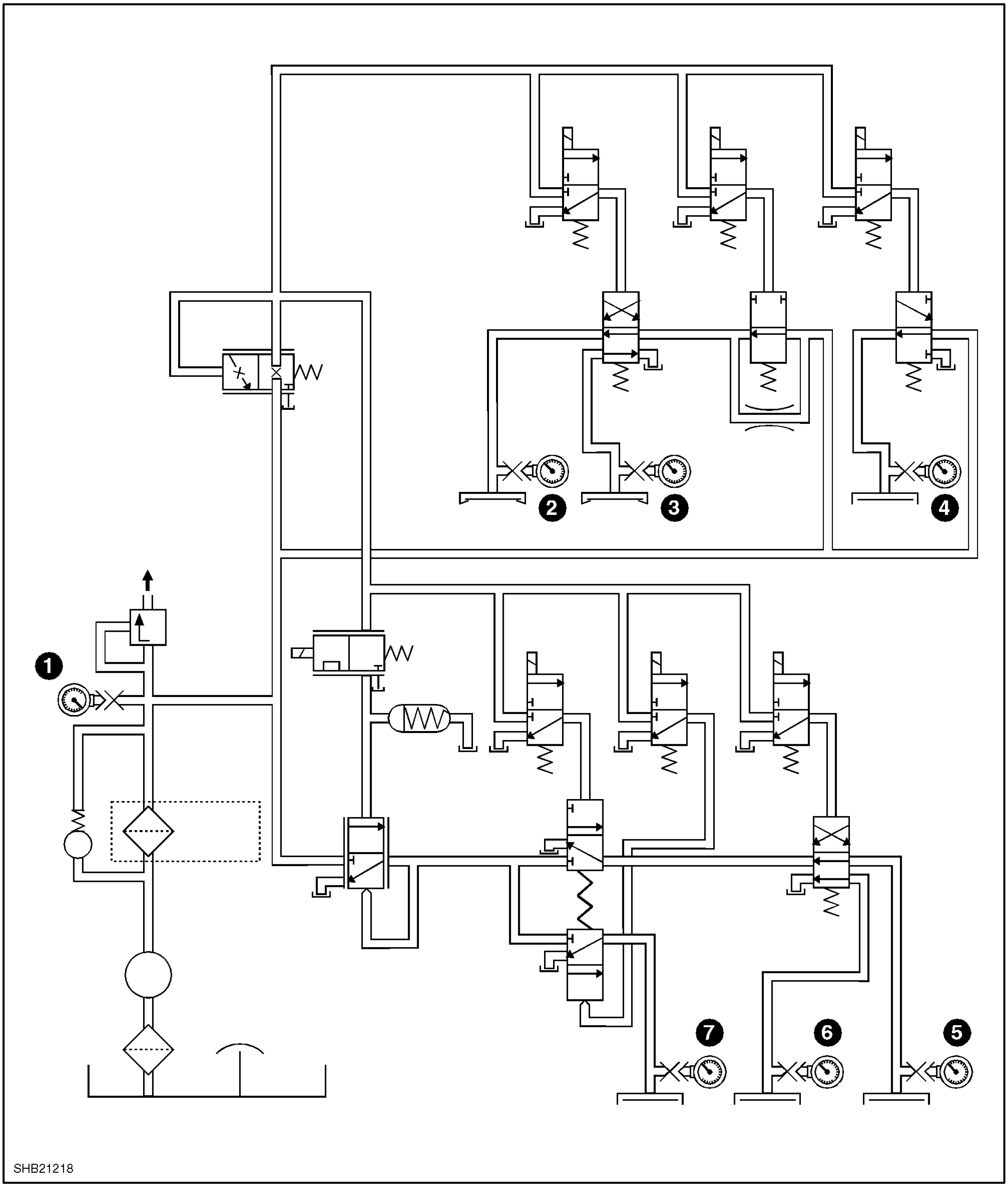
– Engine set to 2200 revs/min pressure range clutch activated 18.1 – 21.5 bar (262 – 312 psi). Clutch released 0 – 0.2 bar (0 – 3 psi).

Port 6 Forward low clutch.

– Engine set to 2200 revs/min pressure range clutch activated 18.1 – 21.5 bar (262 – 312 psi). Clutch released 0 – 0.2 bar (0 – 3 psi).

Port 7 Reverse clutch.

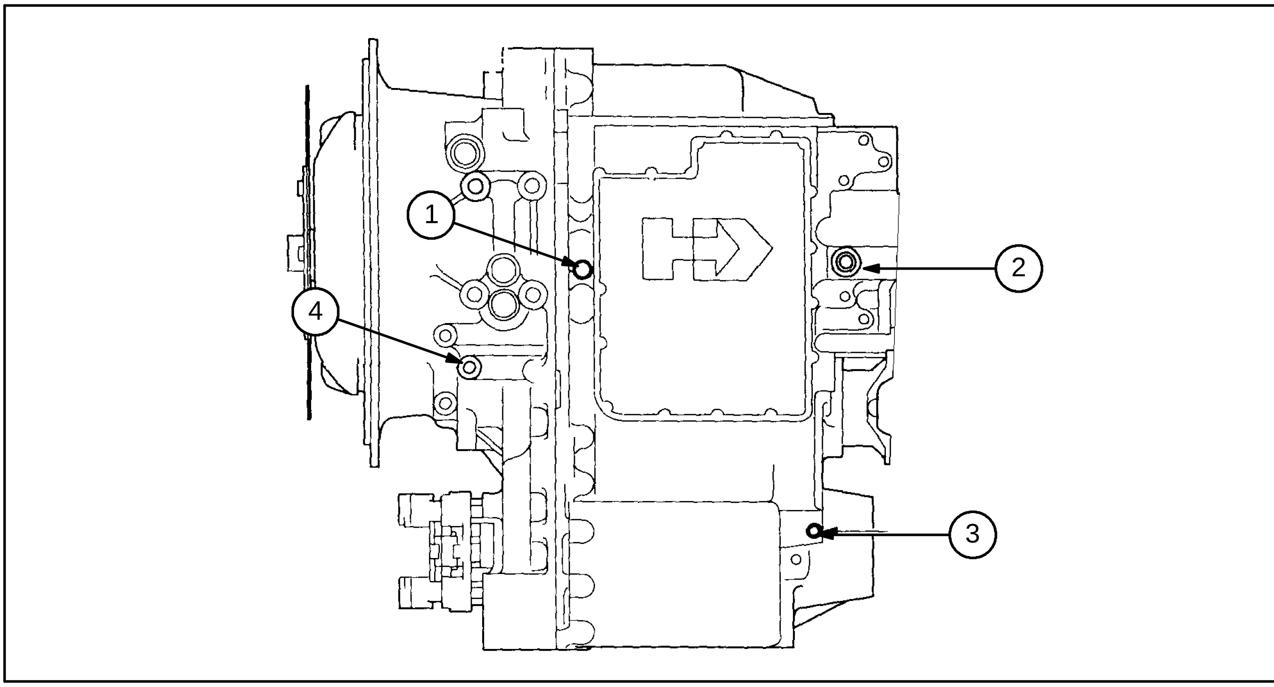
– Engine set to 2200 revs/min pressure range clutch activated 18.1 – 21.5 bar (262 – 312 psi). Clutch released 0 – 0.2 bar (0 – 3 psi).



26

Pressure testing clutches and high pressure circuit.

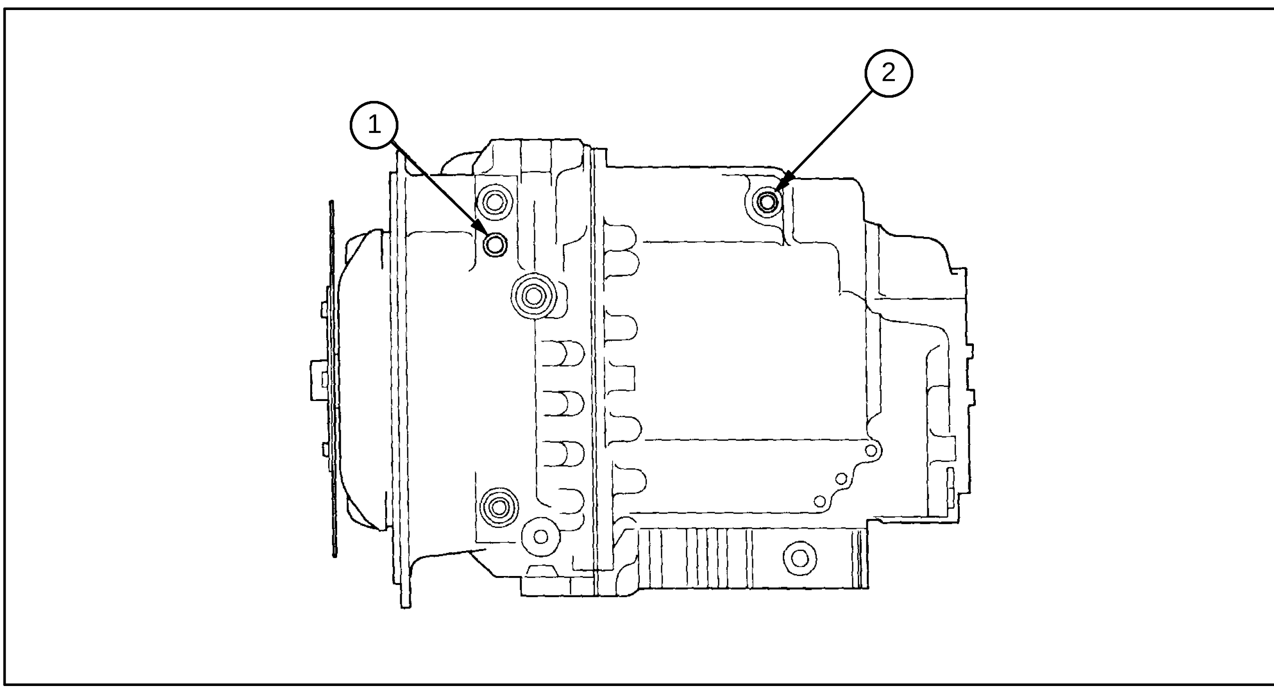
1. System pressure port
2. 2nd clutch pressure port.
3. 1st clutch pressure port.
4. Four wheel drive clutch port.
5. Forward high clutch pressure port.
6. Forward low clutch pressure port.
7. Reverse clutch pressure port.



27

Left Hand Side View

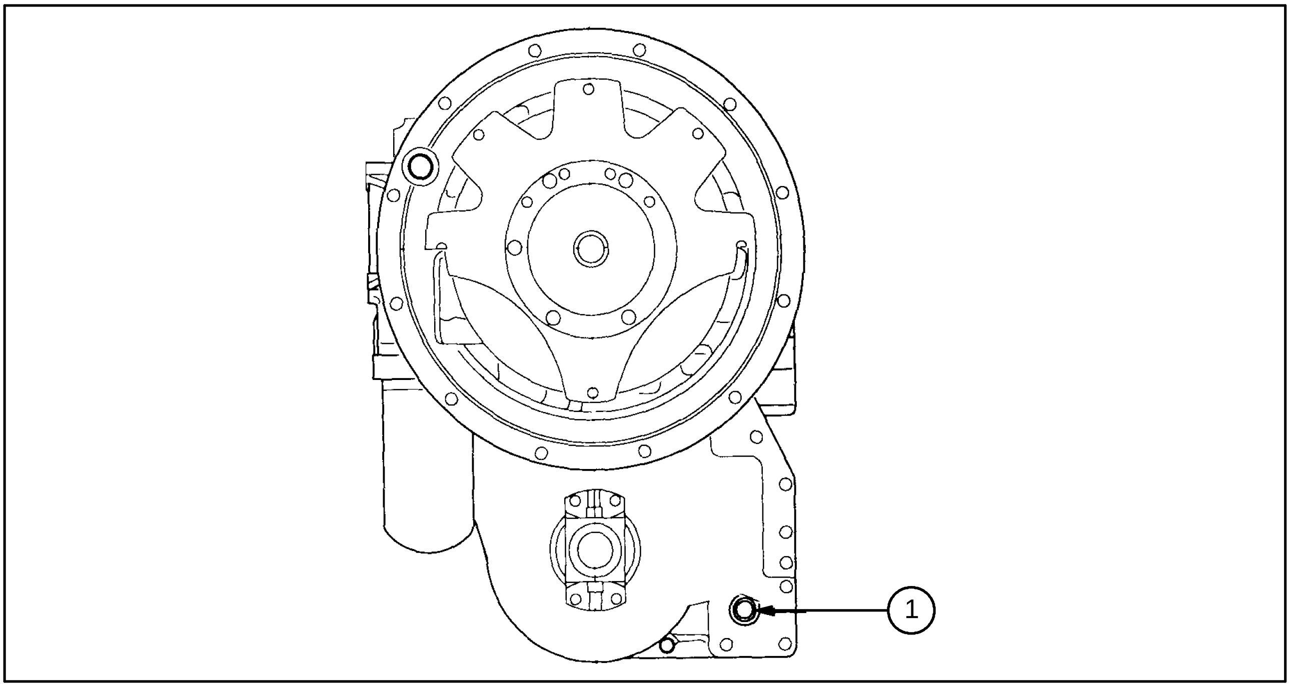
1. Pressure Check Port Convertor in 5 – 11 bar (73 – 159 psi)
2. To Cooler
3. Pressure Check Port Four Wheel Drive 18.9 – 27.5 bar (270 – 397 psi)
4. Pressure Check Port 2nd Clutch (FWD 2nd, FWD 4th, Rev 2nd) 18.1 – 21.5 bar (265 – 312 psi)



28

Top View

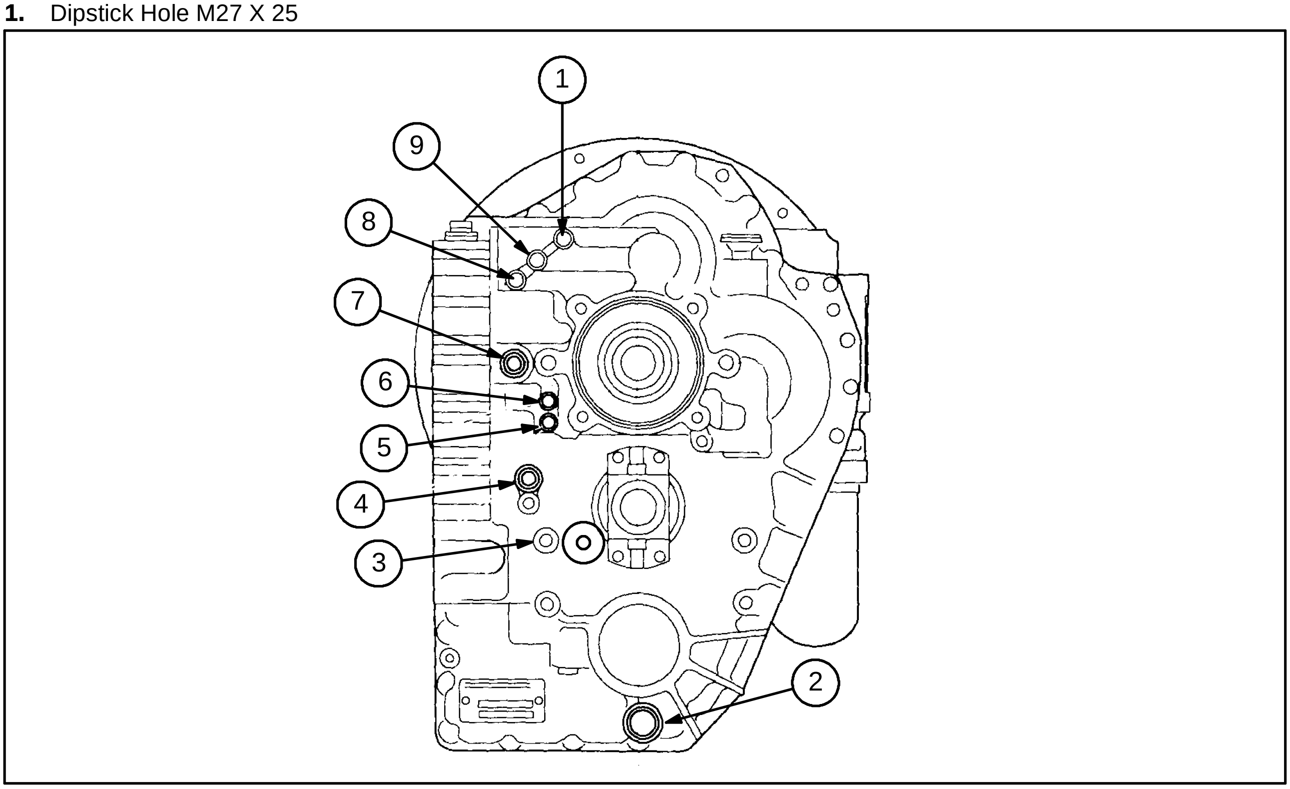
1. Pressure Check, Regulator Pressure 19.6 – 23.7 bar (290 – 340 psi)
2. Filter Plug M22 X 1.5



29

Front View

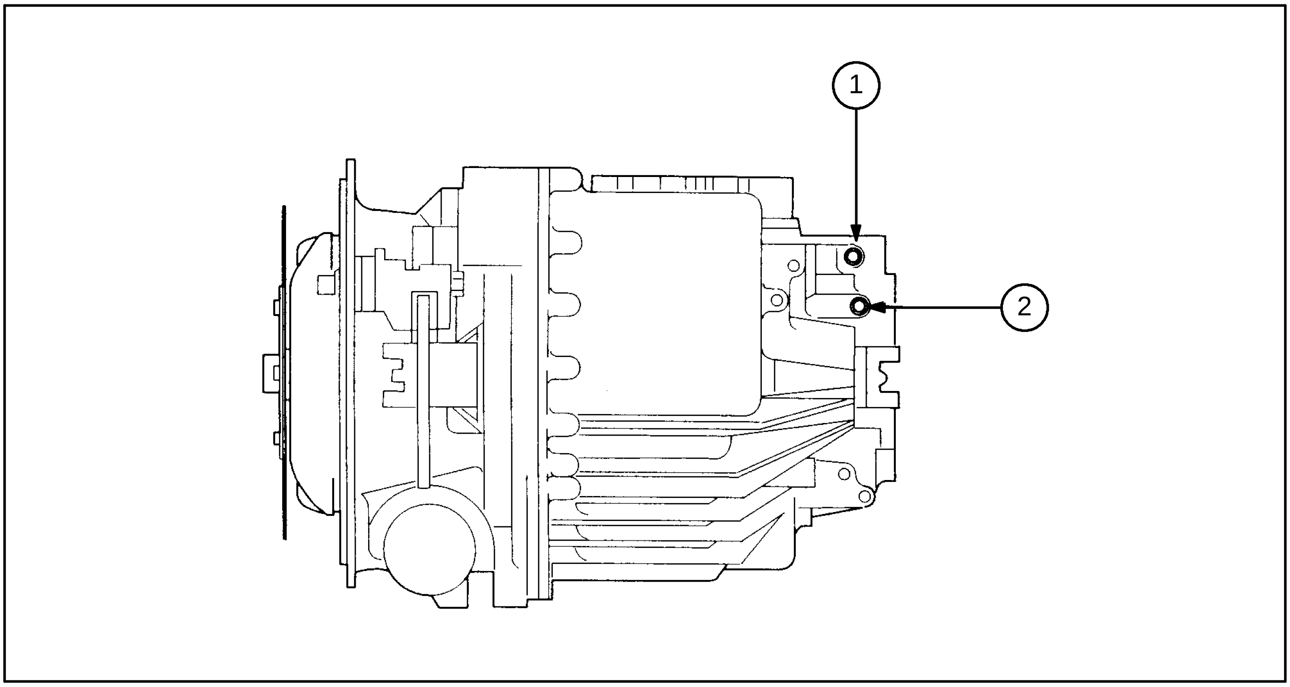
1. Dipstick Hole M27 X 25



30

Rear View

1. Pressure Port Hi Clutch
   18.1 – 21.5 bar (265 – 312 psi)
2. Drain Plug
3. Oil Level Plug
4. Oil return from cooler
5. Pressure check port 1st Clutch,
   18.1 – 21.5 bar (265 – 312 psi)
6. Pressure check port reverse clutch
   18.1 – 21.5 bar (265 – 312 psi)
7. Oil out to cooler1. Pressure check port forward low clutch
   18.1 – 21.5 bar (265 – 312 psi)
8. Pressure check port from cooler

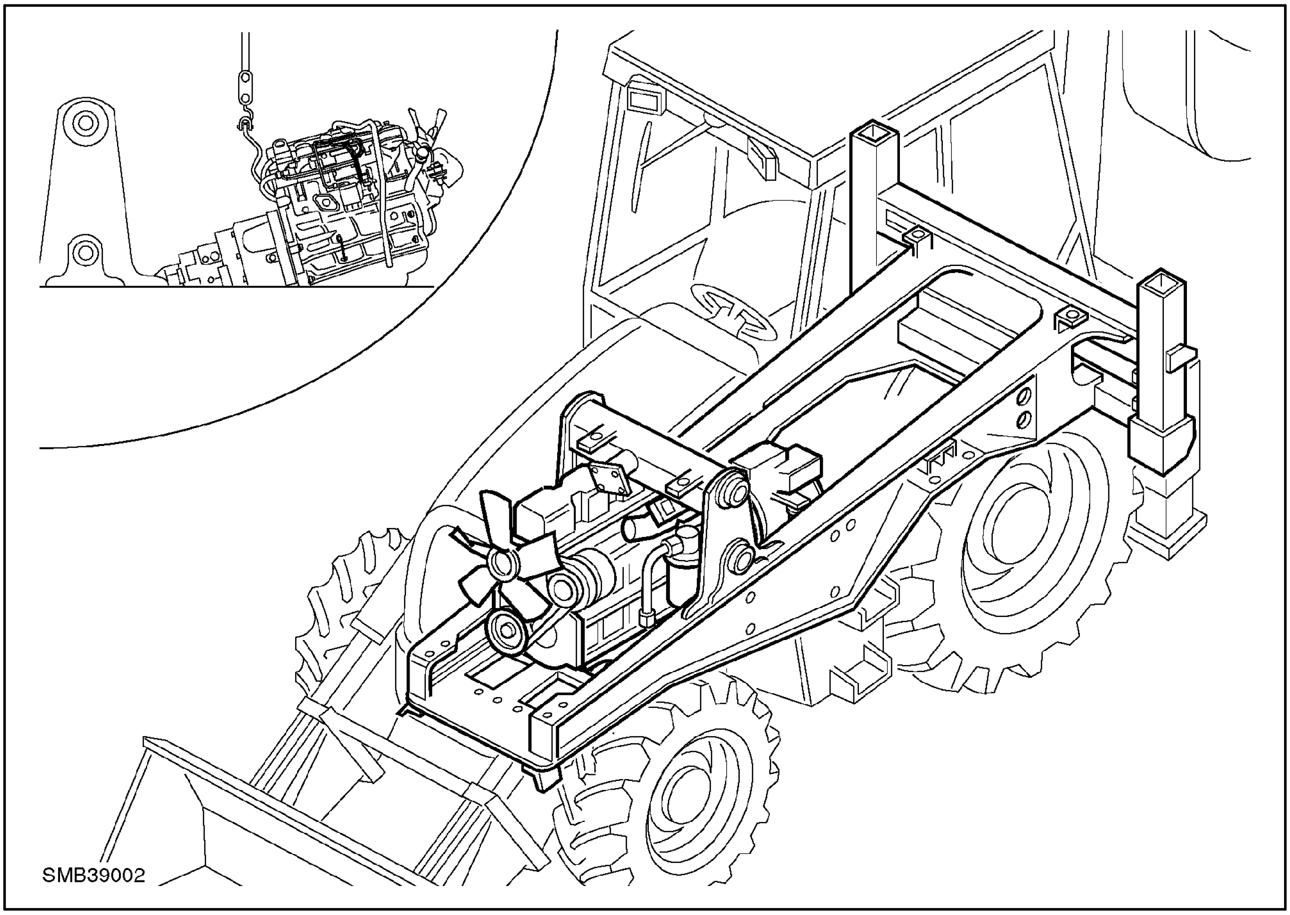


31

Bottom View

1. Temperature check port convertor out to cooler – Thread M10 X 1 ‘O’ ring port ISO 6149–1

2. Pressure check port convertor out to cooler – 1,0625–12 UN 2B SAE ‘O’ ring port



32

Transmission / Engine Removal from Backhoe Loader

Removal

WARNING

Before performing any service or maintenance on the machine ensure the wheels are choked / blocked to prevent the machine from moving.

1. Lower the loader to the ground or raise and secure (dependant upon lifting apparatus) and release any pressure in the system as required. Apply the handbrake and chock the wheels.
2. Drop the backhoe to the ground, switch off engine and release any pressure in the system.
3. Isolate battery
4. Remove all engine panels.
5. Remove front cast cowling
6. Drain engine coolant and remove hoses

IMPORTANT: *Air Conditioning where fitted – Do not disconnect the air conditioning hoses from the compressor or condenser unless a refrigerant reclaim system is to be used. Engine / Transmission removal from the machine does not require the system to be discharged*

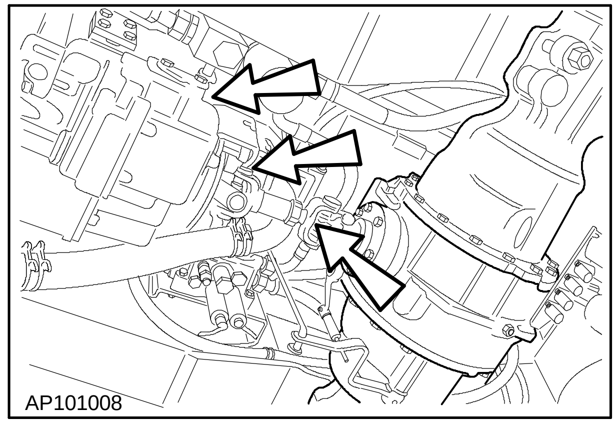
Remove the condenser from the front radiator and place the condenser to one side of the chassis

Disconnect the air conditioning compressor attaching hardware and place the compressor to one side of the chassis.

Disconnect the expansion bottle connections from the radiator.

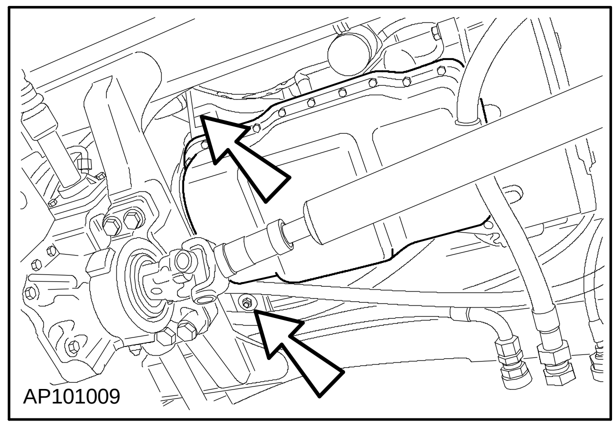
7. Pull main hydraulic cooler over radiator tabs
8. Remove all attaching bolts from radiator
9. Disconnect transmission cooler pipes.
10. Remove radiator, taking care not to damage the fan or hydraulic oil cooler.
11. Remove Air Cleaner assembly
12. Disconnect all electrical connections
13. Disconnect hydraulic pipe clamps
14. Disconnect the fuel tank feed and return pipes pipes
15. Disconnect the foot throttle cable at the fuel injection pump.
16. Remove the cab mat
17. Remove the cab floor access panel

18. Disconnect the 12 pin connector from the transmission valve chest mounted to the left hand side of the of the transmission.
19. Disconnect the transmission to lock out valve pipe
20. Disconnect lock out return pipe and plug the hole (oil will leak out of transmission)



33

21. Remove front drive shaft (where fitted) and remove rear drive shaft
22. Disconnect the hand brake cable
23. Disconnect and pull back hydraulic pump (leaving all pipes attached). Check that the oil pump drive shaft does not slide out with the pump
24. Check return from steering motor is on the outside of transmission oil level tube.

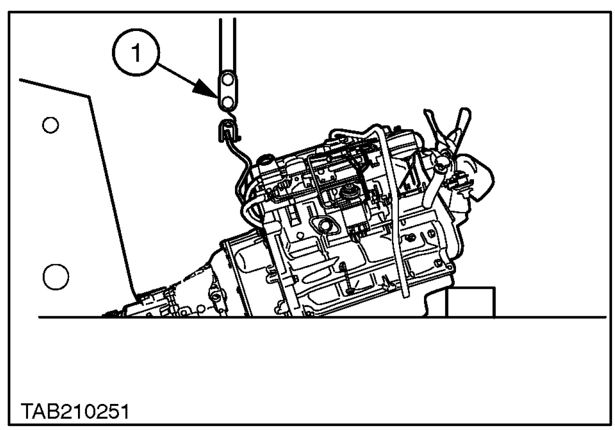


34

25. With the engine supported and using a 'hoist' capable of supporting a total weight of 800 kgs 1760 lbs loosen and remove the Engine and Transmission mounting bolts

IMPORTANT: *If the hydraulic oil pump is removed from the transmission/Engine assembly the balance of the assembly when hoisted will be front end heavy.*

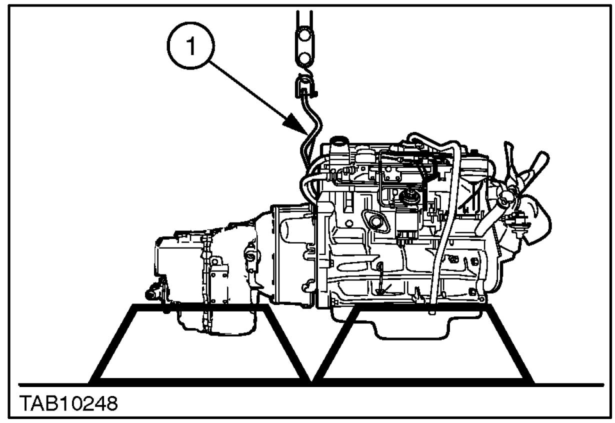
26. Using lifting tool **297392** very carefully raise the hoist and guide the engine/transmission assembly from the vehicle



35

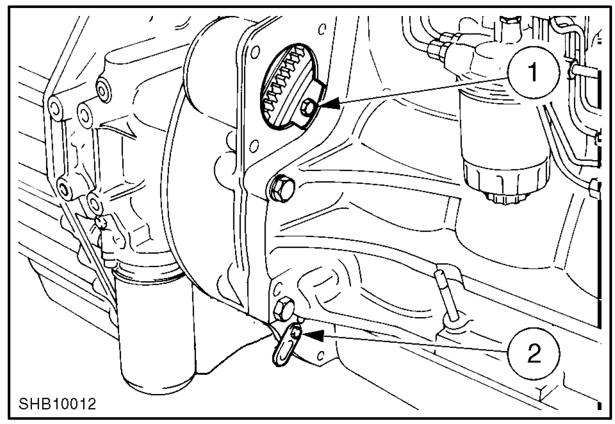
Separating Engine From Transmission with assembly removed from the vehicle

1. Place the engine/transmission assembly on a suitable splitting stand
2. Remove the starter motor assembly



36

3. Remove the torque convertor attaching bolts accessed through the starter motor aperture (1)
4. Remove the engine timing tab (2)
5. Remove the bell housing bolts
6. Gently slide the transmission with the torque convertor from the engine



37

Installation

Place a stud in one tang of the flexi plate and as the transmission is offered upto the engine guide the stud through a bolt hole of the flywheel – remove the stud and refit a bolt.

Refit the attaching bolts transmission to engine

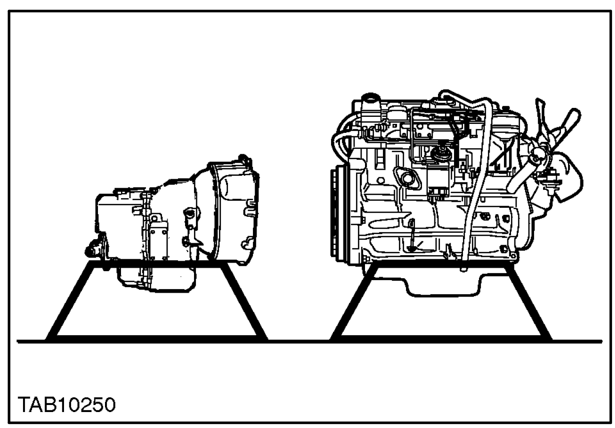
Turn the engine crankshaft using a torque bar to expose in turn each attaching bolt hole of the flywheel through the flexi plate and refit all of the bolts

Hoist the engine / trans assembly back into the vehicle and centralise in the machine using a measure between the chassis and centre line of the crankshaft pulley. This ensures the engine is centrally positioned before torque up of the engine / trans to chassis bolts.

reconnect all ancillary equipment as previously described

Ensure all attaching hardware is tightened to the correct torque value as detailed in the specifications.

Ensure after installation that all fluid levels are correct prior to start up. Start and run the engine until correct operating temperature is achieved to purge air from cooling system. Stop engine, check for leaks, rectify as required and recheck fluid levels.



38

NOTES

SECTION 21 – TRANSMISSIONS

Chapter 3 – Powershift Operating Lever

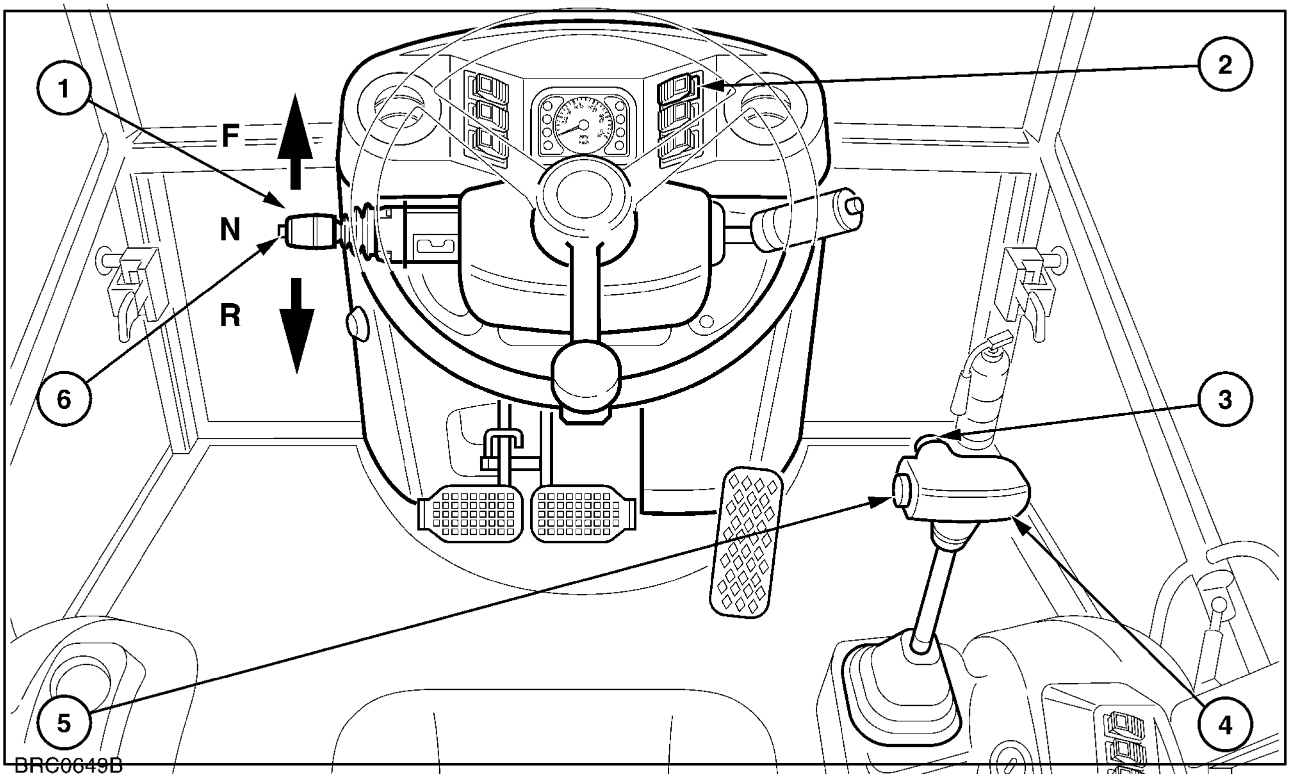
CONTENT

SPECIFICATIONS

ENVIRONMENTAL STANDARDS AND LIMIT'S

The Microprocessor is designed to operate continuously under the environmental conditions which are controlled by the various international authorities.

Subject	Standard	
Steady state voltage	SAEJ 1455	
Jump start requirements	SAEJ 1455	
Reverse polarity	SAEJ 1455	
Negative inductive transients	ISO 7637–1/1	Class IV
Positive inductive transients	ISO 7637 –1/2	Class IV
Commutation noise	ISO 7637 – 1/3	Class IV
Voltage drop	ISO 7637 – 1/4	
Load dump	ISO 7637 – 1/5	Class IV
Electrostatic discharge	IEC 801 – 2	Class IV



1

4X2 Power Shift Transmission Operating Lever and Related Switches

POWERSHIFT TRANSMISSION CONTROLS

1. **Powershift and Direction lever:**

   4 forward gears and 2 two reverse gears are selectable at the Powershift Lever.

IMPORTANT: *The gear changes and direction of travel are governed by a microprocessor in the body of the Powershift Lever. The processor only allows smooth and safe gear changes when the vehicle conditions are correct when the vehicle is on the move, irrespective of gear selected.*

Therefore Upshifting, downshifting or direction of travel through the gears will only occur when the monitored vehicle speed by the processor, determines it is safe to do so.

2. **Differential Lock Selection Switch**
3. **Horn button**
4. **Loader Lever**
5. **Transmission Disconnect Switch:**

   Disengages transmission drive on the move when the vehicle speed is up to 3rd gear.
6. **Kick down Switch:**

   If the vehicle is in 2nd gear and 1st is required for loader work engaging kickdown instantly drops the gear from 2nd to 1st, below 4.0 km/hr. When reverse is selected the transmission reverts to 2nd gear but will select 1st if the kickdown switch is again selected.

TRANSMISSION CONTROL

The transmission fitted to this machine is designed to Powershift gear changes while supplying drive to the vehicle wheels, dependant upon the gear and direction selected.
The transmission is controlled by a microprocessor in the Power Shift Lever unit (1) which is mounted below and to the left of the steering column.

POWER SHIFT LEVER

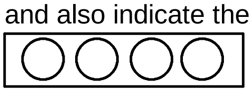
NOTE: *The powershift HANDGRIP (2) is the only moving part of the power shift assembly*

POWER SHIFT LEVER DISPLAY – WITH LIGHT EMITTING DIODES (LEDS),

LEDs – Numbered 1 through 4 :

Indicate the direction of travel by the colour of the LED:
Forward = Green
Neutral = Red
Reverse = Orange

and also indicate the selected shift lever gear.


= 3rd Gear Forward selected

STEADY ILLUMINATED LED: Indicates selected shift lever gear.

FLASHING LED: Indicates the actual transmission gear engaged (when different from the shift lever due to speed protection).

LEDs – Numbered 1 through 8: Used during test modes,

1 2 3 4 5 6 7 8

LED – Number 8: illuminates green when the vehicle is at a standstill (in normal mode).

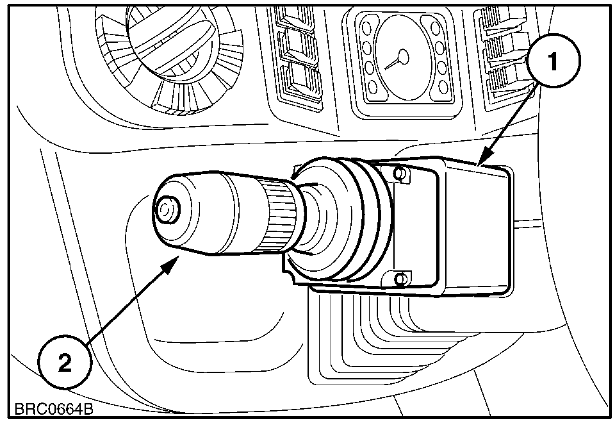
1 2 3 4 5 6 7 8

LED – Letter T = Self-diagnostic Mode: T

Used in self-diagnostic test mode and will illuminate during self test.
In the event of a fault, (the light will flash).

LED – Letter N Indicates Neutral : N

Illuminates RED when the transmission is shifted to neutral.



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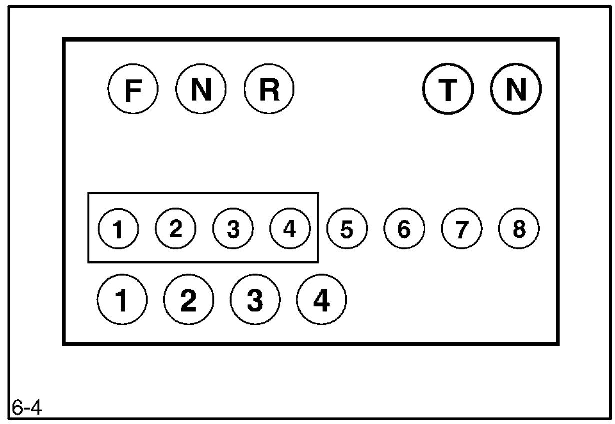


3

POWER SHIFT LEVER AND MICRO-PROCESSOR FUNCTIONS

Power Up:

Immediately after starting up (ignition on) LEDs T & N are switched on, in order to show they are operational.

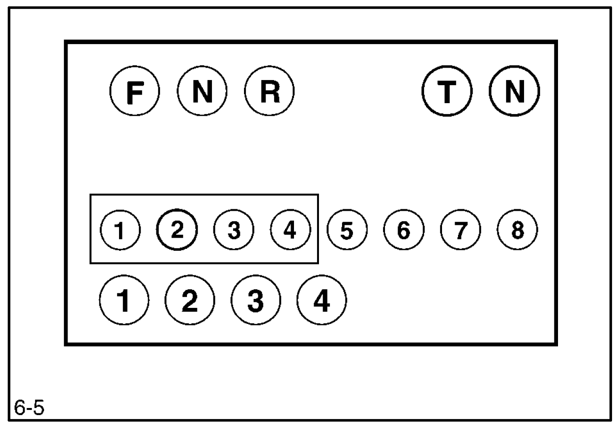
The microprocessor controls the transmission and self checks its own memory continuously to ensure that gear selection and range changes are always performed in a safe manner.

Should a fault occur in the wiring harness or in the solenoid of the control valve the Powershift lever microprocessor, will check if it is still safe to drive. If not the processor will default to a safe mode or lock state

Reset Mode:

When the microprocessor defaults to reset mode both the T and N LED's are displayed simultaneously to indicate that a reset has taken place.

If no critical faults are active the microprocessor selects N2 and goes to the Neutral lock state. Refer to, DRIVING WITH POWER SHIFT.

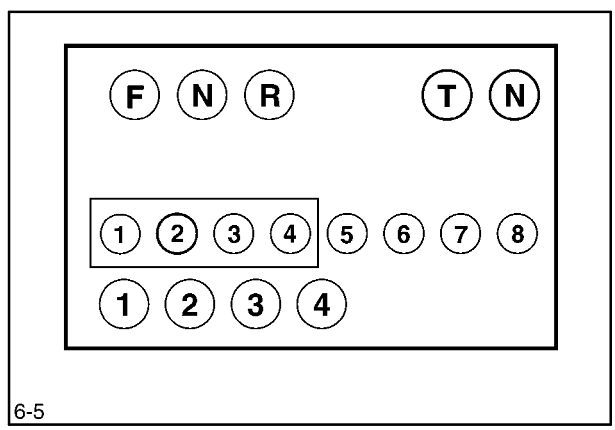


4

Limp home:

If a fault is detected at power up (ignition on) the limp home facility is automatically selected.

IMPORTANT: *If limp home is active, only 1st and 2nd gear will be selectable but without modulation. This means that the take off will be abrupt.*
Limp home active can be identified by the illumination of the following LEDs.



5

T - LED	N - LED	CONDITION
Flashing	ON	Currently shown on display will be the last fault
Flashing	Flashes Slower	Input Fault Detected
Flashing	Flashes in Phase	Non Critical Output Fault Detected
Flashing	Flashes Faster	Safety Critical Output Fault Detected

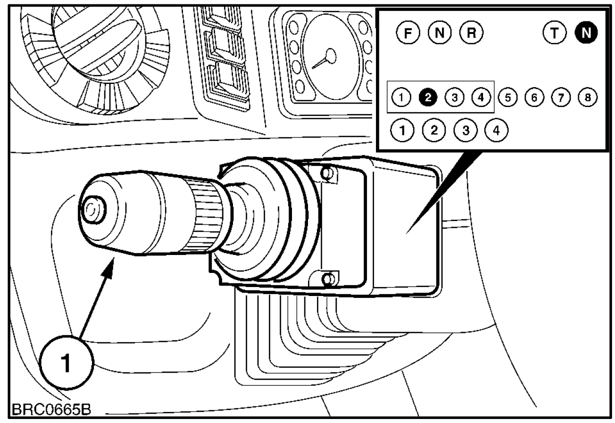
DRIVING WITH POWERSHIFT

Selecting Neutral

At power up, “Neutral and 2nd Gear” are automatically selected regardless of the power shift lever position (1). The LED 2 and the N–LED are illuminated RED, (neutral 2nd), the microprocessor is in a neutral lock state.

If after driving, neutral is selected and the shift lever stays in neutral for more than 3 seconds (vehicle stationary) the microprocessor automatically defaults to the neutral lock state for safety.

NOTE: *In neutral an automatic shift routine takes effect to prevent damage to the transmission if overspeeding.*



6

Leaving Neutral

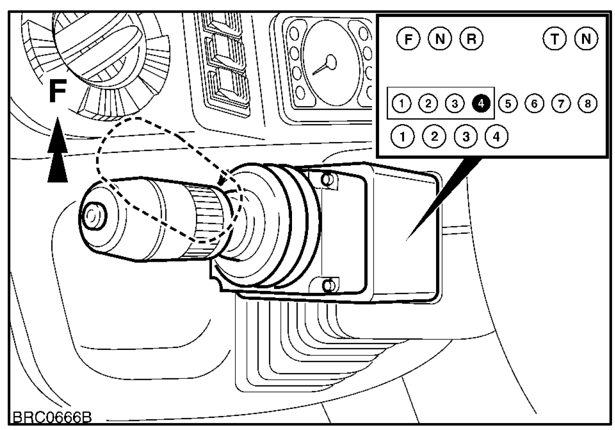
A feature of the power shift lever is the NEUTRAL LOCK STATE, which does not allow forward or reverse direction drive to be selected. This feature prevents the vehicle accidently moving should the lever be knocked into forward or reverse. To leave the neutral lock state, you select drive direction followed by an upshift by rotating the shift lever.

NOTE: *Vehicle speed must be below 15 KPH to leave the neutral lock state if free wheeling.*

Selecting Forward

To select forward travel push the lever away from you and the LED will illuminate green.

NOTE: *When forward is selected you are not given any indication of gear selected, only the maximum gear the transmission will shift too. In addition whether forward actually engages at that time, depends on the status of the vehicle, for example if on the move, road speed and direction will be considered by the microprocessor before any shift changes take place.*

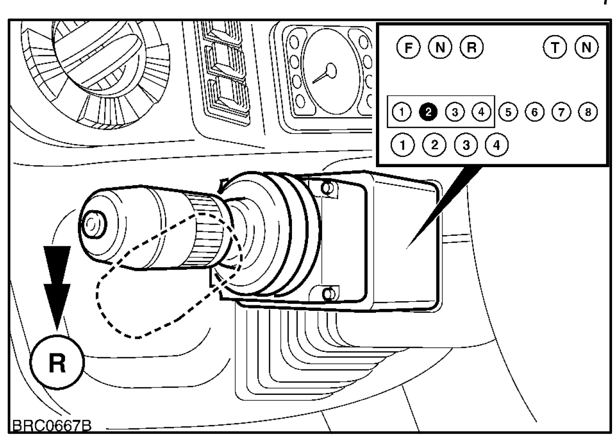


7

Selecting Reverse

To select reverse travel pull the lever towards you and the reverse LED will illuminate orange.

NOTE: *When reverse is selected actually engagement depends on the status of the vehicle, that is if on the move road speed and direction will be considered by the microprocessor.*



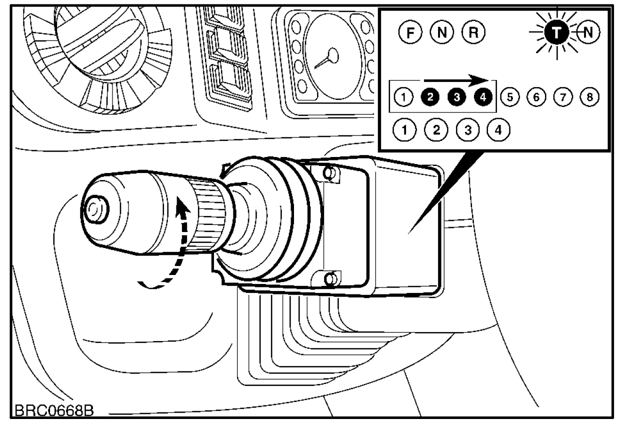
8

Up Shifting

Up shifting to a desired gear from neutral is achieved by twisting the handgrip counter clockwise (+) in single movements, If held in this position the processor will advance the shift selection from 2 though to 4 in 1.8 sec intervals.

NOTE: *An upshift request after a downshift is delayed for 2 seconds. Should an Fault occur with the speed sensor the microprocessor will not allow up shifts above 2nd gear and will be indicated by the 'T' LED flashing and the 'N' LED flashing slower.*

NOTE: *If ascending up a steep incline select 2nd gear and proceed. Only if speed and power allow, upshift onto 3rd and 4th subject to the speed shift sensing.*

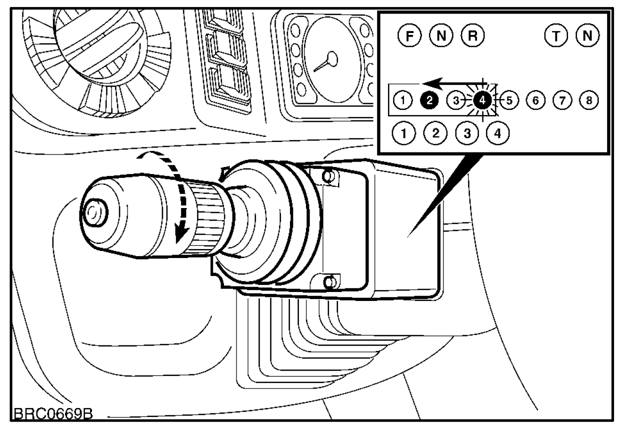


9

Down Shifting

WARNING

If descending a steep incline select 2nd and proceed, upshifting only when safe to do so. YOU CAN NOT DOWNSHIFT TO REDUCE SPEED IF THE VEHICLE SPEED IS ABOVE 15 km/h (9 mph) due to transmission overspeeding protection.



10

Downshifting to the desired gear is achieved by twisting the handgrip clockwise (–) in single movements, If held in this position the processor will decrease the shift from 4, if the shift lever was in this gear, though to 1 in 1.5 sec intervals.

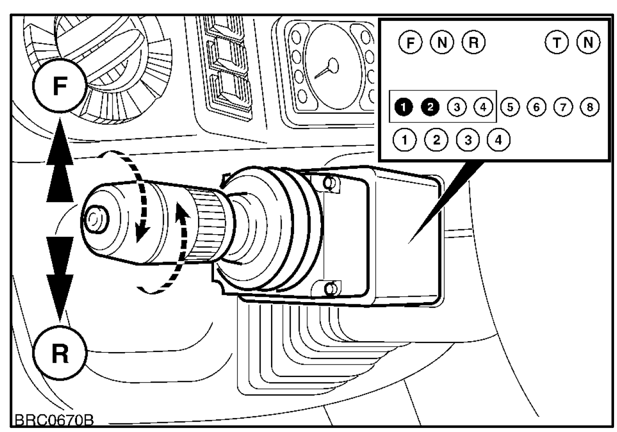
NOTE: *If the gear requested and the shift attainable are not the same because of torque convertor turbine RPM being too high, the gear position LED(e.g. LED 4) will flash and the shift lever position will illuminate, not flashing, (e.g. LED 2), until the requested gear is reached. When a gear position LED is flashing this indicates that the vehicle has to reduce speed to reach the requested gear.*

Direction Changes

Changing driving direction is achieved simply by shuttling the power shift lever between forward and reverse and vice versa which is allowed at any time.

The system response however depends on vehicle speed and currently engaged gear. When driving in 1st or 2nd gear direction changes are unrestricted and are granted immediately.

F1 – R1	F2 – R2
R1 – F1	R2 –F2



11

When driving forward in 3rd or 4th gear two responses are possible depending on vehicle speed.

RESPONSE 1: If the vehicle speed in forward is above 15 km/h (9 m/h) and reverse is selected downshift engages but momentum forward remains, until the speed drops sufficiently to allow reverse 2nd gear to be achieved.

RESPONSE 2: If the vehicle speed in forward is less than 15 km/h (9 mph) reverse takes place immediately into 2nd gear.

Should a speed sensor fault be detected while in F3 or F4 a downshift sequence to 2nd gear will take place and is indicated by the LED ‘T’ flashing fast and the LED ‘N’ flashing slowly.

NOTE: *If the transmission Is in forward 1st gear due to kick down the direction change will result in selection of reverse 2nd gear for efficient pull away. Refer to Kickdown for more information.*

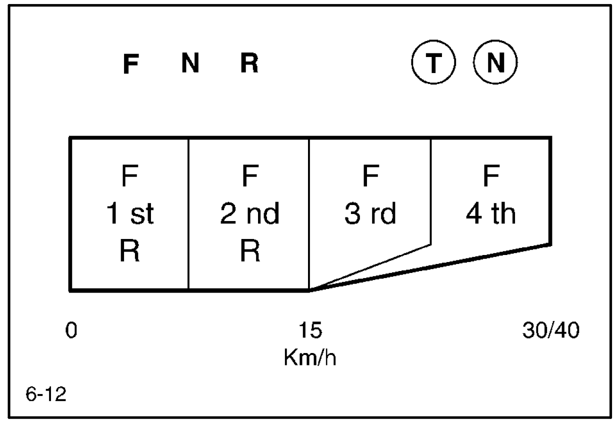
Transmission Power Shifting

In the previous paragraphs shift changes have been shown as precise movements and twist actions of the power shift lever. However the transmission can change gear automatically in forward or reverse as described in the following paragraph:

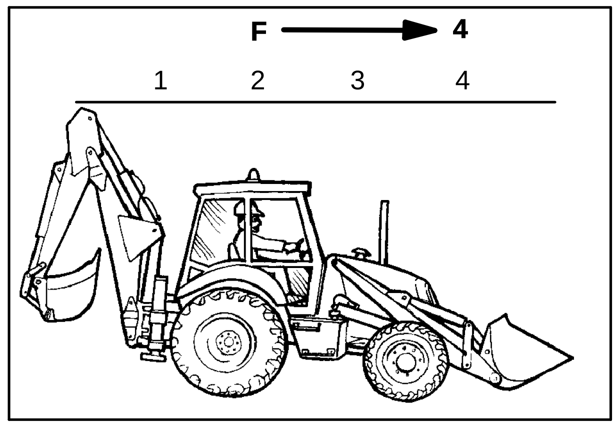
Select forward and 4th gear on the power shift lever and with the handbrake released apply pressure to the foot accelerator. As the engine revs and vehicle speed increase the transmission will start from 2nd gear and change up through 3rd and 4th gears up to maximum road speed.

When you require to slow down or stop release the foot accelerator and apply the footbrakes, the transmission will automatically downshift through 4th, 3rd and 2nd gear as the vehicle speed decreases. Once stopped apply the handbrake and neutral will be selected by the microprocessor. If left for 3 seconds it will return to neutral lock if the declutch input has been activated.

To select drive again, simply twist the handgrip to select 4th and with the handbrake released apply pressure to the foot accelerator.



12



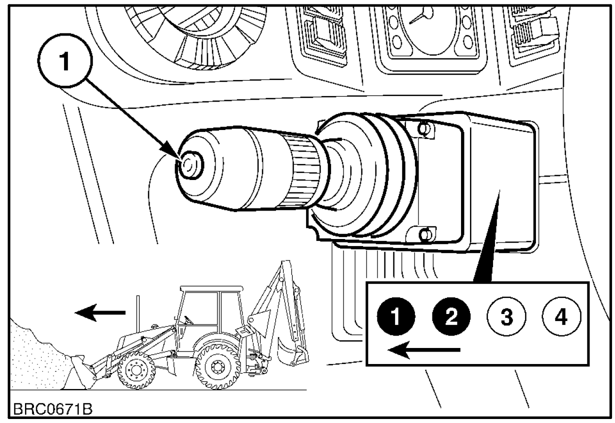
13

Kick Down

The kick down facility (2nd to 1st gear only) on this transmission increases torque instantly to the driving wheels and hence pushing power. For example when the loader is pushing into a pile and more torque is required at the wheels.

This is achieved by the instant gear change from 2nd to 1st by the use of the button (1) without the need to use the twist grip on the power shift lever.

NOTE: *The kick down facility is only available when the transmission is in 2nd gear and the kickdown button (1) is depressed. If kick down can not be achieved (Vehicle speed is too high) the LED 1 will be illuminated and LED 2 will be flashing. The instant change is achieved if the speed is low enough (within 6 seconds) of the kickdown request.*

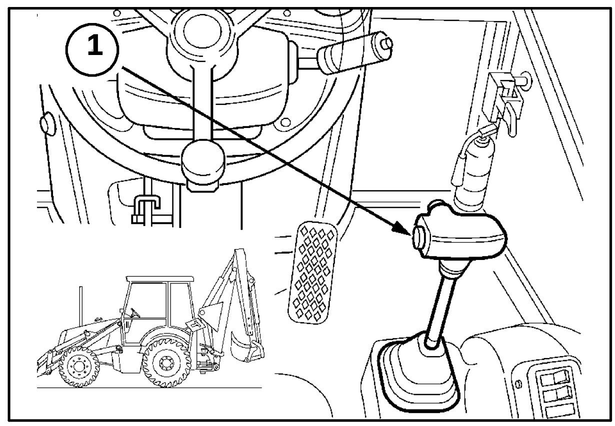


14

Transmission Disconnect

The disconnect feature is useful when loading, for example; when pushing the loader into a pile and you require higher digging force press the disconnect switch which disengages the transmission which allows the full power of the engine to be directed to the hydraulic oil pump.

NOTE: *Transmission disconnect is selectable, when the vehicle speed is less than 5 km/h and by depressing the button on the loader lever and remains active until the switch is released.*



15

Speed Ranges

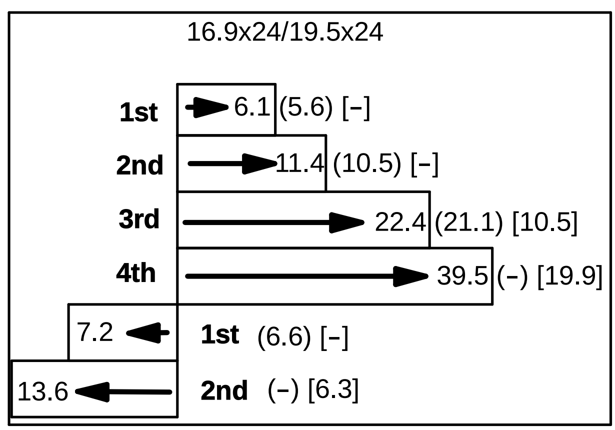
The microprocessor controlling the power shift transmission is pre programmed to control the speed at which the gear changes take place.

This effectively protects the transmission from excess forces, should gear changes be selected at higher speeds than is desirable.

Shown in the chart opposite (within 10%) maximum speed available and at which speed an automatic shift takes place in each gear.

As can be seen when down shifting from 4th gear at maximum speed 39.5 km/h the microprocessor will not allow the down shift to take place until the speed has dropped too approximately 19.9 km/h. Refer to the chart, for complete upshift and downshift speed change details.

NOTE: *In some countries the road speed of 40 km/h is not allowed. In these circumstances the transmission is governed to a maximum of 25 km/h and the shift speed range will reduce accordingly.*

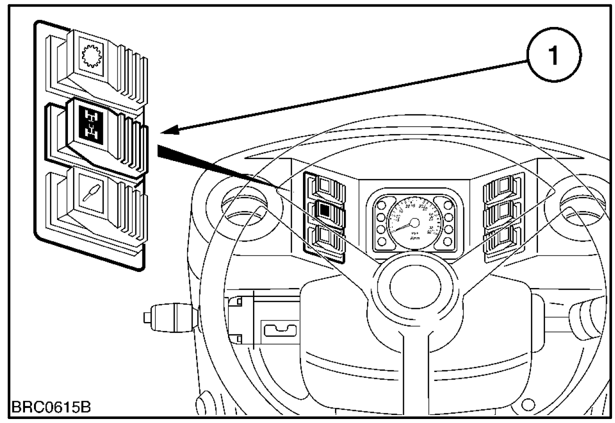


16

(...) = Automatic upshift speed
[...] = Automatic downshift speed km/h

WARNING

These machines should not be allowed to exceed 40 km/h (25 mph). Over speeding or coasting downhill may cause loss of control, personal injury, or failure of the drive line. Keep the machine in the same gear going downhill as would be used when going uphill.



17

Four Wheel Drive

A x3 position switch (1) mounted in the front instrument panel controls selection of 2 or 4 wheel drive.

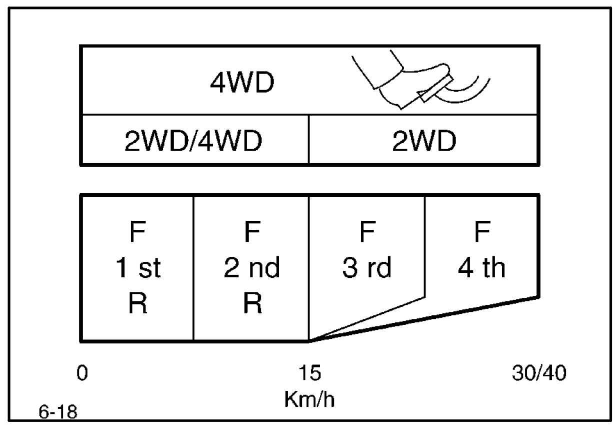
To select 4wd press the switch down and the switch is illuminated indicating 4wd can be engaged. To return to 2wd drive switch off the 4WD switch.

***NOTE:** 4wd is operational under various conditions but is subject to certain conditions as listed below.*

2wd and 4wd Pre Conditions:

- Rear Wheel drive: is always available when drive is selected
- All ‘4’ wheel drive: is available in 1st and 2nd gears
- In 3rd and 4th gear range: rear wheel only is selected regardless of the 4wd switch position
- All ‘4’ wheel braking: is operational in all of the gear range regardless of the 4wd switch position above 3 km/h.

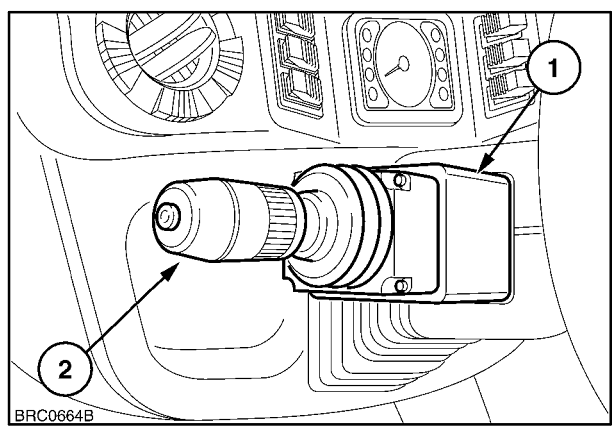
***IMPORTANT:** 4WD braking is only active with both brake pedals latched together.*



18

Powershift Lever

The operating lever (2) as previously explained controls all transmission related functions using a microprocessor (1). Transmission control is achieved by the electronic control of the transmission hydraulic valves.



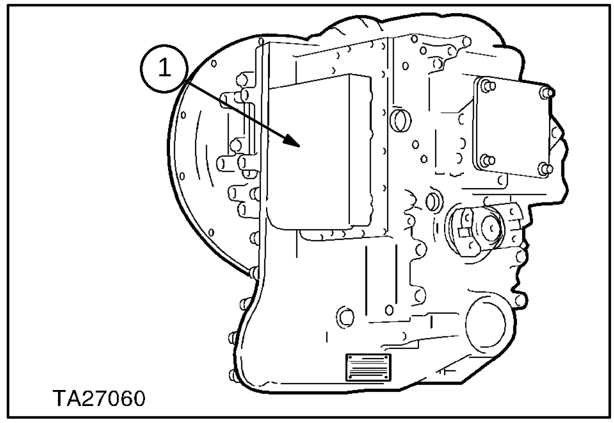
19

Operating Valves and Sensors

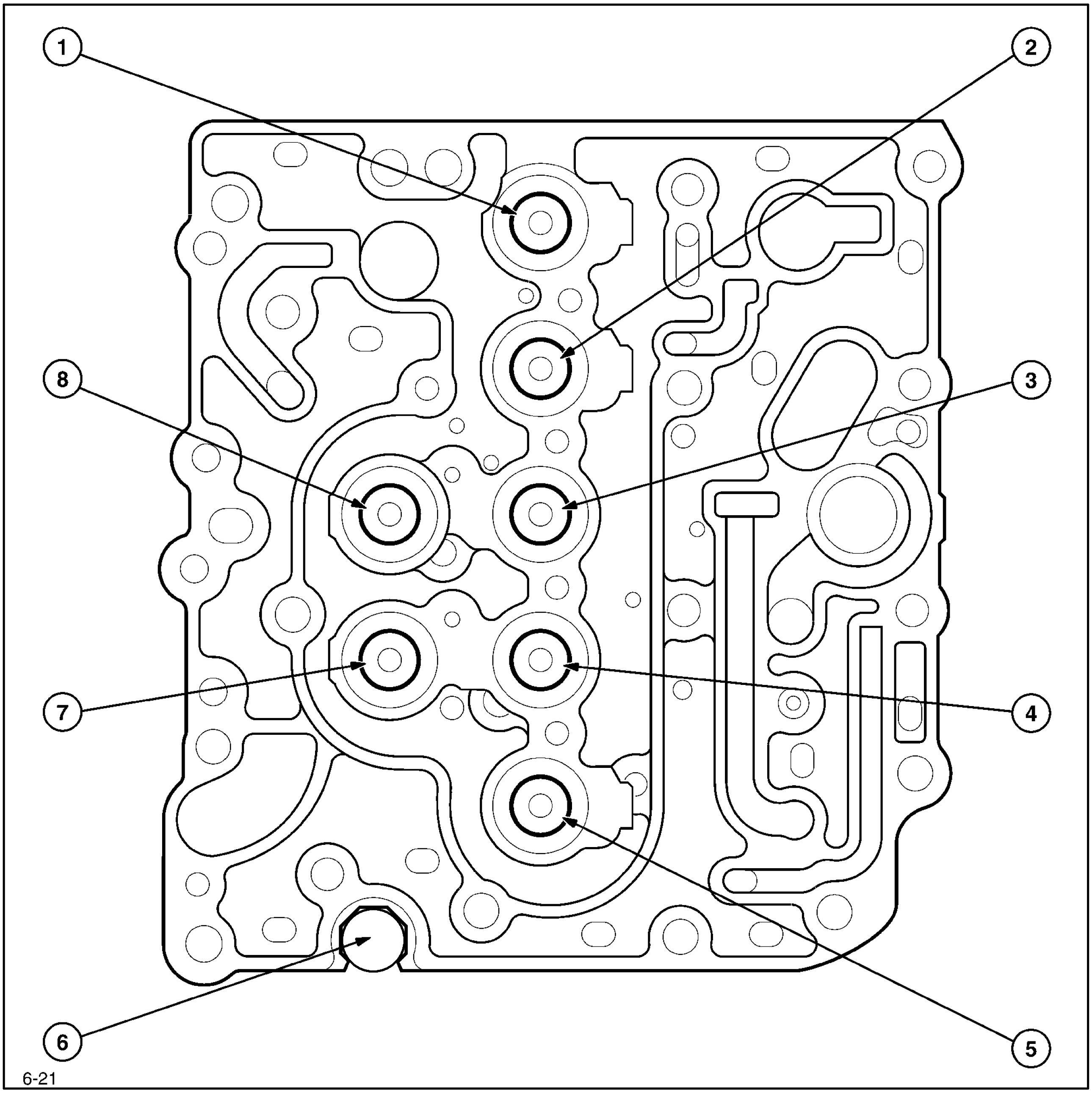
The signals sent out from the microprocessor control the speed and gear shifts by operation of valves and sensors which are situated in the valve chest to the left of the transmission.

Enclosed within the valve chest which requires removal from the transmission if repairs are necessary are:

Forward Solenoid
Reverse Solenoid
1/2 Solenoid
Lo/Hi solenoid
4WD/2WD Solenoid
Direction Modulator
Range Modulator
Speed / Temperature Sensor



20



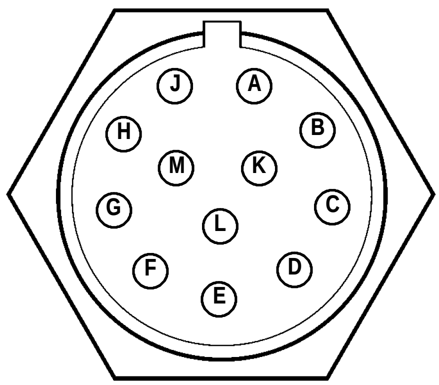
21

Transmission Control Valve Chest as shown (mating face to transmission body)

1. VCS = Variable Current Solenoid (Direction Modulator Solenoid)
2. Range Modulation Solenoid
3. Hi / Lo Solenoid
4. 1st and 2nd Solenoid
5. Four Wheel Drive Solenoid
6. Speed and Temperature Sensor
7. Neutral Reverse
8. Neutral Forward Solenoid

Powershift Control Valve Transmission Connector

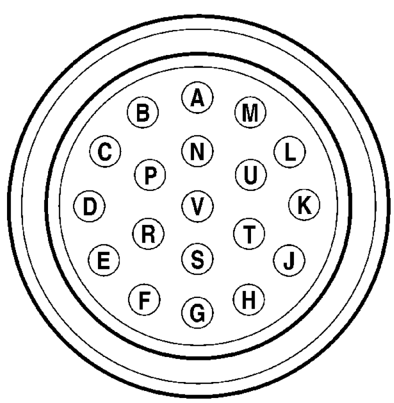
Wire	Pin	Function
CV04	M	Control valve common plus
CV05	L	Transmission temperature out Ground
CV06	K	Range modulation solenoid
CV07	J	Speed sensor, Temperature Sensor, Ground
CV08	H	Control Valve Common Ground
CV09	G	Direction Modulation Solenoid
CV10	F	Reverse Neutral Solenoid
CV11	E	4WD / 2WD Solenoid
CV12	D	Range 1/2 Solenoid
CV13	C	Forward / Neutral Solenoid
CV14	B	Forward Lo/Hi Solenoid
CV15	A	Speed Sensor plus output



22

Powershift Operating Lever Connector

The connector between the operating lever and the transmission harness is a 19 Pole – ITT Trident Neptune Male Connector. The Input wires as listed identify all of the pins and their functions:



23

COMMON CONNECTION BETWEEN MICROPROCESSOR AND CONTROL VALVES

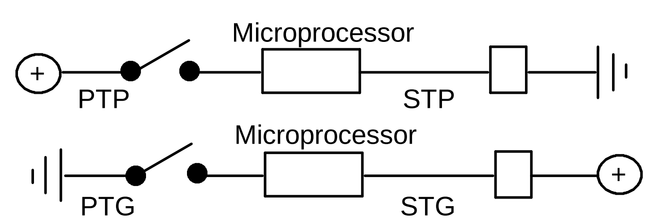
Wire	Pin	Function	Type	Comment	Control Valve
E01	V	Battery +		Use 6A fuse	
E02	U	Ground		Direct to battery GND	CV08-H / CV07-J
E03	T	VCS	switch to ground	Direction Modulation Solenoid	CV09-G
E04	S	Solenoid 1	switch to plus output	1/2 selection Solenoid	CV12-D
E05	R	Solenoid 2	switch to plus output	Forward Lo/Hi selection Solenoid	CV14-B
E06	P	Forward Solenoid	switch to plus output	Forward/Neutral selection Solenoid	CV13-C
E07	N	Reverse Solenoid	switch to plus output	Reverse/Neutral selection Solenoid	CV10-F
E08	M	PWM1	switch to ground output	Range Modulation Solenoid	CV06-K
E09	L	Solenoid 3	switch to plus output	0=FWD 12V = RWD	CV11-E
E10	K	PWM Solenoid Supply		Supply for E03 and E08	CV04-M
E11	J	Not used			
E12	H	Not used			
E13	G	Analogue input 0	pull to ground input	5k Ohm Temperature sensor	CV05-L
E14	F	Analogue input 1	pull to ground input	Braking request	Braking
E15	E	Diagnostic Link Input		RS232 RXD	
E16	D	Speedometer Output/Diagnosis. out	switch to plus output	RS232 TXD	
E17	C	Disconnect request input	pull to plus input	Transmission Disconnect request	
E18	B	Four Wheel Drive request input	pull to plus input	4WD/2WD request	
E19	A	Speed Sns +		Speed sensor input	CV15-A

pull to ground input = PTG

pull to plus input = PTP

switch to ground output = STG

switch to plus output = STP



24

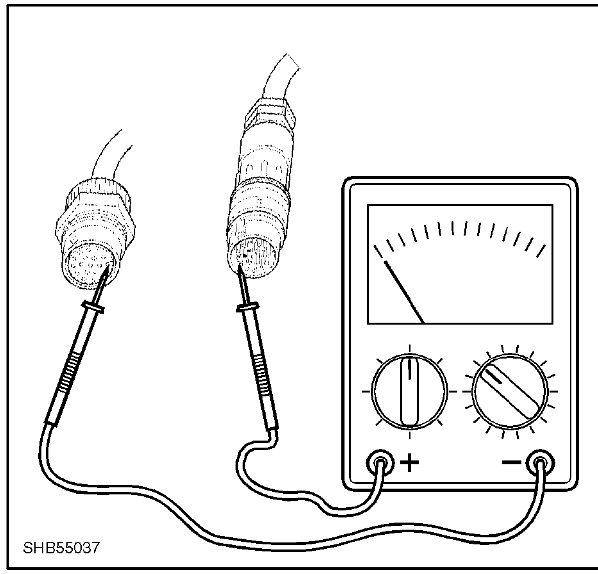
FAULT FINDING

Before attempting any fault finding ensure you have a suitable Multimeter for checking component continuity.

When fault finding remember that with an electrical concern it is often a minor fault that may have occurred and could be as simple as:

Poor continuity between connector pins
Condensation in the connectors
Disconnected cables
Damaged or broken wires all of which could result in a no drive situation but easily remedied when found and corrected.

It should also be remembered that mechanical problems could result in fault codes appearing on the LED display

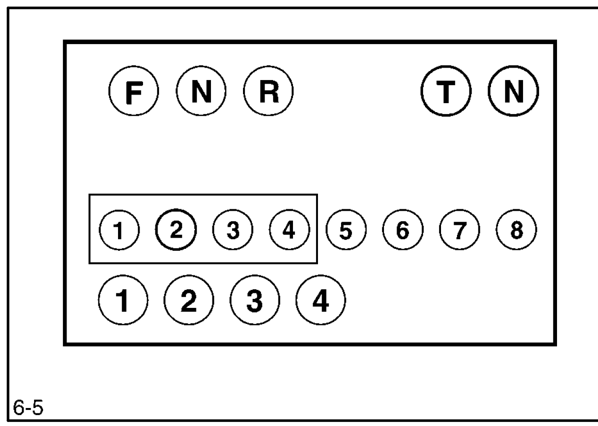


25

Indication of faults

In case a fault is present during normal operation and is detected by the microproccesor, both the T–led and N–led may be blinking in some way as shown in the table below.

NOTE: *That on an open circuit or connection to battery plus on ON/OFF outputs can only be detected while the corresponding output is in the OFF position. Also a short to ground is only detected while the output is on.*

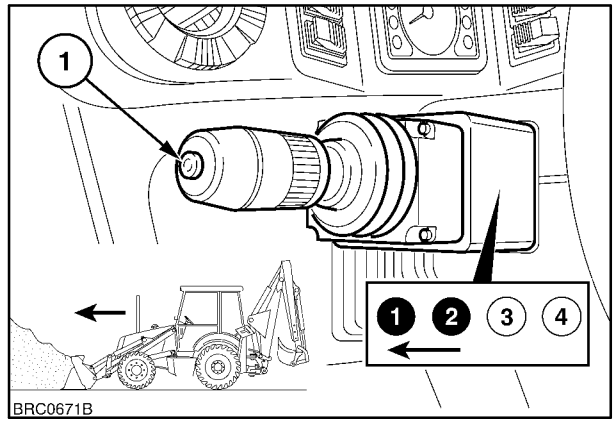


26

T–LED (Orange)	N–LED (Red)	Condition	Situation
Off	Off	Normal operation	–
Off	On	Normal operation – N selected	–
Off	Blinks	Normal operation – N selected / speed too high	–
On	Off	Diagnostic mode was activated at Power up	–
On	On	Controller in RESET – malfunction	Fault
On	Blinks	Self Calibration in Progress	–
Blinks	On	Last fault is currently shown on display	Fault
Blinks	Blinks slower	Input Fault detected	Fault
Blinks	Blinks in Phase	Non critical Output Fault detected	Fault
Blinks	Blinks Faster	Safety Critical Output Fault detected	Fault
Blinks Fast	Blinks out of phase	System Shutdown – Neutral till Power Down	Fault

LED Displayed Faults

If a fault is, or there have been (intermittent faults) present, a detailed fault display can be selected by placing: The Powershift lever in Neutral position and pressing the Kickdown button. The indicated fault on the LED display can then be localised by using the table below, until power down.

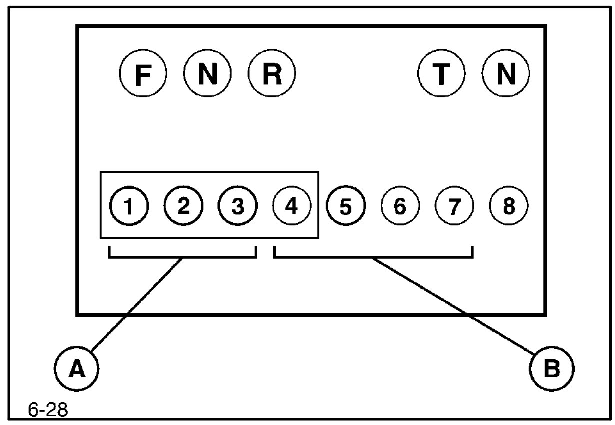


27

Fault Group

The faults are displayed using 2 LEDs on the 8 LED display. Faults are displayed as 3 subgroups – Group A:

Fault Sub Group A	Group Indication
Input related	LED 1 blinks red
Output related	LED 2 blinks red
Other	LED 3 blinks red



28

Within each group several faults are possible. The second LED's position – Group B, indicates the fault area, where the colour indicates the fault type.

Typically an open circuit condition is shown using an orange LED where a short circuit condition is indicated with a red LED.

Once the fault code has been determined proceed to fault codes page 18.

Fault Group LED (A)	Fault Group LED (B)	Fault	Fault Code
None	None	No fault active	–
1 Red	4 Orange	Shift lever input fault	F1
1 Red	5 Orange	Speed sensor Open Circuit	F2
1 Red	5 Red	Speed sensor Short Circuit	F3
1 Red	7 Green	Battery Over voltage	F4
2 Red	4 Orange	Open circuit on one or both direction outputs	F5
2 Red	4 Red	Direction output forced to plus – Critical fault	F6
2 Red	5 Orange	Other output Open Circuit	F7
2 Red	5 Red	Other output Short Circuit	F8
2 Red	6 Orange	Modulation output Open Circuit	F9
2 Red	6 Red	Modulation output Short Circuit	F10
3 Red	5 Red	Startup Fault – Limp Home Mode Selected	F11

FAULT CODE – F1

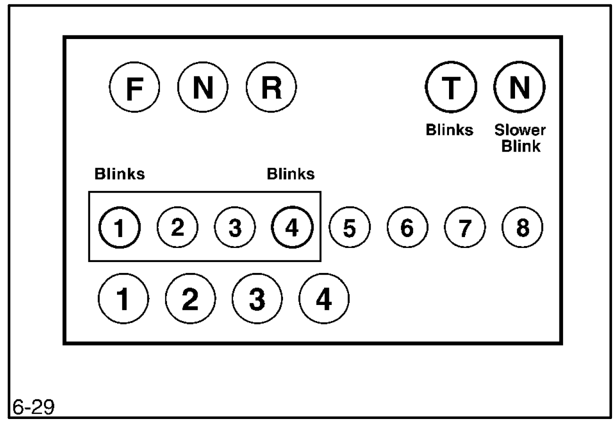
SHIFT LEVER INPUT FAULT

Perform Input test:

This test is used to verify operation of the shiftlever and its inputs.

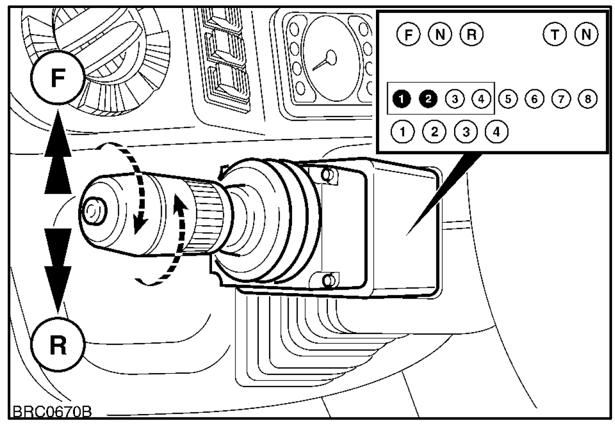
In this mode **driving is possible**

NOTE: *The gear position indicators on the Microprocessor top cover are used to display the test information.*



29

INPUT TEST REQUIREMENTS: *Powershift lever to be in forward position, twist to upshift (keep the shift lever in this position during power up) and turn the ignition on, this will place the microprocessor in the Input test mode.*



30

As shown in the table below placing the shift lever in different positions in this mode illuminates its respective LED (only 2 at the same time).

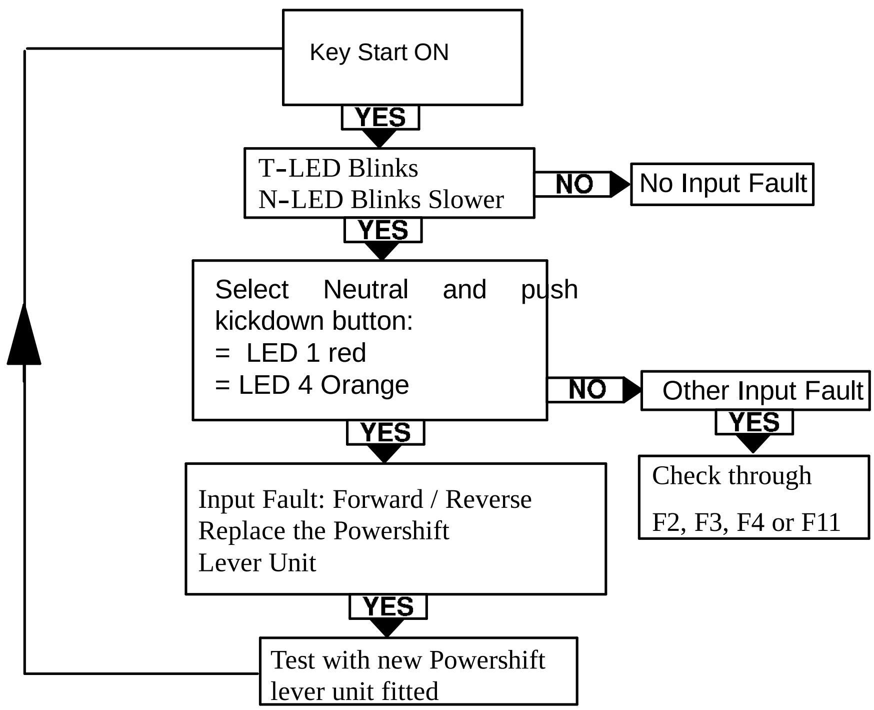
IMPORTANT: *Selftest modes can only be started WHILE POWERING UP (ignition on). Leaving the selftest mode is done by switching OFF the power of the Microprocessor (ignition off).*

POWERSHIFT LEVER POSITIONS – WITH UP AND DOWN SHIFT SELECTION	LED – NUMBER	LED COLOUR – DISPLAYED = Okay
Neutral	2	RED
Neutral and Upshift	3	RED
Neutral and Downshift	1	RED
Forward	2	GREEN
Forward and Upshift	3	GREEN
Forward and Downshift	1	GREEN
Reverse	2	ORANGE
Reverse and Upshift	3	ORANGE
Reverse and Downshift	1	ORANGE

Legend * = Auto transmission Only, ** = Auto / Manual Override

Operate Disconnect Button on loader lever	5 (*) (**)	GREEN
Operate 4WD Switch on Instrument Panel	6 (*) (**)	GREEN
Foot Brake Test + 4WD	6 (**)	GREEN
Foot Brake Test + 4WD	7 (*)	RED
Transmission in automatic mode	7 (*)	RED
Temperature and Speed Sensor: Too test disconnect lead on the sensor and short to ground	8	RED

FAULT CODE – F1
Shift lever input Fault



31

FAULT CODE – F2 & F3

SPEED SENSOR

A fault indication on the display is given to warn of this problem.

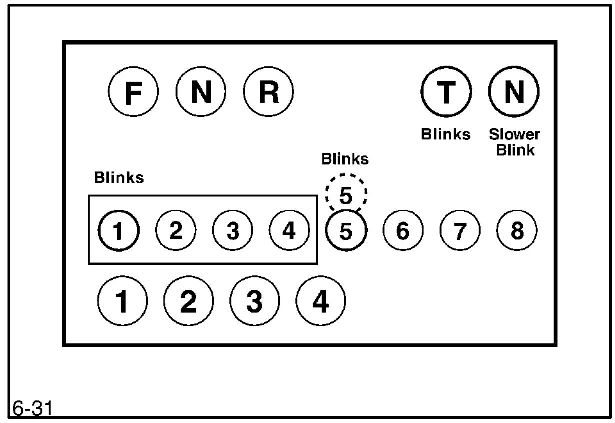
If a speed sensor fault is detected the microproccesor will modify its Behaviour in the following areas:

– no up shifts will be allowed above 2nd gear

– direction change while in F3 or F4: the actual reversal is preceded by a downshift sequence until 2nd gear is obtained.

– 4WD braking remains operative

NOTE: *That the system response in this case is identical to the response in case of a power supply overvoltage*



32

Speed Sensor Test Using The Turbine Speed Display

NOTE: *A lamp test is performed prior to the speed sensor test and monitors all LEDs are operational*

<u>**SPEED SENSOR TEST REQUIREMENTS:** *Powershift lever to be in reverse position, twist to upshift (keep the shift lever in this position during power up) turn the ignition on and start the engine.*</u>
<u>*With engine running return Powershift lever to neutral position and then place lever in forward and twist to upshift. Increase engine speed and compare with the table opposite.*</u>

Turbine Rev/Min	LED
0	1 blinks
0 – 249	1 on
250 – 499	2 on
500 – 749	3 on
750 – 999	4 on
1000 – 1249	5 on
1250 – 1499	6 on
1500 – 1749	7 on
1750 – 1999	8 on
above 2000	8 blinks

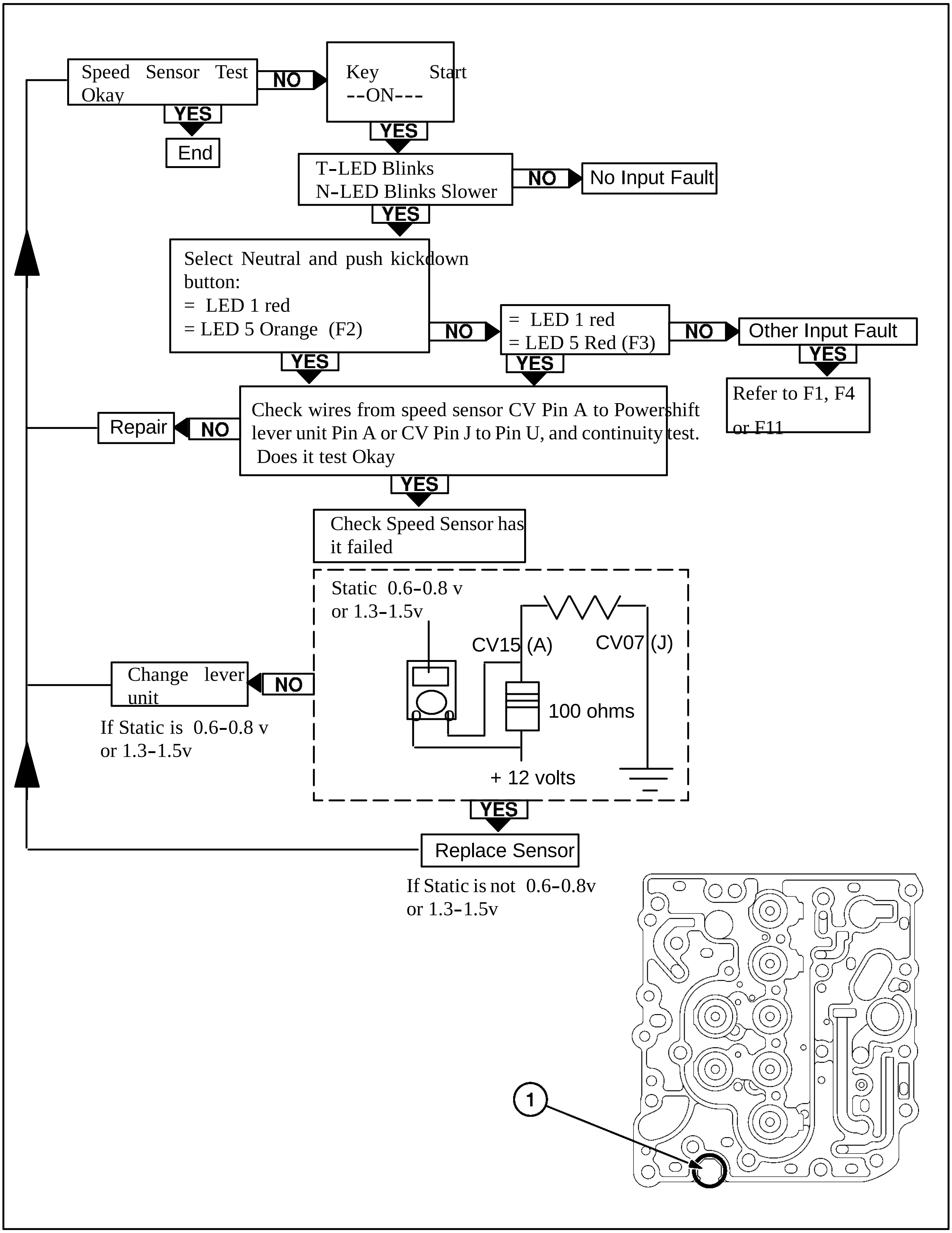
IMPORTANT: *Selftest modes can only be started* ***WHILE POWERING UP*** *(ignition on). Leaving the selftest mode is done* ***by switching OFF the power*** *to the Microprocessor (ignition off).*

In this mode, **driving is possible**

The LED corresponding with the table opposite illuminates to indicate the torque converter turbine speed and increases with engine revs.

NOTE: *Application of the footbrakes during this test will reduce the turbine speed to zero.*

FAULT CODE - F2 and F3
Speed Sensor Fault



33

FAULT CODE – F4

BATTERY OVERVOLTAGE – 17 VOLTS PLUS

Overvoltage

Even power supply levels up to 30V will not damage circuit components.

Above a power supply of 17 Vdc:

Group Fault 1 – Fault code 7

NOTE: *The speed sensor circuit will not operate when an overvoltage is present*

Above a power supply of 24 Vdc:

the analogue signals are not reliable to convert anymore

Overvoltage: When the voltage exceeds 17 Vdc

Action of the Microprocessor:

– no upshifts above 2nd gear

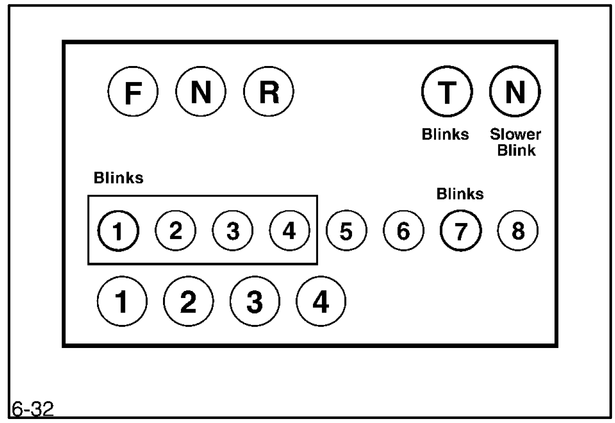
– direction change while in Forward 3 or Forward 4: the actual reversal is preceded by a downshift sequence until 2nd gear is obtained

– Brake switch activation always engages four Wheel Drive

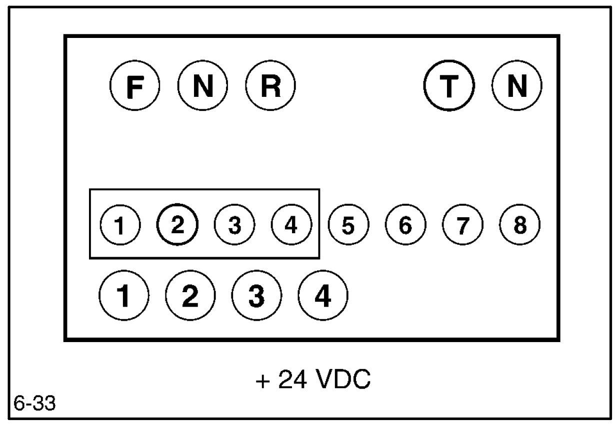
NOTE: *Voltages below 8 volts D.C the microproccessor enters the reset mode*

Intermittent power loss

After power is restored, the Microprocessor goes through the reset mode.



34



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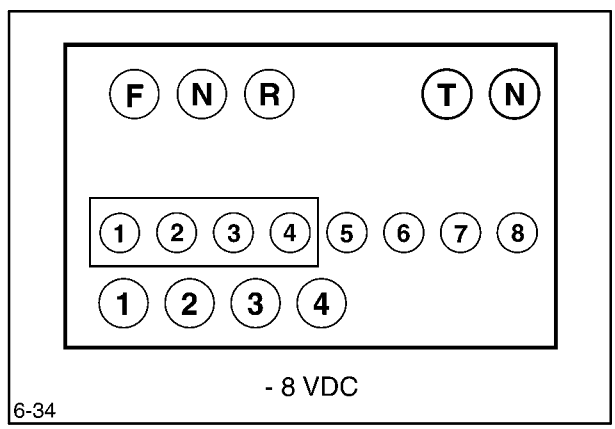
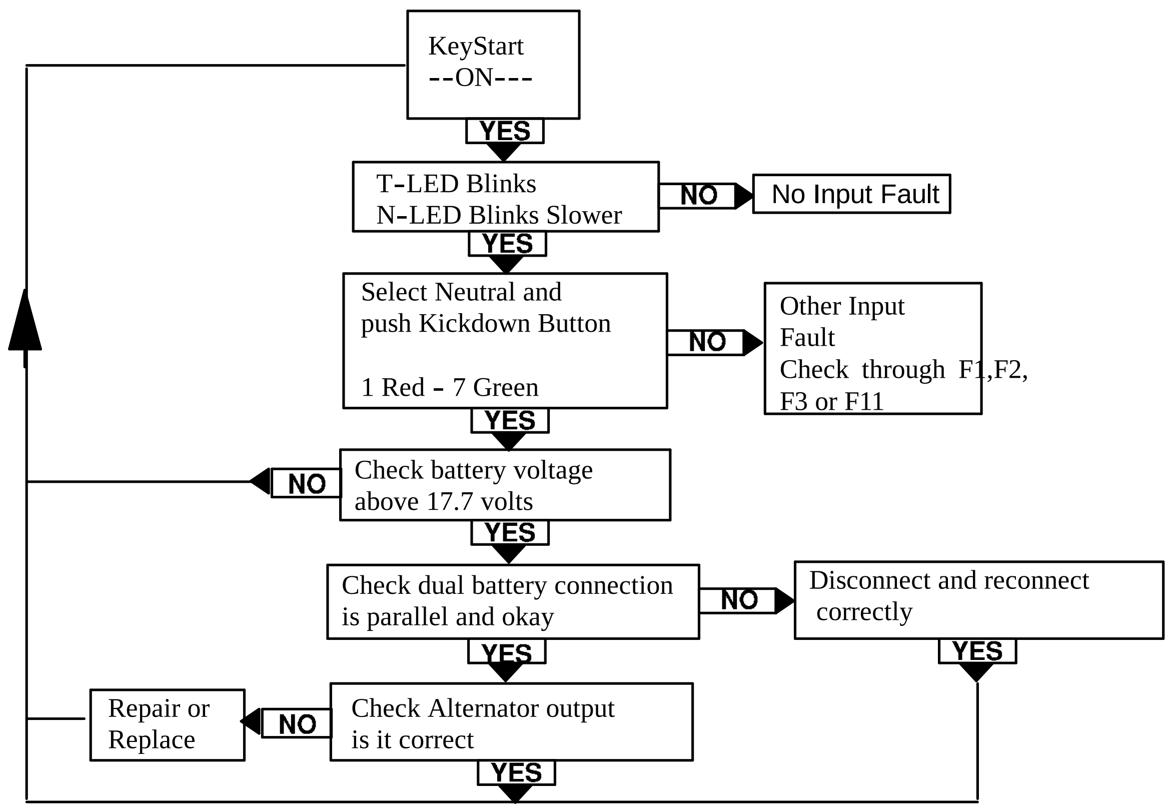


36

FAULT CODE – F4
Battery Overvoltage



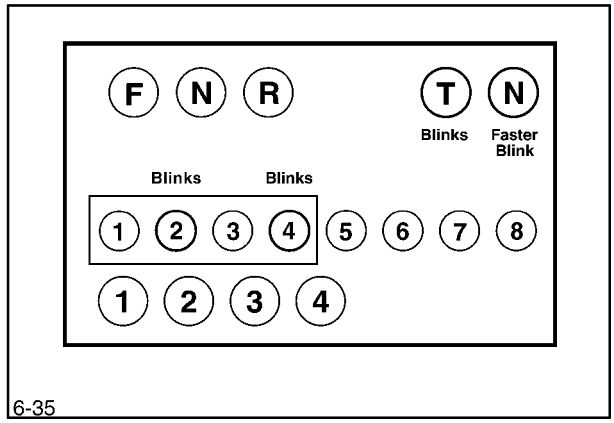
37

FAULT CODE - F5 AND F6

OPEN CIRCUIT DIRECTION OUTPUTS

Direction selection related outputs (E06-Pin P, E07-Pin N):

A short to plus is considered as a critical fault. Shorts to plus usually result in being blocked in either Forward or Reverse. If both are on simultaneously, the transmission Behaviour depends on the state of a mechanical interlock inside the transmission



38

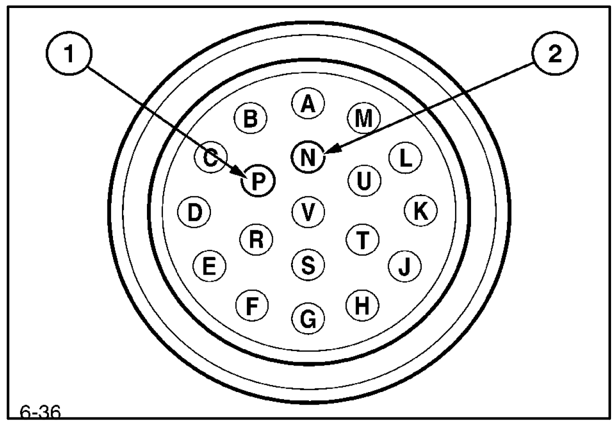
In this case the Microprocessor normally turns on the pressure modulator (E03-Pin T). This results in immediate selection of neutral regardless of the origin of the fault. Indeed even in case the short to plus is applied externally, this response effectively blocks the transmission in neutral.

If however at the time the fault was detected a fault was also present on the pressure modulator, the Microprocessor reverts to shutdown mode and remains this way until power is removed. Shutdown mode is a state in which power is removed from the Microprocessor outputs by opening the internal redundant shutdown path.

This only helps if the fault was caused by the Microprocessor internally.

Additionally, during program execution, critical variables are continuously checked for contents integrity.

NOTE: *To determine output faults proceed to pages 26 to 29.*



39

Gear Shifts

low/high solenoid :
inactive = forward high is selected
active = forward low is selected

Shift diagram - Solenoids	**Forward**				**Reverse.**	
	1	**2**	**3**	**4**	**1**	**2**
rev/n					X	X
fwd/n						
low/high	X	X	X	X		
1st/2nd	X		X		X	

FAULT CODE – F5 and F6
Example of Output Test results

During the output test LEDs 1234567 one by one are used and by colour identifies the possible component at fault.
Red = short circuit yellow = open circuit or short to battery plus

NO → Green = No fault found

YES

Identify component by LED
1 – Forward solenoid
2 – Reverse solenoid
3 – 1/2 Solenoid
4 – Forward Hi / Lo Solenoid
5 – 4WD / RWD Solenoid
6 – Direction modulation solenoid
7 – Range modulation solenoid

YES

Example : LED 1 (red) Forward solenoid output shorted to ground or a component.

Check component and continuity of the cables and connectors

YES

Identify component by LED
1 – Forward solenoid
2 – Reverse solenoid
3 – 1/2 Solenoid
4 – Forward Hi / Lo Solenoid
5 – 4WD / RWD Solenoid
6 – Direction modulation solenoid
7 – Range modulation solenoid

YES

Example : LED 2 (orange) Reverse Solenoid Output open circuit or shorted to battery plus
Check component and continuity of the cables and connectors

Output Test →

40

FAULT CODE – F5 AND F6

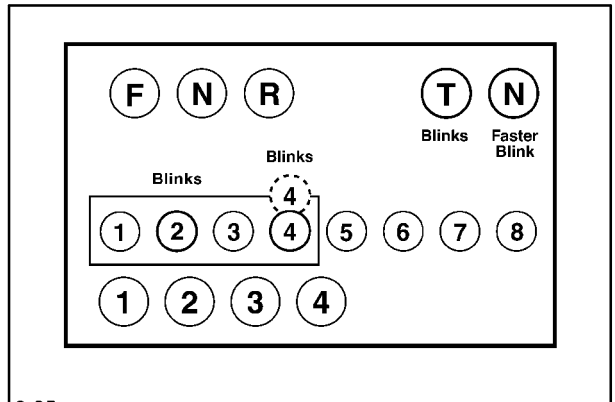
OUTPUT FAULT – STATUS BY LED COLOUR

OUTPUT TEST REQUIREMENTS: *Powershift lever to be in forward position, twist clockwise to downshift and turn ignition on.*

In this mode, **driving is not possible**, since all Microprocessor outputs remain off until the test mode is left.

The colour and number of the LED indicates its status:

COLOUR	STATUS
GREEN	Output OK
ORANGE	Output not connected or shorted to battery plus
RED	Output shorted to ground (or to another output)



6-35a

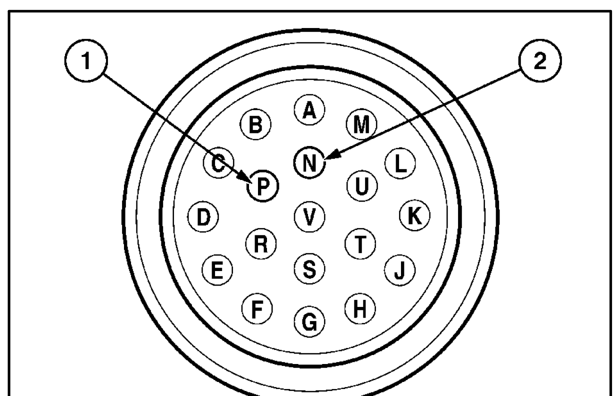
41

Output test – Fault by LED Number

The LED numbers correspond to the connector output wires as follows:

Example: *LED 1 = Forward solenoid – colour Orange = (Output not connected or shorted to battery plus)*

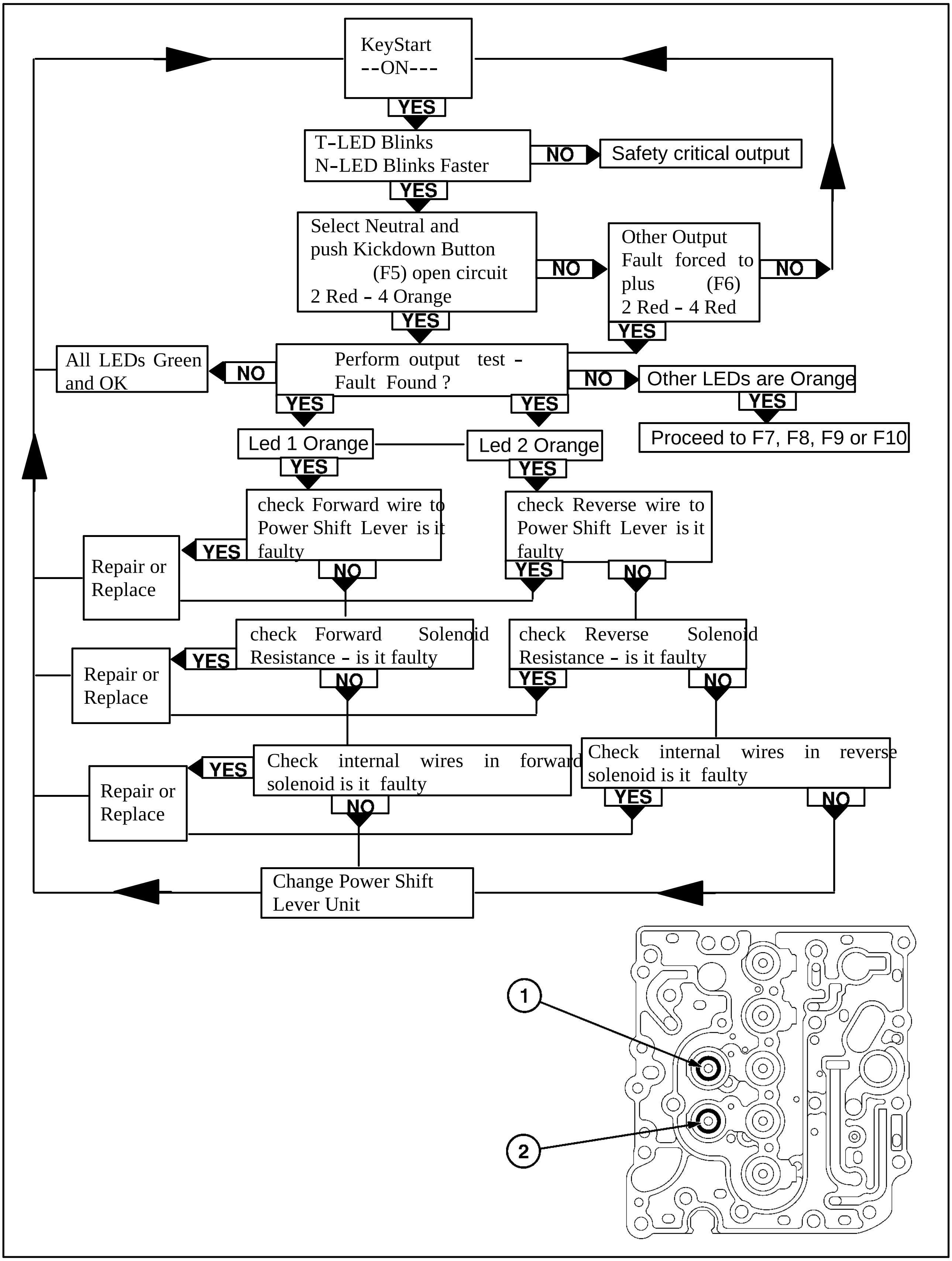
LED NUMBER	OUTPUT WIRE	OUTPUT FUNCTION
1	E06	Forward solenoid
2	E07	Reverse solenoid



6-36

42

FAULT CODE – F5 and F6
Output Fault – Status by LED Colour



FAULT CODE – F7 AND F8

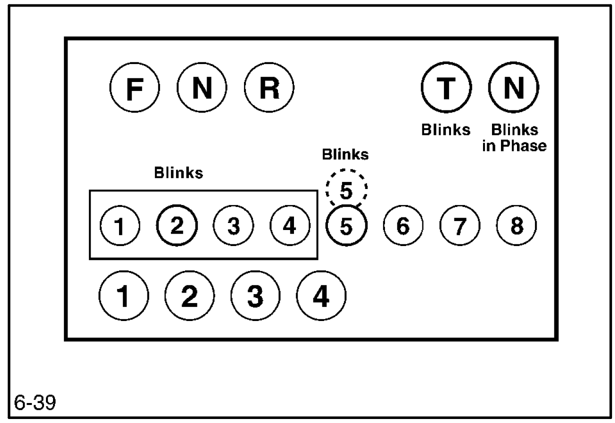
OUTPUT FAULT – STATUS BY LED COLOUR

OUTPUT TEST REQUIREMENTS: *Powershift lever to be in forward position, twist clockwise to downshift and turn ignition on.*

In this mode, **driving is not possible**, since all Microprocessor outputs remain off until the test mode is left.

The colour and number of the LED indicates its status:

COLOUR	STATUS
GREEN	Output OK
ORANGE	Output not connected or shorted to battery plus
RED	Output shorted to ground (or to another output)

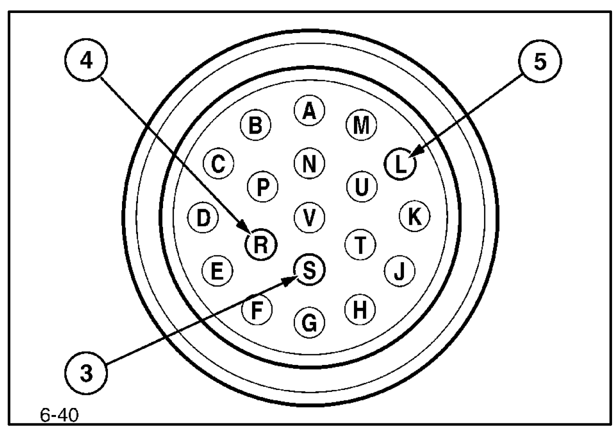


44

Output test – Fault by LED Number

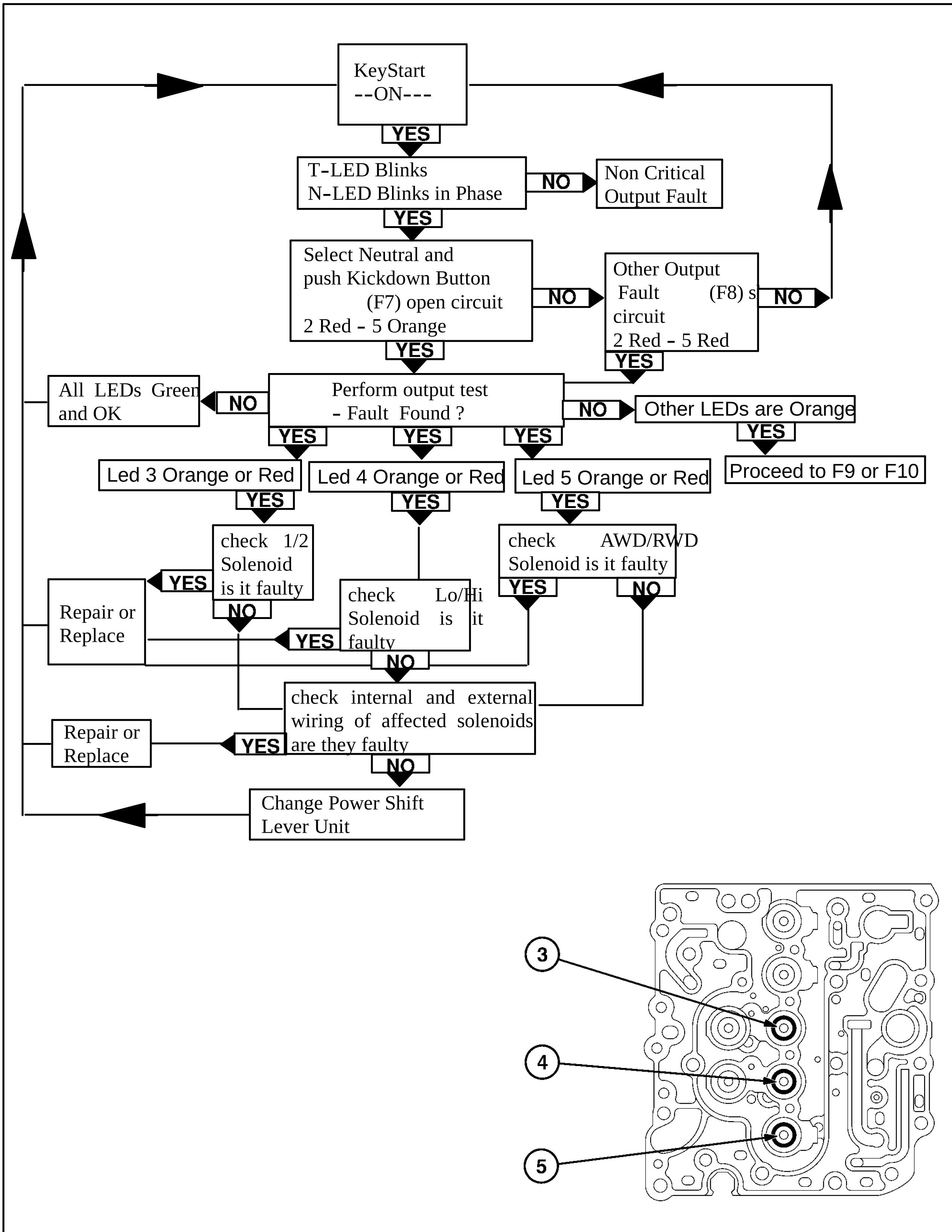
The LED numbers correspond to the connector output wires as follows:
Example: *LED colour Red and numbered 3 = 1/2 solenoid output shorted to ground.*

LED NUMBER	OUTPUT WIRE	OUTPUT FUNCTION
3	E04	1/2 Solenoid
4	E05	Forward Lo/Hi solenoid
5	E09	AWD/RWD Solenoid



45

FAULT CODE – F7 and F8
Open Circuit Direction Outputs



FAULT CODE – F9 AND F10

DIRECTION MODULATION OUTPUT SHORT OR OPEN CIRCUIT

A fault on this output is considered as a problem potentially reducing transmission life.

For this reason while a fault is persistent, the allowable direction change speed limit is decreased gradually (10%) each time a direction change was inhibited, down to a minimum of 20% of the maximum allowable shift speed.

After a while this can result in severely degraded performance (only low speed reversals are possible), but it has the advantage that the driver cannot be surprised by a sudden performance loss which could constitute a safety hazard in itself.

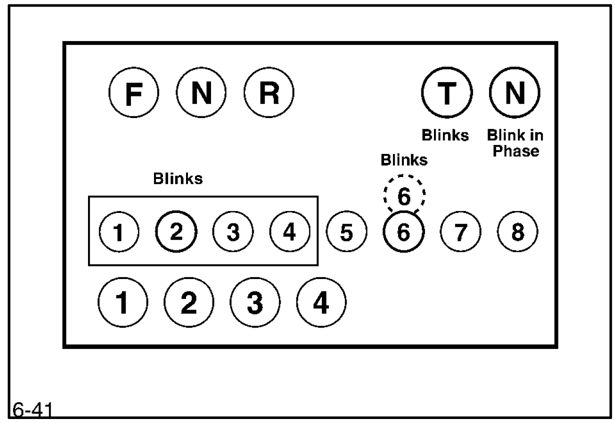
Direction Modulation Solenoid (E03) Pin T.

The variable Current solenoid for direction modulation is connected to the modulation Common Plus (Pin K) at one side and to (Pin T) at the other side.

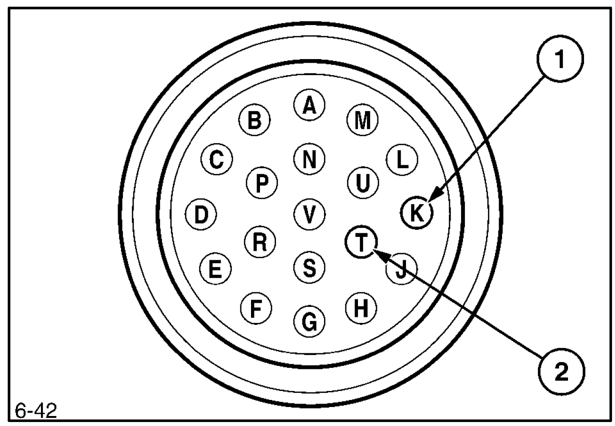
A programmable current is increased or reduced to the solenoid controlling the modulating pressure

No current corresponds to maximum pressure.

Approximately 1 Amp corresponds with no pressure

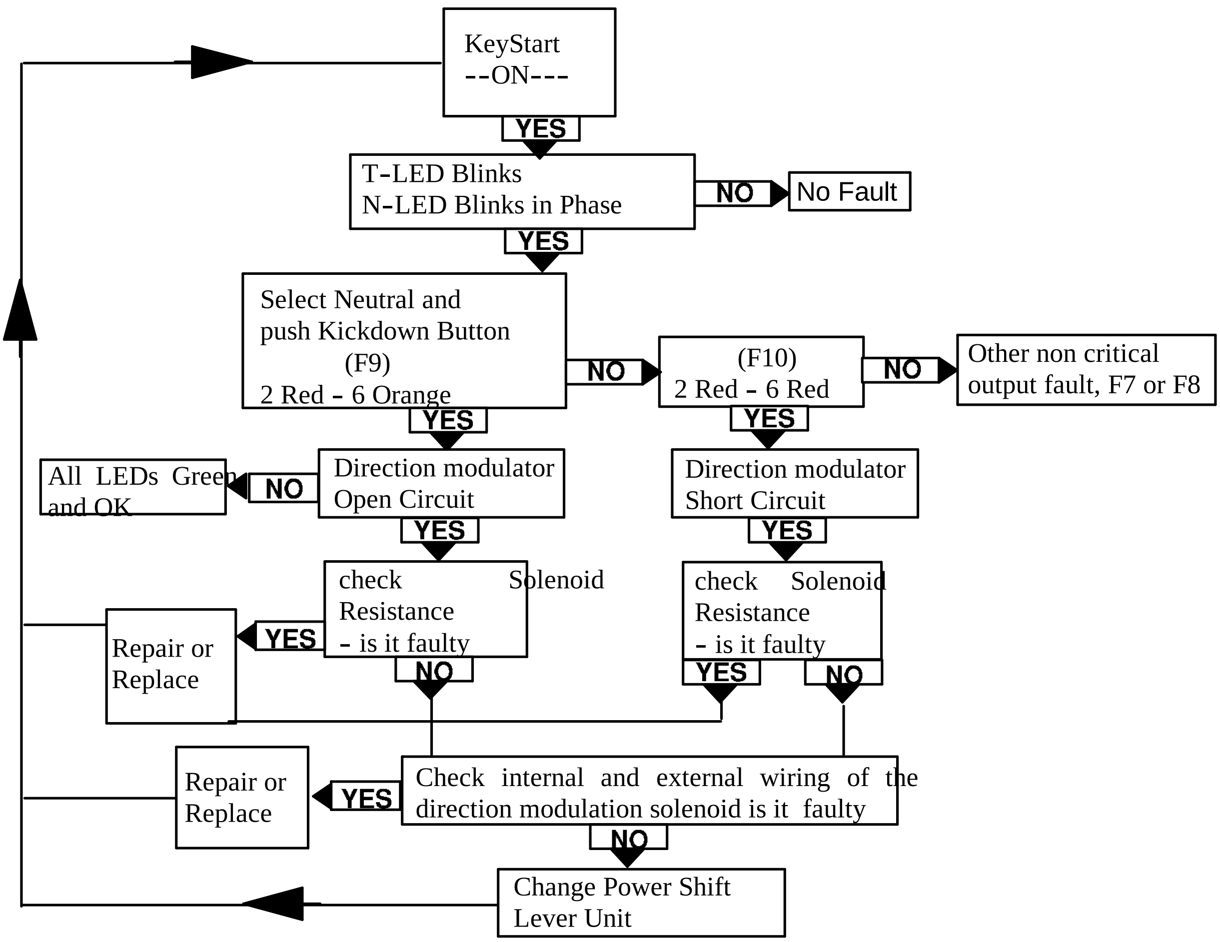


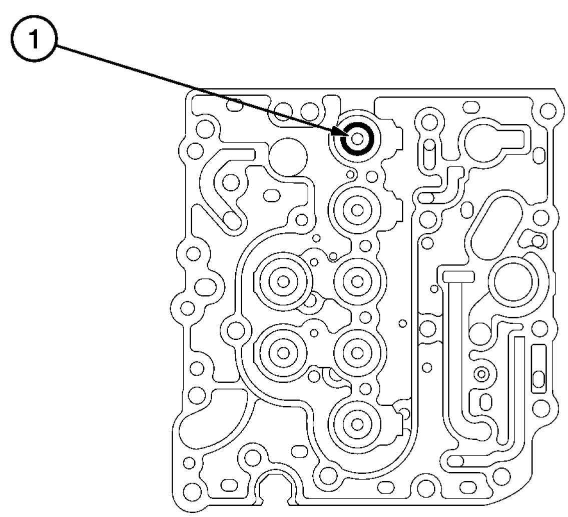
47



48

FAULT CODE – F9 and F10
Modulation Output Short or Open Circuit





49

FAULT CODE – F11

START UP FAULT LIMP HOME SELECTED

Internal faults

At power up a series of integrity checks is done.

If a fault is detected:

– and the fault prevent operation as a transmission controller : the Microprocessor **locks itself in a reset state**.

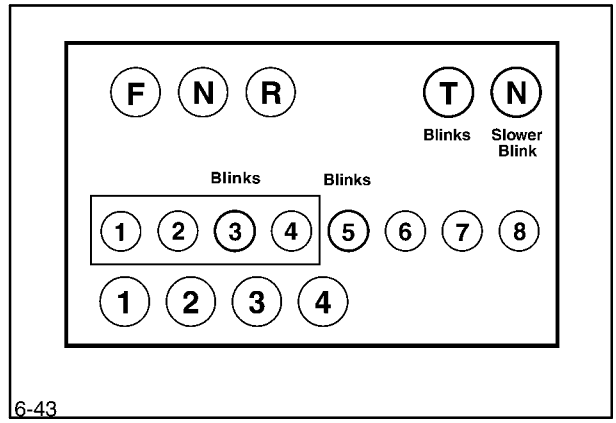
– and controlling the transmission is still possible : the Microprocessor **reverts to limp home mode**.

Limp Home mode

Defaulted to if an internal problem is detected **at power up.**

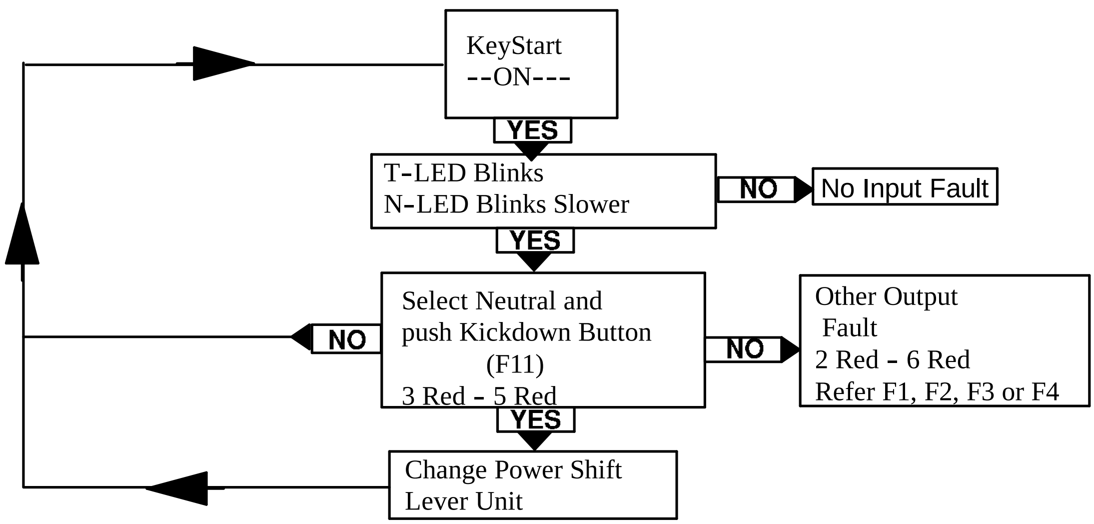
This mode is automatically selected at power up if the integrity tests show that **EPROM parameters are corrupt,** but the microprocessor can still function as a transmission controller (other component's integrity are intact).

In this mode the user can operate the transmission in either direction in 1st. and 2nd. There are **no protections**; all shifts are **unmodulated**.



50

FAULT CODE – F11
Start Up Fault Limp Home Selected



FAULTS OTHER – F 12

NOT IDENTIFIED BY THE LEDS

There may be situations when an individual component develops a fault but it is not highlighted by the LEDs. If a component is in doubt proceed to Input Test as follows:

Perform Input test:

This test is used to verify the inputs.

In this mode **driving is possible**

NOTE: *The gear position indicators on the Microprocessor top cover are used to display the test information.*

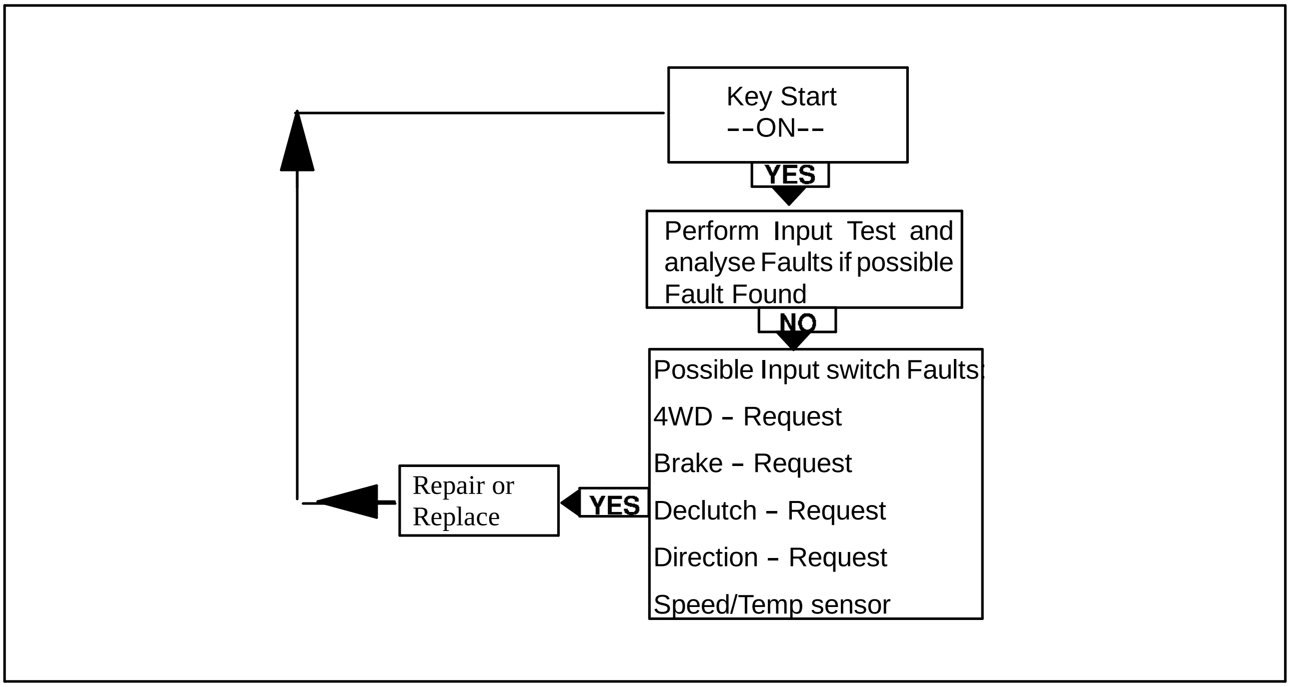
INPUT TEST REQUIREMENTS: *Powershift lever to be in forward position, twist to upshift and turn the ignition on, this will place the microprocessor in the Input test mode.*

As shown in the table below placing the shift lever in different positions in this mode illuminates its respective LED.

IMPORTANT: *Selftest modes can only be started WHILE POWERING UP (ignition on). Leaving the selftest mode is done by switching OFF the power of the Microprocessor.*

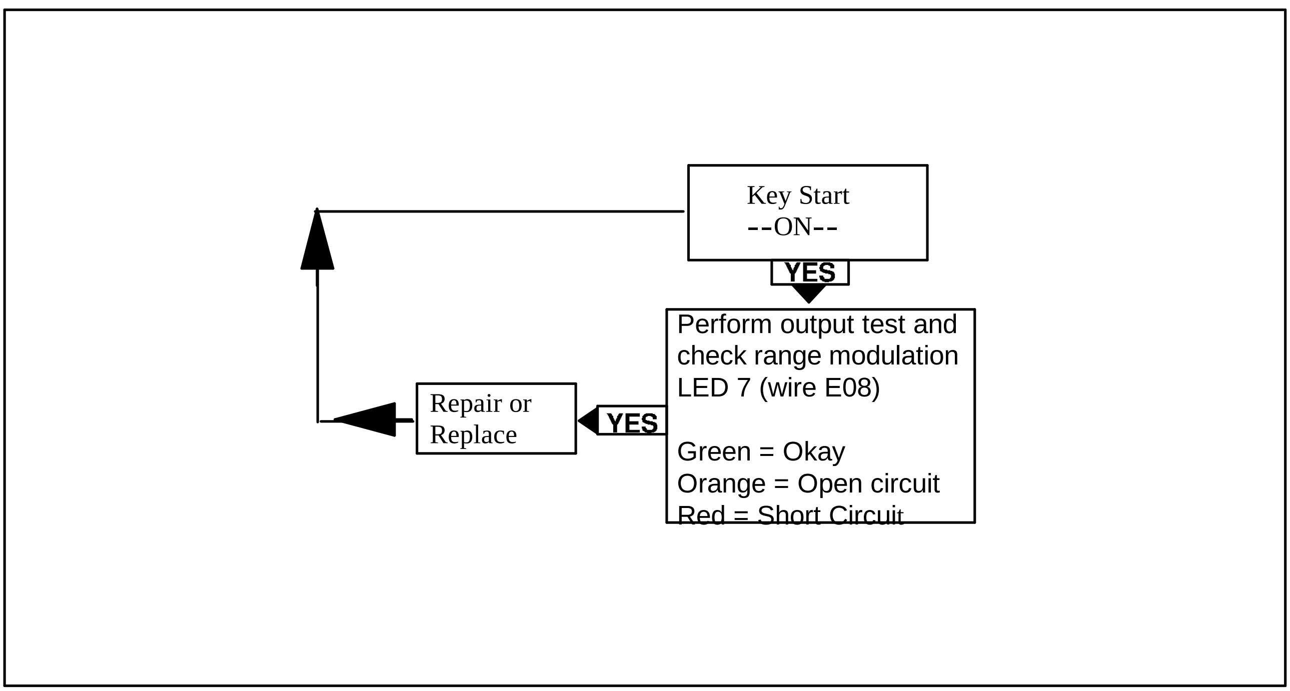
CHECKING OF INPUT REQUESTS	LED – NUMBER	LED COLOUR – DISPLAYED
Confirm Input Test Is Okay (Lever Forward, Neutral, Reverse) and In Order Check As Below:		
1. Operate Disconnect Button on loader lever	5	GREEN = OKAY
2. Operate 4WD Switch on Instrument Panel and Foot brakes	6	GREEN = OKAY
3. Foot Brake Test on later models	7	RED = OKAY
4. Temperature and Speed Sensor: Too test disconnect lead on the sensor and short to ground	8	RED = OKAY

FAULT CODE – F12



52

FAULT CODE – F13

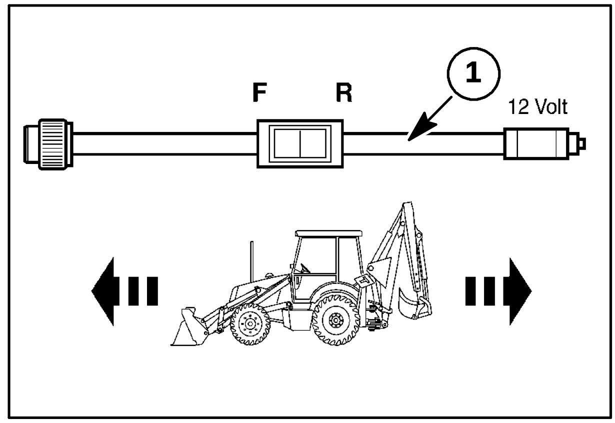


53

LIMP HOME LEAD

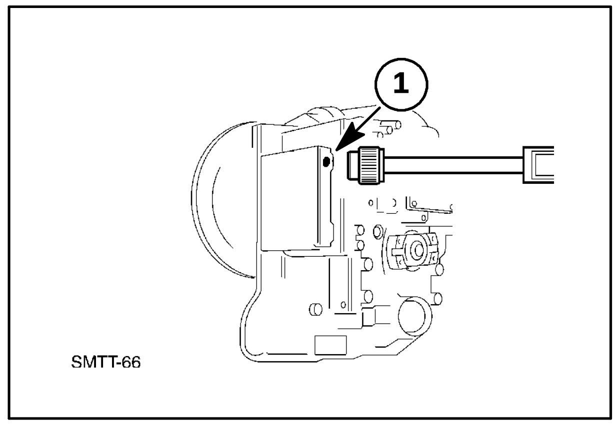
In the event of a total failure of the microprocessor such as a serious cab or loom fire the vehicle can be moved by using the limp home lead to bypass the microprocessor.

Tool No – **380000715**



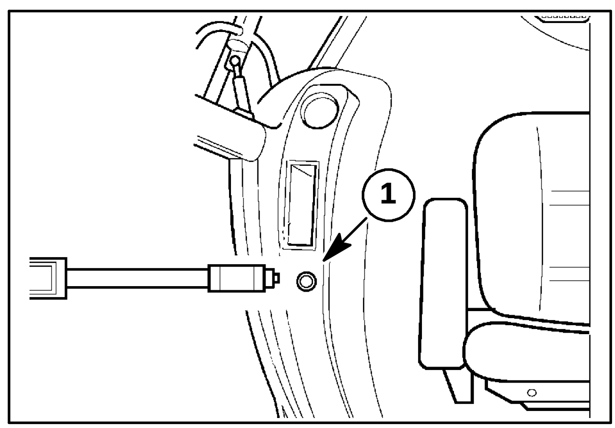
54

Mounted to the left hand side and to the top of the transmission is the microprocessor loom connector. Disconnect the damaged loom and connect the limp home lead in its place.



55

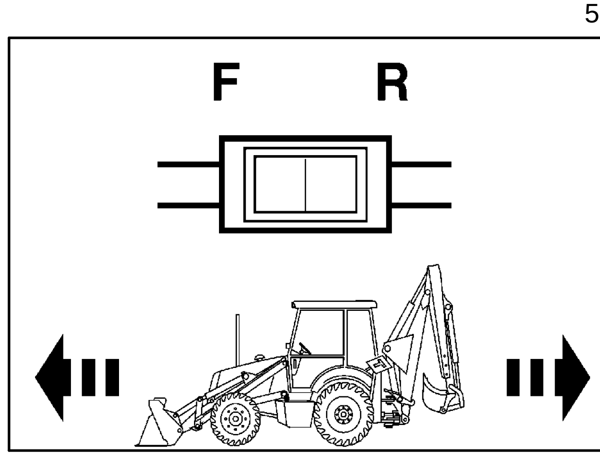
Connect the plug end into the 12 volt auxiliary socket or any available 12 volt supply



56

When seated in the cab start the engine and ensuring that all personnel are clear of the machine select either forward or reverse on the switch and the machine will move as requested.

NOTE: *When using the limp home lead only 2nd gear (forward or reverse) is selectable no other gear change or modulation is available.*



57

SECTION 21 – TRANSMISSIONS

Chapter 4 – Powershift Overhaul (include 4 Wheel Steer)

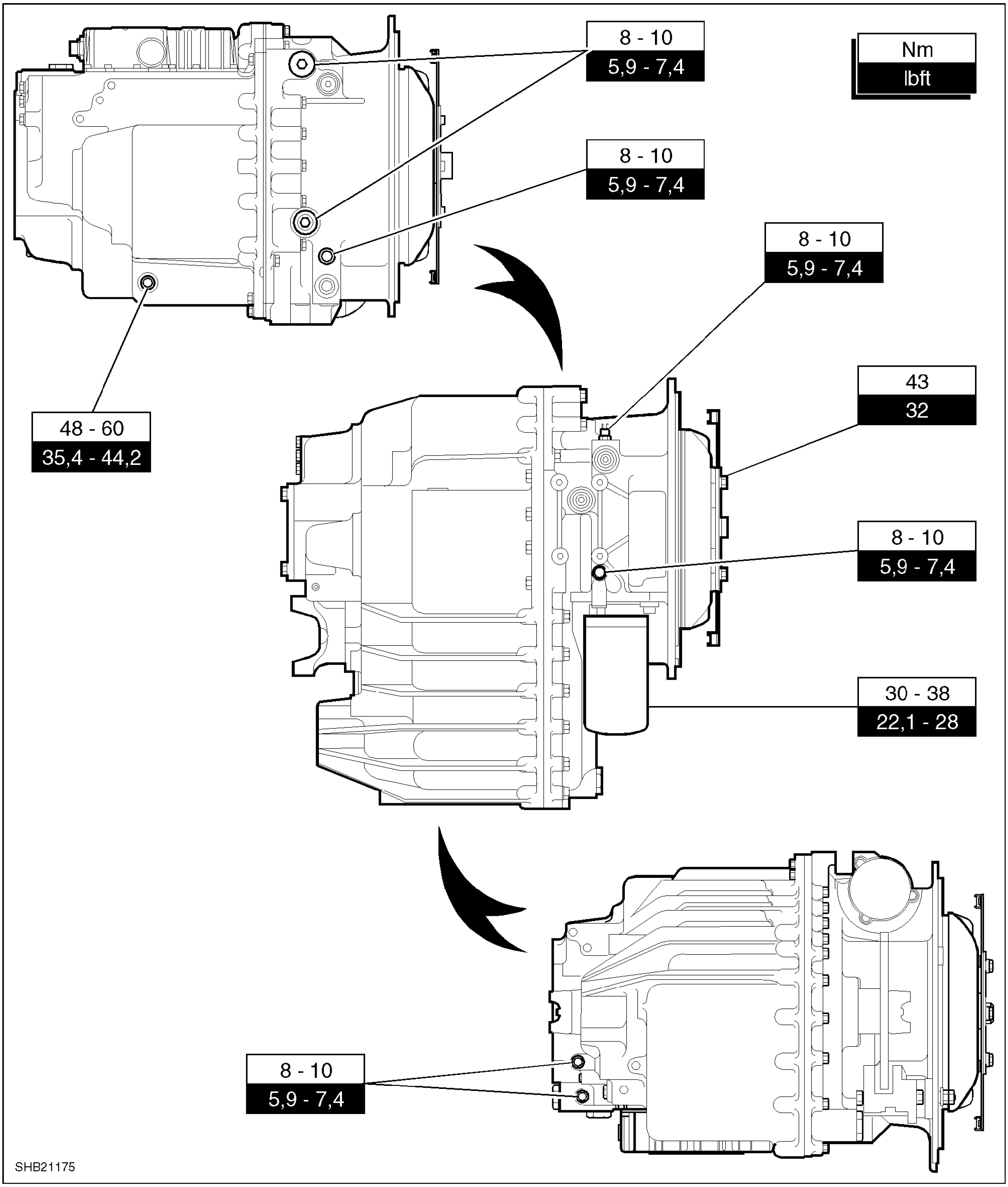
CONTENT

SPECIFICATIONS

Weight, dimensions, oil capacity		
Weight (dry)	290 kg	(639 lb)
Maximum length	705,3 mm	(27,8”)
Maximum width	465 mm	(18,3”)
Maximum height	648 mm	(25,35”)
Oil capacity:	14 Litres (3.7 US Gals) without cooler and hydraulic lines.	
Stall Speed Test	T.B.E	

TOOLS

Transmission Drive Gear Locking tool	380000708
Forward/Reverse Shaft Lift Hook	380000709
Transmission Lift Bracket	380000710
60mm thin wall Socket – Output yoke nuts	297400
Piston Spring Compressor	380000711
Output Seal Installer	380000712
Pressure Test Gauge Extension Connector	380000713
Pressure Test Gauge Connector	380000493
Test lead for Speed Sensor	380000714
Limp Home Lead	380000715



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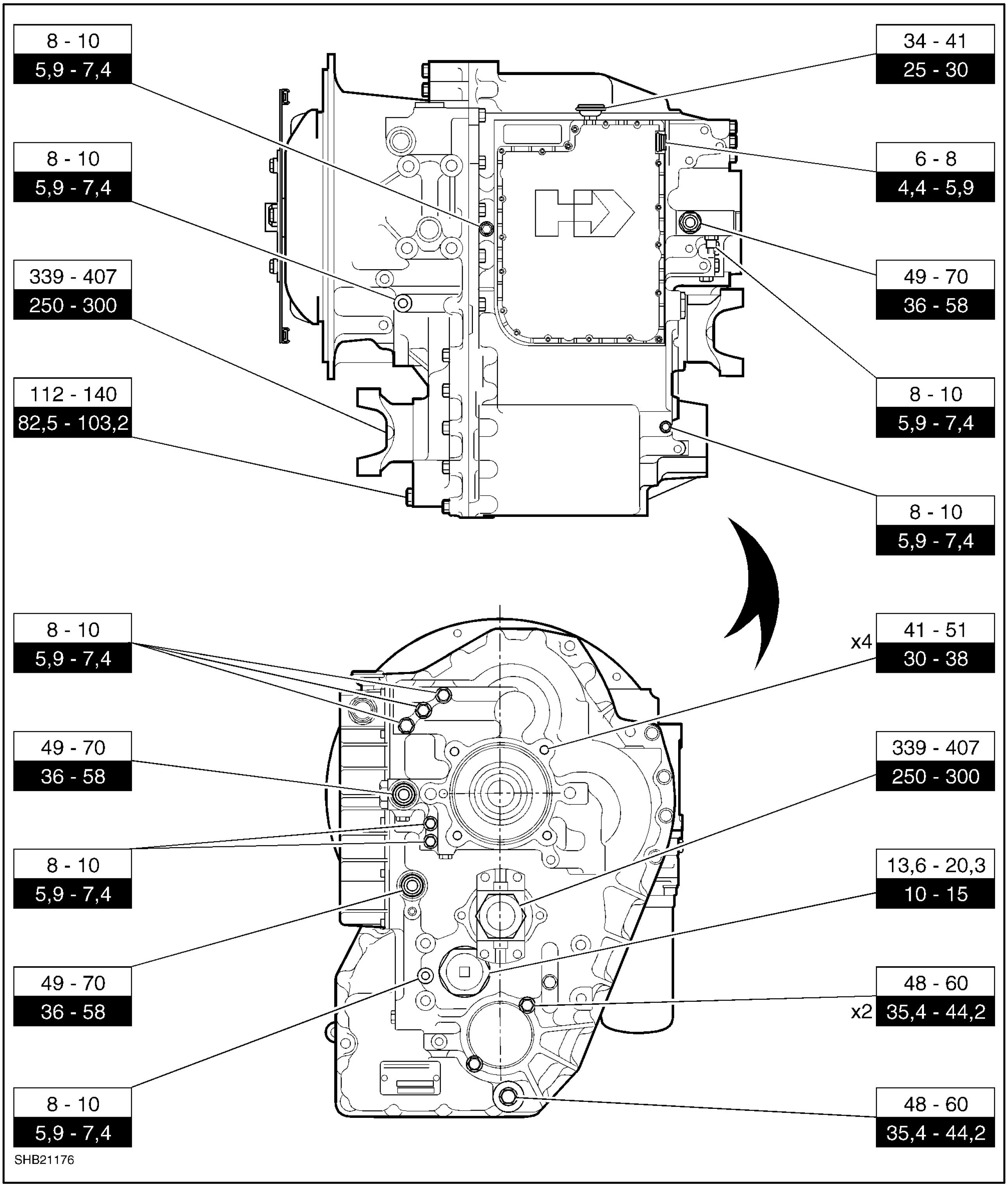
Torque Chart



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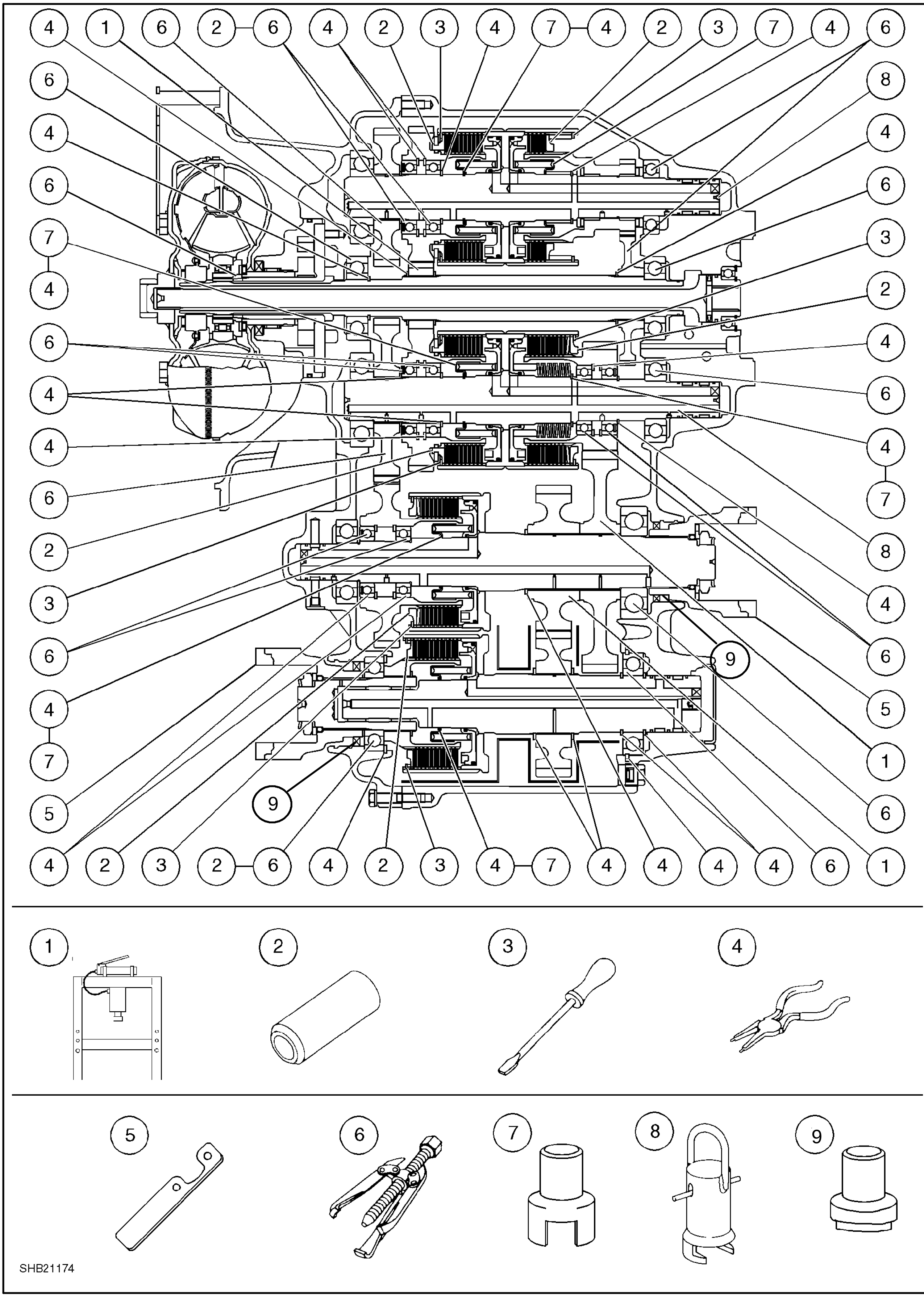
Torque Chart



3

Tooling Chart

FAULT FINDING

When troubleshooting a ”transmission” problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, torque converter, transmission assembly, oil cooler, filter, connecting lines, and controls, including the engine, as a complete system.

Power shift with torque converter transmission troubles fall into three general categories: mechanical hydraulic and electrical problems.

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the ”life blood” of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to ensure converter operation, to engage and hold the clutches from slipping, and to cool and lubricate the working components.

Stall Test:

Use a stall test to identify transmission, converter, or engine problems.

Transmission pressure checks:

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.

In addition, converter charging pressure and transmission lubrication pressure may also be measured.

Mechanical and electrical checks:

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake for correct adjustment.
- Be sure all lever linkage is properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure that all components of the cooling system are in good condition and operating correctly. The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.
- The engine must be operating correctly. Be sure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

Hydraulic check:

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:

Check oil level in the transmission. The transmission fluid must be at the correct (full level). All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times. See NOTE below.

NOTE: *The transmission fluid must be at operating temperature of 82 - 93_ C (180 - 200 F) to obtain correct fluid level and pressure readings.*
DO NOT ATTEMPT TO MAKE THESE CHECKS WITH COLD OIL.

To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with converter at ”stall”. (Refer to converter stall procedure).

CAUTION

Be careful that the vehicle does not move unexpectedly when operating the engine and converter at stall R.P.M.

CONVERTER STALL PROCEDURE

1. Put the vehicle against a solid barrier, such as a wall, and/or apply the parking brake and block the wheels.
2. Put the directional control lever in FORWARD (or REVERSE, as applicable).
3. Select the highest speed. With the engine running, slowly increase engine speed to approximately one-half throttle and hold until transmission (converter outlet) oil temperature reaches the operating range.

CAUTION

Do not operate the converter at stall condition longer than 30 seconds at one time, shift to neutral for 15 seconds and repeat the procedure until desired temperature is reached. Excessive temperature (120_ C) 250 F maximum) will cause damage to transmission clutches, fluid, converter, and seals.

FAULT FINDING

Refer to the following troubleshooting guide for the diagnosis of typical transmission troubles.

LOW CLUTCH PRESSURE

CAUSE	REMEDY
1. Low oil level	1.Fill to proper level
2. Clutch pressure regulating valve stuck open	2.Clean valve spool and housing
3. Faulty charging pump	3.Replace pump
4. Broken/worn clutch shaft/piston sealing rings	4.Replace sealing rings

LOW CHARGING PUMP OUTPUT

CAUSE	REMEDY
1. Low oil level	1.Fill to proper level
2. Suction screen plugged	2.Clean section pump
3. Defective charging pump	3.Replace pump

OVERHEATING

CAUSE	REMEDY
1. Worn oil sealing rings	1.Remove, disassemble, and rebuild converter
2. Worn charging pump	2.Replace
3. Low oil level	3.Fill to proper level
4. Dirty oil cooler	4.Clean cooler
5. Restriction in cooler lines	5.Change cooler lines

NOISY CONVERTER

CAUSE	REMEDY
1. Worn charging pump	1.Replace
2. Worn or damaged bearings	2.A complete disassembly will be necessary to determine what bearing is faulty

LACK OF POWER

CAUSE	REMEDY
1. Low engine R.P.M. at converter stall	1.Tune engine check governor
2. See ”Overheating” and make same checks	2.Make corrections as explained in ”Overheating”

GENERAL INFORMATION

Grease 'O' rings before assembly.

Add grease to piston rings before assembly slots of piston rings are not allowed to pass bores in housings

Teflon seals must be sized prior to assembly, add some grease to steel and friction dia of clutch drum before assembly.

Pump must be filled up with test oil prior to assembly.

Pump drive shaft must be installed after torque converter

CLUTCH PACK ASSEMBLY

Forward Low: Rev, 1st, and 2nd clutch: 9 separator plates with steel splines. 8 friction plates (friction material both sides) with friction splines, 2 1–side friction plates (friction material 1 side) with friction splines.

Start with one 1–side friction plate, metal against piston, then alternately separator and friction plate. End with a 1–side friction plate, metal side against end plate or disc spring.
Be sure disc spring is mounted as shown.

Forward low and Reverse:
min. clearance = 2,79 mm
max. clearance = 5,21 mm

If clearance is more than 4,79 mm, add one separator plate upon last separator plate.

First and second:
min. clearance = 2,54 mm
max. clearance = 5,41 mm

If clearance is more than 4,54 mm, add one separator plate upon last separator plate.

Forward High:
4 separator plates, 3 friction plates and two 1–side friction plates.
min. clearance = 1,24 mm
max. clearance = 2,76 mm

4WD Disconnect clutch:
12 separator plates, 11 friction plates and two 1–side friction plates.

min. clearance = 3,66 mm

max. clearance = 6,78 mm

If clearance is more than 5,66 mm, add one separator plate upon last separator plate.

CAUTION

Installation force of disc spring is 3280 N !

Be sure that shielded and sealed bearings are mounted as shown.

Seals must be pressed in perpendicular upon shaft axis from bearing side. Except lower rear output.

Plug to be screwed in and torqued but without Loctite.

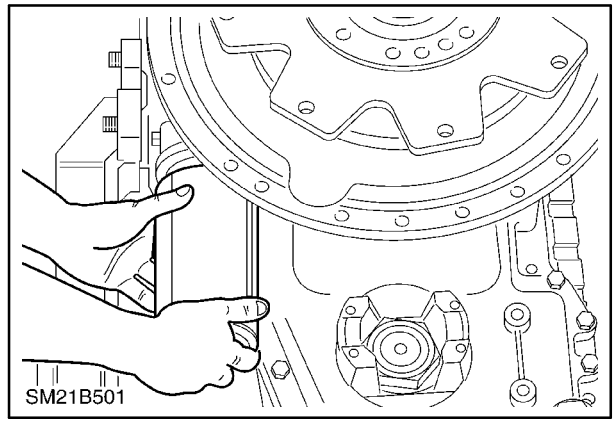
First clutch springs concave side of first disc spring to be placed against clutch piston wear sleeve. Remaining 10 springs to be stacked alternately reversed as shown.

Heat gears up to 150_C (302_F) before assembling.

IMPORTANT: *For disassembly and reassembly of this unit you will need, besides normal workshop tools and the special tools mentioned in the last chapter of this manual, a press capable of minimum 20 tons and an induction heater of minimum 3,5 kW to heat gears up to 150_ C (302 F).*

DISASSEMBLY OF FRONT EXTERNAL PARTS

Remove filter adapter screws, filter adapter and 'O' ring.



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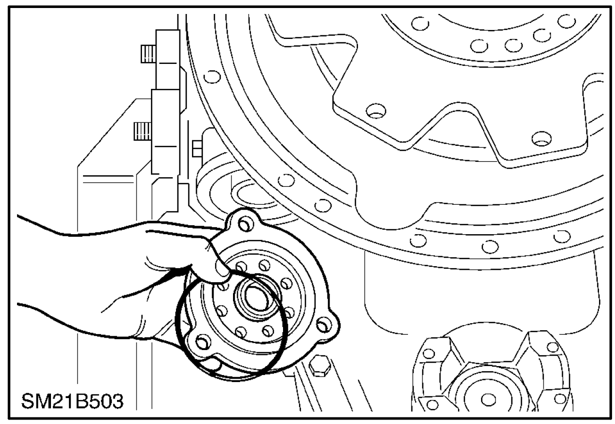

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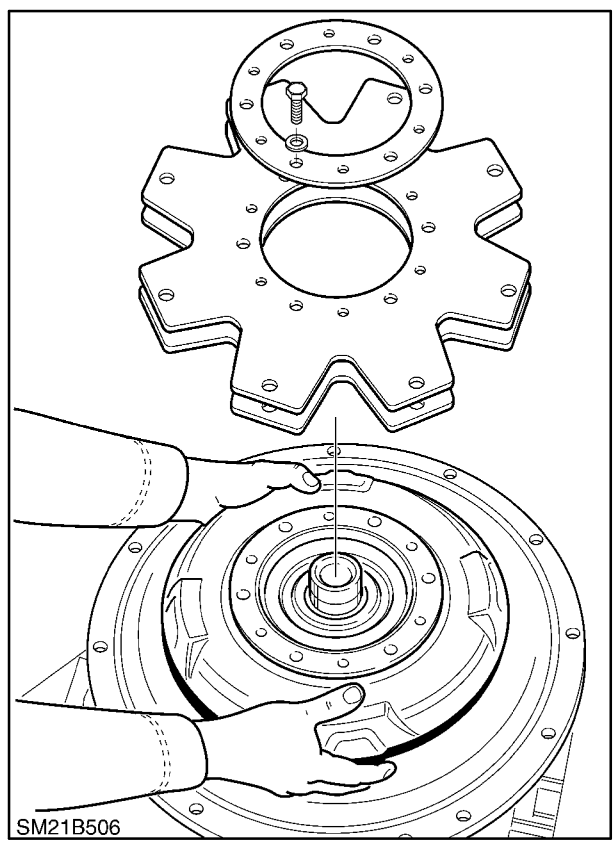
Remove drive plate screws, drive plates and remove the torque converter as an assembly.

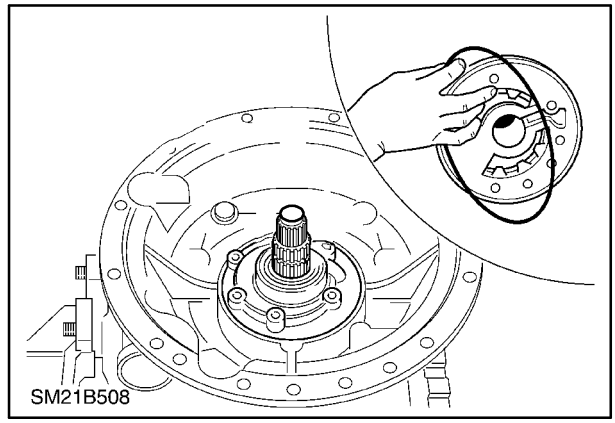


6

OIL PUMP DISASSEMBLY

NOTE: *The oil pump can only be removed when the transmission is separated from the engine. Disassembly of the oil pump is not generally recommended since individual components are matched and are non serviceable. However it may be dismantled for cleaning purposes.*

1. Remove the attaching bolts from the oil pump body and withdraw pump from the bell housing.



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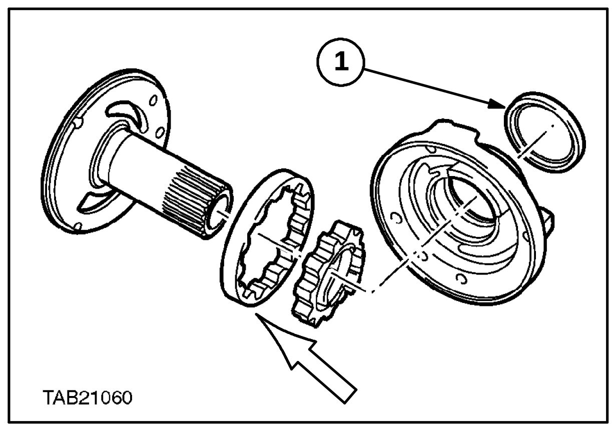
IMPORTANT: *The 'O' ring must be replaced with new before re-assembly of the pump.*

2. Carefully separate the oil pump components and clean, inspect the components for wear. If in any doubt replace the pump.

IMPORTANT: *A worn oil pump will reduce the efficiency of the transmission and the machine if not corrected.*

3. A single lipped seal (1) is incorporated in the front oil pump housing and should be changed when ever a complete teardown has taken place. Push out the old seal and replace with new, grease friction seal and push in ensuring it is fully seated into the housing.



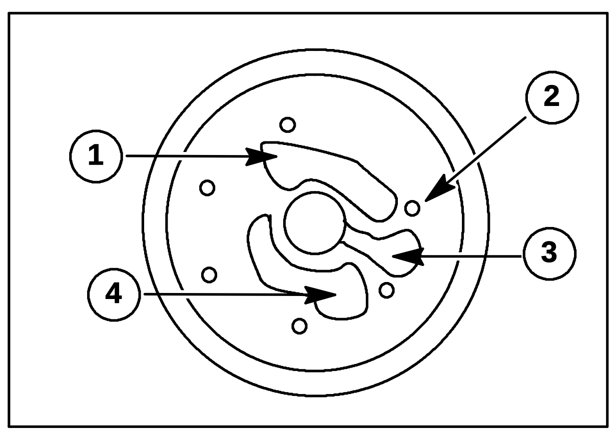
8

Re-assemble the pump in reverse order, fit new seals and copper washers under the bolt heads and torque the retaining bolts to 20-27 Nm (15-20 lbf ft)

IMPORTANT: *Ensure the pump friction ring face with chamfer enters the pump body first.*

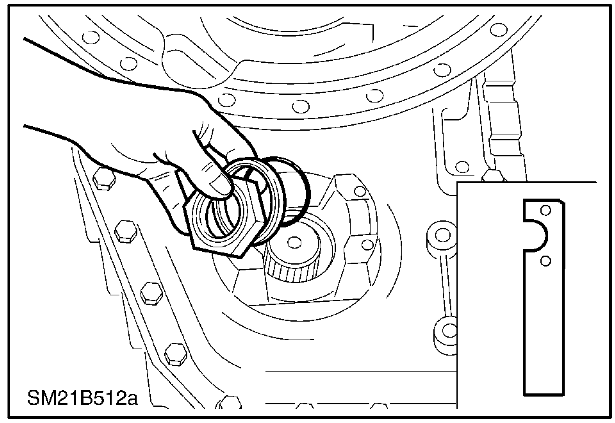
Oil galleries in the transmission bell housing.

1. Output to valve chest.
2. Oil seal pressure relief to sump port.
3. Torque convertor in.
4. Intake port from sump to pump.



9

Using Tool and a thin wall 60mm socket remove upper output nut, washer, ’O’ ring and flange.

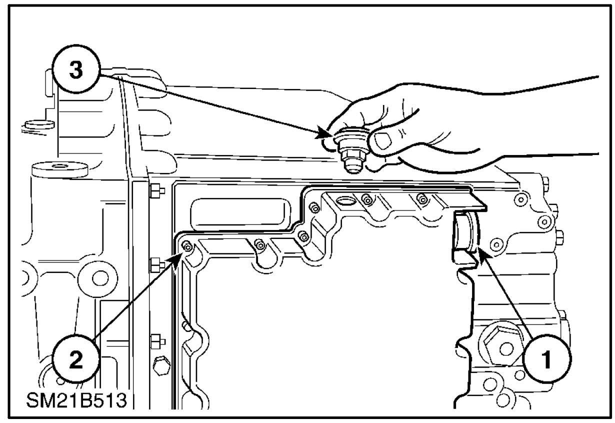


10

CONTROL VALVE – REMOVAL

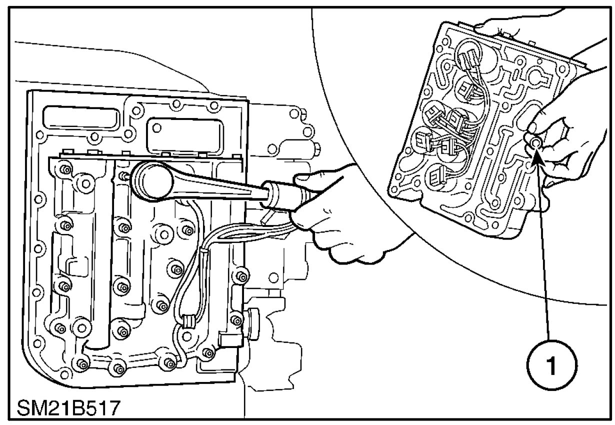
Disconnect the wiring connector mounting nut (1), control valve protection cover mounting screws (2).

and breather (3) from the side control cover.



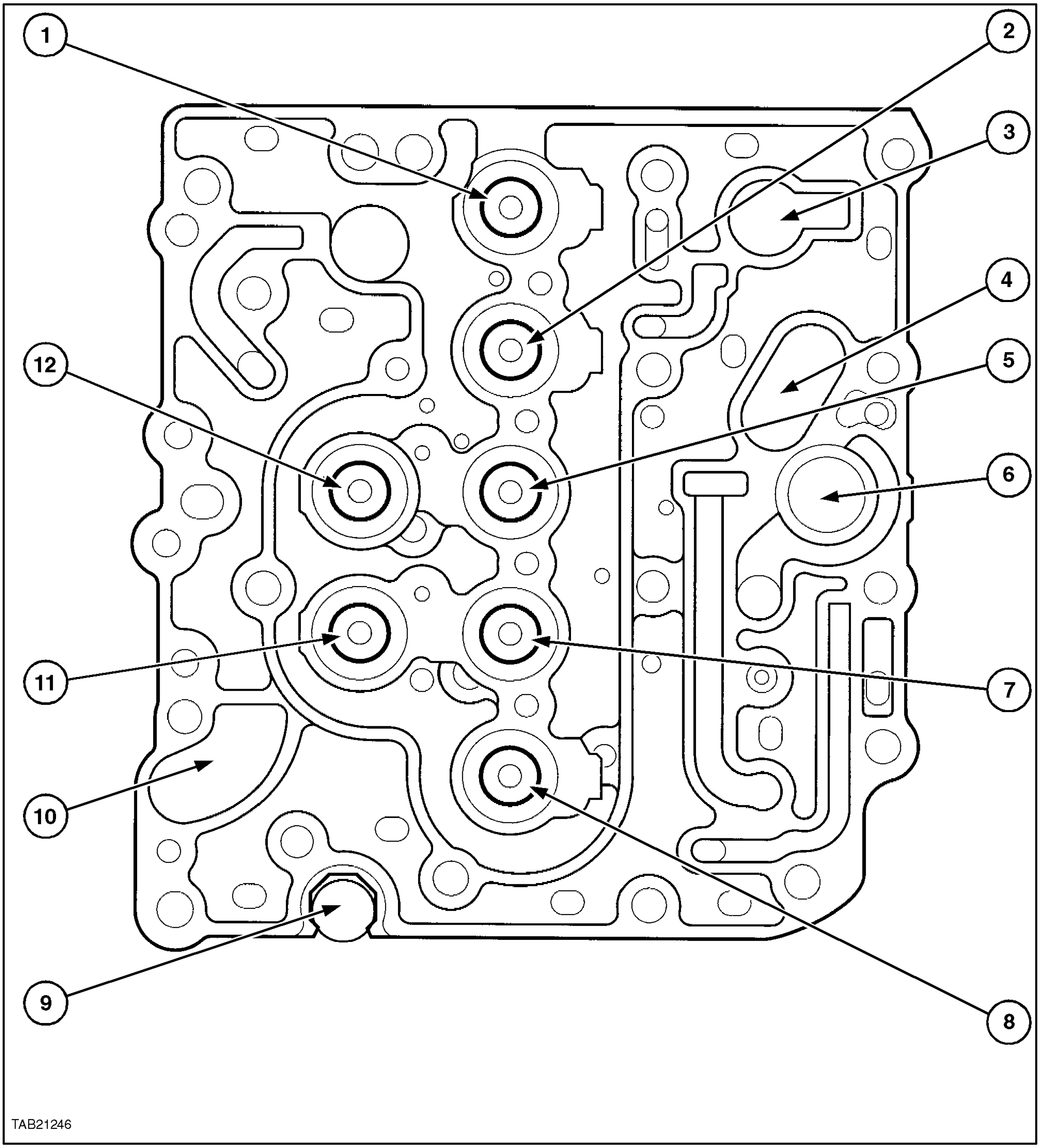
11

Remove control valve protection cover and gasket. Remove control valve as an assembly and remove bypass valve spool and spring (1).



12

CONTROL VALVE



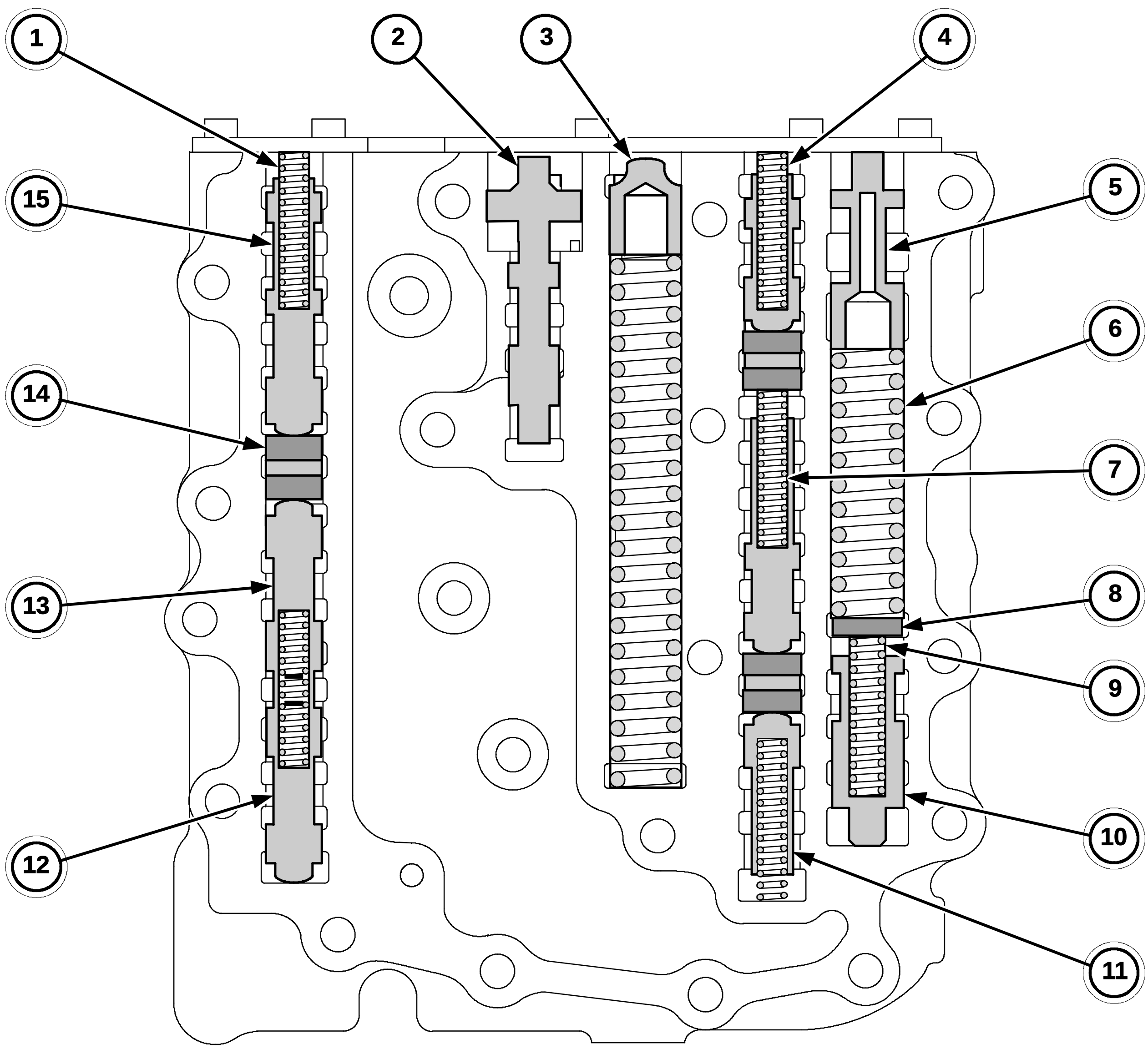
13

Transmission Control Valve Chest as shown (mating face to transmission body)

With reference to Figure 13, listed below are the positions of solenoids, valves, ports and sensor

1. VCS = Variable Current Solenoid (Direction Modulator Solenoid)
2. Range Modulation Solenoid
3. Oil flow in from pump
4. Oil to torque convertor
5. Hi / Lo Solenoid
6. System pressure regulating valve
7. 1st and 2nd Solenoid
8. Four Wheel Drive Solenoid
9. Speed and Temperature Sensor
10. To Dump
11. Neutral Reverse
12. Neutral Forward Solenoid

SPOOL VALVES



TAB21243

14

Transmission Control Valve Chest as shown (mating face to transmission body)

1. Forward High low Spring
2. Booster Spool
3. Accumulator
4. Range Modulation
5. System Pressure Regulator Valve
6. System Pressure Regulator Spring 20 bar
7. 2nd and 1st Clutch Spool
8. Separator Plate
9. Pressure Reducing Spring 5 bar
10. Pressure Reducing Spool
11. Four Wheel Drive Spool
12. Reverse Spool
13. Forward Spool
14. Separator Plate
15. Forward High Low Spool

CONTROL VALVE – OPERATION

SYSTEM PRESSURE REGULATOR

Oil from the pump acts on the regulating valve port (10). The spool moves down against spring pressure as the pressure increases in the system. The spool then uncovers the lubrication port (11) which allows excess flow to go to lubrication and maintain 20 bar in port (10).

PRESSURE REDUCER

Oil from the pressure regulator spool acts on the pressure reducing spool through port (19) holding the valve down. This supplies system pressure through port (20). This port is connected internally to the pilot port (22) which acts against the spool. The spool then moves against spring pressure due to the oil pressure acting on a larger surface area. This restricts the oil thus supplying a reduced pressure through port (20) at 5 bar.

RANGE MODULATION

In normal operation the spring holds the valve down allowing oil flow from port (8) to port (9) and onto 1st and 2nd clutch with no modulation. When changing 1st to 2nd clutch or 2nd to 1st clutch an electrical signal is sent to energise the range modulation solenoid, which opens. This allows oil pressure to act through port (12) onto the spool, which moves upwards. Oil can not flow from port (8) to port (9) but flows up port (8) and into port (9) through a small orifice in the 1st and 2nd clutch spool thus modulating the the oil supply via small orifices thus modulating the oil supply.

1st and 2nd CLUTCH SPOOL

When the 1st clutch is selected the solenoids energised allow pilot pressure to flow through port (28) acting on the end of the spool pushing the spool up against spring pressure. Oil flow from the range modulation spool through the port (16) and out at port (15) to engage the 1st clutch.

When the 2nd clutch is selected the solenoid is de–energised there is no pressure in port (28). The spring pushes the spool down allowing oil from the range modulation to go through port (16) and out of port (17) to the 2nd clutch.

FOUR WHEEL DRIVE SPOOL

With the solenoid de–energised there is no oil pressure in port (26) the spring holds the spool up allowing system pressure oil to flow from port (25) to port (24) engaging the FWD clutch. When the solenoid is energised pilot pressure acts through port (26) pushing the spool down against spring pressure preventing system pressure from flowing from port (25) to port (24) and opening port (23) to drain to tank disengaging FWD.

ACCUMULATOR SPOOL

As the current drops to the variable force solenoid it allows oil to flow through port (6) past the accumulator as pressure and flow increase from the solenoid the accumulator is pushed down against spring pressure this allows an even and steady increase in pressure acting on the pressure booster valve.

PRESSURE BOOSTER VALVE

Oil is supplied from the VFS past the accumulator spool onto the pressure booster spool via port (5) as pressure increases on the spool it moves down allowing system pressure to flow from port (4) to port (3) as the pressure increases on the directional clutch, a sensing line senses the clutch pressure and acts on the bottom of the spool pushing it upward reducing flow and pressure to the directional clutches.

Pressure then increases on the top side of the spool pushing it down allowing an increase in flow and pressure to the directional clutches this repeats many times during clutch engagement enabling smooth modulation.

REVERSE SPOOL

With the reverse solenoid energised pilot pressure is supplied to port (30) pushing the spool upwards against spring pressure this also ensures the forward spool is pushed into the neutral position. Modulated oil from the pressure boosting valve flows into port (33) and out of port (32) to the reverse clutch. When the solenoid is de–energised the spring returns the spool to neutral allowing oil in the reverse clutch to return to tank via port (31).

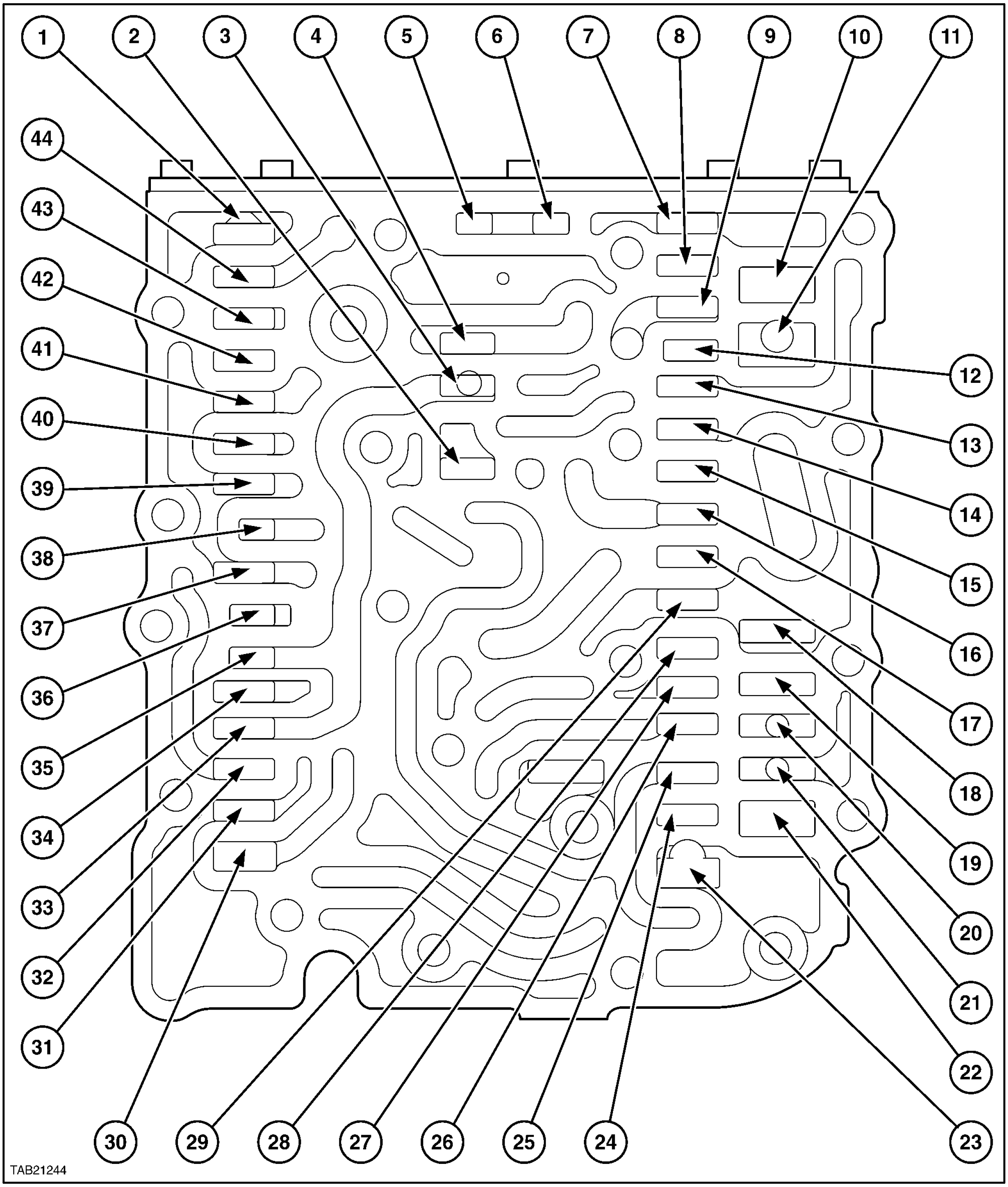
FORWARD SPOOL

When the forward solenoid is energised pilot pressure builds up in port (38) pushing the spool downwards against spring pressure allowing modulated oil pressure from the booster valve to flow from port (35) to port (36) which supply oil to the forward low high clutch spool. When the solenoid is de–energised the spring returns the spool to neutral allowing oil to return to tank via port (37).

FORWARD HIGH LOW SPOOL

When the high low solenoid is de–energised the spring holds the spool down. Oil from port (43) which comes from the forward spool can flow out of port (44) to engage the high clutch. When the the high solenoid is energised pilot pressure acts on the end of the spool via port (40) thus pushing the spool upwards compressing the spring this allows oil from the forward spool to enter through port (3) and flow out of port (42) to the forward low clutch.

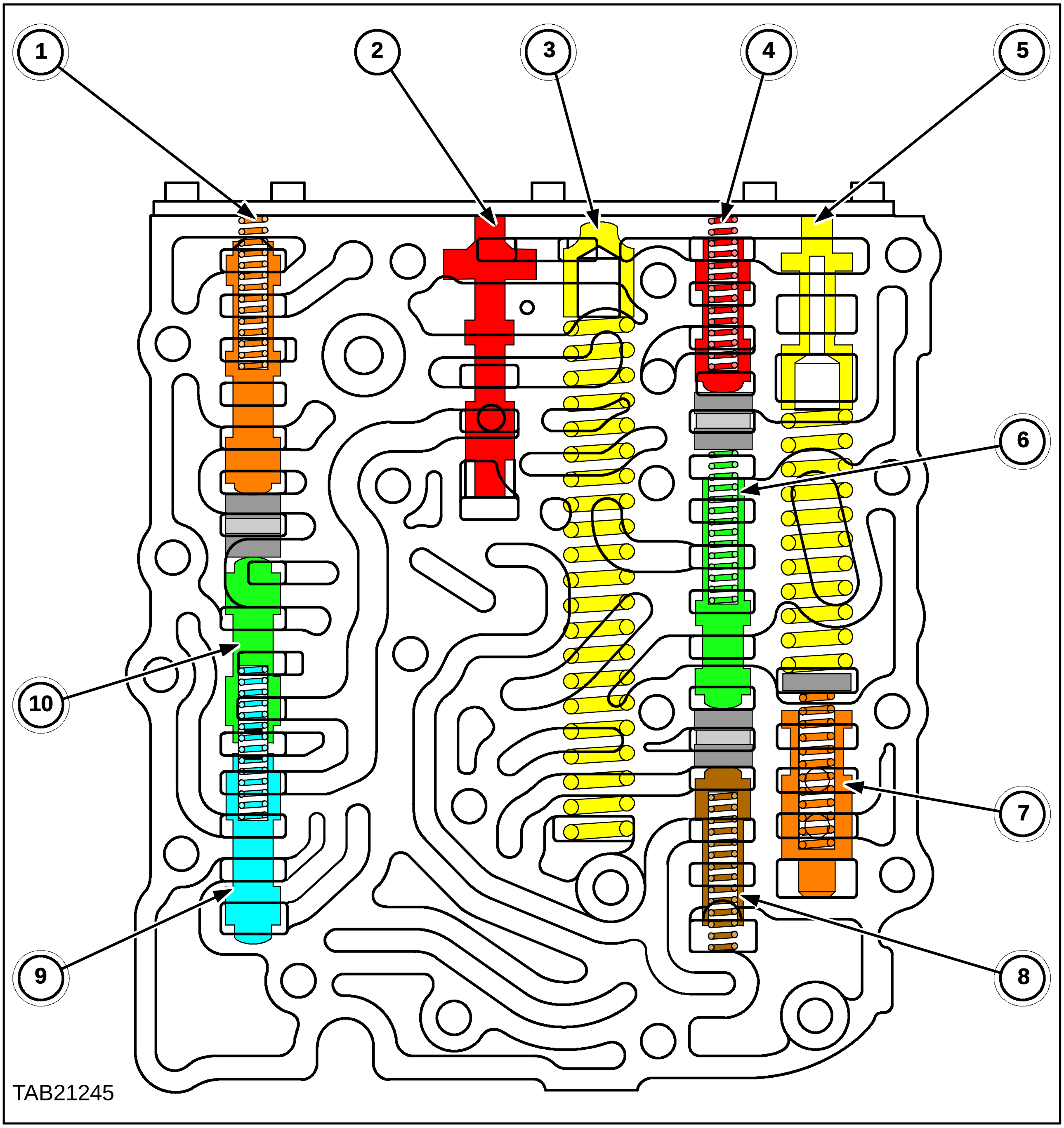
OIL PORTS



15

Transmission Control Valve Chest as shown (mating face to transmission body)

SPOOLS



16

Transmission Control Valve Chest as shown (mating face to transmission body)

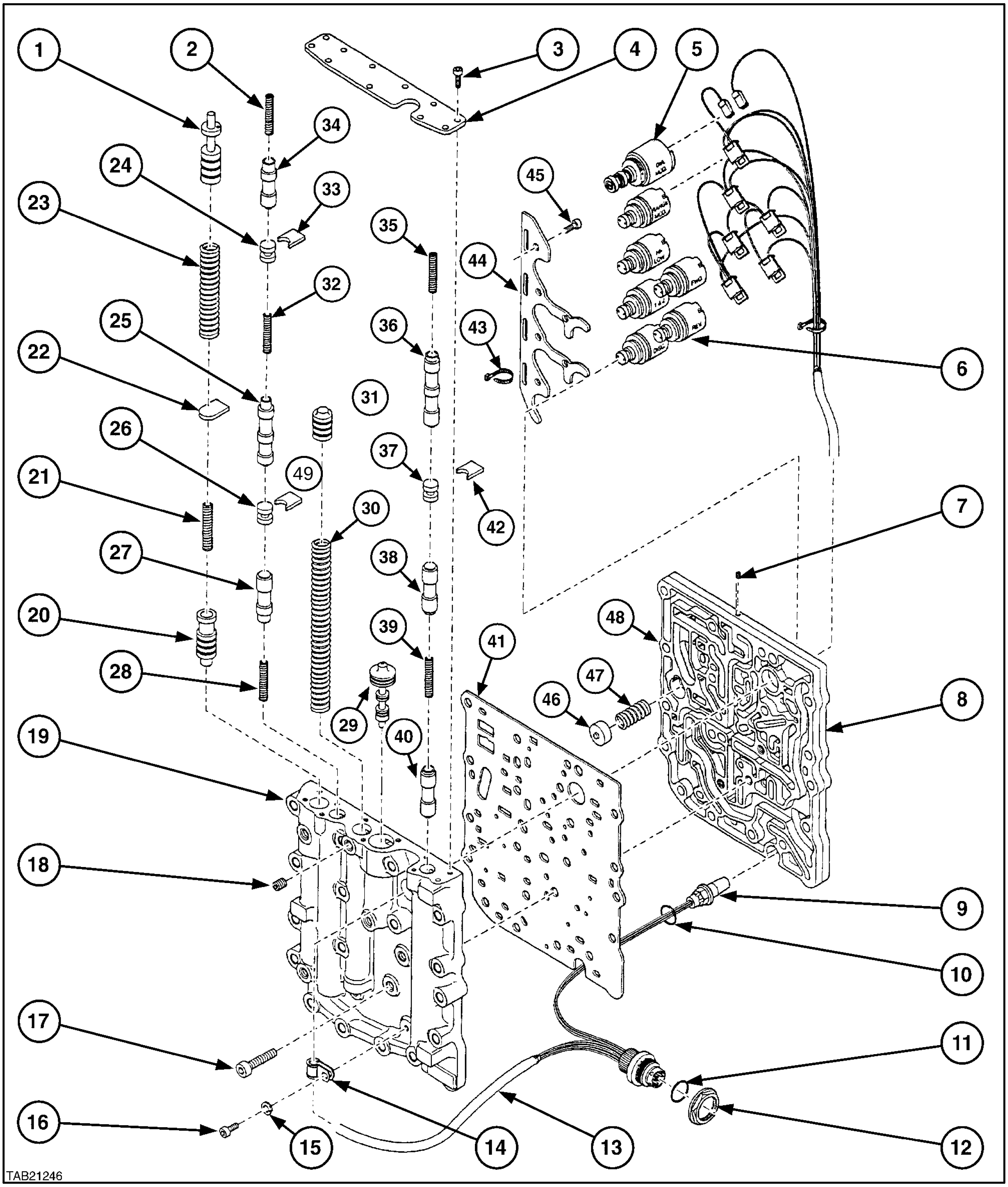
1. Forward high Low Valve Spool
2. Pressure Booster Spool
3. Accumulator Spool
4. Range Modulation Spool
5. System Pressure Regulating Spool
6. 2nd and 1st Clutch Spool
7. Pressure Reducer Spool
8. Four Wheel drive Spool
9. Reverse Spool
10. Forward Spool

NOTES

CONTROL VALVE – COMPONENTS

1. System Pressure Regulator Spool
2. Range Spool Spring
3. Spool Cover Screw
4. Spool Cover
5. Electronic Controlled Modulation Valve
6. Solenoid
7. Plug
8. Solenoid Plate
9. Speed Sensor
10. Speed Sensor ‘O’ ring
11. ‘O’ ring
12. Nut
13. Wiring Harness ‘O’ rings and Speed Sensor assembly
14. Wiring Clamp
15. Clamp Screw Lock Washer
16. Clamp Screw
17. Spool Body to Solenoid Plate Screw
18. Check Port Plugs
19. Spool Body
20. Pressure Reducer Spool
21. Pressure reducer Spring
22. Separator Plate
23. System Pressure Regulator Spring
24. Spool Stop
25. 1st/2nd spool
26. Spool Stop
27. Four Wheel Drive Spool
28. Four Wheel Spool Spring
29. Booster Spool
30. Accumulator Spring
31. Accumulator Spool
32. 1st and 2nd Spool Spring
33. Separator Plate
34. Range Modulation Spool
35. Forward Low High Spool Spring
36. Forward Low High Spool
37. Spool Stop
38. Forward Spool
39. Reverse Spool Spring
40. Reverse Spool
41. Spacer Plate
42. Separator Plate
43. Wiring Strap
44. Solenoid Clamp
45. Solenoid Clamp Screw
46. Bypass Valve Spool
47. Bypass Valve Spring
48. Solenoid Plate
49. Separator Plate

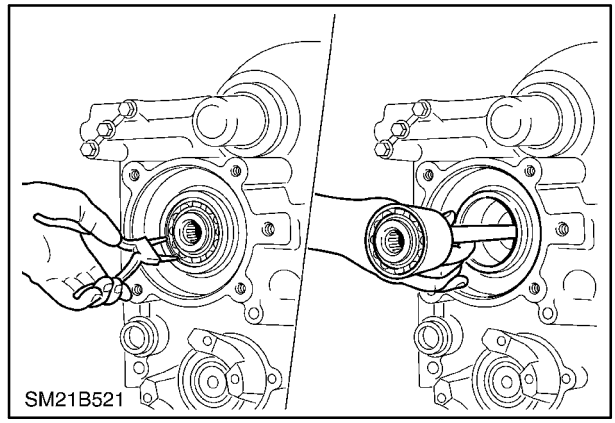
CONTROL VALVE – COMPONENTS



17

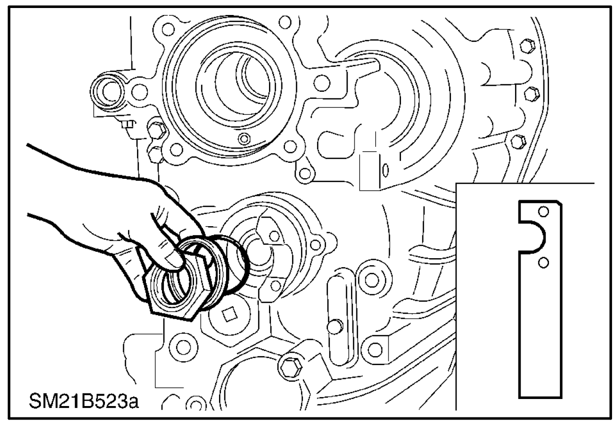
DISASSEMBLY OF THE TRANSMISSION

Remove the hydraulic pump screws and gasket detach the pump drive shaft rear bearing Circlip and remove the pump drive shaft and bearing as an assembly.



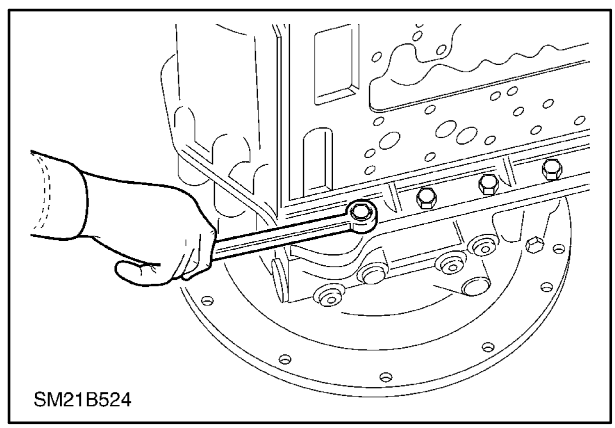
18

Using Tool no **380000708** to hold the flange steady remove the upper output nut, washer, 'O' ring and flange.



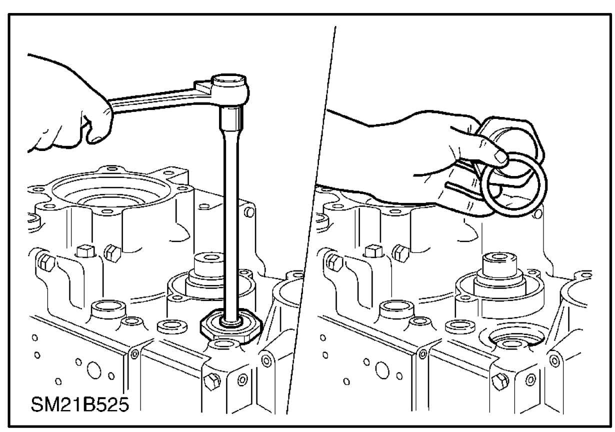
19

Remove converter housing to transmission case screws and lockwashers.



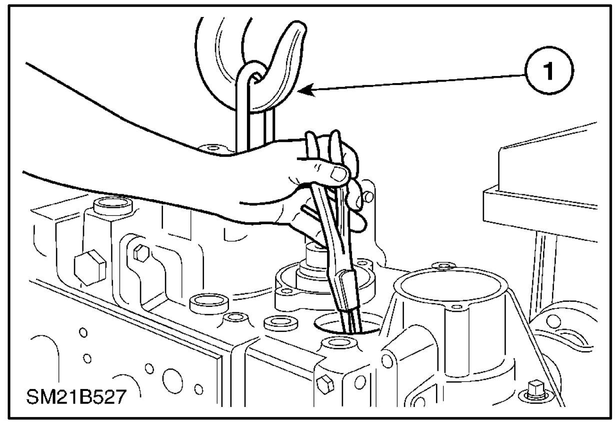
20

To gain access to the output shaft circlip remove the case plug and gasket.



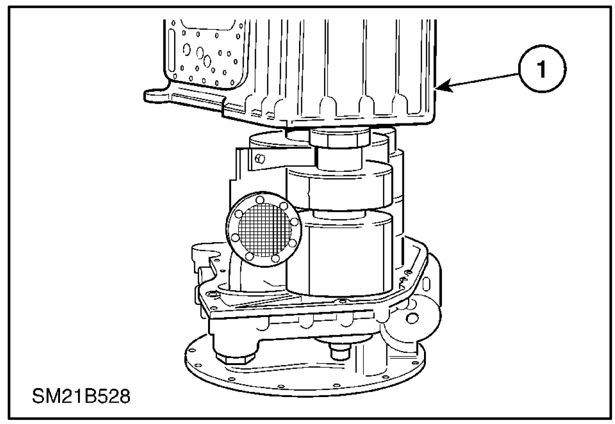
21

Using a spreading type snap ring plier, spread ears on output shaft rear bearing snap ring. Holding snap ring open, tap on output shaft and transmission case to remove case from converter housing. Lift transmission case from converter housing (using lifting bracket number **380000710**).



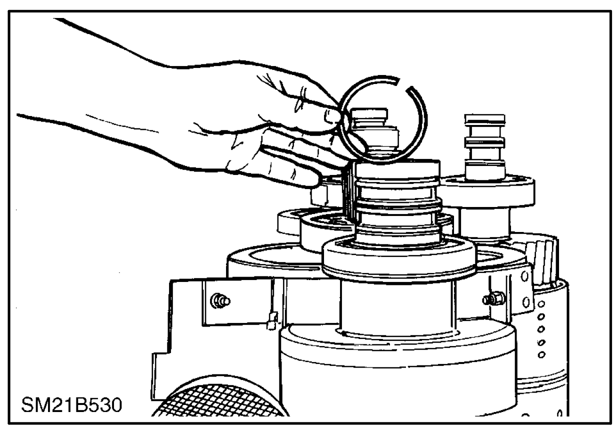
22

Carefully raise transmission case to expose shaft assemblies and remove converter housing gasket.



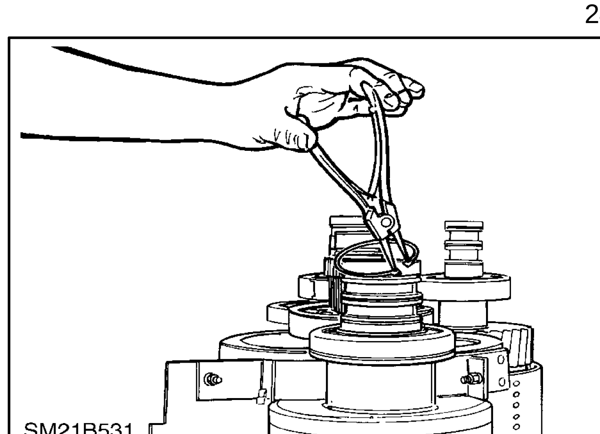
23

Remove Four Wheel Drive (FWD) shaft sealing rings.



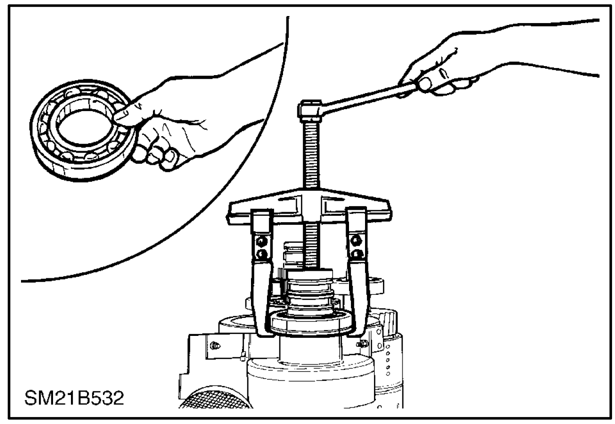
24

Remove FWD shaft rear bearing circlip.



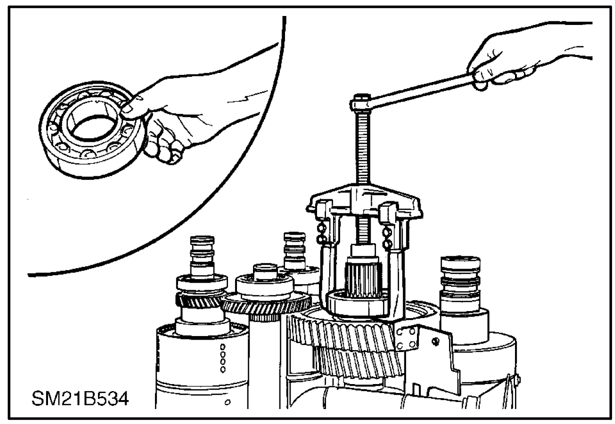
25

Use bearing puller remove FWD shaft rear bearing.



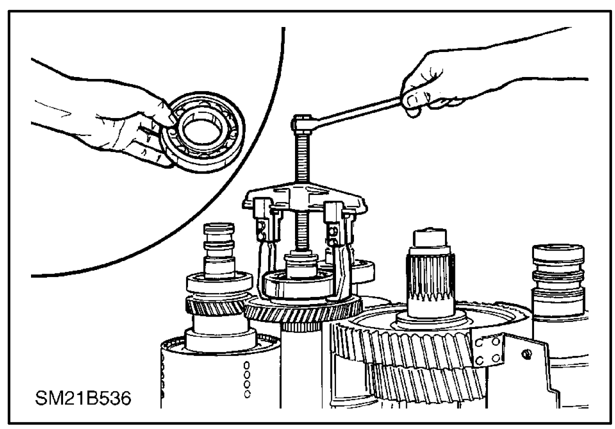
26

Using bearing puller to remove Output shaft rear bearing.



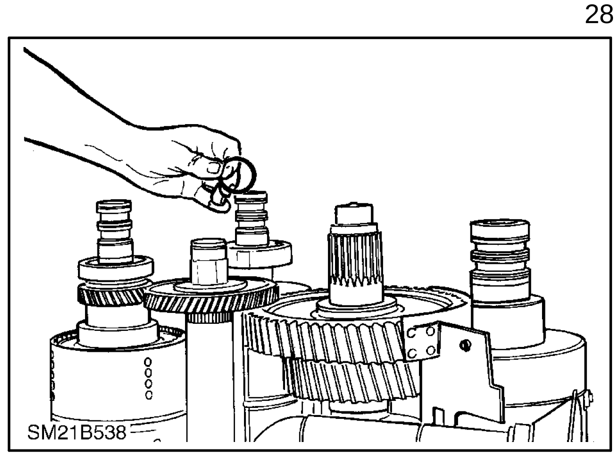
27

Using bearing puller remove input shaft rear bearing



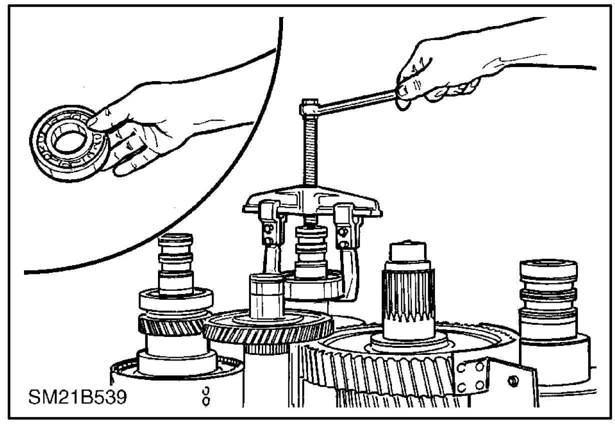
28

Remove reverse Idler input and 1st Reverse shaft sealing rings



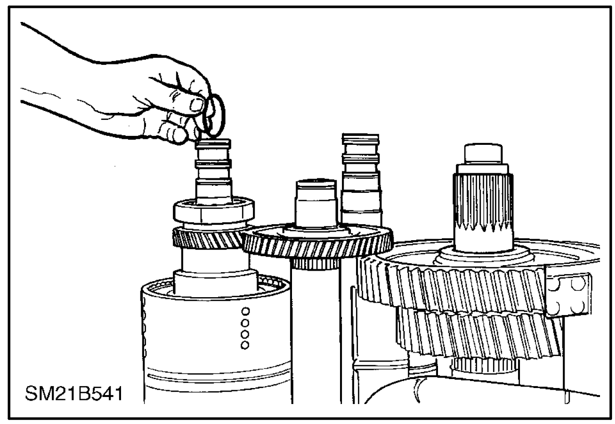
29

Use bearing puller to remove 1st reverse shaft and bearing.



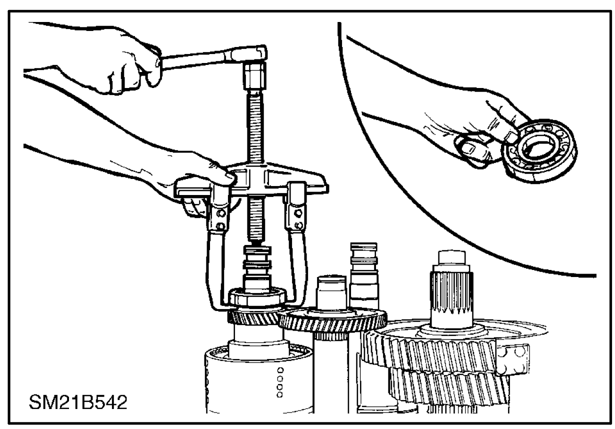
30

Remove Input shaft sealing rings



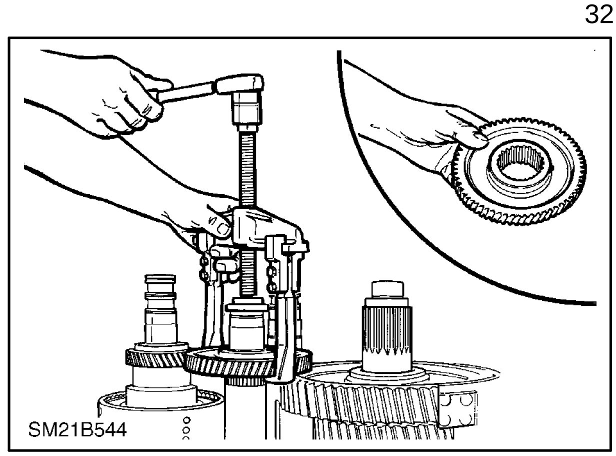
31

Using bearing puller to remove Input shaft rear bearing.



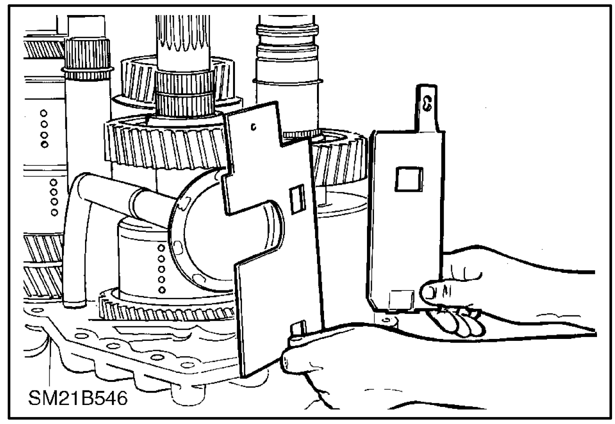
32

Use bearing puller to remove forward high gear from the input shaft.



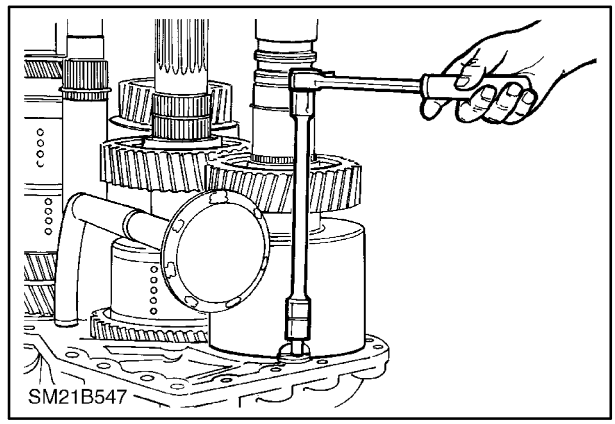
33

Remove upper baffle plates screws.



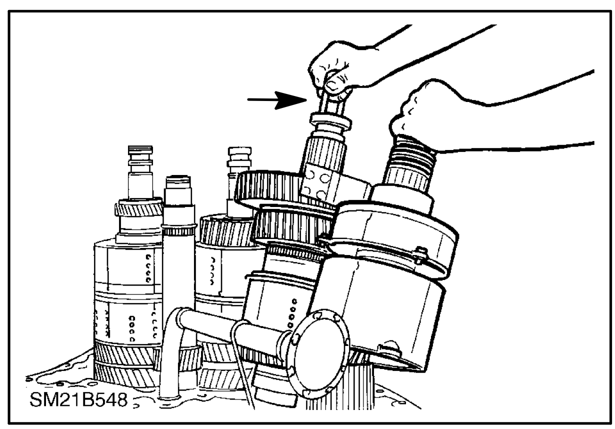
34

Remove lower oil baffle to converter housing screws, you can not remove oil baffle from output shaft.



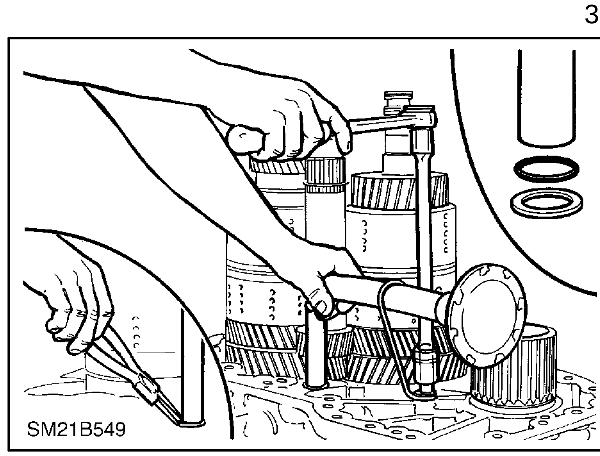
35

Using a suitable eye bolt remove output shaft, 2nd shaft and oil baffle at the same time.



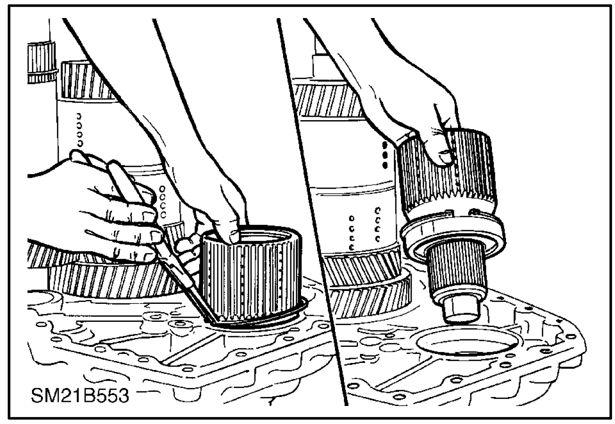
36

Remove suction tube retainer screw and lockwasher, suction tube retainer ring, 'O' ring and washer.



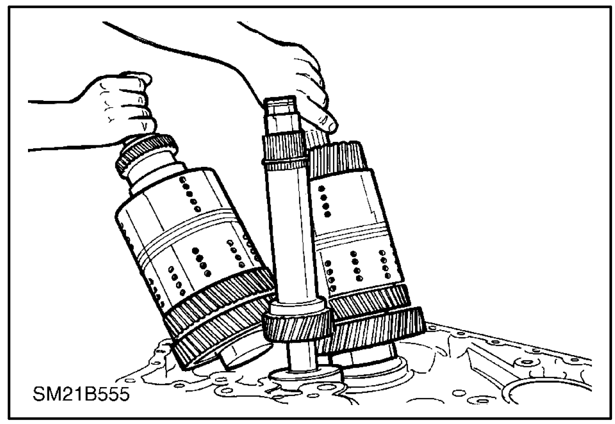
37

Remove output shaft front bearing retainer ring and remove output shaft front assembly.



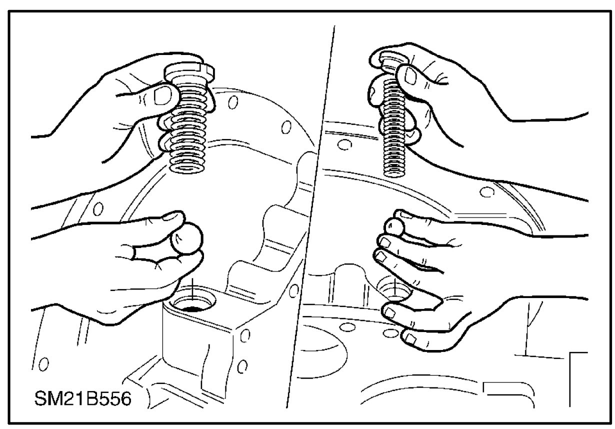
38

Using lifting tool **380000709** remove reverse and forward shaft at the same time along with the input shaft.

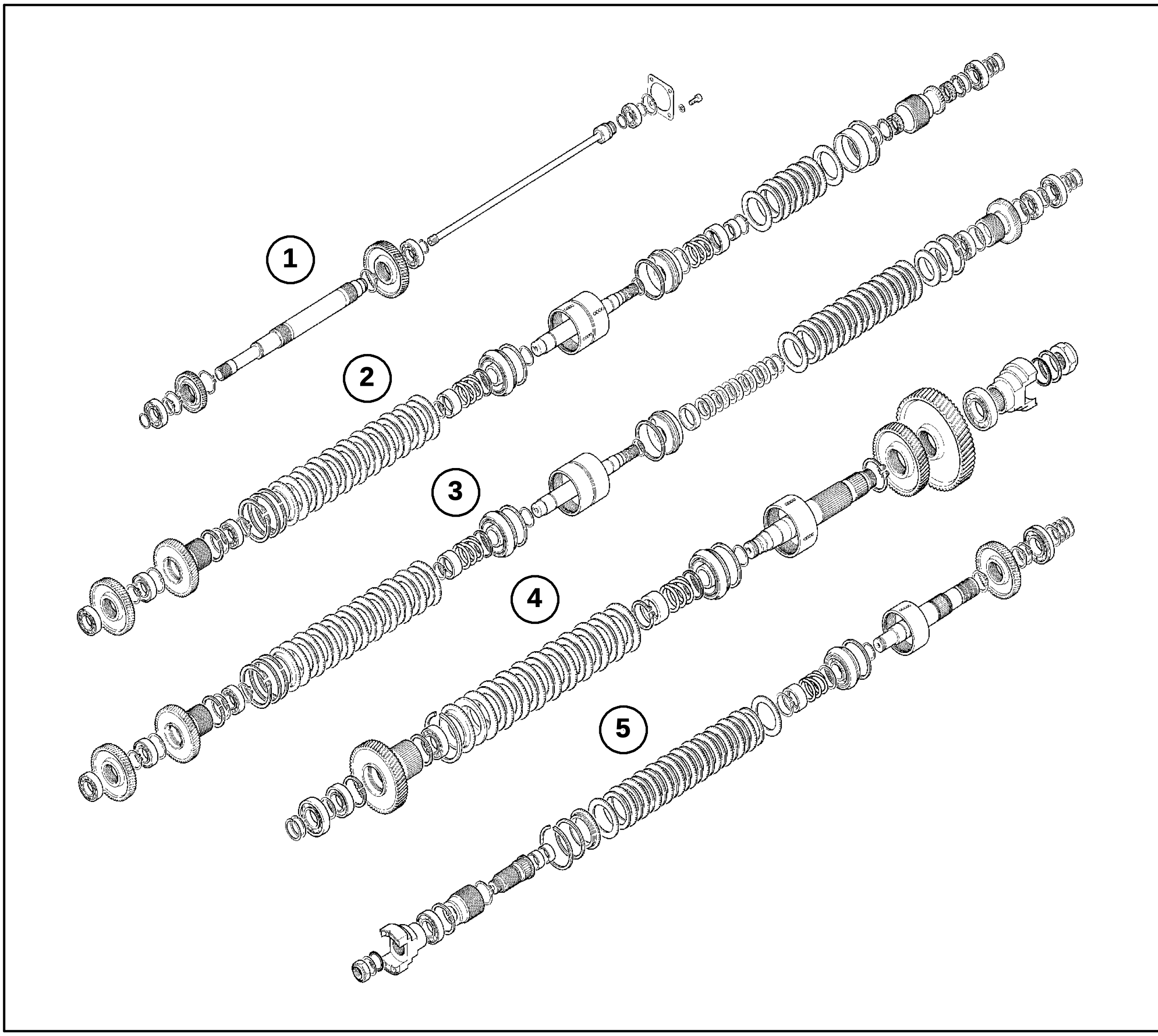


39

Remove safety valve plug, spring and ball and by-pass plug, spring and ball..



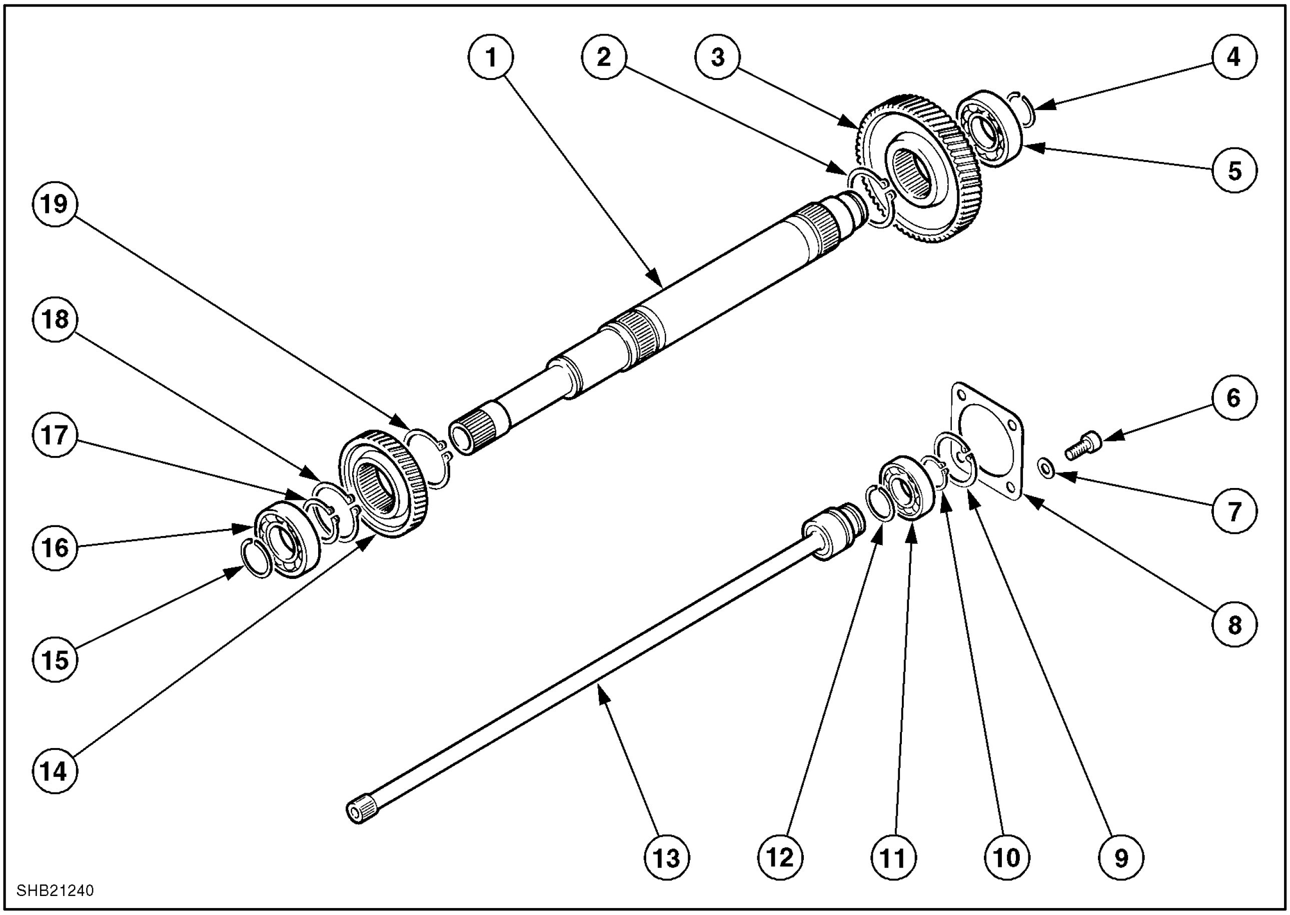
40



41

Powershift Transmission Operating Shafts

Disassembly of the above shafts can be found the following pages as listed.



42

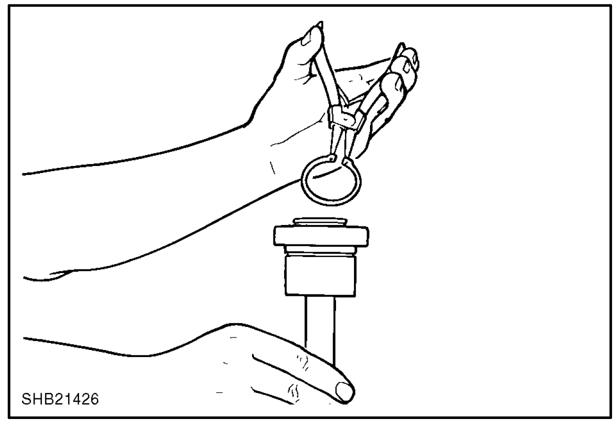
Input shaft and integral Hydraulic pump Drive shaft

1. Input Shaft
2. Circlip
3. Forward High Drive gear
4. Piston Ring
5. Bearing
6. Bolt
7. Spring washer
8. Oil Pump Gasket
9. Circlip Large
10. Circlip Small
11. Bearing
12. Piston Ring
13. Pump drive shaft
14. Forward Low and Reverse Drive Gear
15. Piston Ring
16. Bearing
17. Circlip
18. Circlip
19. Circlip

NOTE: *The hydraulic pump drive shaft can be removed from the transmission assembly after removing the hydraulic pump. Without disassembly of the transmission.*

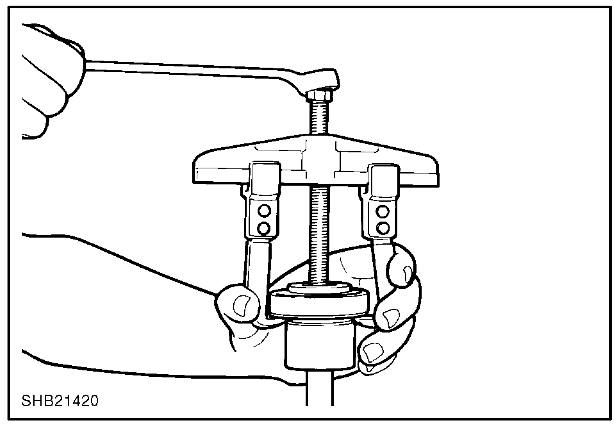
Disassembly pump drive shaft

Remove rear bearing circlip.



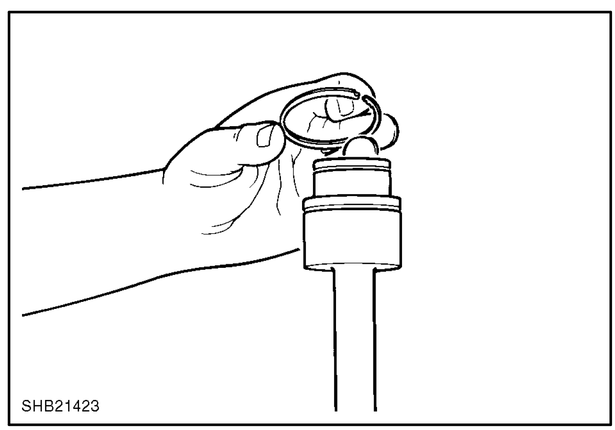
43

Use bearing puller to remove rear bearing.



44

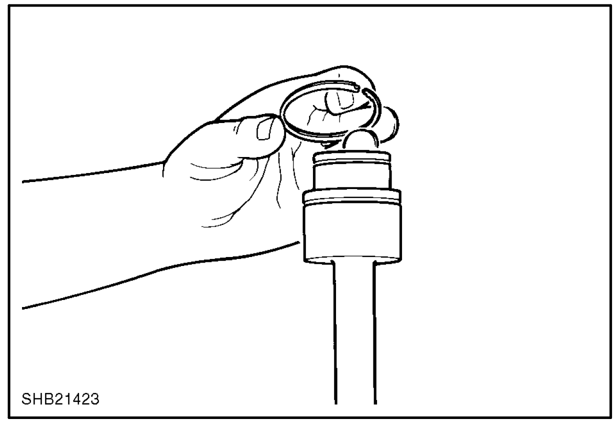
Remove sealing ring from shaft.



45

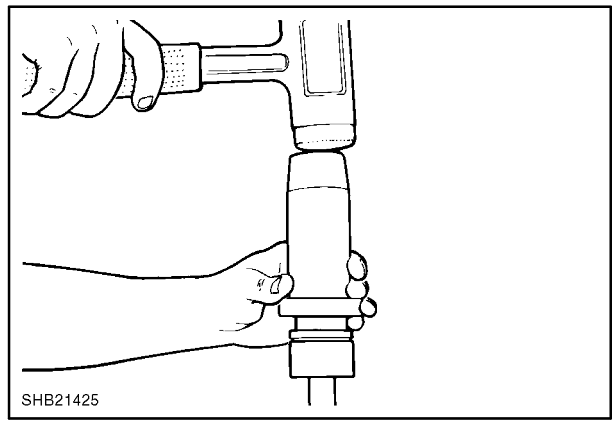
Reassembly pump drive shaft

Install sealing ring on shaft.



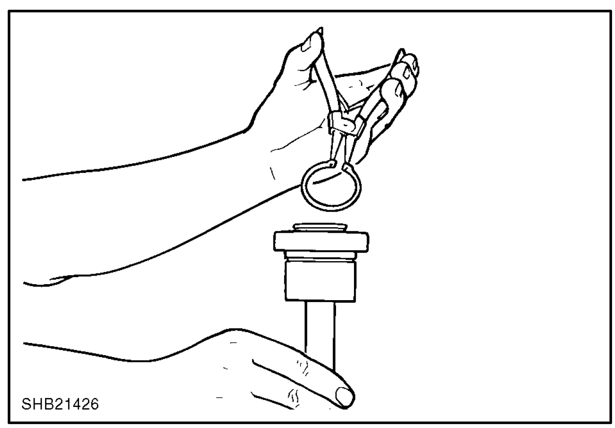
46

Install rear bearing on shaft and tap bearing into place.



47

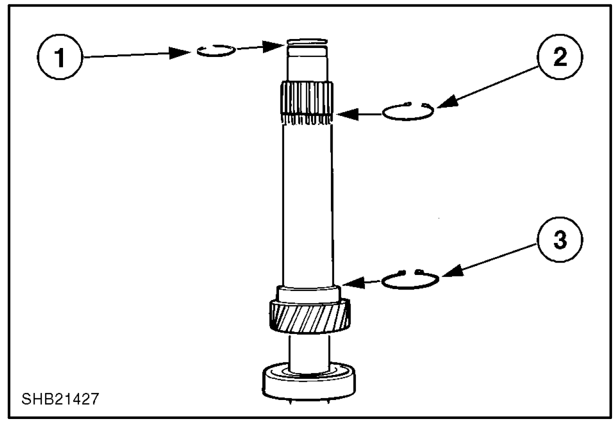
Install rear bearing retainer ring.



48

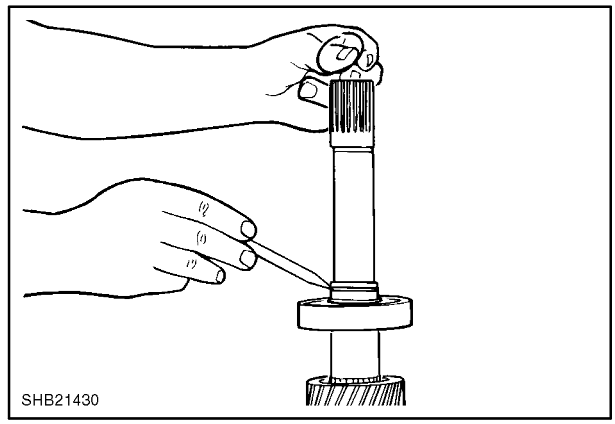
Disassembly input shaft

Remove input shaft rear sealing ring (1).
– forward high gear circlip (2).
– forward low gear circlip (3).



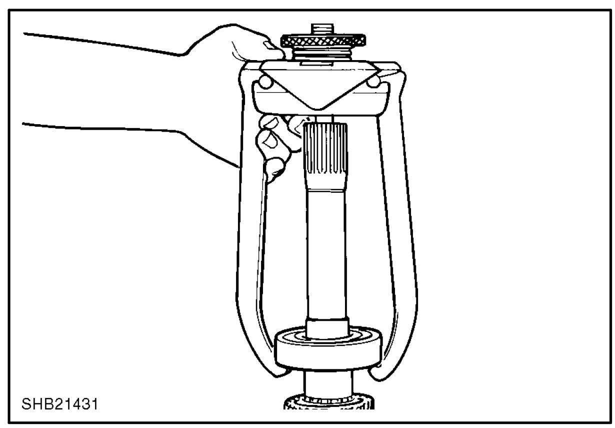
49

Remove input shaft front sealing ring.



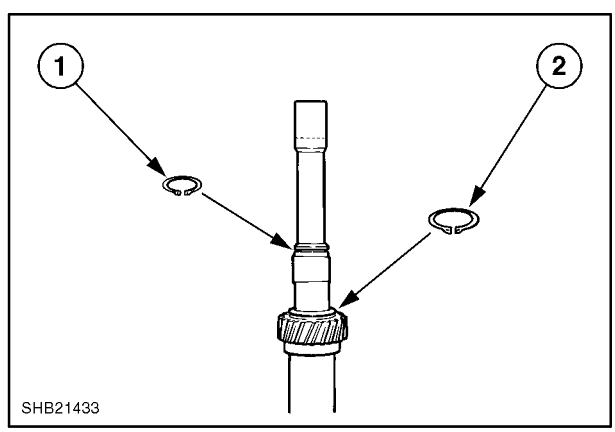
50

Use bearing puller to remove input shaft front bearing.



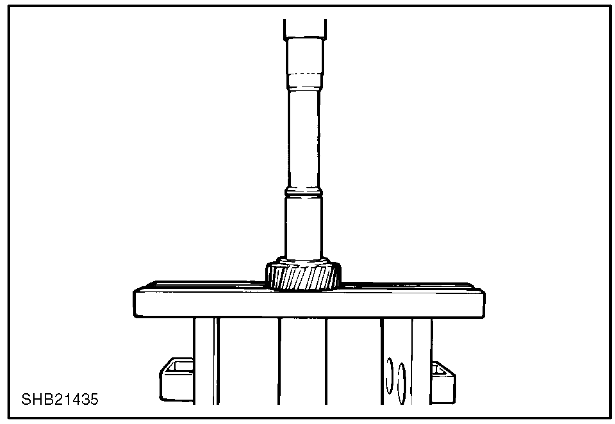
51

Remove input shaft front bearing circlip (1) and forward low gear circlip (2).



52

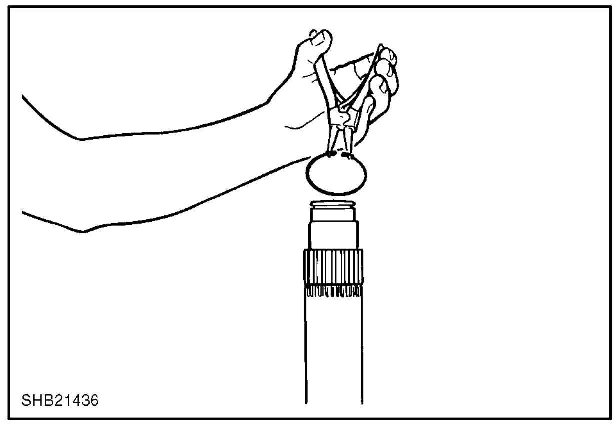
Press forward low gear from shaft.



53

Reassembly input shaft

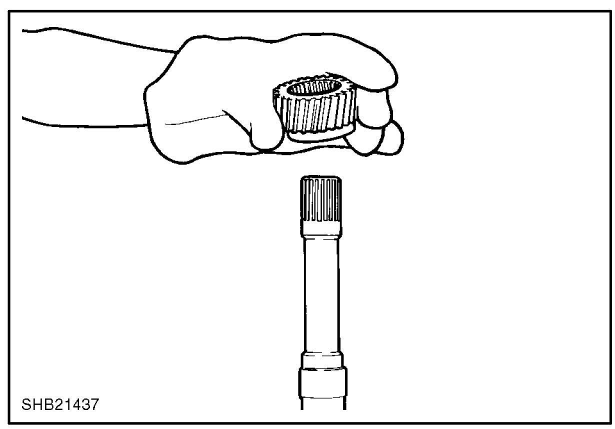
Install forward low gear circlip.



54

Warm gear to 150_ C (302 F), install gear.

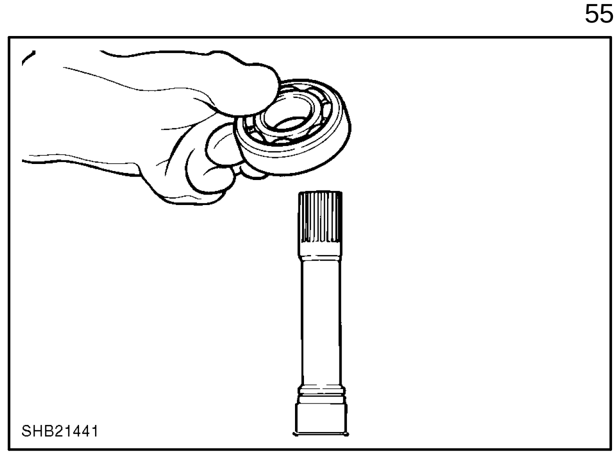
Install forward low gear circlip.
– input shaft front bearing circlip.
– Install input shaft front sealing ring.



55

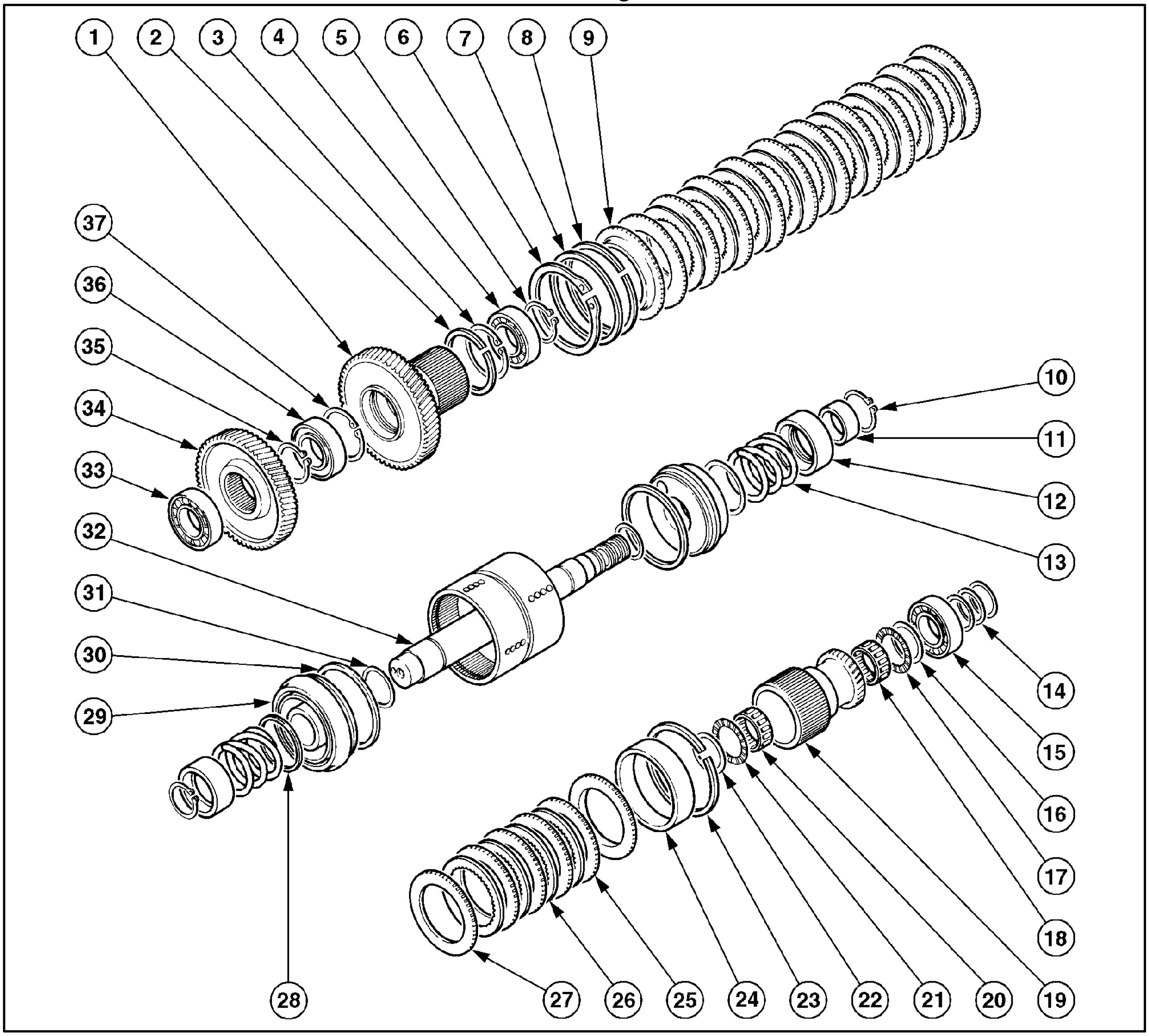
Warm input shaft front bearing to 120_ C (248 F), install bearing.

Turn shaft and install input shaft
– forward high gear circlip
– input shaft rear sealing ring.



56

Forward Low High Shaft

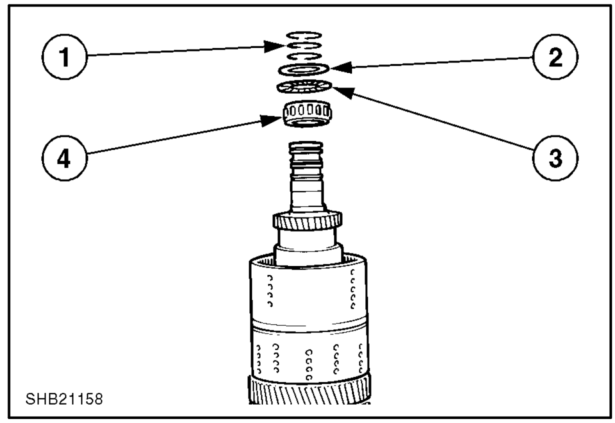


57

1. Gear Forward Low High
2. Snap Ring
3. Circlip
4. Bearing
5. Circlip
6. Circlip
7. Washer
8. Snap Ring
9. Clutch Disc Backing Plate
10. Circlip
11. Spacer
12. Spring Retainer
13. Spring
14. Sealing Rings
15. Bearing
16. Thrust Washer
17. Needle Bearing
18. Roller Bearing
19. Gear Forward High Clutch
20. Roller Bearing
21. Needle Bearing
22. Thrust Washer
23. Snap Ring
24. Spacer
25. Friction disc
26. Steel Disc
27. Clutch Disc Backing plate
28. Spring Wear Ring
29. Piston
30. Piston Seal outer
31. Piston Seal Inner
32. Shaft / Drum Assembly
33. Bearing
34. Gear Forward Driven
35. Circlip
36. Bearing
37. Circlip

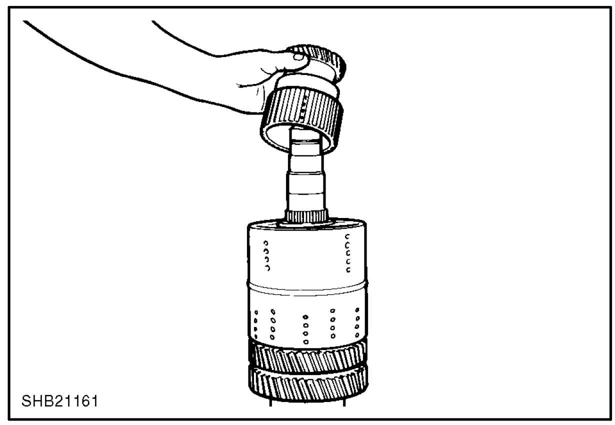
Disassembly forward high clutch

Remove clutch shaft sealing rings (1), thrust washer (2), thrust bearing (3), clutch gear needle bearing (4).



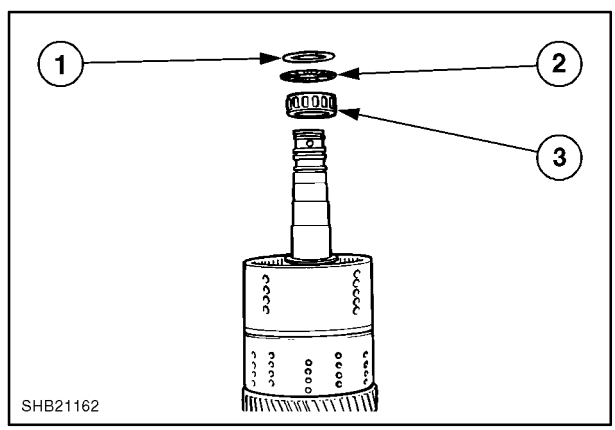
58

Remove clutch gear.



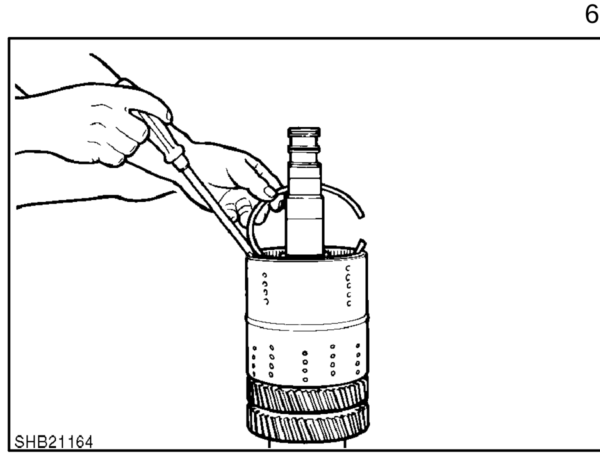
59

Remove thrust washer (1), thrust needle bearing (2) and clutch gear steel bearing.



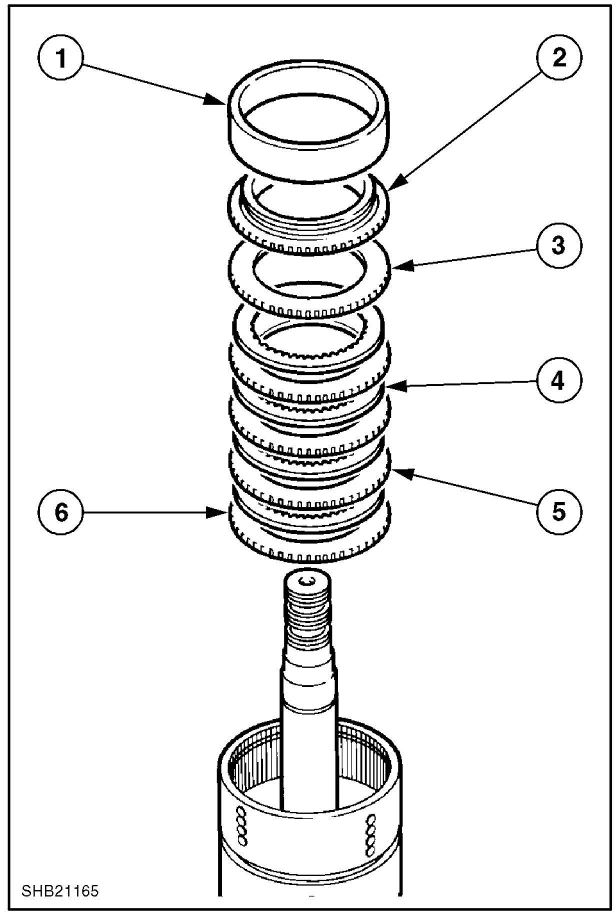
60

Remove clutch plate snap ring.



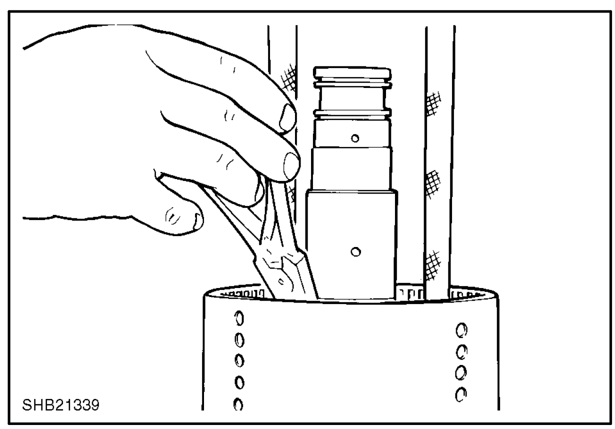
61

Remove 1x clutch plate spacer (1)
1x – clutch disc backing plate (2)
1x – one friction half disc (3).
3x – friction discs (4)
4x – steel discs (5).
1x – one friction half disc (6).



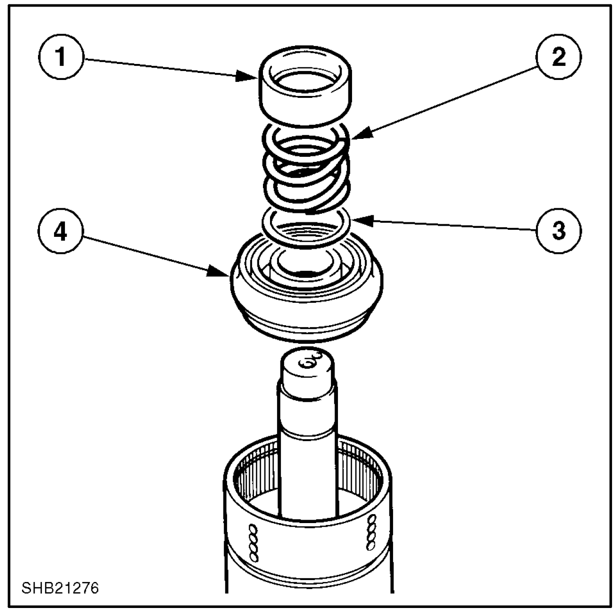
62

Compress spring using tool no **380000711** and remove spring retainer circlip



63

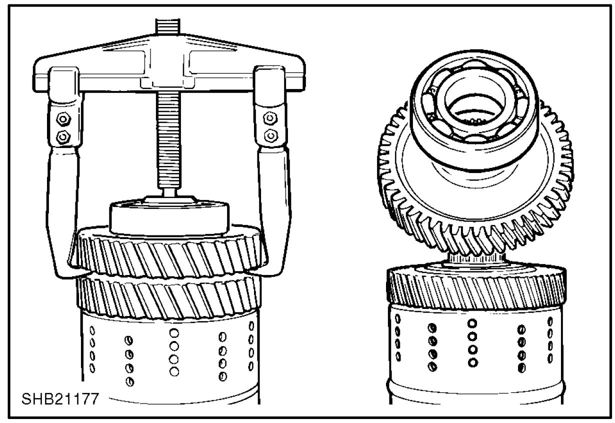
Remove clutch spring spacer.
- clutch piston spring retainer (1).
- clutch piston spring (2).
- clutch piston wear plate (3).
- clutch piston assembly (4)



64

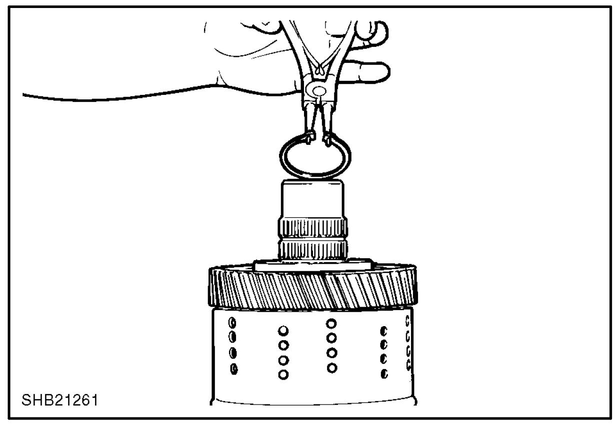
Disassembly forward low clutch

Use bearing puller remove front bearing and gear.



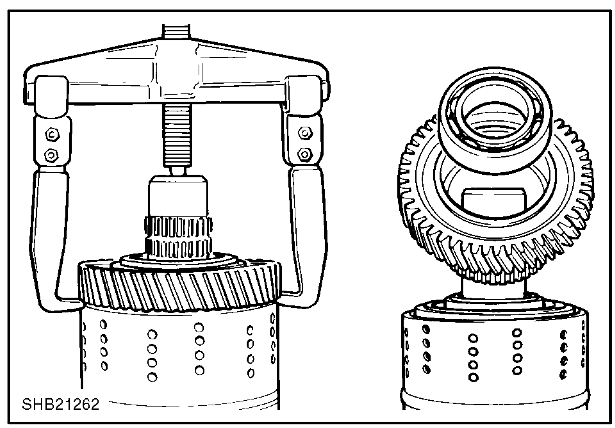
65

Remove gear retainer ring.



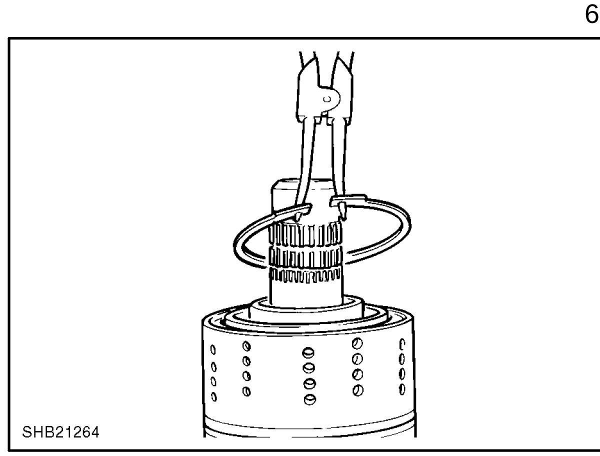
66

Use a bearing puller and slice to remove clutch gear and bearing.



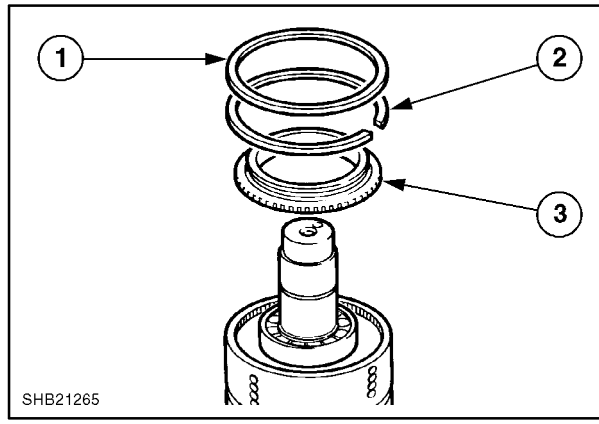
67

Remove circlip and spacer.



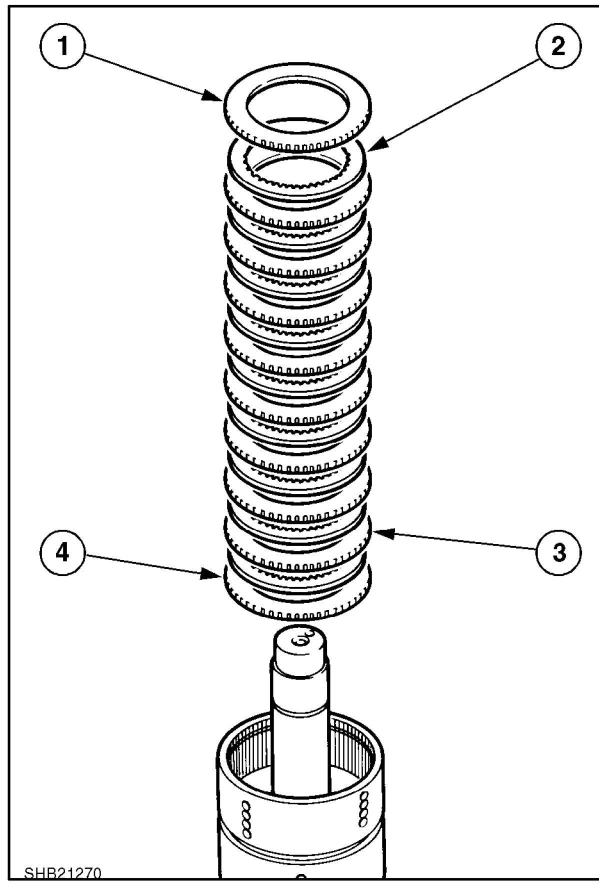
68

Remove spacer (1), backing plate (2) and snap ring (3).



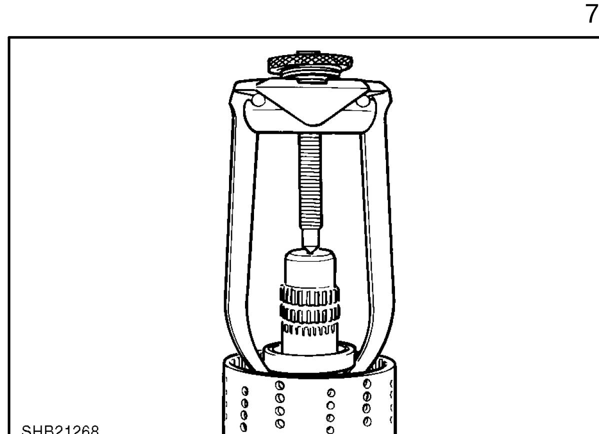
69

Remove 1x friction half disc (1).
9x – Steel Discs (2).
8x – Friction Discs (3)
1x – Half Friction Disc (4).



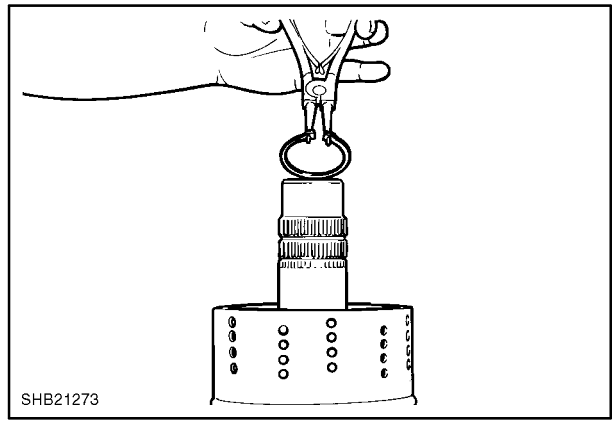
70

Use a bearing puller to remove clutch gear steel bearing



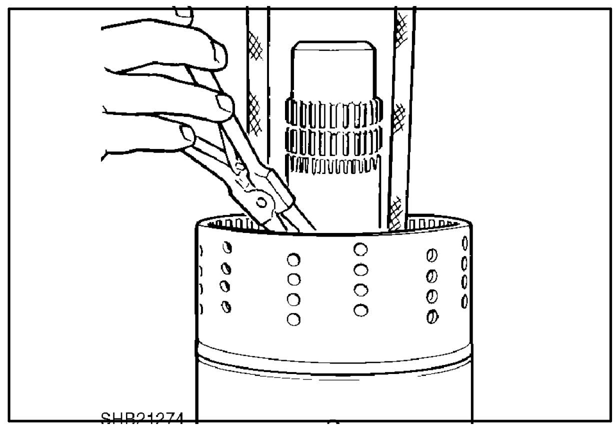
71

Remove clutch gear steel bearing locating ring



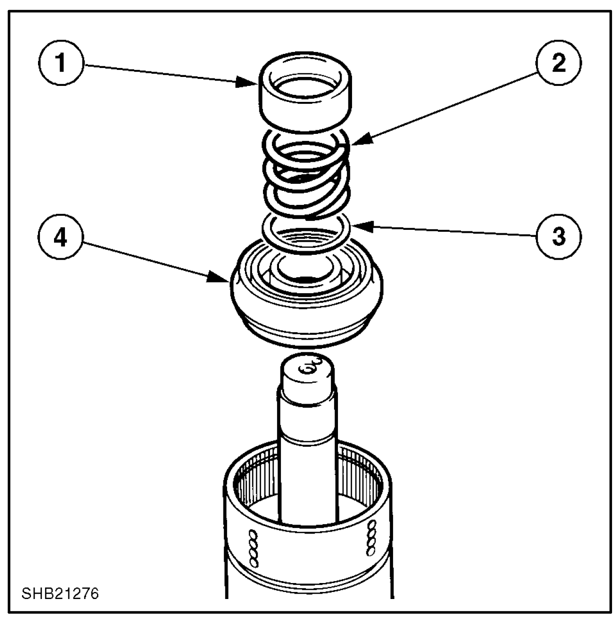
72

Compress spring to remove spring retainer circlip **380000711**.



73

Remove clutch piston spring retainer (1).
– clutch piston spring (2).
– clutch piston wear plate (3)
– clutch piston assembly (4).



74

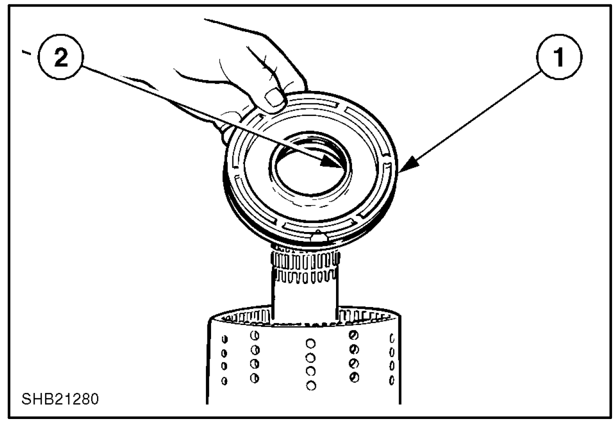
Reassembly forward low clutch

Install clutch piston friction seal. Note: Ring must be sized before installing in clutch drum. Sealing ring must be flush with friction diameter of piston. Install clutch piston steel seal.

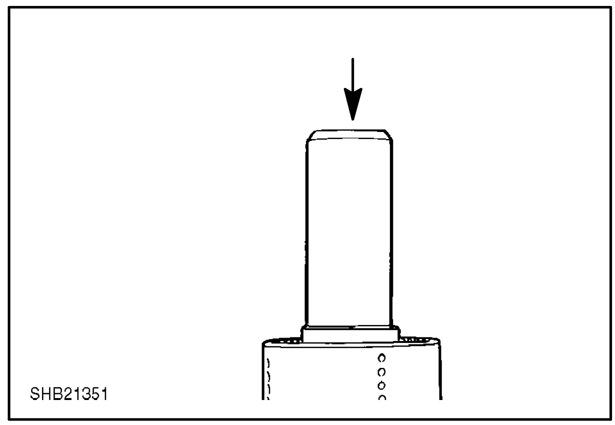
Reassemble in reverse order as for disassembly:

Install clutch piston in clutch drum, use caution not to damage sealing rings and install:
- clutch piston wear plate on piston
- Install clutch piston spring
- clutch piston spring retainer
- clutch spring retainer snap ring

Using tool no **380000711** compress spring refit circlip.



75



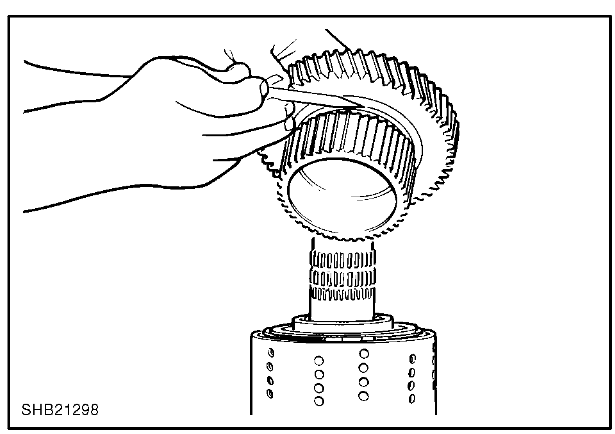
76

Install one friction half disc, with friction material away from the piston.

Install one steel disc. Alternate friction and steel discs until the proper amount of discs are installed. First and last discs are steel.

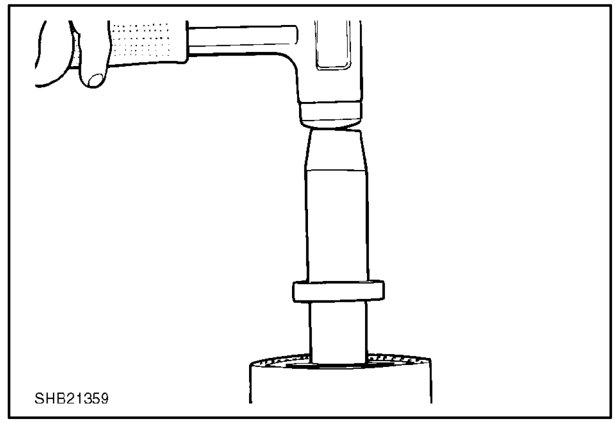
- Install one half disc with friction material down.
- backing plate snap ring.
- Spacer.
- Spacer snap ring.
- steel bearing snap ring.
- Clutch gear steel bearing.

Install clutch gear sealing ring. Install clutch gear in clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation. Gear splines must be in full position with internal teeth of all steel discs.



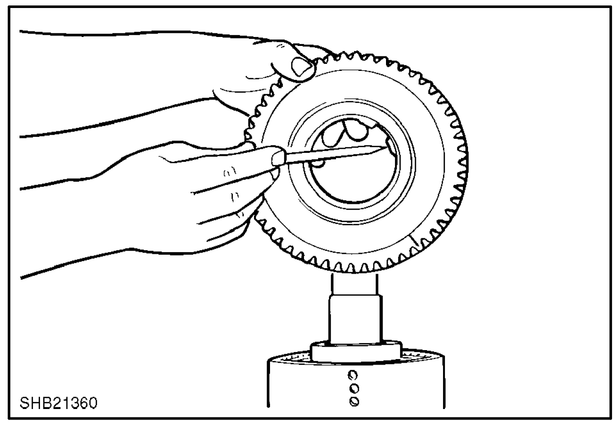
77

Tap steel bearing into place.



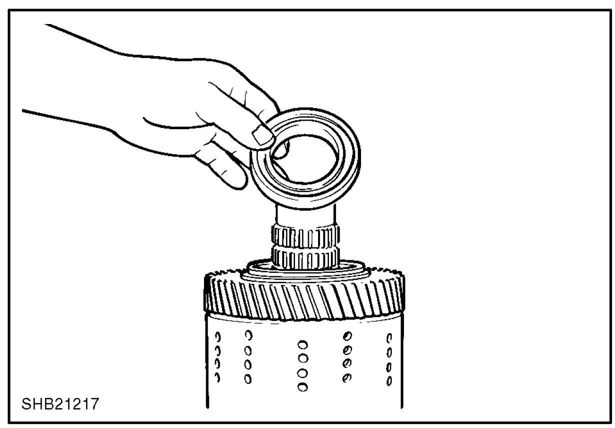
78

Install clutch gear bearing locating rings.



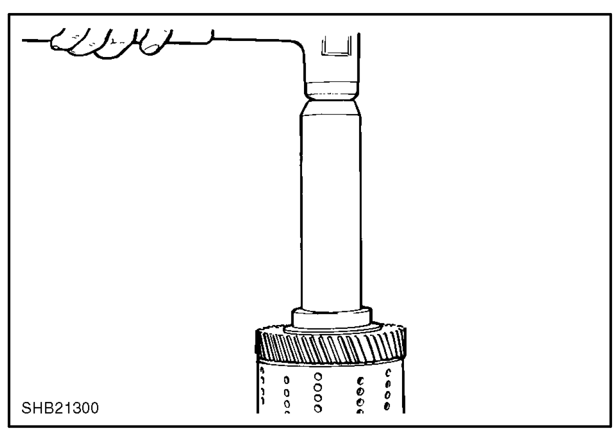
79

Install clutch gear bearing. Be sure that bearing shield is on the outside.



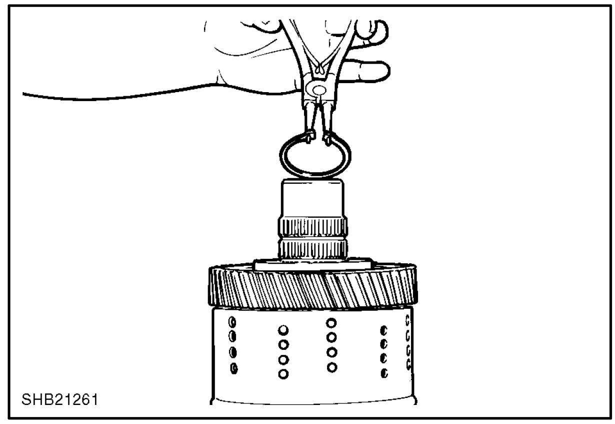
80

Tap bearing into place.



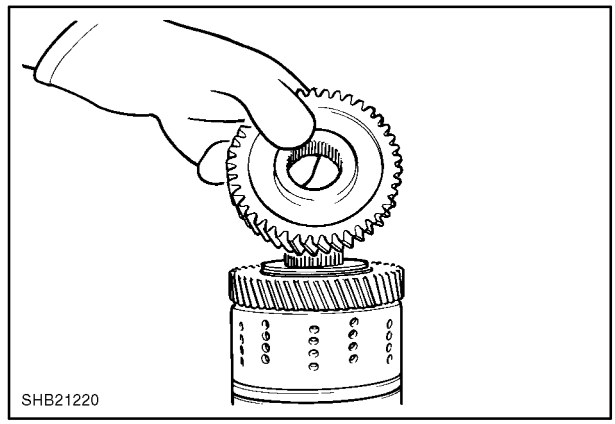
81

Install bearing circlip.



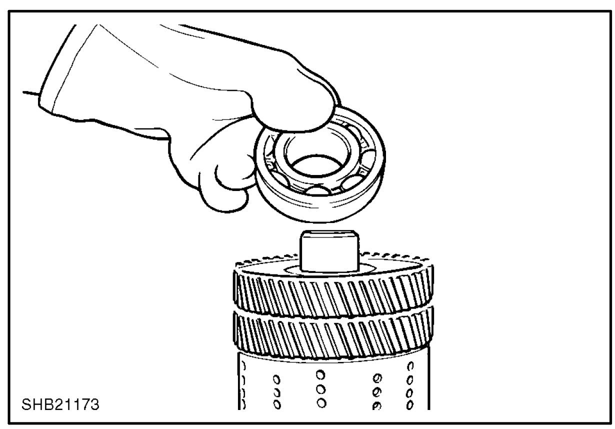
82

Warm gear to 150_ C (302_ F), install gear.



83

Warm front bearing to 120_ C (248 F), install bearing.

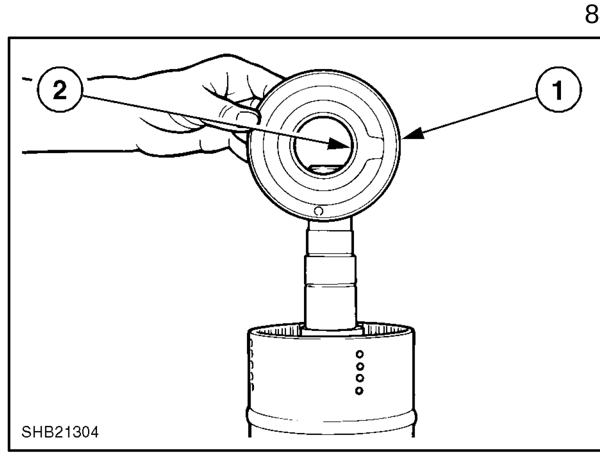


84

Reassembly forward high clutch

Install clutch friction seal. Note: Ring must be sized before installing in clutch drum. Sealing ring must be flush with friction diameter of piston.

Install piston steel seal

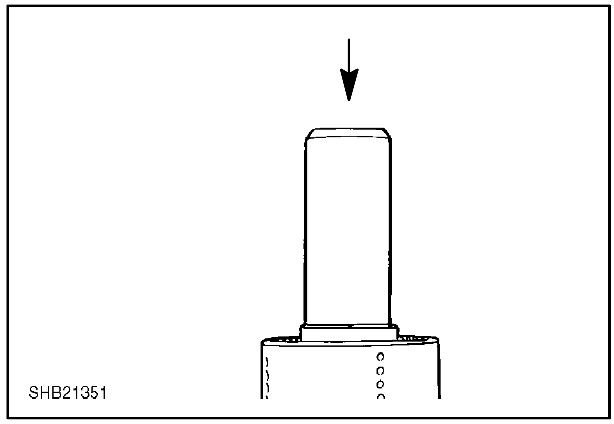


85

Reassemble in reverse order as for disassembly:

Install clutch piston in clutch drum; use caution not to damage sealing rings and install:
– piston wear plate on piston.
– clutch piston return spring.
– piston return spring retainer.
– spring retainer spacer.
– spring retainer snap ring.

Use a sleeve and press spring to refit (thick snap ring).



86

Install one friction half disc with friction material away from the piston.
– Install one steel disc.
– Alternate friction and steel discs until the proper amount of discs are installed, first and last discs are steel.
– Install one friction half disc with friction material down.

Install backing plate.
– backing plate spacer.
– backing plate spacer retainer ring.

Install thrust washer and thrust bearing.

Install clutch gear steel needle bearing.

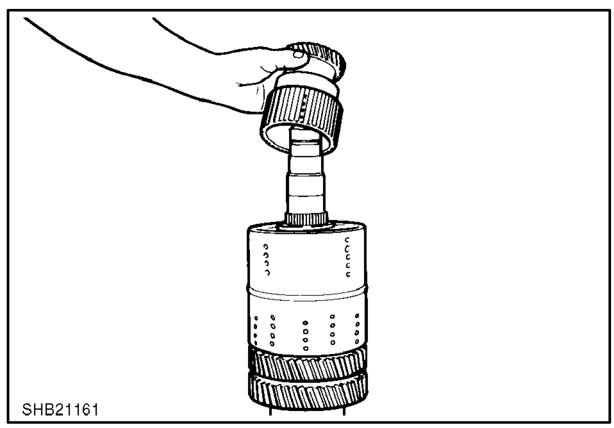
Install clutch gear in clutch drum. Align splines on clutch gear with internal teeth of steel discs.
Do not force this operation. Gear splines must be in full position with internal teeth of all steel discs.

Install clutch gear needle bearing.

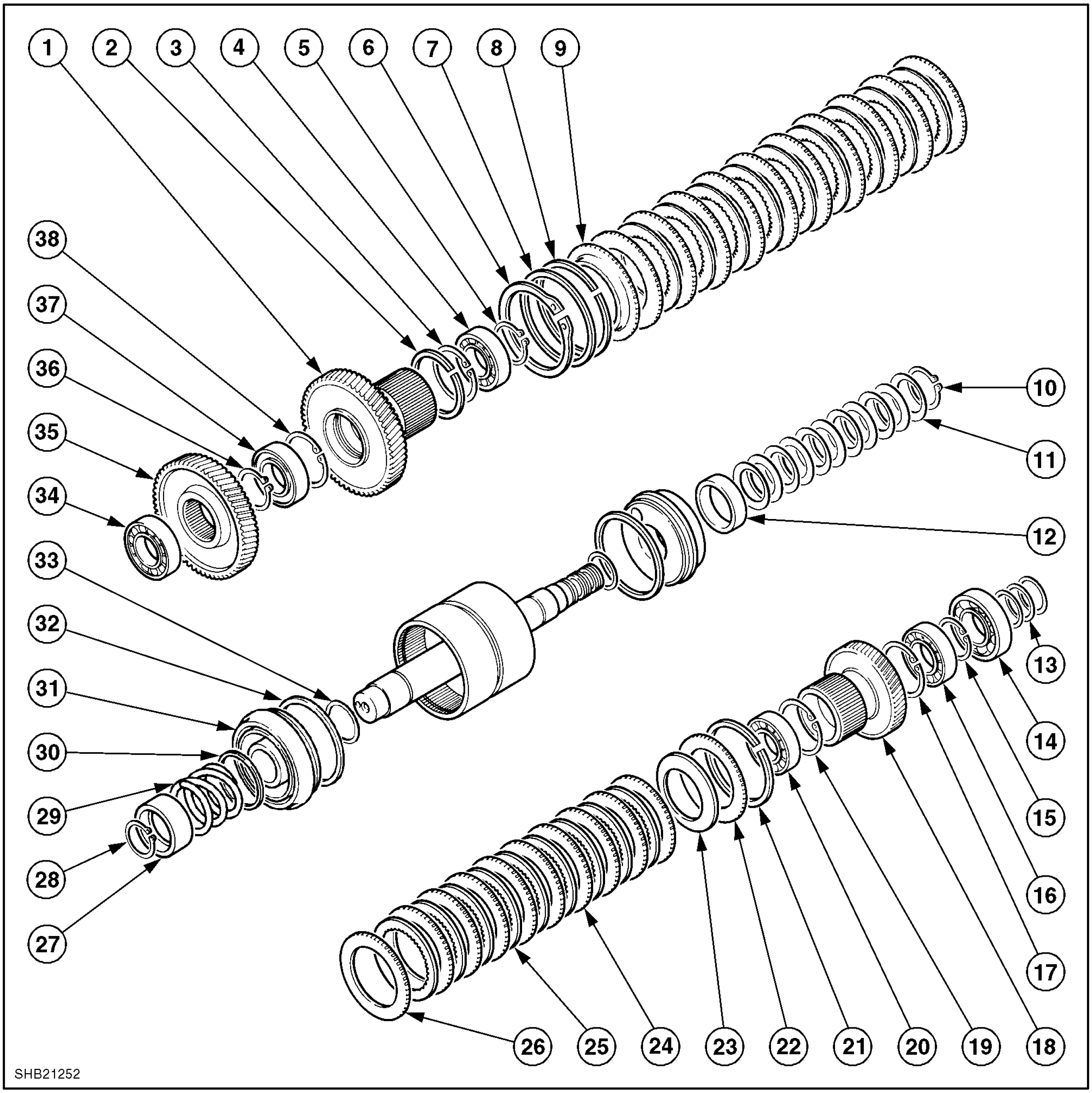
Install thrust washer and thrust bearing.

Install bearing

Install clutch shaft sealing rings.



87



88

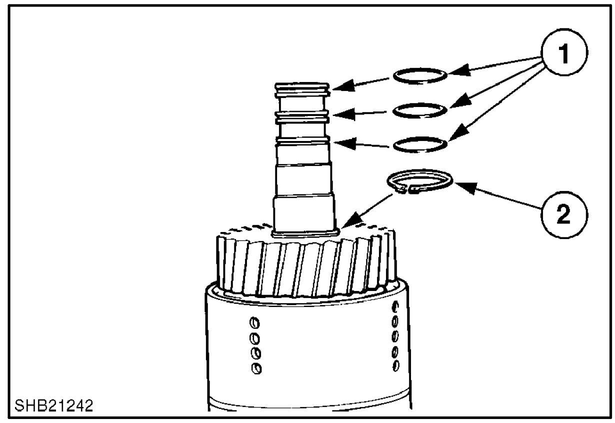
1st Reverse shaft

1st Reverse shaft

1. Gear Forward Low Clutch
2. Snap Ring
3. Circlip
4. Bearing
5. Circlip
6. Circlip
7. Washer
8. Snap Ring
9. Clutch Disc Backing Plate
10. Circlip
11. Belleville washers
12. Spacer
13. Sealing Rings
14. Bearing
15. Circlip
16. Bearing
17. Circlip
18. Gear 1st Clutch
19. Circlip
20. Bearing
21. Snap Ring
22. Clutch Disc Backing Plate
23. Modulation Spring
24. Friction Disc
25. Steel disc
26. Outer Half Disc
27. Spring retainer
28. Circlip
29. Spring
30. Spring wear Ring
31. Piston
32. Piston Outer Sealing Ring
33. Piston Inner Sealing Ring
34. Bearing
35. Gear Reverse Driven
36. Circlip
37. Bearing
38. Circlip

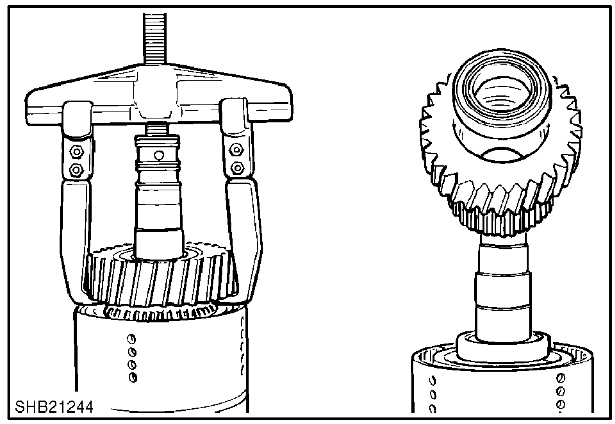
Disassembly first clutch

Remove clutch shaft sealing rings (1).
– clutch gear bearing circlip (2).



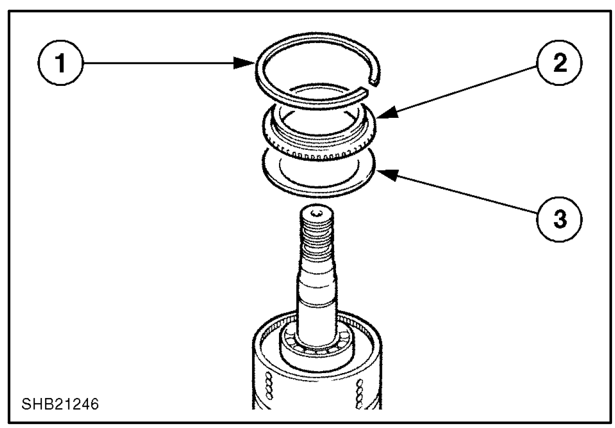
89

Use a bearing puller and slice remove clutch gear and bearing.



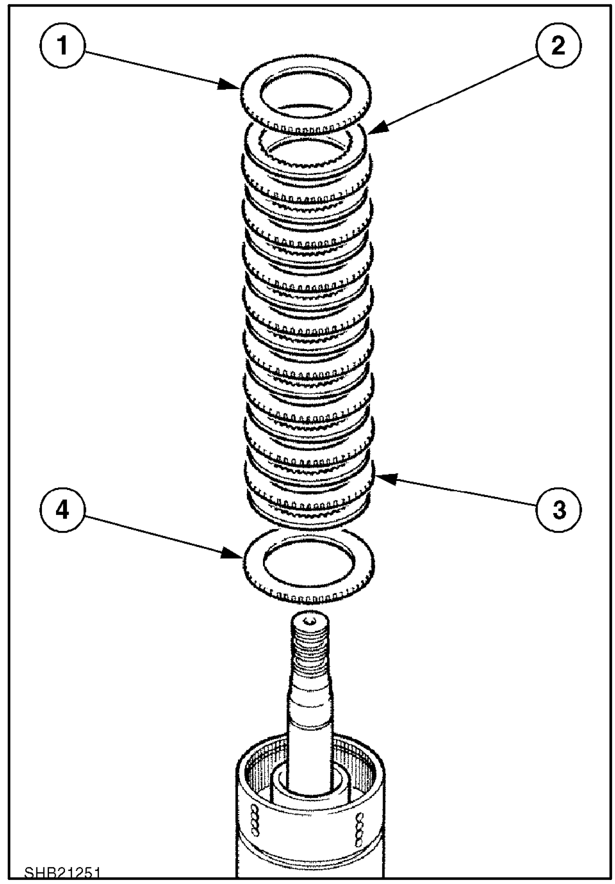
90

Remove backing plate retainer ring (1).
– backing plate (2).
– modulation spring (3).



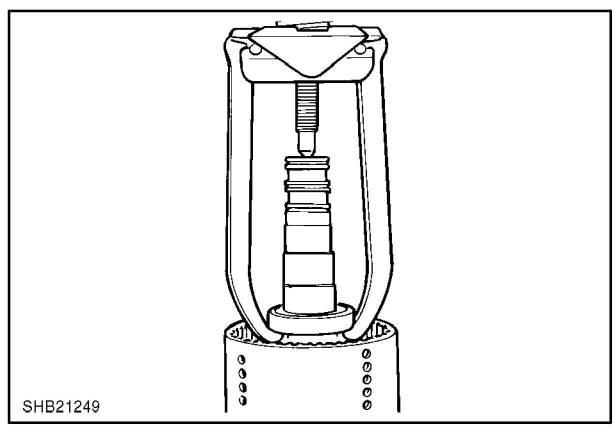
91

Remove 1x friction half disc (1).
9x – Steel Discs (2).
8x – Friction Discs (3)
1x – Friction Half Disc (4)



92

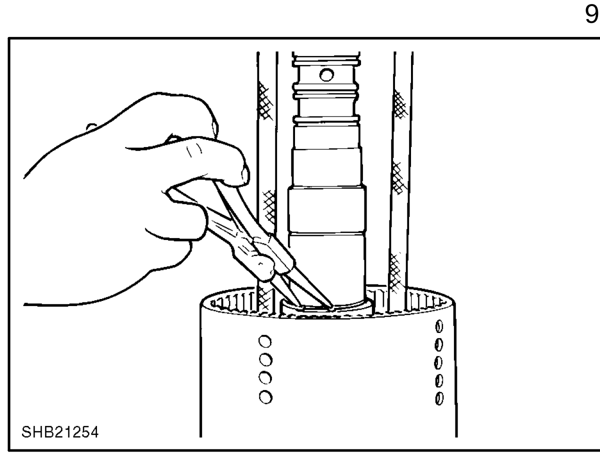
Use bearing puller to remove clutch gear steel bearing.



93

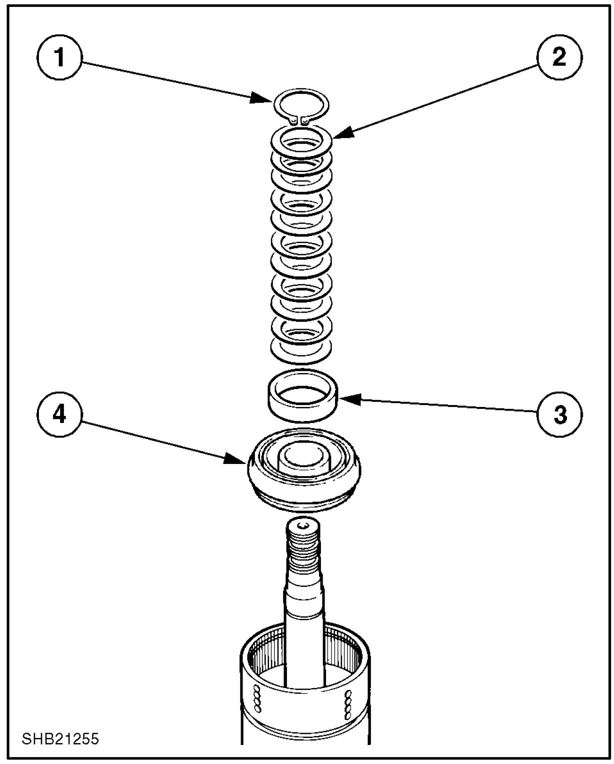
Compress clutch piston Belleville washer spring using tool no **297401**. Remove spring snap ring.

NOTE: *Force of disc spring is 3.280N !*



94

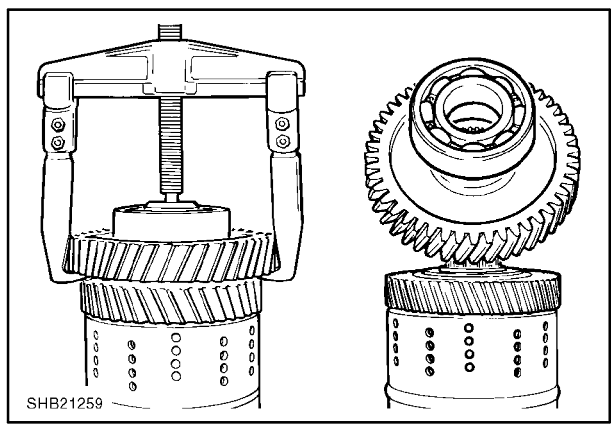
With circlip removed (1)
- remove Belleville washers (2)
- clutch piston wear sleeve (3).
- clutch piston assembly.



95

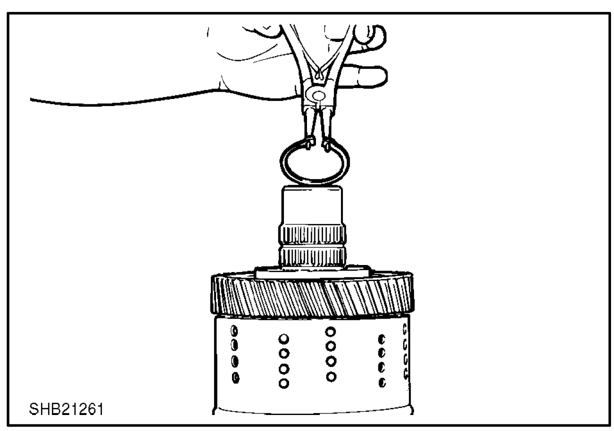
Disassembly reverse clutch

Use a bearing puller to remove gear and front bearing.



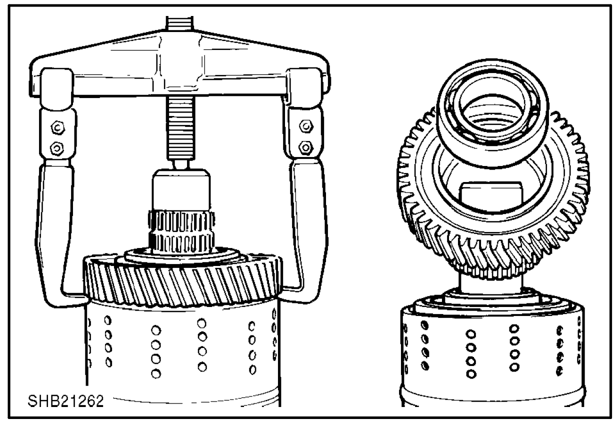
96

Remove clutch gear bearing circlip.



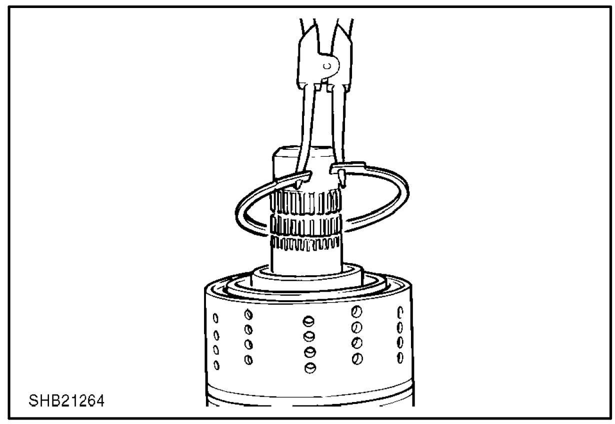
97

Use a bearing puller to remove clutch gear and clutch gear bearing.



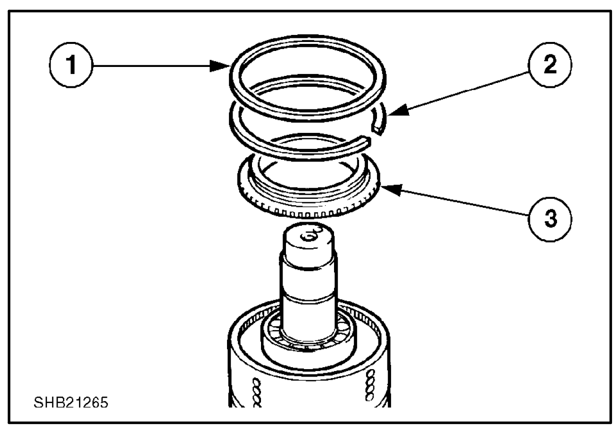
98

Remove spacer snap ring



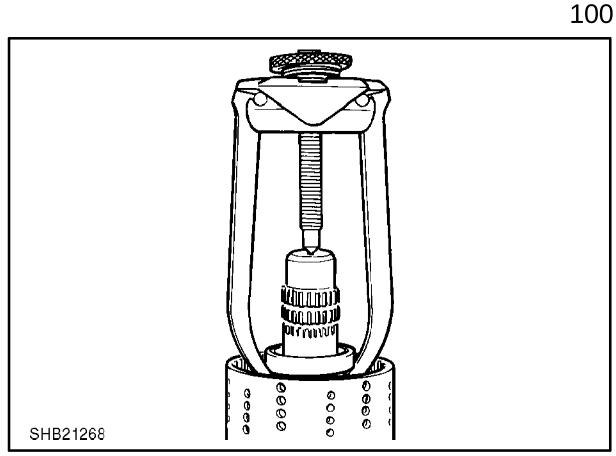
99

Remove spacer (1).
- backing plate snap ring (2)
- clutch disc backing plate.



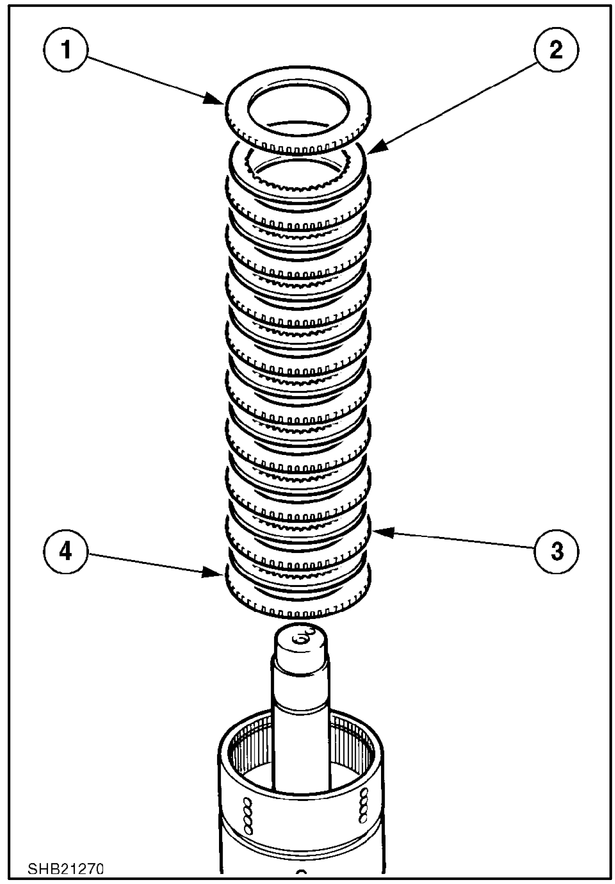
100

Use a bearing puller to remove clutch gear steel bearing.



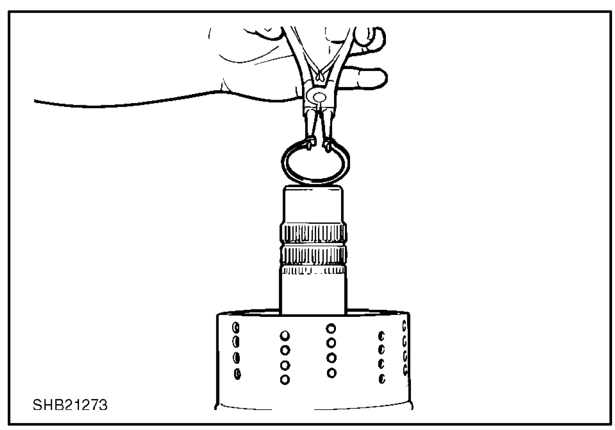
101

Remove 1x friction half disc (1).
9x – Steel Discs (2).
8x – Friction Discs (3).
1x– Friction Half Disc (4).



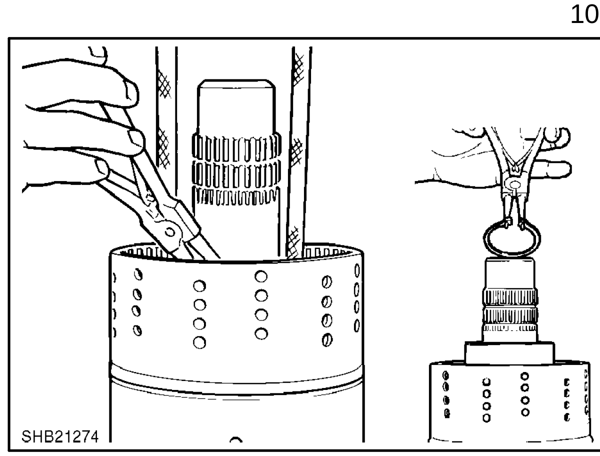
102

Remove steel bearing locating ring.



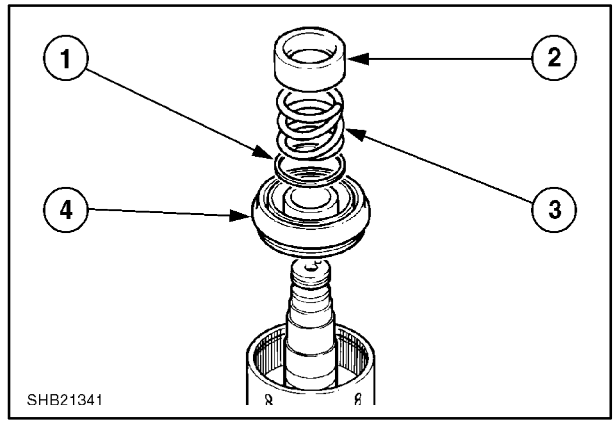
103

Compress spring using tool no **380000711** to remove spring retainer circlip.



104

Remove clutch piston spring circlip (1).
- clutch piston spring (2).
- clutch piston wear plate (3).
- clutch piston (4)

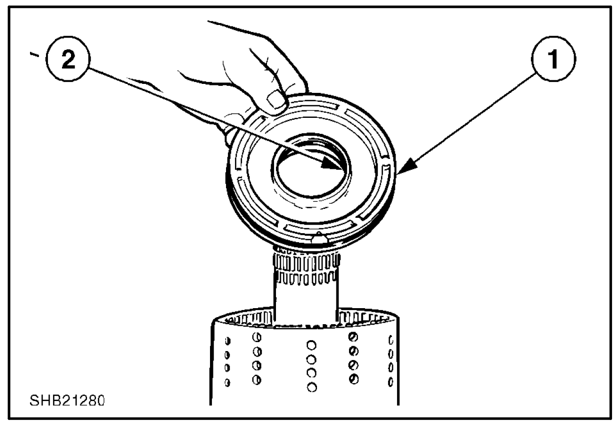


105

Reassembly reverse clutch

Install a new clutch piston friction seal.

NOTE: *Ring must be sized before installing in clutch drum. Sealing ring must be flush with friction diameter of piston. Install clutch piston steel seal.*

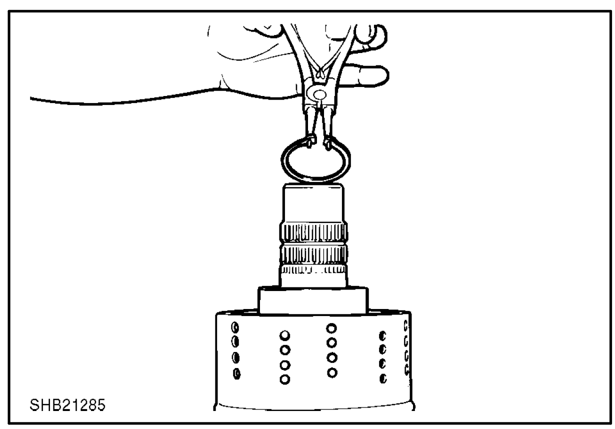


106

Reassemble in reverse order as for disassembly:

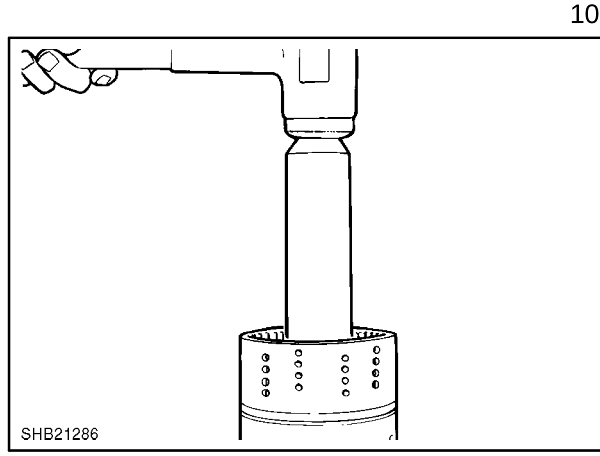
Install clutch piston in clutch drum, use caution as not to damage sealing rings and install:
- piston wear plate on piston (1).
- piston spring (2).
- piston spring retainer (3).

Install clutch spring circlip.



107

Using tool no **380000711** press spring and seat to fit circlip ring. Be sure ring is in full position in groove.

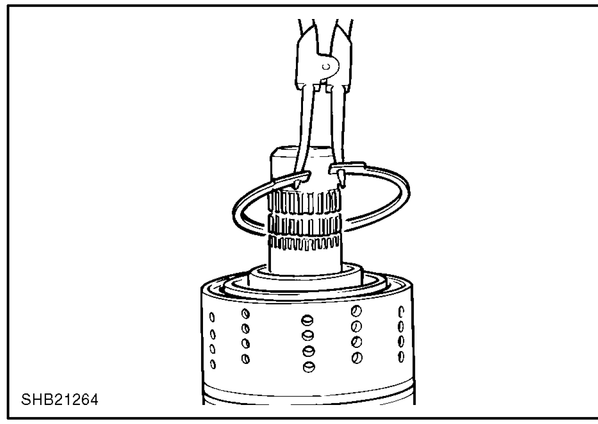


108

Install one friction half disc, with friction material away from the piston.

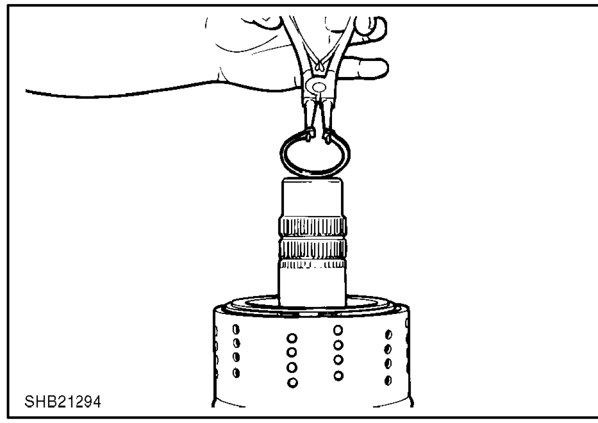
Install one steel disc. Alternate friction and steel discs until the proper amount of discs are installed.

– Install one friction half disc with friction material down.
– Install backing plate.
– Install backing plate snap ring.
– Install spacer.
– Install spacer snap ring.



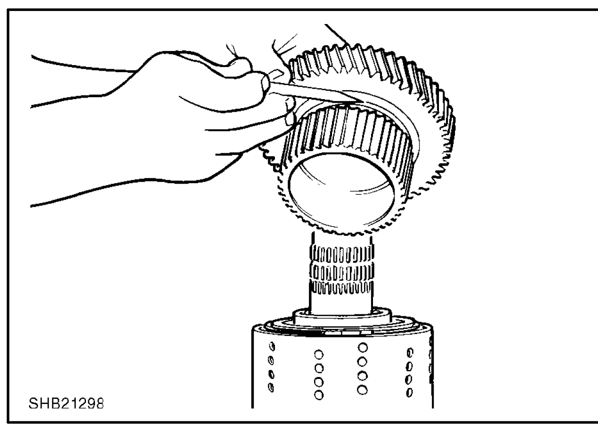
109

Install steel bearing snap ring.



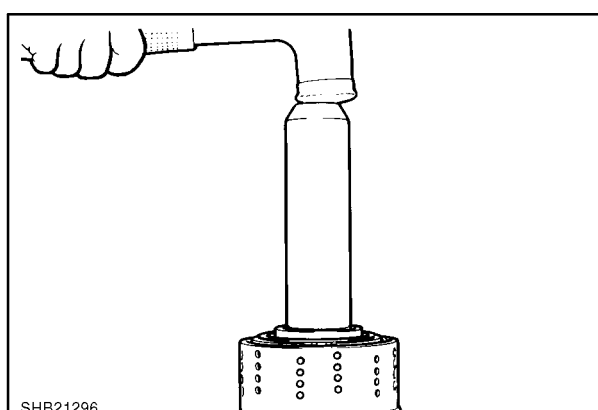
110

Install clutch gear sealing ring. Install clutch gear in clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation. Gear splines must be in full position with internal teeth of all steel discs.



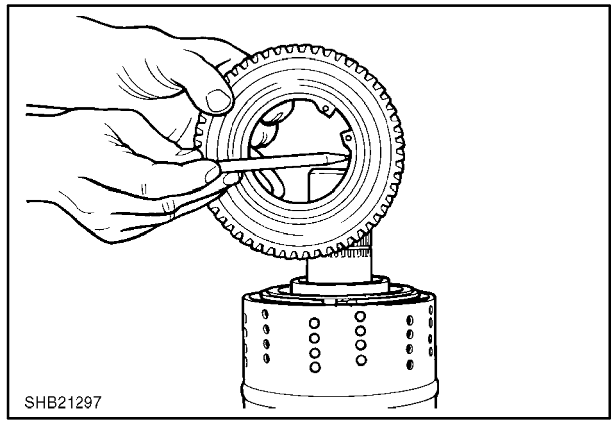
111

Install clutch gear steel bearing and tap bearing into place.



112

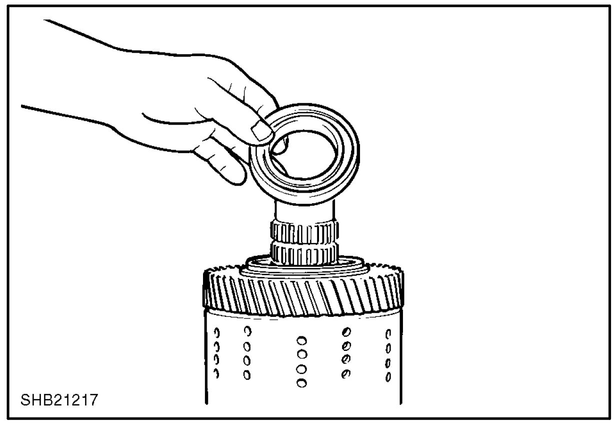
Install clutch gear bearing locating rings.



113

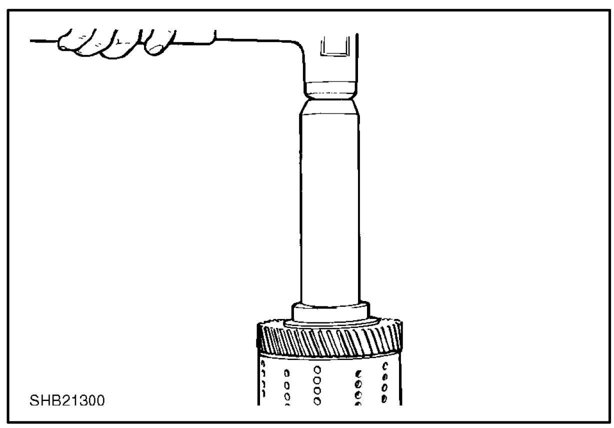
Install clutch gear bearing.

IMPORTANT: *Be sure that bearing shield is on the outside.*



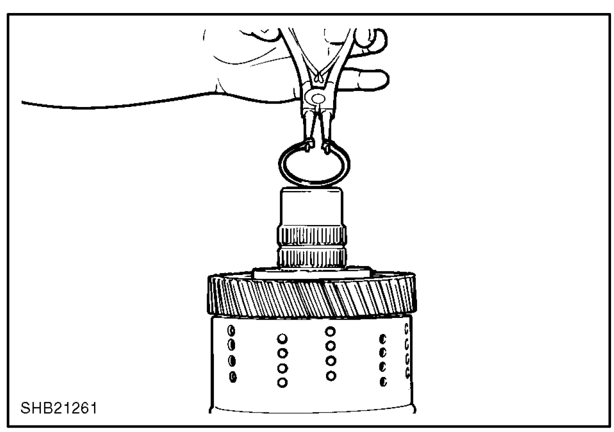
114

Tap bearing into place.



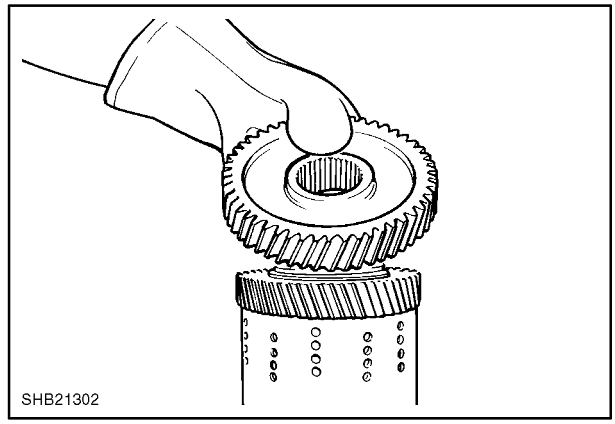
115

Install bearing snap ring.



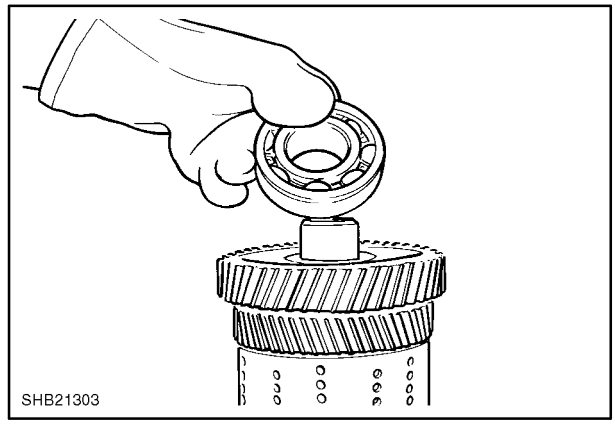
116

Warm gear to 150_ C (302 F), install gear.



117

Warm front bearing to 120_ C (248 F), install bearing.

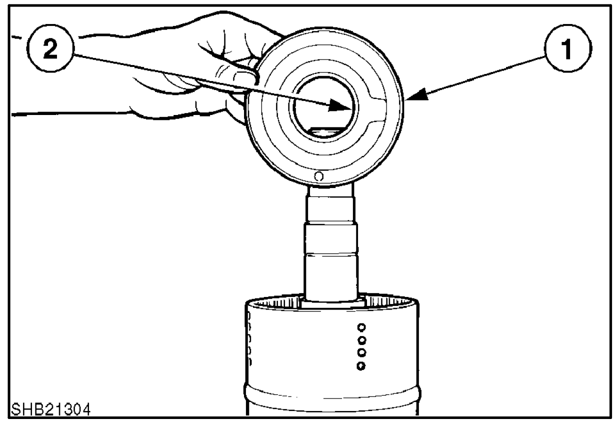


118

Reassembly first clutch

Install clutch piston friction seal. Note: Ring must be sized before installing in clutch drum. Sealing ring must be flush with friction diameter of piston.

Install piston steel seal. Install clutch piston in clutch drum. Use caution as not to damage sealing rings.

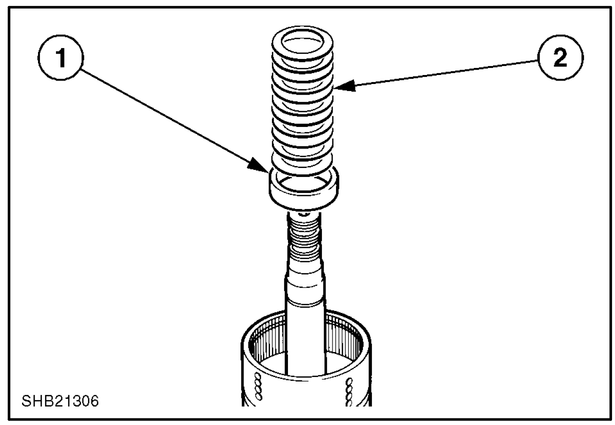


119

Install clutch piston wear sleeve (1) and Install piston return disc springs (2).

IMPORTANT: *Install first spring with large diameter of bevel towards the wear sleeve. Alternate eleven (11) Belleville washers.*

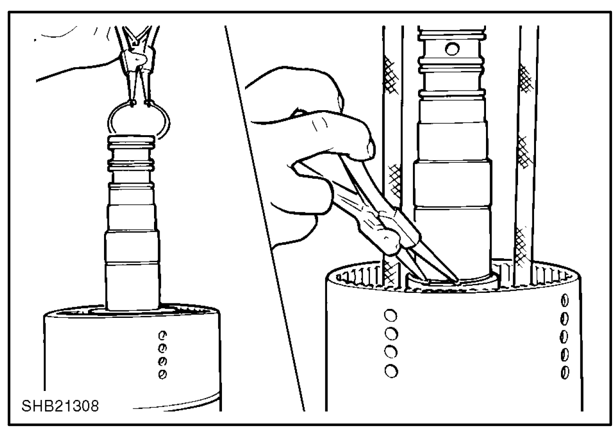
Install disc Belleville washer spring circlip and compress the spring using **380000711** to install spring . Be sure ring is in full position in groove.



120

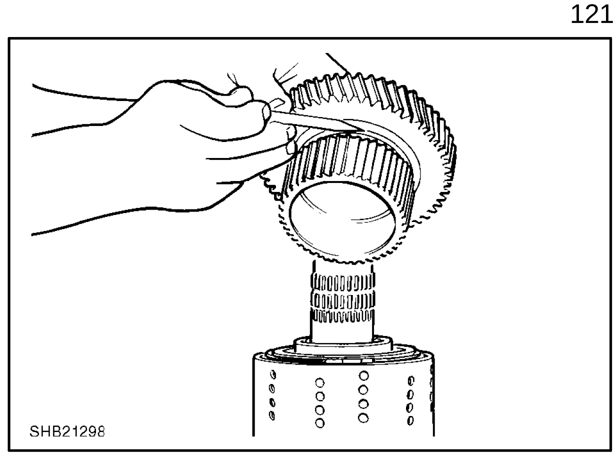
Install one Belleville washer facing downwards and install one friction half disc with friction material away from the Belleville washer. Install one steel disc. Alternate friction and steel discs until the proper amount of discs are installed. First and last discs are steel.

- one friction half disc with friction material down.
- modulation spring with large diameter up to the backing plate.
- backing plate.
- backing plate snap ring.



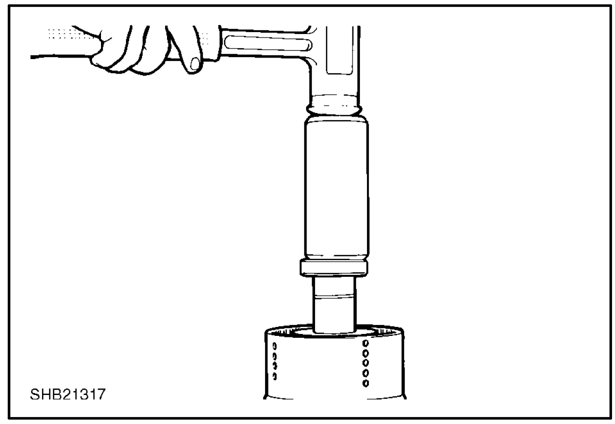
121

Install clutch hub bearing locating rings. Install clutch gear in clutch drum. Align spines on clutch gear witch internal teeth of steel discs. Do not force this operation. Gear spines must be in full position with internal teeth of all steel discs.



122

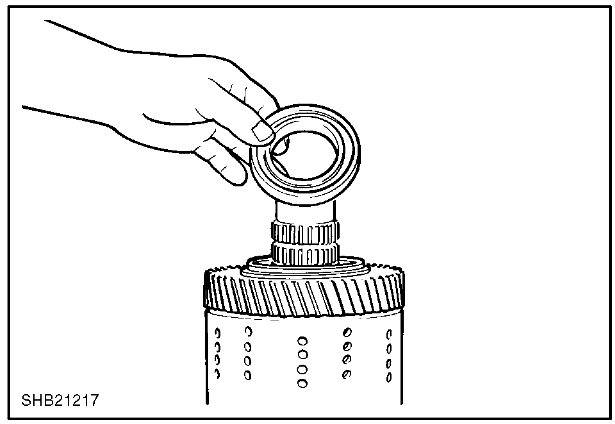
Install clutch disc hub steel bearing and tap steel bearing into place.



123

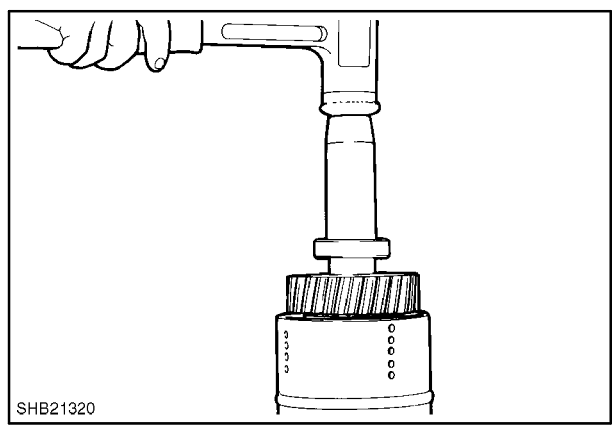
Install clutch hub bearing.

IMPORTANT: *Be sure that bearing shield is on the outside.*

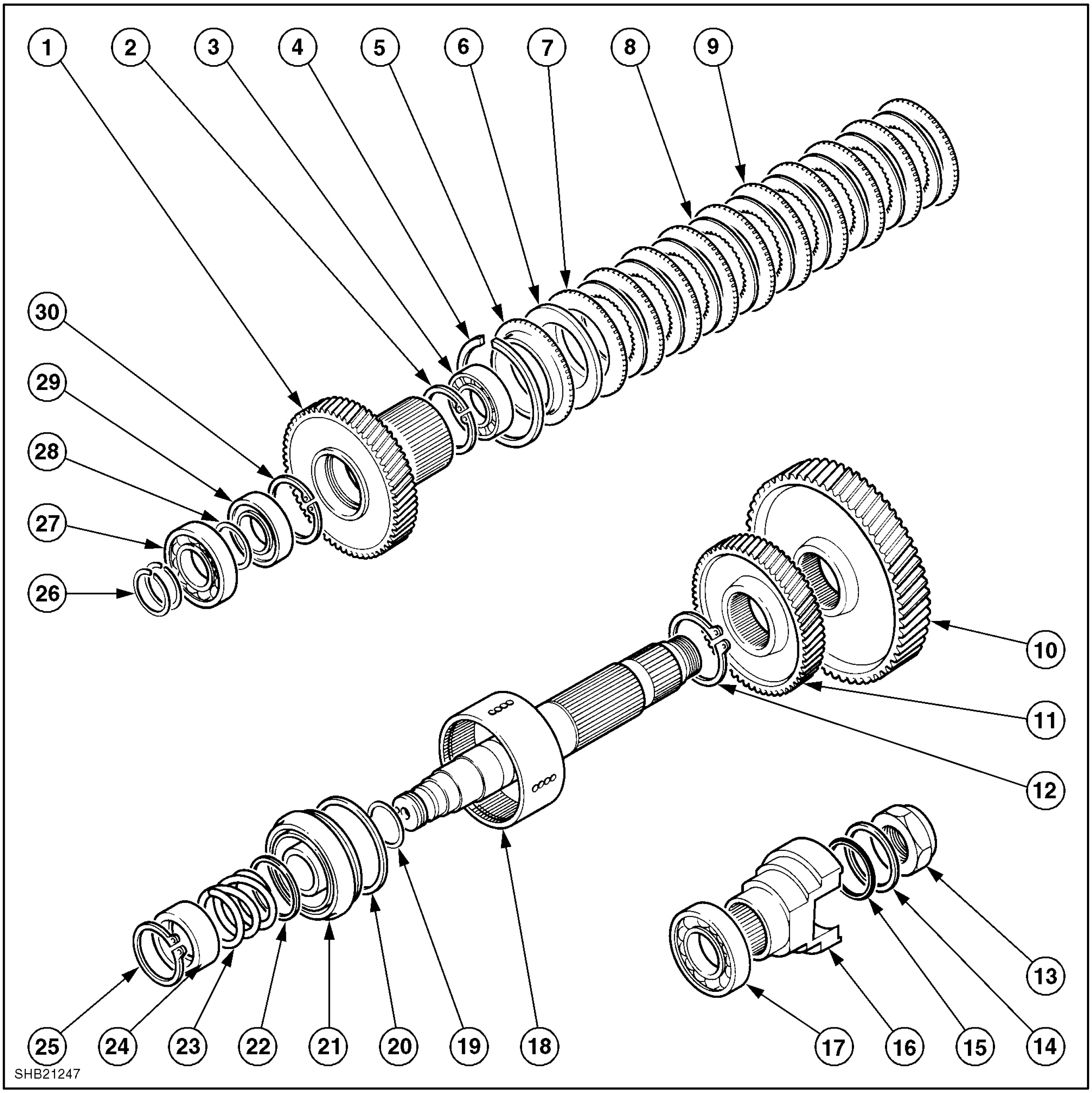


124

Tap friction bearing into clutch hub.
– Install friction bearing circlip.
– Install clutch shaft sealing rings.



125



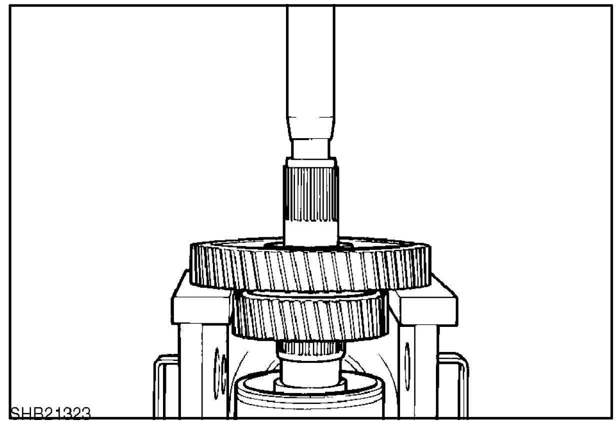
126

2nd Clutch Drum Output Shaft

1. Gear 2nd Clutch
2. Circlip
3. Bearing
4. Snap Ring
5. Outer Half Disc
6. Modulation Spring
7. Steel Disc
8. Steel Disc
9. Friction Disc
10. Gear Upper Output
11. Gear Lower Output Drive
12. Circlip
13. Retaining nut Output Yoke
14. Washer
15. Sealing Ring
16. Output Yoke
17. Bearing
18. 2nd Shaft / Drum Assembly
19. Piston Seal Inner
20. Piston Seal Outer
21. Piston
22. Spring Wear Ring
23. Spring
24. Spacer
25. Circlip
26. Piston Rings
27. Bearing
28. Washer Bearing Support
29. Bearing
30. Circlip

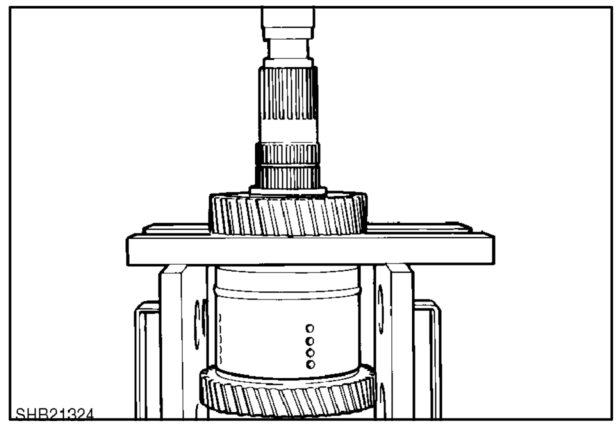
Disassembly 2nd clutch drum

Press upper output gear from 2nd shaft.



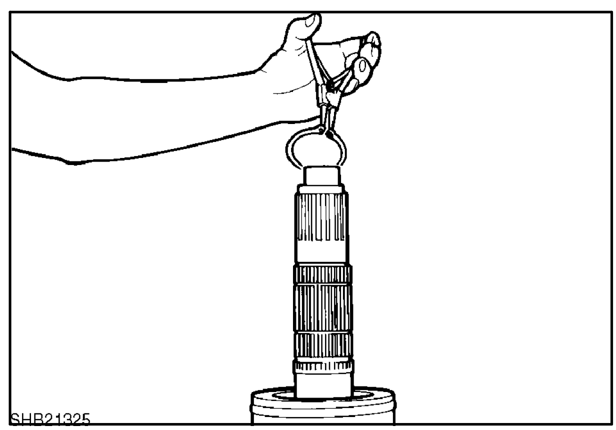
127

Press lower output gear from 2nd shaft.



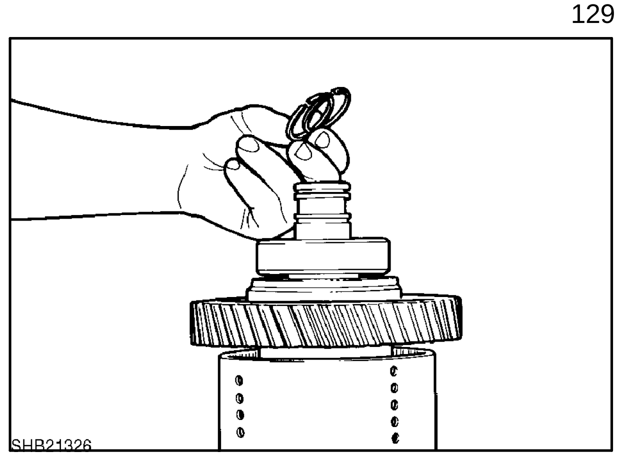
128

Remove gear circlip.



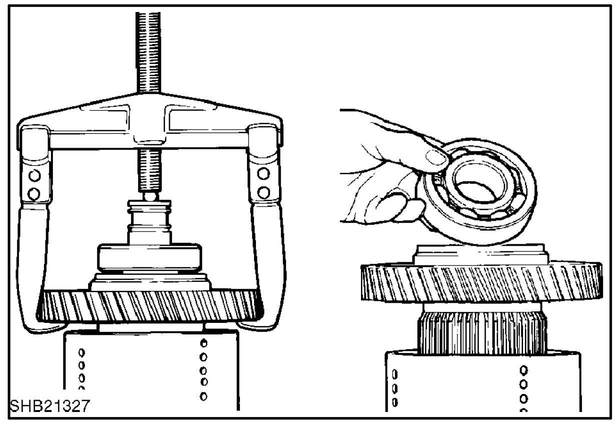
129

Remove clutch shaft sealing rings.



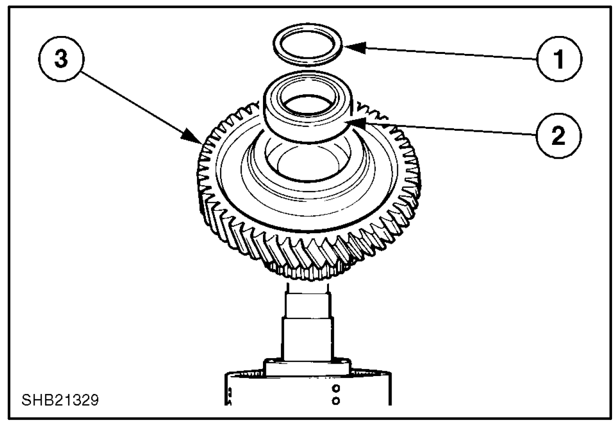
130

Use bearing puller to remove clutch hub and front bearing.



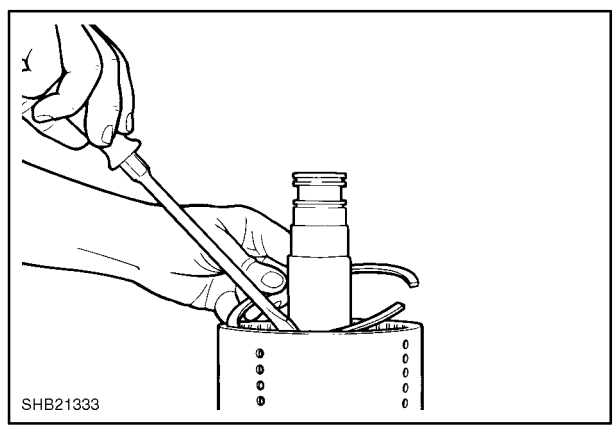
131

Remove bearing washer (1), clutch hub (2) and bearing (3).



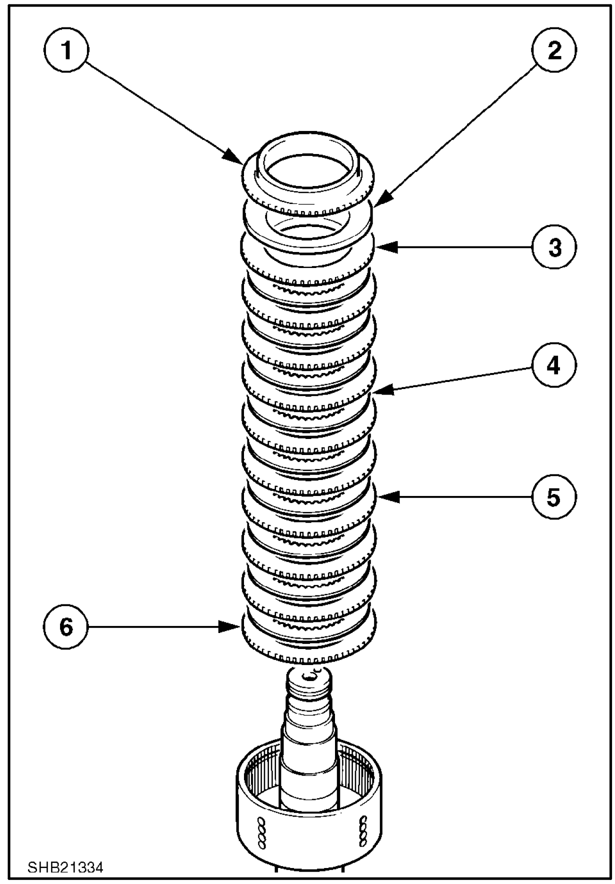
132

Remove backing plate snap ring.



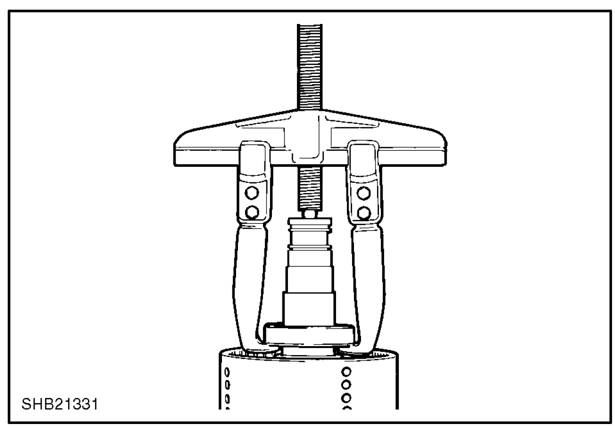
133

Remove 1x backing plate (1).
1x – modulation spring (2).
1x – friction half disc (3).
9x – steel discs (4)
8x – friction discs (5)
1x – friction half disc (6)



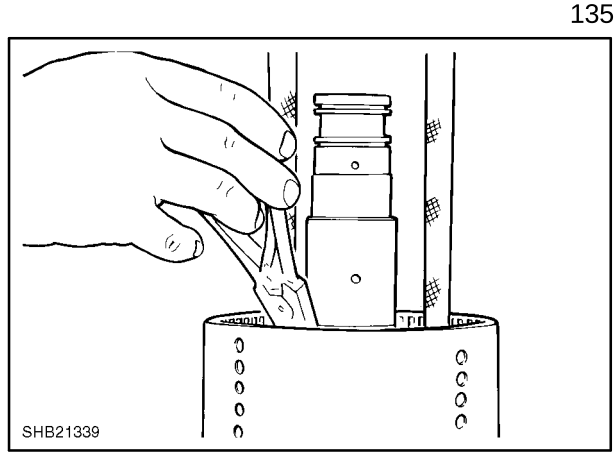
134

Use a bearing puller to remove clutch hub steel bearing.



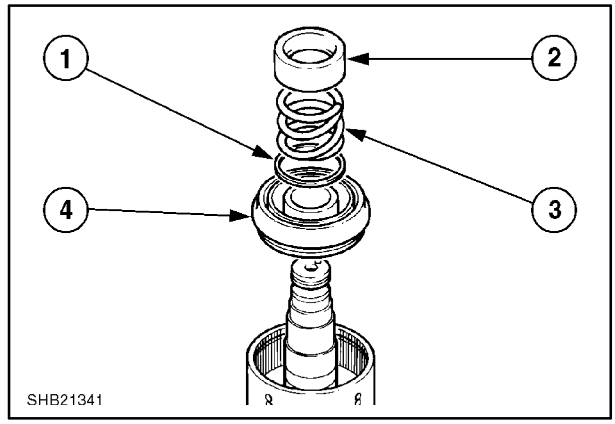
135

Compress spring using tool no **360000711** to remove spring circlip.



136

Remove spring circlip.
- spring retainer.
- clutch piston return spring.
- piston wear plate.
- Remove clutch piston assembly.

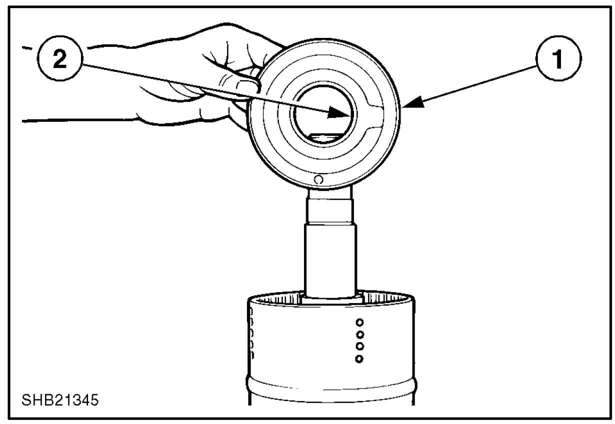


137

Reassembly 2nd clutch drum

Install piston friction seal.

NOTE: *Ring must be sized before installing in clutch drum. Sealing ring must be flush with friction diameter of piston. Install clutch piston steel seal.*

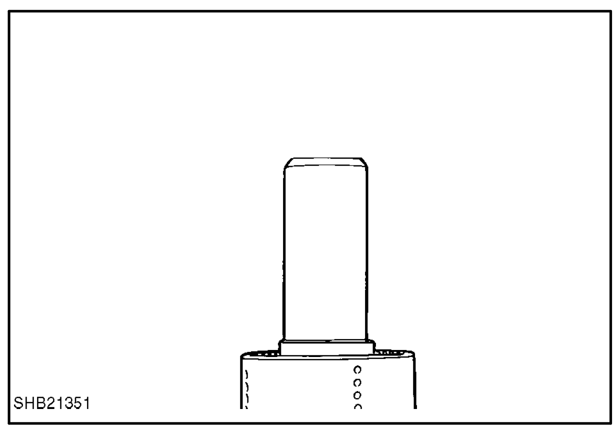


138

Reassemble in reverse order as for disassembly:

Install clutch piston in clutch drum.
Use caution as not to damage sealing rings and install:
- piston wear plate.
- piston return spring.
- spring retainer.
- spring retainer .
- snap ring

Using tool no **380000711** compress spring and seat retainer ring. Be sure ring is in full position in groove.



139

Install one friction half disc with friction material away from the piston.

Install one steel disc. Alternate friction and steel discs until the proper amount of discs are installed.

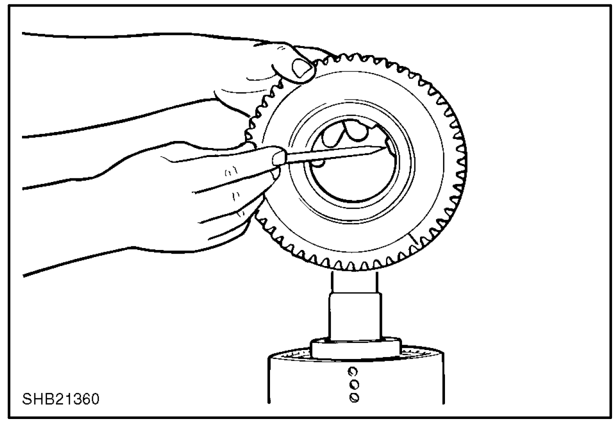
Install one friction half disc with friction material down.

Install Belleville with large diameter up to the backing plate.

Install backing plate.

Install backing plate retainer ring.

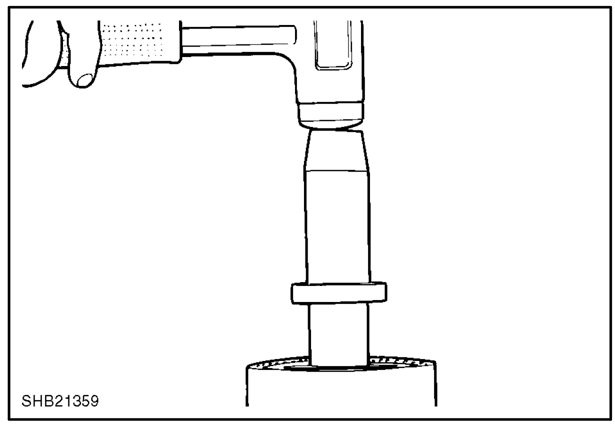
Install clutch hub bearing locating rings. Install clutch gear in clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation. Gear splines must be in full position with internal teeth of all steel discs.



140

Install clutch hub steel bearing.

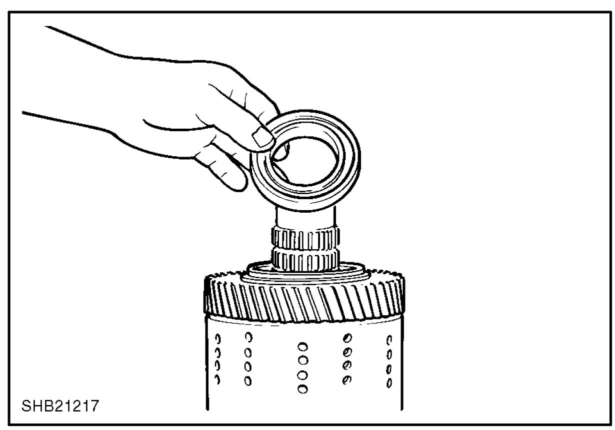
Tap clutch gear steel bearing into place.



141

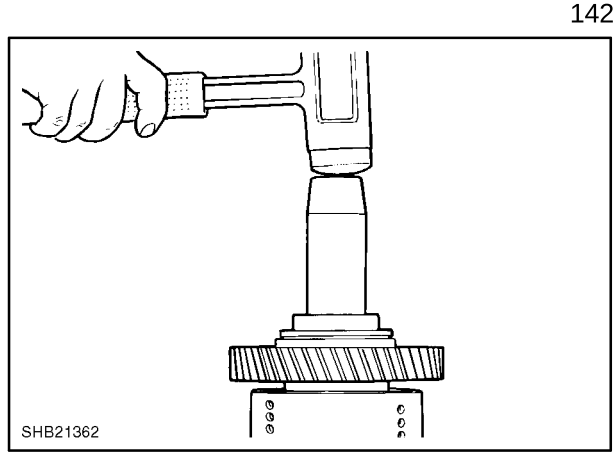
Install clutch hub bearing.

IMPORTANT: *Be sure that bearing shield is on the outside.*



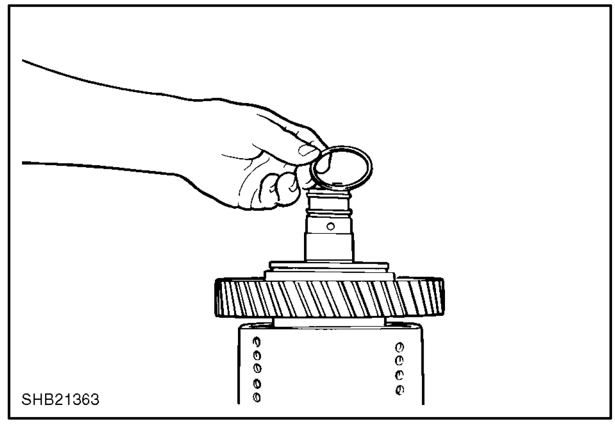
142

Tap bearing into place.



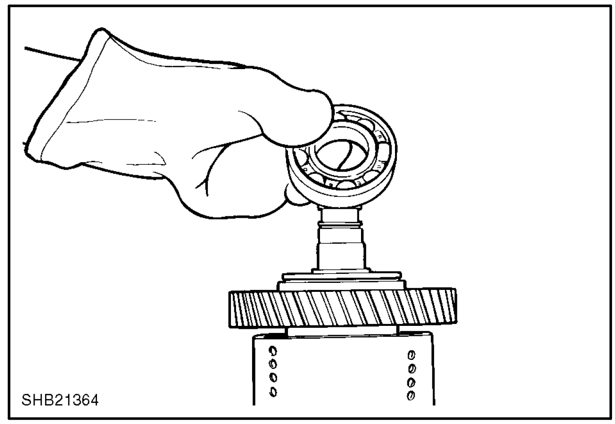
143

Install bearing washer.



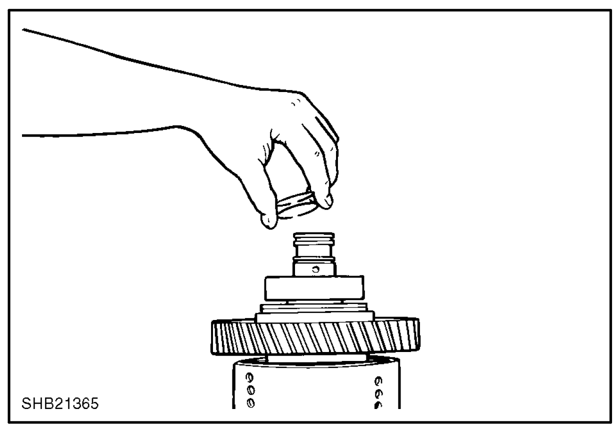
144

Warm front bearing to 120_C (248 F), install bearing.



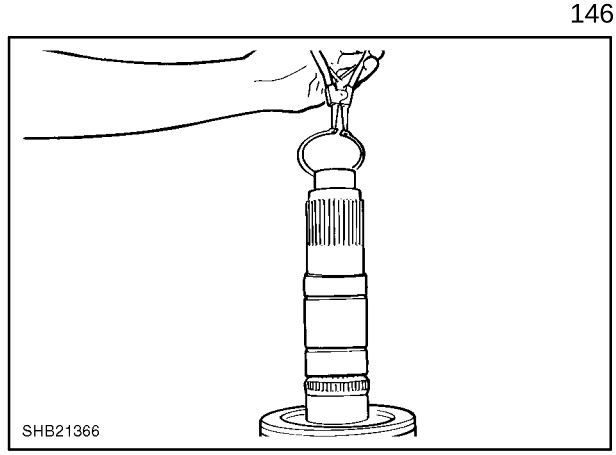
145

Install clutch shaft sealing rings.



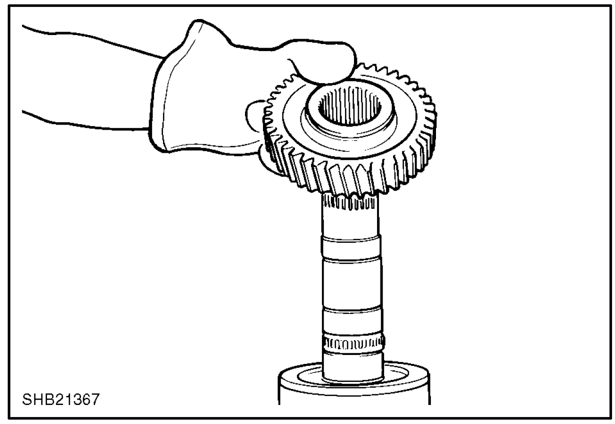
146

Install gear circlip



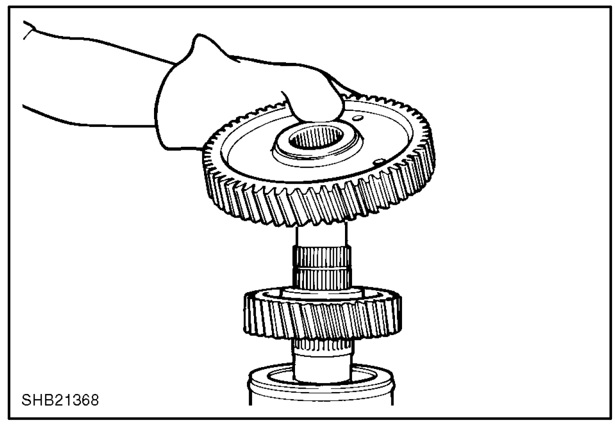
147

Warm gear to 150_ C (302 F), install gear.

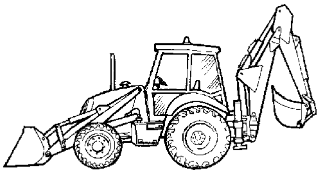


148

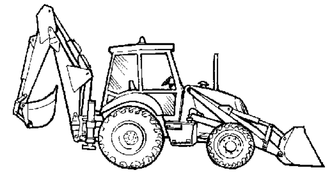
Warm upper output gear to 150_ C (302 F) install gear.

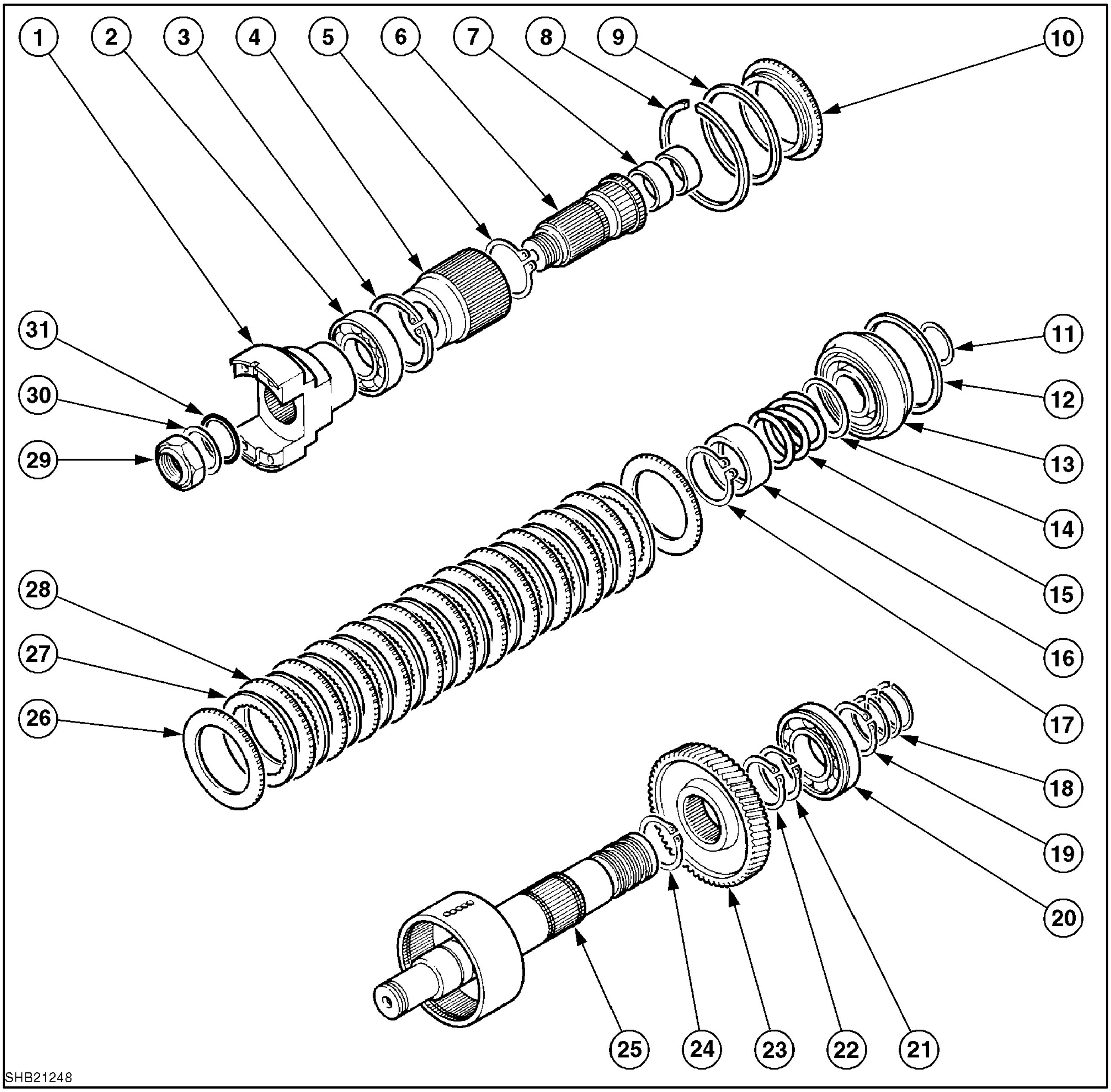


149



NOTES PAGE





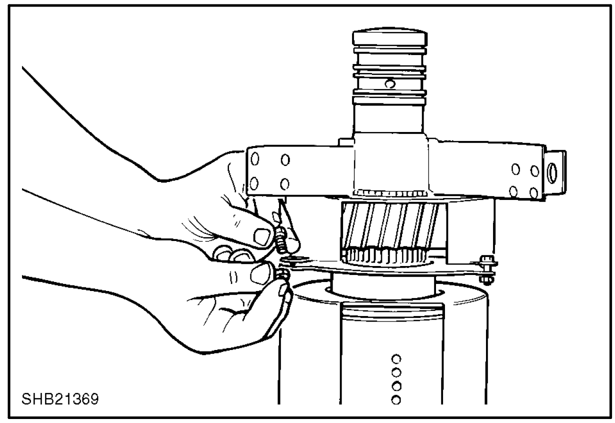
150

Four Wheel Drive Disconnect Output Shaft

1. Output Yoke
2. Bearing
3. Circlip
4. Disconnect Hub
5. Circlip
6. Front Output Shaft
7. Bushing
8. Snap Ring
9. Spacer
10. Clutch Disc Backing Plate
11. Piston Seal Inner
12. Piston Seal Outer
13. Piston
14. Spring Wear Plate
15. Spring
16. Spring Retainer
17. Circlip
18. Sealing Rings
19. Circlip
20. Bearing
21. Circlip
22. Circlip
23. Gear Lower Output
24. Circlip
25. Output Shaft / Drum
26. Outer Half Disc
27. Steel Disc
28. Friction Disc
29. Nut Output Yoke
30. Washer
31. ‘O’ Ring

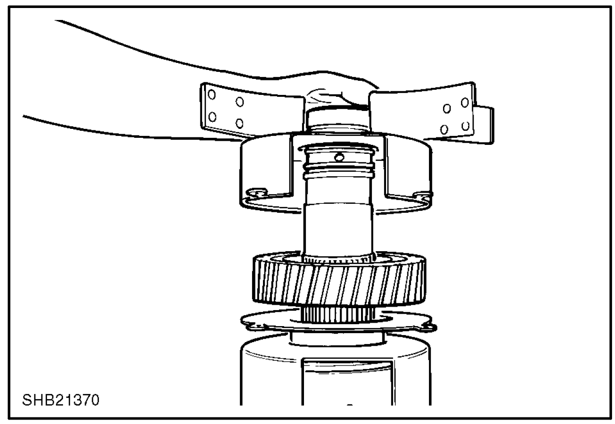
Disassembly output shaft

Remove oil baffle screws and nuts.



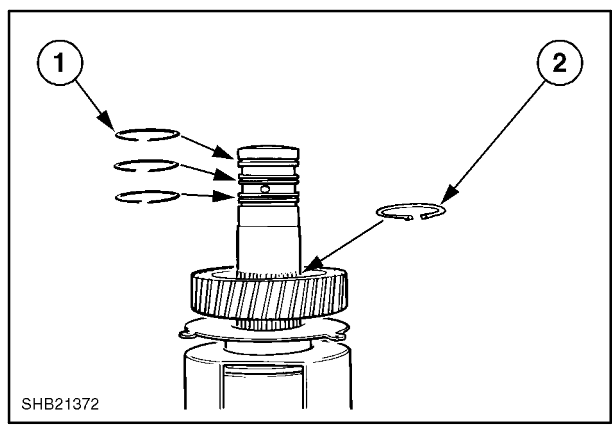
151

Remove oil baffle.



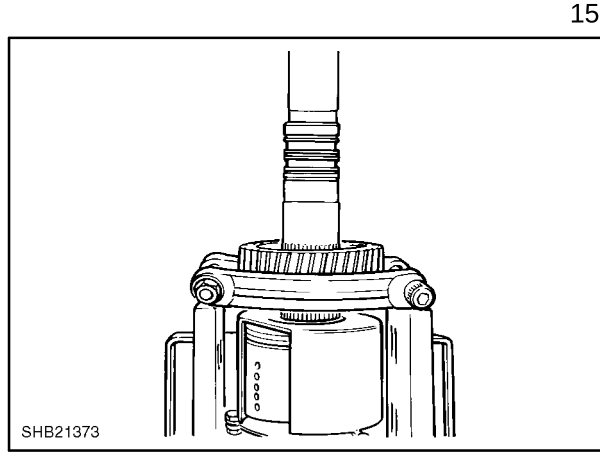
152

Remove output shaft sealing rings (1) and output shaft gear circlip (2).



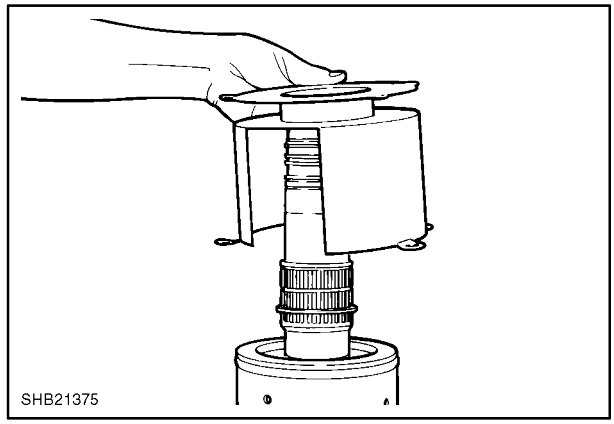
153

Press output gear from shaft



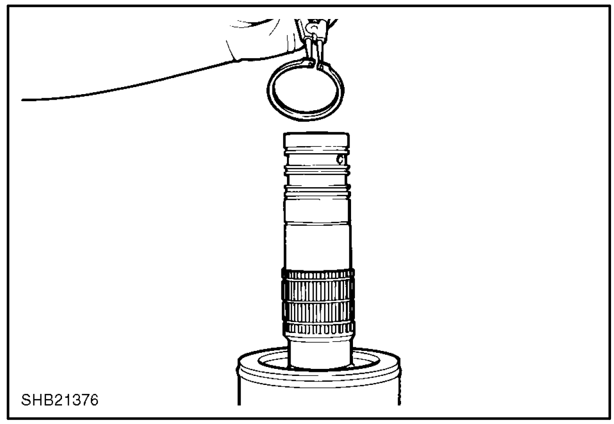
154

Remove oil baffle from output shaft.



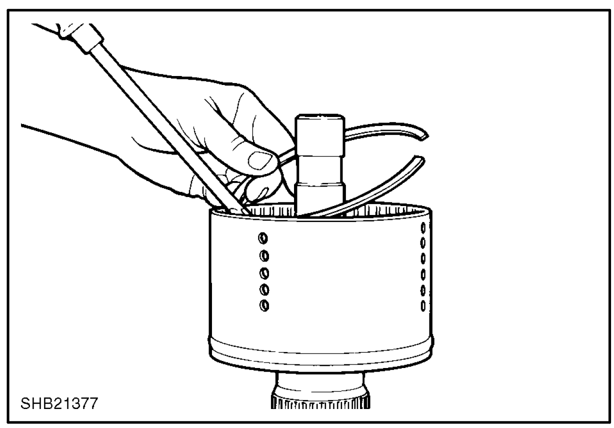
155

Remove gear circlip.



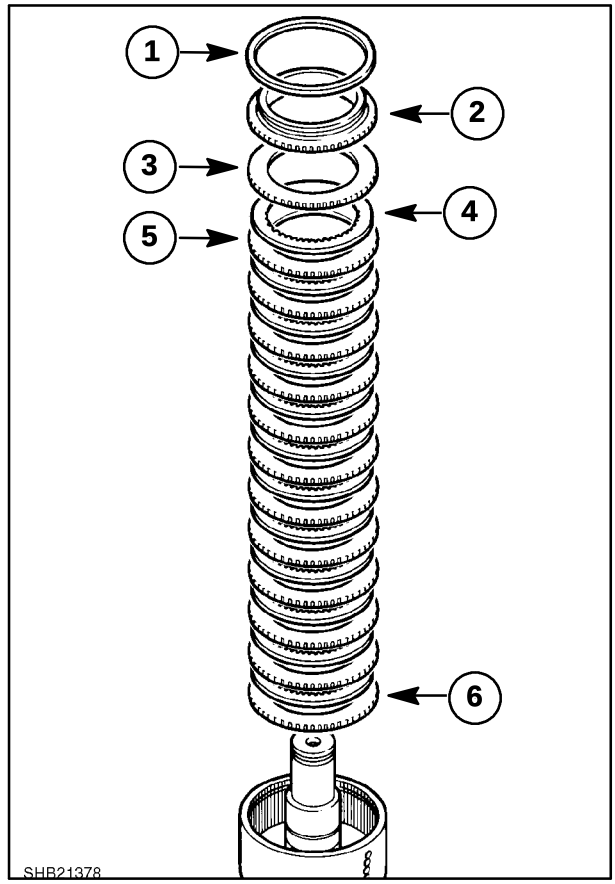
156

Remove backing plate snap ring.



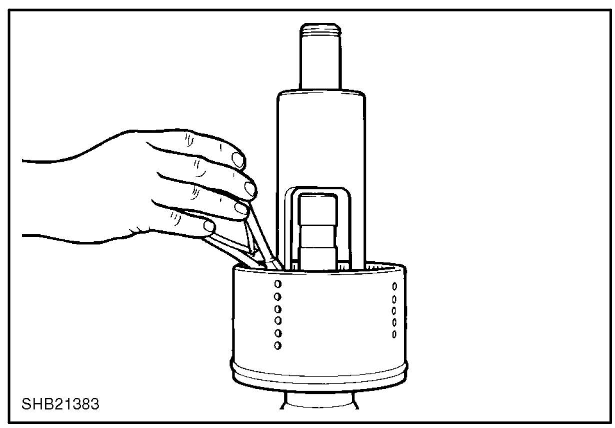
157

Remove 1x backing plate spacer (1).
1x – backing plate (2).
1x – friction half disc (3)
12x – steel discs (4)
11x – friction disc (5)
1x – friction half disc (6)



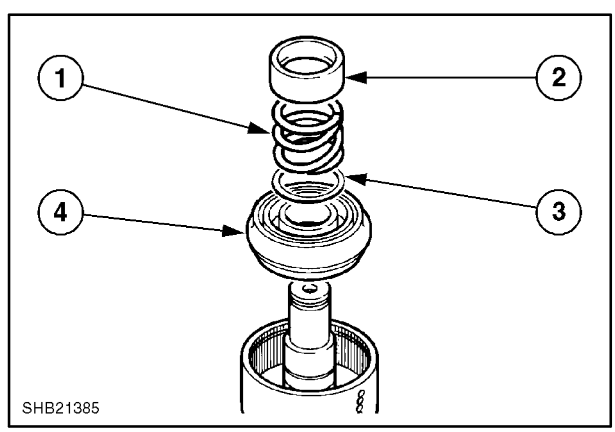
158

Compress spring to remove circlip.



159

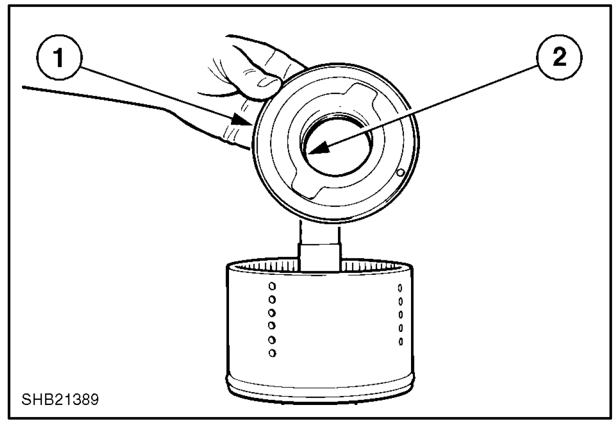
Remove spring retainer (2).
– clutch piston spring (1)
– piston wear plate (3).
– piston assembly (4).



160

Reassembly output shaft

Install piston friction seal. Note: Ring must be sized before installing in clutch drum. Sealing ring must be flush with friction diameter of piston.



161

Reassemble in reverse order as for disassembly:

Install clutch piston in clutch drum.
Use caution as not to damage sealing rings and install:
- piston wear plate.
- piston return spring.
- spring retainer.
- spring retainer .
- snap ring

Install spring retainer snap ring. Compress spring and seat retainer ring. Be sure ring is in full position in groove.

Install one friction half disc with friction material away from the piston.Install one steel disc.

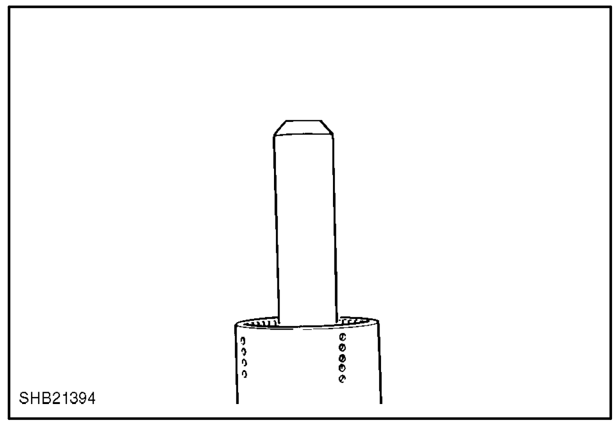
Alternate friction and steel discs until the proper amount of discs are installed.

Install one half disc with friction material down

Install backing plate.

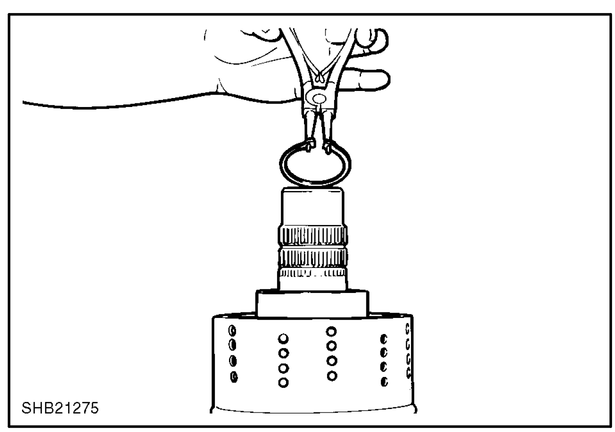
Install backing plate spacer.

Install backing plate snap ring.



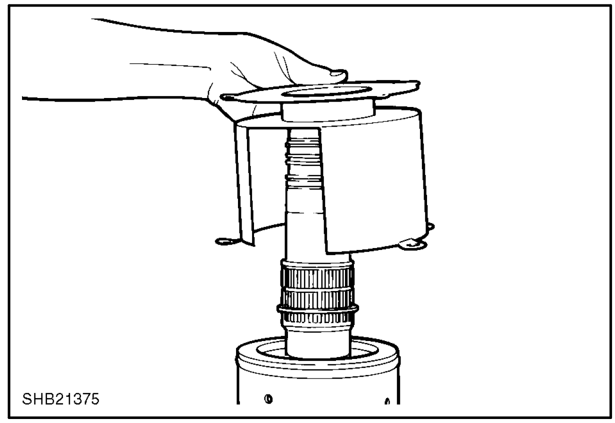
162

Install output gear circlip.



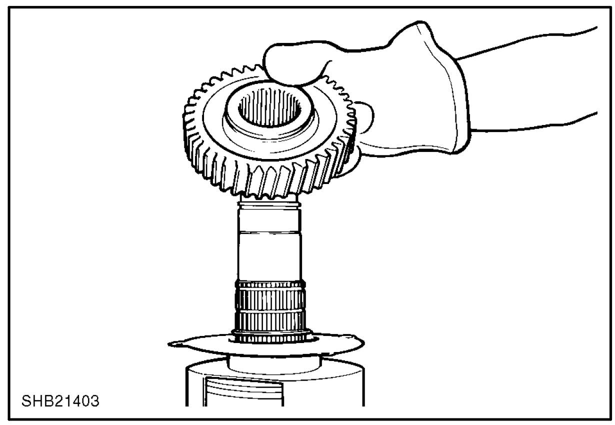
163

Install oil baffle on output shaft.



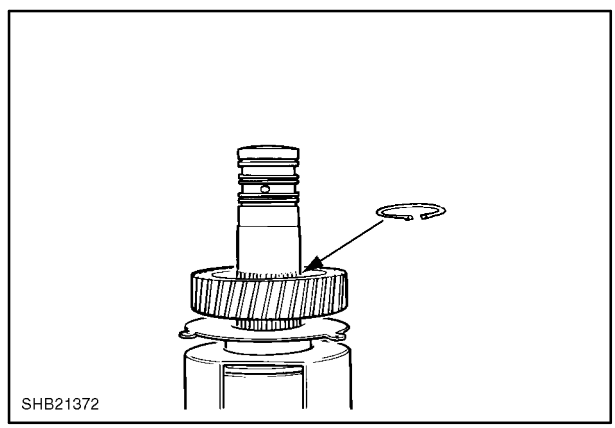
164

Warm gear to 150_ C (302 F),



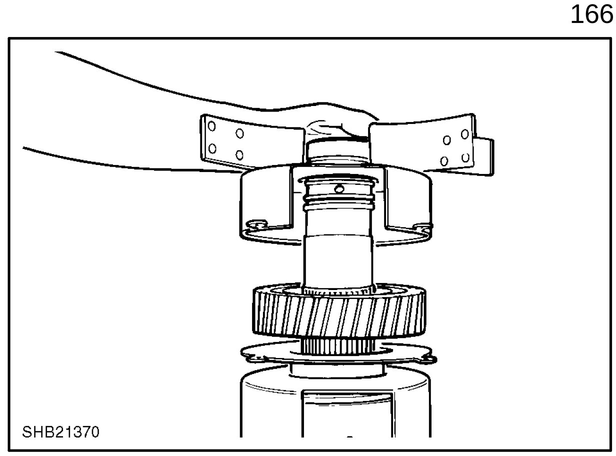
165

Install gear.Install output gear circlip.



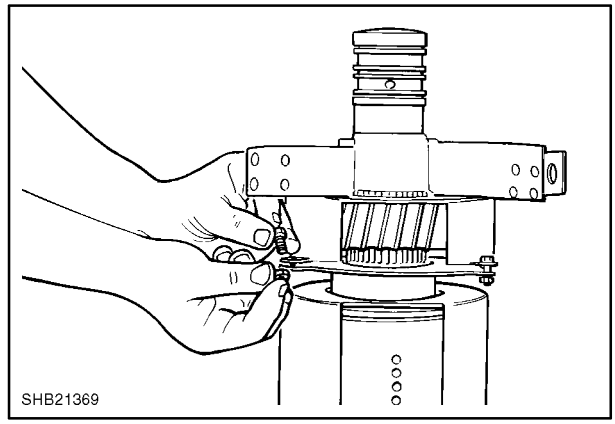
166

Install output shaft sealing rings and rear oil baffle on output shaft.



167

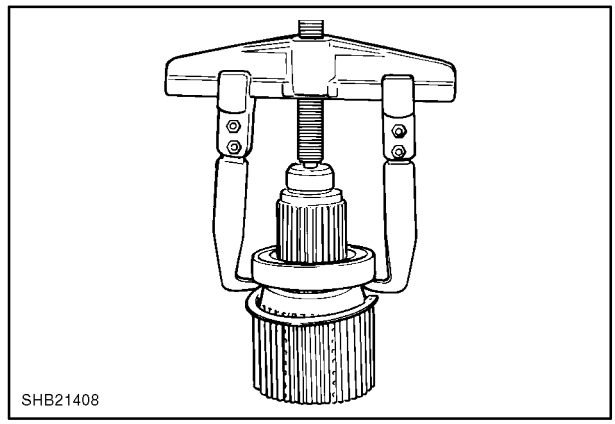
Install oil baffle mounting screws, washer and nuts and tighten nuts to specified torque (Use Loctite 243).



168

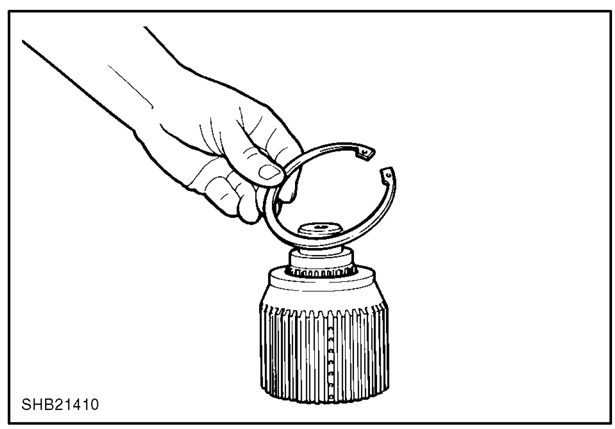
Disassembly disconnect shaft

Use bearing puller to remove disconnect shaft front bearing.



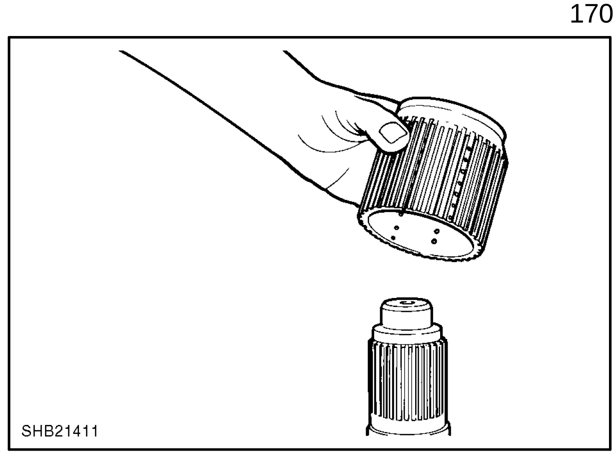
169

Remove front bearing circlip.



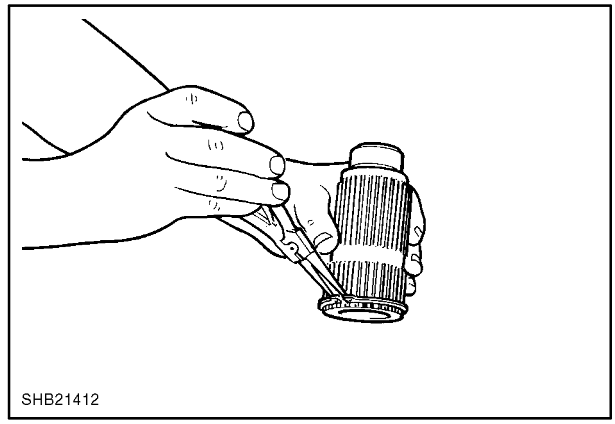
170

Remove clutch hub from shaft.



171

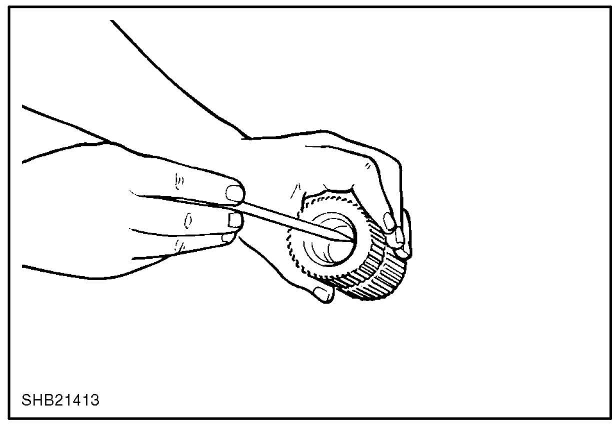
Remove clutch hub locating ring from shaft.



172

Reassembly disconnect shaft

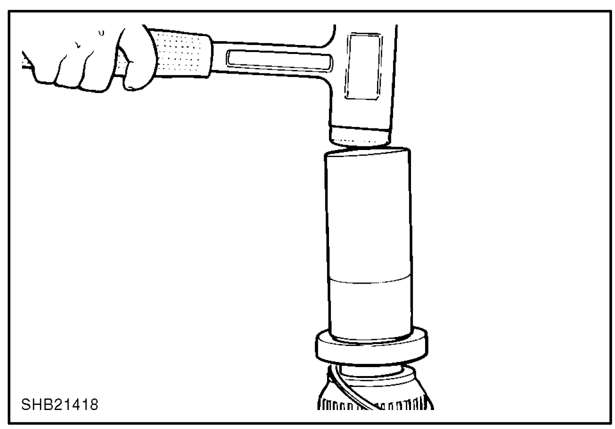
Install bushing if necessary.



173

Reassemble in reverse order as for disassembly:

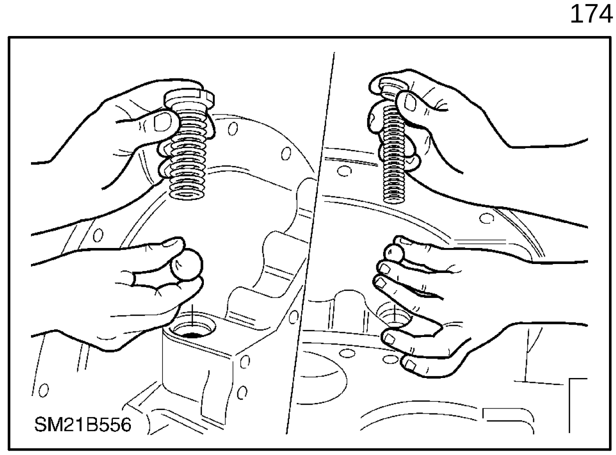
Install clutch hub locating ring and install:
- clutch hub on shaft.
- front bearing circlip.
- Install front bearing on shaft.
- tap bearing on shaft.



174

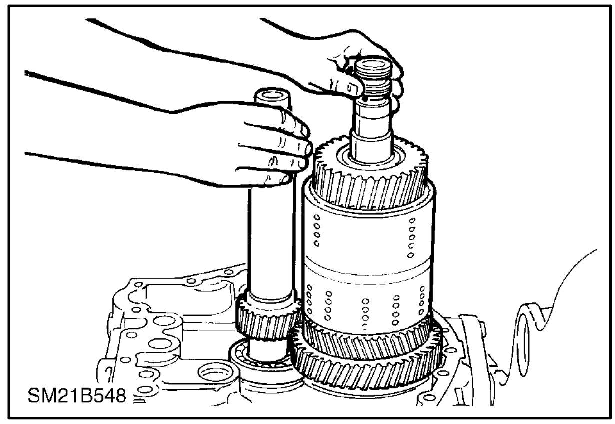
Reassembly converter housing

Install safety valve ball spring and plug. Install by–pass valve ball spring and plug.



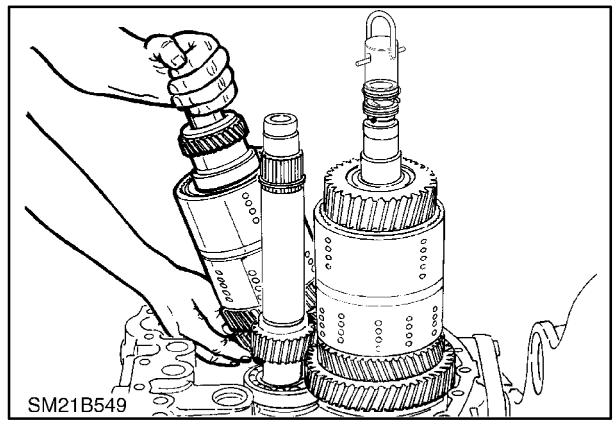
175

Install input shaft into housing and in the meantime install reverse and first shaft (they have to be installed together). Using caution as not to damage any of the first shaft sealing rings.



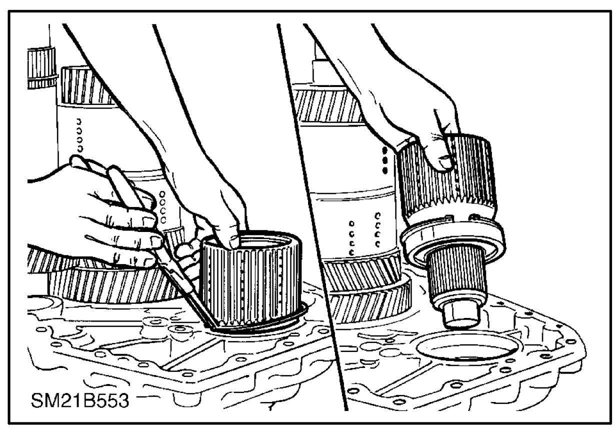
176

Install forward low shaft and high shaft into housing. Using caution as not to damage any sealing rings.



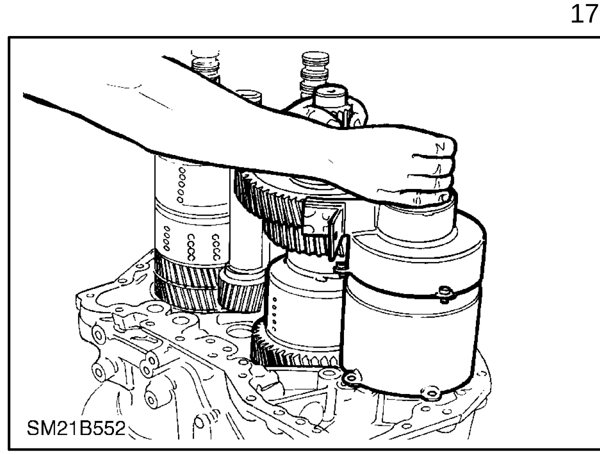
177

Install FWD shaft assembly into housing and open bearing circlip. Tap shaft into place be sure ring is in groove.



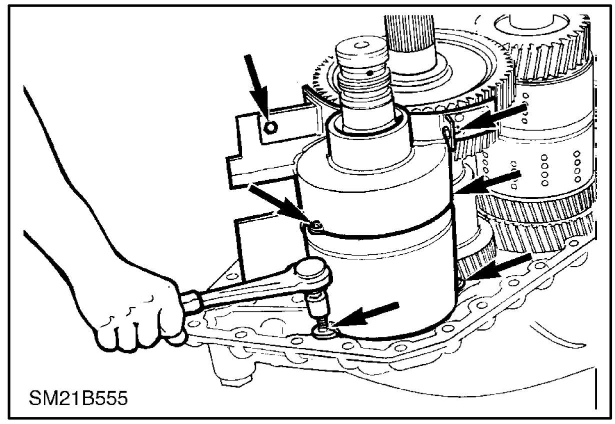
178

Install 2nd gear output shaft and FWD output at the same time. Do not force this operation, be sure discs of disconnect are in full position. Using caution as not to damage any of the lower shaft sealing rings.



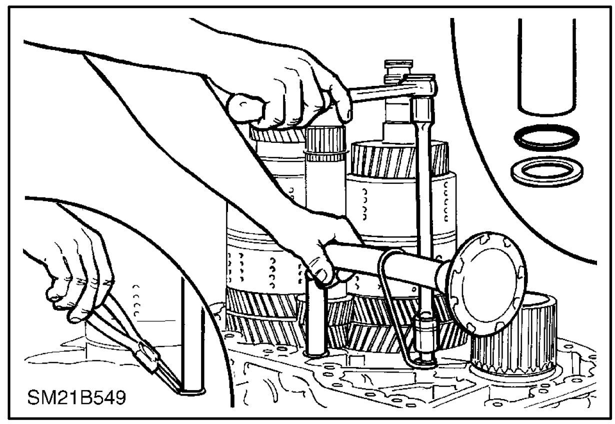
179

Install baffle plate, mounting screws, washers and nuts. Tighten nuts to specified torque. (Use Loctite 243).



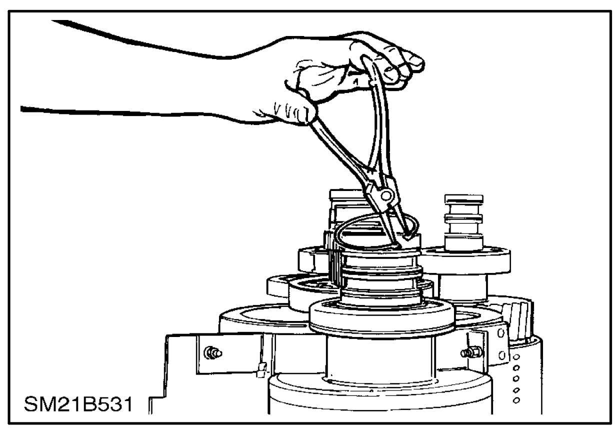
180

Install 'O' ring, spacer and snap ring on suction tube. Install suction tube into housing. Be sure ring is in groove. Install suction tube retainer, mounting screw and lockwasher (Use Loctite 243).Tighten mounting screw to specified torque.



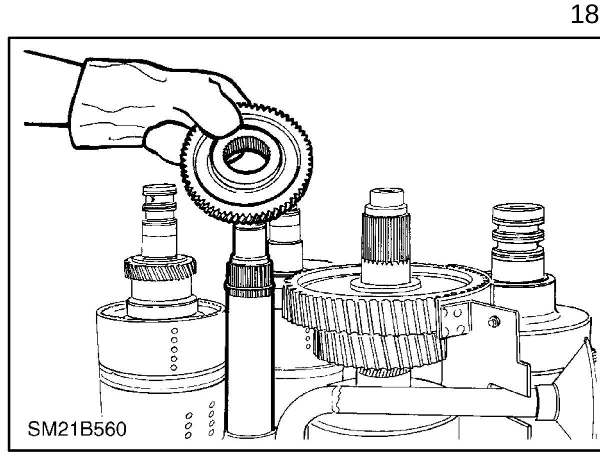
181

Install FWD shaft rear bearing circlip.



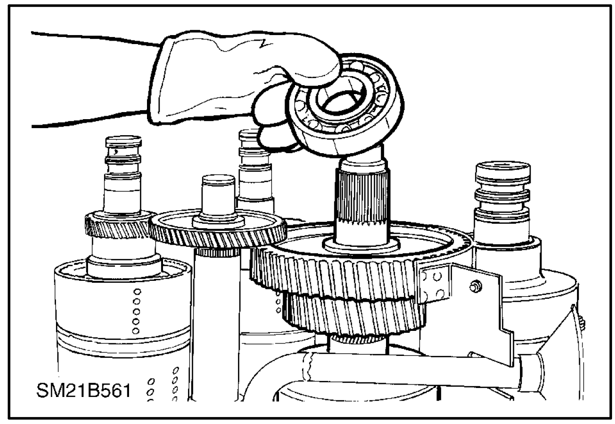
182

Warm forward high gear to 150_ C (302 F), install gear.



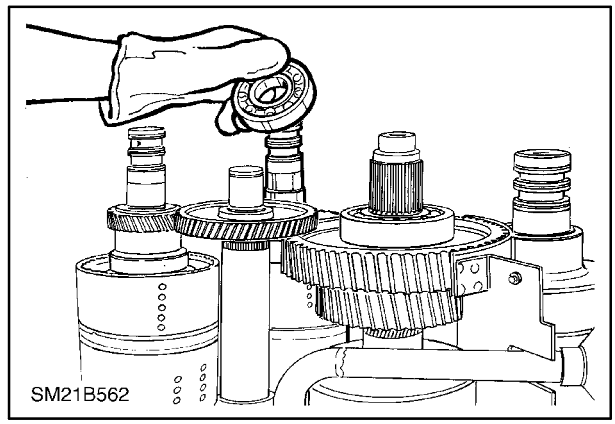
183

Warm upper output rear bearing to 120_ C (248 F), install bearing.



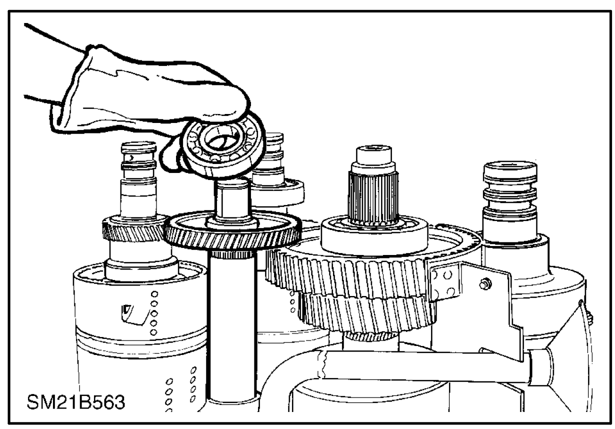
184

Warm reverse and 1st shaft rear bearing to 120_ C (248 F), install bearing.



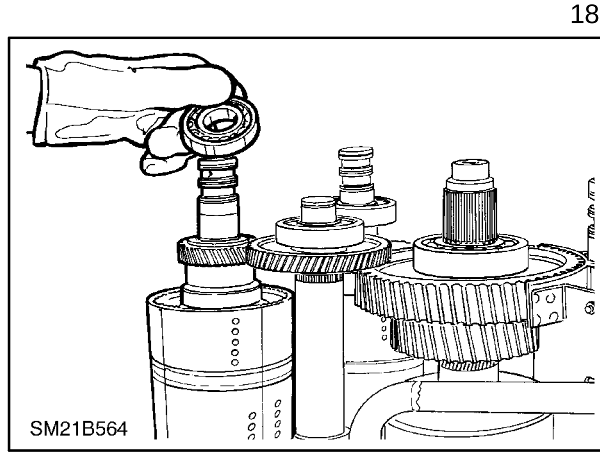
185

Warm input shaft rear bearing to 120_ C (248 F), install bearing.



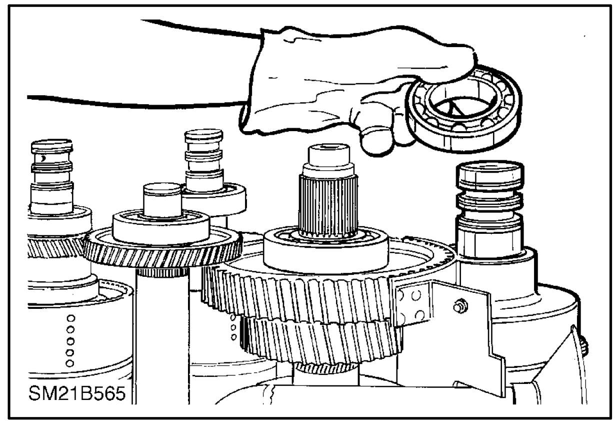
186

Warm forward low and high shaft rear bearing to 120_ C (248 F), install bearing.



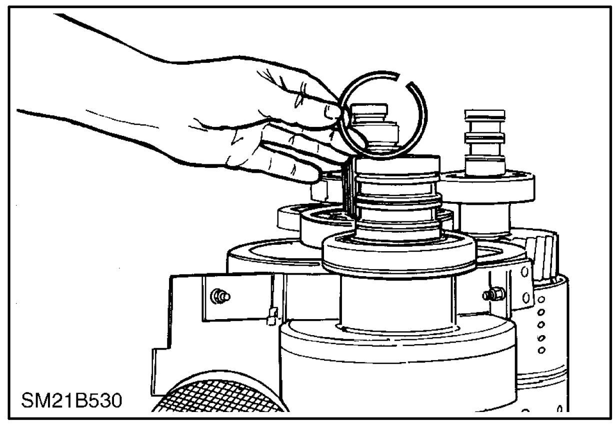
187

Warm FWD shaft rear bearing to 120_ C (248 F), install bearing.



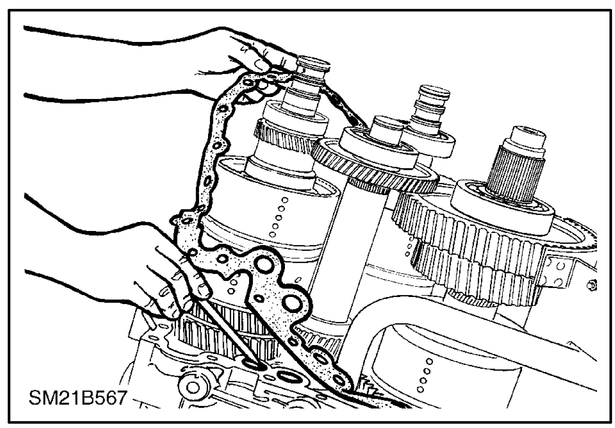
188

Install output shaft rear sealing rings.



189

Install gasket and ’O’ rings into ’O’ ring grooves.

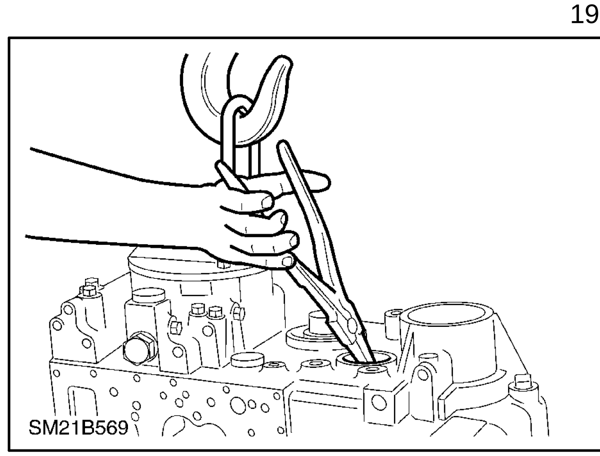


190

Reassembly Powershift transmission

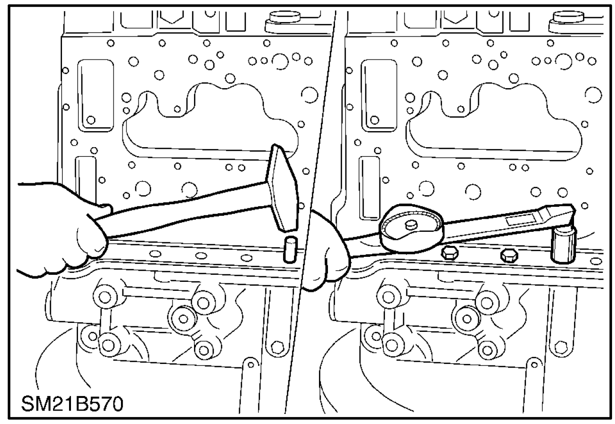
Remove lower output bore plug. Position transmission case on converter housing (using lifting bracket).

Using spreading type snap ring pliers, spread ears on FWD shaft rear bearing circlip. Holding snap ring open. Tap transmission case into place.



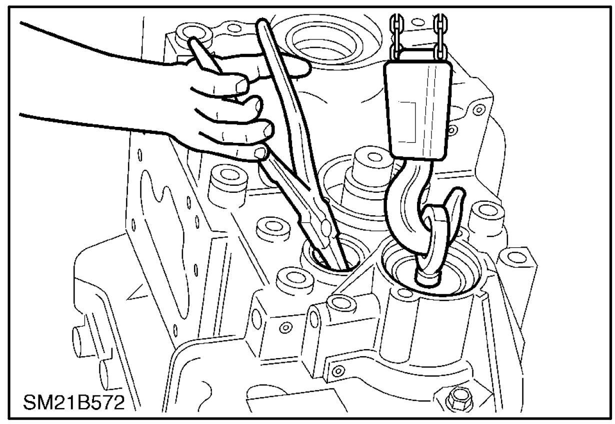
191

Tap dowel pin in transmission case and converter housing and install transmission bolts and torque to required specification.



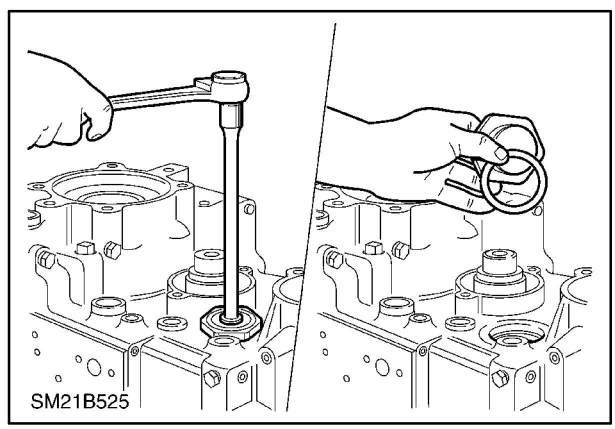
192

Using spreading type snap ring plier, spread ears on output shaft rear bearing circlip. Hold snap ring open, pry or lift output shaft. Be sure circlip is complete in bearing groove (Using a lifting eye or screw M12) gently lift shaft.



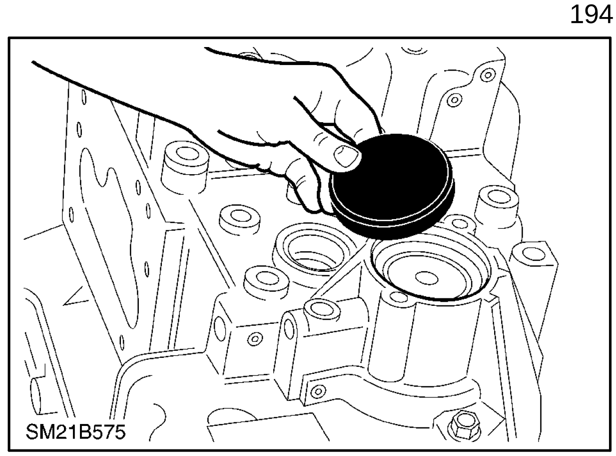
193

Tighten plug to 13,6 - 20,3 Nm (10 -15 lb ft).



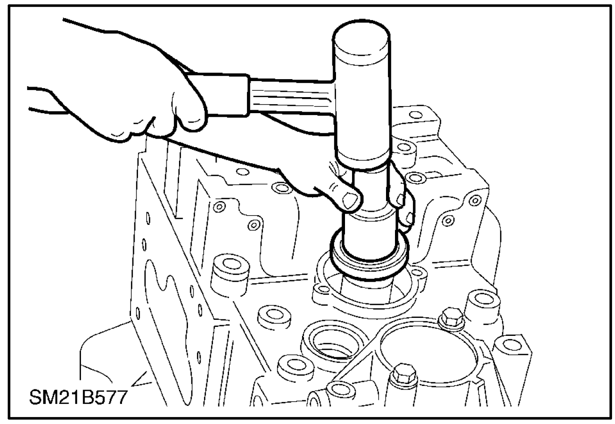
194

Position FWD bore plug and tap bore plug into place.



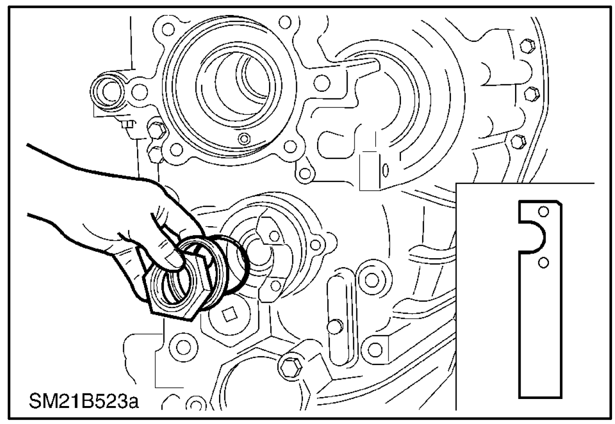
195

Position upper output seal and tap seal into place.



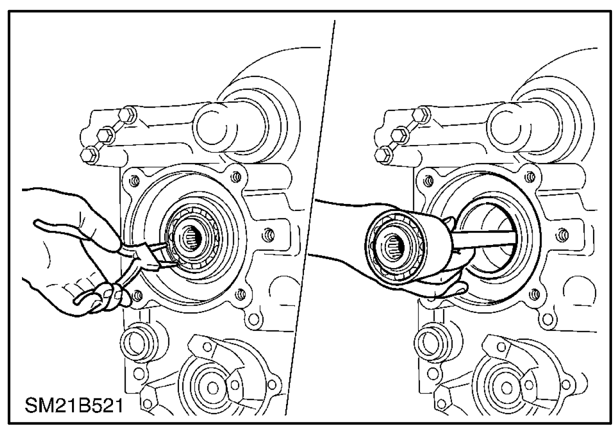
196

Install upper output flange, 'O' ring, washer and nut and tighten nut to 339–407 Nm. (205–300 lb ft).



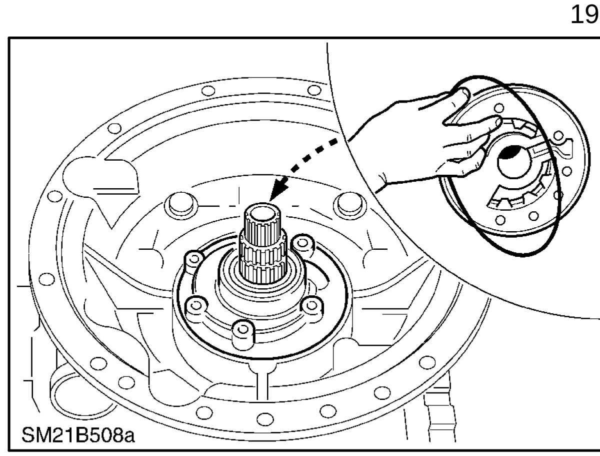
197

Install pump drive shaft assembly into housing and Install pump drive shaft rear bearing circlip.



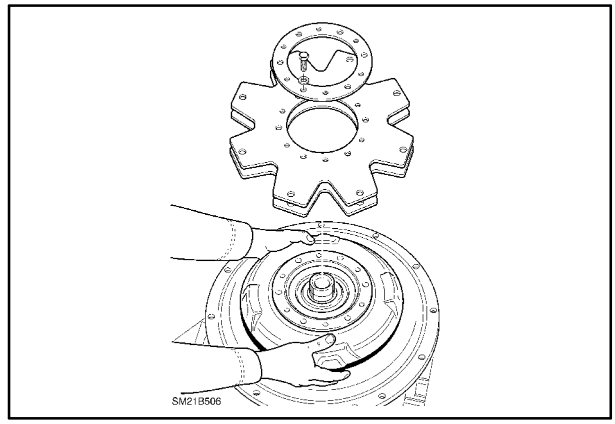
198

Install oil pump, 'O' ring, gasket, screws and lock-washers into converter housing and tighten bolts to 20–27 Nm (15–20 lbf ft).



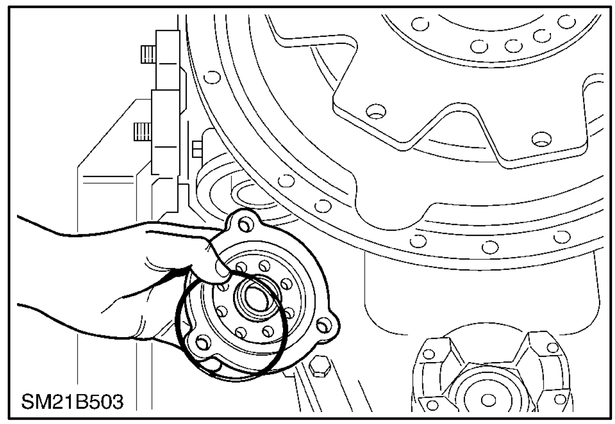
199

Install convertor assembly on input shaft.
Install drive plates on converter.
Install drive plates screws and lockwashers and tighten screws to specified torque.



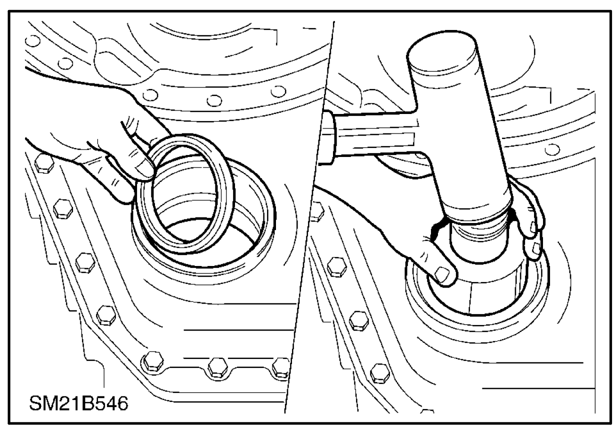
200

Install filter adapter, 'O' ring, lockwashers and mounting screws.



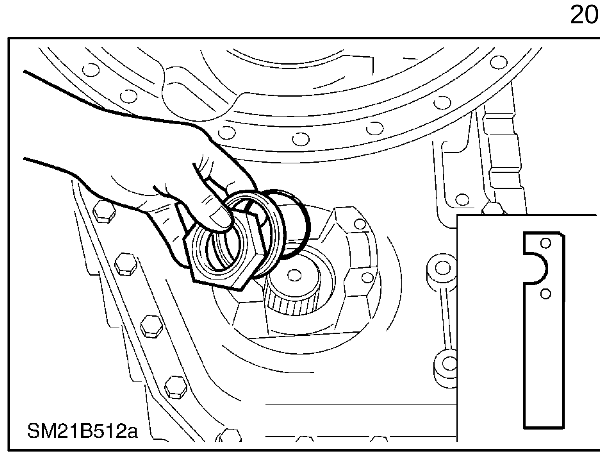
201

Install front seal and tap into the cover using tool no **380000712.**



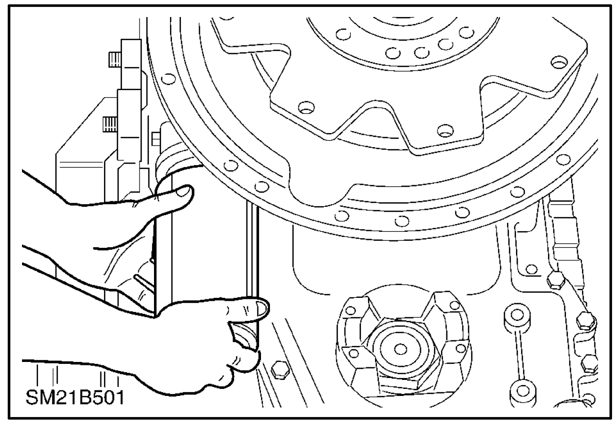
202

Instal output shaft front flange, 'O' ring, washer and nut. Tighten nut to 339 – 407 Nm (250 – 300 lb ft).



203

Install oil filter and tighten to 30 - 38 Nm (22,1 - 28 lb ft).



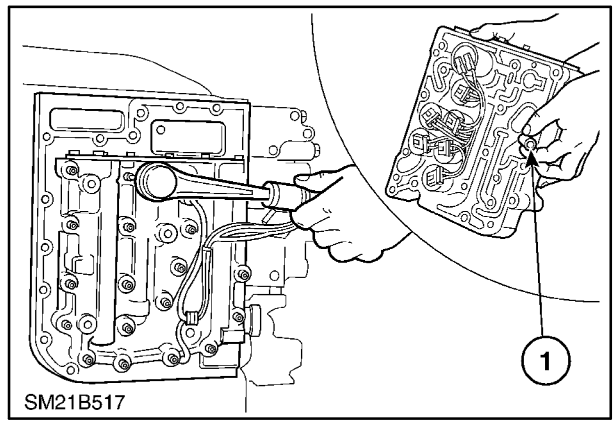
204

Reassembly of valve chest to transmission

Install pressure regulating valve spool into solenoid housing and spring into transmission case, position control valve on transmission case.
Install control valve mounting screws and lock-washers, tighten screws to specified torque.

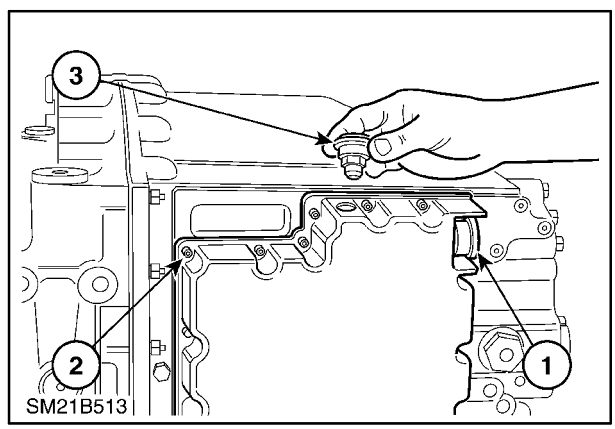
IMPORTANT: *The torque procedure of the valve chest to transmission should be carried out in the following manner.*

Torque form the centre of the valve body and alternate left to right of the centre line to the outside of the edge of the valve chest. this ensures that there is minimum distortion of the valve chest body.



205

Position wiring connector in valve protection cover(1). Install gasket and valve protection cover mounting screws (2) and tighten screws to specified torque.
Install air breather (3) and tighten to 34 - 41 Nm (25 - 30 lb ft). Install wiring connector nut and tighten to 6 - 8 Nm (4,4 - 5,9 lbft).



206

SECTION 25 – FRONT AXLES

Chapter 1 – Front Axle for 2 and 4 Wheel Drive Only

CONTENT

SPECIFICATIONS

Type	Centre driven, double reduction (Crown wheel and pinion) and integral steering cylinder
Overall width	1974 mm
Oil Capacities	
Hubs (each)	1.0 litres (2 US. pints)
Axle differential	5.5 litres (1.45 US. gals)
Oil change period	Every 1200 hours or annually
Lubricants	See operator's manuel

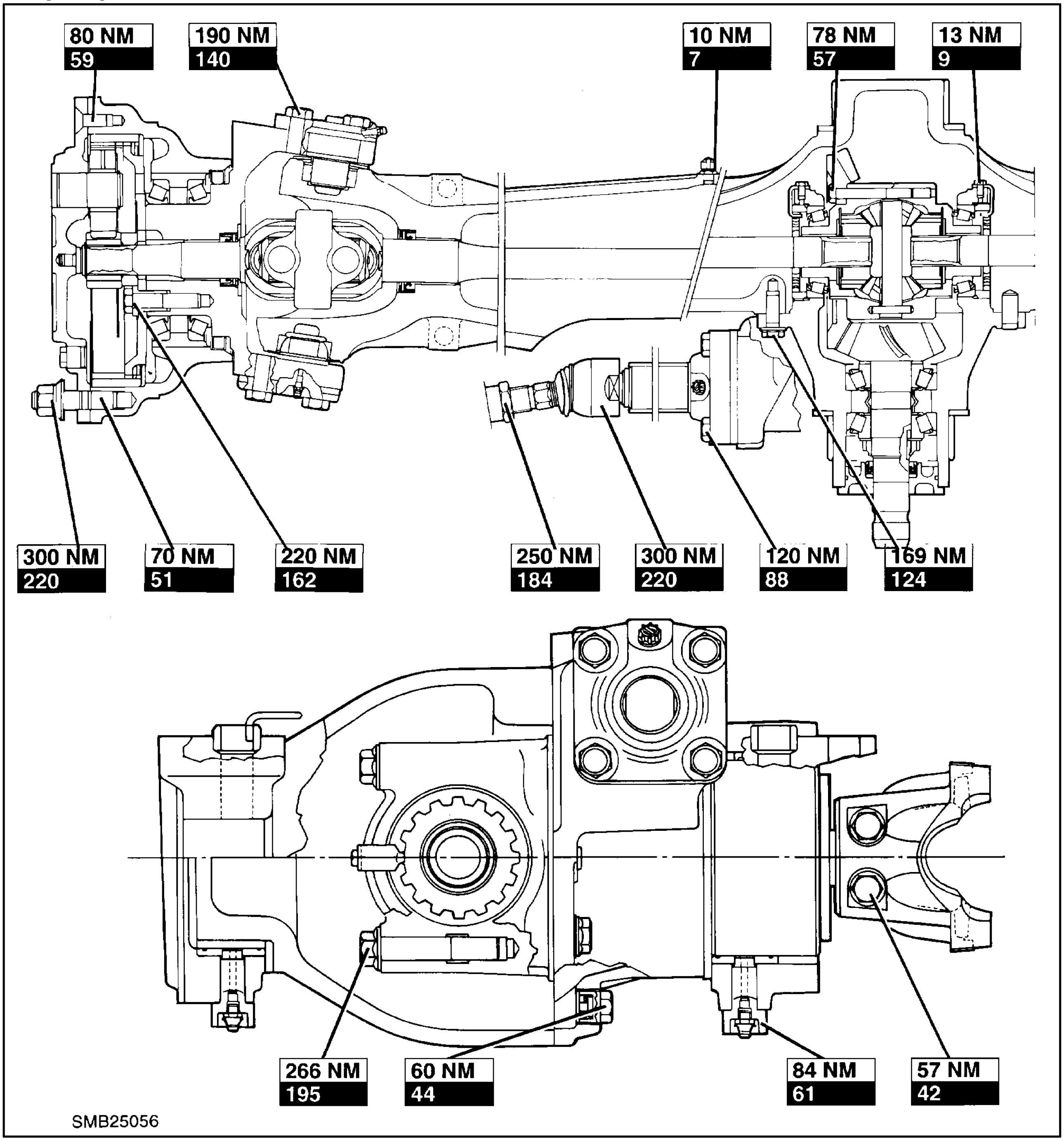
CLEARANCES AND ADJUSTMENTS

Front wheel toe–in	0 – 2.0 mm
Axle hub bearing rolling resistance	Non–adjustable pre–set
Swivel bearing freeplay	Non–adjustable pre–set
Drive pinion bearing rolling resistance	2.0 Nm (18.0 lbs in)
Pinion to crown wheel backlash	0.17 – 0.23 mm (0.067 – 0.090 in)
Pinion to crown wheel tooth engagement	110.3 mm (4.301 in)
Differential bearing rolling resistance	0.9 Nm (8.2 lbs in)

SEALANTS

Thread sealant	NH 82995773
Dowel fixative adhesive	NH 82995772
Flange sealant	NH 82995770

Torque Specification

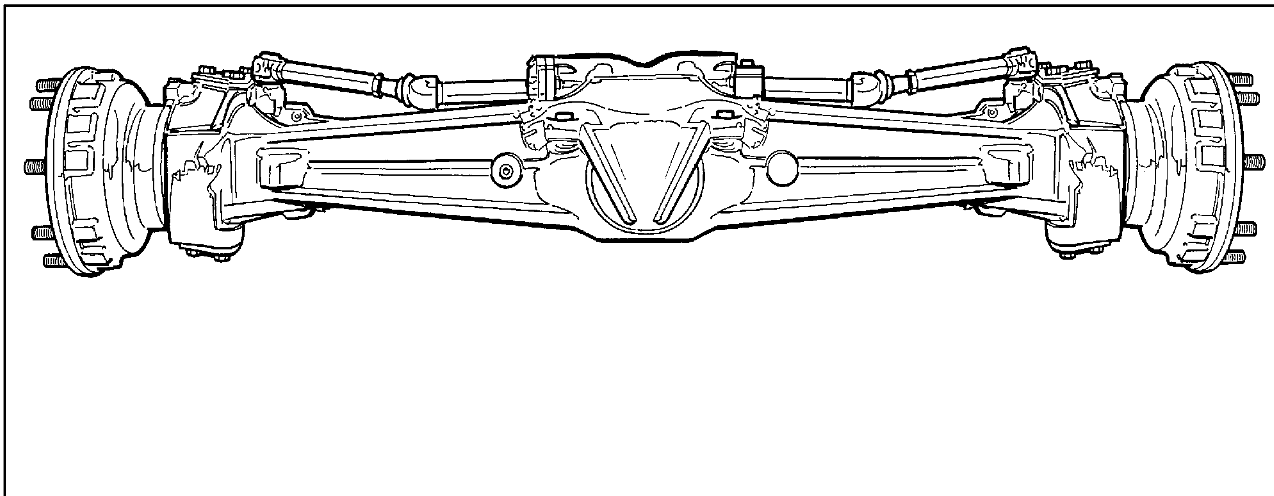


1

SPECIAL TOOLS

Pinion setting tool	297132 or 4775
Pinion nut tool	297511

DESCRIPTION


SMB25060

2

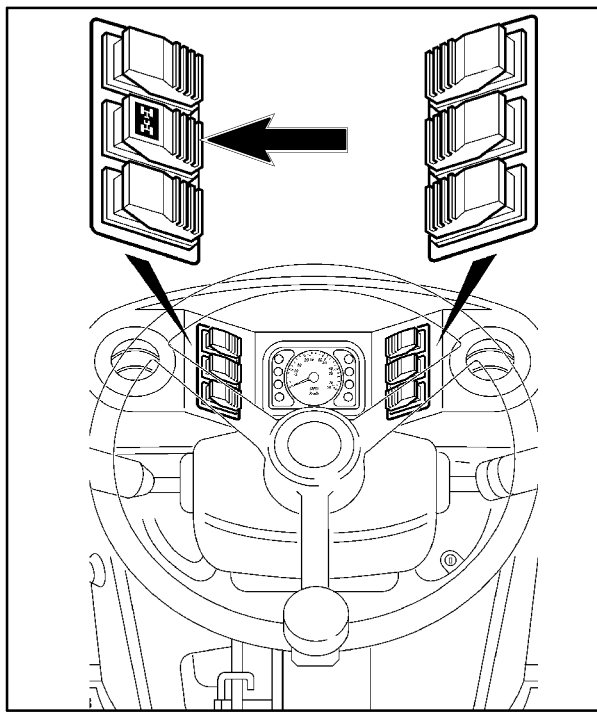
The 26.18 axle fitted to this unit incorporates

- integral steering cylinder
- centre drive
- double reduction (crown wheel & pinion plus planetary hubs).

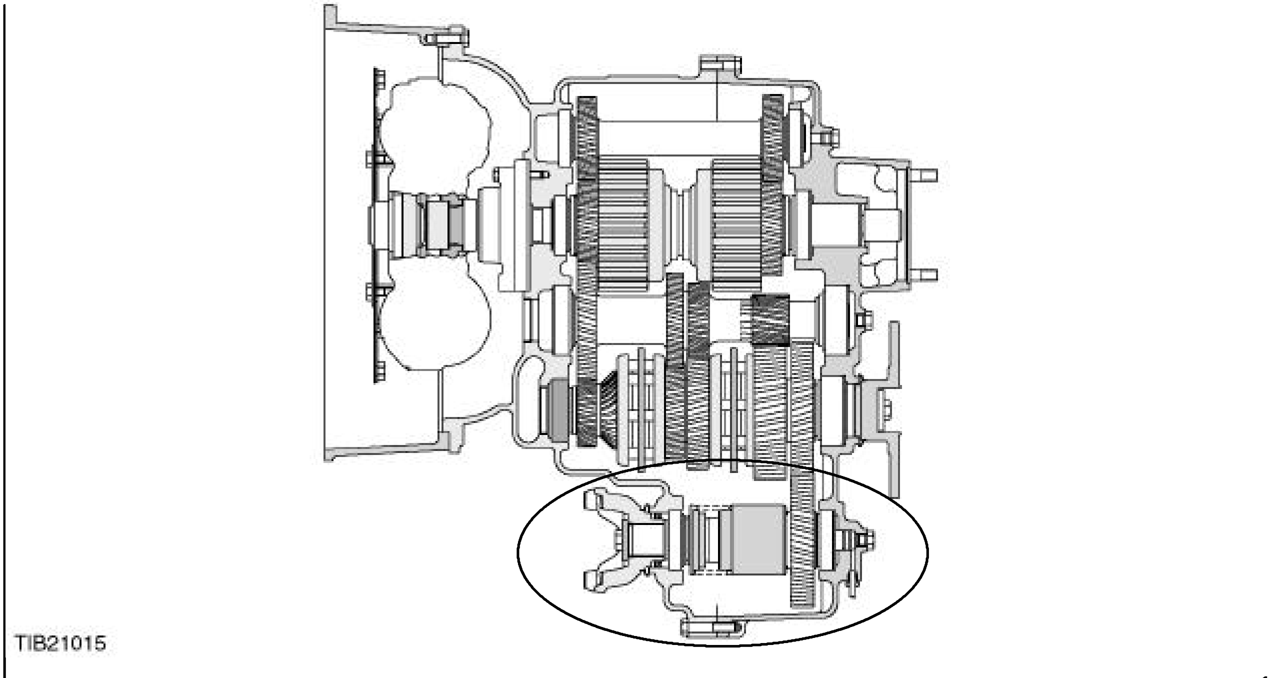
The four wheel drive is electrically operated by a switch (1) mounted on the front instrument panel.

The four wheel drive should be disengaged for road work.

NOTE: *Four wheel drive will re-engage when both brakes are applied giving four wheel braking.*

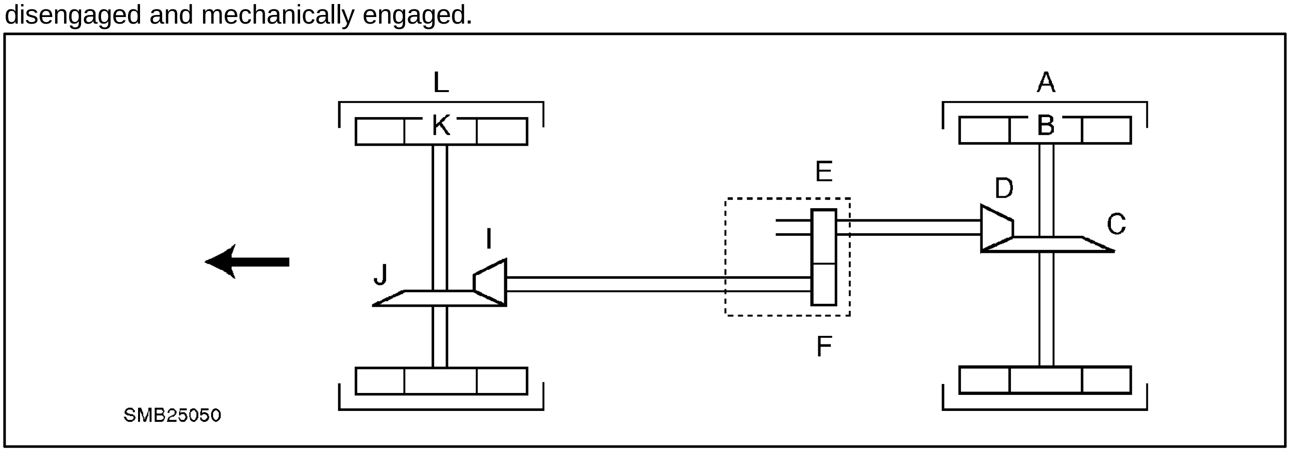


3



1
4

The four wheel drive is engaged and disengaged by a clutch pack mounted in the transmission. Hydraulically disengaged and mechanically engaged.



5

Drive Gear Ratio	Number of Teeth (ISO)	Number of Teeth (NASO)	Formulae	Ratio
A	56	56	$\frac{A+B}{B} \times \frac{C}{D}$ =Rear axle ratio	18.5 : 1
B	16	16		
C	37	37		
D	9	9		
E	37	37	$\frac{F}{E}$ =Transfer ratio	0.9459 : 1
F	35	35		
I	15	18		
J	32	37	$\frac{L+K}{K} \times \frac{J}{I}$=Front axle ratio	12.8 : 1 (ISO) 12.33 :1 (NASO)
K	15	15		
L	75	75	FWD. factor	1.528 (ISO) 1.586 (NASO)

Four wheel drive slip factor

To achieve the maximum tractor efficiency and tyre life, the four wheel drive system must have a minimum slip factor of 0.5% (ie. front wheels drive faster than the rear).

The slip factor is calculated by a simple formula;

$$\% \text{ slip} = \frac{\text{FWD factor x *Front wheel rolling circumference} - 1 \text{ x } 100}{\text{*Rear wheel rolling circumference}}$$

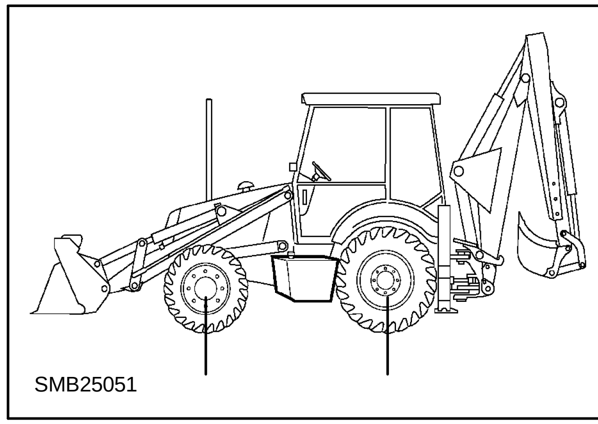
* weighting and tyre pressures for site work

NOTE: *where radial ply tyres are used, the rolling circumference must be multiplied by 1.015*

$$\text{FWD Factor} = \frac{\text{Rear axle ratio}}{\text{Front axle ratio x Transfer ratio}}$$

To ensure correct front and rear tyre compatibility establish front and rear loaded wheel rolling circumferences on a hard level surface with tyre pressures and weights as for normal operation.

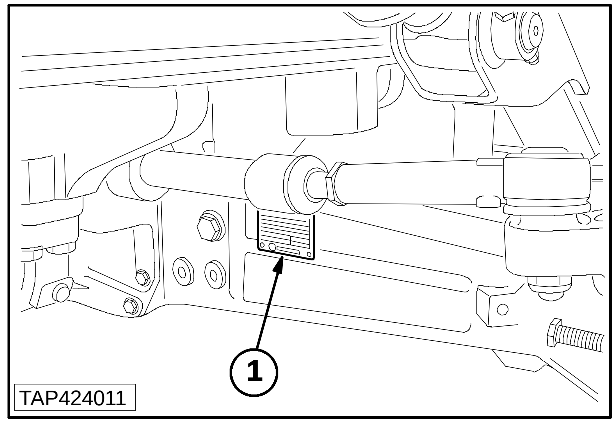
- Mark the point where front and rear tyres contact the ground using a plumb line.
- Ensure 4WD is disengaged.
- Drive slowly forward in 1st gear until the front and rear wheels have made one complete revolution, marking the ground again at the contact marks.
- Measure the distance between the two front wheel marks and the two rear wheel marks, which are the respective loaded wheel rolling circumference.
- Use the figures in the above formula to calculate % slip.



6

The data plate details the axle type, serial number, total gear ratio, reference number, oil capacity, type and grease type.

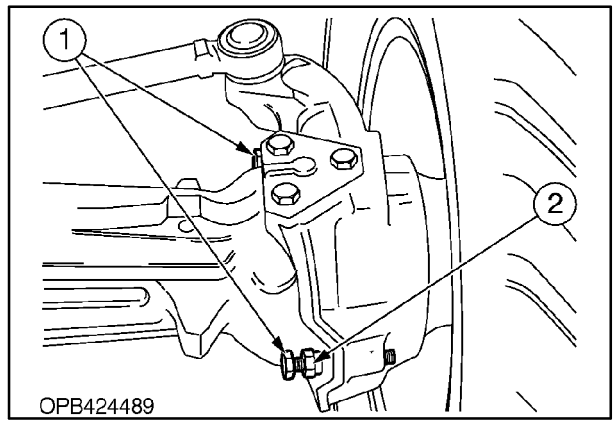
NOTE: *When ordering parts, always quote the type, reference and serial numbers. Refer to later sections for oil and grease specifications.*



7

Steering stops (1) are incorporated on the axle at each end.

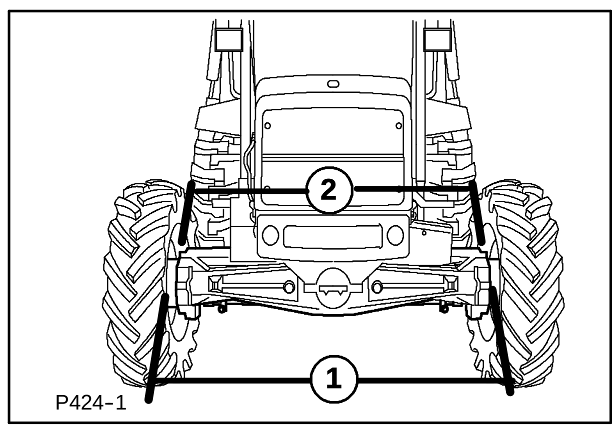
The stops are adjustable to prevent the tyres contacting any part of the loader when on full left or right lock and held by the lock nut (2).



8

When checking the toe in of the front wheels the measurements should be through the centre of the hub.
Measuring the front inner wheel rim to rim (1) and then measuring the rear inner wheel rim to rim (2).
The variance between (1) and (2) should be:

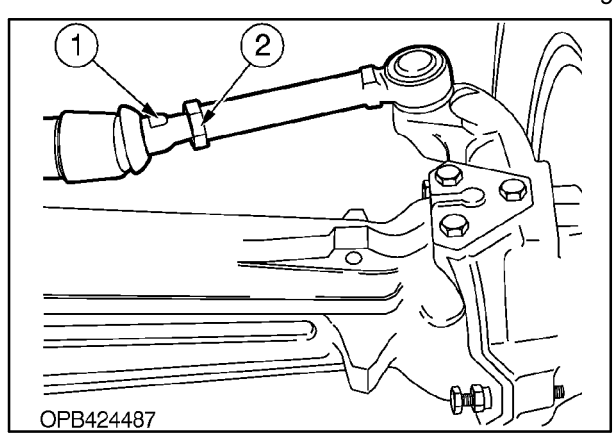
Toe-in should measure: 0 – 2 mm (0 – 0.08 ins)



9

To adjust front wheel toe-in slacken both lock nuts and turn rams equally to correct toe-in measurement. Re-tighten both lock nuts.

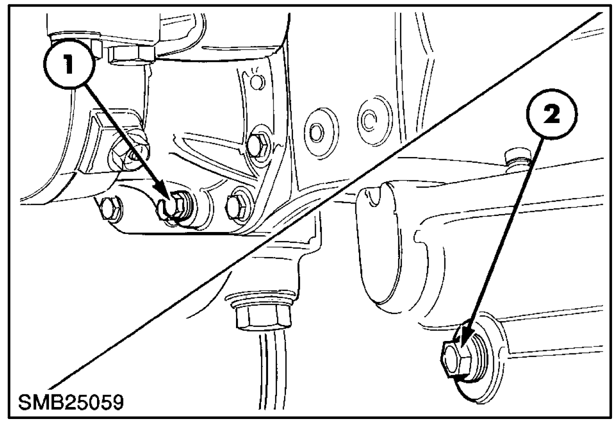
1. Clamp Bolt
2. Track Rod End
3. Adjuster



10

FRONT AXLE – Differential Housing

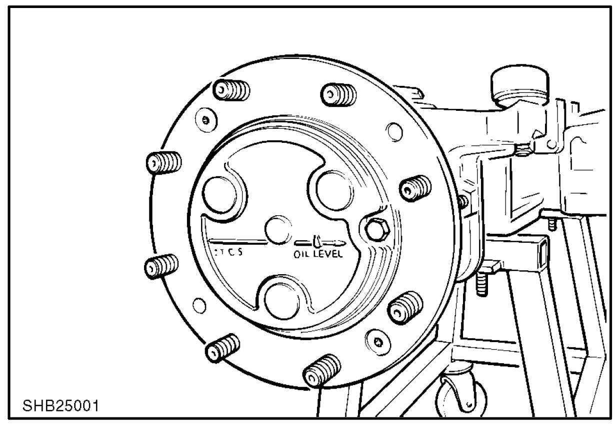
Oil capacity—5.5 litres (1.45 US. gals)
Check oil level every 50 hours, check using plug (2)
Change oil every 1200 hours, drain from plug (1).



11

HUBS

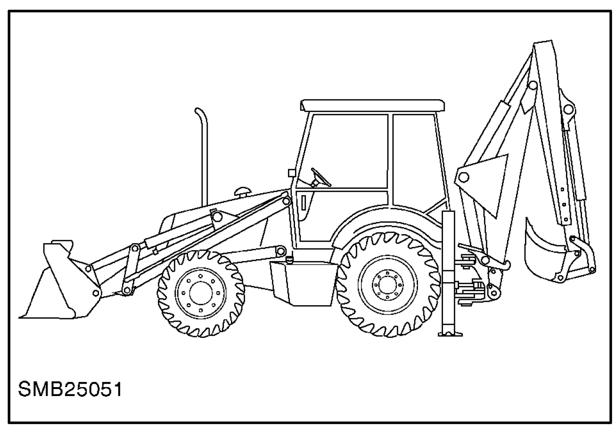
Oil capacity – 1 litre (2 US. pints)
Check oil level every 50 hours, with hub level (1) at plug (2)
Change oil every 1200 hours, with plug (2) at lowest point.



12

COMPONENT OVERHAUL – with Axle in situ

- Steering cylinder
- Planetary Reduction Hub Assembly
- Swivel Casing
- Swivel Pin Assembly
- Axle Drive Shaft Assemblies, Seals and Bushes
- Drive Pinion Oil Seal



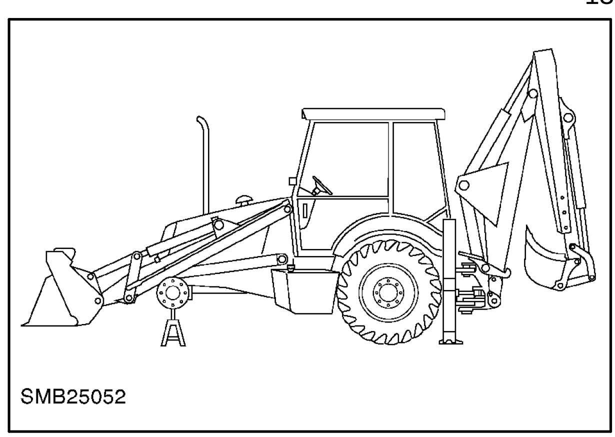
13

COMPONENT OVERHAUL – with Axle removed

- Differential Assembly
- Pinion Assembly

Front Axle adjustments

- Pinion to Crown Wheel Tooth engagement
- Pinion Bearing Preload
- Crown Wheel to Pinion Backlash
- Differential Bearing Preload



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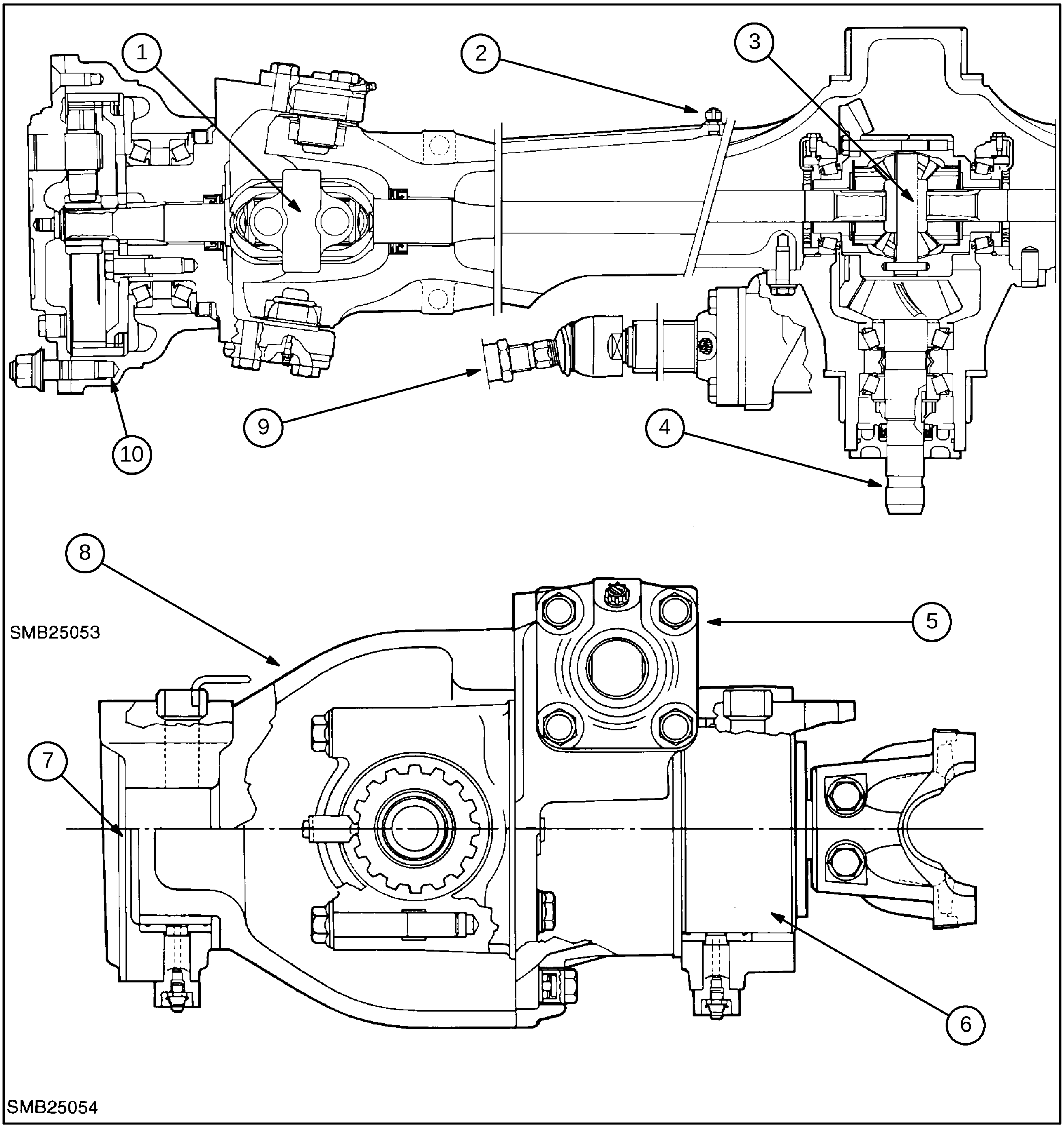


15

Front Axle – Cutaway View

1. Axle Shaft Double Universal Joint
2. Centre Casing Breather
3. Crown Wheel and Differential Assembly
4. Pinion
5. Steering Cylinder
6. Rear Swivel Pin Assembly
7. Front Swivel Pin Assembly
8. Axle Centre Casing
9. Track Rod
10. Hub and Planetary Gear Assembly

FAULT FINDING

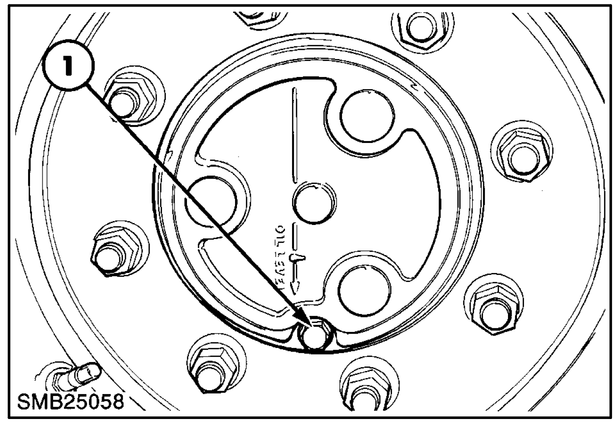
IMPORTANT: *When making a repair, the cause of the failure must be corrected to avoid a repeat failure.*

PROBLEM	POSSIBLE CAUSES	CORRECTION
No steering or excessive effort required to steer	1. Incorrect oil level in reservoir.	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of air
	3. Pump relief valve faulty	3. Check system pressure
	4. Worn pump	4. Inspect and repair
	5. Leaking power cylinder	5. Inspect and repair
	6. Damaged valve spool	6. Inspect and replace
	7. Broken or damaged steering column	7. Inspect and replace
	8. Damaged or worn metering element	8. Inspect and replace
Steering wanders	1. Excessive play in steering linkage ball joints	1. Inspect and replace
	2. Leaking power cylinder	2. Inspect and repair
	3. Control valve spool sticking or worn	3. Inspect and replace
	4. Weak or broken torsion bar	4. Inspect and repair
	5. Incorrect valve spool shimming adjustment	5. Check and adjust
	6. Damaged or worn metering element	6. Inspect and replace
Front wheels surge when steering	1. Leaking power cylinder	1. Inspect and repair
	2. Control valve spool sticking	2. Inspect and repair
	3. Weak or broken torsion bar	3. Inspect and replace
	4. Damaged or worn metering element	4. Inspect and replace
Noisy pump	1. Incorrect oil level in reservoir	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of oil
	3. Water in oil	3. Drain and replace the oil

OVERHAUL

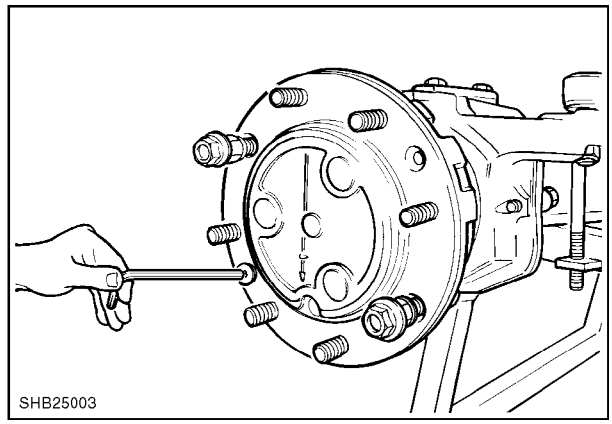
Planetary Reduction Assembly and Wheel Hubs

Turn the hub so that the filler/drain plug is at its lowest point and drain the hub oil.



16

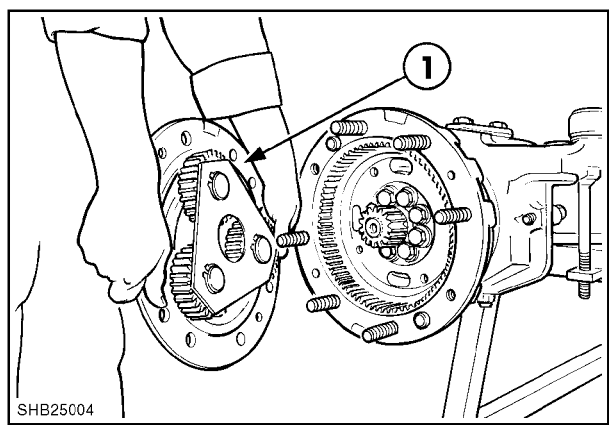
Remove the two 8mm socket screws and the two shouldered wheel studs, securing the planetary carrier assembly to the hub assembly.



17

Gently tap the planetary carrier with a soft face mallet and, using the slots provided, lever the carrier from the hub. Carefully withdraw the planetary carrier assembly.

1. Planetary Assembly



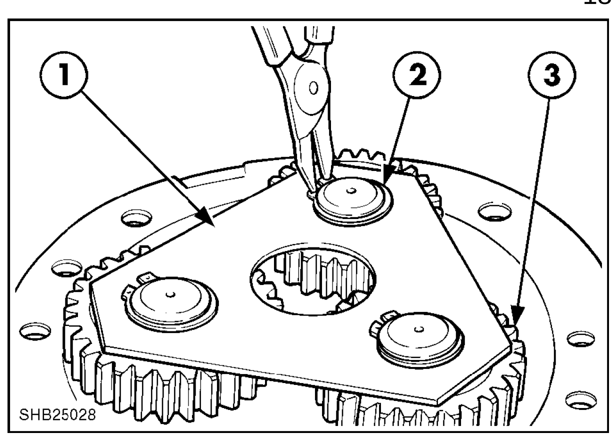
18

Remove the three snap rings and remove the retaining plate.

Remove planetary gears. Note: the needle roller bearings will fall out.

Finally, remove the thrust washer.

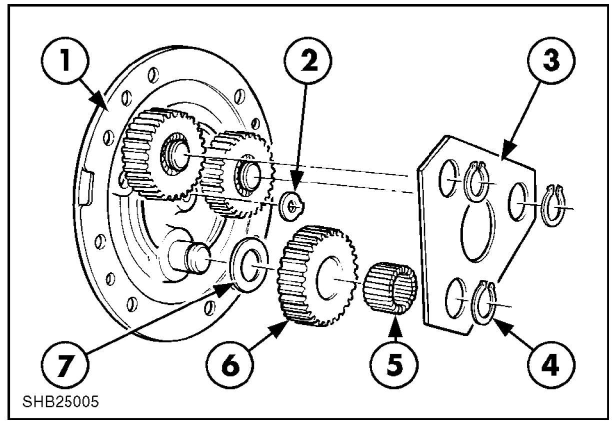
1. Retaining Plate
2. Snap Ring
3. Planetary Gear



19

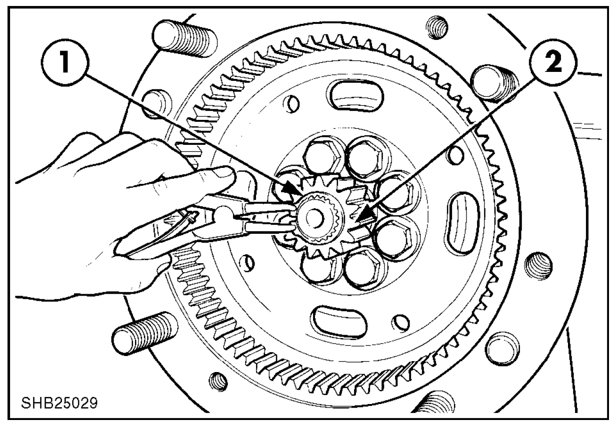
Check components for wear and replace worn or damaged components and then reassemble.

1. Planetary Carrier
2. Thrust Pad
3. Retaining Plate
4. Snap Ring
5. Needle Roller Bearings
6. Planetary Gear
7. Thrust Washer



20

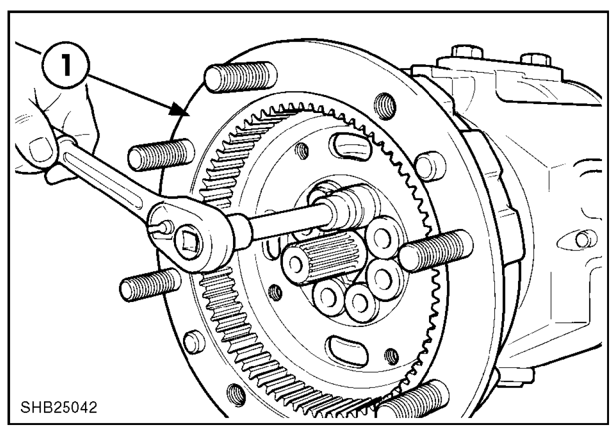
Remove the sun gear retaining snap ring (1) and remove the sun gear (2) from the axle shaft, followed by the spacer and thrust washer.



21

Carrier assembly bolts removal.

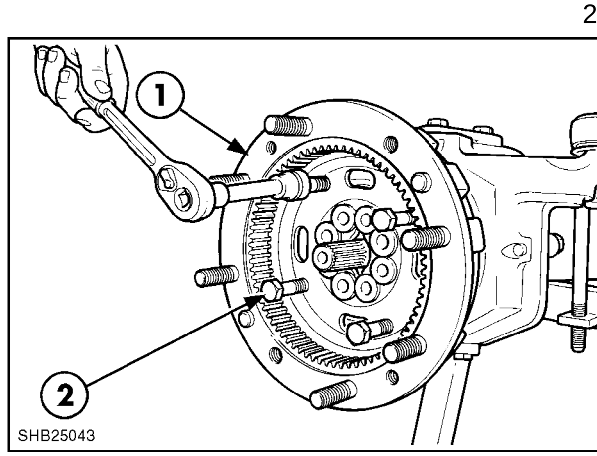
1. Carrier Assembly



22

Remove the assembly by installing 4 of the bolts into the threaded jacking holes in the rear gear. Tighten the bolts evenly to draw off the planetary ring gear.

1. Carrier Assembly
2. Jacking Bolts

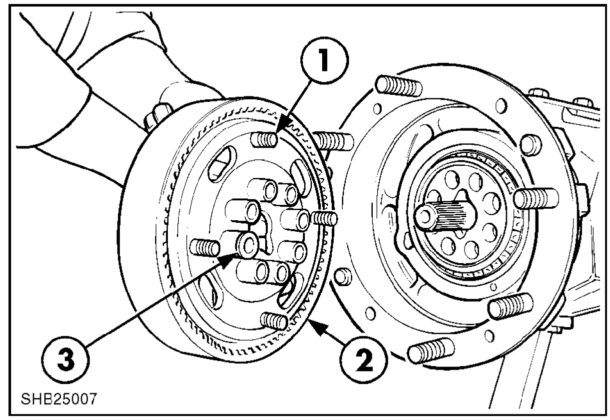


23

Remove planetary ring gear.

NOTE: *Observe master dowel.*

1. Jacking Bolt
2. Planetary Ring Gear
3. Master Dowel

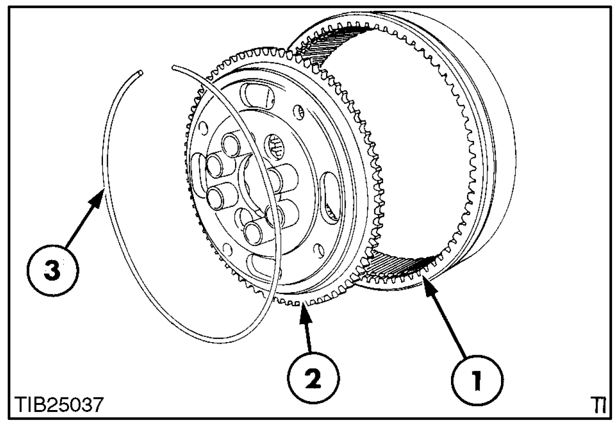


24

Planetary disassembly

Remove snap ring and disassemble planetary ring gear.

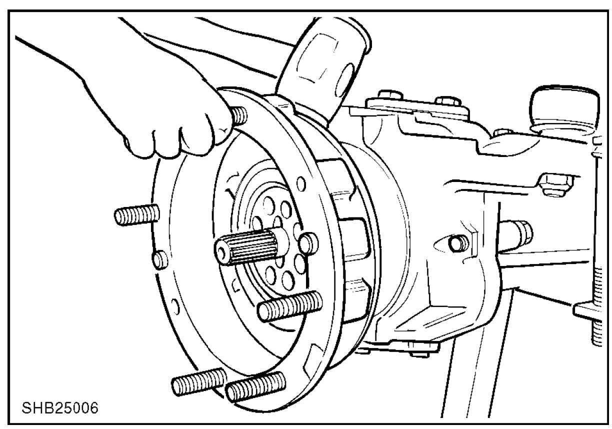
1. Ring Gear
2. Carrier
3. Retaining Ring



25

Remove the hub assembly

Using a soft faced mallet carefully withdraw the hub from the axle.

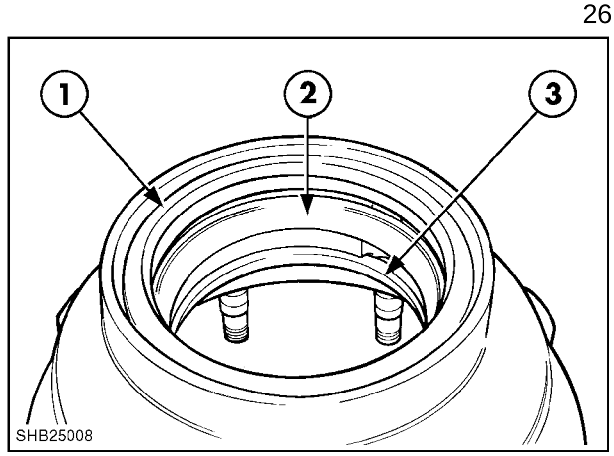


26

Final reduction hub assembly

Check oil seal and inner and outer bearing cups for wear and damage.

1. Oil Seal
2. Inner Bearing Cup
3. Outer Bearing Cup



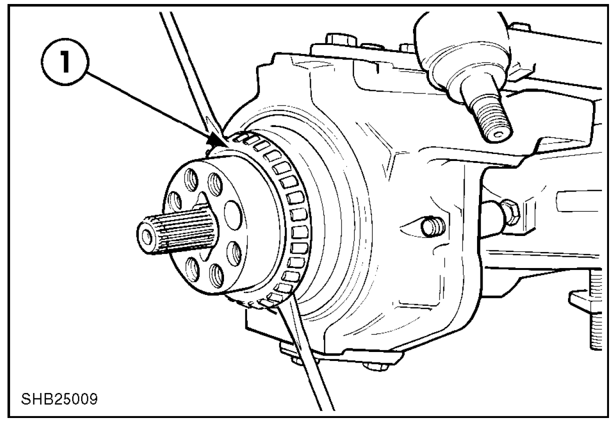
27

Inner Hub Bearing Removal

Remove the inner hub bearing (1) by prying off with two suitable levers equally spaced on the bearing.

1. Inner Hub Bearing

IMPORTANT: *Take care not to damage the bearing during disassembly*

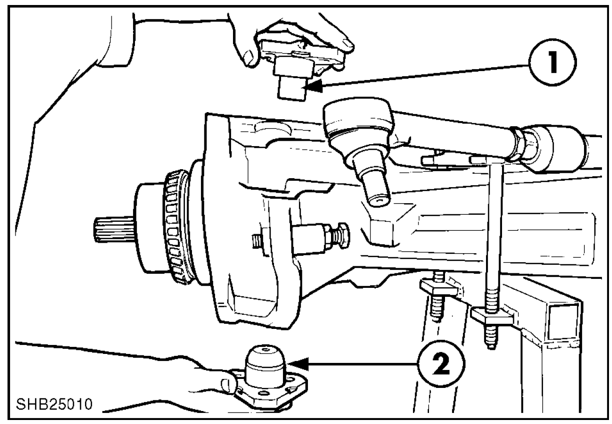


28

Swivel Pin Removal

Remove the upper and lower swivel pins from the axle hubs.

1. Upper Swivel Pin
2. Lower Swivel Pin

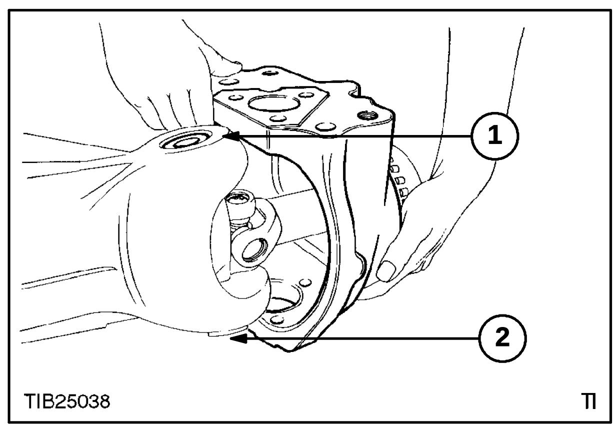


29

Hub Removal

Carefully remove the hub from the axle.

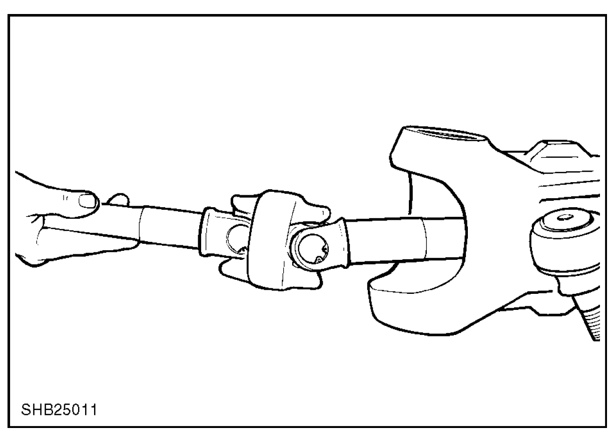
NOTE: *When removing the hub there are two Belleville washers between the hub and axle, the larger washer (2) on the bottom and the smaller (1) on the top.*



30

AXLE SHAFT REMOVAL

Withdraw the shaft from the axle

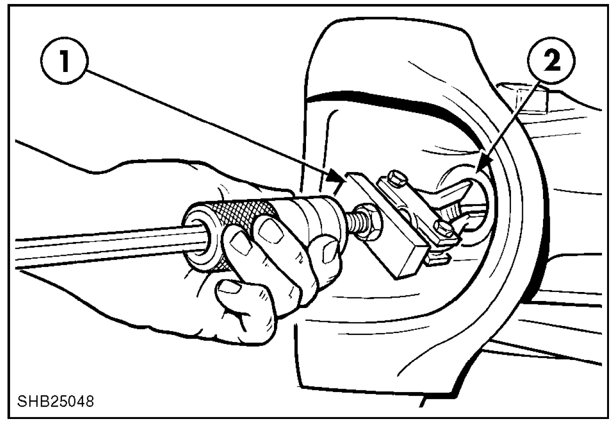


31

Axle shaft seal and bushing removal

Using tool **297111** remove the seal and bushing from the housing.

1. Puller Tool
2. Oil Seal

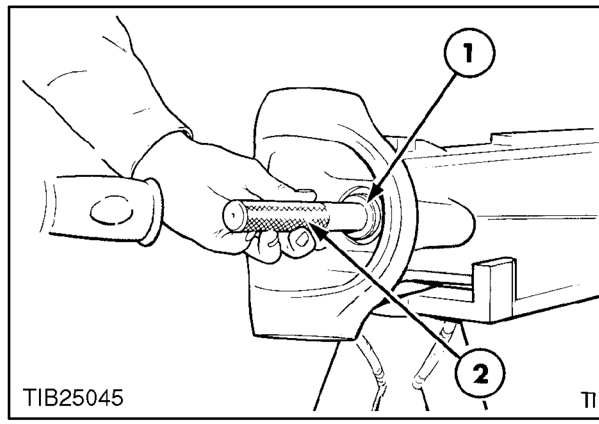


32

Axle shaft seal and bush installation

Prior to fitting a new seal and bush thoroughly clean the inner axle. Using tool **297103** gently tap with a soft faced hammer the seal and bush into the axle.

1. Bushing Installation Tool
2. Driver Handle

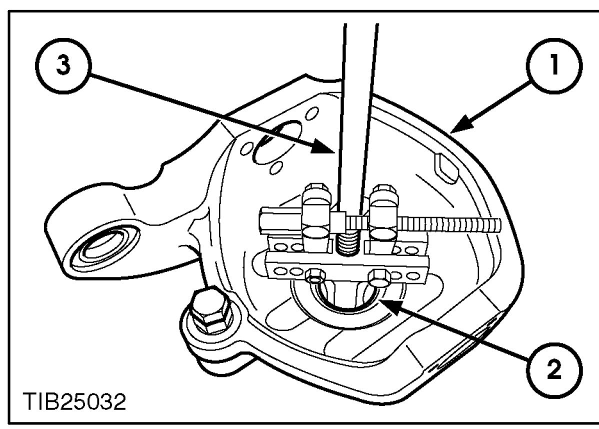


33

Swivel hub seal removal

Remove the seal from swivel casing using special tool **297101** in conjunction with slide hammer **297504**

1. Swivel Casing
2. Seal
3. Slide Hammer

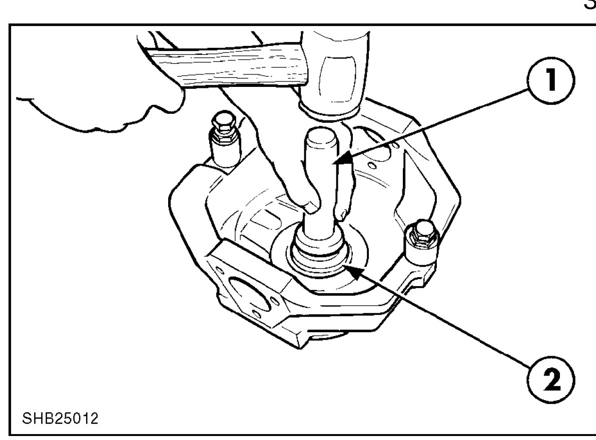


34

Install seal into swivel housing

Using tool **297111** refit the seal and bushing into the housing.

1. Driver Handle Tool
2. Oil Seal Installer Tool

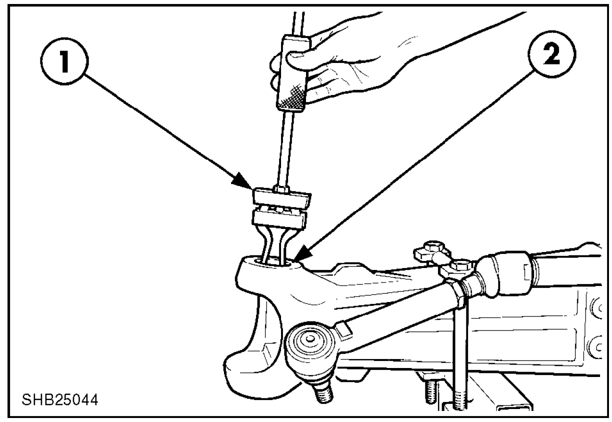


35

Swivel pin bearing cup removal

Remove the outer bearing cups with slide hammer **297111**

1. Slide Hammer
2. Bearing Cup

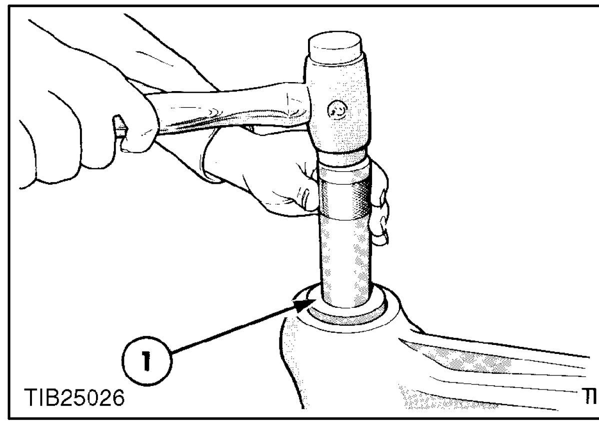


36

Installation of swivel pin bearing outer cone.

Before assembly of a new cone, ensure the swivel area is thoroughly clean. Using a driving tool gently tap with a soft faced hammer.

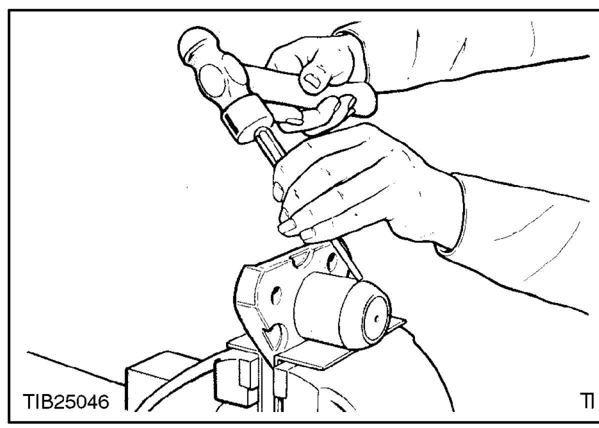
1. Suitable Driving Tool



37

Removal of lower swivel pin bearing cone.

Hold the swivel in a soft jawed vice and using a suitable drift carefully remove the bearing cone from the swivel.

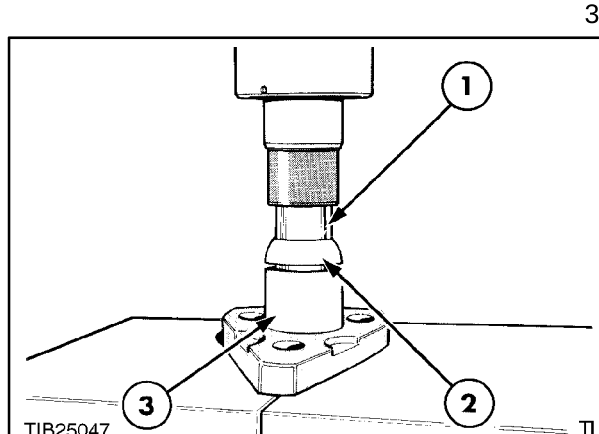


38

Press on lower swivel pin bearing cone.

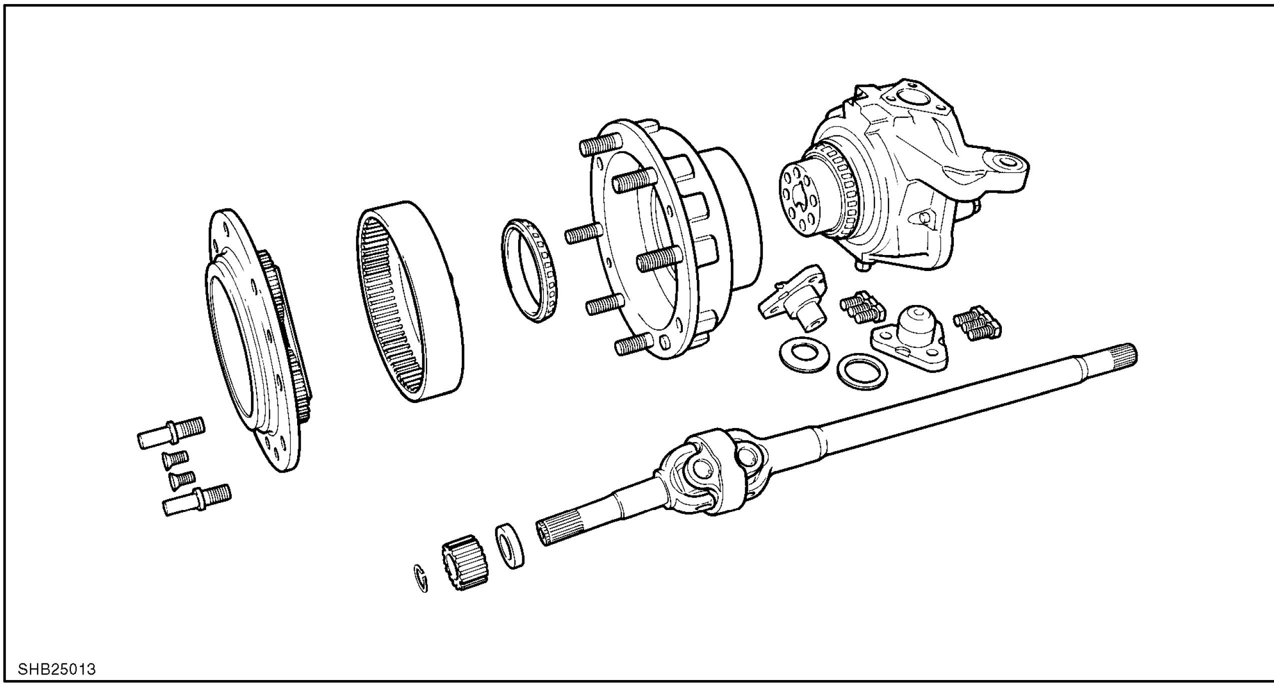
Thoroughly clean the swivel shaft and check for damage or scoring. Carefully Stone any imperfections away before fitting a new cone. Using a suitable spacer fit a new cone.

1. Spacer Block
2. Bearing Cone
3. Swivel Pin



39

Reduction Hub, Swivel Housing and Axle Shaft Re-assembly

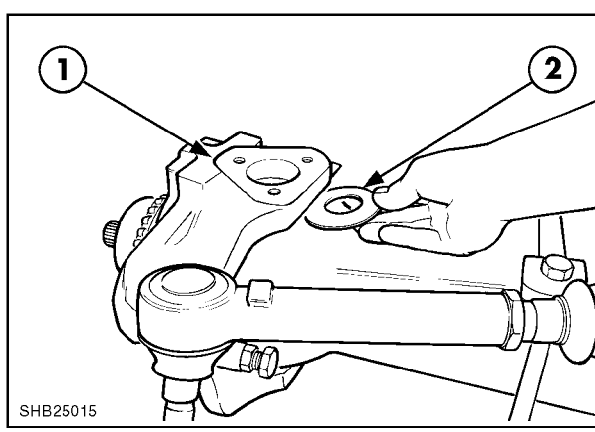


40

Reduction Hub, Swivel Housing and Axle Shaft Assembly

- Re-assembly is in the reverse sequence to the dis-assembly illustrated.
- It is important to locate the axle shaft inner end splines into the differential side gear before fitting the swivel casings.
- Wrap protective tape over the axle shaft outer end spline to protect the hub drive shaft oil seal, before location of swivel casing assembly.
- There are no swivel pin freeplay adjustments. Two Belleville washers are now installed to automatically preset swivel free play. The small washer is installed at the top of the swivel hub and the larger washer installed on the bottom of the swivel hub assembly.

1. Swivel Housing
2. Belleville Washer

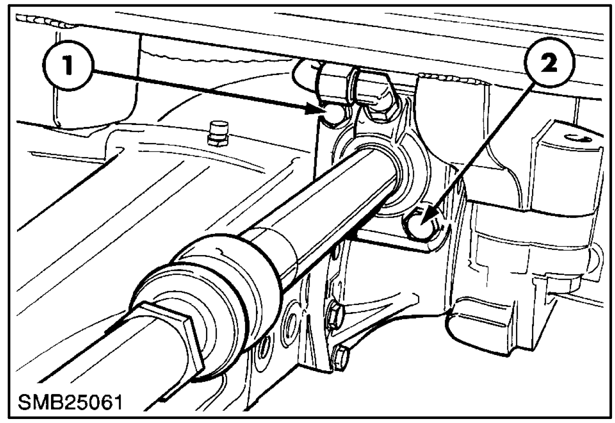


41

Steering Cylinder Removal

The steering cylinder is located in lugs on the differential casing and is retained by four bolts.

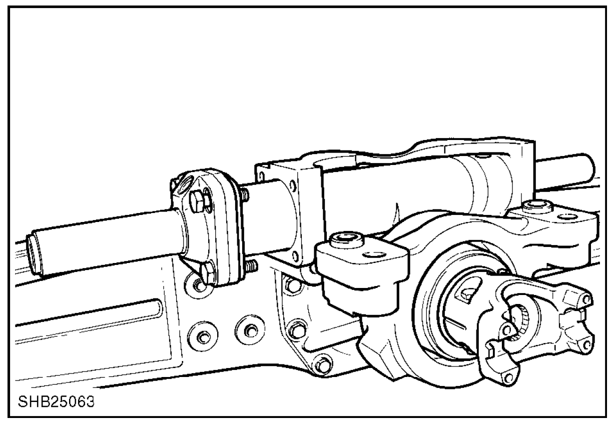
The cylinder can be removed with the axle in situ or with the axle removed. However the cylinder must be removed for differential removal.



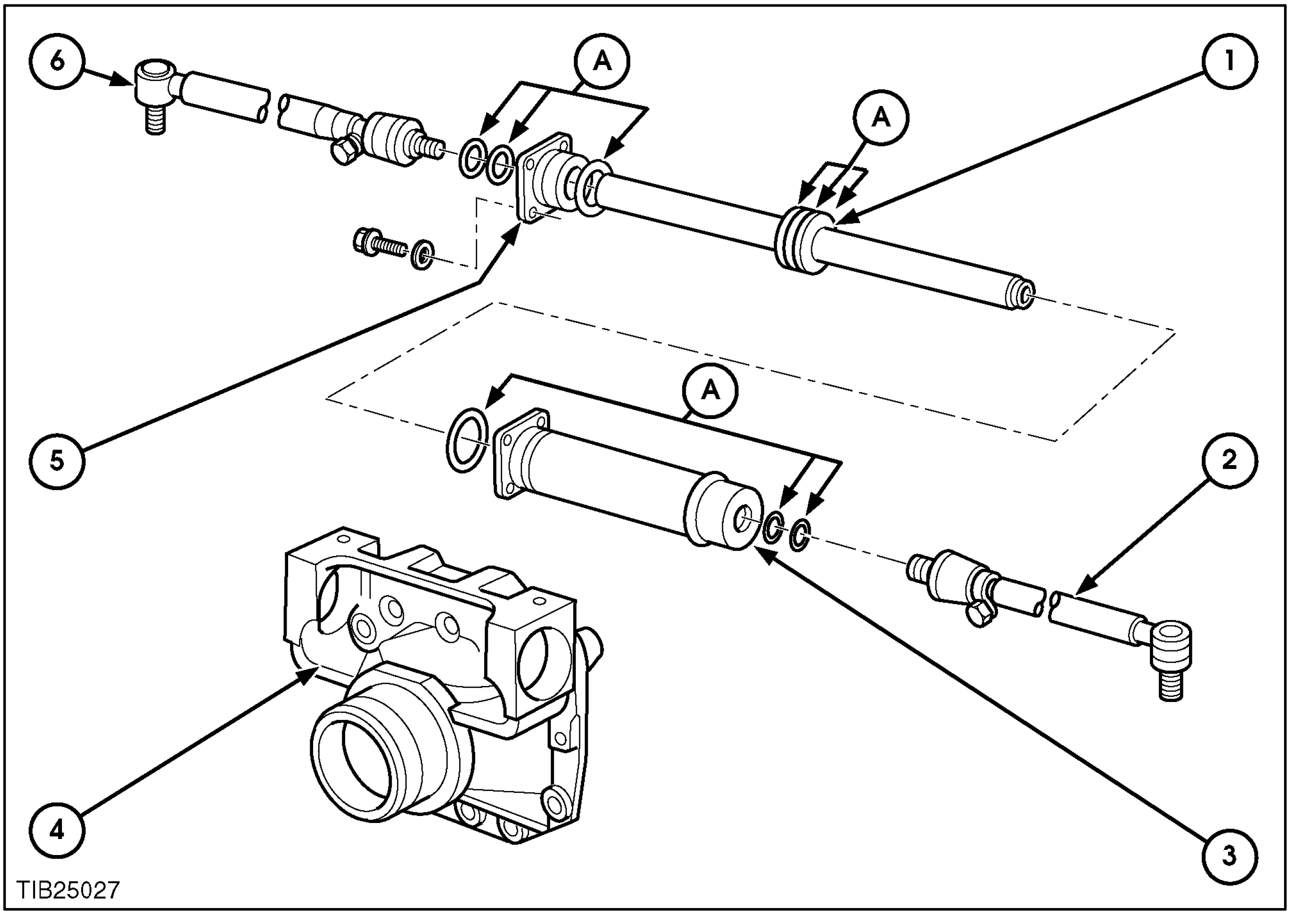
42

Steering Cylinder Removal with Axle in situ

- Loosen retaining bolts two turns, turn the steering wheel to the left to unseat cylinder assembly.
- Jack up and support front axle and remove left hand front wheel.
- Slacken track rod clamps.
- Slacken ball joints from cylinder rod. (Note: High production tightening torques!)
- Remove track rods from steering arms.
- Remove track rod end and ball joint assemblies from the steering cylinder rod.
- Disconnect hydraulic hoses and right hand cylinder hose fitting.
- Remove cylinder retaining bolts and pull out the complete assembly.



43



44

Steering Cylinder—Serviced Parts

1. Rod & Piston Assembly
2. Track Rod Assembly
3. Cylinder
4. Differential Carrier
5. End Plate
6. Track Rod Assembly

A. Seal Kit Items

Serviced Parts

The cylinder rod and cylinder barrel are only serviced as a complete steering cylinder assembly.

The seals and wear rings will only be available as a complete seal kit.

Steering Cylinder Re-assembly

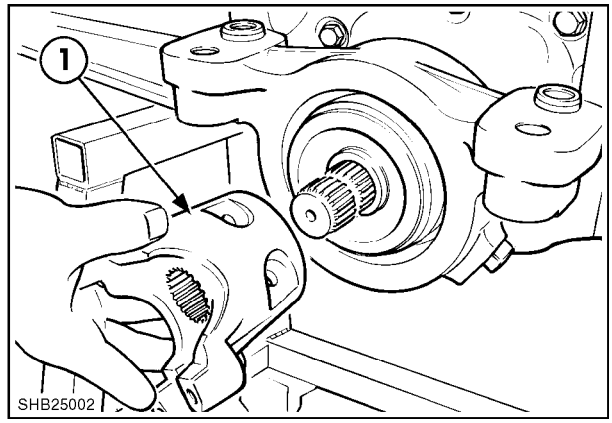
- Replace all seals.
- Allow new piston seal, located on 'O' ring, to contract before entering the piston and rod into the cylinder barrel.
- Replace end plate.
- Relocate cylinder.
- Rebuild steering connections in the reverse sequence to disassembly.
- Adjust and set the front wheel toe-in 0 – 2 mm (0 – 0.08 in). Ensure this measurement is made at the inside of each wheel rim and at hub height.

Differential Assembly Removal

Remove both Reduction Hub Swivel Housings and Axle Shafts.

Remove drive yoke (1) to allow access to the pinion shaft oil seal.

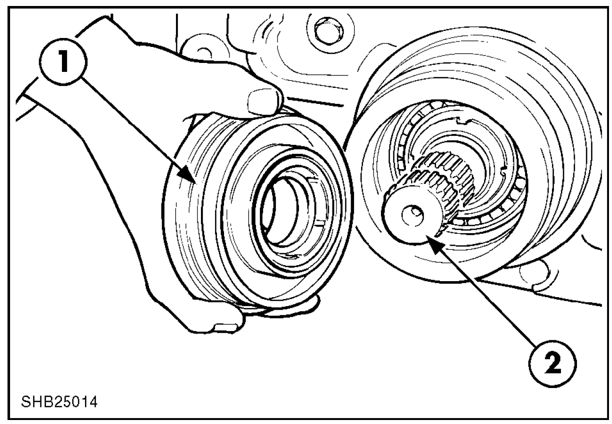
Drain the differential housing of oil and discard into a suitable container for disposal.



45

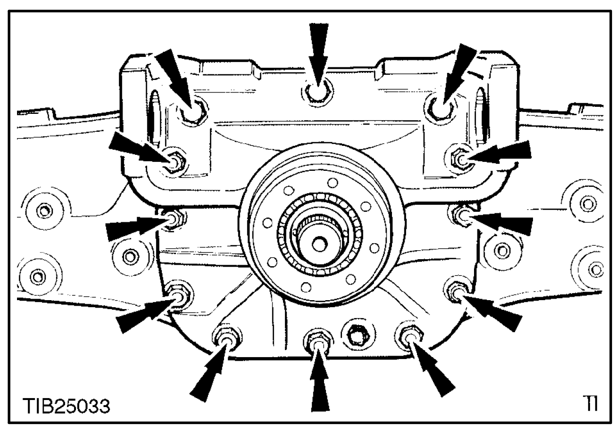
Remove pinion shaft oil seal housing.

1. Oil Seal and Housing
2. Pinion Shaft



46

Remove the differential support casing retaining bolts and place in a suitable container.

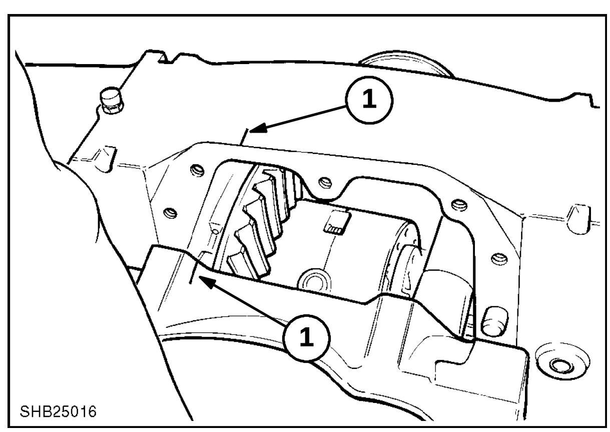


47

Remove differential.

Mark the differential housing with felt pen, which side the crown wheel is in relation to the assembly (1).

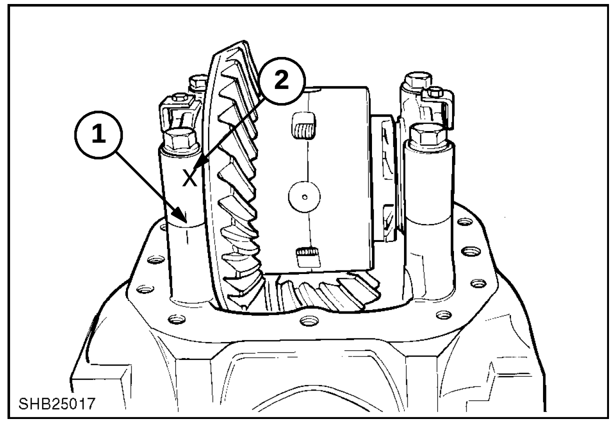
IMPORTANT: *Use a Small hoist to support the differential when removing it from the axle, as its combined weight is greater than for safe manual handling.*



48

Differential Disassembly

Before disassembly, mark each bearing cap (1) to ensure they are not interchanged during re-assembly. Also mark which side the crown wheel is in relation to the assembly (2).



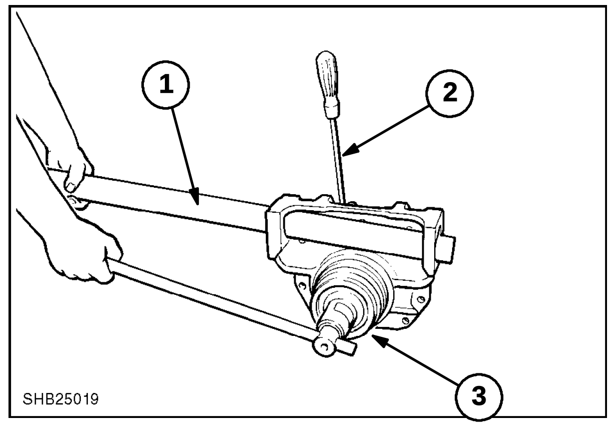
49

NOTE: *Before differential disassembly loosen the pinion nut.*

Place a bar (1) through the steering cylinder lugs to support the assembly.

Put a screwdriver (2) between the crown wheel and pinion teeth to hold the pinion still.

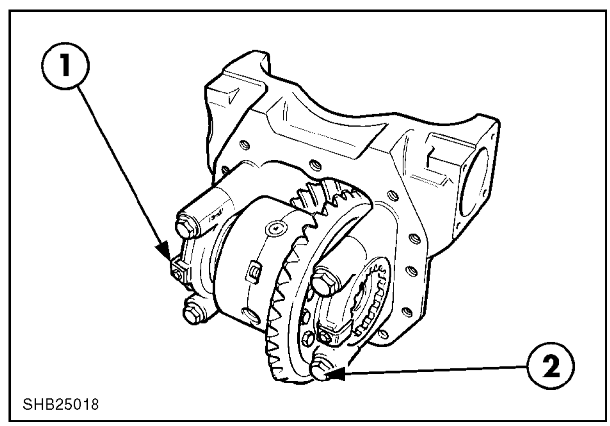
Loosen the pinion nut using special tool **297511** (3).



50

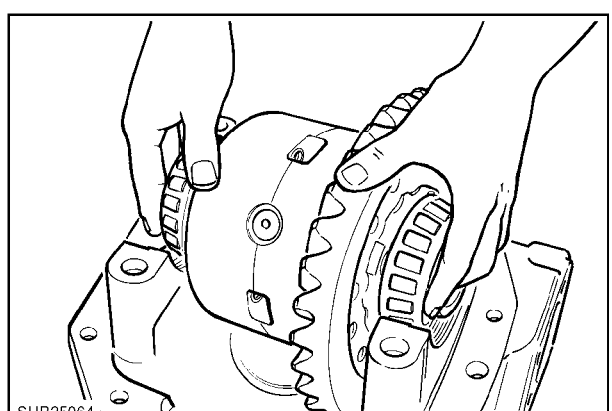
Remove the locking tabs (1) and cap retaining bolts (2).

NOTE: *Fit new locking tabs upon re-assembly*



51

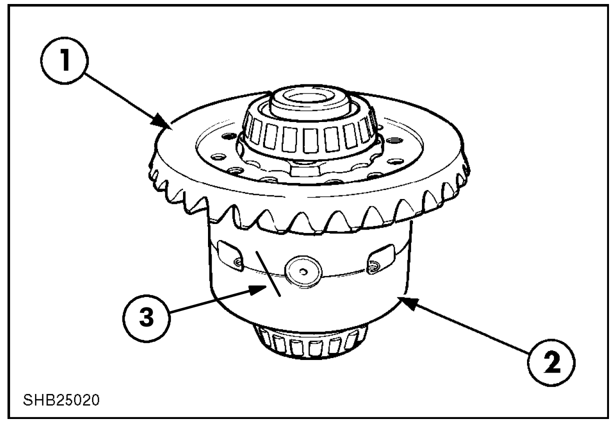
Remove the differential assembly from the housing and place on a clean bench prior to disassembly.



52

Differential casing (1) and crown wheel assembly (2).

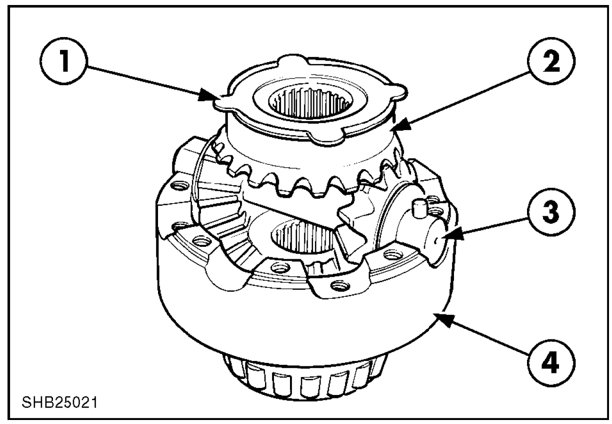
***NOTE:** Prior to disassembly mark with a felt pen the two halves of the differential to ensure correct re-assembly.*



53

Differential Components

1. Thrust Washer
2. Side Gear
3. Spider Shaft
4. Differential Casing

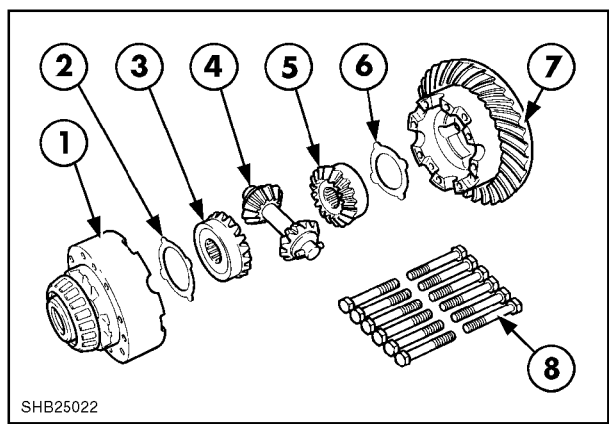


54

Differential disassembly

***NOTE:** This is not a limited slip differential. The side gear flange is extended and a single thrust washer is fitted.*

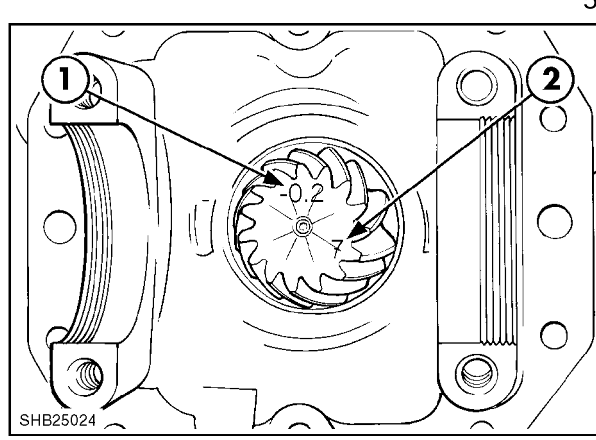
1. Differential Housing
2. Thrust Washer
3. Side Gear
4. Spider Shaft
5. Side Gear
6. Thrust Washer
7. Crown Wheel
8. Retaining Bolts



55

Pinion Identification marks

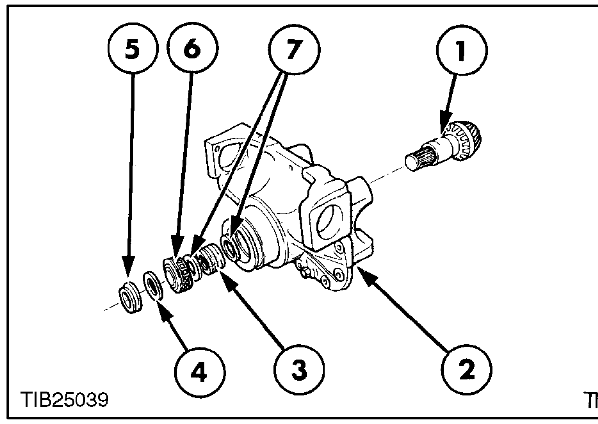
1. Pinion Height Measurement
2. Pinion to Crown Wheel Serial Number



56

Drive pinion components

1. Pinion Shaft
2. Pinion Casing
3. Collapsible Spacer
4. Spacer
5. Retaining Nut
6. Inner Bearing
7. Washers



57

Differential Component Inspection

In addition to normal inspection of bearing assemblies, differential gear and crown wheel/pinion tooth wear, and spline wear, check:

- Thrust washers
- Drive pinion nut

Differential re-assembly is in the reverse sequence to disassembly. However, special attention should be given to the following:

If the crown wheel and pinion are to be replaced, carry out pinion engagement adjustment to determine pinion shim thickness required.

- Pinion bearing preload, differential bearing preload and crown wheel to pinion backlash must be correctly adjusted as described on the following pages.
- Tighten bolts and nuts to specified tightening torques listed in the specifications.
- Differential housing bearing cap nuts must be tightened to specified torque before measuring bore diameter.
- The collapsible spacer must be replaced on re-assembly.

The crown wheel and pinion are a ‘matched’ set.

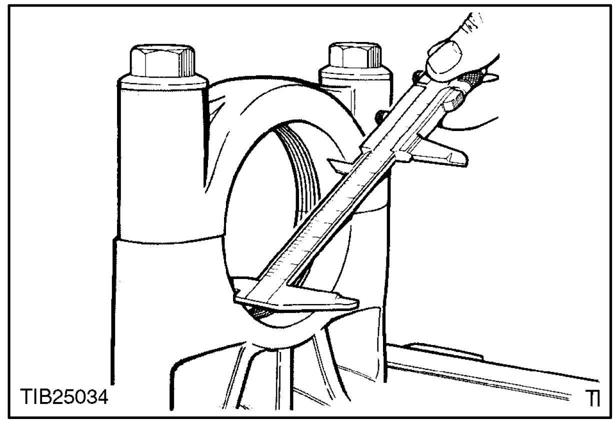
Differential Adjustments

Pinion to Crown Wheel Tooth Engagement

To determine the shim thickness required to provide the correct pinion to crown wheel tooth engagement, the differential casing 'pinion height' dimension 'C', must be calculated and compared to the dimension etched on the pinion. This adjustment is only required if new components are being fitted.

- Install new pinion bearings in the differential casing and clamp in position with special tool 297132. Make sure bearing cones can just be turned by hand.
- Measure dimension 'A'
- Calculate C=B–Bar Ø + 1/2 A

NOTE: *297132 Bar gauge 25mm dia.*



58

Measuring dimension 'A'
Differential housing bearing bore diameter

Example:

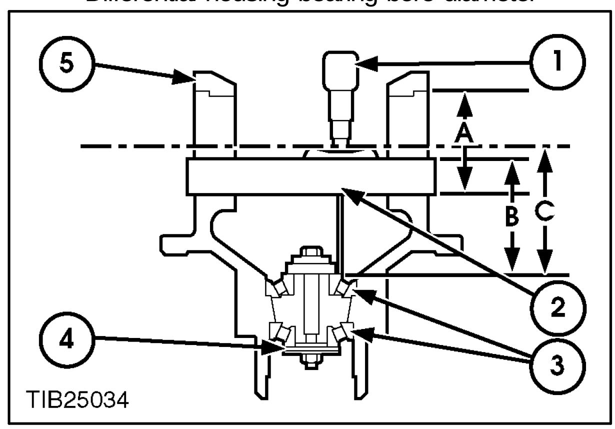
Dimension A = 90 mm

Dimension B = 90.3 mm

Calculate dimension 'C'
= 90.3 – 25 + 45 mm
= 110.3 mm

Pinion dimension
= 107 + 0.2 mm
= 107.2 mm

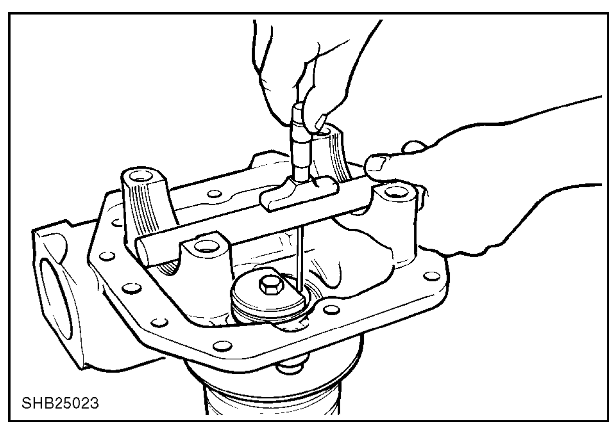
Required shim thickness
= 110.3 – 107.2 mm
= 3.1 mm



59

Measuring dimension 'B'

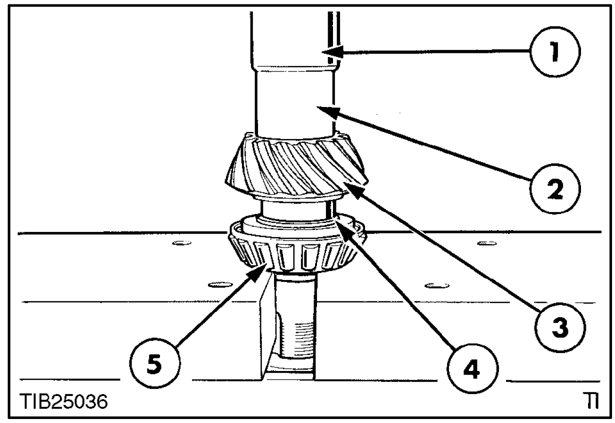
1. Depth gauge
2. Bar gauge part of tool **297132**
3. Pinion shaft bearing
4. Pinion setting gauge **297132**
5. Differential Support Casing



60

Pressing inner bearing onto pinion

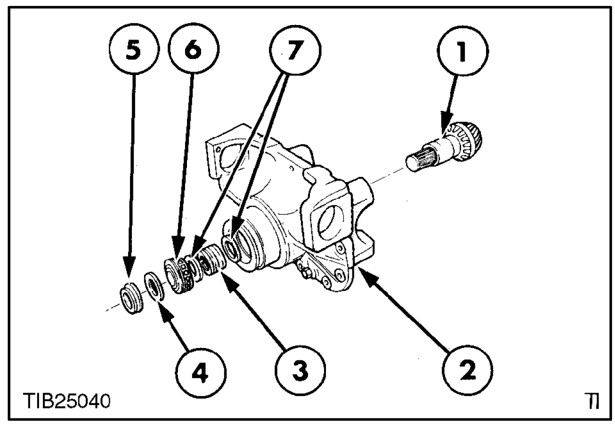
1. Press
2. Protector
3. Pinion
4. Shim
5. Inner Bearing



61

Drive Pinion Re-assembly

1. Pinion & Bearing
2. Support Housing
3. Collapsible Spacer
4. Tab Washer
5. Pinion Nut
6. Outer Bearing
7. Washers

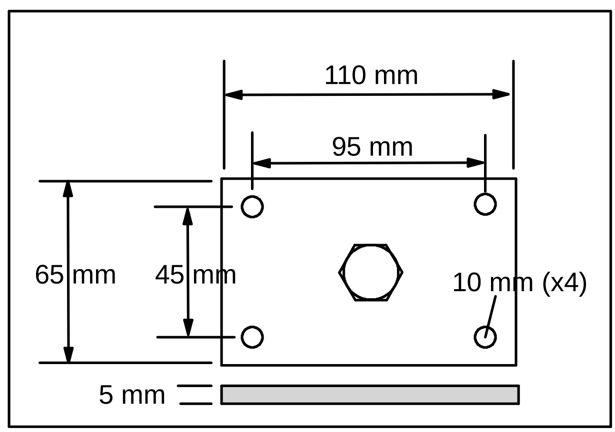


62

Differential Adjustments Pinion Bearing Preload

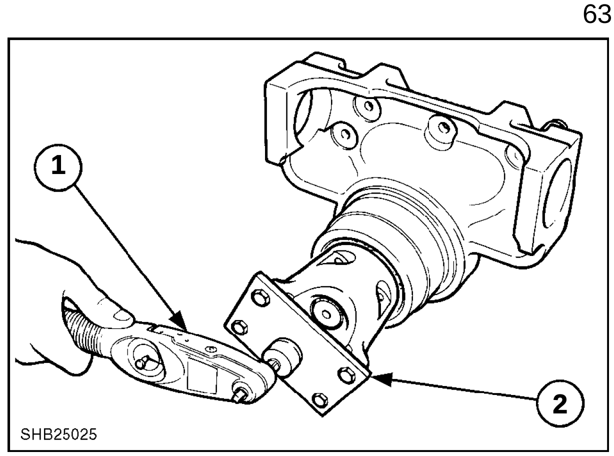
To check the preload of the bearing, it will be necessary to fabricate a bracket to the dimensions shown. Weld a nut of a size suitable to match a socket available to you in the centre of the bracket.

NOTE: *The adjustment can only be carried out with a new collapsible spacer fitted to the pinion.*



63

- Attach the bracket (2) to the yoke. Apply a torque meter (1) to the centre nut and rotate the pinion shaft to achieve a torque of:
  1.6–2.3 Nm (14.1–20.9 lbs in)
- Tighten nut with special tool to just eliminate free play
- Check pinion bearing rolling resistance as illustrated
- Tighten pinion nut progressively until correct torque is indicated.



64

Crown Wheel to Pinion Backlash

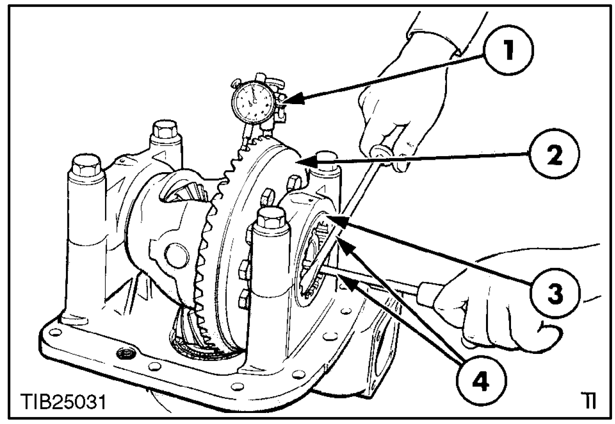
Measure Crown Wheel to Pinion Backlash

1. Dial Indicator
2. Crown Wheel
3. Adjuster Ring
4. Pry Bars

= 0.17 – 0.23 mm (0.086 – 0.009 in)

Install differential assembly into the differential casing with crown wheel to the right hand side of the pinion, the bearing cap nuts should be finger tight.

- Tighten adjusting ring (3) to just eliminate differential bearing free play.
- Adjust crown wheel to pinion backlash by adjusting rings by equal amounts.



65

Differential Bearing Preload

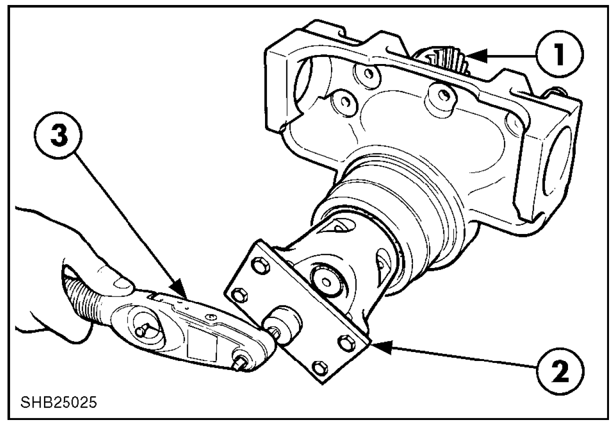
Checking Pinion and Differential Bearing Rolling Resistance

1. Installed Differential
2. Spring Balance
3. Pinion

Pre Load 0.75–1.0 Nm (6.6–9.7 lbs in)

To determine the differential (1) bearing preload, the turning torque required to slowly turn both the pinion and the differential is compared to the torque recorded to turn the pinion only.

- Tighten ring opposite crown wheel progressively until indicated turning torque is within specification.



66

Example:

Turn the torque meter slowly:

A. Pinion and differential:

2.98 Nm (26.5 lbs in)

B. Pinion only:

2.0 Nm (18.02 lbs in)

Differential bearing preload:

0.9 Nm (8.22 lbs in)

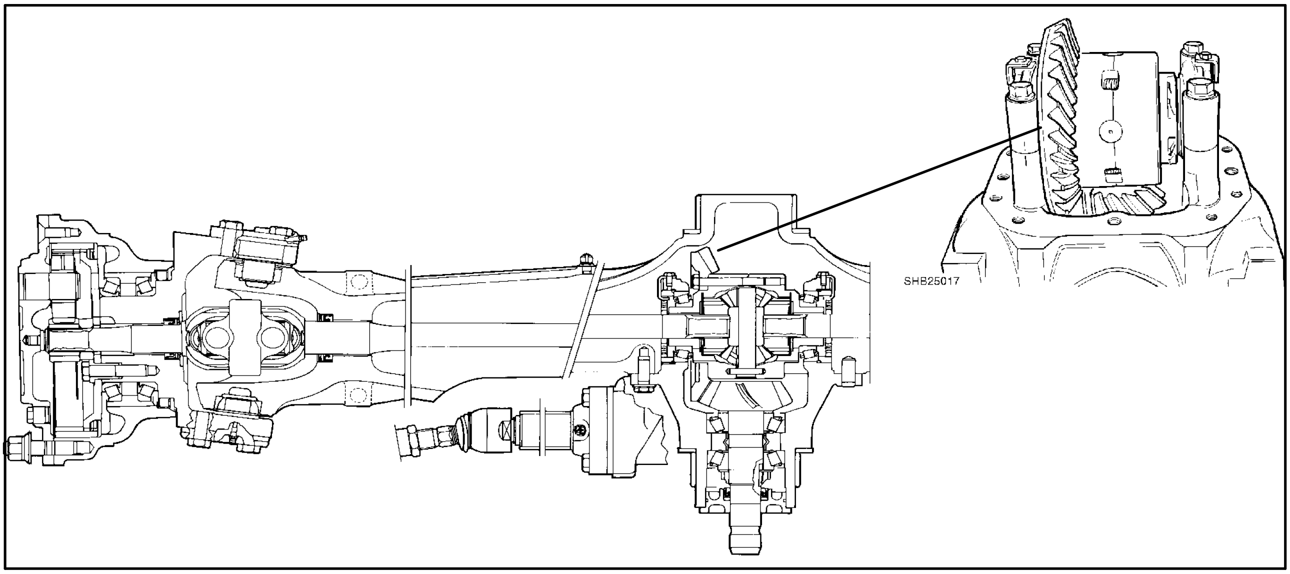
Resultant preload is within specification.

- Install adjusting ring locking tabs.
- Recheck differential bearing preload and crown wheel to pinion backlash.
- Finally, tighten bearing cap nuts to 266 Nm (196 lbf ft).

Differential Disassembly

Whilst all dimensions and teardown operations remain the same for both front axles, it must be remembered that on the the Powershuttle Front Axle the differential is mounted to left of the front axle:

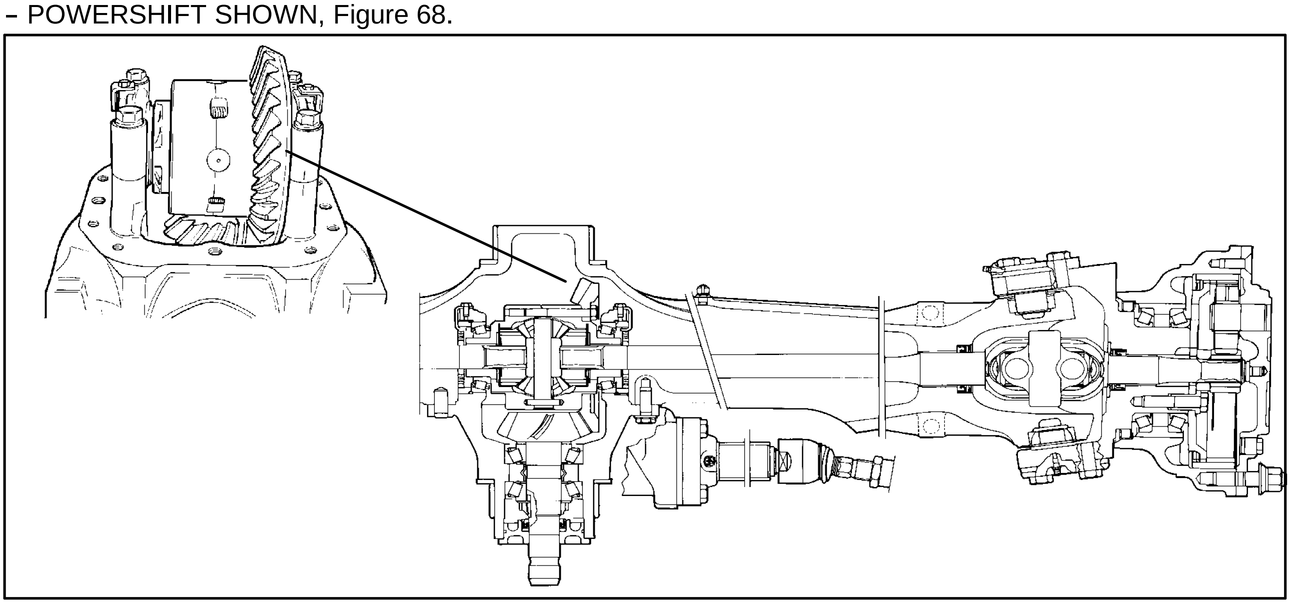
– POWERSHUTTLE SHOWN, Figure 67.



67

On Powershift Front Axles the differential is mounted to the right of the front axle:

– POWERSHIFT SHOWN, Figure 68.



68

SECTION 25 – FRONT AXLES

Chapter 2 – Front Axle for 4 Wheel Steer Only

CONTENT

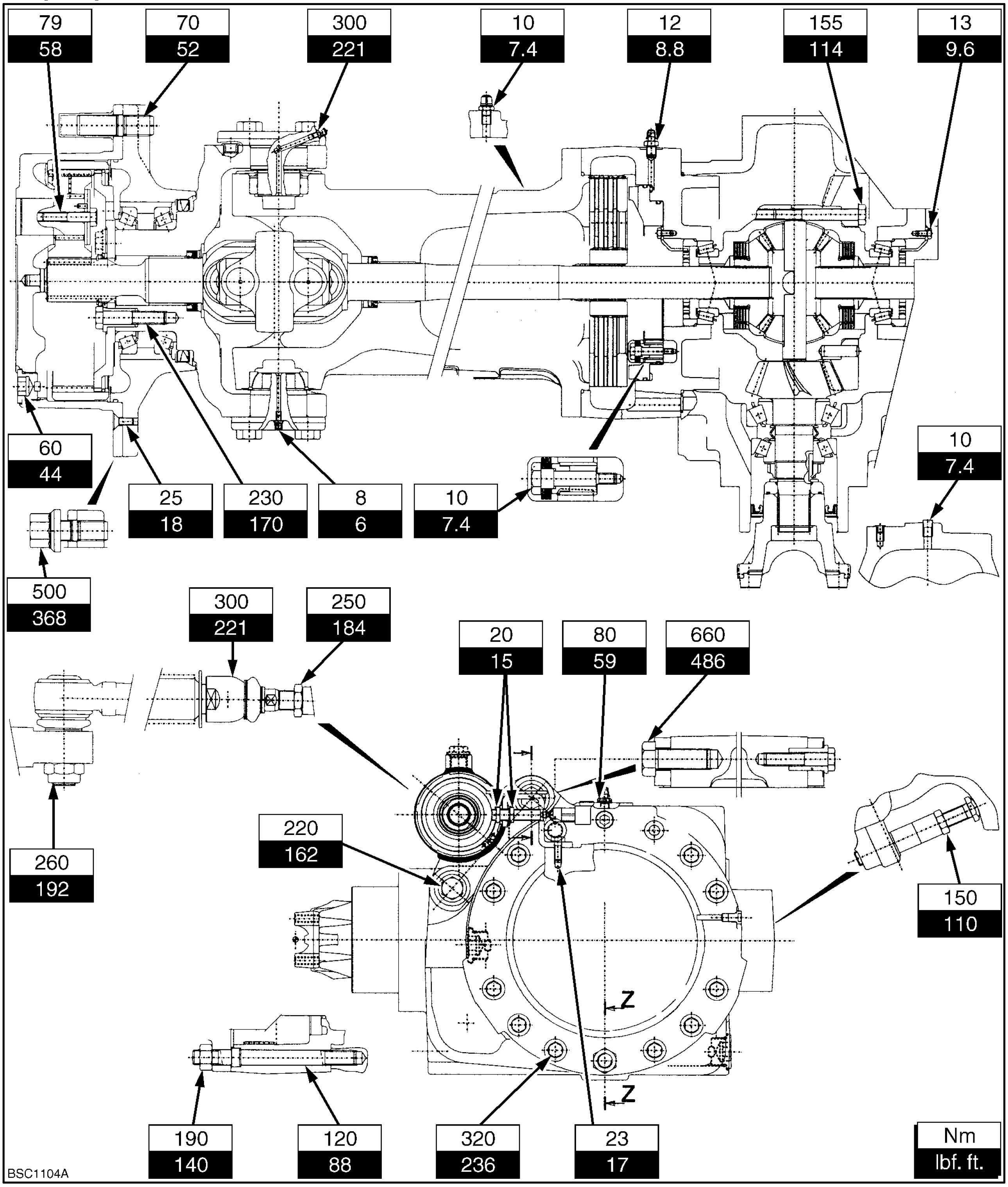
SPECIFICATIONS

Component	
Axle Type	Modular
Planetary Reduction	6.923 : 1
Overall Ratio	18.5 : 1
Number of Planetary Gears	3
Load Carrying Capacity Dynamic	8000 kg (17636 lb) at 1890 mm track width
Overall Width	2304 mm
Oil Capacity	11 Litres (2.9 US. gals)
Oil Change Period	1 year or 1200 hours
Lubricants	See operator’s manuel

CLEARANCES AND ADJUSTMENTS

Drive pinion preload	9.2–13.7 Nm
Steering Sensor to steering rod disc	1.5mm – 1.6mm

Torque Specification



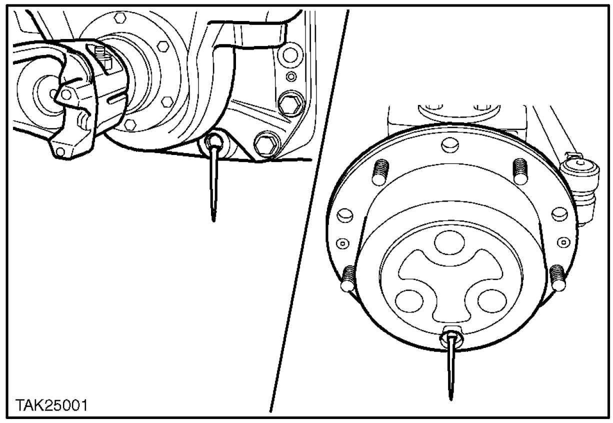
1

SPECIAL TOOLS

Pinion setting tool	297132 or 4775
Pinion nut tool	297511
Slide hammer	297111

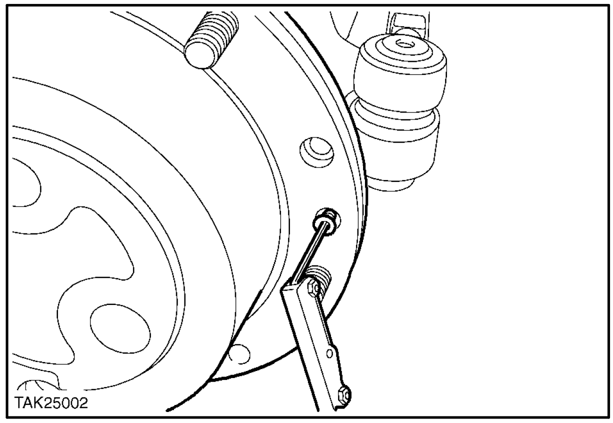
Axle Disassembly
Hub Disassembly

1. Remove the hub oil drain plug and drain the hub oil. Remove the differential plug and drain the oil from the centre housing.


TAK25001

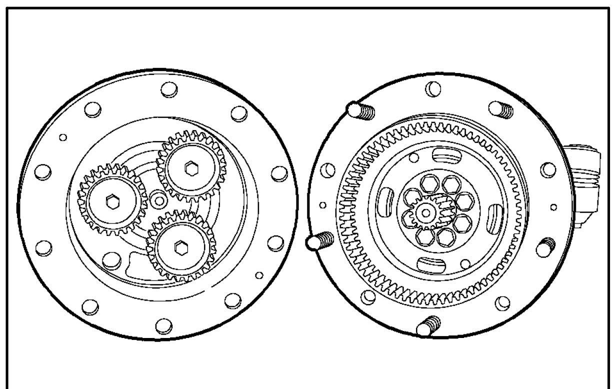
2

2. Remove the hub outer casing allen screws


TAK25002

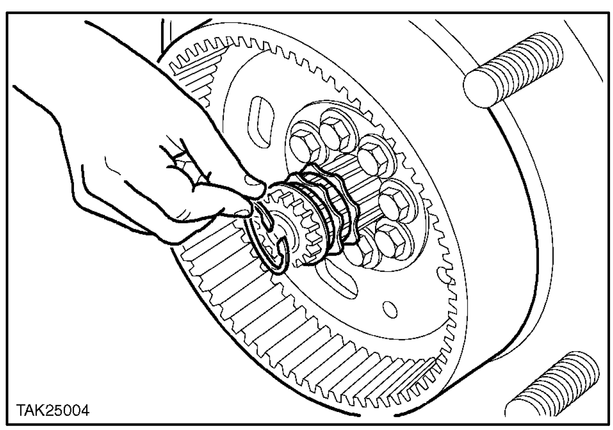
3

3. Remove the hub outer casing.


TAK25003

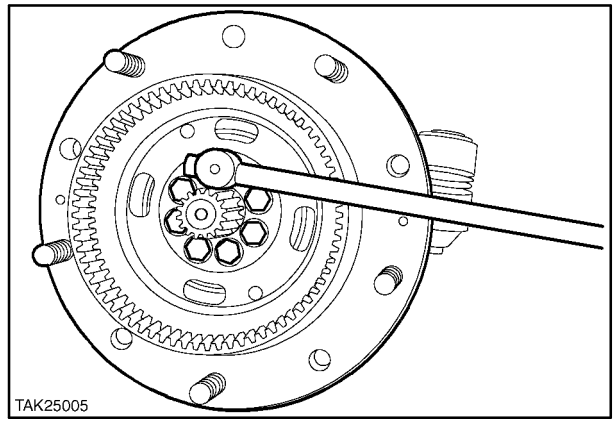
4

4. Remove the sun gear airclip and 3 spacers.


TAK25004

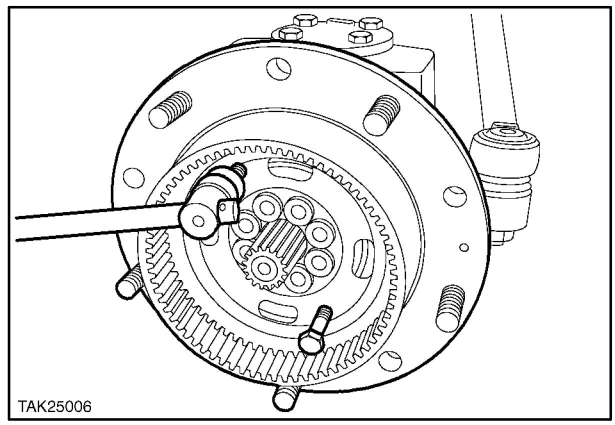
5

5. Remove the eight ring gear fixing bolts.



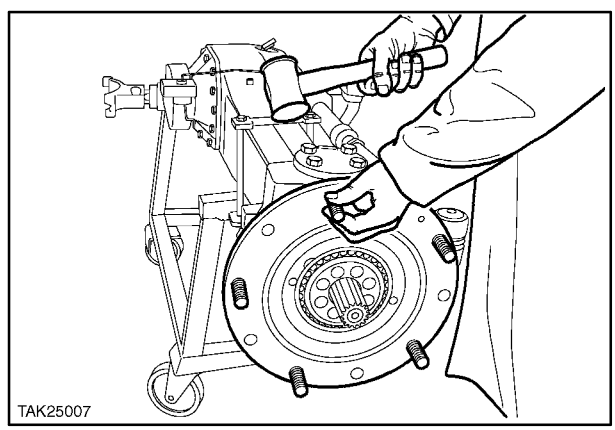
6

6. Using two of the fixing bolts, fit these to the outer threaded holes and tighten to push the ring gear away from the hub.



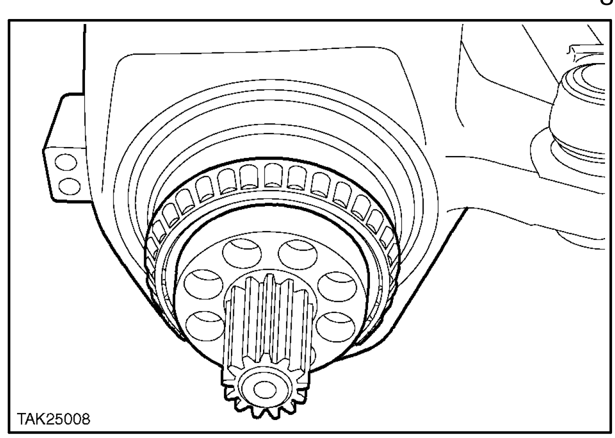
7

7. With a soft faced mallet hammer off the hub centre housing and also the outer conical bearing.



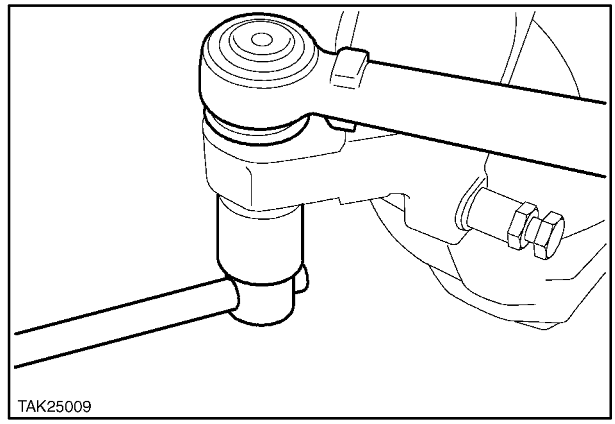
8

8. Then remove the inner conical bearing by hand.



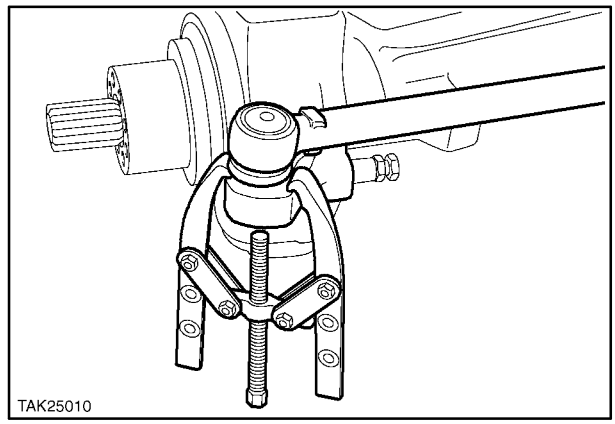
9

9. Undo the nut which holds the steering rod to the hub.



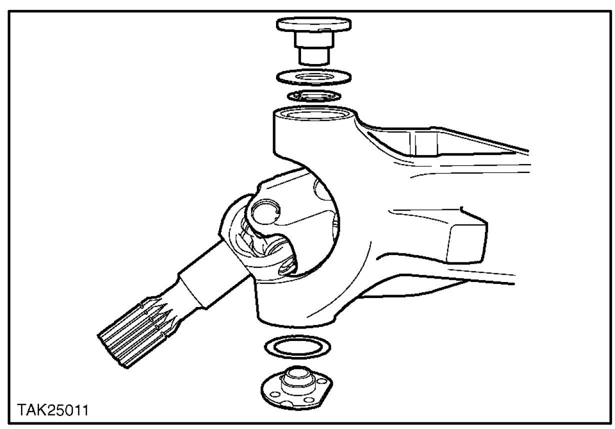
10

10. Use a set of bearing pullers to press the tapered shaft from the hub assembly



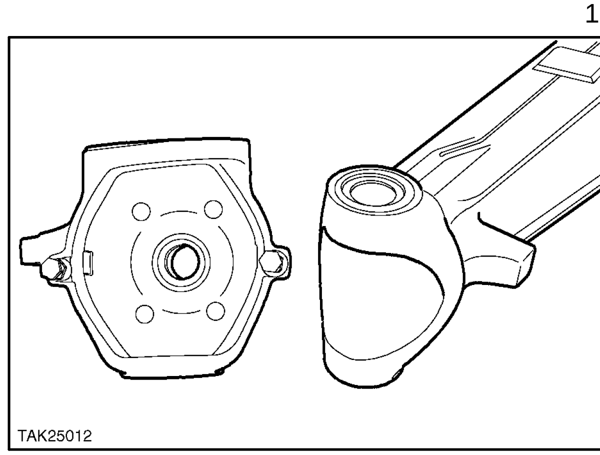
11

11. Undo the bolts holding the top and bottom pivot pins. Then remove the pivot pins and also the belleville washers and spacers.



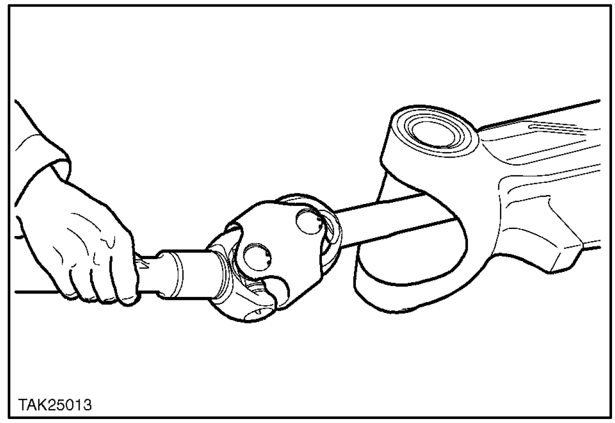
12

12. Remove the remainder of the hub assembly.



13

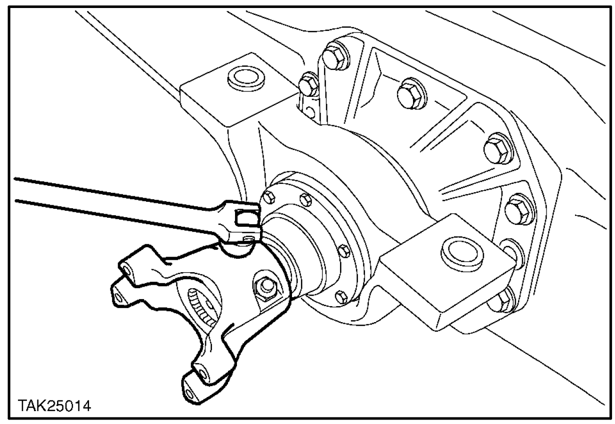
13. Remove the axle drive shaft from the centre housing.



14

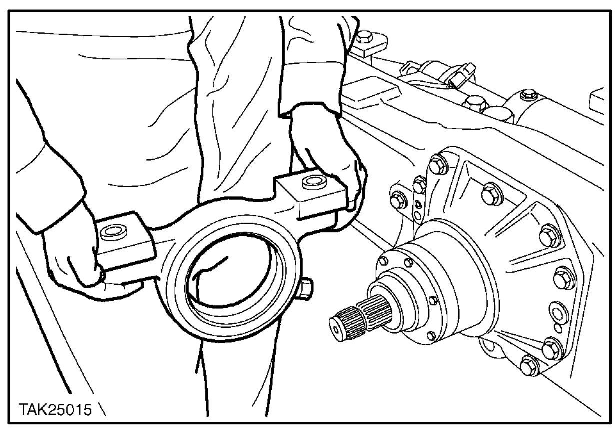
Centre Housing Disassembly.

14. Remove the input shaft coupler fixing bolts and remove the coupler.



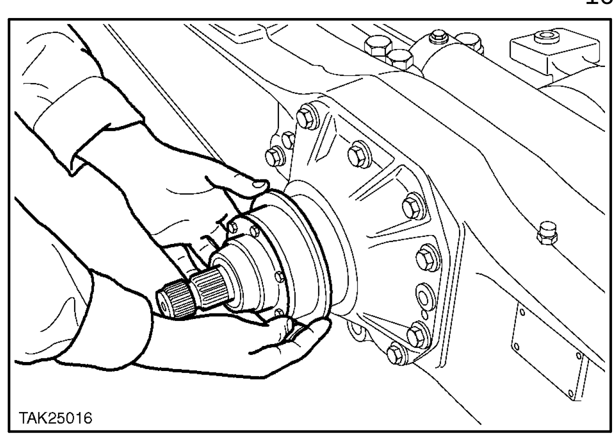
15

15. By hand slide off the pivot bearing and housing assembly.



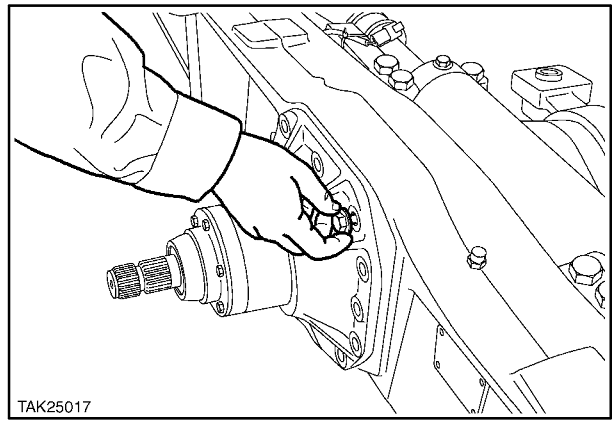
16

16. Remove the pivot spacer ring.



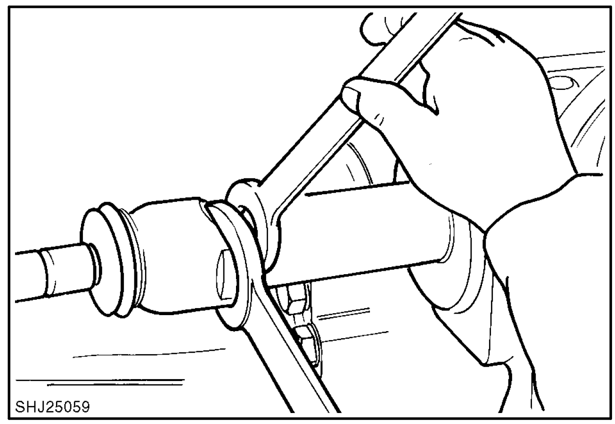
17

17. Remove the differential to main housing fixing bolts and withdraw the complete differential housing.



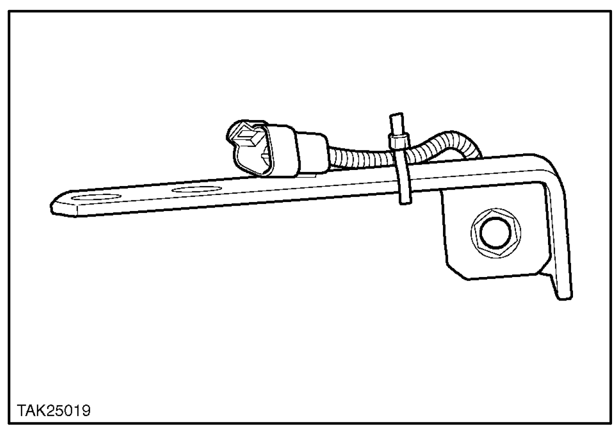
18

18. **Steering Cylinder Removal.**
Remove the track rod ends from the steering cylinder rods.



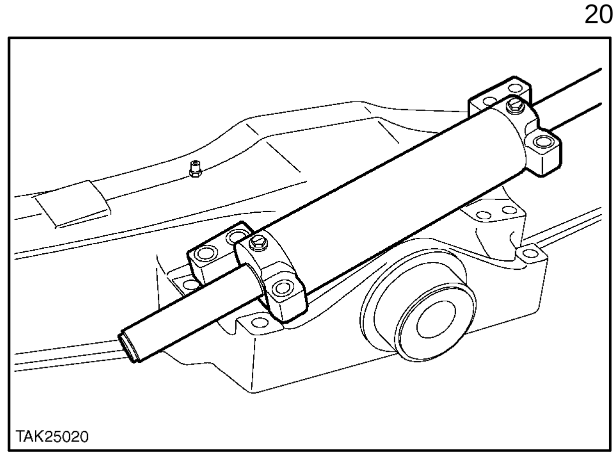
19

19. Undo and remove the 6 steering cylinder fixing bolts and remove the steering angle sensor.



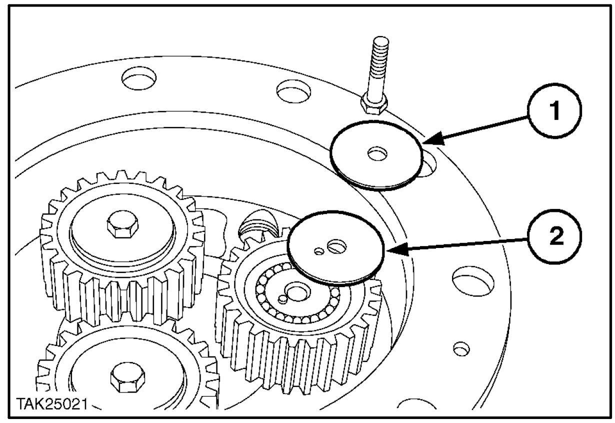
20

20. Lift off the steering cylinder assembly.



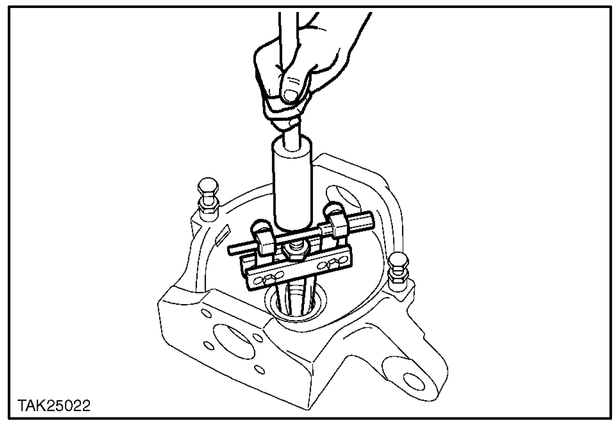
21

21. Disassembly of the planetry housing.
    Remove the bolt from each of the planet gears. Then remove the Upper (1) and Lower (2) washer. The gear can then be removed and also the individual needle bearings.



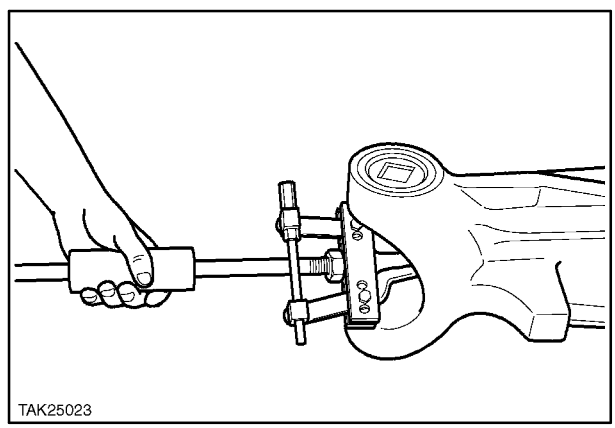
22

22. Swivel hub seal and bush removal.
    Remove the shaft seal and bush using a suitable puller or drift.



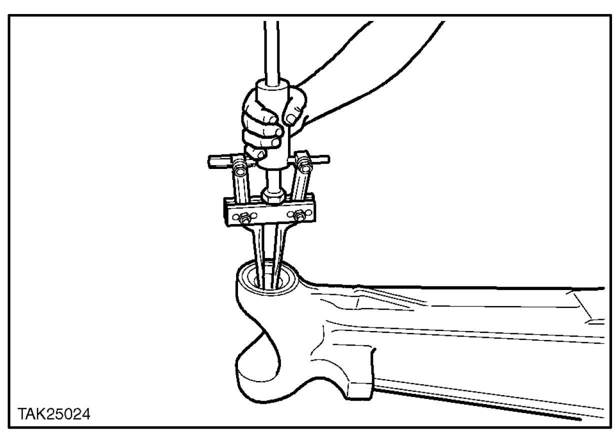
23

23. Axle shaft seal and bush removal.
    Use an internal puller and slide hammer to remove the seal and bush.



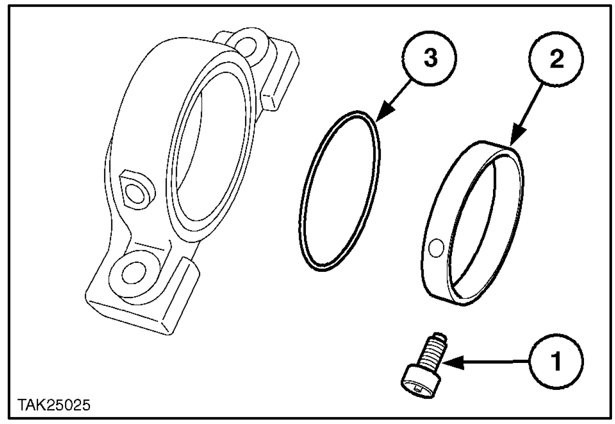
24

24. Pivot bush removal.
    Remove the upper and lower pivot bushes using an internal puller and slide hammer.



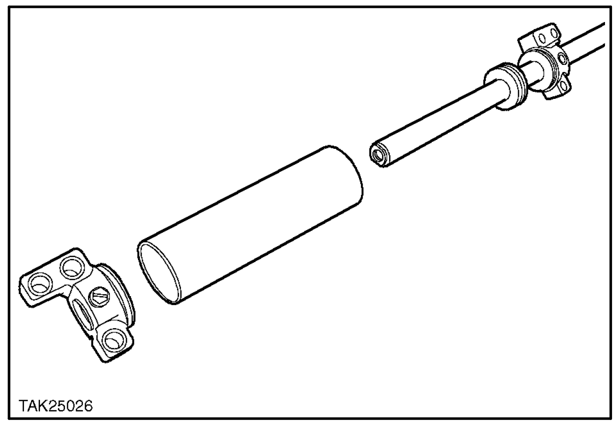
25

25. Swivel Housing Disassembly.
Firstly remove the bush retaining bolt (1) which also houses the grease nipple. Then pull out the bush (2) the bush has one 'O' ring (3) which is situated in the internal bush groove furthest from the axle.



26

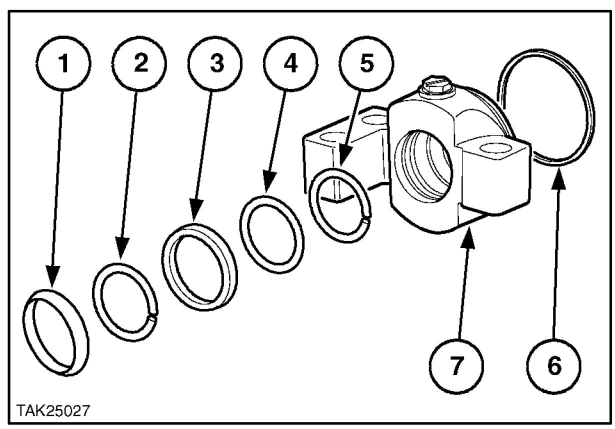
26. Steering Cylinder Disassembly
The gland ends of the steering cylinder are not retained by any circlips, bolts, etc. Therefore to remove the gland ends simply stroke the rod and piston to the end of its travel in both directions and this action will knock out the glands.



27

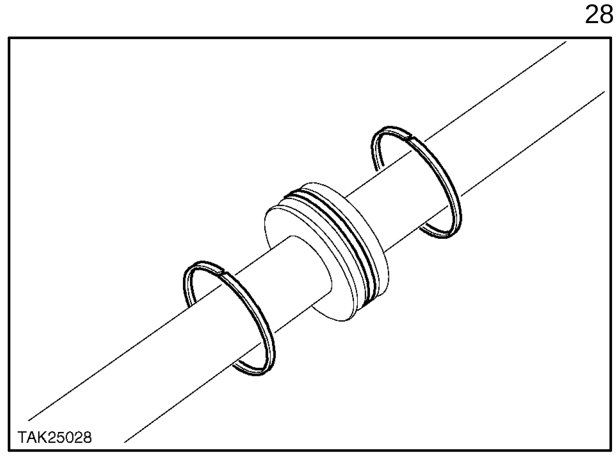
27. The gland consists of a number of seals.

1. Dust Seal
2. Friction Ring
3. Oil Seal
4. Back-up Oil Seal
5. Friction Seal
6. Gland Block
7. Gland Block to Cylinder Seal



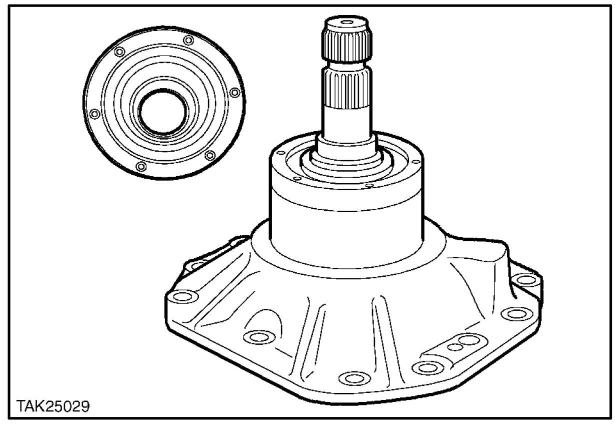
28

28. The Piston contains 3 seals, 2 outer slip seals and the central main seal.



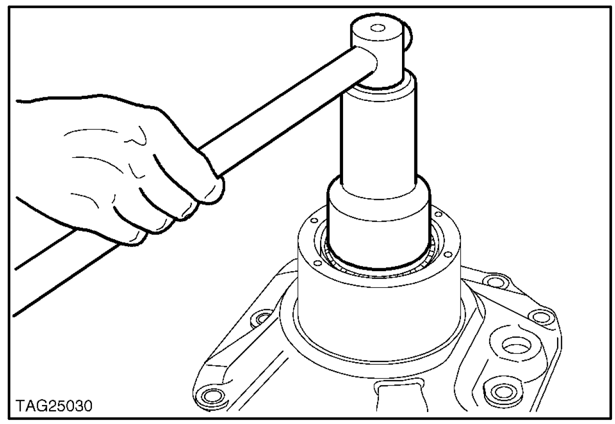
29

29. **Differential disassembly and set up.**
Undo the seal housing fixing bolts and remove the housing.



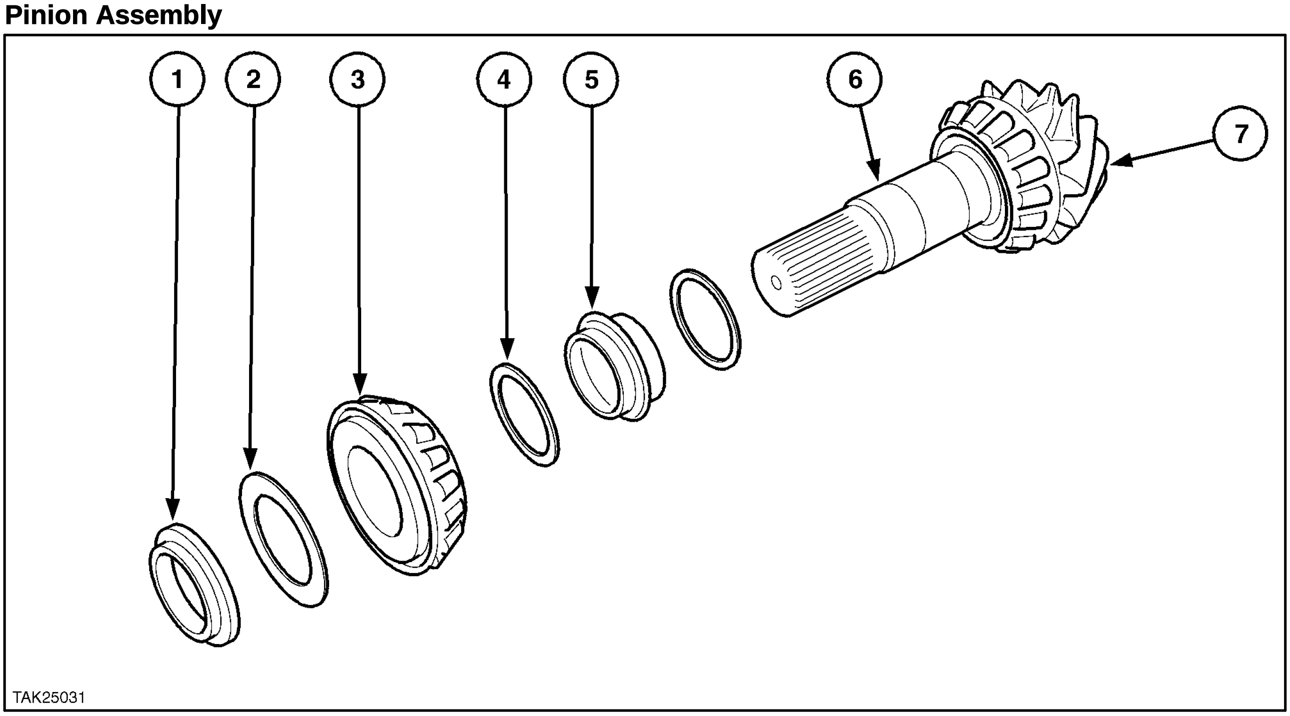
30

30. Lock the differential and bend back the locking tabs on the pinion nut. Then using tool number **297511** and a $^3/_4$" drive socket, undo the pinion nut.



31

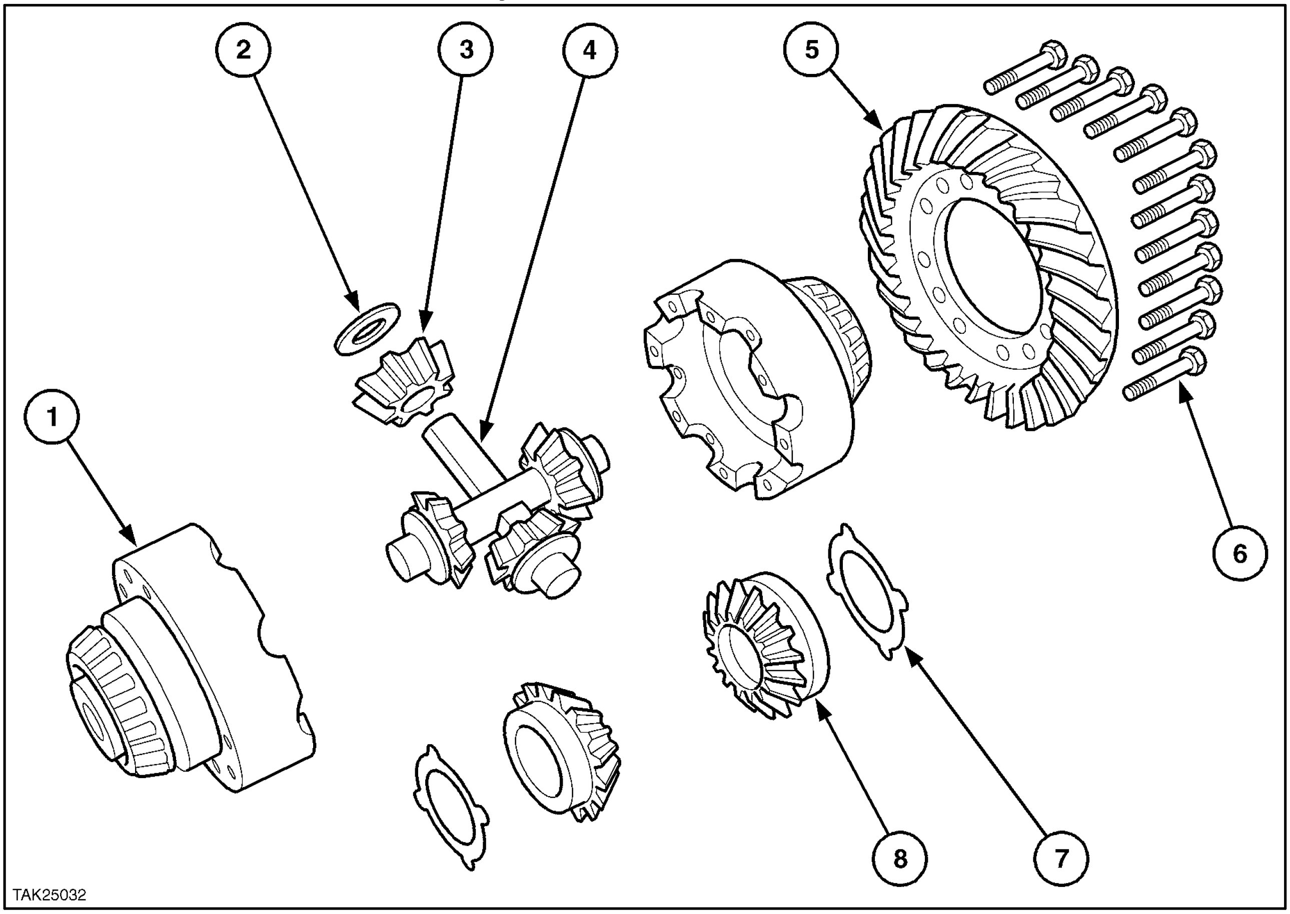
Pinion Assembly



32

1. Pinion Nut
2. Washer
3. Bearing
4. Washer
5. Collapsable Bush
6. Pinion
7. Bearing

Crown Wheel and Differential Assembly



33

1. Differential Housing
2. Thrust Washer
3. Planet Gears
4. Shaft
5. Crown Wheel
6. Fixing Bolts
7. Thrust Washer
8. Side Gears

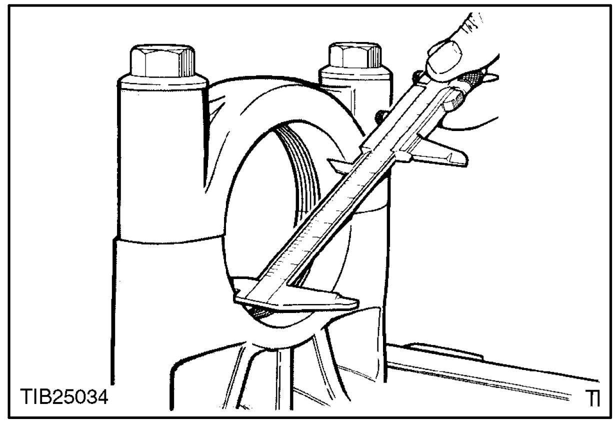
Before reassembly inspect all components for wear and damage.

Pinion Reassembly

If any new components have been fitted then the following set-up procedure must be followed.

Measure the differential housing bearing bore diameter. This is dimension A.

Install the new pinion bearings into the housing and clamp into position using tool number **297132**. Ensure the bearings can still be turned by hand after clamping.



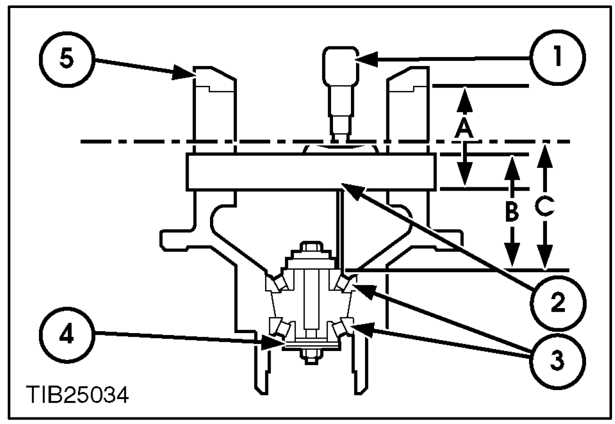
34

Dimension C is the valve required, to find this use the following equation.

C = B – Bar ∅ + 1/2 A.

NOTE: *Bar ∅ (297132) = 25mm.*

1. Depth Gauge.
2. Bar Gauge tool 297132.
3. Pinion Shaft Bearing.
4. Pinion Bearing Clamp 297132.
5. Differential Support Housing.



35

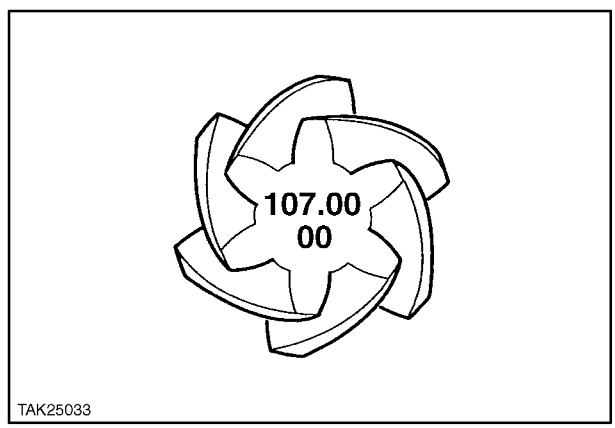
Example of Calculation

Dimension A = 90mm
Dimension B = 90.3mm

C = B – Bar ∅ + $^{1}/_{2}$ A
C = 90.3 – 25 + 45
C = 110.3mm

Calculation of Shim Requirement

Pinion Dimension = 107.00
(See end of pinion).



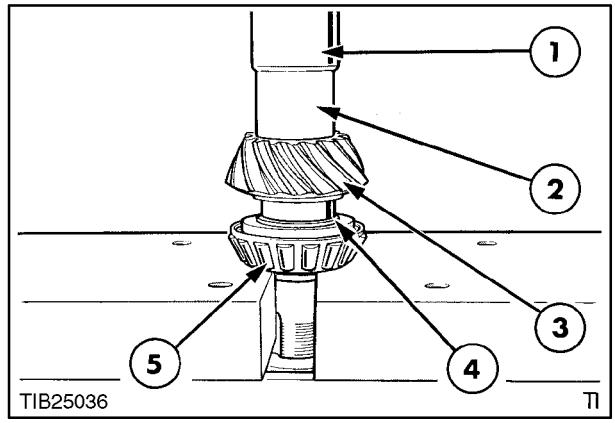
36

Required Shim Thickness = 110.3 – 107.0 = 3.3

Shims are available from 2.5mm – 3.4mm in 0.1mm increments.

Fit the calculated shim to the pinion head with the champered face towards the pinion gear.

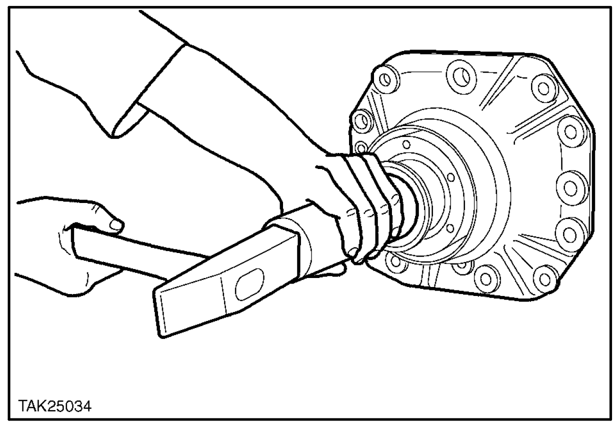
1. Press
2. Protector
3. Pinion
4. Shim
5. Inner Bearing



37

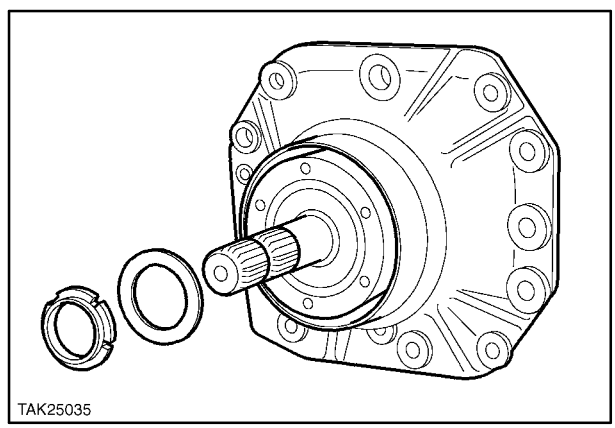
Fit the Pinion with the two new washers and a new collapsable bush.

Position the pinion into its housing and place the other bearing over the pinion shaft. Using a suitable drift and hammer fit the bearing or alternatively use a press.



38

Fit a new washer and ring nut on to the pinion.



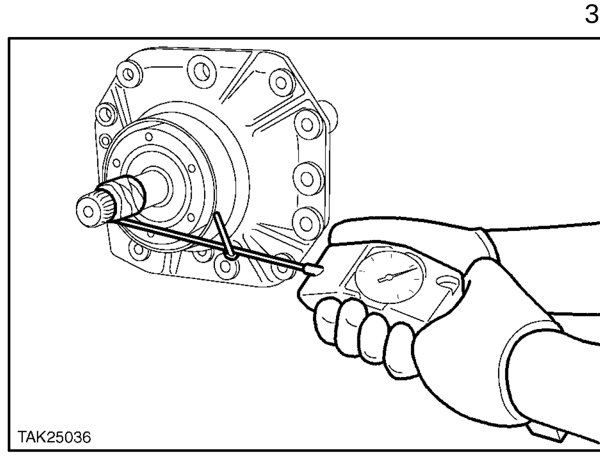
39

Pinion Preload

Tighten the ring nut (using tool no. **297511**) in incremental steps to eliminate any bearing end freeplay.

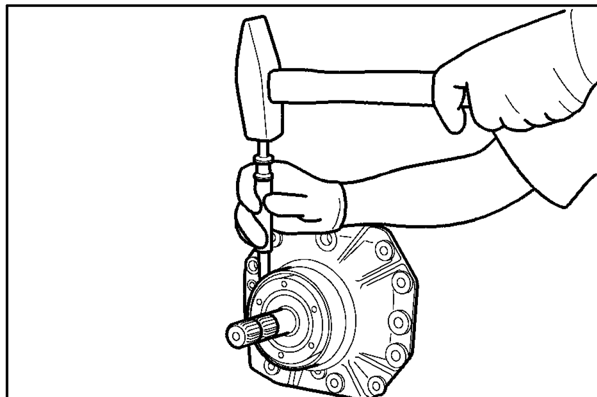
Using a spring torque meter with a piece of string wrapped around the pinion shaft, ensure the preload is within 9.2 – 13.7N.

Adjustment is carried out by gradually increasing the tightening torque of the ring nut.



40

Once the correct preload is obtained lock the pinion ring nut to the pinion shaft.

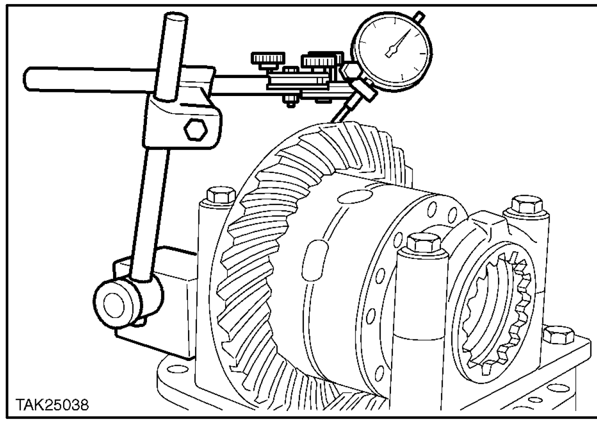

TAK25037

41

Crown Wheel Backlash

Position a magentic–base dial gauge on the differential carrier and record the backlash. Ensure the stylus touches the crown wheel teeth at 90° angle.

Backlash should be 0.18mm – 0.23mm.


TAK25038

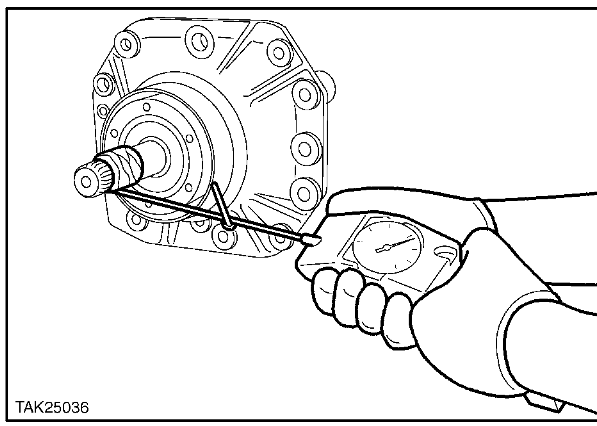
42

If the backlash is too small, loosen the locknut on the same side as the crown wheel and tighten the locknut on the opposite side by the same amount.

If the backlash is too big, loosen the locknut on the opposite side to the crown wheel and tighten the locknut on the same side as the crown wheel.

To check the combined differential and pinion preload perform the same test as before using the spring balance and string on the pinion shaft.

The combined preload should be Pinion Preload + (1.53 – 2.29N).


TAK25036

43

If the combined preload is below the minimum then tighten the locknuts on each side. If the combined preload is above the maximum, loosen both locknuts by equal amounts.

SECTION 25 - FRONT AXLE

Chapter 3 - Front Axle

TABLE OF CONTENTS

IDENTIFICATION - SPECIFICATIONS

P/N **CNH**	**85824329**	**85824333** **85824341**	**85824337** **85824335**
P/N **Carraro**	140968	138198 138197	138015 138196
Type of axle	26/16	26/16	26/16
Overall width	2080	2080	2080
Planetary reduction	6.00/1	6.00/1	6.00/1
Crown wheel and pinion reduction	2.385/1	2.055/1	2.130/1
Total reduction	14.308/1	12.33/1	12.80/1

Number of satellites (per side) 3
Hub oil capacity.......... 2 x 0.7 litre
Differential housing oil capacity .... 7 litres
Lubricants .... (see Driver's Manual)
Brake .... none
Number of discs .... none
Differential lock .... none

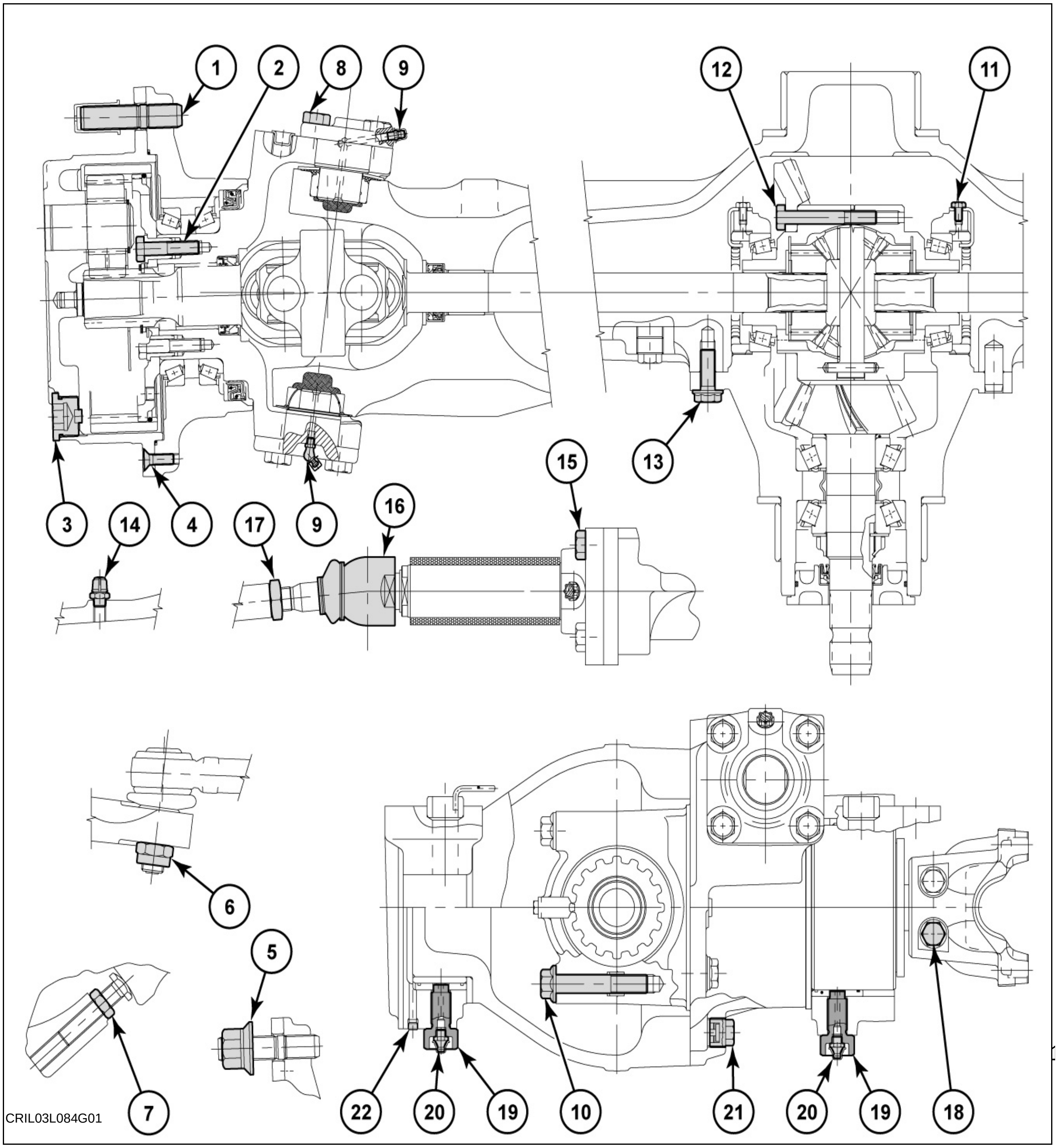
CLEARANCES AND ADJUSTMENTS

Backlash of drive pinion and ring gear.......... 0.18 to 0.25 mm
Preload on drive pinion bearings .... P = 92 to 137 Nm
Total preload on crown wheel and pinion.......... (P+ 43 Nm) to (P+ 64 Nm)
Preload on hub pivots .... Not adjustable, pre-defined in factory
Air gap clearance on steering lock detector.......... none
Steering lock stops.......... RH side 33 mm, LH side 44 mm

SEALING AND ADHESIVE PRODUCTS

Loctite 510
Loctite 270
Loctite 638

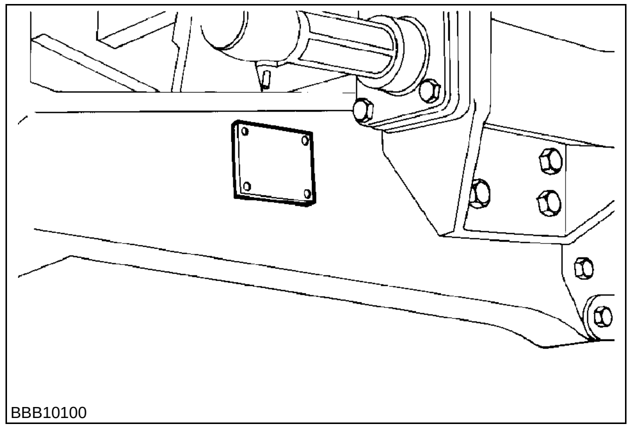
SPECIAL TORQUE SETTINGS



SPECIAL TORQUE SETTINGS

1	Wheel stud	70 Nm
2	Stub axle screw	95 Nm
3	Plug	80 Nm
4	Cover screw	25 Nm
5	Wheel nut	350 Nm
6	Steering ball-joint nut	165 Nm
7	Pivot stop lock-nut	150 Nm
8	Pivot shaft screw	120 Nm
9	Grease fitting	8 Nm
10	Differential cap screw	266 Nm
11	Set screw	13 Nm
12	Crown wheel screw	95 Nm
13	Differential pinion screw	169 Nm
14	Vent	10 Nm
15	Cylinder bearing screw	120 Nm
16	Cylinder ball-joint	300 Nm
17	Steering rod lock-nut	250 Nm
18	Universal joint yoke	57 Nm
19	Grease-fitting support	84 Nm
20	Grease fitting	8 Nm
21	Plug	60 Nm
22	Plug	10 Nm

The type of axle, the serial number, the transmission ratios, the reference number, the oil capacity and the type of grease are written on the plate.

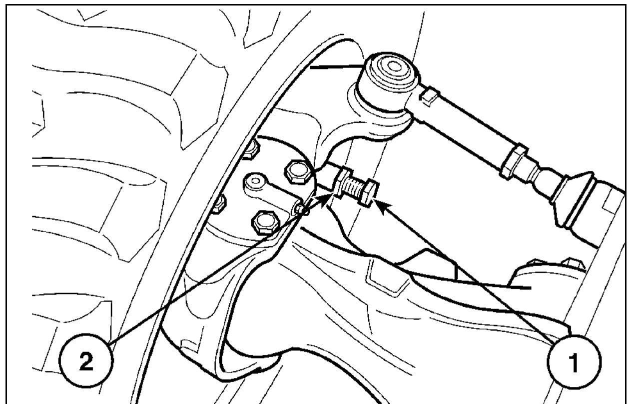


BBB10100

TOE-IN ADJUSTMENT

Steering stops (1) are mounted at either end of the axle.

These stops are adjustable to prevent the tires touching any part of the vehicle when the wheels are turned to the LH or RH steering lock. They are held by a nut (2).

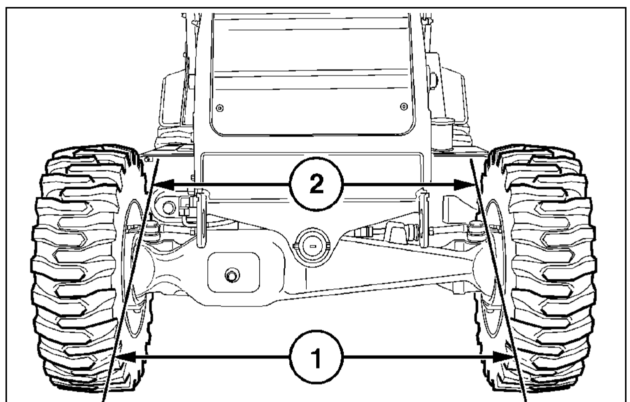


BRB0506C

The measurements to check the toe-in of the front wheels must be taken at the centre of the hub.

Measure the distance between the inner faces (wheel rim to wheel rim) at the front and rear of the front axle. The difference between (1) and (2) must lie within the following values:

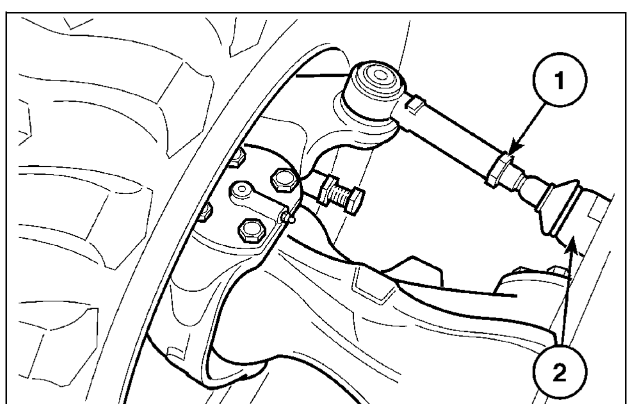
The toe-in must be 0 to 2 mm.



BRD0910B

To adjust the toe-in of the front wheels, loosen the lock-nuts (1), screw in or unscrew the cylinder rod (2). Retighten the lock-nuts (1).

1. Lock-nut
2. Cylinder rod



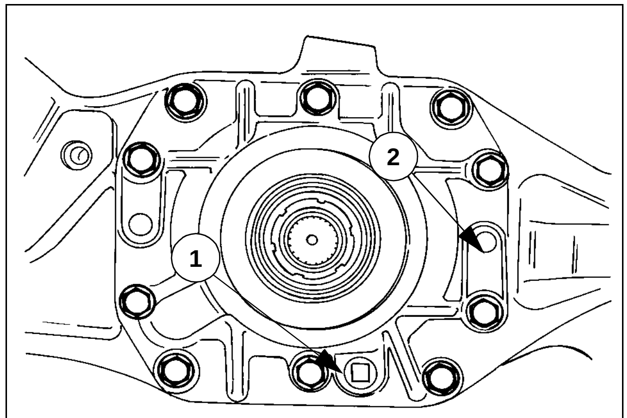
BRB0506A

FRONT AXLE - Differential housing

Oil capacity: 7 litres

Level plug (2)

Drain plug (1)

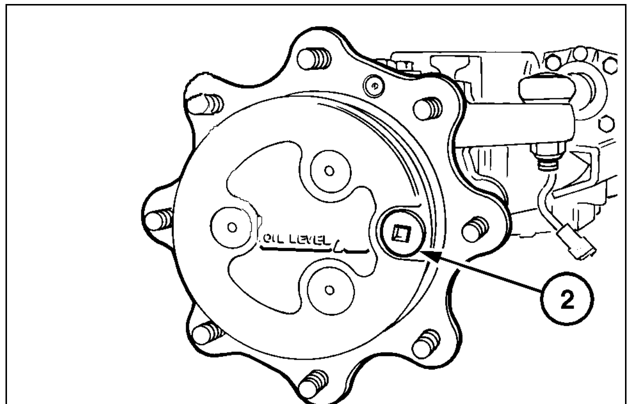


BSD1566A

Hubs

Oil capacity: 0.7 litre

Level plug and drain plug (2)



BSD1550A

SERVICING PARTS - without removing the axle

Steering cylinder

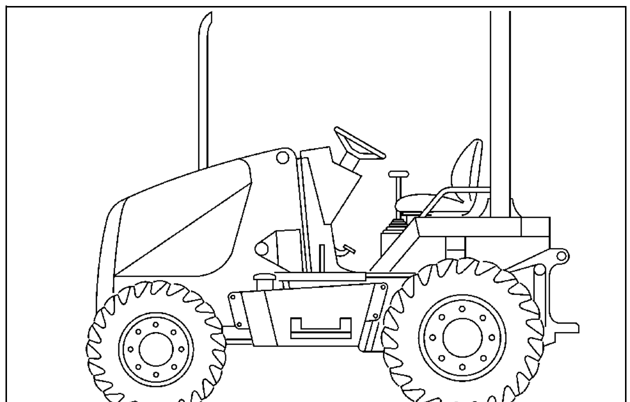
Hub and planetary reduction assembly

Stub axle pivot assembly

Stub axle casing

Shafts, seals and bushes

Drive pinion seal



2505001

SERVICING PARTS - with axle removed

Differential

Pinion gear assembly

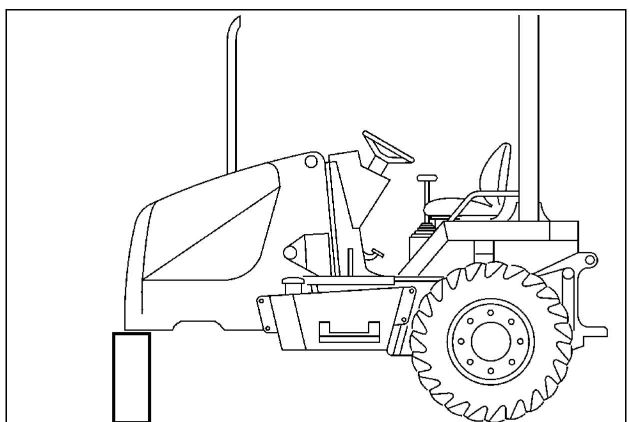
Adjustment of front axle

Drive pinion - ring gear tooth space

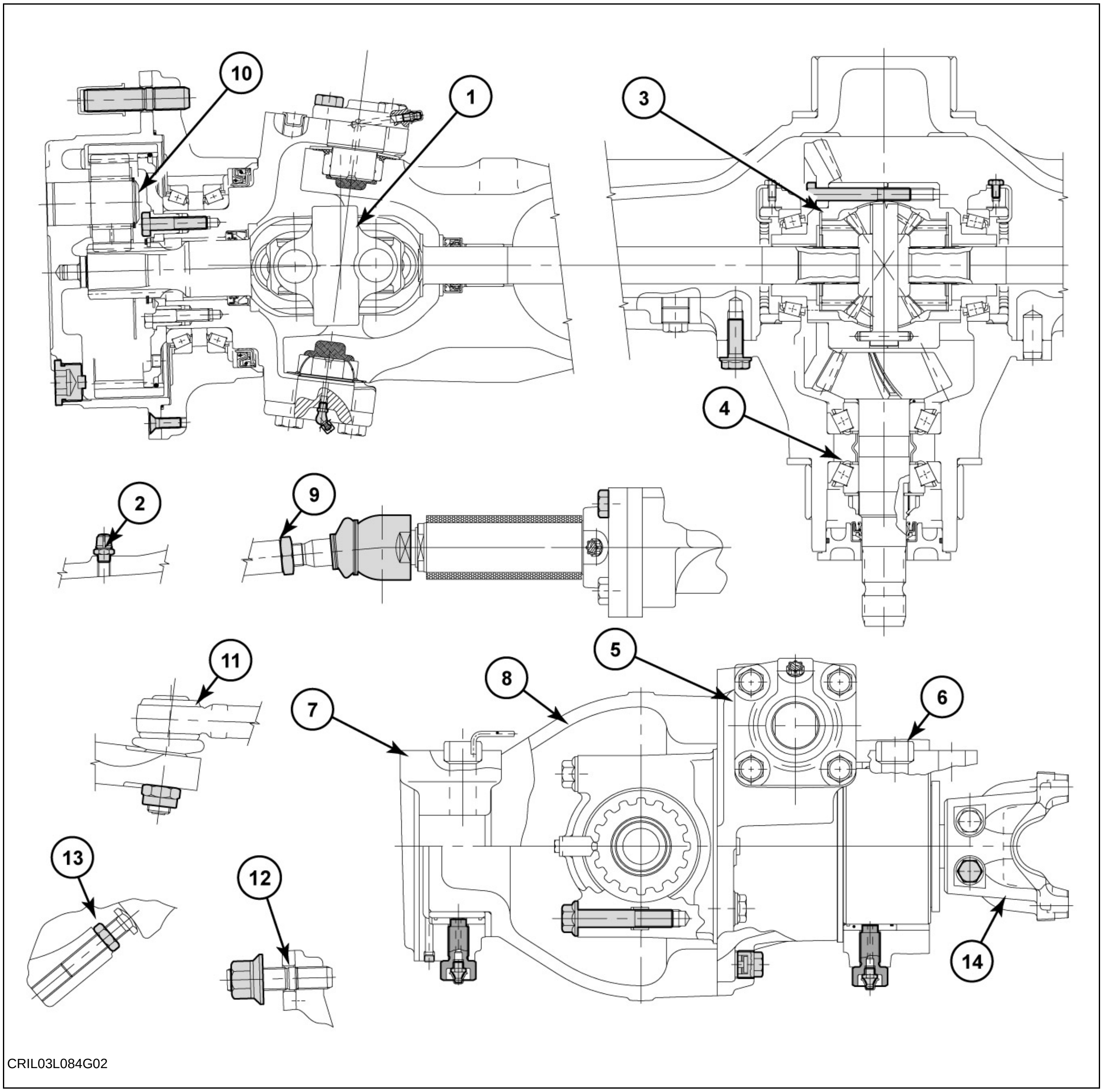
Drive pinion bearing preload

Backlash of ring gear and drive pinion

Differential bearing preload



2505002



Front axle - Cross-sectional view

1. Universal joint double seal
2. Central housing breather
3. Ring gear and differential
4. Drive pinion
5. Steering cylinder
6. Rear axle pivot
7. Front axle pivot
8. Axle central housing
9. Tie rod
10. Hub and planetaries assembly
11. Steering ball joint
12. Stud bolt
13. Stop screw
14. Universal joint yoke

TROUBLESHOOTING

IMPORTANT: *At each repair, always determine the cause of the problem and eliminate it to prevent it from occurring again.*

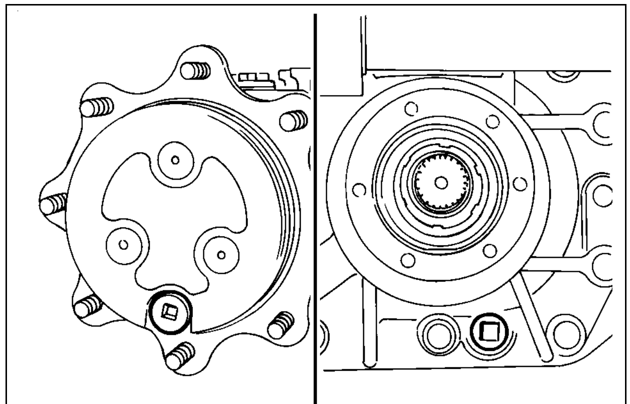
PROBLEM	POSSIBLE CAUSES	REMEDIES
The steering is blocked or stiff.	1. Not enough oil in the tank. 2. Air present in the circuit. 3. Pump pressure limiter defective. 4. Pump worn. 5. Steering cylinder leak. 6. Control valve spool damaged. 7. Steering column broken or damaged. 8. Metering device worn or damaged.	1. Top up the oil level. 2. Check the tightness of the unions and the condition of the pipes, bleed the air from the circuit. 3. Check the circuit pressure. 4. Inspect and repair. 5. Inspect and repair. 6. Inspect and repair. 7. Inspect and repair. 8. Inspect and repair.
The steering goes off-centre.	1. Excessive play in the steering linkage ball joints. 2. Steering cylinder leak. 3. Control valve spool stuck or worn. 4. Torsion bar weak or broken. 5. Incorrect setting of control valve spool. 6. Metering device worn or damaged.	1. Inspect and replace. 2. Inspect and repair. 3. Inspect and replace. 4. Inspect and repair. 5. Check and adjust. 6. Inspect and replace.
Front wheel steering movements are jerky.	1. Steering cylinder leak. 2. Control valve spool stuck. 3. Torsion bar weak or broken. 4. Metering device worn or damaged.	1. Inspect and repair. 2. Inspect and repair. 3. Inspect and replace. 4. Inspect and replace.
Pump noisy.	1. Not enough oil in tank. 2. Air present in the circuit. 3. Water in the oil.	1. Top up the oil level. 2. Check the tightness of the unions and the condition of the pipes, bleed the air from the circuit. 3. Drain and replace the oil.

DISASSEMBLY

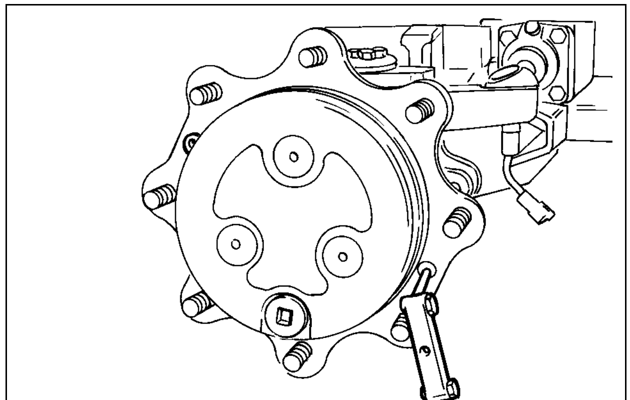
Planetary reduction gear and wheel hub assemblies

Position the hub filling/draining plug at the lowest possible level.

Drain the oil from the hub and the differential casing.

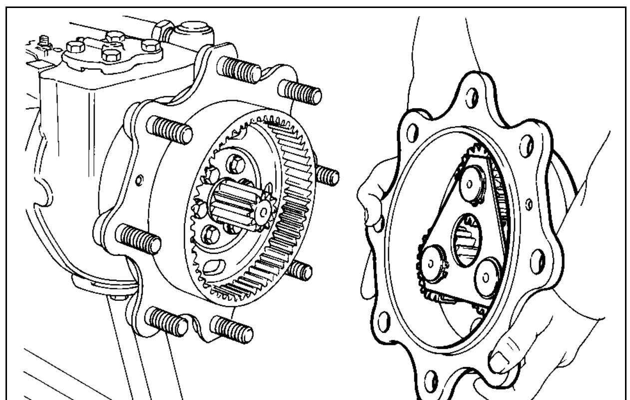

BSD1551A

Remove the two Allen head satellite-carrier attaching screws with the hub.


BSD1552A

Extract the hub using the extraction slots.

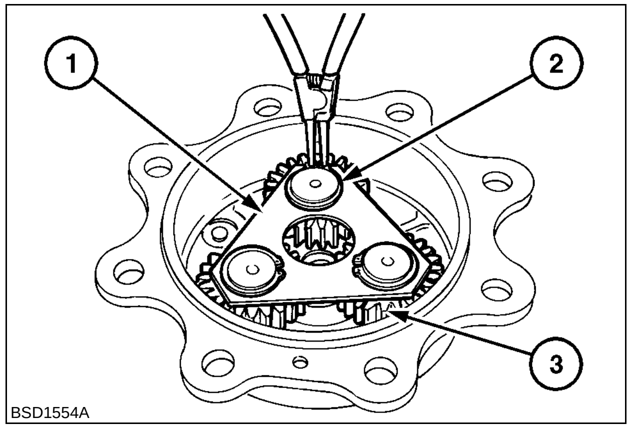
Remove and discard the seal.


BSD1553A

Extract circlips (2) and remove plate (1).

Remove the satellites (3) and retain the needles of the bearings.

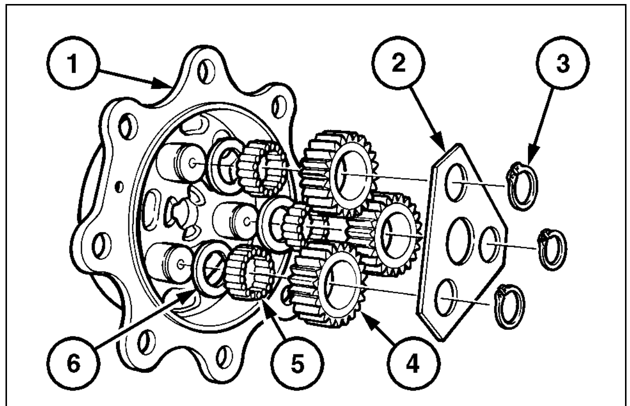
Retain the thrust washers.



BSD1554A

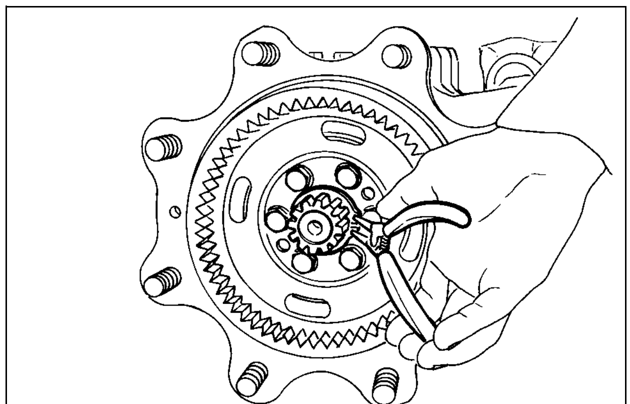
Inspect the items, if they are worn or damaged, replace them before reassembling.

1. Satellite-carrier
2. Plate
3. Circlips
4. Satellite pinions
5. Needle bearings
6. Thrust washer

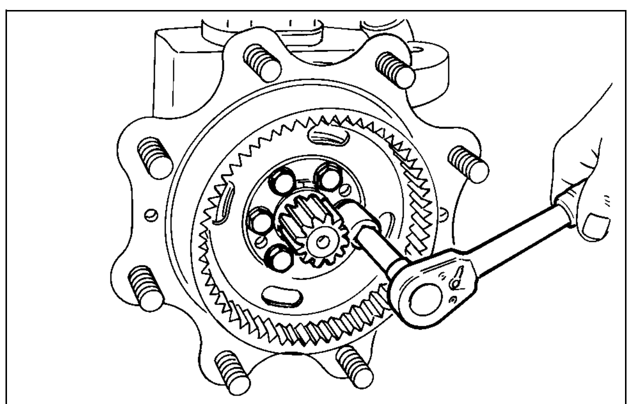


BSD1555A

Extract the planetary retaining circlips and remove the planetary.

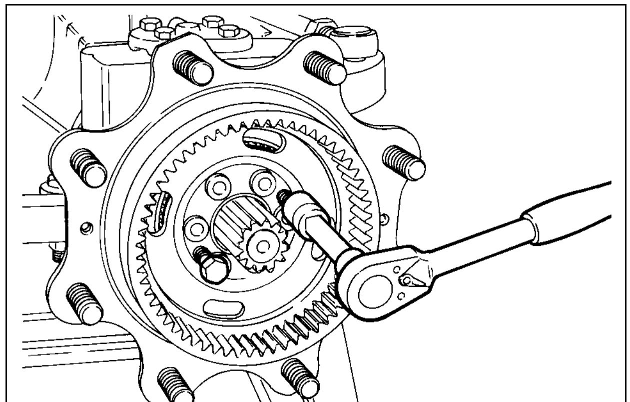

BSD1556A

Remove the bolts from the ring gear carrier.


BSD1557A

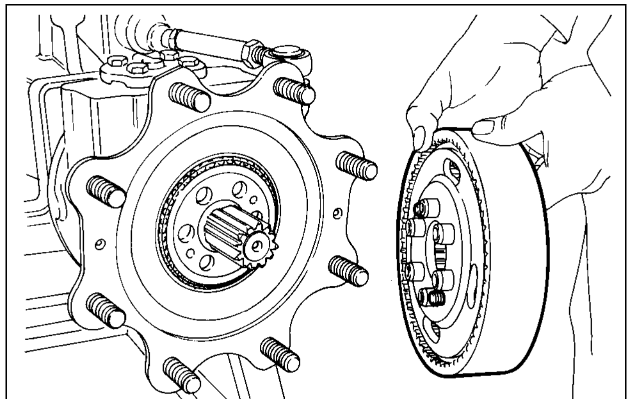
Remove the ring gear carrier by installing the extraction screws in the holes tapped in the ring gear.

Tighten the extraction screws uniformly.



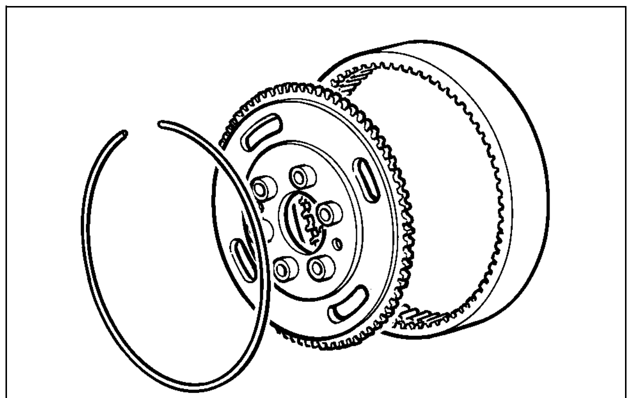
BSD1558A

Remove the large ring gear from the hub.



BSD1559A

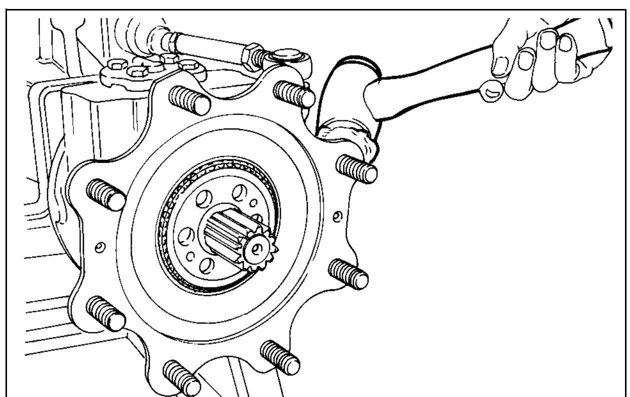
Remove the circlips and ring gear from the ring gear carrier.



BSD1561A

Remove the hub by striking it with a rubber-headed mallet.

Remove the large seal of the stub axle pivot.



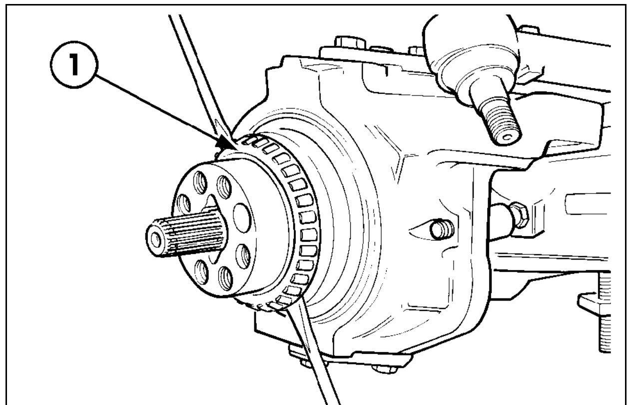
BSD1560A

Hub bearing

Extract the inner cage (1) of the hub bearing by introducing two diametrically opposed levers under the bearing.

Remove the steering ball joint.

IMPORTANT: *Take care not to damage the bearing when extracting it.*

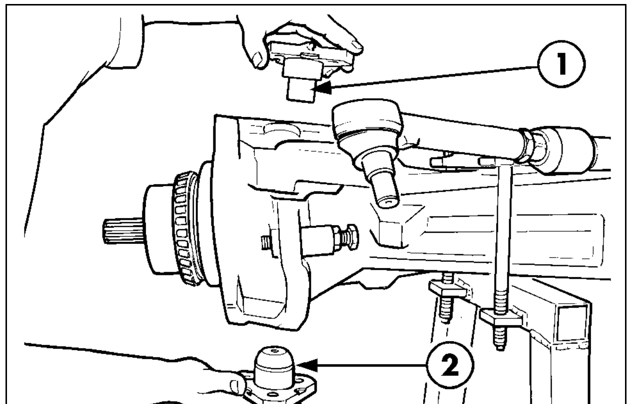


SHB25009

Stub axle pivots

Remove the sub axle upper and lower pivots.

1. Stub axle upper pivot
2. Stub axle lower pivot

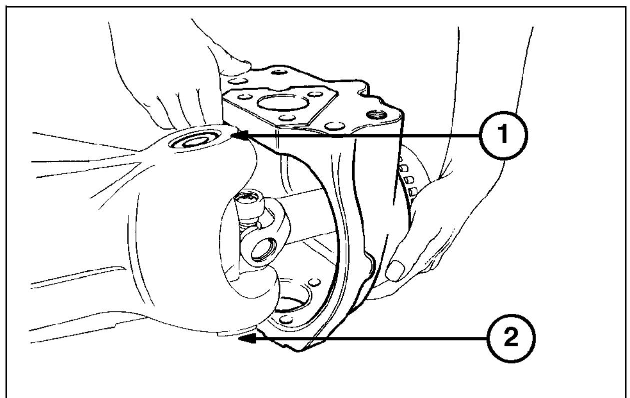


SHB25010

Stub axle

Carefully remove the stub axle from the half-axle housing.

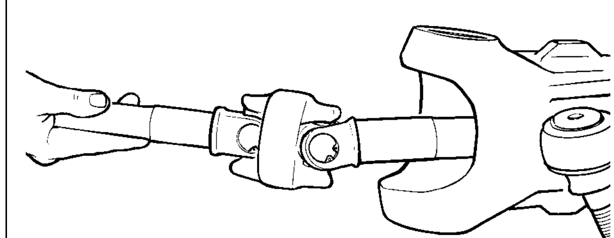
NOTE: *Two spring washers are situated between the half-axle housing and the stub axle, the larger one (1) at the top and the smaller one (2) at the bottom.*



TIB25038

Wheel shaft

Disengage the wheel shaft from the half-axle housing.

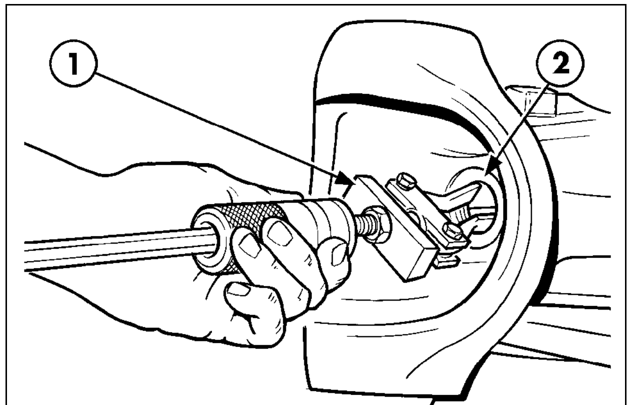


SHB25011

Removal of the half-axle housing bush and seal

Use tool P/N **380000985** to extract the seal and bush from the half-axle housing.

1. Extractor
2. Oil seal

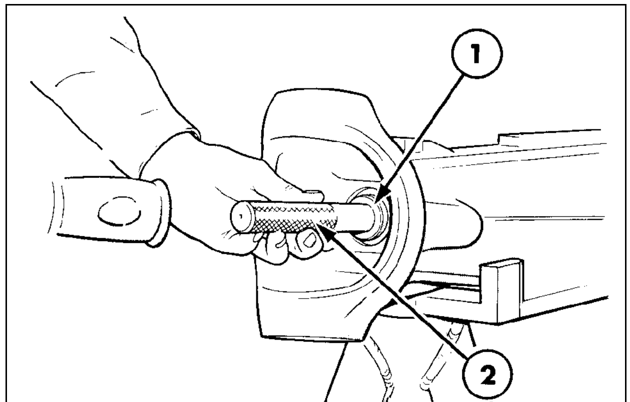


SHB25048

Reinstallation of stub axle bush and seal

Thoroughly clean the stub axle recess before installing a new seal and bush. Use tool kit P/N **380000563** and strike gently with a rubber-headed mallet.

1. Bush installation tool
2. Tool handle

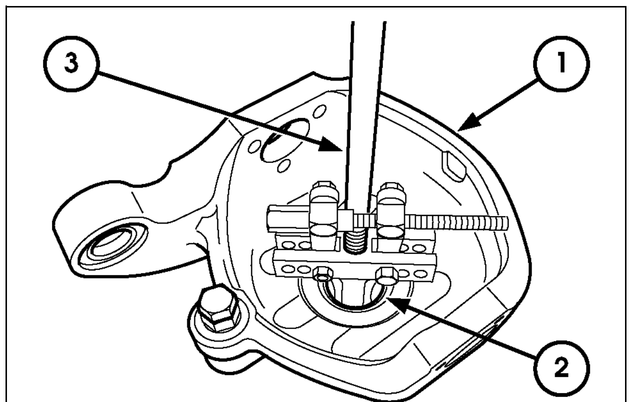


TIB25045

Removal of stub axle seal

Remove the seal from the stub axle housing using tool P/N **380000986** and a hammer extractor P/N **380000987**.

1. Stub axle
2. Union
3. Hammer extractor

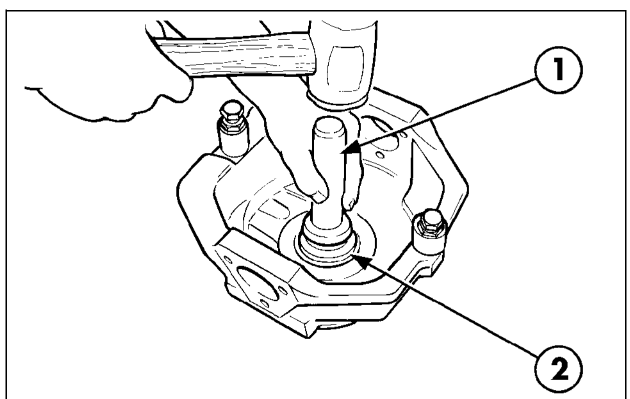


TIB25032

Reinstallation of stub axle seal

Reinstall the seal and bush in the stub axle housing using tool P/N **380000985**.

1. Tool handle
2. Installation tool

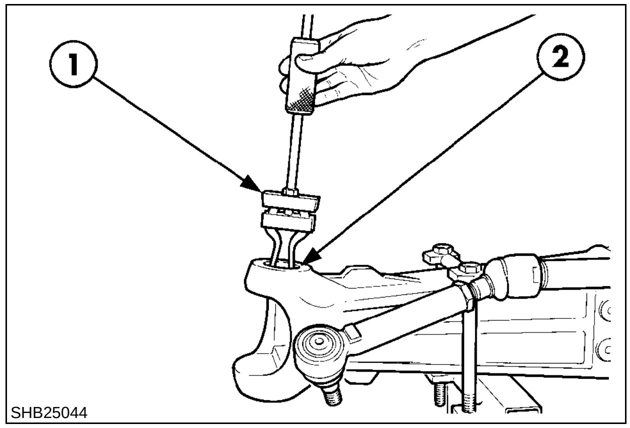


SHB25012

Removal of pivot bushes

Remove the pivot bushes using a hammer extractor P/N **380000985**.

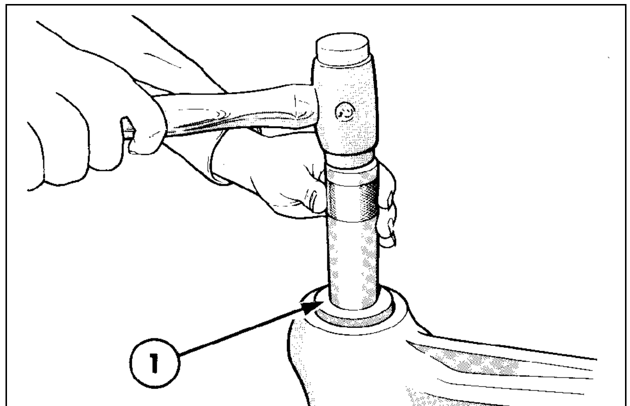
1. Hammer extractor
2. Pivot bush



SHB25044

Reinstallation of the pivot bushes

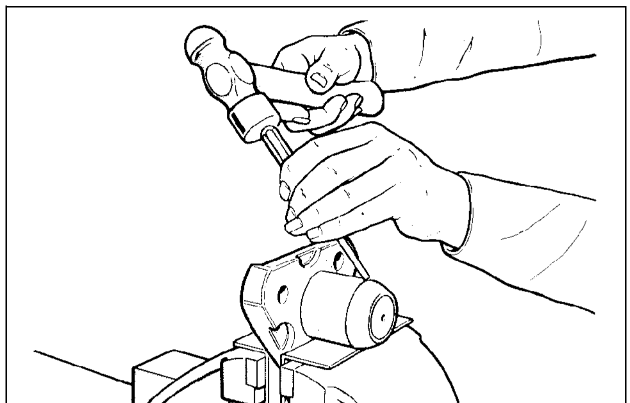
Before installing the bushes, ensure that their housing recesses are perfectly clean. Install the bushes using tool kit P/N **380000563**.



TIB25026

1. Installation tool - Removal of lower pivot shaft cone

Grip the pivot shaft in a vice and drive out the cone with a pin drift.

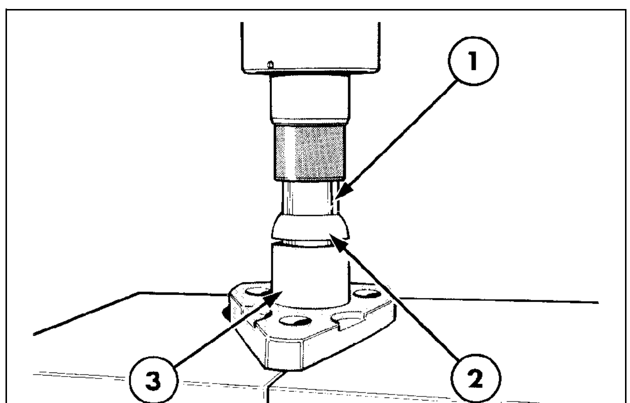


TIB25046

Installation of lower pivot shaft cone

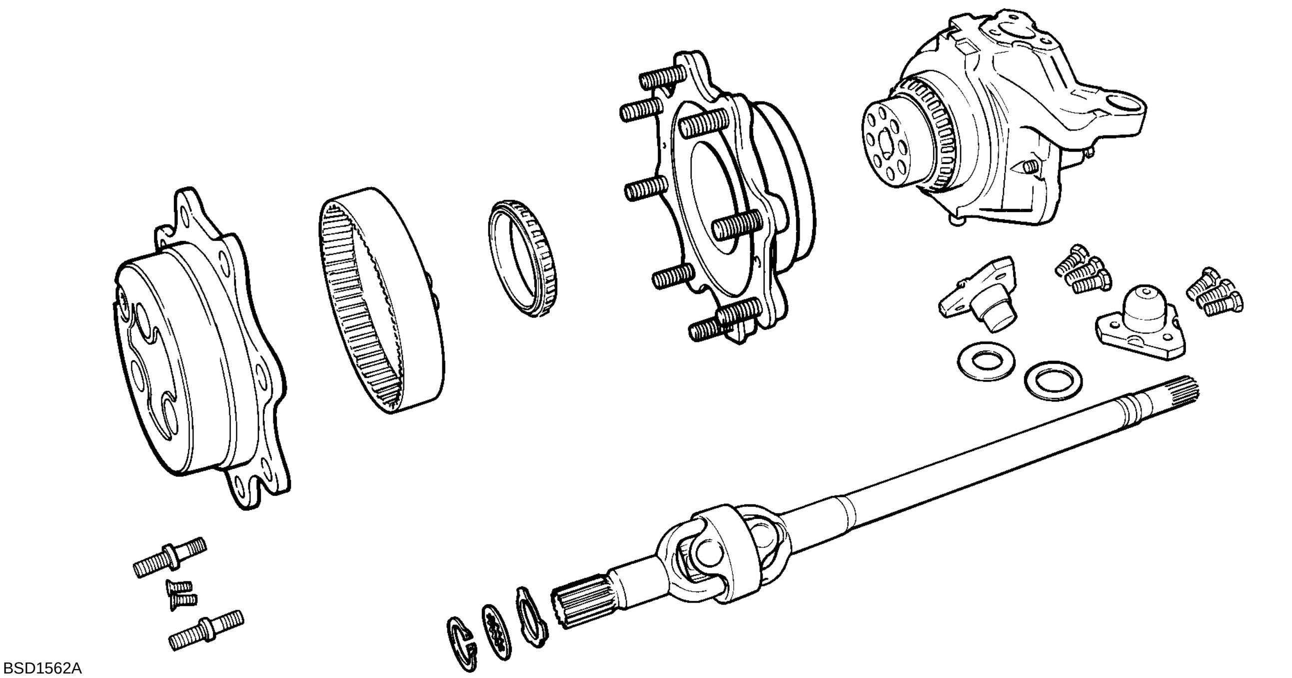
Carefully clean the pivot shaft and check that it is not damaged. Install the cone using a spacer placed under a press.

1. Spacer
2. Pivot shaft cone
3. Pivot shaft



TIB25047

Assembly of reducing gear assembly and wheel shaft



BSD1562A

Reassembly of reducing gear assembly and wheel shaft

Reassemble proceeding in the reverse order of disassembly.

If the wheel stud is replaced, apply Loctite 270 to the threads.

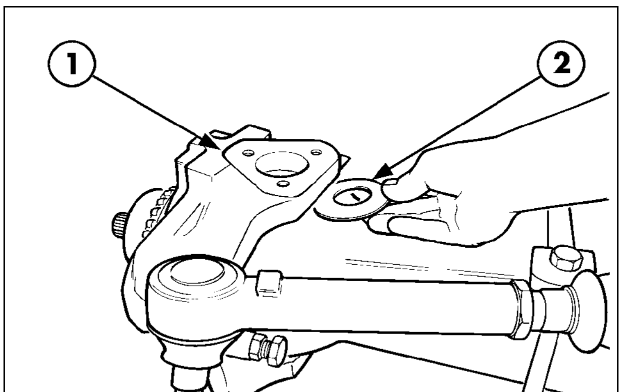
Install the wheel shaft before installing the stub axle.

Use tool P/N **380000610** to fit the large hub seal.

Before installing the stub axle housing, wrap the external splines of the wheel shaft with tape to protect the oil seal of the hub drive shaft.

There is no need to adjust the stub axle clearance. The clearance is determined automatically by two spring washers. The smaller washer must be placed at the bottom of the stub axle and the larger washer at the top.

1. Stub axle casing
2. Spring washer

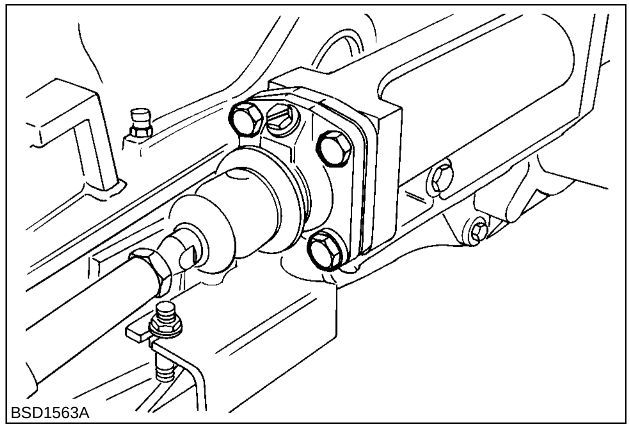


SHB25015

Removal of the steering cylinder

The steering cylinder is mounted in the differential housing and held by four bolts.

It is possible to remove the steering cylinder without removing the axle.



BSD1563A

Removal of the steering cylinder without removing the axle

Loosing the attaching bolts by two turns and turn the wheel to the left to free the cylinder.

Raise the front axle using a jack and immobilize it on supports, then remove the front LH wheel.

Loosen the tie bar attaching fittings.

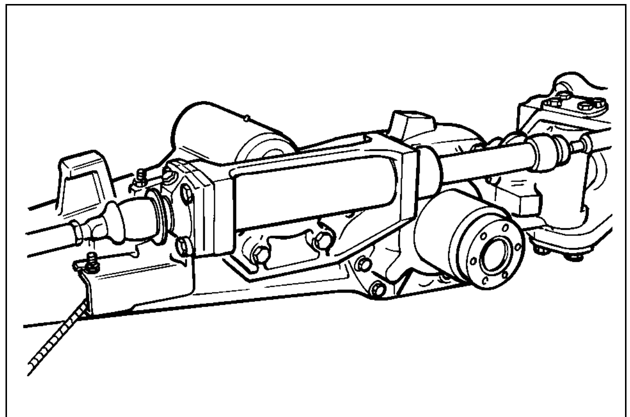
Loosen the cylinder rod ball joints. (Remark: a lot of force must be applied!)

Separate the tie rods from the connecting rods.

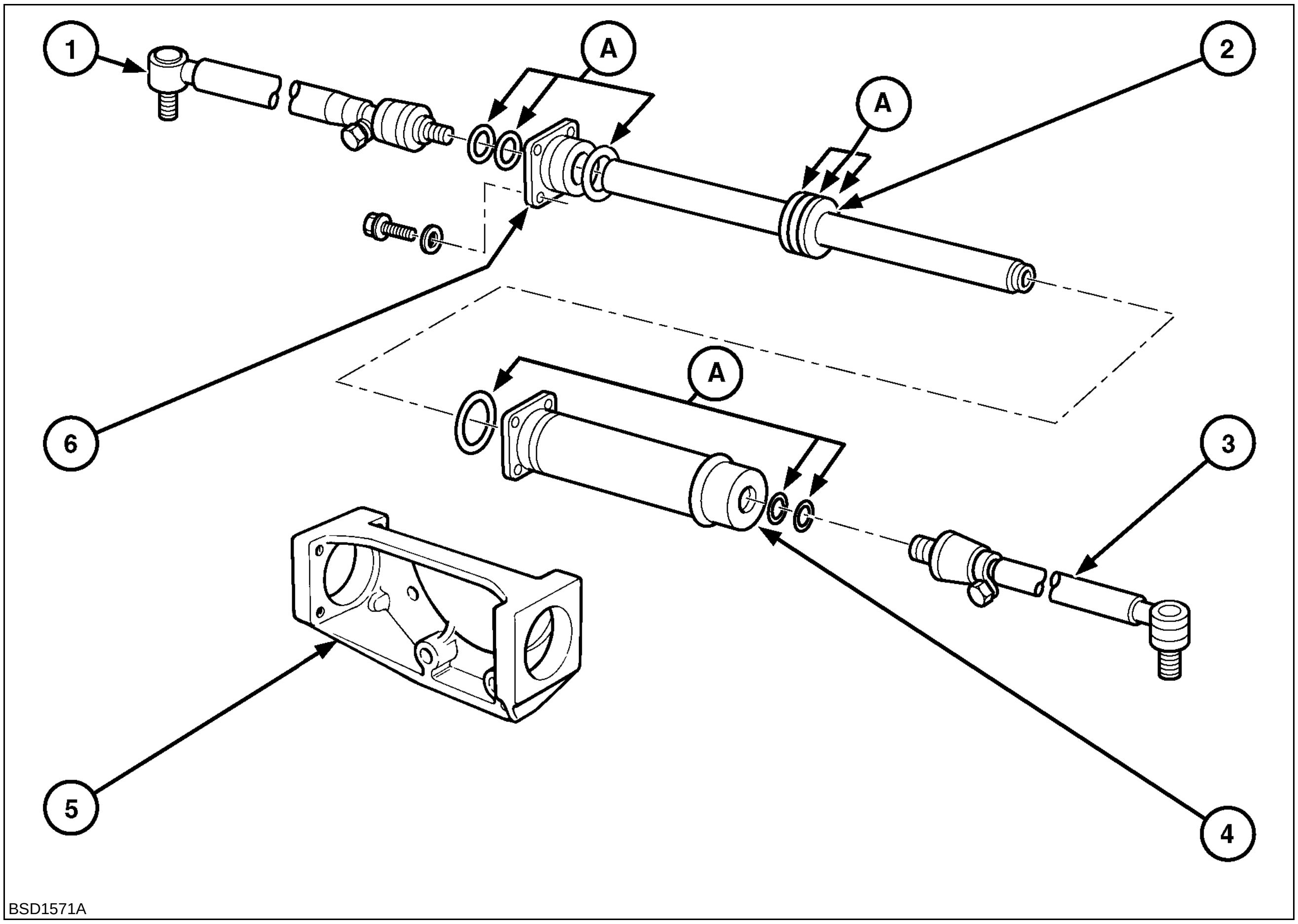
Separate the end of the tie rod and the cylinder rod ball joints from the steering cylinder rod.

Disconnect the hydraulic pipes and the union on the RH side of the cylinder.

Remove the cylinder attaching bolts and withdraw the complete assembly.



BSD1564A



STEERING CYLINDER

1. Tie-rod assembly
2. Rod and piston
3. Tie-rod
4. Cylinder
5. Differential housing
6. Cylinder bearing

A. Set of seals

Spare parts

The rod and cylinder are not available separately as spare parts.

The seals and wear bushes are only supplied in complete kits.

Reassembly of the steering cylinder

Replace all the seals.

Wait for the new piston ring placed over the O-ring to shrink before introducing the piston and rod into the body.

Replace the cylinder bearing.

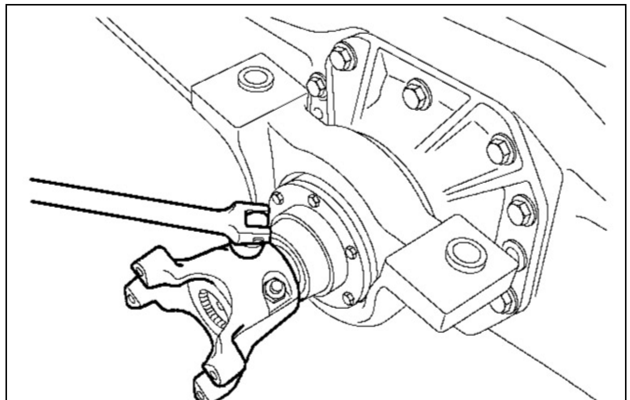
Put the steering cylinder back in place.

Removal of the differential

Remove the two hubs and the wheel shafts.

Remove the universal joint yoke in order to remove the drive pinion seal.

Drain the oil from the differential housing.



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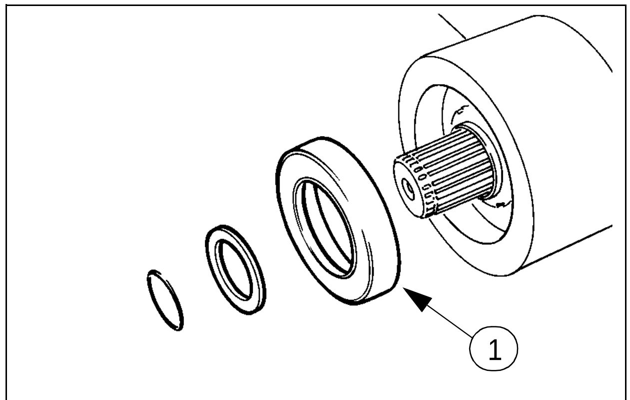
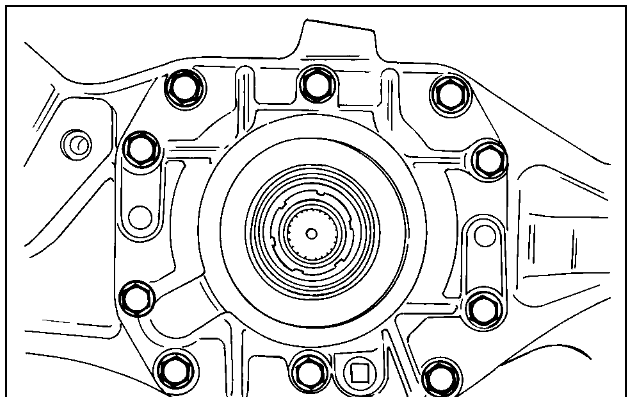
Withdraw the sealing box (1) from the drive pinion.



BSD1565A

Remove the differential housing attaching screws.

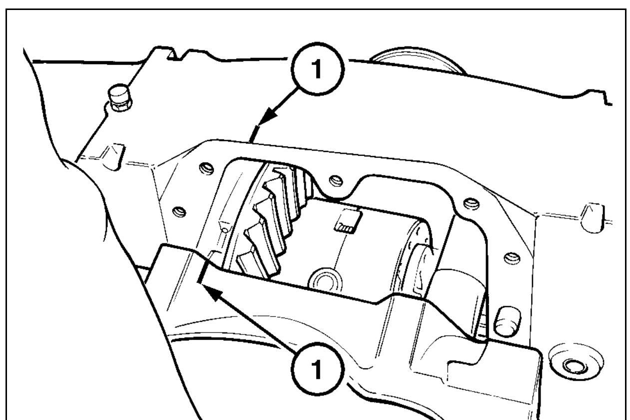


BSD1566A

Remove the differential.

Mark the position of the differential housing on the ring gear (1) side.

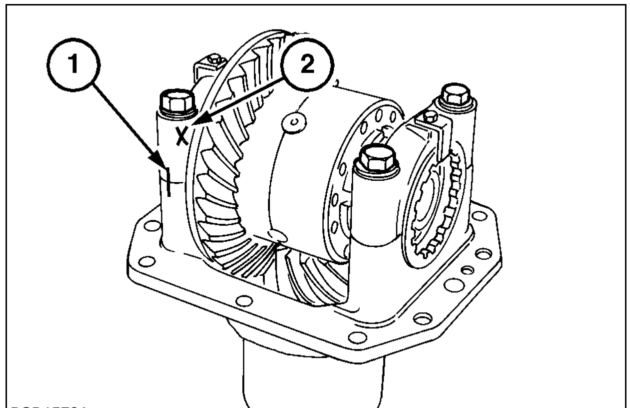
IMPORTANT: *Support the weight of the differential housing with a small pulley block during the removal operation.*



BSD1572A

Disassembly of the differential

Mark the position of the caps (1) and of the ring gear (2). Check and measure the backlash of the drive pinion and the ring gear. (Measured value necessary when reinstalling the previously installed parts).

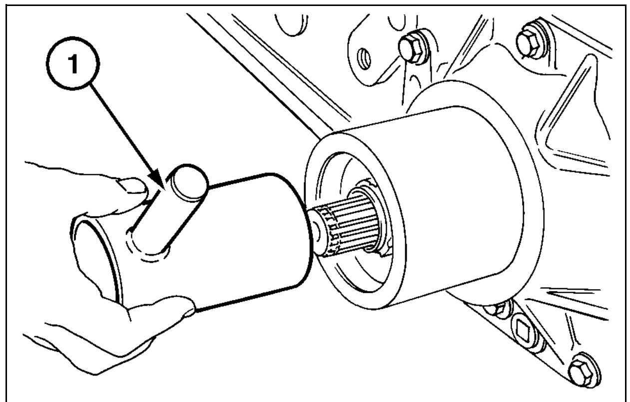


BSD1573A

NOTE: *Before disassembling the differential, remove the nut from the drive pinion.*

Block the ring gear.

Loosen the drive pinion nut using the special wrench P/N **38000021** (1).



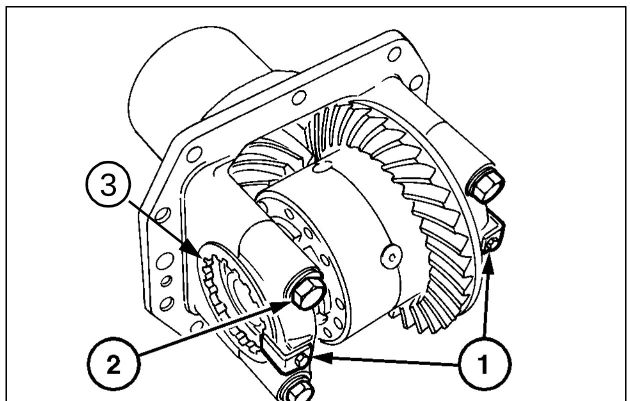
BSD1569A

Remove the screws and remove the locking lugs (1).

Remove the nuts (3) with special wrench P/N **380000406**.

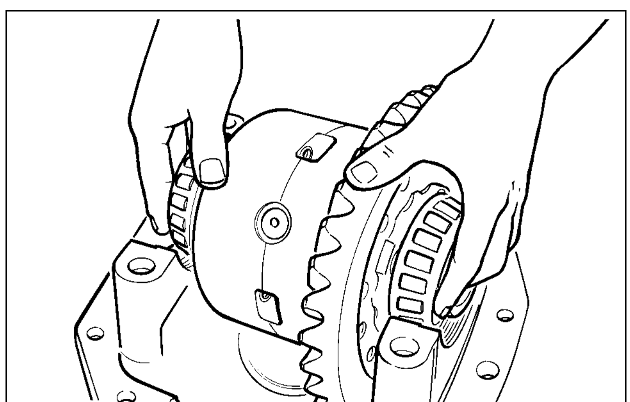
Remove the nuts (2).

NOTE: *On reassembly, the locking lugs must be replaced by new ones.*



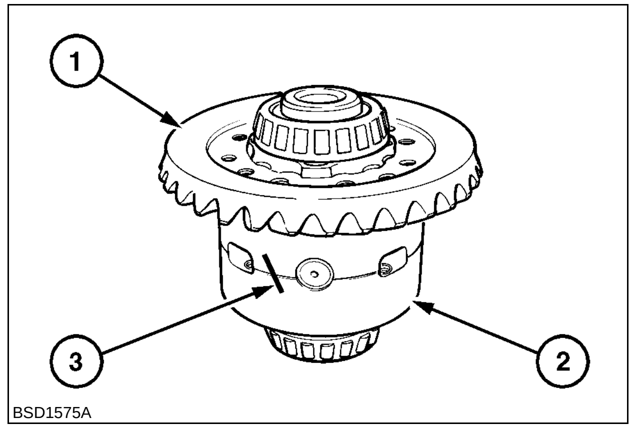
BSD1567A

Remove the differential from the housing and place it on a clean workbench for disassembly.


BSD1574A

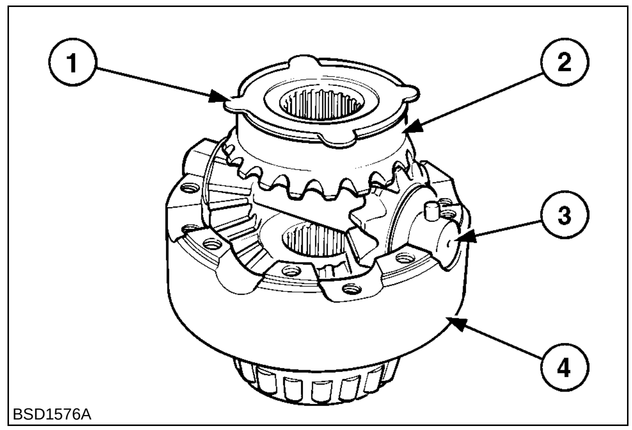
Differential housing (2) and ring gear (1)

NOTE: *Before disassembly, make a pencil mark (3) on the two sections of the differential housing to ensure correct reassembly later on.*



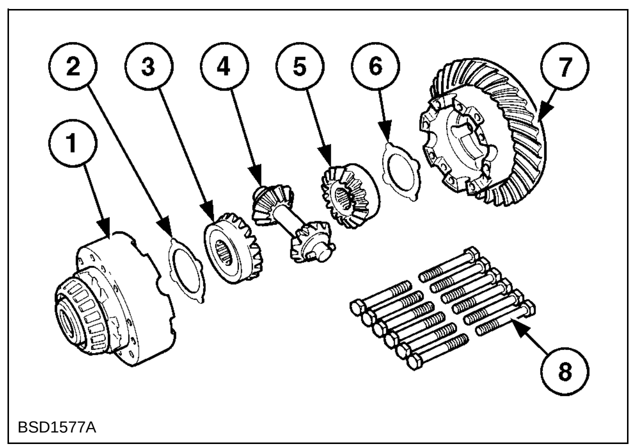
Differential components

1. **1.** Thrust washer
2. **2.** Planetary
3. **3.** Satellite carrier pin
4. **4.** Differential housing



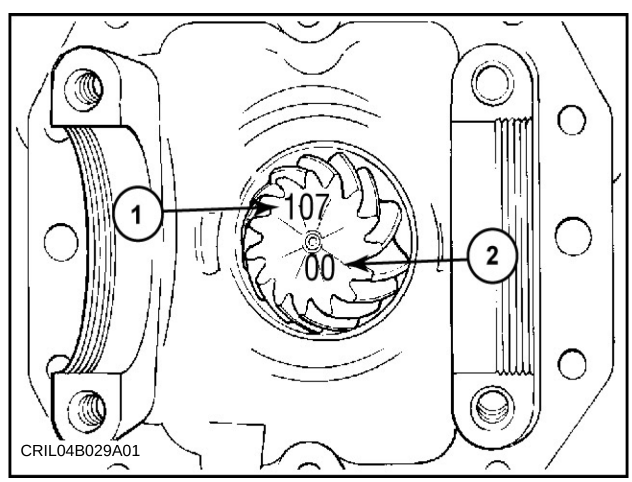
NOTE: *The differential is not of the limited slip type and a single thrust washer is mounted on each side.*

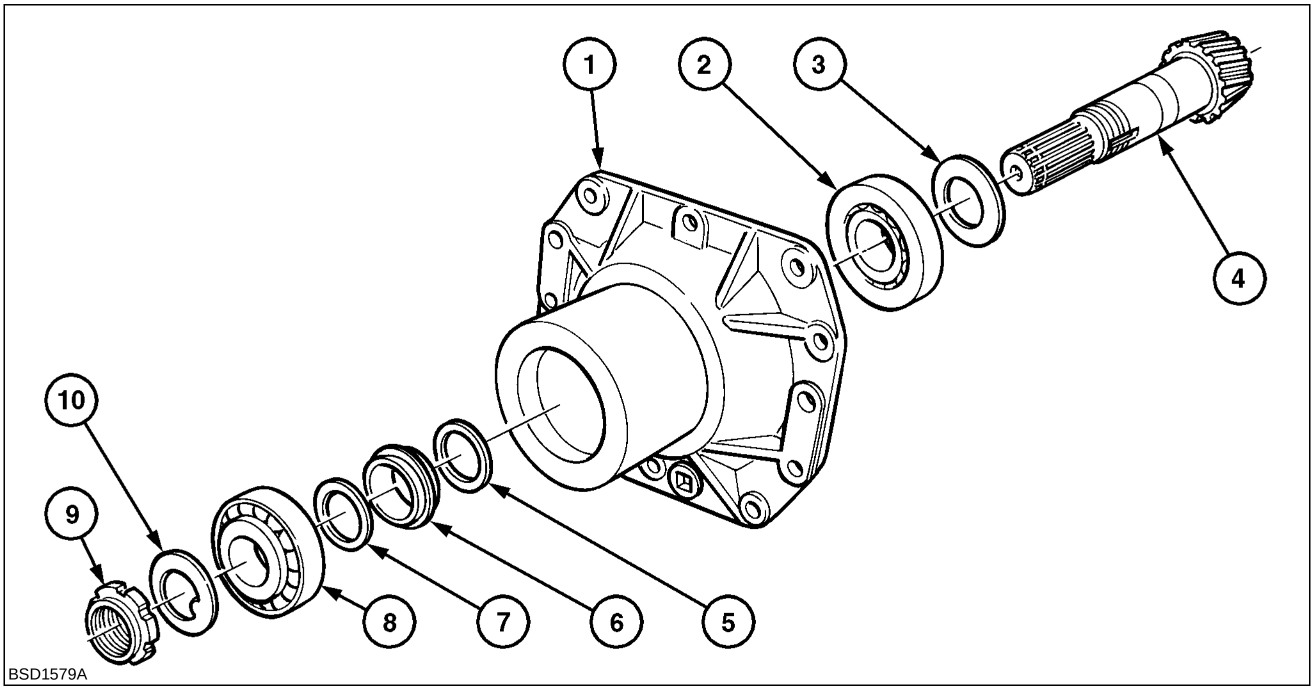
1. **1.** Differential housing
2. **2.** Thrust washer
3. **3.** Planetary
4. **4.** Satellite carrier pin
5. **5.** Planetary
6. **6.** Thrust washer
7. **7.** Ring gear
8. **8.** Attaching screw



Pinion identification mark

1. **1.** Nominal ring gear - pinion distance
2. **2.** Pinion correction factor





Drive pinion components

1. Differential housing
2. Bearing
3. Adjusting shim
4. Pinion
5. Washer
6. Collapsible spacer
7. Washer
8. Bearing
9. Nut
10. Washer

Inspection of differential components

In addition to the normal inspection of the bearings, pinions and ring gear, wear of the gear teeth and splines, inspect:

The thrust washers

The drive pinion nut

To reassemble the differential, proceed in the reverse order of disassembly. The following operations must nevertheless be performed:

If the ring gear and the drive pinion have to be replaced, adjust the crown and pinion and the tooth spacing.

The ring gear and drive pinion must be replaced together.

Replace the collapsible spacer at each disassembly.

Refer to the following description for this operation.

Crown and pinion adjustment

Adjustment of the crown and pinion distance

If components have to be changed, proceed as follows:

Measure the diameter of the differential housing bore.

Dimension **A**

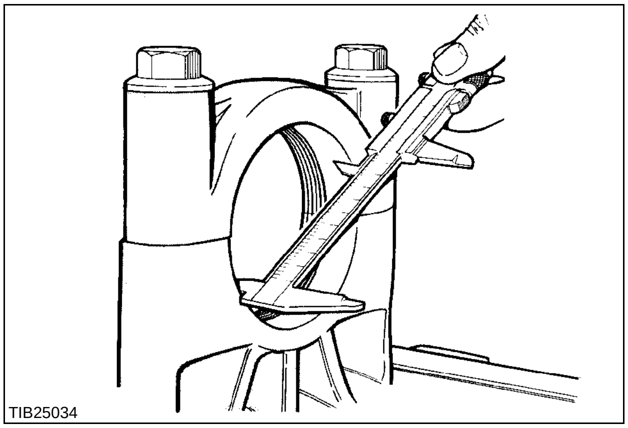
Install the new pinion bearings in the housing and tighten them using tool P/N **380000600**. Check that is still possible to turn the bearings by hand.

Dimension **C** is the measurement to be calculated using the following equation.

C = **B** - Ø of the rod + 1/2 **A**

NOTE: Ø of the rod (**380000600**) = 25 mm.

1. Depth gauge
2. Calibration rod P/N (**380000600**)
3. Drive pinion bearings
4. Bearing tightening tool P/N (**380000600**)
5. Differential housing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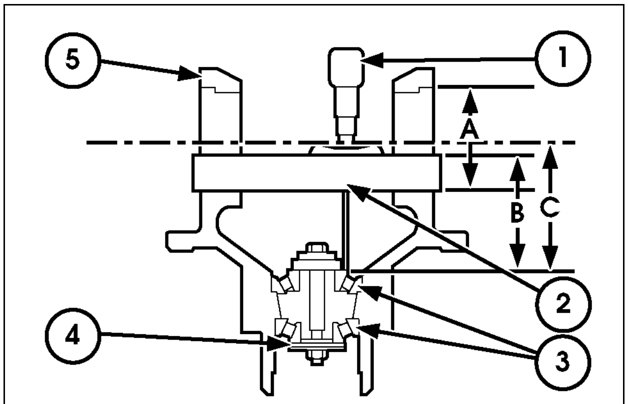


TIB25034-1

Calculation example

Dimension **A** = 90 mm
Dimension **B** = 90.3 mm
C = **B** - Ø rod + 1/2 **A**
C= 90.3 - 25 + 45 = 110.3 mm

Calculation of adjusting shim thickness

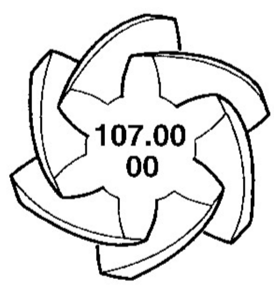
(it is vital to look at the value engraved on the end of the pinion).

Dimension of the pinion
= 107 mm
Correction value
= 00

Calculation of adjusting shim thickness

Shim thickness
= 110.3 - 107 = 3.3 mm

Shims available from 2.5 mm to 3.4 mm by 0.1 mm.



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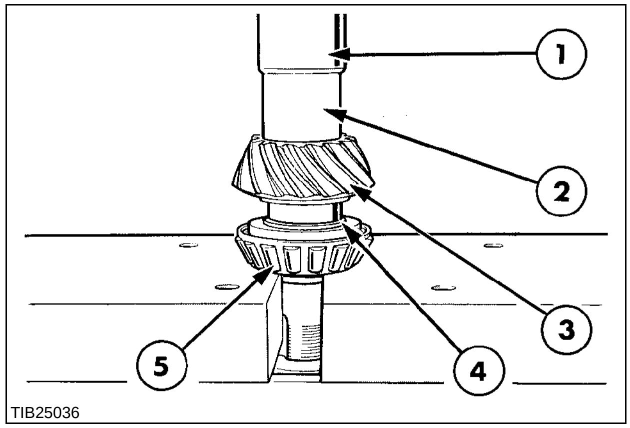
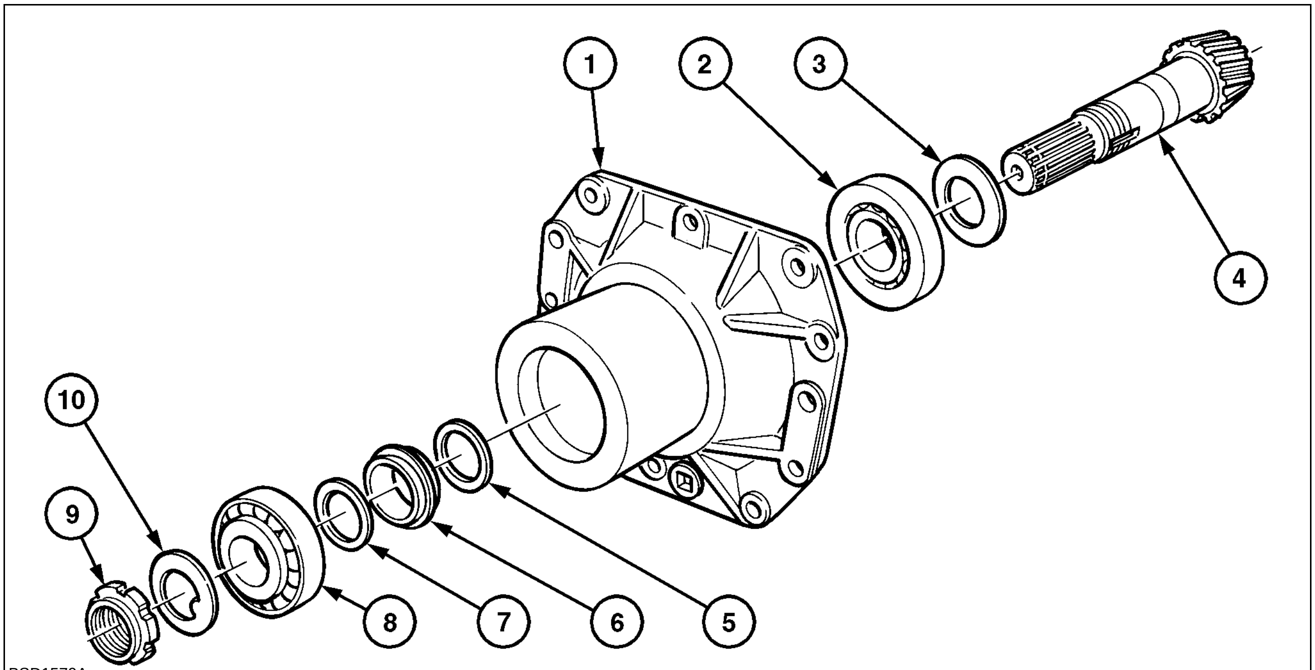
Place the selected shim (4) on the pinion shaft, orienting the chamfered face towards the pinion teeth.

1. Press
2. Sleeve
3. Drive pinion
4. Shim
5. Bearing inner cage



TIB25036

Reassembly of the drive pinion



BSD1579A

1. Differential housing
2. Bearing
3. Adjusting shim
4. Pinion
5. Washer
6. Collapsible spacer
7. Washer
8. Bearing
9. Nut
10. Washer

Mount the pinion (4) equipped with the adjusting shim and the bearing in the housing (1).

Install washer (5), the new collapsible spacer (6) and washer (7).

Install bearing (8), washer (10) and nut (9).

Drive pinion preload adjustment

Manufacture locally a 5-mm thick plate to the following dimensions and weld a nut to the centre of the plate.

A = 110 mm

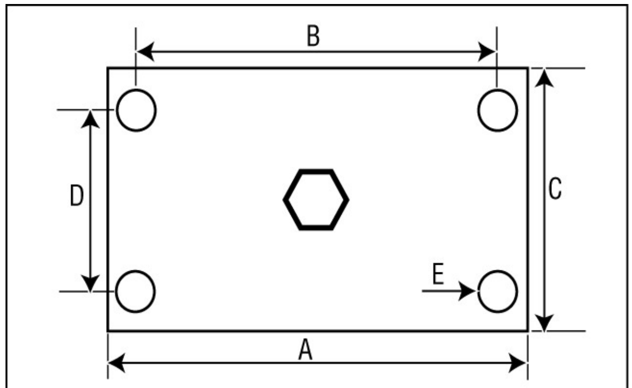
B = 95 mm

C = 65 mm

D = 45 mm

E = Ø 10 mm

NOTE: *This adjustment cannot be done until a new collapsible shim has been installed.*



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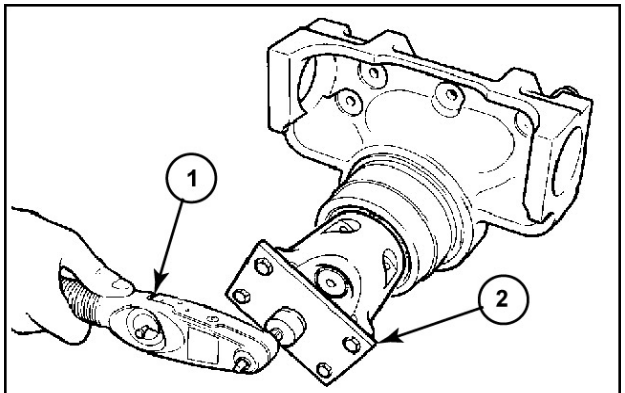
Fix support (2) to the universal joint yoke. Mount a torque meter (1) on the central nut, turn the pinion shaft and record the rotation torque value, tighten the drive pinion nut to obtain a torque P = 92 to 137 Nm.

Use wrench P/N **380000021** to tighten the drive pinion nut, while holding the shaft stationary with the wrench P/N **380000020**.



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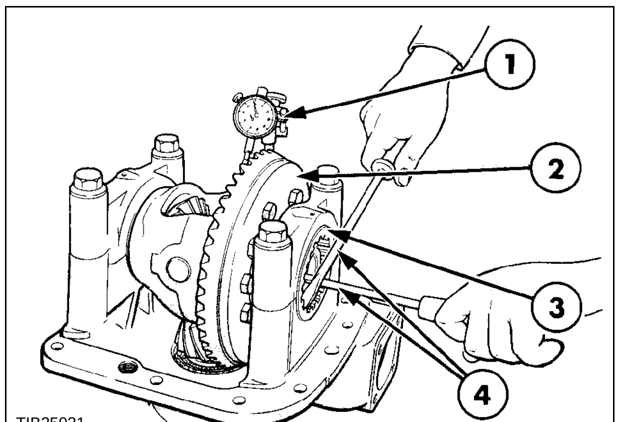
Adjustment of backlash

1. Dial gauge
2. Ring gear
3. Bush
4. Levers



TIB25031

Backlash measurement

New parts between 0.18 - 0.25 mm.

If the removed pinion and ring gear are reinstalled, apply the value measured at disassembly.

Mount the differential in the housing, placing the ring gear on the side of the mark made at disassembly. Hand-tighten the bearing cap screws and check that the caps are in good contact with the bearings.

Tighten the adjusting bush (3) with wrench P/N **380000406**) on the ring gear side to eliminate the play of the differential bearings.

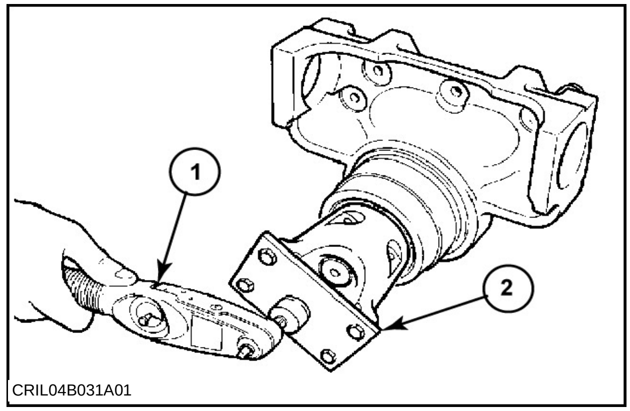
Adjust the backlash of the ring gear and drive pinion by turning the adjusting bushes (3) by the same amount in the opposite direction.

Take measurements at 90° intervals; if the measurements are not identical, adjust the backlash to the position that give the smallest dimension.

Preloading the differential bearings

Check the resistance of the drive pinion and differential bearings.

To determine the preload of the differential bearings (1), compare the rotation torque necessary to turn the drive pinion at the same time as the differential with the rotation torque of the drive pinion alone (recorded previously).
Gradually tighten bush (3) on the side opposite the ring gear until the rotation torque lies between the indicated values.



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Example:

Turn the torque meter slowly:

A. Drive pinion alone:
P = (92 to 137 Nm)
B. Drive pinion and differential:
(P + 43 Nm to P + 64 Nm)
(= 135 to 201 Nm)

When the required torque is obtained

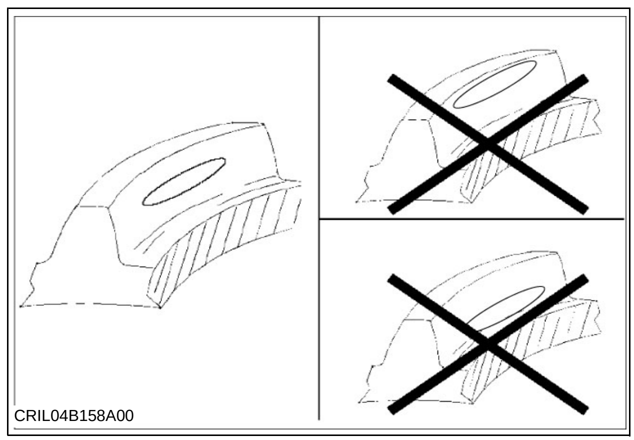
Coat the cap screws with Loctite 270.

Coat the screws with Loctite 270 and install the adjusting bush locking lugs.

Recheck the preload and backlash.

Tighten the cap screws to torque.

Coat the teeth of the ring gear with red hematite, then turn the drive pinion shaft while braking the ring gear to clearly mark the contact surfaces. The mark should be centred on the side and mid-height of the teeth.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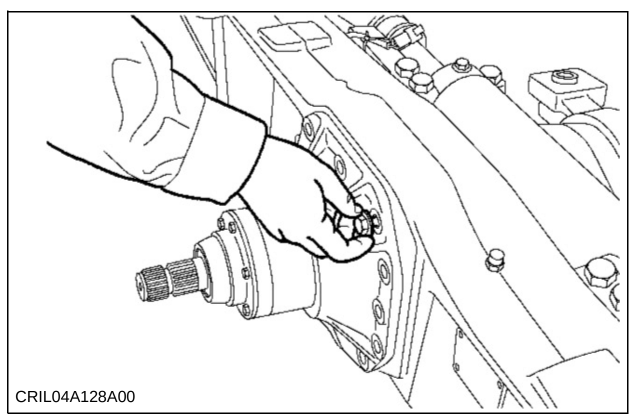
Coat the reducing gear housing joint plane with Loctite 510 sealant.

Coat the centring studs with Loctite 638.

Mount the differential on the axle housing.

Install the attaching screws and tighten them to the required torque.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SECTION 25 - FRONT AXLE

Chapter 7 - Front Axle

TABLE OF CONTENTS

IDENTIFICATION - SPECIFICATIONS

P/N **CNH**	**85821297**	**85821298**
P/N **Carraro**	138074	140060
Type of axle	26/28	26/28
Overall length (mm)	2304	2304
Planetary reduction	6.92/1	6.92/1
Crown wheel and pinion reduction	2.666/1	2.666/1
Total reduction	18.46/1	18.46/1
Differential lock	None	Limited slip
Steering lock stops	Angle of 20° 30' $^{+0}_{-1}$°	Angle of 20° 30' $^{+0}_{-1}$°

Number of satellites (per side) 3
Hub oil capacity .... 2 x 1.3 litres
Differential housing oil capacity .... 10.5 litres
Lubricants .... (See Driver's Manual)
New steel differential disc (worn) .... 1.5 ± 0.03 mm (1.4 mm)
New friction differential disc (worn) .... 1.6 ± 0.03 mm (1.45 mm)
New differential stop disc (worn) .... 2.8 ± 0.03 mm (2.7 mm)

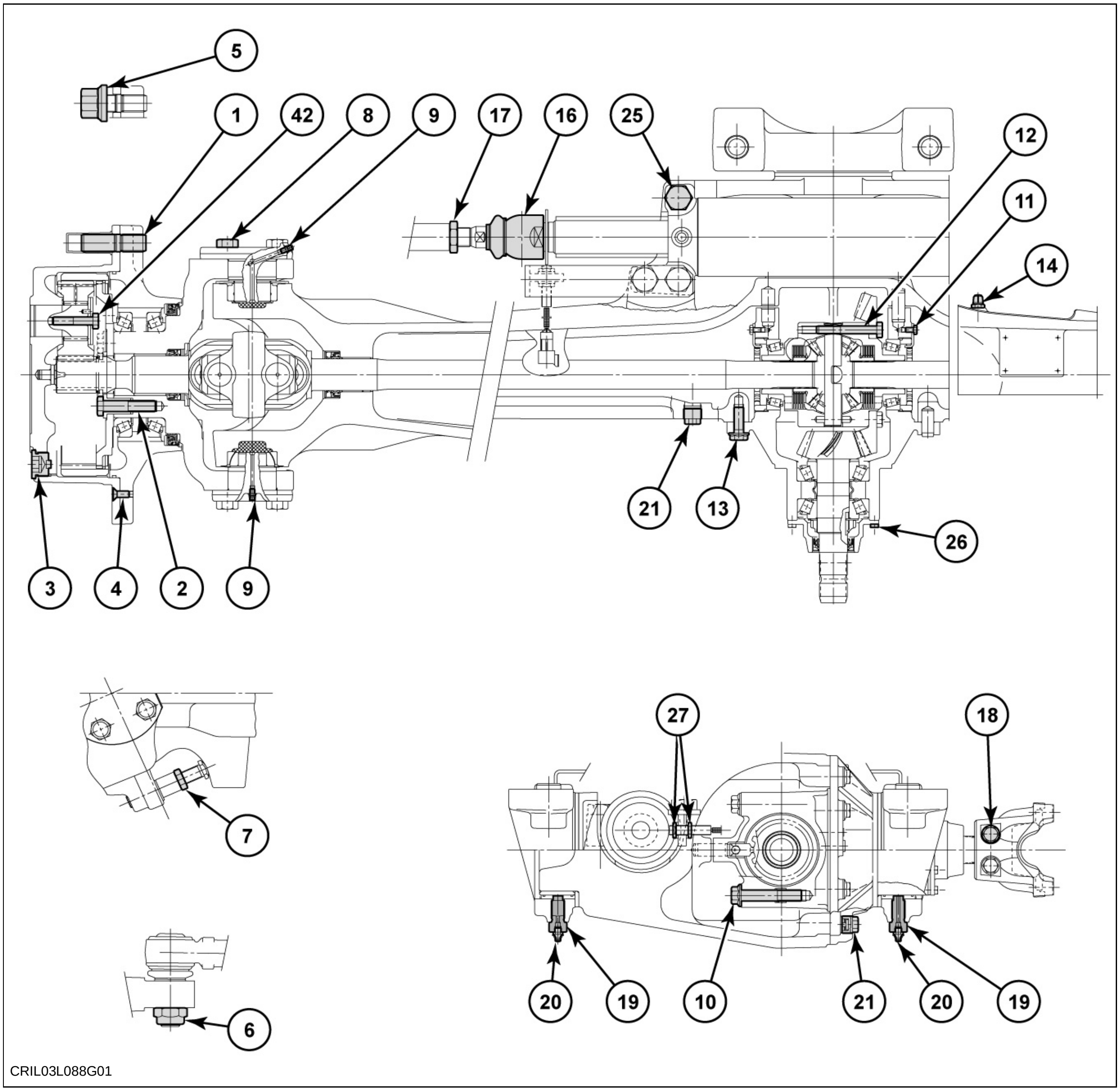
CLEARANCES AND ADJUSTMENTS

Backlash of drive pinion and ring gear .... 0.18 to 0.25 mm
Preload on drive pinion bearings .... P = 92 to 137 Nm
Total preload on crown wheel and pinion .... (P+ 34 Nm) to (P+ 51 Nm)
Preload on hub pivots .... Not adjustable, pre-defined in factory
Air gap clearance on steering lock detector .... 0.5 to 0.75 mm

SEALING AND ADHESIVE PRODUCTS

Loctite 510
Loctite 270
Loctite 638

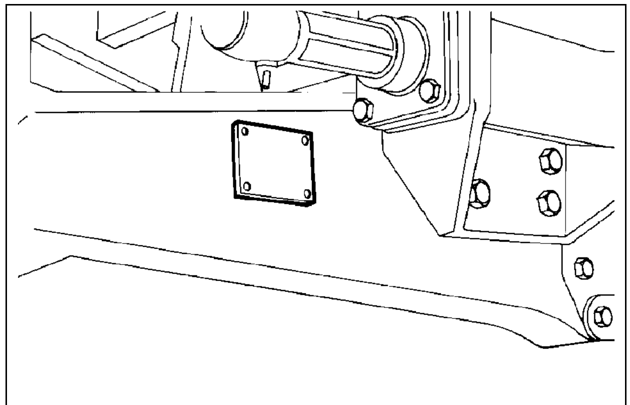
SPECIAL TORQUE SETTINGS



SPECIAL TORQUE SETTINGS

1	Wheel stud	70 Nm
2	Stub axle screw	220 Nm
3	Plug	60 Nm
4	Cover screw	25 Nm
5	Wheel nut	800 Nm
6	Steering ball-joint nut	260 Nm
7	Pivot stop lock-nut	150 Nm
8	Pivot shaft screw	300 Nm
9	Grease fitting	8 Nm
10	Differential cap screw	266 Nm
11	Set screw	13 Nm
12	Crown wheel screw	95 Nm
13	Differential pinion screw	169 Nm
14	Vent	10 Nm
16	Cylinder ball-joint	300 Nm
17	Steering rod lock-nut	250 Nm
18	Universal joint yoke	57 Nm
19	Grease-fitting support	84 Nm
20	Grease fitting	8 Nm
21	Plug	60 Nm
25	Cylinder retaining screw	460 Nm
26	Differential pinion cover screw	12 Nm
27	Detector adjustment nut	20 Nm
42	Satellite screw	79 Nm

The type of axle, the serial number, the transmission ratios, the reference number, the oil capacity and the type of grease are written on the plate.



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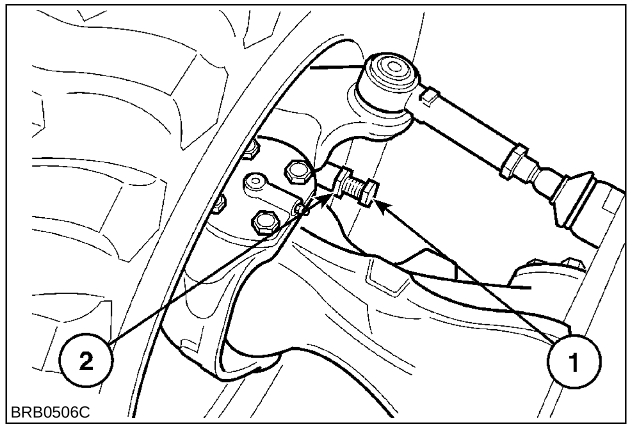
Steering stops (1) are mounted at either end of the axle.

These stops are adjustable to prevent the tires touching any part of the vehicle when the wheels are turned to the LH or RH steering lock. They are held by a nut (2).

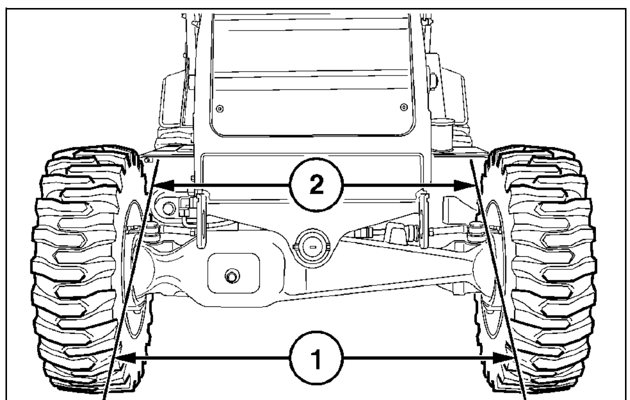


BRB0506C

The measurements to check the toe-in of the front wheels must be taken at the centre of the hub.

Measure the distance between the inner faces (wheel rim to wheel rim) at the front and rear of the front axle. The difference between (1) and (2) must lie within the following values:

The toe-in must be 0 to 2 mm.



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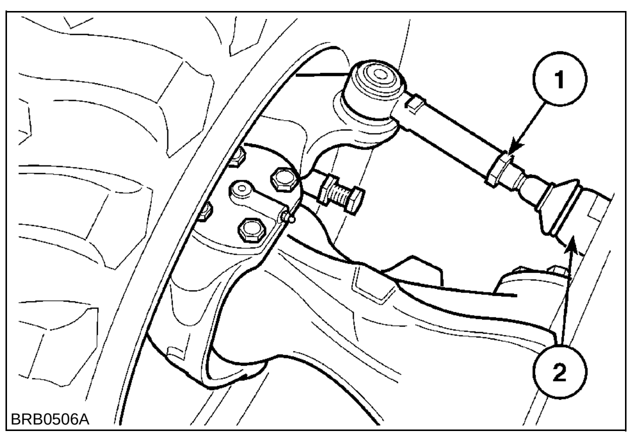
To adjust the toe-in of the front wheels, loosen the lock-nuts (1), screw in or unscrew the cylinder rod (2). Retighten the lock-nuts (1).

1. Lock-nut
2. Cylinder rod



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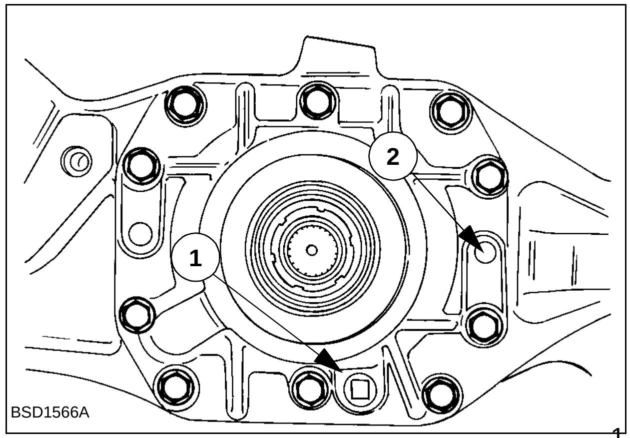
FRONT AXLE - Differential housing

Oil capacity: 7 litres

Level plug (2)

Drain plug (1)

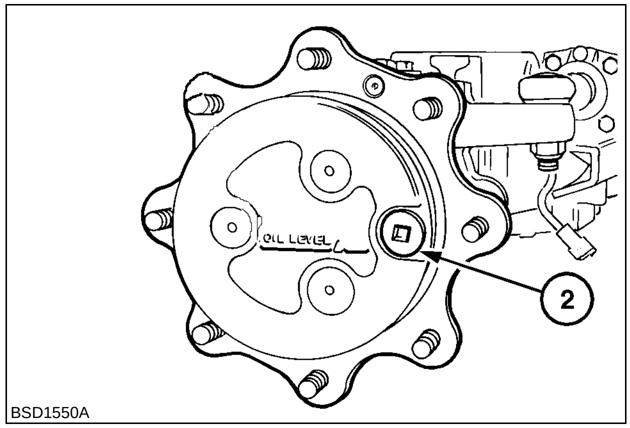


1

Hubs

Oil capacity: 0.7 litre

Level plug and drain plug (2)



SERVICING PARTS - without removing the axle

Steering cylinder

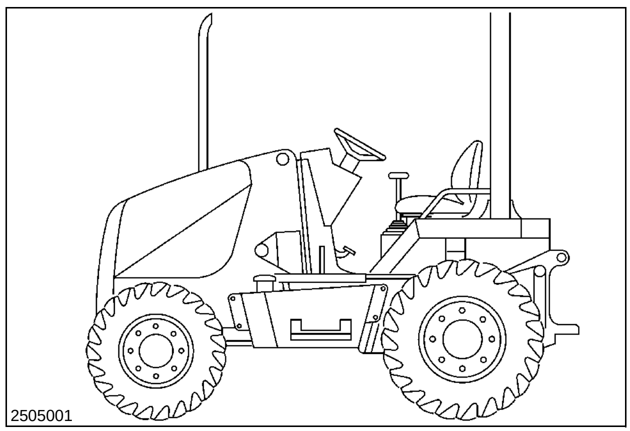
Hub and planetary reduction assembly

Stub axle pivot assembly

Stub axle casing

Shafts, seals and bushes

Drive pinion seal



SERVICING PARTS - with axle removed

Differential

Pinion gear assembly

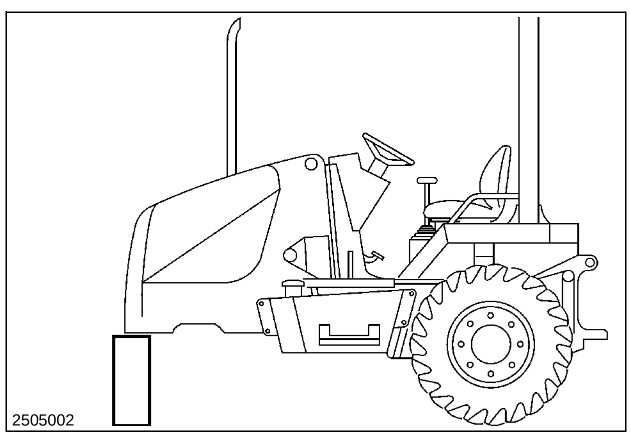
Adjustment of front axle

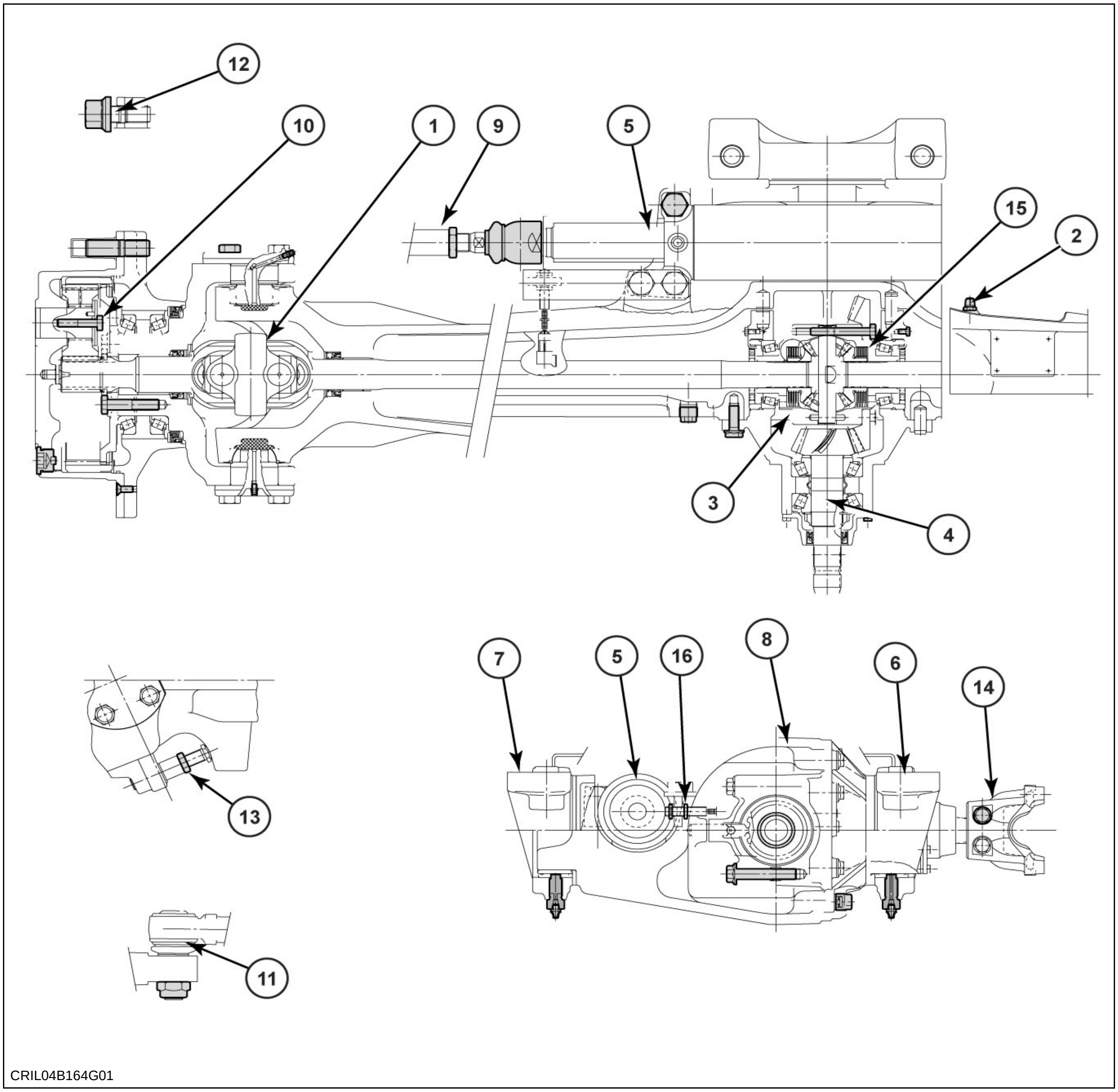
Drive pinion - ring gear tooth space

Drive pinion bearing preload

Clearance between teeth of ring gear and drive pinion

Differential bearing preload





Front axle - Cross-sectional view

1. Universal joint double seal
2. Central housing breather
3. Ring gear and differential
4. Drive pinion
5. Steering cylinder
6. Rear axle pivot
7. Front axle pivot
8. Axle central housing
9. Tie rod
10. Hub and planetaries assembly
11. Steering ball joint
12. Stud bolt
13. Stop screw
14. Universal joint yoke
15. Friction discs (only on 85821298)
16. Steering lock detector

TROUBLESHOOTING

IMPORTANT: *At each repair, always determine the cause of the problem and eliminate it to prevent it from occurring again.*

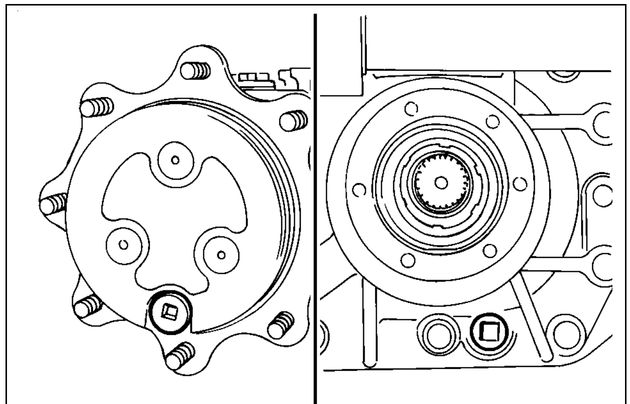
PROBLEM	POSSIBLE CAUSES	REMEDIES
The steering is blocked or is stiff.	1. Not enough oil in the tank. 2. Air present in the circuit. 3. Pump pressure limiter defective. 4. Pump worn. 5. Steering cylinder leak. 6. Control valve spool damaged. 7. Steering column broken or damaged. 8. Metering device worn or damaged.	1. Top up the oil level. 2. Check the tightness of the unions and the condition of the pipes, bleed the air from the circuit. 3. Check the circuit pressure. 4. Inspect and repair. 5. Inspect and repair. 6. Inspect and repair. 7. Inspect and repair. 8. Inspect and repair.
The steering goes off-centre.	1. Excessive play in the steering linkage ball joints. 2. Steering cylinder leak. 3. Control valve spool stuck or worn. 4. Torsion bar weak or broken. 5. Incorrect setting of control valve spool. 6. Metering device worn or damaged.	1. Inspect and replace. 2. Inspect and repair. 3. Inspect and replace. 4. Inspect and repair. 5. Check and adjust. 6. Inspect and replace.
Front wheel steering movements are jerky.	1. Steering cylinder leak. 2. Control valve spool stuck. 3. Torsion bar weak or broken. 4. Metering device worn or damaged.	1. Inspect and repair. 2. Inspect and repair. 3. Inspect and replace. 4. Inspect and replace.
Pump noisy.	1. Not enough oil in tank. 2. Air present in the circuit. 3. Water in the oil.	1. Top up the oil level. 2. Check the tightness of the unions and the condition of the pipes, bleed the air from the circuit. 3. Drain and replace the oil.

DISASSEMBLY

Planetary reduction gear and wheel hub assemblies

Position the hub filling/draining plug at the lowest possible level.

Drain the oil from the hub and the differential casing.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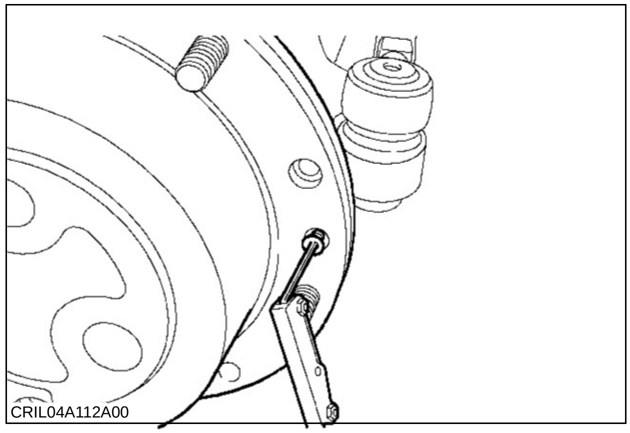
Remove the two Allen head satellite-carrier attaching screws with the hub.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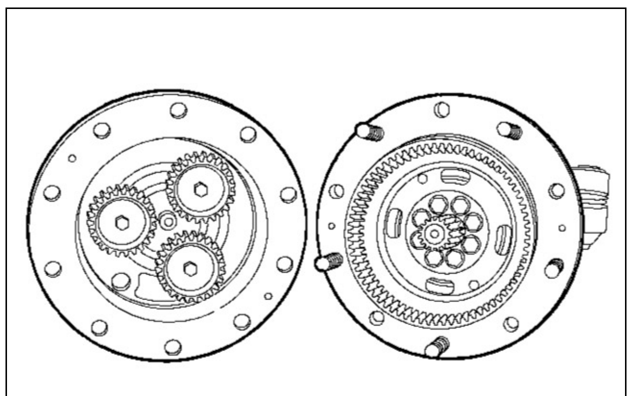
Extract the hub using the extraction slots.

Remove and discard the O-ring.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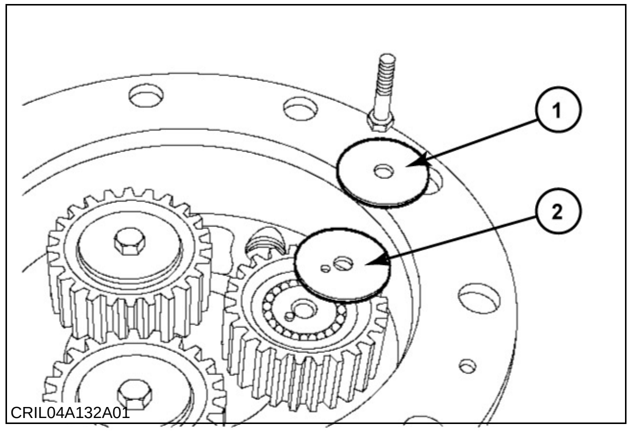
Disassemble the planetary gear train.

Remove the screws from all the satellites. Remove the upper washer (1) and the lower washer (2).

Now remove the satellites with their needle bearings.

Inspect the items, if they are worn or damaged, replace them before reassembling.



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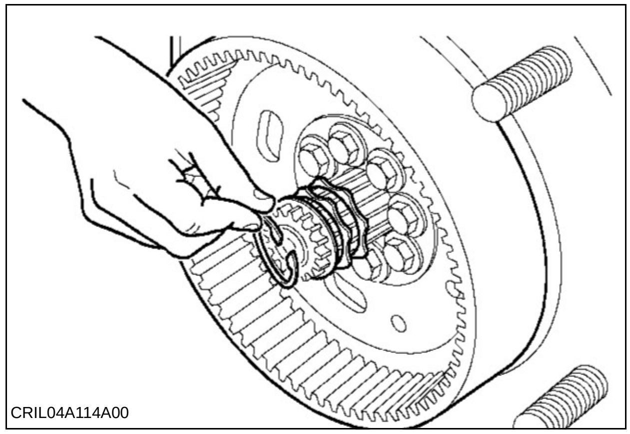
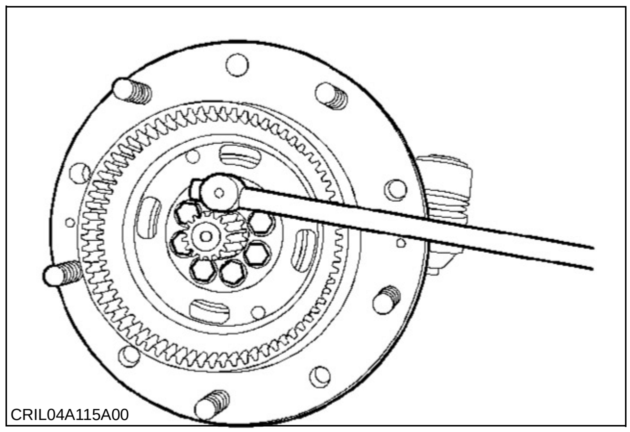
Extract the planetary retaining circlips and remove the planetary.



CRIL04A114A00

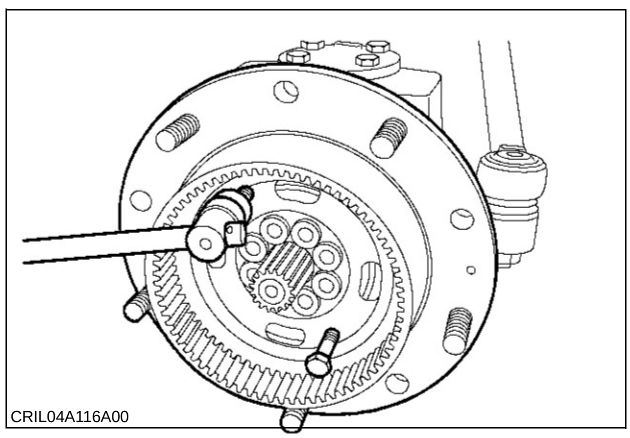
Remove the screws from the ring gear carrier.



CRIL04A115A00

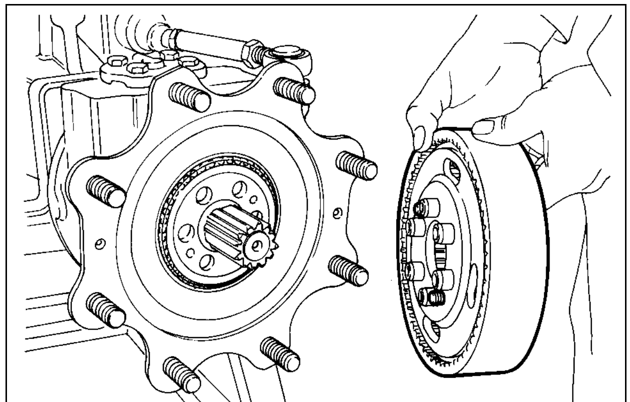
Remove the ring gear carrier by installing the extraction screws in the holes tapped in the ring gear.

Tighten the extraction screws uniformly.



CRIL04A116A00

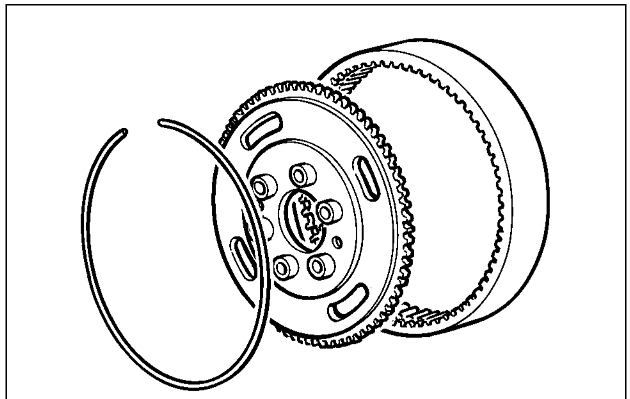
Remove the large ring gear from the hub.



BSD1559A

Remove the circlips and ring gear from the ring gear carrier.

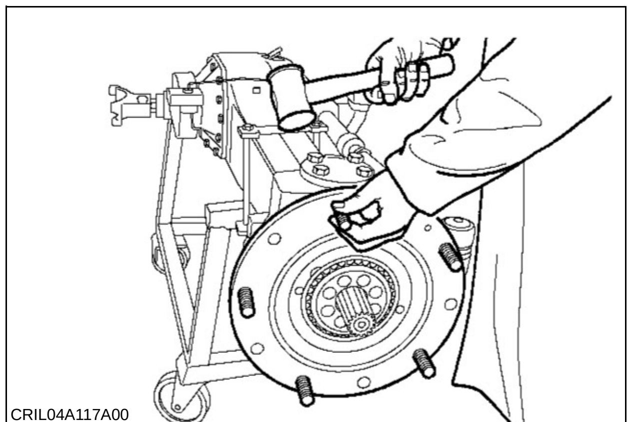
Drive out the centring studs.



BSD1561A

Remove the hub by striking it with a rubber-headed mallet.

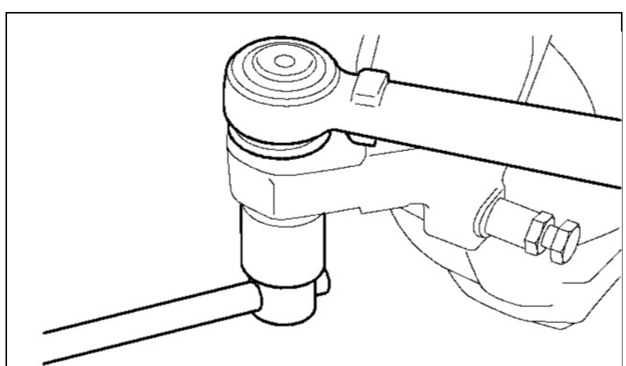
Remove the large seal of the stub axle pivot.



CRIL04A117A00

Remove the ball joint nut.

Use an extractor to separate the cone from the ball joint.

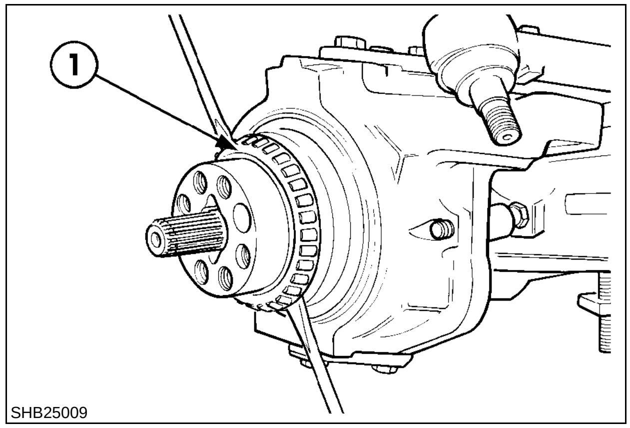


CRIL04A119A00

Hub bearing

Extract the inner cage (1) of the hub bearing by introducing two diametrically opposed levers under the bearing.

IMPORTANT: *Take care not to damage the bearing when extracting it.*

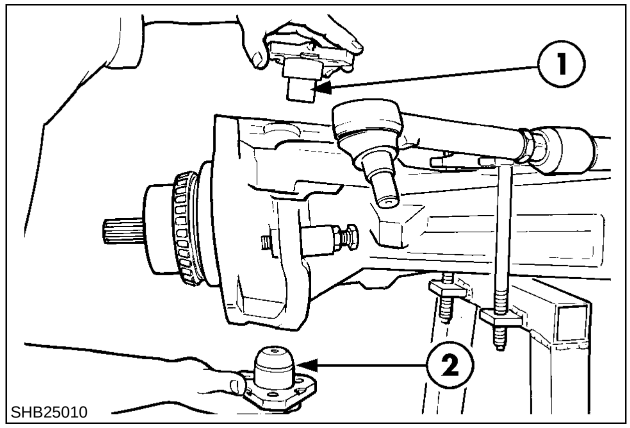


SHB25009

Stub axle pivots

Remove the upper king pin (1) and lower king pin (2) attaching screws. Remove the upper and lower king pins.

1. Upper king pin
2. Lower king pin

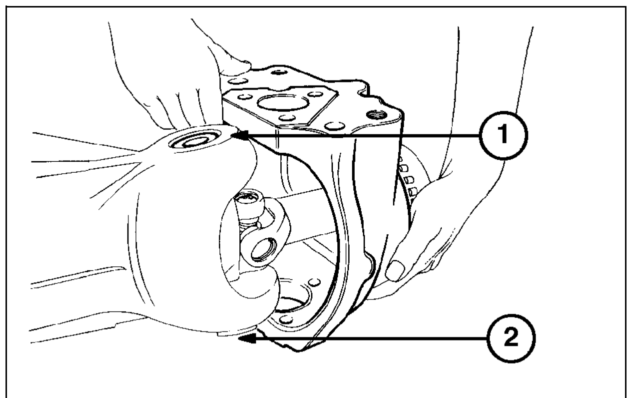


SHB25010

Stub axle

Carefully remove the stub axle from the half-axle housing.

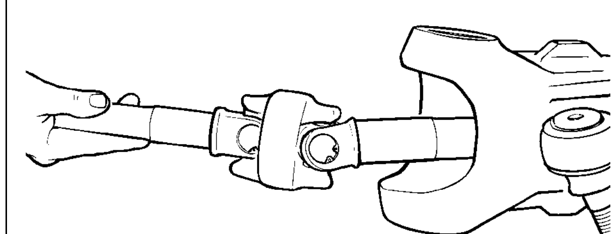
NOTE: *Two spring washers are situated between the half-axle housing and the stub axle, the larger (1) at the top and the smaller (2) at the bottom.*



TIB25038

Wheel shaft

Disengage the wheel shaft from the half-axle housing.

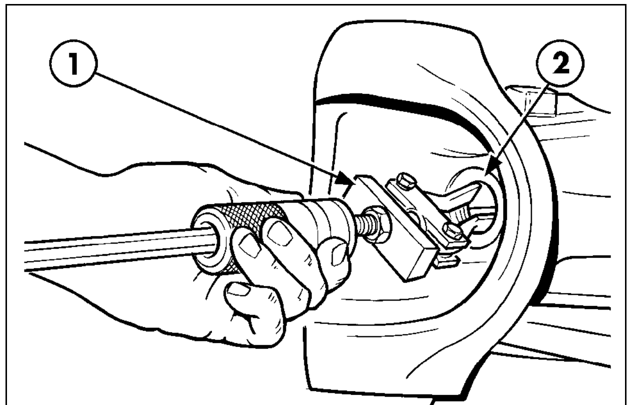


SHB25011

Remove the half-axle housing bush and seal

Use tool P/N **380000985** to extract the half-axle housing seal and bush.

1. Extractor
2. Oil seal

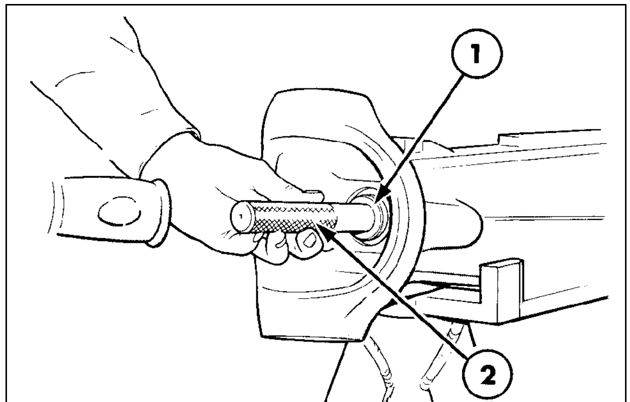


SHB25048

Reinstallation of stub axle bush and seal

Thoroughly clean the stub axle housing before installing a new seal and bush. Use tool kit P/N **380000563** and strike gently with a rubber-headed mallet.

1. Bush installation tool
2. Tool handle

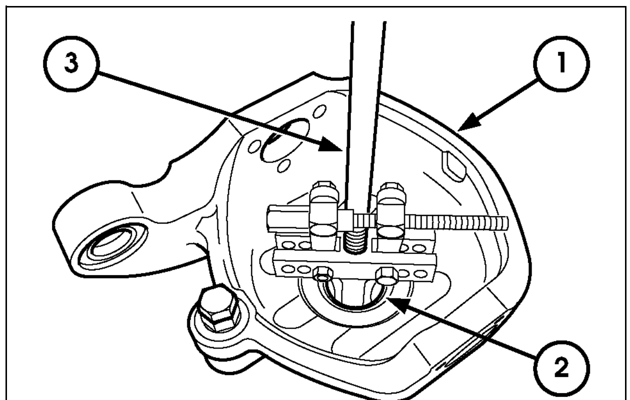


TIB25045

Removal of stub axle seal

Extract the seal and bush from the stub axle housing using tool P/N **380000986** and a hammer extractor P/N **380000987**.

1. Stub axle
2. Union
3. Hammer extractor

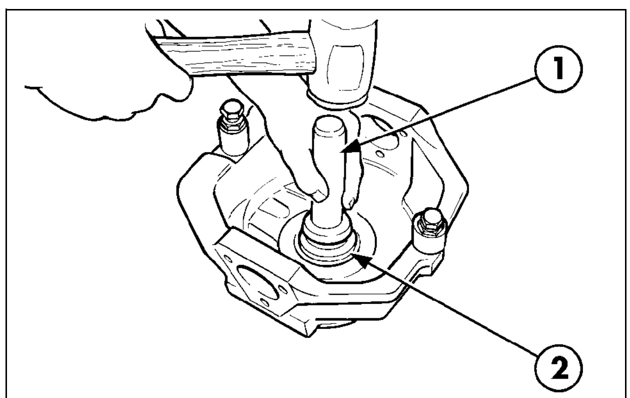


TIB25032

Reinstallation of the stub axle seal and bush

Reinstall the seal and bush in the stub axle housing using tool kit P/N **380000563**.

1. Tool handle
2. Installation tool

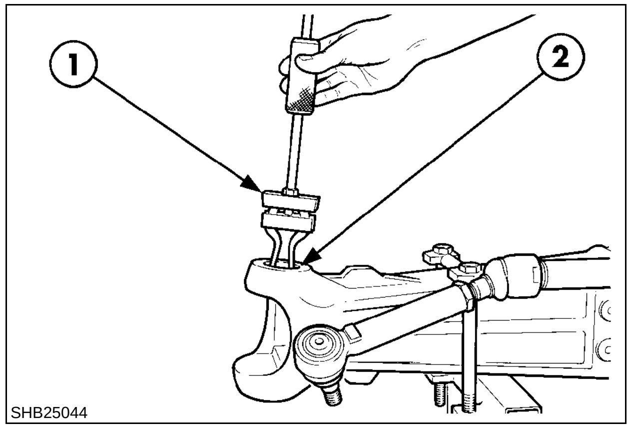


SHB25012

Removal of pivot bushes

Remove the pivot bushes using a hammer extractor P/N **380000985**.

1. Hammer extractor
2. Pivot bush

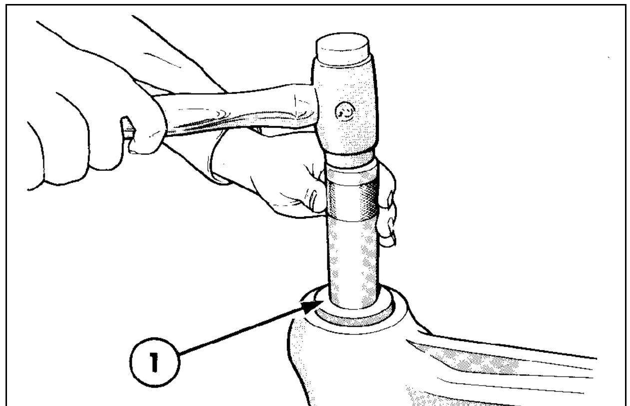


SHB25044

Reinstallation of pivot bushes

Before installing the bushes, ensure that their housing recesses are perfectly clean. Install the bushes using tool kit P/N **380000563**.

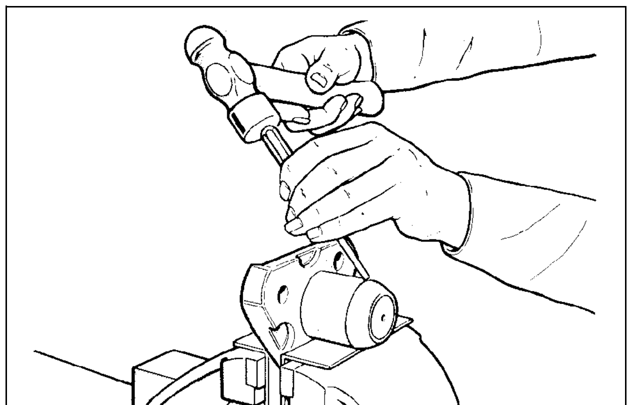
1. Installation tool



TIB25026

Removal of lower pivot shaft cone

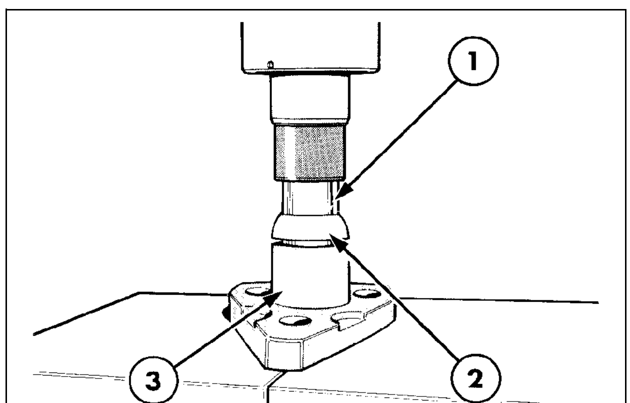
Grip the pivot shaft in a vice and drive out the cone with a pin drift.


TIB25046

Installation of lower pivot shaft cone

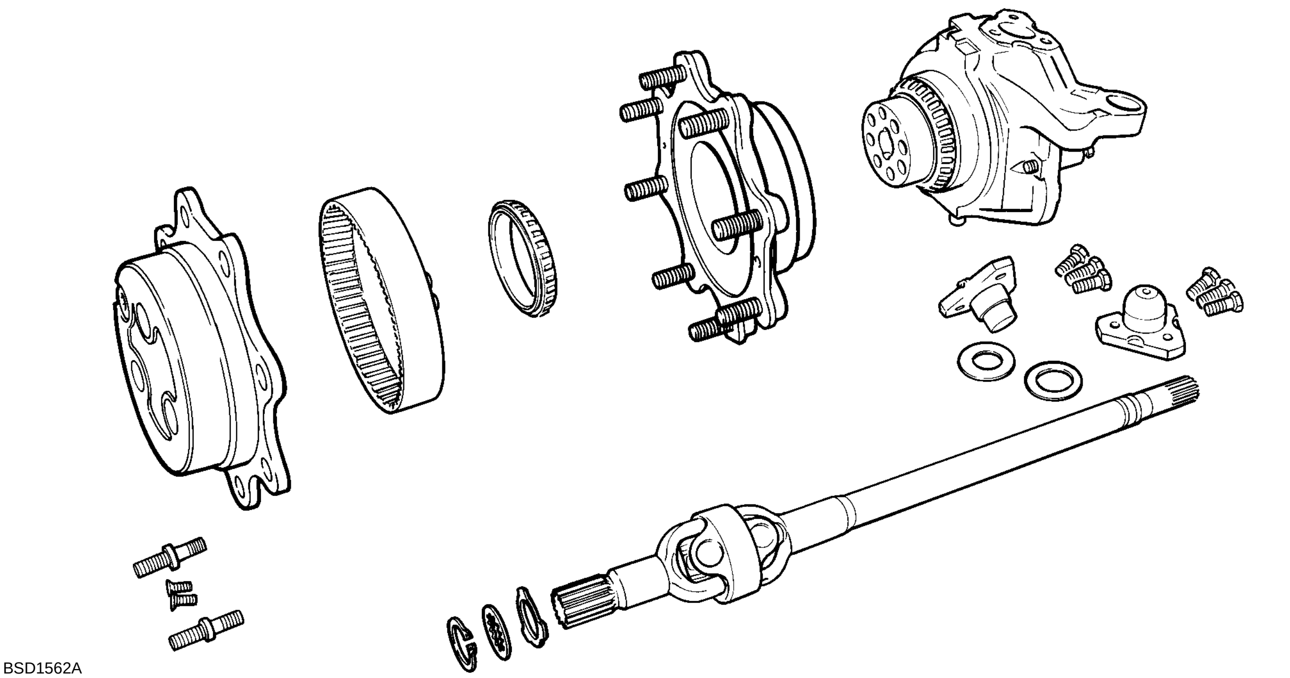
Carefully clean the pivot shaft and check that it is not damaged. Install the cone using a spacer placed under a press.

1. Spacer
2. Pivot shaft cone
3. Pivot shaft



TIB25047

Assembly of reducing gear and wheel shaft assembly



BSD1562A

Reassembly of reducing gear assembly and wheel shaft

Reassemble proceeding in the reverse order of disassembly.

If the wheel stud is replaced, apply Loctite 270 to the threads.

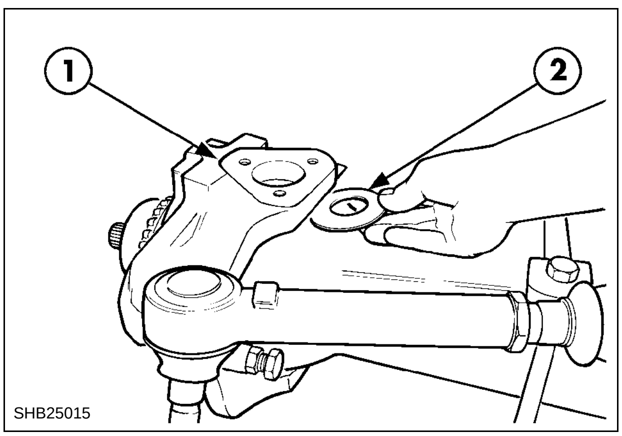
Install the wheel shaft before installing the stub axle.

Use tool P/N **380000610** to fit the large hub seal.

Fit a protective sheath over the wheel shaft splines for installation of the stub axle.

There is no need to adjust the stub axle clearance. The clearance is determined automatically by two spring washers. The smaller washer must be placed at the bottom of the stub axle and the larger washer at the top.

1. Stub axle casing
2. Spring washer

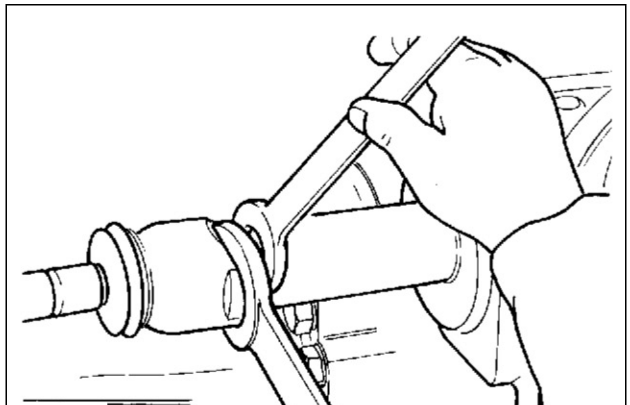


SHB25015

Removal of steering cylinder

The steering cylinder is mounted on the axle housing and held by screws.

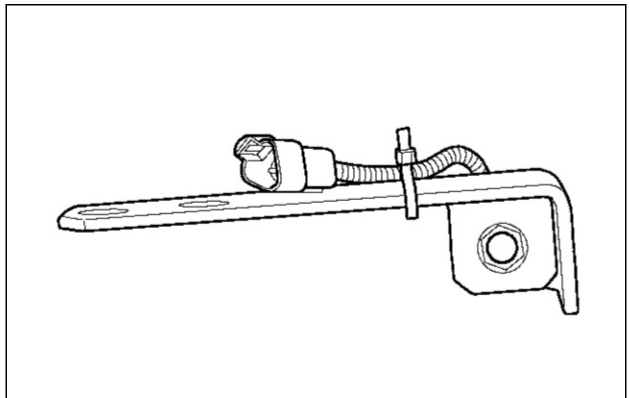
Disassemble the ends of the tie-rod from the cylinder rod.


CRIL04A129A00

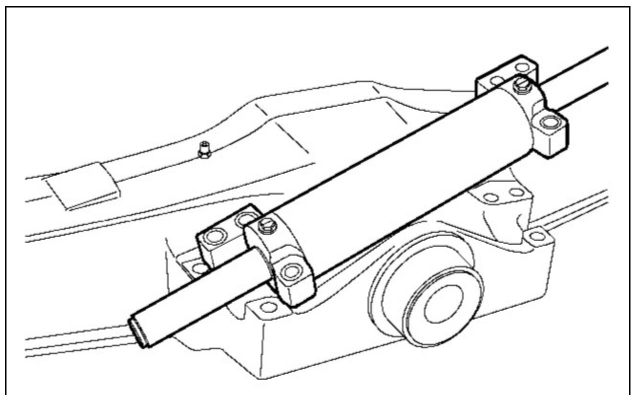
Removal of the steering cylinder without removing the axle

Unscrew and remove the steering angle detector attaching screws.

Disconnect the hydraulic pipes and the union in the RH side of the cylinder.


CRIL04A130A00

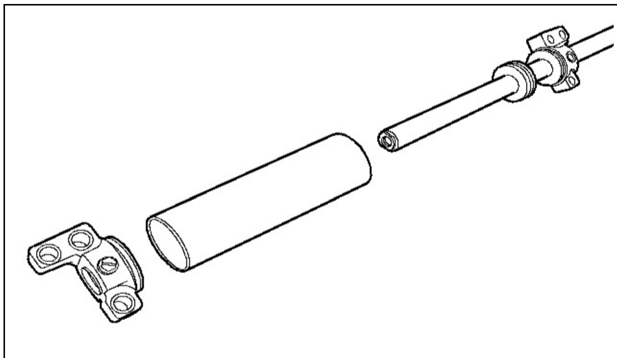
Remove the cylinder attaching screws and remove the cylinder aided by hoisting means.


CRIL04A131A00

Disassembly of cylinder

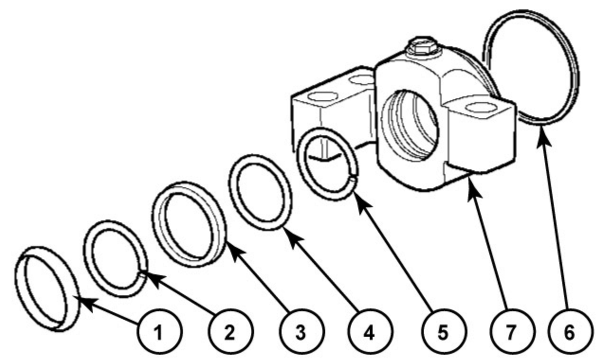
Remove the RH bearing, the LH bearing and the cylinder rod.

Remove the cylinder.



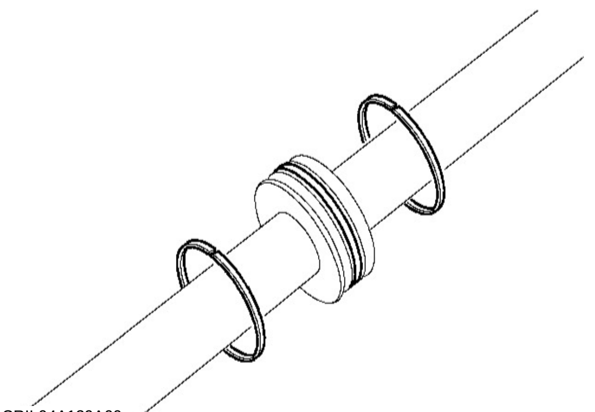
CRIL04A137A00

Remove the dust seals (1), the friction ring (2), the oil seal (3), the backing seal (4), the friction seal (5), the RH bearing (7), and the seal (6).



CRIL04A138A00

Remove the carrier seals and the seal ring from the cylinder piston.



CRIL04A139A00

Spare parts

The rod and cylinder are not available separately as spare parts. The seals and wear bushes are only supplied in complete kits.

Reassembly of the steering cylinder

Replace all the seals.

Wait for the new piston ring placed over the O-ring to shrink before introducing the piston and rod into the body.

Reinstall the cylinder RH and LH bearings.

Put the steering cylinder back in place and tighten the screws to the required torque.

Reassemble the steering connections, proceeding in the reverse order of disassembly.

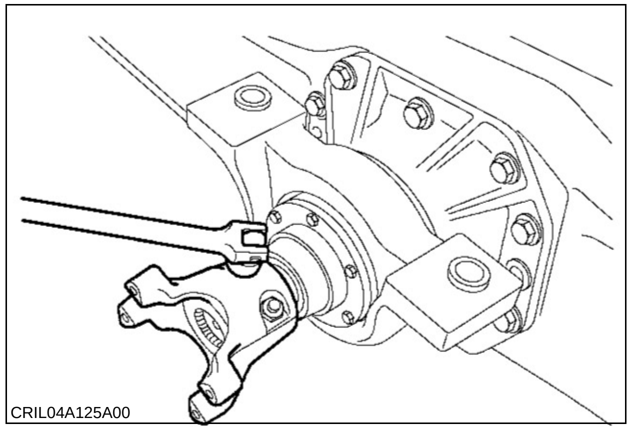
Adjust the toe-in of the wheels. This value must be obtained at the inside of each wheel and over the height of the hub.

Removal of the differential

Remove the two hubs and the wheel shafts.

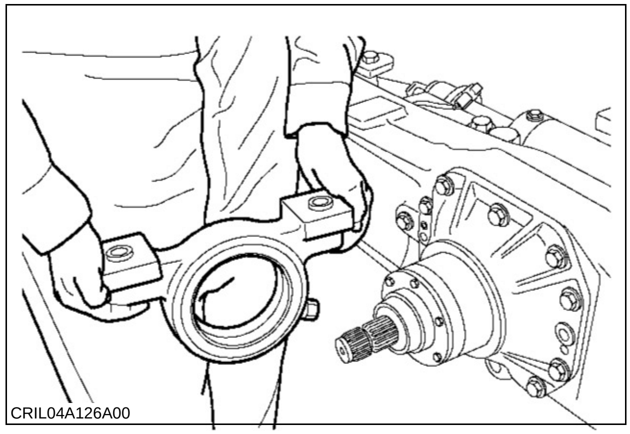
Remove the universal joint yoke.

Remove the screws from the seal-holder cover and remove the seal.



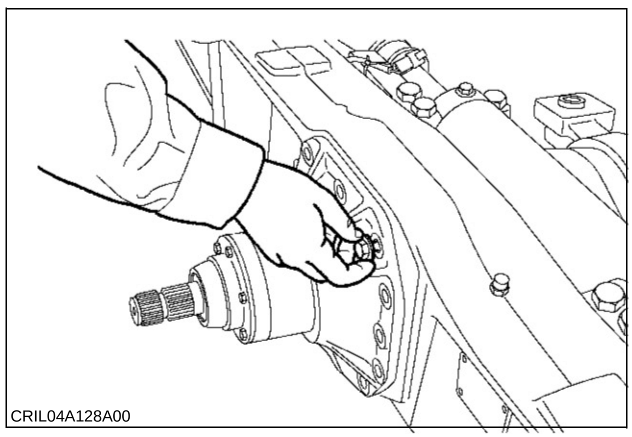
CRIL04A125A00

Remove the axle pivot and the adjusting shim.



CRIL04A126A00

Remove the differential housing attaching screws.

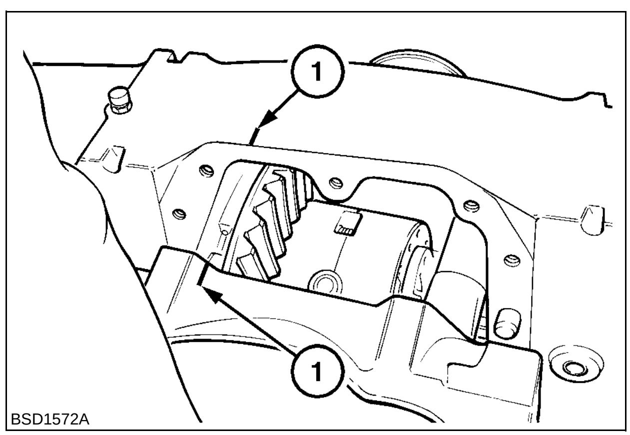


CRIL04A128A00

Mark the position of the differential housing on the ring gear (1) side.

Remove the differential housing assembly, withdraw the centring pins.

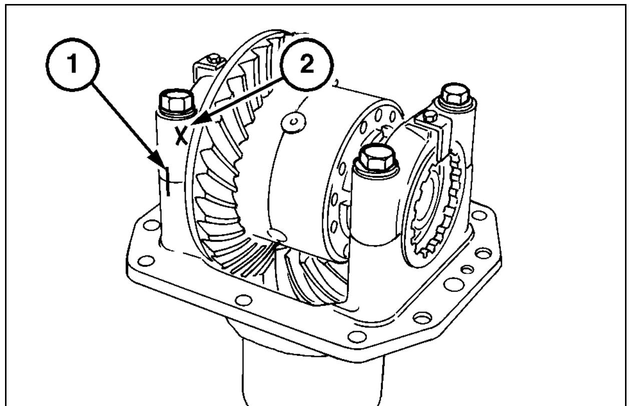
IMPORTANT: *Support the weight of the differential housing with a small pulley block during the removal operation.*



BSD1572A

Disassembly of the differential

Mark the position of the caps (1) and of the ring gear (2). Check and measure the clearance between the teeth of the drive pinion and the ring gear. (Measured value necessary when reinstalling the previously installed parts).

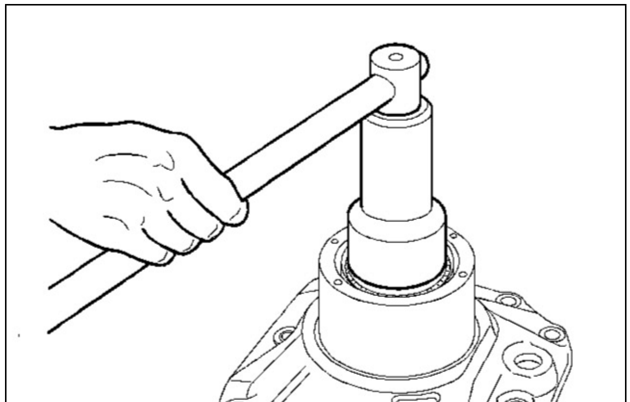


BSD1573A

NOTE: *Before disassembling the differential, remove the nut from the drive pinion.*

Tighten the shaft with wrench P/N **380000020**.

Loosen the drive pinion nut using the special wrench P/N **380000021** (1).

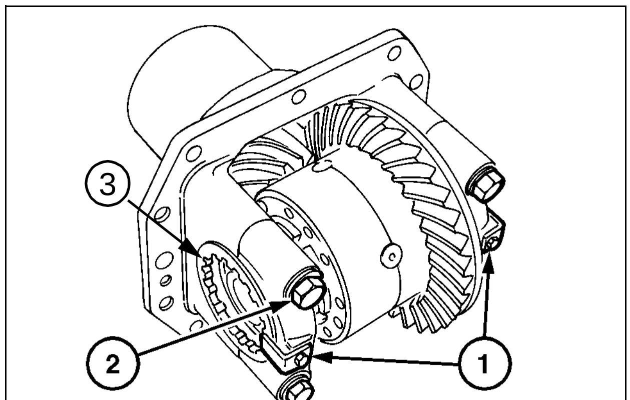

CRIL04A141A00

Remove the screws and remove the locking lugs (1).

Remove the nuts (3) using special wrench P/N **380000406**.

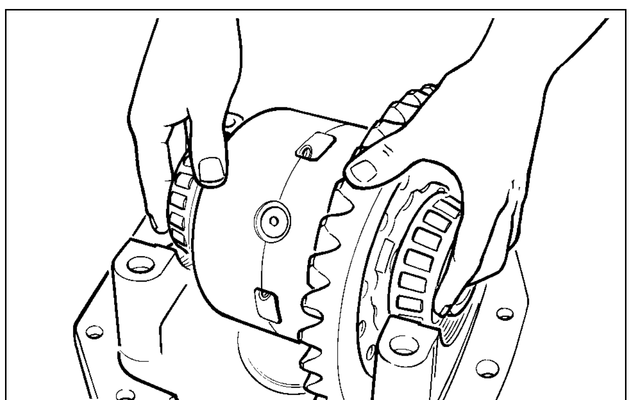
Remove the screws (2).

NOTE: *On reassembly, the locking lugs must be replaced by new ones.*



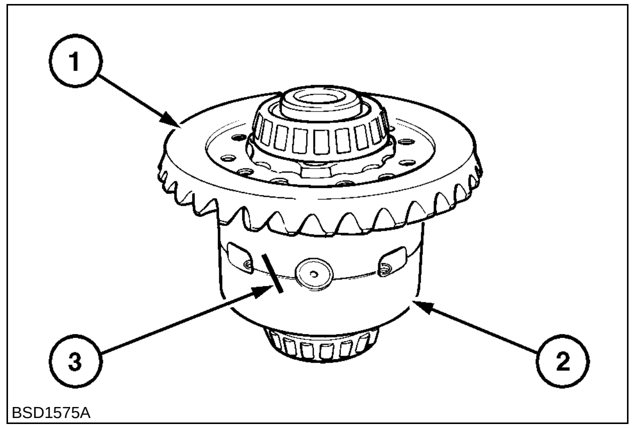
BSD1567A

Remove the differential from the housing and place it on a clean workbench for disassembly.


BSD1574A

Differential housing (2) and ring gear (1)

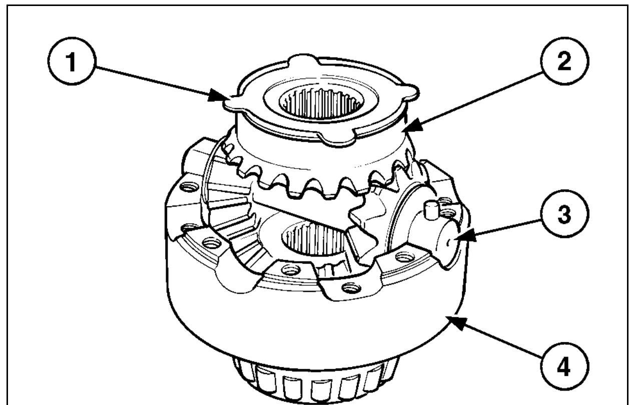
NOTE: *Before disassembly, make a pencil mark (3) on the two sections of the differential housing to ensure correct reassembly later on.*



BSD1575A

Differential components

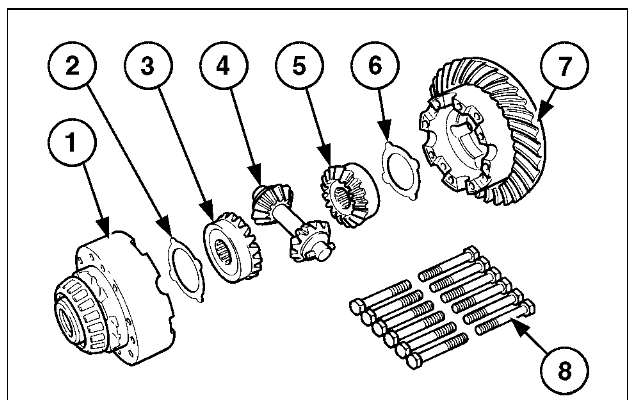
1. Thrust washer
2. Planetary
3. Satellite carrier pin
4. Differential housing



BSD1576A

NOTE: *If the differential is not of the limited slip type, a single thrust washer is mounted on each side.*

1. Differential box
2. Thrust washer
3. Planetary
4. Satellite-carrier pin
5. Planetary
6. Thrust washer
7. Ring gear
8. Attaching screw



BSD1577A

With limited slip differential.

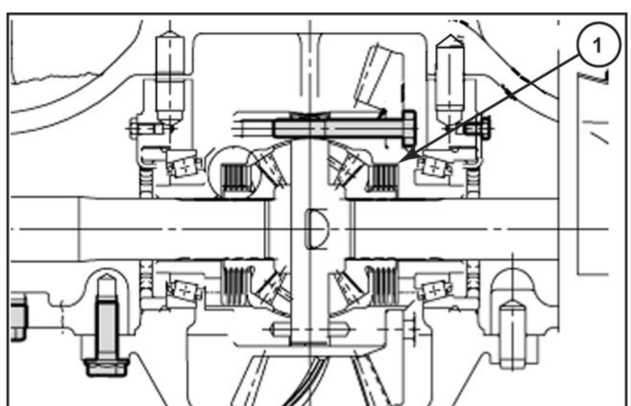
Mark the position of the friction discs (1) and remove them.

Check the thickness of the discs:

Steel disc, minimum thickness = 1.4 mm

Friction disc, minimum thickness = 1.45 mm

Stop disc, minimum thickness = 2.7 mm



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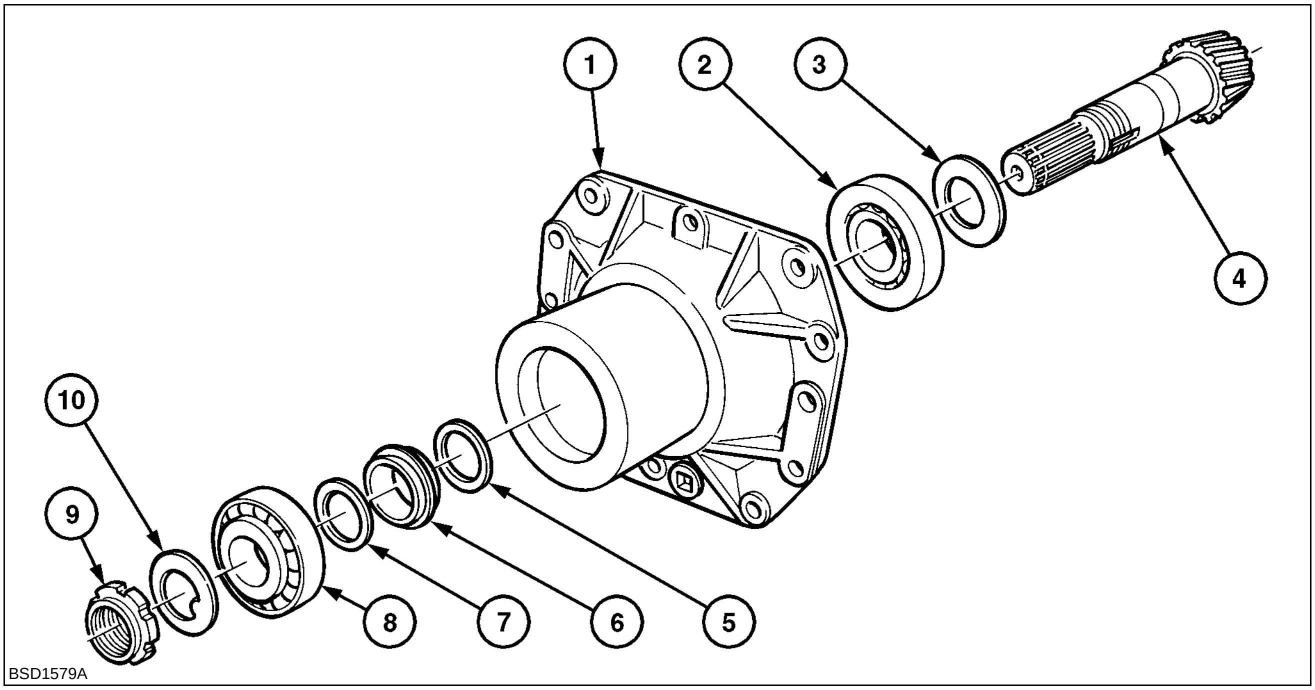


Drive pinion components

1. Differential housing
2. Bearing
3. Adjusting shim
4. Drive pinion
5. Washer
6. Collapsible spacer
7. Washer
8. Bearing
9. Nut
10. Washer

Inspection of differential components

In addition to the normal inspection of the bearings, pinions and ring gear, wear of the gear teeth and splines, inspect:

The thrust washers or differential discs.

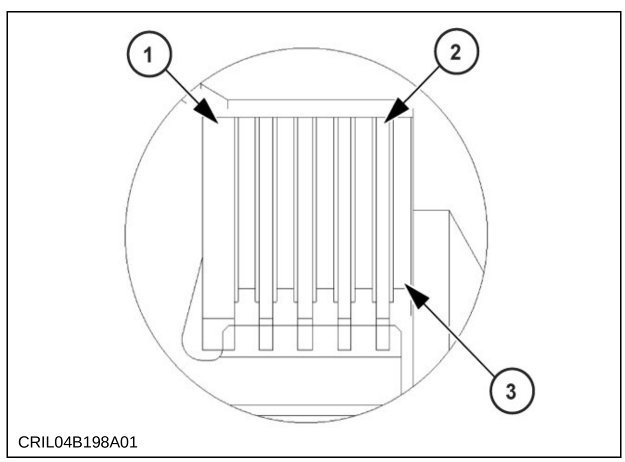
To reassemble the differential, proceed in the reverse order of disassembly. The following operations must nevertheless be performed:

If the ring gear and the drive pinion have to be replaced, adjust the crown wheel and pinion and the tooth spacing.

Replace the collapsible spacer at each disassembly.

Limited slip differential

Make sure the steel discs (3), friction discs (2) and stop (1) are positioned correctly.



Crown and pinion adjustment

Adjustment of the crown and pinion distance

If components have to be changed, proceed as follows (example of adjustment):

Measure the diameter of the differential housing bore.

Dimension **A**

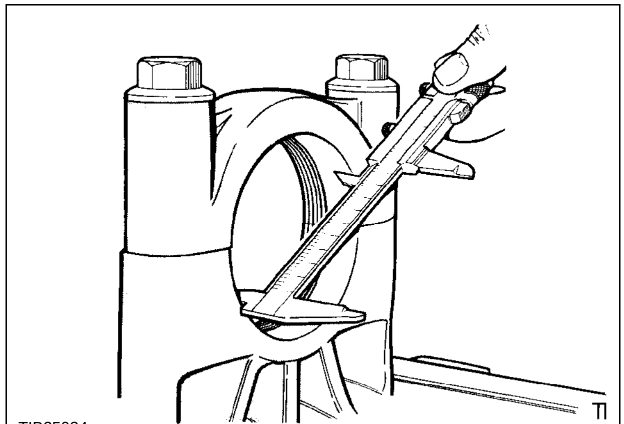
Install the new drive pinion bearings in the differential housing and tighten them with tool P/N **380000600**. Check that is still possible to turn the bearings by hand.

Dimension **C** is the measurement to be calculated using the following equation.

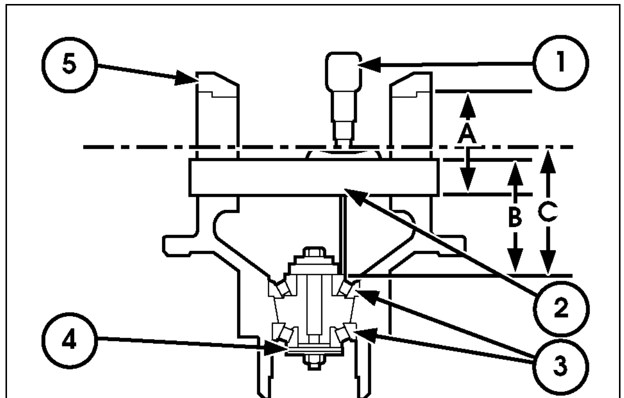
C = **B** - Ø of the rod + 1/2 **A**

NOTE: Ø of the rod (**380000600**) = 25 mm.

1. Depth gauge
2. Calibration rod P/N (**380000600**)
3. Drive pinion bearings
4. Bearing tightening tool P/N (**380000600**)
5. Differential housing



TIB25034



TIB25034-1

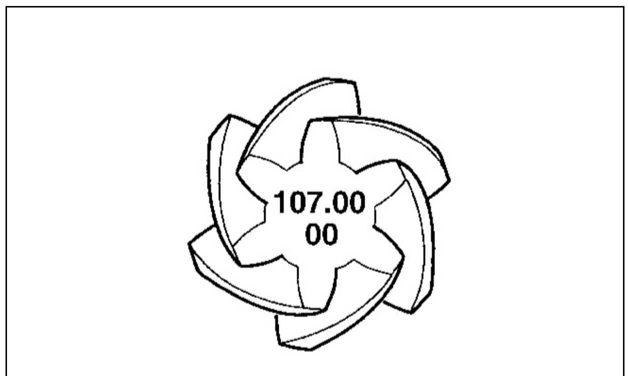
Calculation example

Dimension **A** = 90 mm
Dimension **B** = 90.3 mm
C = **B** - Ø rod + 1/2 **A**
C = 90.3 - 25 + 45 =110.3 mm

Calculation of adjusting shim thickness

(it is vital to look at the value engraved on the end of the pinion).

Dimension of the pinion
= 107 mm
Correction value
= 00



CRIL04A146A00

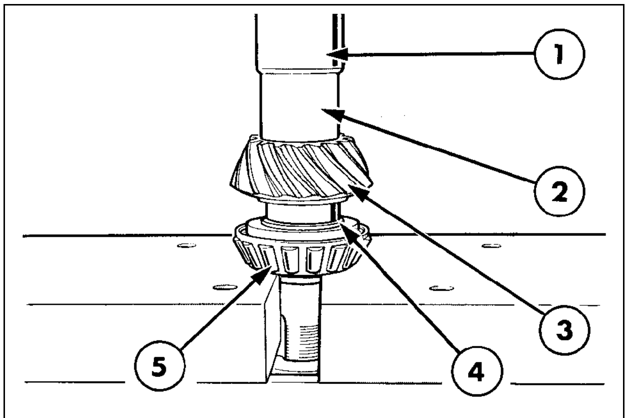
Calculation of adjusting shim thickness

Shim thickness
= 110.3 - 107 = 2.9 mm

Shims available from 2.5 mm to 3.4 mm by 0.1 mm.

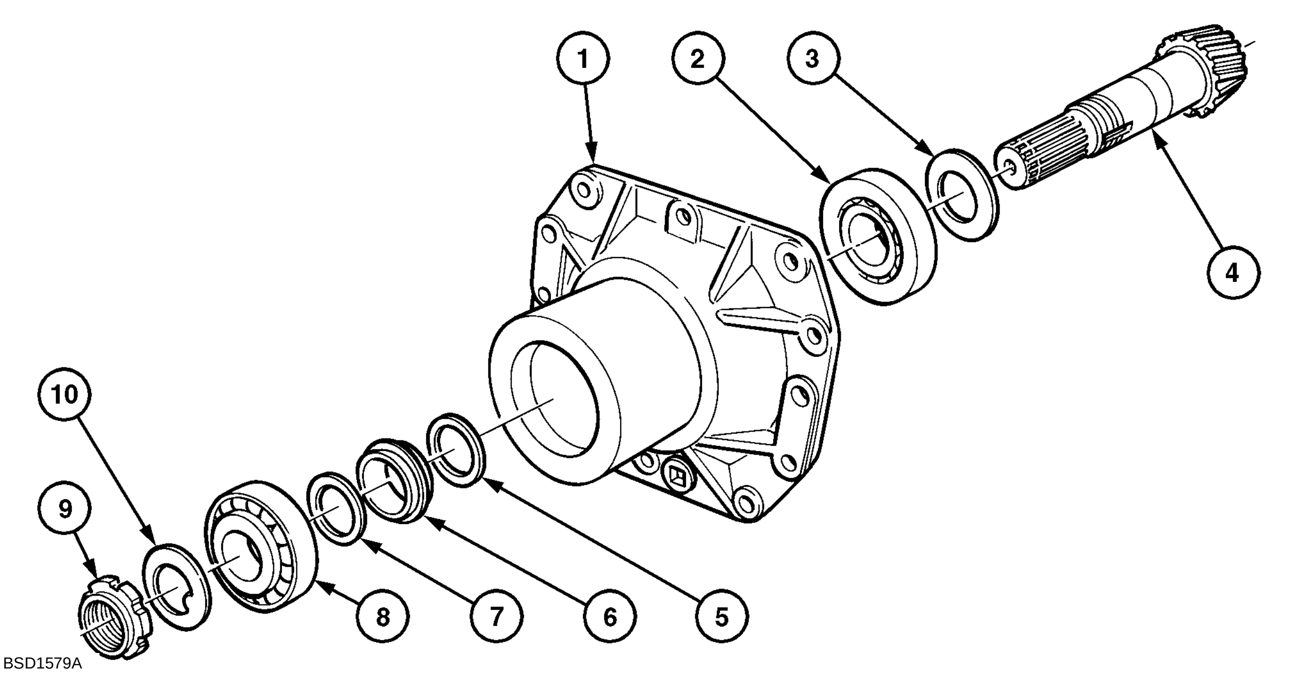
Place the selected shim (4) on the pinion shaft, orienting the chamfered face towards the pinion teeth.

1. Press
2. Sleeve
3. Drive pinion
4. Shim
5. Bearing inner cage



TIB25036

Reassembly of drive pinion



BSD1579A

1. Differential housing
2. Bearing
3. Adjusting shim
4. Drive pinion
5. Washer
6. Collapsible spacer
7. Washer
8. Bearing
9. Nut
10. Washer

Mount the pinion (4) equipped with the adjusting shim and the bearing in the housing (1).

Install washer (5), the new collapsible spacer (6) and washer (7).

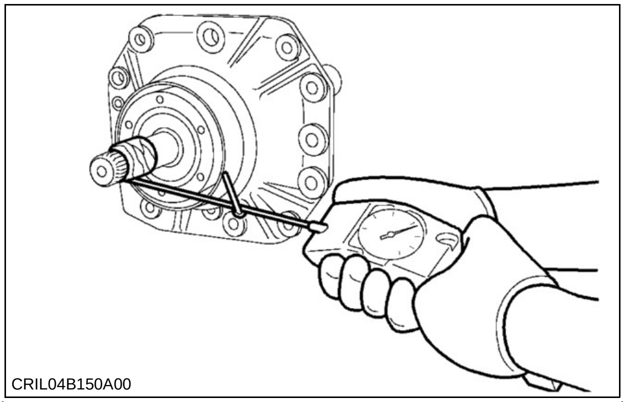
Install bearing (8), washer (10) and nut (9).

Drive pinion preload adjustment

NOTE: *This adjustment cannot be done until a new collapsible shim has been installed.*

Wind a rope around the drive pinion, install a torque meter, then pull the rope to rotate the pinion shaft and record the rotation torque value, tighten the drive pinion nut to obtain a torque P = 92 to 137 Nm.

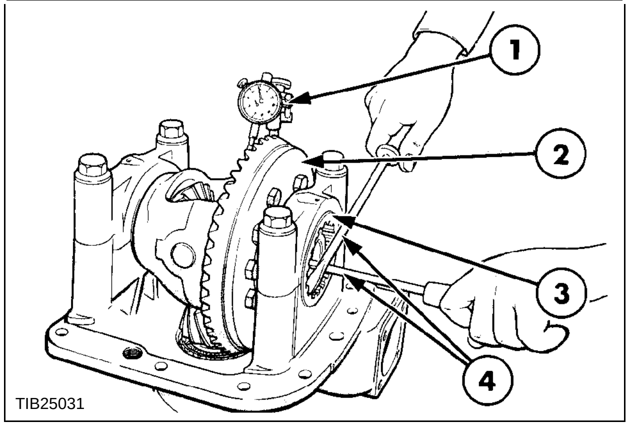
Use wrench P/N **380000021** to tighten the drive pinion nut, holding the shaft stationary with wrench P/N **380000020**.



CRIL04B150A00

Adjustment of the backlash of the ring gear and the drive pinion

1. Dial gauge
2. Ring gear
3. Bush
4. Levers



TIB25031

Backlash measurement

New parts between 0.18 - 0.25 mm.

If the removed pinion and ring gear are reinstalled, apply the value measured at disassembly.

Mount the differential in the housing, placing the ring gear on the side of the mark made at disassembly. Tighten the bearing cap screws and check that the caps are in good contact with the bearings.

Tighten the adjusting bush (3) (with wrench P/N **380000406**) on the ring gear side to eliminate the play of the differential bearings.

Adjust the backlash of the ring gear and drive pinion by turning the adjusting bushes (3) by the same amount in the opposite direction.

Take measurements at 90° intervals; if the measurements are not identical, adjust the backlash to the position that give the smallest dimension.

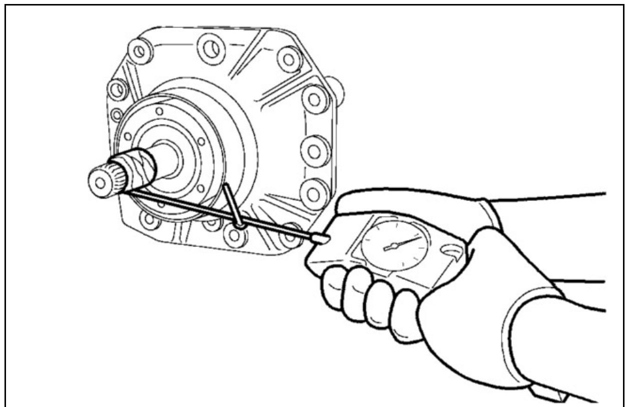
Preloading of the differential bearings

Check the resistance of the drive pinion and differential bearings.

To determine the preload of the bearings of the differential (1), compare the rotation torque required to turn the drive pinion slowly at the same time as the differential with the rotation torque of the drive pinion alone (recorded previously).
Gradually tighten bush (3) on the side opposite the ring gear until the rotation torque lies between the indicated values.

Example:
Wind a rope around the drive pinion, install a torque meter, then pull the rope to rotate the pinion shaft and record the rotation torque value.

A. Drive pinion alone:
P = (92 to 137 Nm)
B. Drive pinion and differential:
(P + 34 Nm to P + 51 Nm)
(= 126 to 188 Nm)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When the required torque is obtained

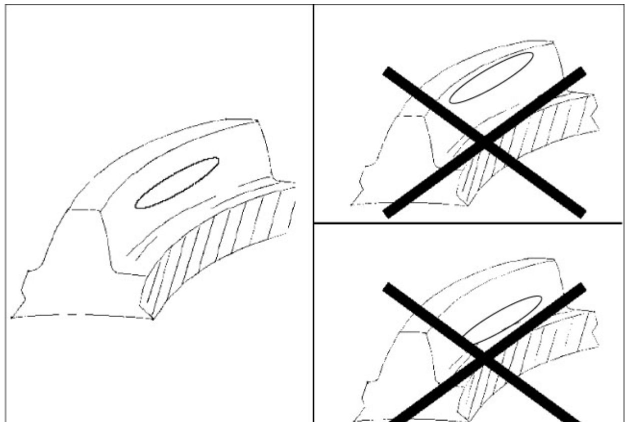
Coat the cap screws with Loctite 270.

Coat the screws with Loctite 270 and install the adjusting bush locking lugs.

Recheck the preload and backlash.

Tighten the bearing cap screws to the required torque.

Coat the teeth of the ring gear with red hematite, then turn the drive pinion shaft while braking the ring gear to clearly mark the contact surfaces. The mark must be centred on the side a mid-height of the teeth.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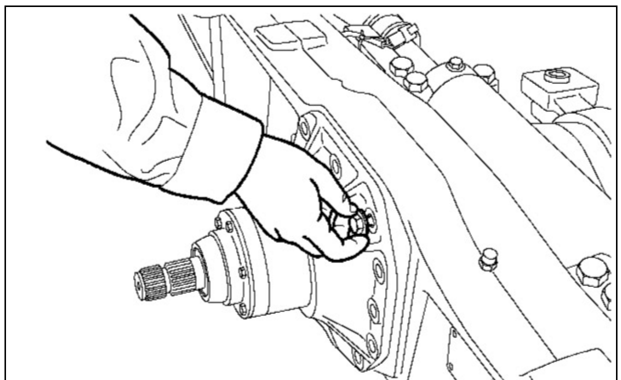
Coat the reducing gear housing joint plane with Loctite 510 sealant.

Coat the centring studs with Loctite 638.

Mount the differential on the axle housing.

Install the attaching screws and tighten them to the required torque.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SECTION 25 - FRONT AXLE

CHAPTER 10 - FRONT AXLE

IDENTIFICATION

CNH Part No. 85824339
Carraro Part No. 138277

TABLE OF CONTENTS

SPECIFICATIONS

Type of axle .... Modular 26/00
Overall width .... 1995 mm
Hub oil capacity .... 2 x 0.2 litres
Lubricants .... Ambra Multi G
Brake .... none
Number of discs .... none

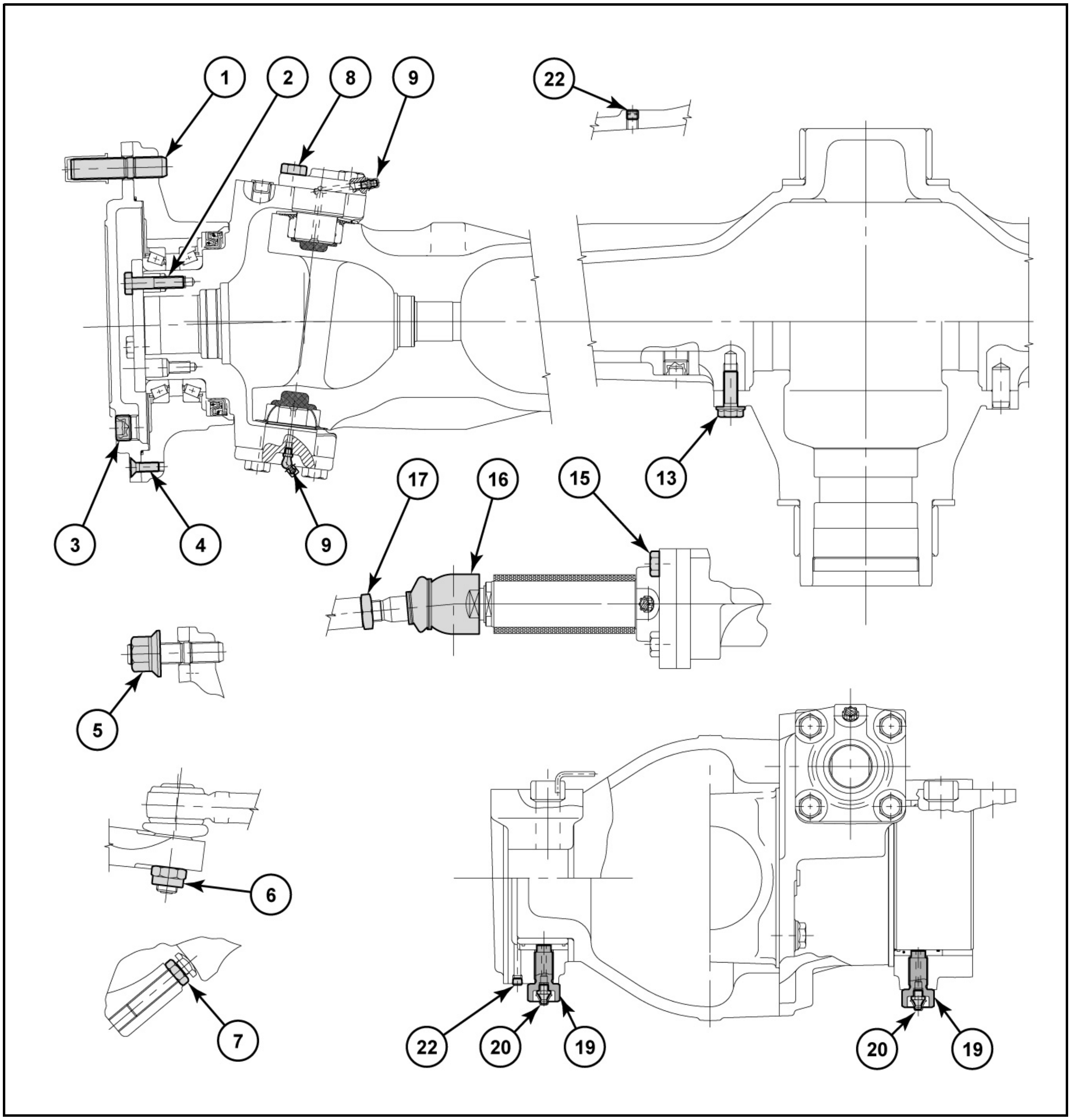
CLEARANCES AND ADJUSTMENTS

Preload on hub pivots .... Not adjustable, factory pre-defined
Clearance on stub axle bearings .... Not adjustable, factory pre-defined
Steering toe-in .... 0 - 2 mm
Air gap clearance on steering lock detector .... none
Steering lock stops .... angle of 55°±2°

SEALING AND ADHESIVE PRODUCTS

Anaerobic sealing for threads .... NH 82995773
Polyesterurethane sealing .... NH 82995774
Anaerobic low strength sealing .... NH 82995768
Adhesive for studs .... NH 82995772
Sealing for flanges .... NH 82995770
Silicone sealing .... NH 82995776

SPECIAL TORQUE SETTINGS



CRIL03L087G01

SPECIAL TORQUE SETTINGS

1	Wheel stud	70 Nm
2	Stub axle screw	95 Nm
3	Plug	60 Nm
4	Cover screw	25 Nm
5	Wheel nut	350 Nm
6	Steering ball-joint nut	165 Nm
7	Pivot stop lock-nut	150 Nm
8	Pivot shaft screw	120 Nm
9	Grease fitting	8 Nm
13	Differential pinion screw	169 Nm
15	Cylinder bearing screw	120 Nm
16	Cylinder ball-joint	300 Nm
17	Steering rod lock-nut	250 Nm
19	Grease-fitting support	84 Nm
20	Grease fitting	8 Nm
22	Plug	10 Nm

SPECIAL TOOLS

Seal extractor...380000985
Seal assembly mandrel kit...380000563
Hammer extractor ends...380000986
Hammer extractor...380000987
Stud wrench for drive pinion shaft nut...380000021
Drive pinion shaft maintaining wrench...380000020
Front wheel hub seal assembly mandrel...380000610
Crown wheel and pinion adjustment kit...380000600

SECTION 27 - REAR AXLE

CHAPTER 1 - REAR AXLE WITH FOOT-CONTROLLED LOCKING DIFFERENTIAL FOR 2 AND 4 WHEEL DRIVE

IDENTIFICATION

CNH Part No. **85825120**
CNH Part No. **85825119**

TABLE OF CONTENTS

SPECIFICATIONS

Type of axle .... Modular
Overall width .... 1740 mm
Planetary reduction 4.5/1
Crown wheel and pinion reduction (**85825120**) 4.11/1
Crown wheel and pinion reduction (**85825119**) 4.62/1
Total reduction (**85825120**) 18.5/1
Total reduction (**85825119**) 20.80/1
Number of satellites (per side) 3
Differential housing oil capacity .... 26 litres
Lubricants .... Ambra Multi G
Brake type .... Hydraulic
Brakes .... oil-bath disc
Number of sintered discs (per side) 4
Foot-controlled differential lock .... 100% mechanical

CLEARANCES AND ADJUSTMENTS

Clearance between drive pinion teeth .... not adjustable, factory pre-set
Preload on drive pinion bearings .... 1.3 to 4.1 Nm
Pre-load on differential bearings .... 2.3 to 10 Nm
Drive pinion direction of rotation .... Clockwise
Pre-load on stub axle bearings .... 2.3 to 10 Nm

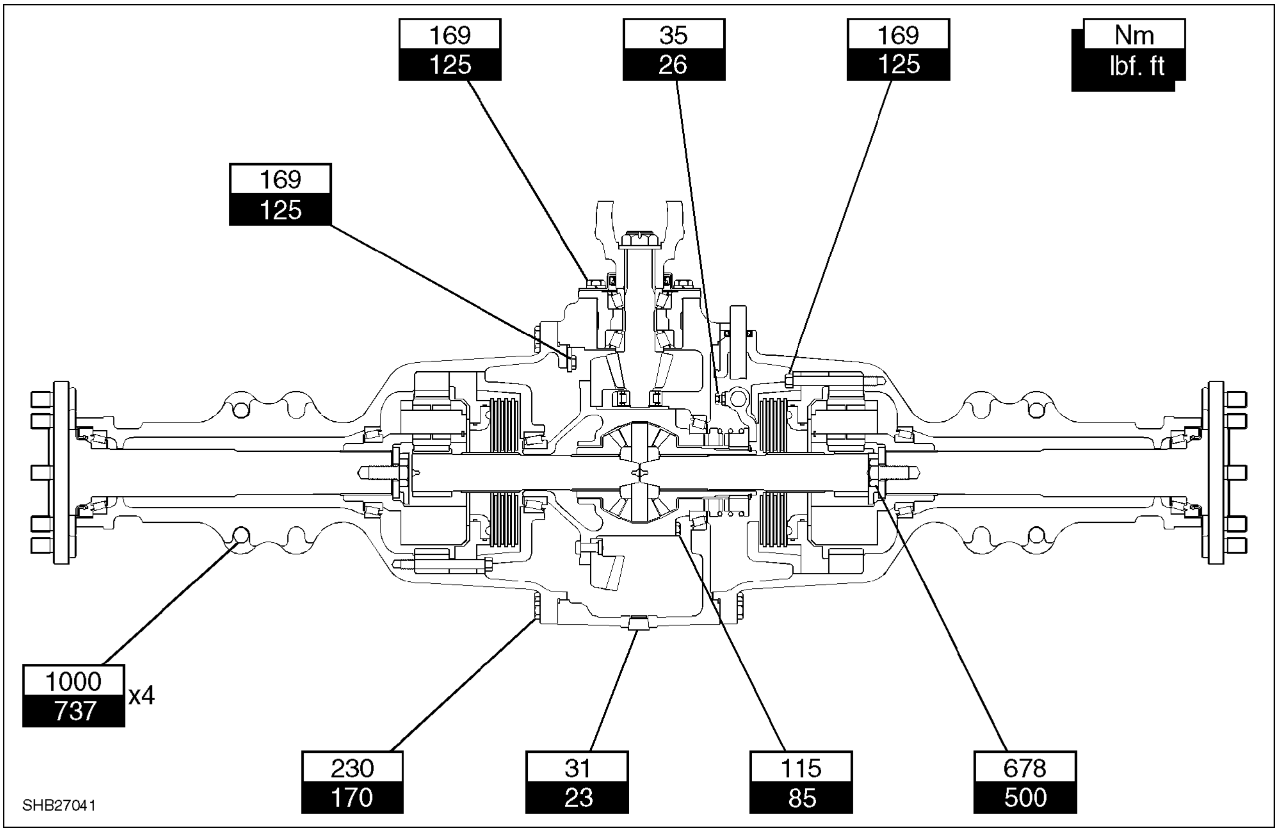
SEALING AND ADHESIVE PRODUCTS

Loctite 510
Loctite 270
Loctite 638

CLEARANCES AND ADJUSTMENTS

Drive pinion preload	1.3–4.1 Nm (10 - 40 lb in)
Rolling resistance	2.3–10 Nm (20–90 lb in)

TORQUE VALUES



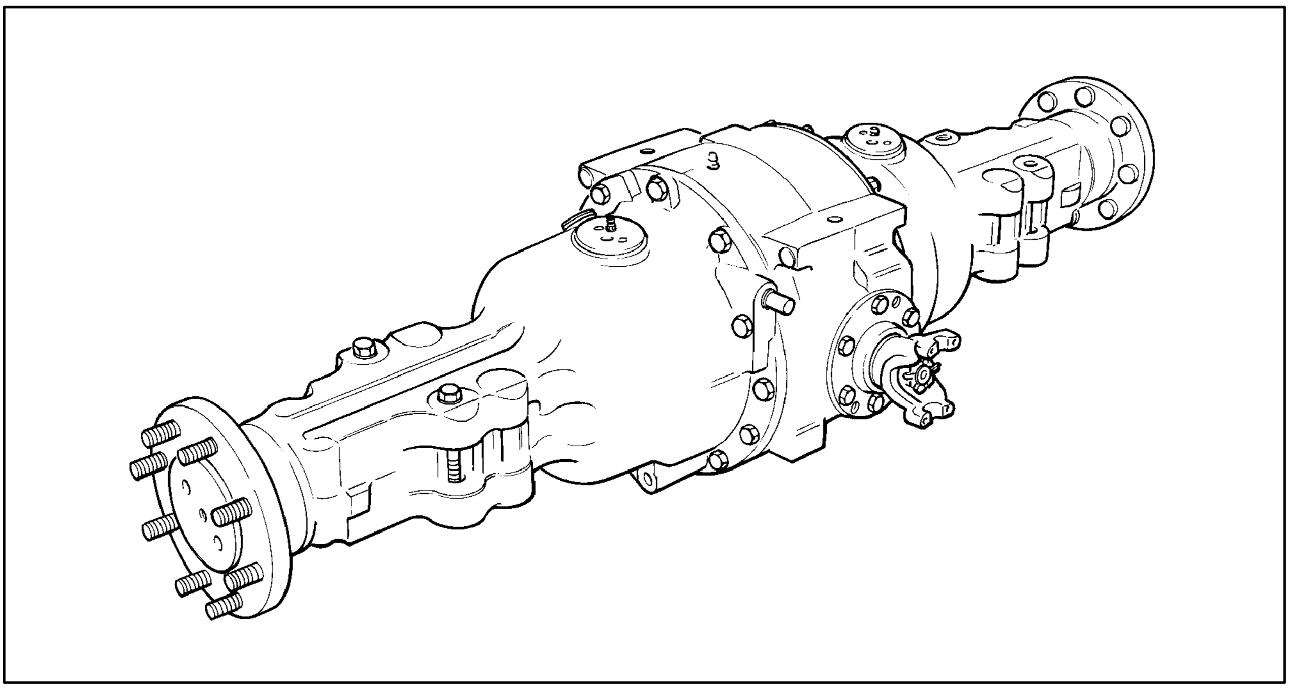
1

SPECIAL TOOLS

	APPLICATION
Splitting Tool	Axle removal
Half axle lifting bracket	Half shaft removal
Sliding Hammer	Axle bearing cup removal
Ratchet Tool	Axle housing bearing/seal
Puller Tool	Axle housing bearing/seal
Pulling Attachment Tool	Axle housing bearing/seal

SEALANTS

Code	Number	Name
82995768	Sealer	Anaerobic Low strength
82995776	Sealer	Silicone
82995774	Sealer	Polyester Urethane
82995773	Sealer	Anaerobic



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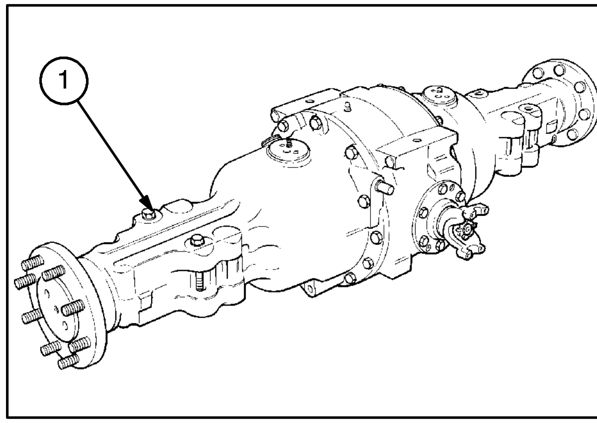
DESCRIPTION

The rear axle (1) is of modular design and is fixed by 4 bolts to the chassis with a torque value of 1000 Nm (737lbf ft). It incorporates the following features:

Mechanically operated diff-lock

Hydraulically operated oil immersed foot brakes fitted with four disc brakes

Three planetary reduction carrier



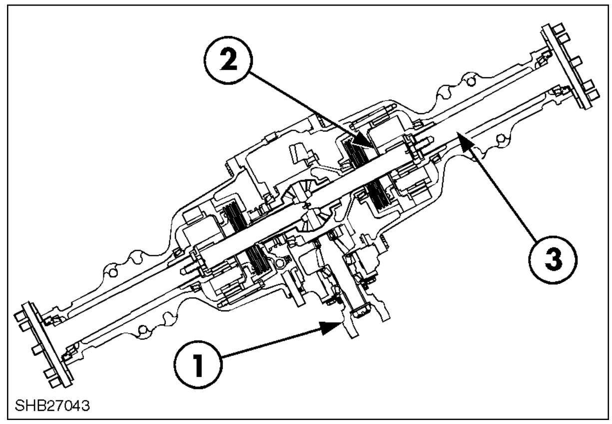
3

Operation, Figure 4.

Power from the transmission output shaft is transmitted to the rear axle through (1) the brake disc (2) and onto the half shaft (3).

The spiral bevel pinion is located in preloaded taper roller bearings.

The differential is located on two taper roller bearings, the right hand bearing supported by an internal web of the axle centre housing.



4

The crown wheel is rivetted to the differential housing. Drive from the housing is transmitted through a conventional four pinion differential to sun gear shafts which are splined into the differential side gears.

NOTE: *If repaired in service the rivets are replaced by grade 8 bolts and must be torqued to: 115 Nm (85 lbf ft)*

The differential lock sliding coupling is located on the splines of the right hand differential side gear. The coupling has dog teeth which engage with the dog teeth on the differential housing lock adaptor.

If the dog teeth are not aligned, the spring engagement link will be preloaded, ensuring rapid and full tooth engagement when the dog teeth align.

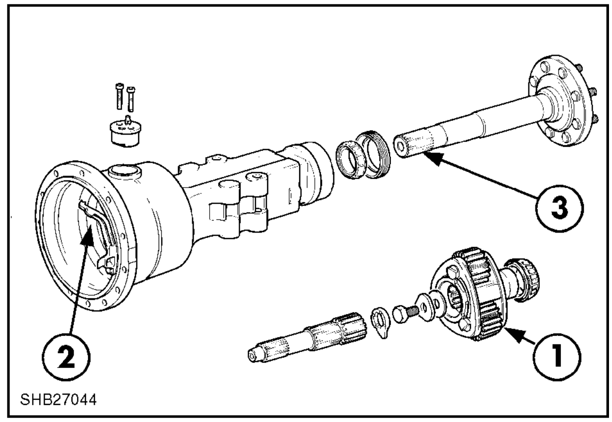
The differential lock will remain engaged due to dog tooth side loading as long as the rear wheels have unequal traction.

The return spring disengages the lock when both wheels have equal traction or drive is disengaged.

The brakes are mounted on the final reduction sun gears. These brakes are wet disc type with hydraulic piston actuator operated by foot pedals, independently for turning assistance, or together for transport.

The planetary gears (1) are mounted in a carrier and are positioned around the sun gear and within the planetary ring gear (2). The rear axle shafts (3) locate into the internal splines in the carriers.

As the sun gear is driven by the differential, the reduction planet gears revolve inside the stationary planetary ring gear and drive the carrier and axle shaft at reduced speed.



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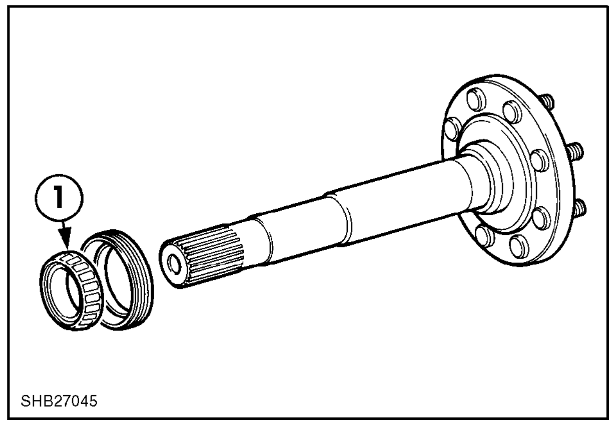
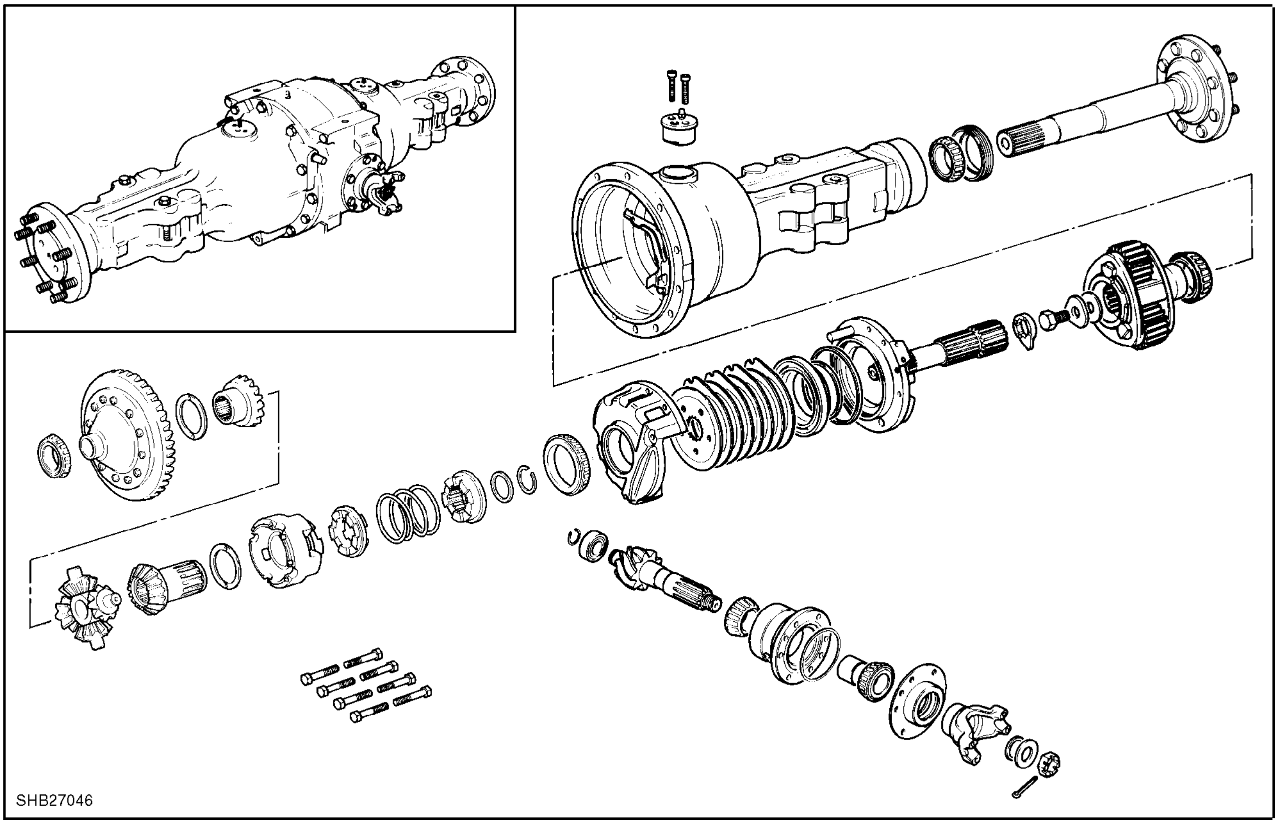
The rear axle shaft is supported on taper roller bearings (1). Preload is adjusted by means of selective shims held under the retaining plate and bolts.



6

FAULT FINDING

Differential Lock not engaging (mechanically engaged)	1. External linkage damaged or broken. 2, Internal linkage, cross shaft rod, fork or pivot shaft damaged/broken. 3. Damaged or broken teeth on differential lock adaptor or coupling.	1. Replace/repair as required. 2. Remove and inspect. 3. Remove differential and inspect differential lock assembly.
Differential Lock not disengaged (mechanically engaged)	1. Spring broken between adaptor and coupling 2. Teeth of adaptor or coupling damaged/ burred.	1. Remove differential and replace spring. 2. Remove differential and replace damaged parts.



7

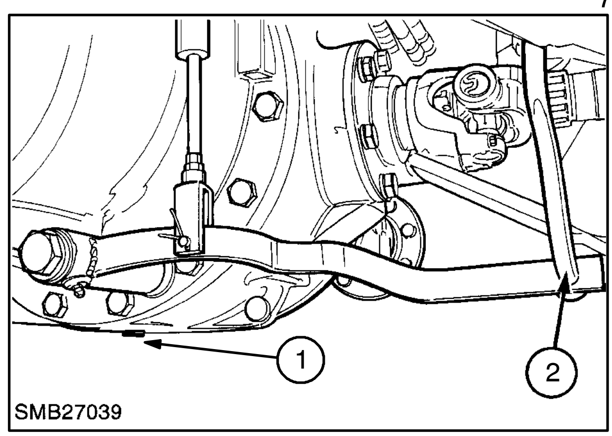
OVERHAUL

Rear Axle Removal

For servicing of any rear axle component the axle must be removed.

Prior to removal of the axle place a suitable clean container under the axle, capable of holding 26 litres (6.86 US. gals) and drain the oil from the plug at the base of the axle (1).

Disconnect the differential Lock lever(2)



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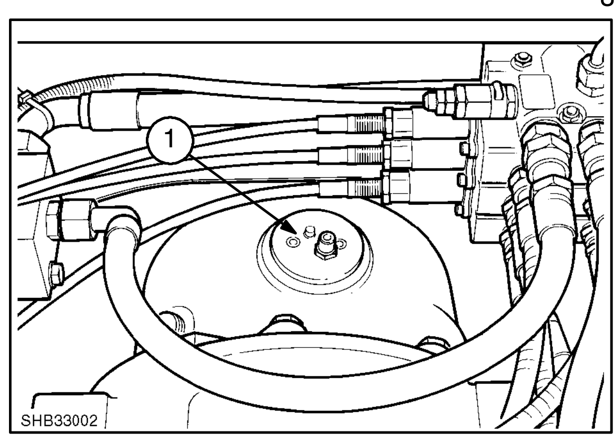
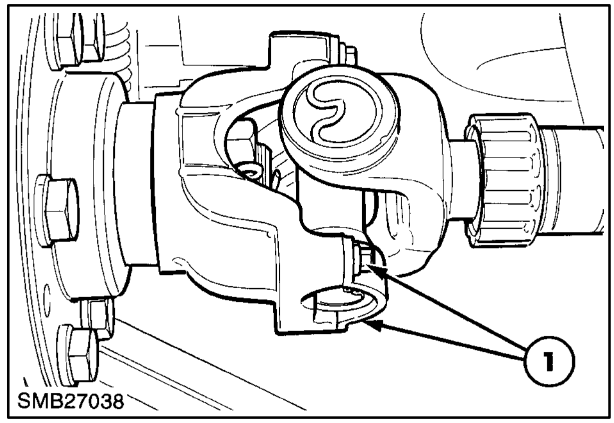
Accessed from the top of the rear axle disconnect and drain the residual brake oil into a suitable clean container. Remove the pipes from both sides of the axle half shafts. Plug the brake pipes to prevent any dirt or contamination entering the brake system.



9

Remove the 4 attaching bolts (1) from the drive shaft coupling and remove from the axle



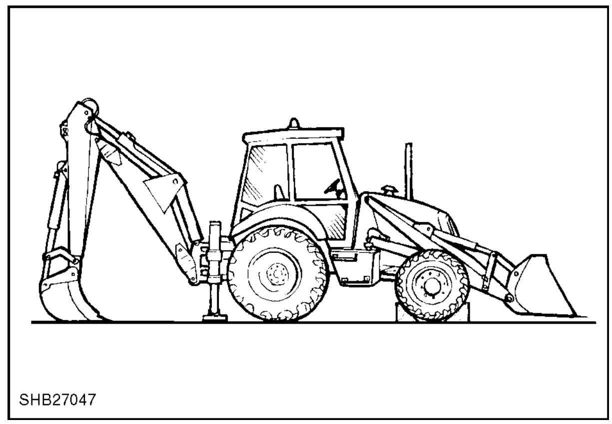
10

Before removal of the axle make sure the machine is on level ground with the loader fully lowered and backhoe resting on the ground. The stabilisers must be lowered to the ground and the front wheels chocked.

IMPORTANT: *Do not rely on the stabilisers, install axle stands to support the unit.*

With the axle (1) supported using a suitable support plate (2) and attached to splitting stand (3). Remove the retaining bolts and gently lower the axle to the ground.

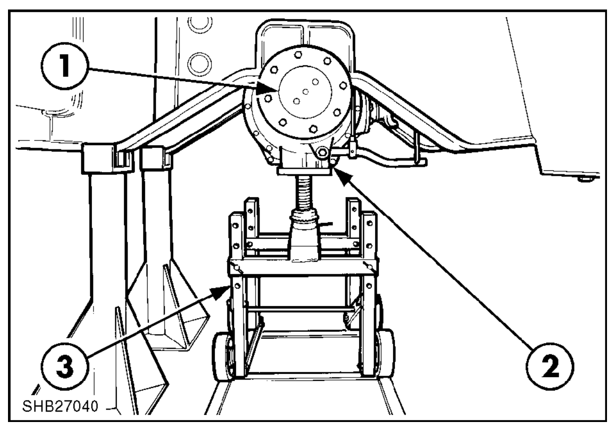
Place the axle onto a suitable axle stand to facilitate repairs



11

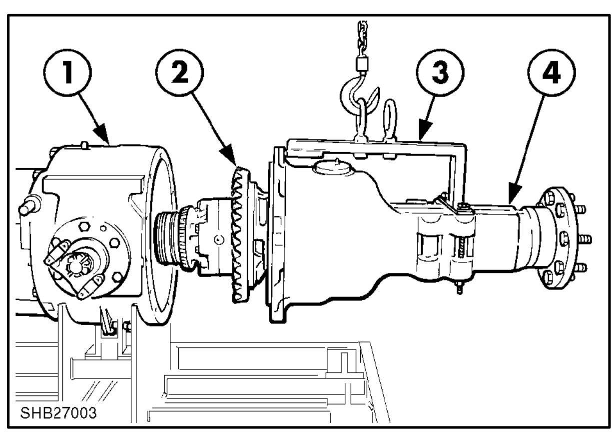
Differential Removal

NOTE: *Remove the left hand axle housing using lifting tool 380000990 and the differential will be removed with the axle housing.*



12

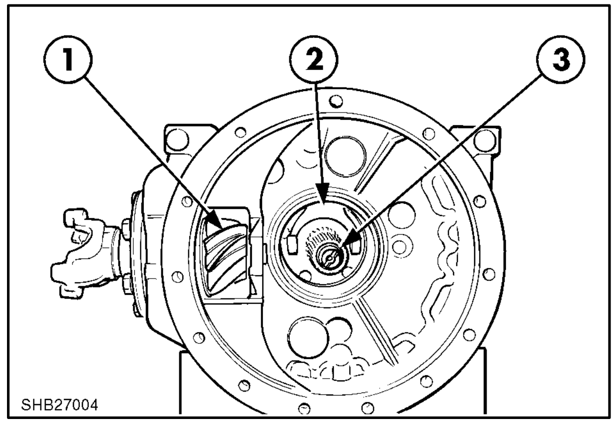
1. Centre Housing
2. Differential Assembly
3. Lifting Tool
4. Half Shaft Axle Housing



13

Pinion location in axle housing

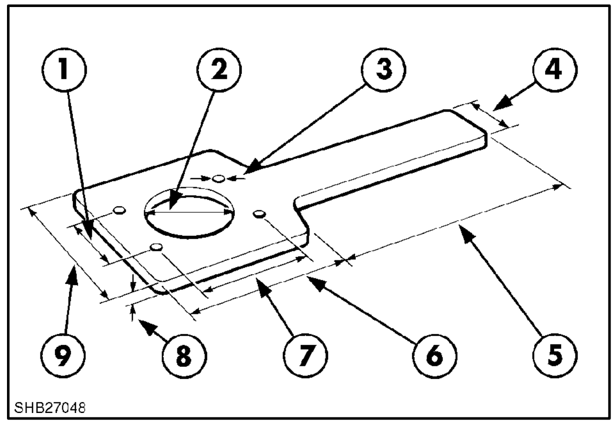
1. Pinion Shaft
2. Differential Lock Actuator
3. Half Shaft



14

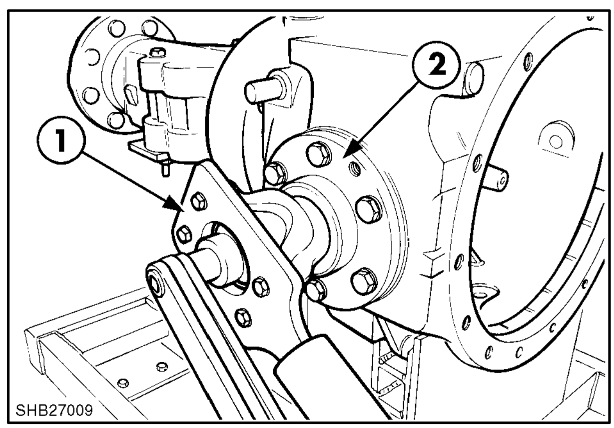
Loosen the pinion nut using a pre fabricated tool, the dimensions being:

1. 46mm (1.811in)
2. 65mm (2.559in)
3. 9mm (0.354)
4. 40mm (1.575in)
5. 220mm (8.66in)
6. 140mm (5.51in)
7. 95mm (3.74in)
8. 10mm (0.394in)
9. 110mm (4.33in)



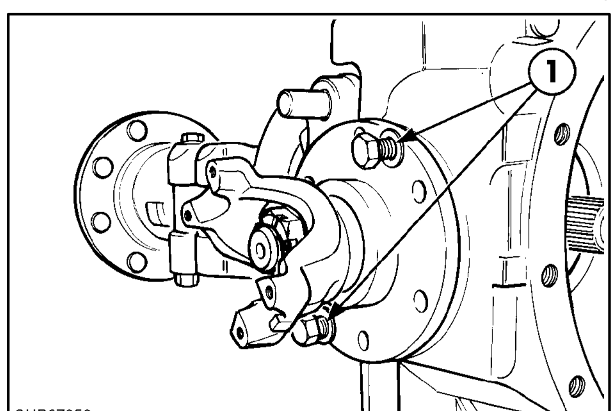
15

Using the special tool (1) hold the coupling steady while loosening the coupling retaining nut. Loosen the pinion housing bolts.

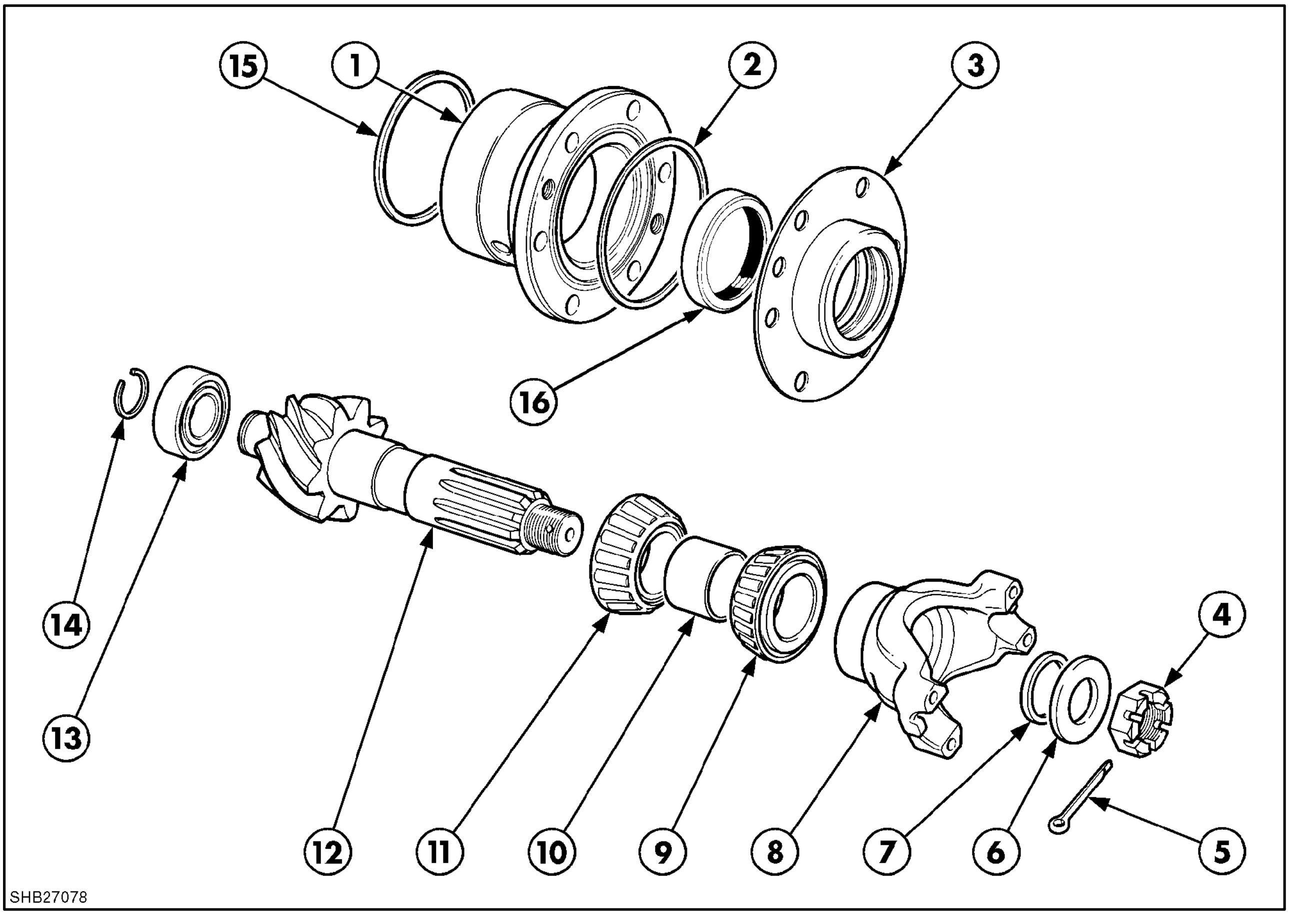


16

Leave 2 bolts in the position shown removing the remaining bolts and jack the pinion out evenly.



17



18

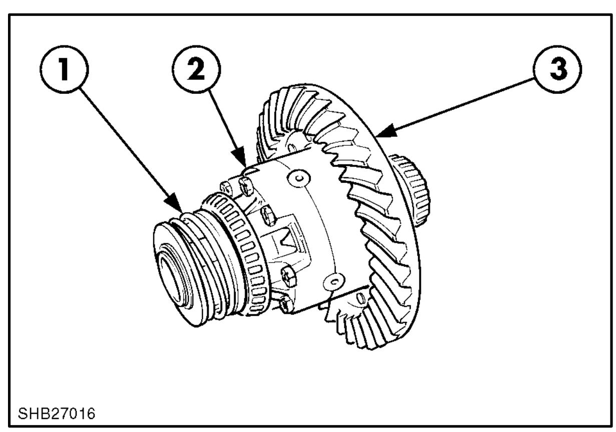
Pinion Shaft Layout

1. Pinion Housing
2. Seal
3. Retainer
4. Nut
5. Lock Pin
6. Washer
7. Seal
8. Flange
9. Bearing
10. Shim Various Sizes
11. Bearing
12. Pinion Shaft
13. Bearing
14. Lock Ring
15. Seal
16. Seal Assembly

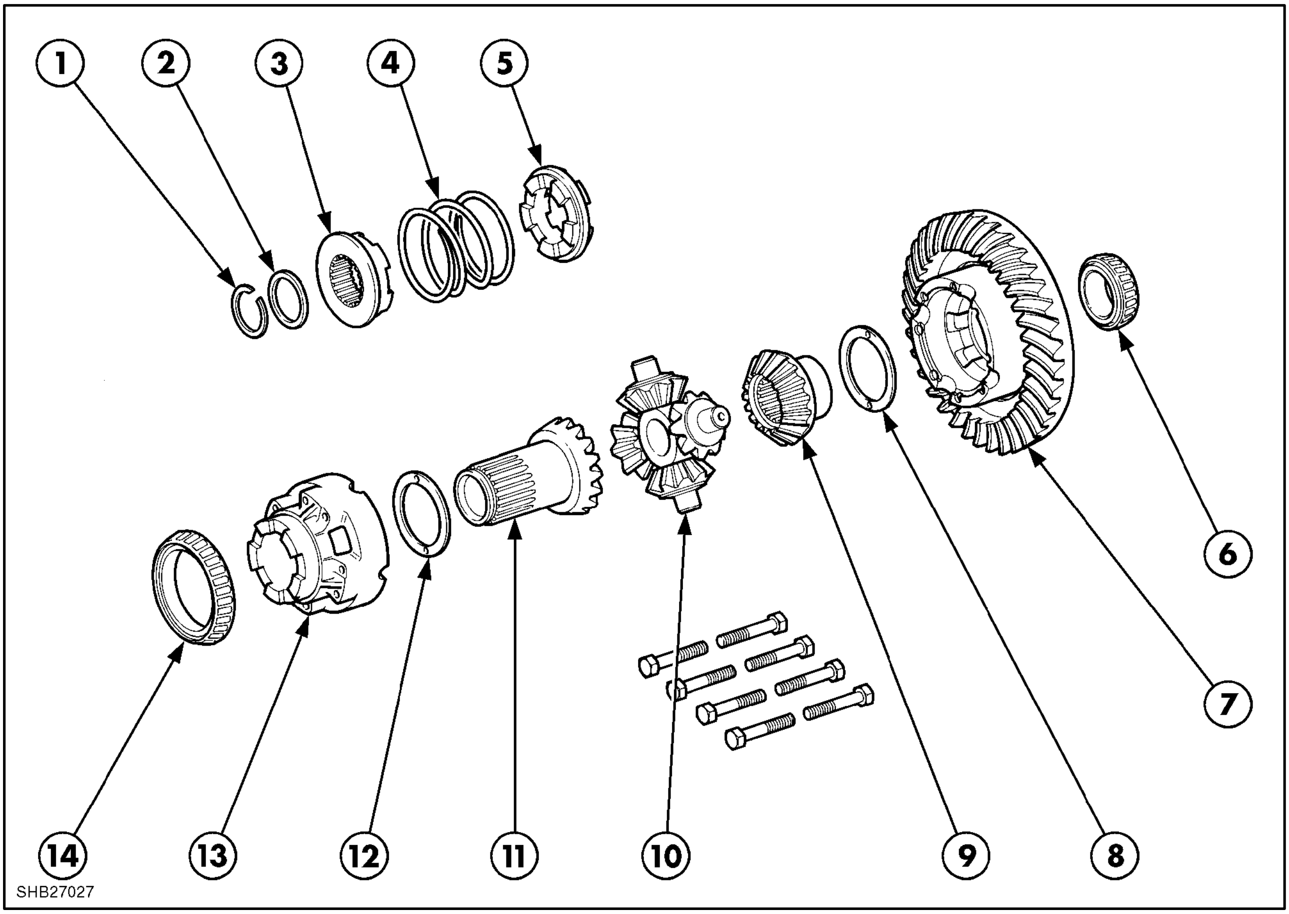
***NOTE:** the pinion and crown wheel are a matched pair and must always be replaced together.*

Differential assembly.

1.Differential Lock Return Spring
2.Differential Housing
3.Crown Wheel



19



20

Differential Assembly Exploded View

1. Lock Ring
2. Washer
3. Dog Gear
4. Spring
5. Dog Gear
6. Bearing
7. Crown Wheel
8. Thrust Washer
9. Side Gear
10. Spider Assembly
11. Side Gear
12. Thrust Washer
13. Differential Housing
14. Bearing

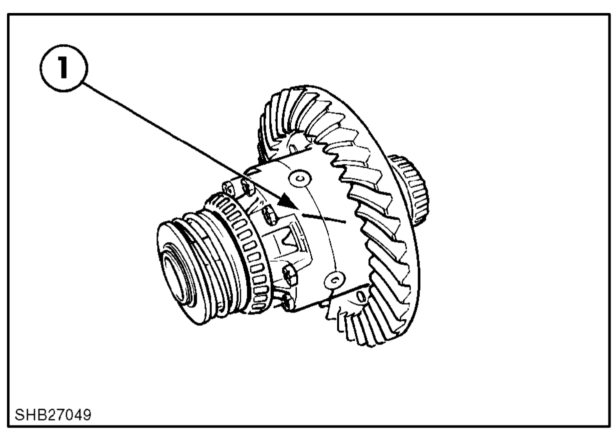
Differential lock.

Prior to separating the differential, mark the two half housings (1) to ensure correct re-assembly.

Replace the differential lock coupling and adaptor if worn or damaged.

The crown wheel is rivetted to the differential housing in production.

Replacement crown wheels are secured with nuts and bolts for easier field service.



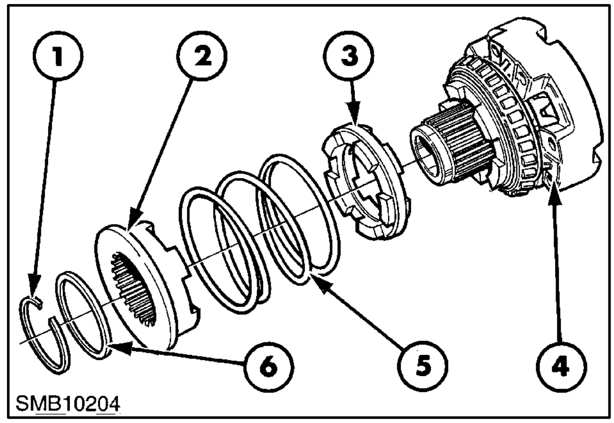
21

The differential lock consists of a sliding dog type coupling splined to the right hand side of the differential and a fixed adaptor located to the differential housing.

The differential lock can be disassembled by compressing the spring and carefully detaching the snap ring (1).

With the snap ring removed disassemble the:
Washer (6), Outer Dog (2), Spring (5), Inner Dog (3), from the housing (4).

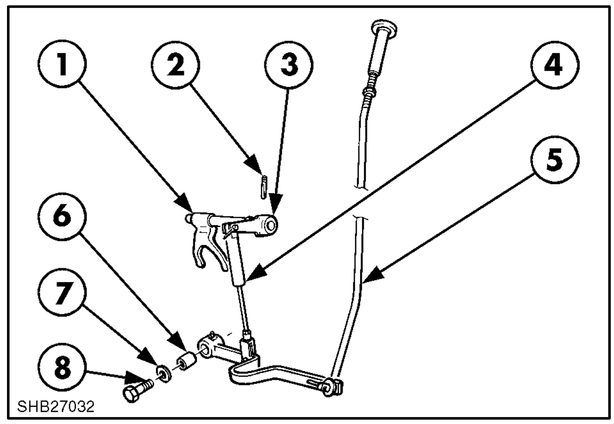
Carefully inspect all moving parts for signs of scoring, wear, or damage, if evident replace with new parts.



22

Differential lock fork & actuator.

1. Differential Lock Fork
2. Retaining Pin
3. Lever and Shaft
4. Sprung Engagement Rod
5. Engagement Rod
6. Bush
7. Washer

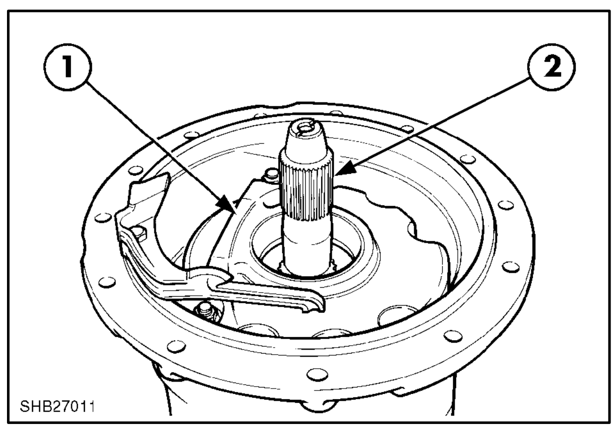


23

Axle Shaft Component Removal

Remove the fork and shaft (right hand side housing only). With either of the left or right brake housings (1) exposed remove the attaching nuts and lift the outer housing over the axle half shaft (2).

Inspect the housing scoring damage or distortion, repair as required.

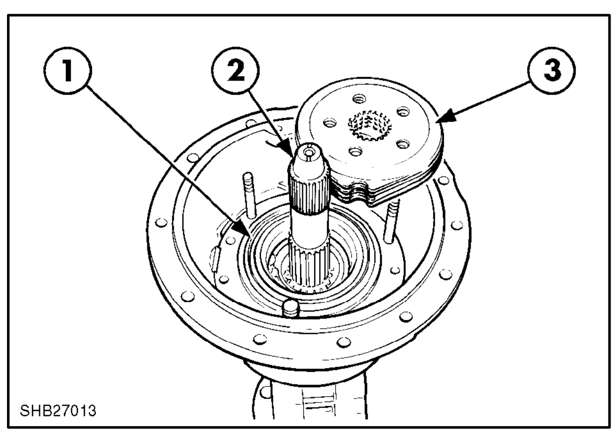


24

Lift the brake discs (3) over the half shaft (2) to expose the inner brake housing (1).

Inspect the steel separator plates and rotating brake discs for wear or distortion. Replace the brake discs if worn to a thickness of less than 4.23 mm (0.170in). Maximum allowable warpage is 0.08mm (0.003in)

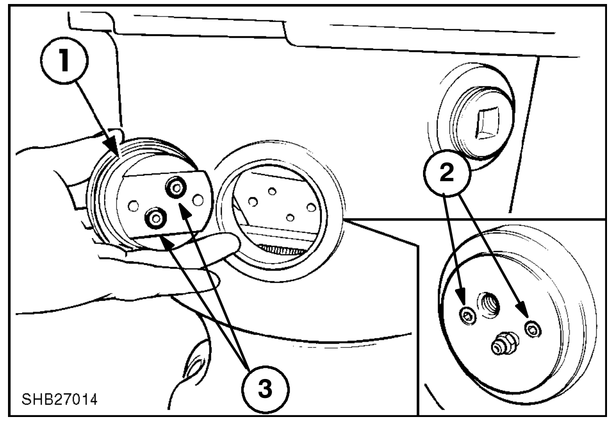
Reassemble in reverse order to disassembly.



25

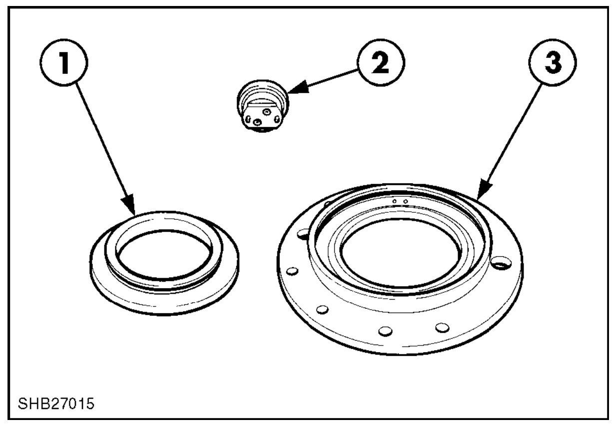
The brake pipe fitting (1) can be removed by loosening and removal of the attaching Allen screws (2).

Before re-assembly fit a new ‘O’ ring (1) to the fitting and new ‘O’ rings (3) that seal the oil galleries. On re-assembly torque the attaching bolts to 8-13.5Nm (6-10lbs ft).



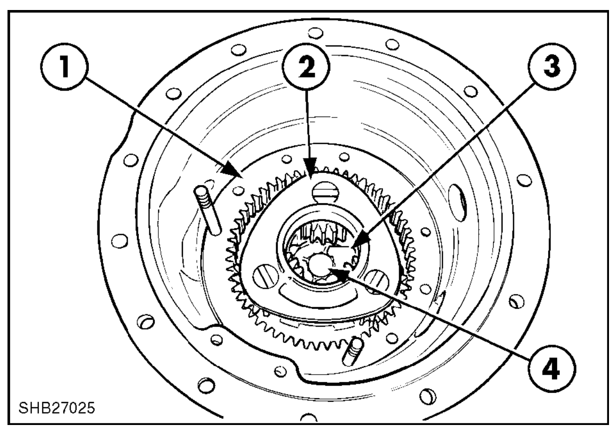
26

Remove the brake housing (3) and brake piston (1) and inspect all moving parts for wear or scoring. If in any doubt replace suspect parts with new.



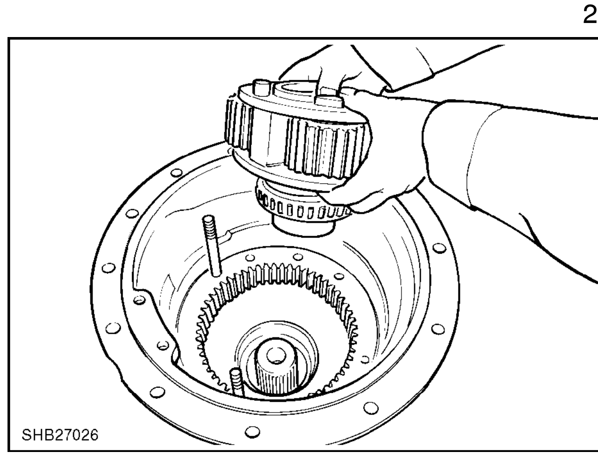
27

To remove the planetary gear (2) from the carrier (1) remove the lock washer (3) and retaining bolt (4).



28

Remove the planetary gear carrier.

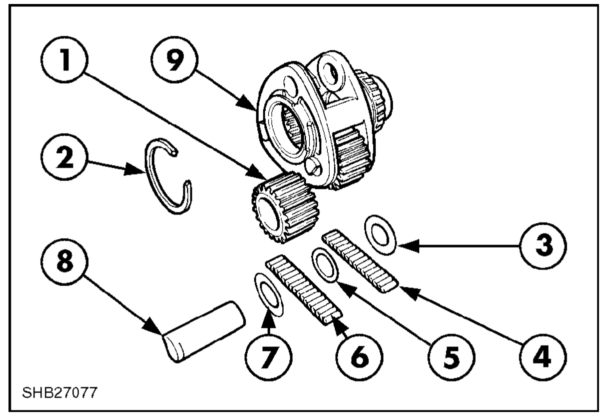


29

The planetary gear assembly can be disassembled by rotating the retaining ring (2) to allow the slot to align with the individual gear shafts (8) which allows them to be withdrawn from the body.

Carefully inspect the shafts, gears, bearings and washers and housing for wear, scoring or damage and ensure new are parts fitted or repairs performed.

1. Planetary Gear
2. Retaining Ring
3. Thrust Washer
4. Roller Bearings
5. Thrust Washer
6. Roller Bearings
7. Thrust Washer



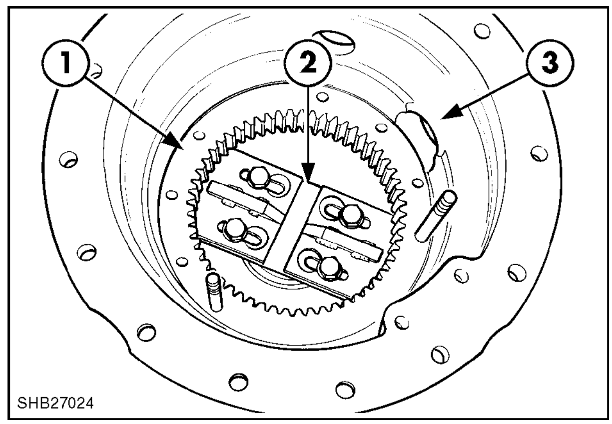
30

8. Planet Gear Shaft
9. Carrier

Position the axle housing to allow removal of the axle shaft.

The planetary ring gear (1) can be removed from the axle (3) with the aid of Tool (2), No 380000716. Position the tool beneath the ring gear, expand the plates and tighten the bolts. Invert the axle and press out the gear form the wheel hub side

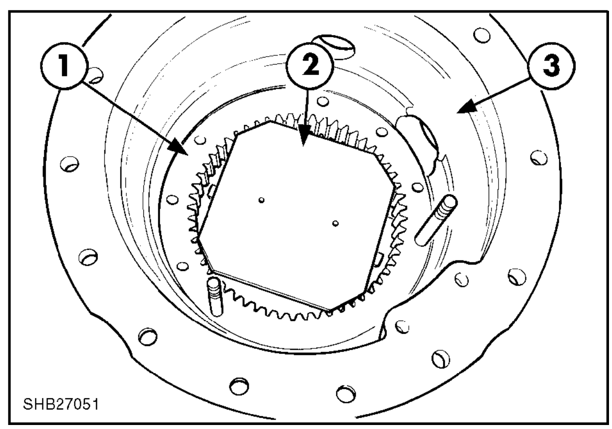
Inspect the gear for wear scoring or damage and repair or replace.



31

Refitting the ring gear (1) is the reverse procedure but using Tool (2) the ring gear is pressed back into the axle (3) from the brake side. If fitting a new ring gear ensure the gear is seated equally in the axle by placing a feeler gauge between the gear and housing.

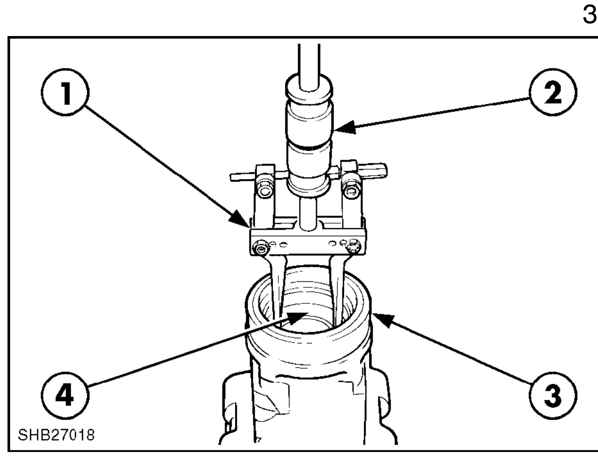
IMPORTANT: *If a new ring gear has been fitted in the left hand axle housing, the differential bearing preload must be checked.*



32

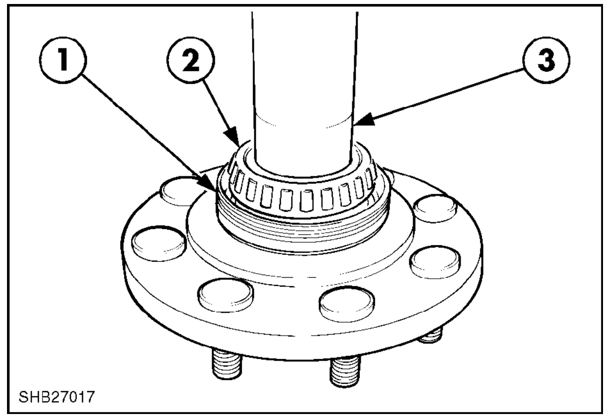
Axle housing bearing cup removal.

1. Puller Tool No 380000986
2. Slide Hammer Tool No 380000987
3. Axle Housing
4. Bearing Cup



33

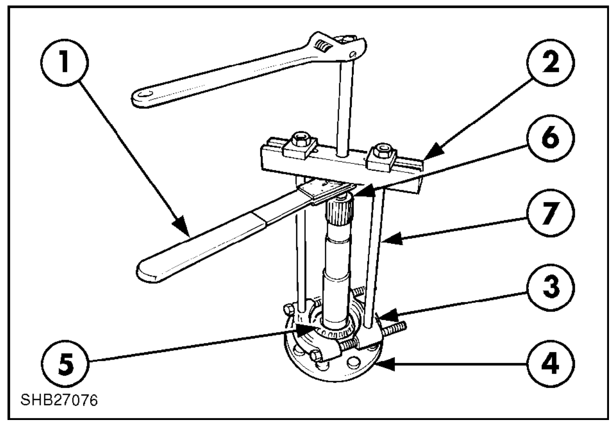
The half shaft axle seal (1) is retained in position by the axle bearing (2). To remove the seal it is necessary to remove the bearing.



34

To remove the bearing, stand the half axle (4) upright and attach the bearing removal tool as shown.

1. Ratchet Tool
2. Puller Tool
3. Pulling Attachment Tool
4. Axle Shaft
5. Bearing
6. Shaft Protector
7. Legs



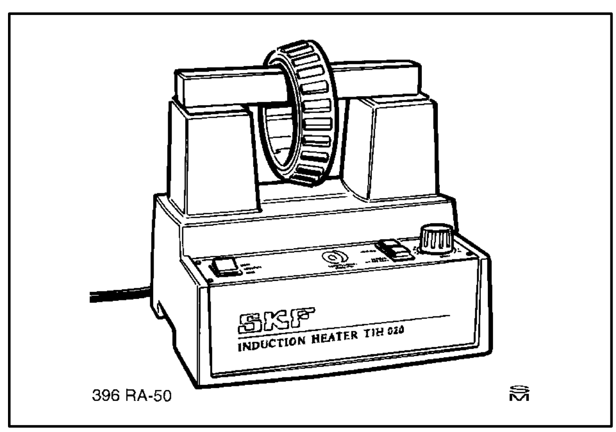
35

Applying gradual pressure to the puller tool the bearing will separate from the half axle.

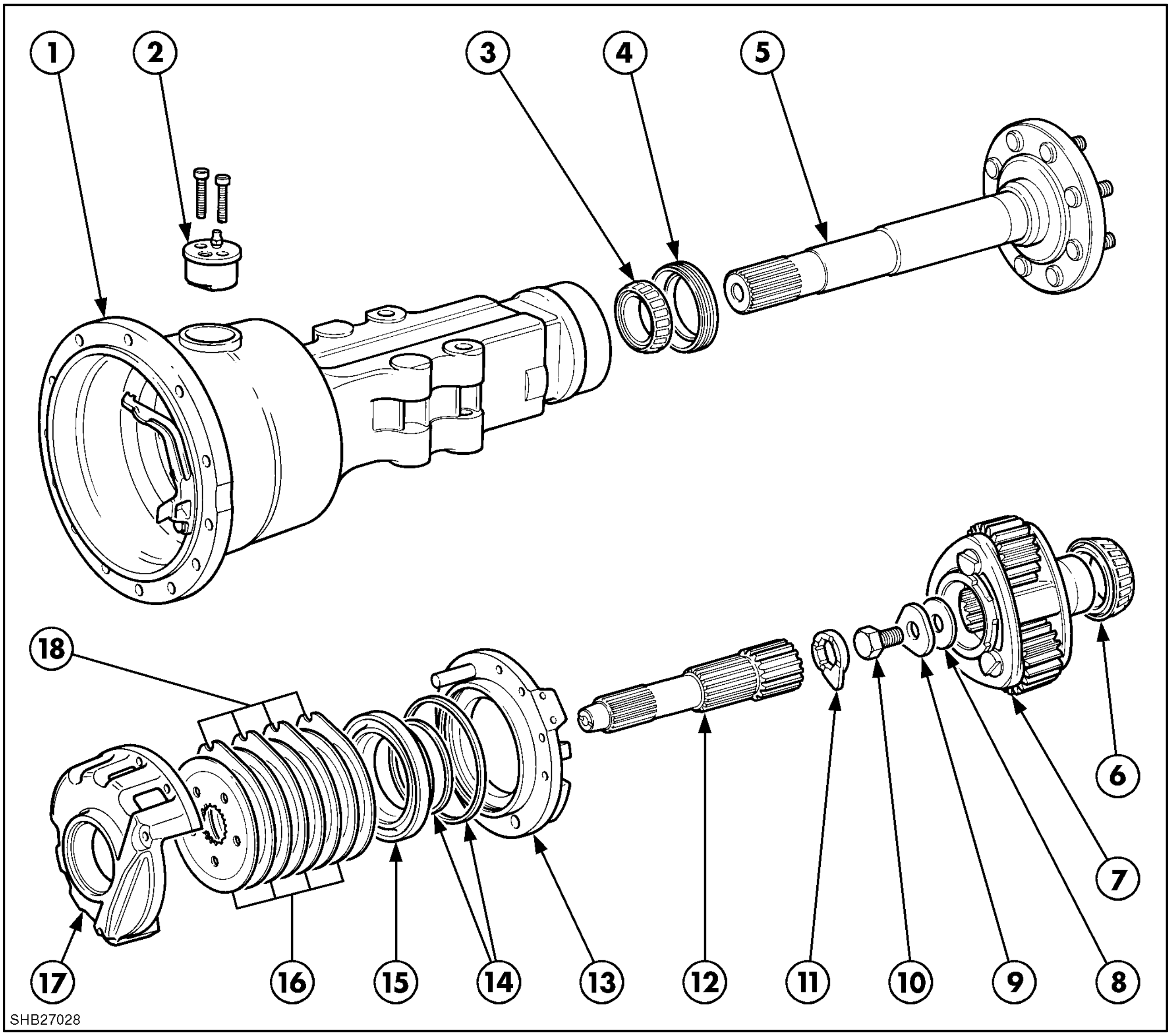
Inspect the bearing for wear, scoring or damage and replace if in any doubt.

IMPORTANT: *Always fit a new axle seal if the axle bearing is removed for any reason.*

Re-assembly of the seal and bearing is the reverse procedure. Locate the seal and using an induction heater, heat the bearing sufficiently to expand it enough to allow it to easily seat onto the half shaft.



36



37

Rear Axle Shaft Components

1. Axle Housing
2. Brake Fitting
3. Bearing
4. Seal
5. Half Shaft
6. Bearing
7. Planetary Reduction Assembly
8. Shim
9. Washer
10. Bolt
11. Lock Washer
12. Shaft
13. Inner Brake Housing
14. Seals
15. Brake Piston
16. Friction Discs
17. Outer Brake Housing
18. Discs

ADJUSTMENTS

Drive pinion preload

Axle shaft bearing preload

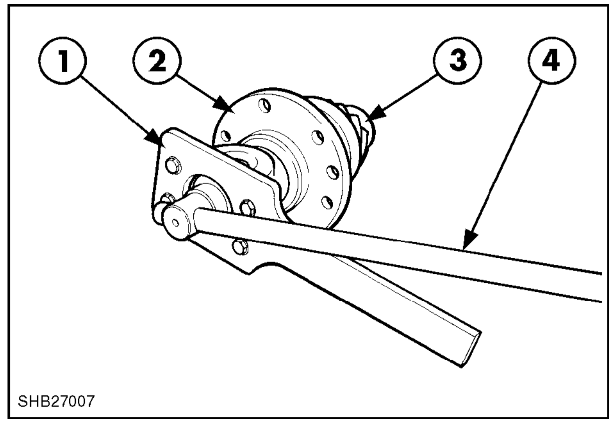
Differential bearing preload

NOTE: *Crown wheel to pinion backlash is preset by manufacturing tolerances in production.*

The pinion bearing preload is set by selecting the correct shim (spacer) which is placed between the bearings.

Re-assemble the pinion assembly, attach the fabricated spanner (1) to the assembly (2) and torque to 406-813 Nm (300-600 lbf ft) with spanner (4) to the locknut.

Shims Available:
From 2.5 mm to 3.4 mm, in increments of 0.1mm



38

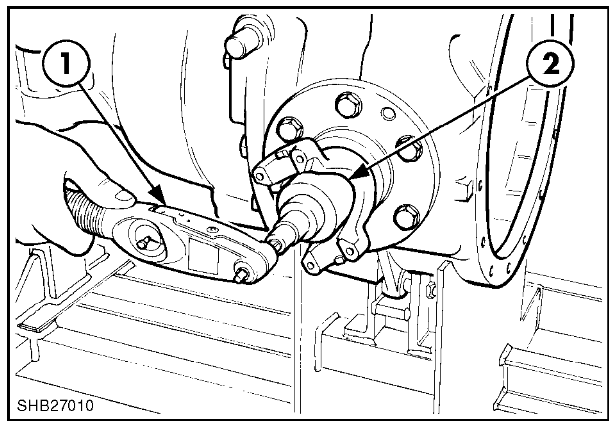
Use a torque meter (1) to check rolling resistance when the assembly is fitted back into the axle.
The rolling resistance should be: 1.3 Nm (10-40 lb in)

Leave pinion retainer bolts loose for this check.

If under specification, fit a smaller shim

If over specification, fit a larger shim

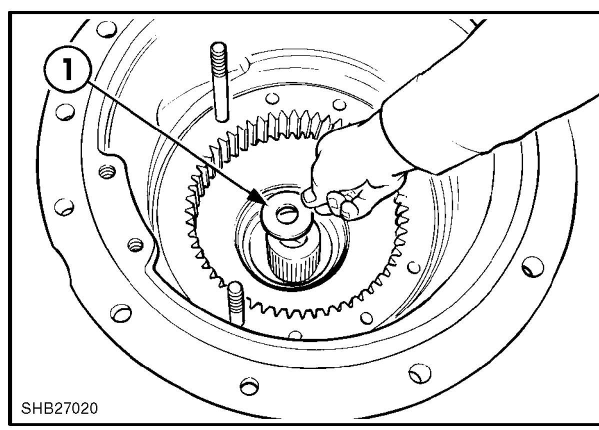
NOTE: *Make sure both bearings are well lubricated and, once preload is set, lock nut to pinion.*



39

Axle shaft bearing preload

Adjustable shims (1) are located between the inner end of the axle shaft and carrier retainer.



40

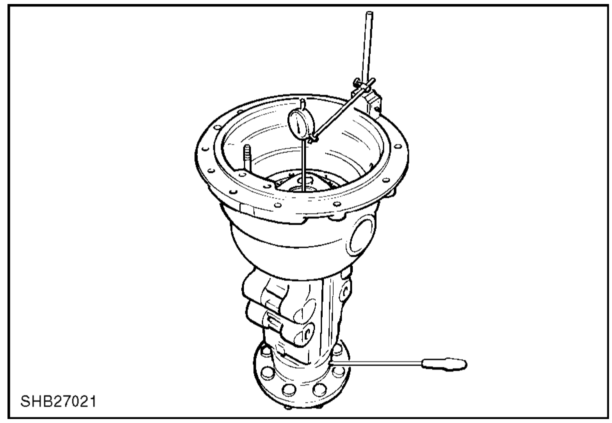
Adjustment procedure

To achieve the correct preload proceed through steps 1 to 7

1. Fit a shim 2.06mm (0.081in) thus reducing end float and possible damage to the seal.
2. Replace the planetary gear assembly.
3. Tighten the retaining bolt to 745 Nm (550 lb ft).
4. Position the dial gauge and measure end float eg. 0.562mm (0.022in).
5. To ensure correct preload, subtract endfloat from shims already fitted for example 2.06 – 0.562mm=1.498mm.
6. Select shim from table to provide specified preload of 1.72mm (0.067in).

IMPORTANT: *Increasing shim thickness will reduce preload.*
Decreasing shim thickness will increase preload.

7. Fit selected shim and re-tighten retained bolt to correct torque and allow lock plate to locate.



41

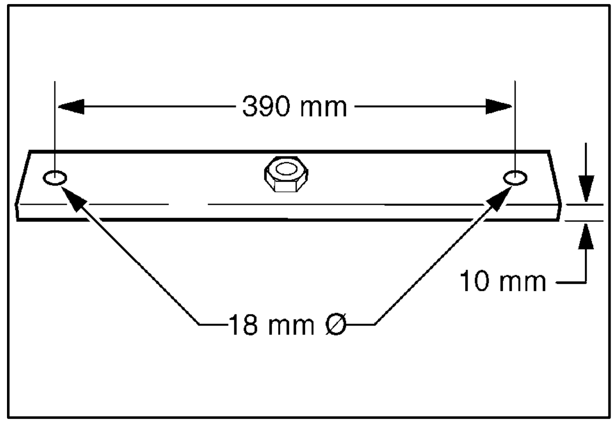
Shim Selection Table

Resultant Figure	Shim to be Installed
1.24 – 1.32mm (0.049 – 0.052in)	A13 81803491 1.14mm (0.045in)
1.35 – 1.42mm (0.053 – 0.056in)	A13 81803502 1.24mm (0.049in)
1.45 – 1.54mm (0.057 – 0.060in)	A13 81803503 1.35mm (0.053in)
1.55 – 1.64mm (0.061 – 0.064in)	A13 81803504 1.45mm (0.057in)
1.65 – 1.74mm (0.065 – 0.068in)	A13 81803505 1.55mm (0.061in)
1.75 – 1.84mm (0.069 – 0.072in)	A13 81803506 1.65mm (0.065in)
1.85 – 1.94mm (0.073 – 0.076in)	A13 81803507 1.75mm (0.069in)
1.96 – 2.04mm (0.077–0.080in)	A13 81803508 1.85mm (0.073in)
2.06 – 2.14mm (0.081 – 0.084in)	A13 81803509 1.96mm (0.077in)
2.16 – 2.24mm (0.085 – 0.088in)	A13 81803510 2.06mm (0.081in)
2.26 – 2.34mm (0.089 – 0.092in)	A13 81803511 2.16mm (0.085in)

Axle Shaft Rolling Resistance

After fitting the correct shim to set the preload:

Manufacture a bridging bar to span opposing bolt holes to the dimensions shown.

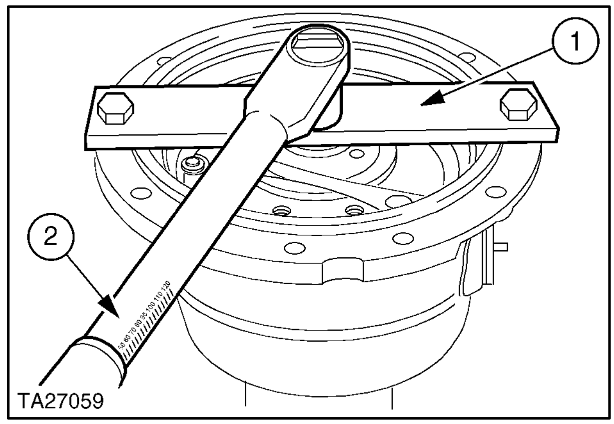


42

Fit bridging bar (1) across the rear axle housing flange and use a torque meter (2) to check rolling resistance which should be 2.3–10 Nm (20–80 lb in).

NOTE: *The brake housing, brake discs and 1/4 shaft should not be installed but all bearings well lubricated.*

If out of specification the shim should be adjusted and rolling resistance rechecked.



43

Differential bearing preload

This adjustment is made by shimming the right hand differential bearing cone using two methods:

If the left hand axle housing, ring gear or brake housing are replaced the following checks should be made:

Method 1

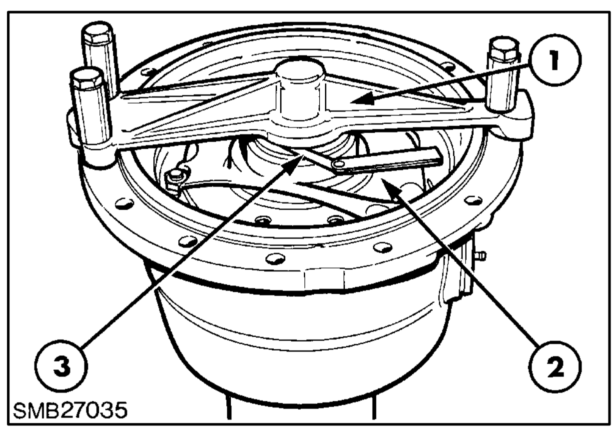
Remove the differential bearing cone and shim from the outer brake housing.

Place the gauge ring of tool **380000991** (1) into the vacant bearing location.

Bolt bridge tool **380000991** (1) across the rear axle housing flange with spacers (2) located between the axle housing flange and the tool.

Measure the gap between the bridge tool and the gauge ring using a feeler gauge (3).

Refer to the following table to determine the correct size shim which should be installed between the brake housing and bearing cone, thus preloading the bearing back to specifications.



44

Method 2

When the differential bearings are not changed the differential rolling resistance must be checked.

Remove the right hand axle bearing.

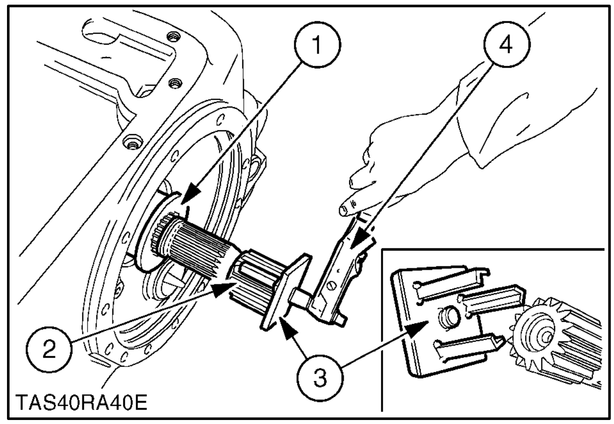
Remove the left hand axle housing and differential

Remove pinion.

Compress the differential Lock Spring and install shim stock to constantly engaged differential lock.

Refit differential and left hand axle housing but less the 1/4 shaft and brake discs.

Fit the 1/4 shaft in from the right hand side and fit adaptor tool onto shaft.



45

1. Differential Lock
2. 1/4 Shaft
3. Adapter Tool
4. Torque Meter
5. Right Hand Brake Housing

Check rolling resistance is between 2.3–10 Nm (20–90 lb in)

If out of specification the shim should be adjusted and bearing preload rechecked.

Differential Bearing Preload Adjustment Shims

Gap Reading	Part Number of Shim	Shim Thickness
0.86 – 0.99mm 0.034 – 0.039in	1803515	0.097 – 10.2mm 0.038 – 0.040in
1.02 – 1.14mm 0.040 – 0.045in	1803516	1.12 – 1.18mm 0.044 – 0.046in
1.17 – 1.13mm 0.046 – 0.051in	1803517	1.28 – 1.33mm 0.050 – 0.052in
1.32 – 1.45mm 0.052 – 0.057in	1803518	1.43 – 1.48mm 0.056 – 0.058in
1.47 – 1.60mm 0.058 – 0.063in	1803519	1.59 – 1.64mm 0.062 – 0.064in
1.63 – 1.75mm 0.064 – 0.069in	1803520	1.74 – 1.79mm 0.068 – 0.070in
1.78 – 1.90mm 0.070 – 0.075in	1803521	1.89 – 1.95mm 0.074 – 0.076in
1.93 – 2.06mm 0.076 – 0.081in	1803522	2.05 – 2.10mm 0.080 – 0.082in

NOTES

SECTION 27 - REAR AXLE

CHAPTER 2 - REAR AXLE WITH ELECTRICALLY-CONTROLLED LOCKING DIFFERENTIAL FOR 2 AND 4 WHEEL DRIVE

IDENTIFICATION

CNH Part No. 85825118

TABLE OF CONTENTS

SPECIFICATIONS

Type of axle	Modular
Overall width	1740 mm
Planetary reduction	4.5/1
Crown wheel and pinion reduction	4.11/1
Total reduction	18.5/1
Number of satellites (per side)	3
Differential housing oil capacity	26 litres
Lubricants	Ambra Multi G
Brake type	Hydraulic
Brakes	oil-bath disc
Number of sintered discs (per side)	4
Electrically-controlled differential lock	100% mechanical

CLEARANCES AND ADJUSTMENTS

Clearance between drive pinion teeth	not adjustable, factory pre-set
Preload on drive pinion bearings	1.3 to 4.1 Nm
Pre-load on differential bearings	2.3 to 10 Nm
Drive pinion direction of rotation	Anti-clockwise
Pre-load on stub axle bearings	2.3 to 10 Nm

SEALING AND ADHESIVE PRODUCTS

Loctite	510
Loctite	270
Loctite	638

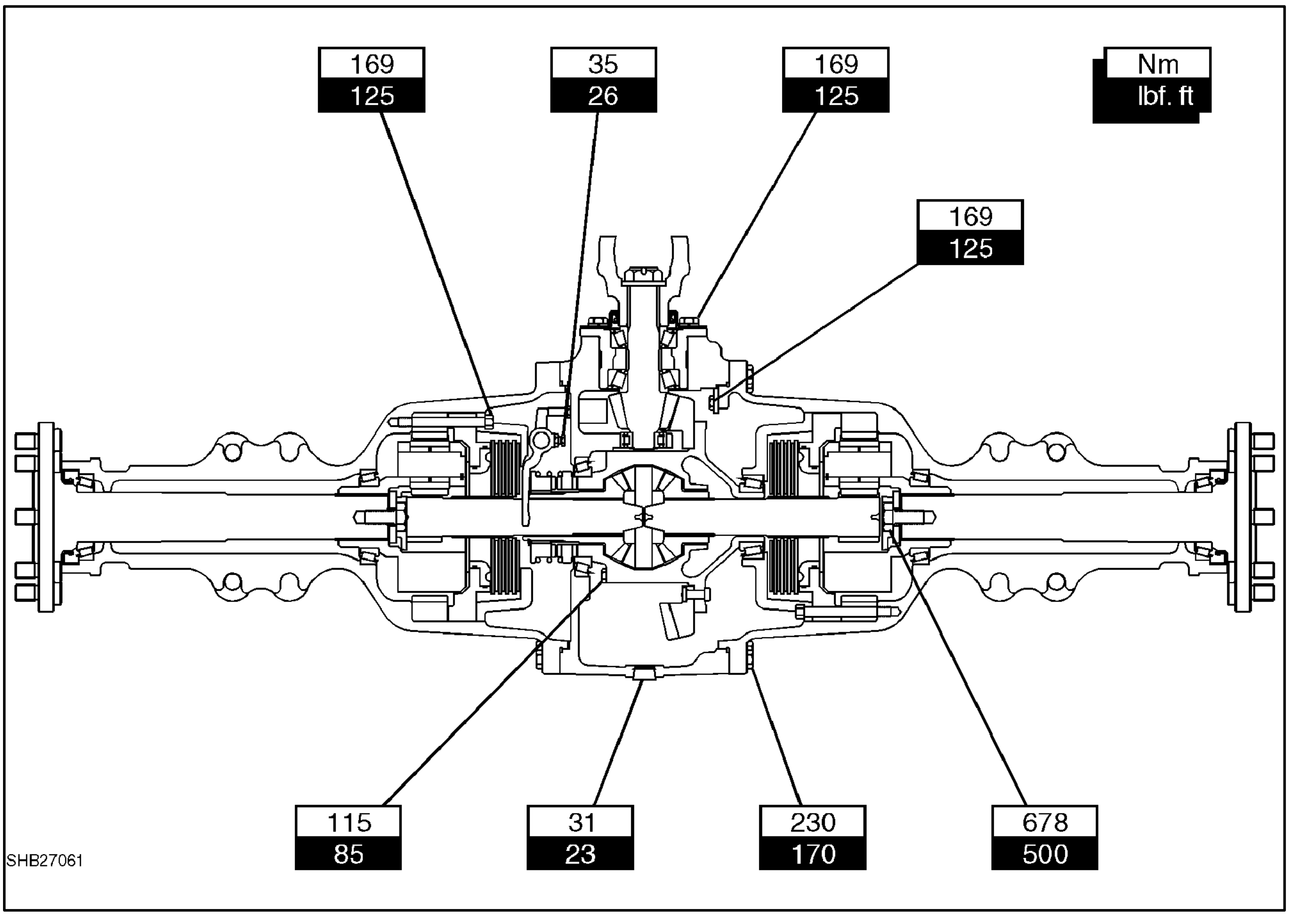
SPECIFICATIONS

Overall width	1740mm (67.86 in)
Oil capacity	26 Litres (6.8 US. Gals)
Oil change period	1 year or 1200 hours
Lubricants	Multi-G API GL4 ISO32/46
Thread sealant	Pt. No. 82995768

CLEARANCES AND ADJUSTMENTS

Drive pinion preload	1.3-4.1 Nm (10 - 40 lb in)
Rolling resistance	2.3-10 Nm (20-90 lb in)

TORQUE VALUES



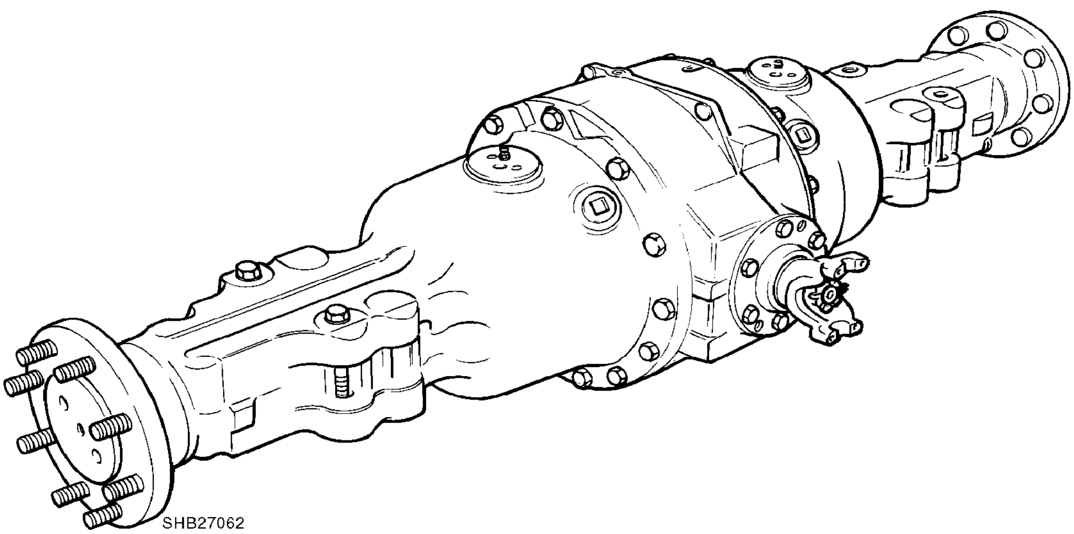
1

SPECIAL TOOLS

	APPLICATION
Splitting Tool	Axle removal
Half axle lifting bracket	Half shaft removal
Sliding Hammer	Axle bearing cup removal
Ratchet Tool	Axle housing bearing/seal
Puller Tool	Axle housing bearing/seal
Pulling Attachment Tool	Axle housing bearing/seal

SEALANTS

Code	Number	Name
82995768	Sealer	Anaerobic Low strength
82995776	Sealer	Silicone
82995774	Sealer	Polyester Urethane
82995773	Sealer	Anaerobic



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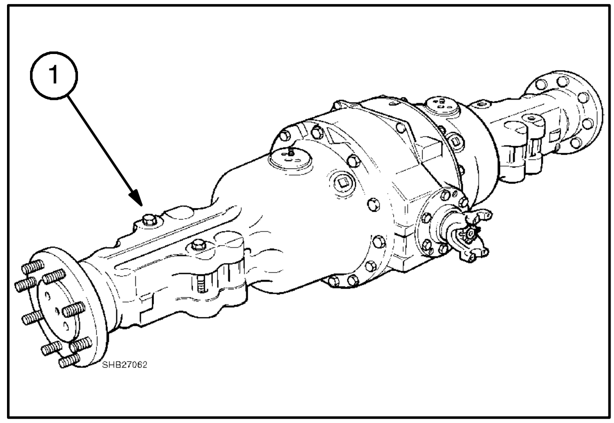
DESCRIPTION AND OPERATION

The rear axle (1) is of modular design and is fixed by 4 bolts to the chassis with a torque value of 1000 Nm (737lbf ft). It incorporates the following features:



3

Differential Lock (Electrically operated)

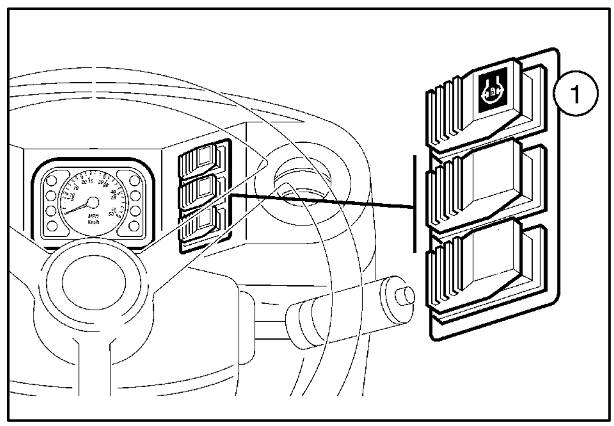
WARNING

Never use the differential lock at speeds above 8 km/h (5 miles/h) or when turning the machine. When engaged the lock will prevent the machine turning and personal injury could result.

The differential lock fitted to this machine is operated by oil pressure and controlled by an electrically operated solenoid. The solenoid is energised when the switch (1) mounted in the front console is depressed. The differential lock effectively places both rear wheels into a direct drive when selected, this action stops one rear wheel spinning.

In conditions inducing wheel slip (differential lock not yet engaged), press down the differential lock switch and the lock will engage giving direct drive to both rear wheels.

The lock will remain engaged until traction at the rear wheels equalises or until either of the foot brakes are applied and the vehicle stops. The warning light on the instrument panel will go out when the differential lock has disengaged.

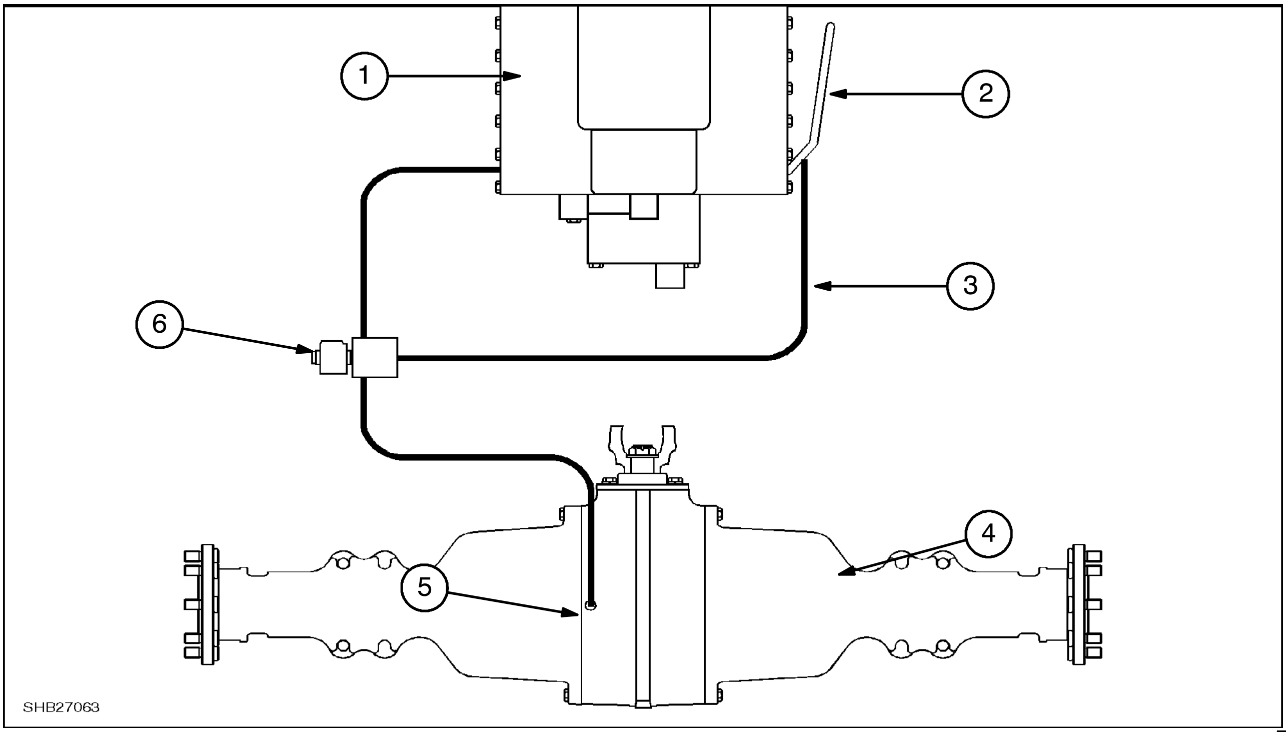


4

Operating System

When the instrument panel switch is selected the differential is operated by the pressure of the oil it receives from the transmission, acting on the differential operating piston.

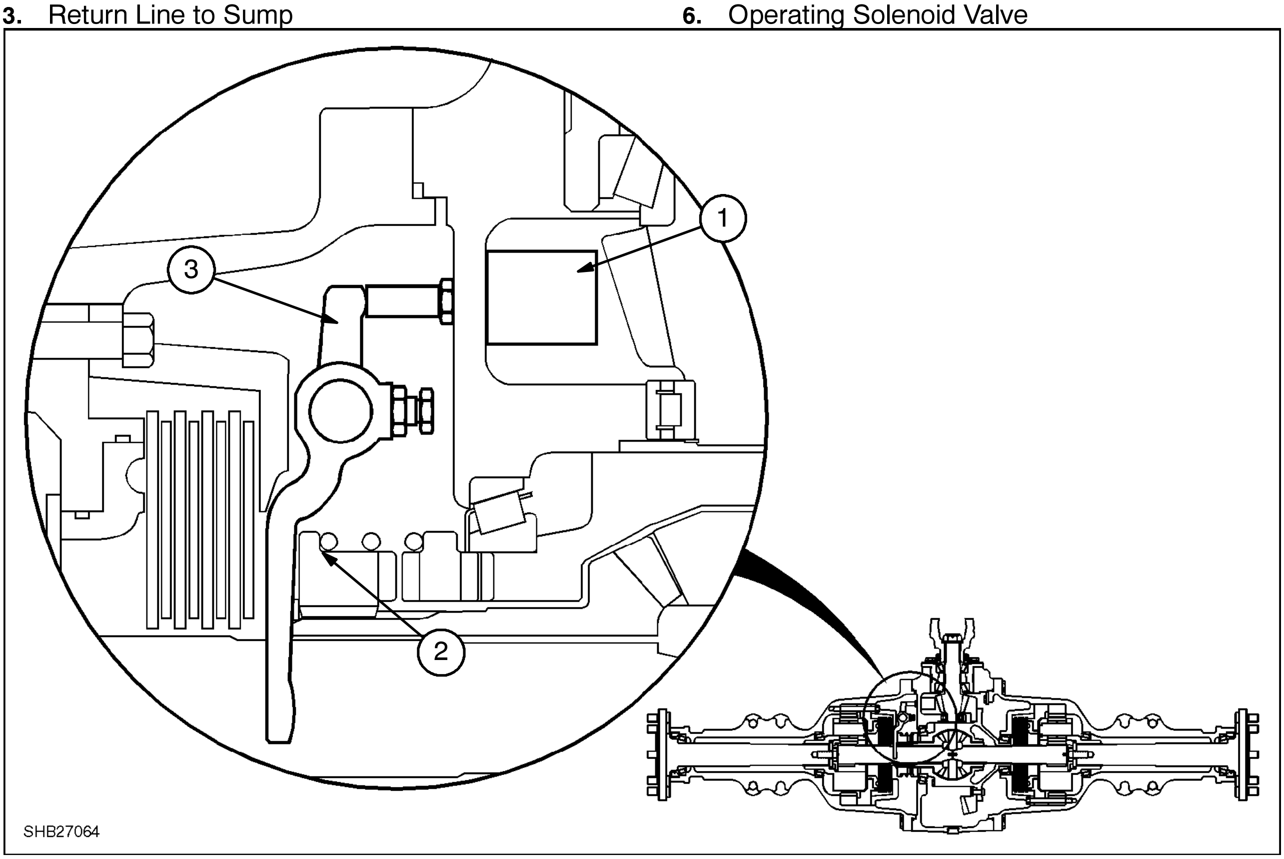
This oil pressure 13 - 14 bar (188 - 203 psi) which is constantly available when the engine is running is controlled by a solenoid operated valve. When the switch is deselected (differential lock not required) the oil is diverted back to the dipstick tube (dump) and the differential piston spring releases the lock.



5

Differential Schematic Control

1. Powershift Transmission
2. Dipstick Tube
3. Return Line to Sump
4. Rear Axle
5. Actuating Valve
6. Operating Solenoid Valve



6

Differential Schematic Operation

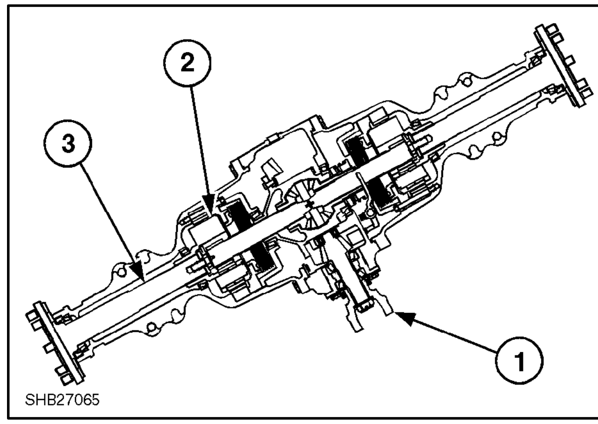
1. Actuating Valve
2. Differential Assembly
3. Actuating Fork

Hydraulically operated oil immersed foot brakes fitted with four disc brakes

three planetary reduction carrier

Operation

Power from the transmission output shaft is transmitted to the rear axle through (1) the reduction gear (2) and onto the half shaft (3).



7

The spiral bevel pinion is located in preloaded taper roller bearings.

The differential is located on two taper roller bearings, the right hand bearing supported by an internal web of the axle centre housing.

The crown wheel is rivetted to the differential housing. Drive from the housing is transmitted through a conventional four pinion differential to sun gear shafts which are splined into the differential side gears.

The differential lock sliding coupling is located on the splines of the left hand differential side gear. The coupling has dog teeth which engage with the dog teeth on the differential housing lock adaptor.

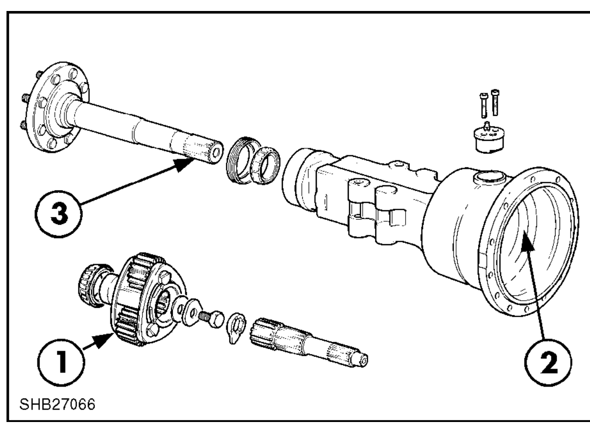
If the dog teeth are not aligned, the spring engagement link will be preloaded, ensuring rapid and full tooth engagement when the dog teeth align.

The differential lock will remain engaged due to dog tooth side loading as long as the rear wheels have unequal traction.

The return spring disengages the lock when both wheels have equal traction or drive is disengaged.

The brakes are mounted on the final reduction sun gears. These brakes are wet disc type with hydraulic piston actuator operated by foot pedals, independently for turning assistance, or together for transport.

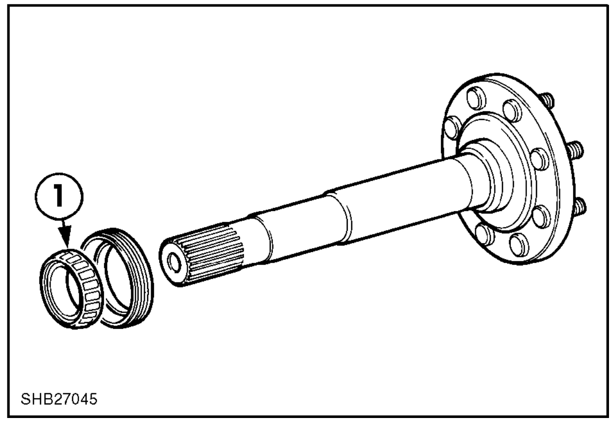
The planetary gears (1) are mounted in a carrier and are positioned around the sun gear and within the planetary ring gear (2). The rear axle shafts (3) locate into the internal splines in the carriers.



8

As the sun gear is driven by the differential, the reduction planet gears revolve inside the stationary planetary ring gear and drive the carrier and axle shaft at reduced speed.

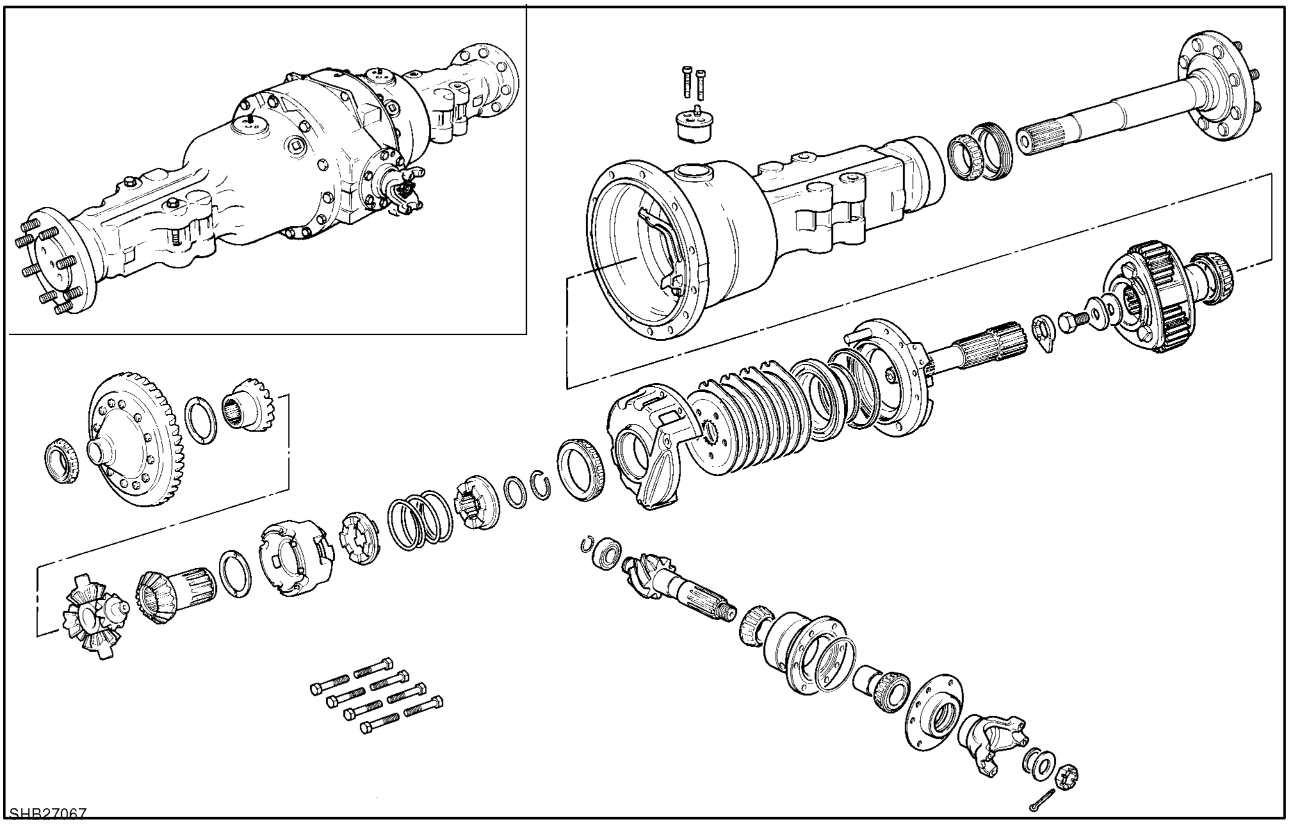
The rear axle shaft is supported on taper roller bearings (1). Preload is adjusted by means of selective shims held under the retaining plate and bolts.



9

FAULT FINDING

Differential Lock Not Engaging	1, Internal linkage, cross shaft rod, fork or pivot shaft damaged/broken.	4. 1. Remove inspect and repair.
	2. Damaged or broken teeth on differential lock adaptor or coupling.	5. 2. Remove differential and inspect differential lock assembly.
	3. Solenoid valve sticking not operating.	6. 3. Replace/repair as required.
	4. Solenoid valve Electrical connection poor or coil not energising.	7. 4. Replace/repair as required.
Differential Lock Not Disengaging	1. Spring broken between adaptor and coupling	8. 1. Remove differential and replace spring.
	2. Teeth of adaptor or coupling damaged/burred.	9. 2. Remove differential and replace damaged parts.
	2, Internal linkage, cross shaft rod, fork or pivot shaft damaged/broken.	10.3. Remove and inspect.
	4. Damaged or broken teeth on differential lock adaptor or coupling.	11.4. Remove differential and inspect differential lock assembly.
	5. Solenoid valve Electrical connection poor or coil not energising.	12.5. Replace/repair as required.



10

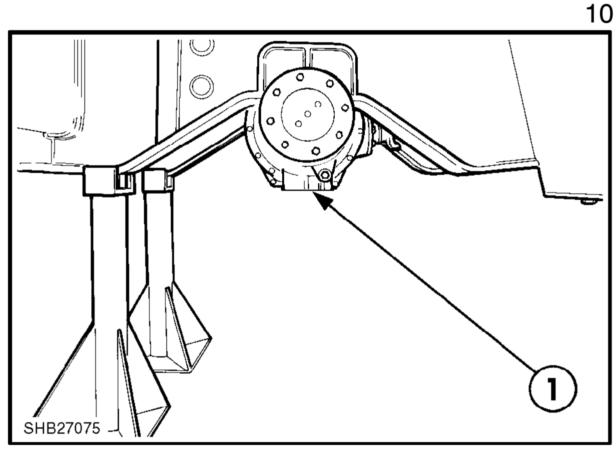
OVERHAUL

Rear Axle Removal

For servicing of any rear axle component the axle must be removed.

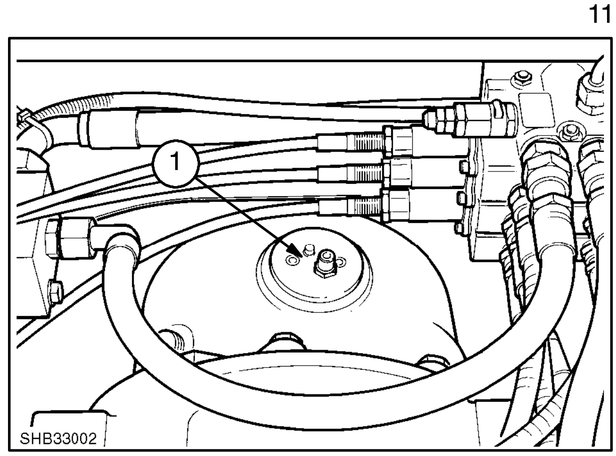
Prior to removal of the axle place a suitable clean container under the axle, capable of holding 26 litres (6.86 US. gals) and drain the oil from the plug at the base of the axle (1).

Disconnect the differential Lock hydraulic hose



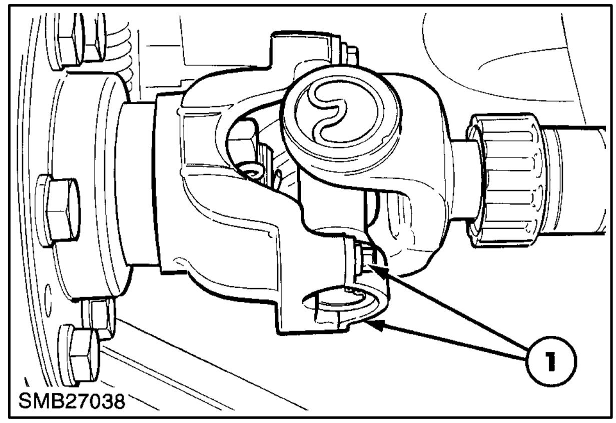
11

Accessed from the top of the rear axle disconnect and drain the residual brake oil into a suitable clean container. Remove the pipes from both sides of the axle half shafts. Plug the brake pipes to prevent any dirt or contamination entering the brake system.



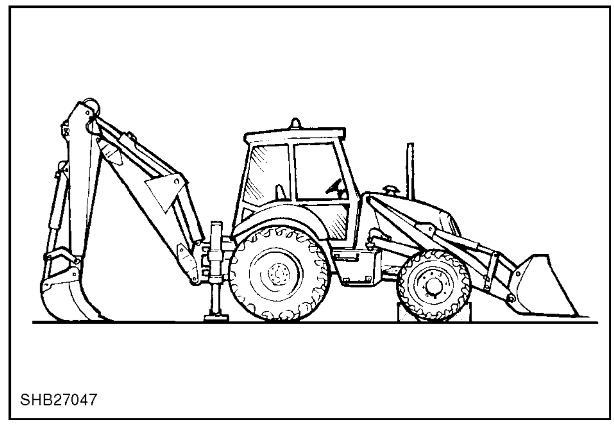
12

Remove the 4 attaching bolts (1) from the drive shaft coupling and remove from the axle



13

Before removal of the axle make sure the machine is on level ground with the loader fully lowered and backhoe resting on the ground. The stabilisers must be lowered to the ground and the front wheels chocked.

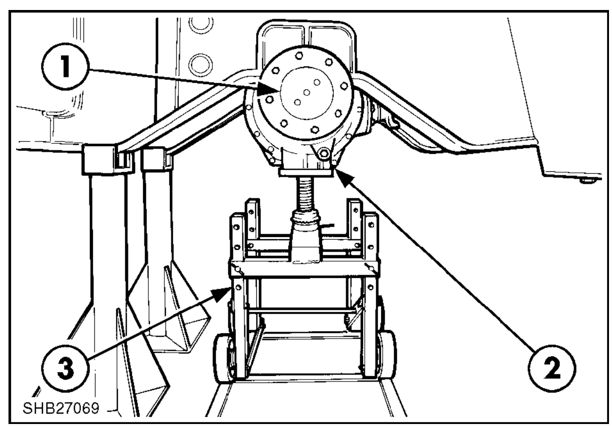


14

IMPORTANT: *Do not rely on the stabilisers, install axle stands to support the unit.*

With the axle (1) supported using a suitable support plate (2) and attached to splitting stand (3). Remove the retaining bolts and gently lower the axle to the ground.

Place the axle onto a suitable axle stand to facilitate repairs

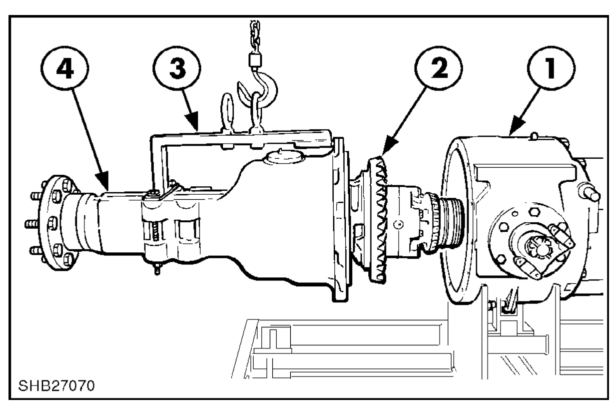


15

Differential Removal

NOTE: *Remove the right hand axle housing using lifting tool 380000990 and the differential will be removed with the axle housing.*

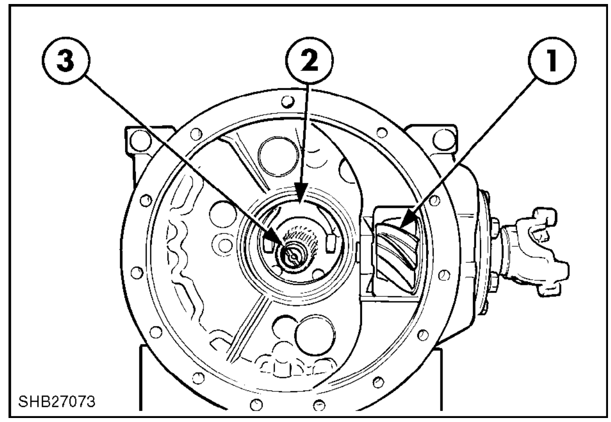
1. Centre Housing
2. Differential Assembly
3. Lifting Tool
4. Half Shaft Axle Housing



16

Pinion location in axle housing

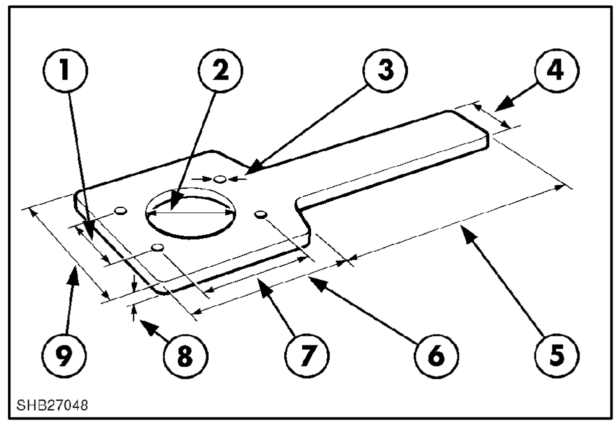
1. Pinion Shaft
2. Differential Lock Actuator
3. Half Shaft



17

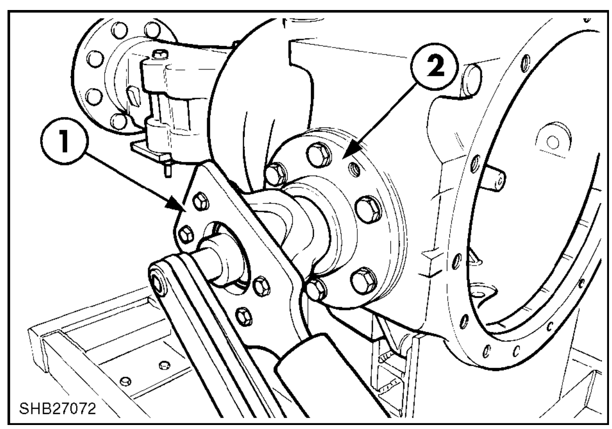
Loosen the pinion nut using a pre fabricated tool, the dimensions being:

1. 46mm (1.811in)
2. 65mm (2.559in)
3. 9mm (0.354)
4. 40mm (1.575in)
5. 220mm (8.66in)
6. 140mm (5.51in)
7. 95mm (3.74in)
8. 10mm (0.394in)
9. 110mm (4.33in)



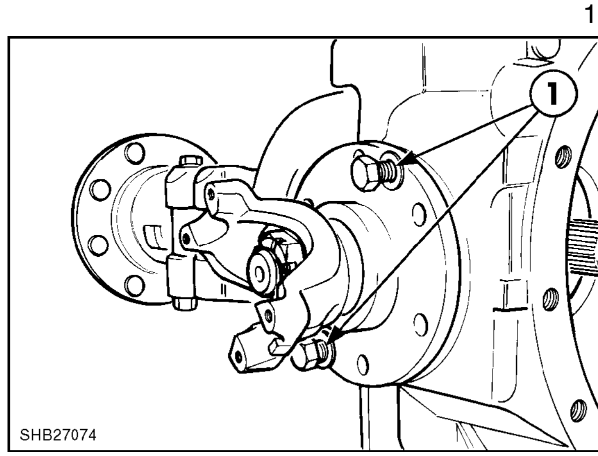
18

Using the special tool (1) hold the coupling steady while loosening the coupling retaining nut. Loosen the pinion housing bolts.

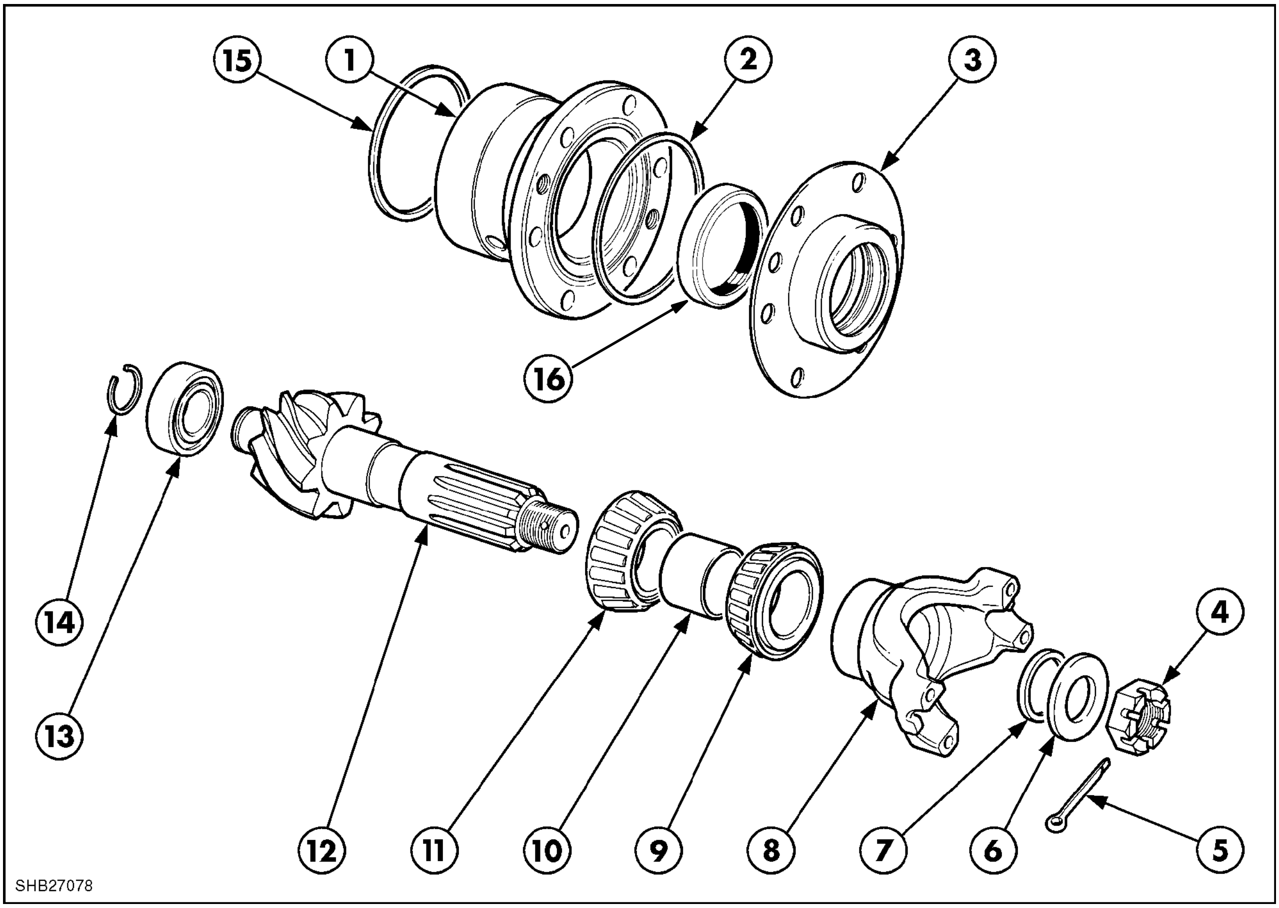


19

Leave 2 bolts in the position shown removing the remaining bolts and jack the pinion out evenly.



20



21

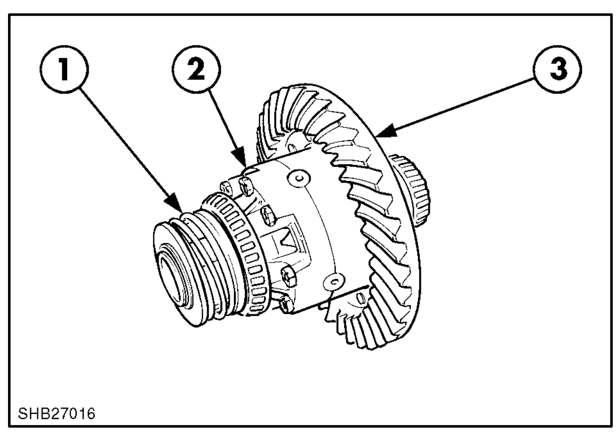
Pinion Shaft Layout

1. Pinion Housing
2. Seal
3. Retainer
4. Nut
5. Lock Pin
6. Washer
7. Seal
8. Flange
9. Bearing
10. Shim Various Sizes
11. Bearing
12. Pinion Shaft
13. Bearing
14. Lock Ring
15. Seal
16. Seal Assembly

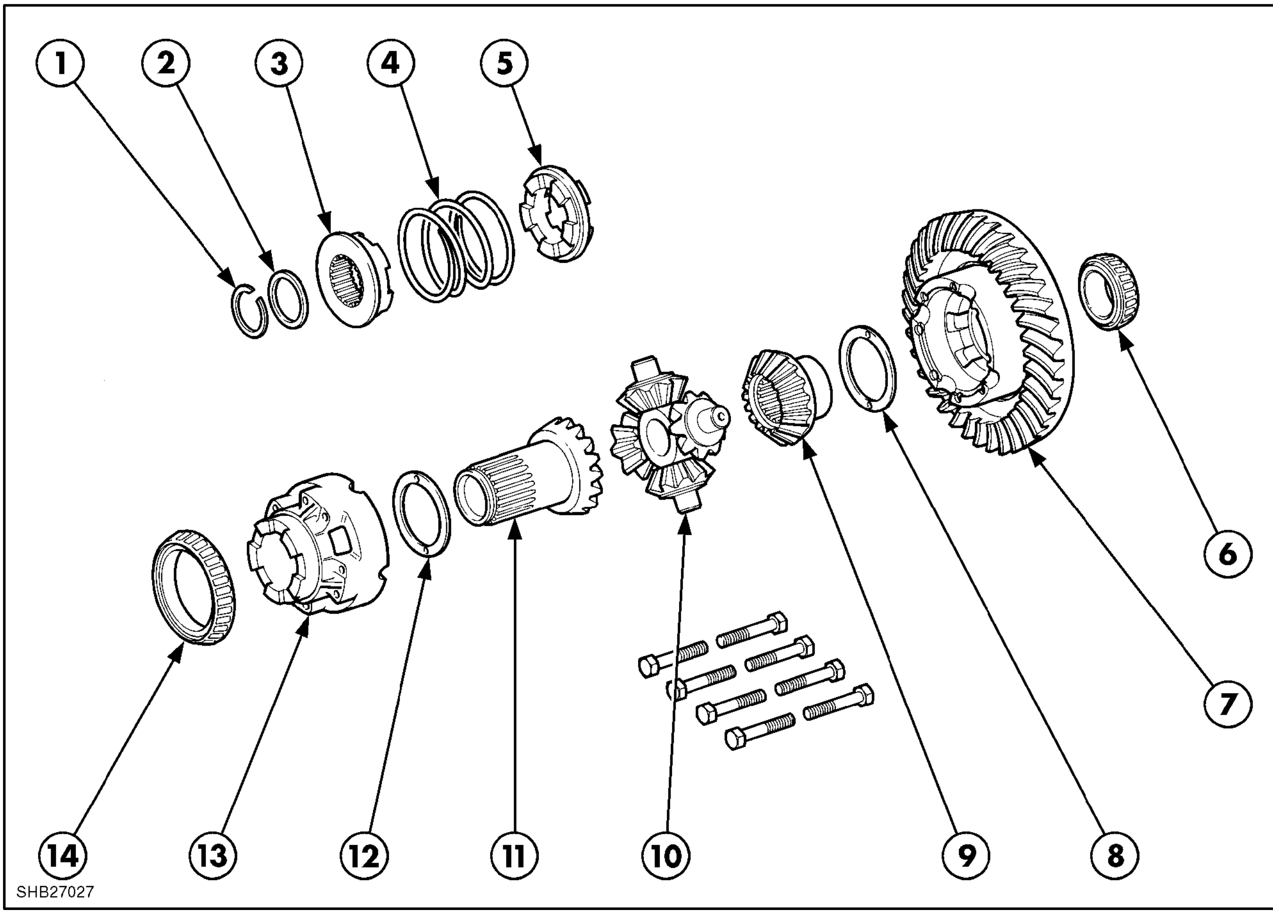
NOTE: *the pinion and crown wheel are a matched pair and must always be replaced together.*

Differential assembly.

1. Differential Lock Return Spring
2. Differential Housing
3. Crown Wheel



22



23

Differential Assembly Exploded View

1. Lock Ring
2. Washer
3. Dog Gear
4. Spring
5. Dog Gear
6. Bearing
7. Crown Wheel
8. Thrust Washer
9. Side Gear
10. Spider Assembly
11. Side Gear
12. Thrust Washer
13. Differential Housing
14. Bearing

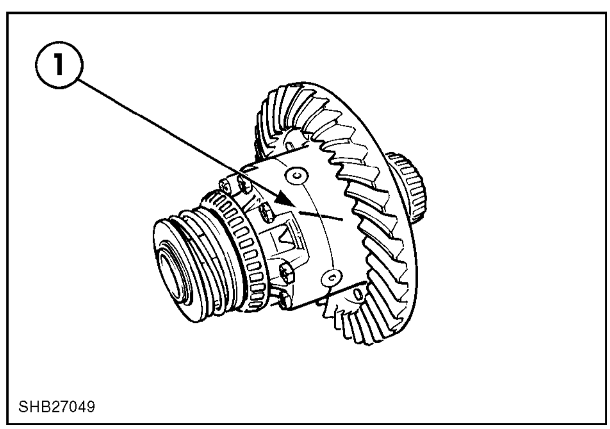
Differential lock.

Prior to separating the differential, mark the two half housings (1) to ensure correct re-assembly.

Replace the differential lock coupling and adaptor if worn or damaged.

The crown wheel is rivetted to the differential housing in production.

Replacement crown wheels are secured with nuts and bolts for easier field service.



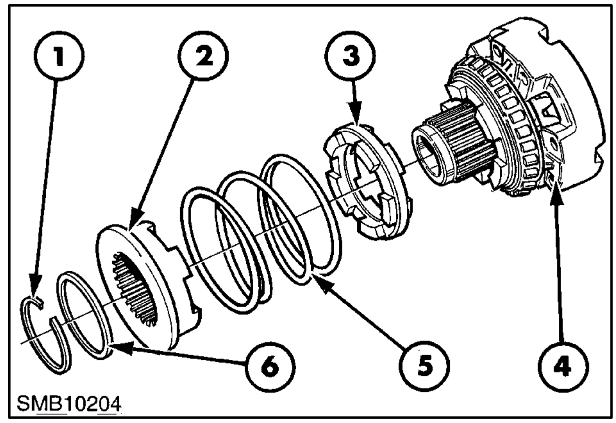
24

The differential lock consists of a sliding dog type coupling splined to the right hand side of the differential and a fixed adaptor located to the differential housing.

The differential lock can be disassembled by compressing the spring and carefully detaching the snap ring (1).

With the snap ring removed disassemble the:
Washer (6), Outer Dog (2), Spring (5), Inner Dog (3), from the housing (4).

Carefully inspect all moving parts for signs of scoring, wear, or damage, if evident replace with new parts.

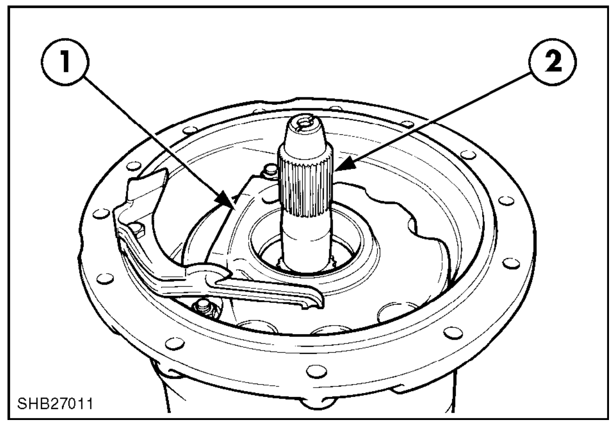


25

Axle Shaft Component Removal

Remove the fork and shaft (right hand side housing only). With either of the left or right brake housings (1) exposed remove the attaching nuts and lift the outer housing over the axle half shaft (2).

Inspect the housing scoring damage or distortion, repair as required.

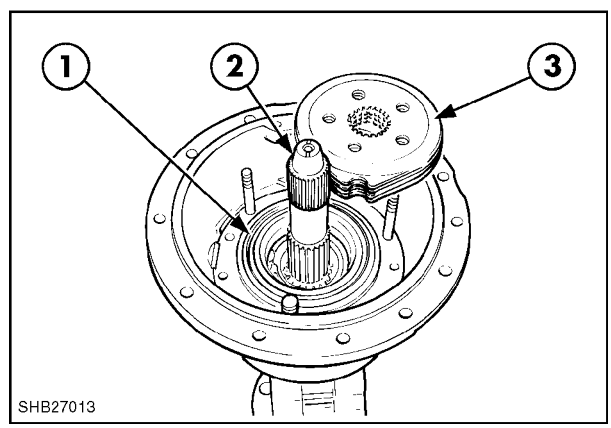


26

Lift the brake discs (3) over the half shaft (2) to expose the inner brake housing (1).

Inspect the steel separator plates and rotating brake discs for wear or distortion. Replace the brake discs if worn to a thickness of less than 4.23 mm (0.170in). Maximum allowable warpage is 0.08mm (0.003in)

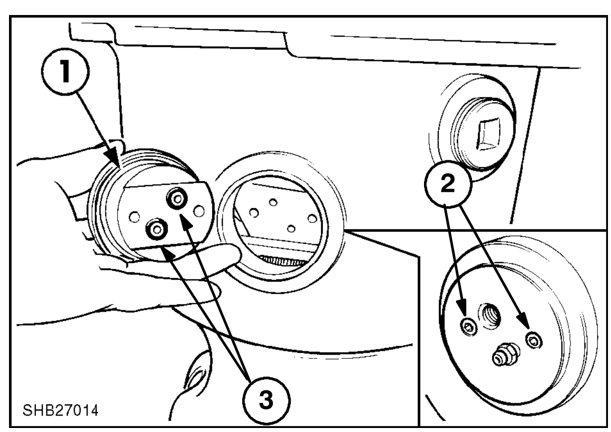
Reassemble in reverse order to disassembly.



27

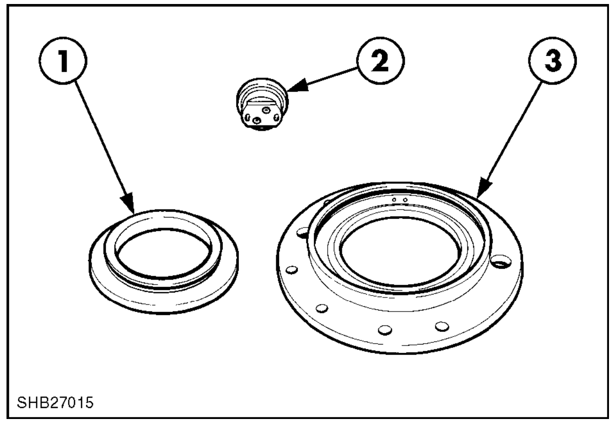
The brake pipe fitting (1) can be removed by loosening and removal of the attaching Allen screws (2).

Before re-assembly fit a new ‘O’ ring (1) to the fitting and new ‘O’ rings (3) that seal the oil galleries. On re-assembly torque the attaching bolts to 8-13.5Nm (6-10lbs ft).



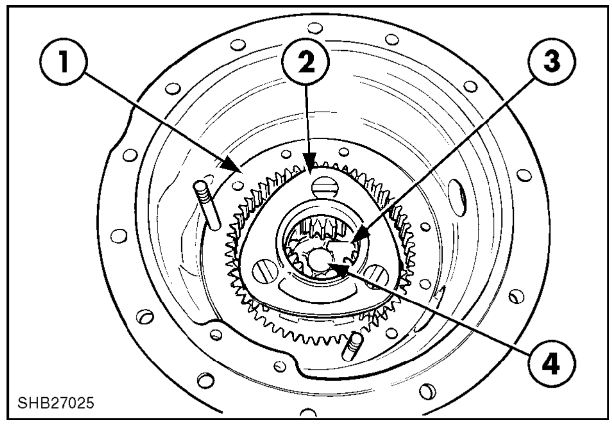
28

Remove the brake housing (3) and brake piston (1) and inspect all moving parts for wear or scoring. If in any doubt replace suspect parts with new.



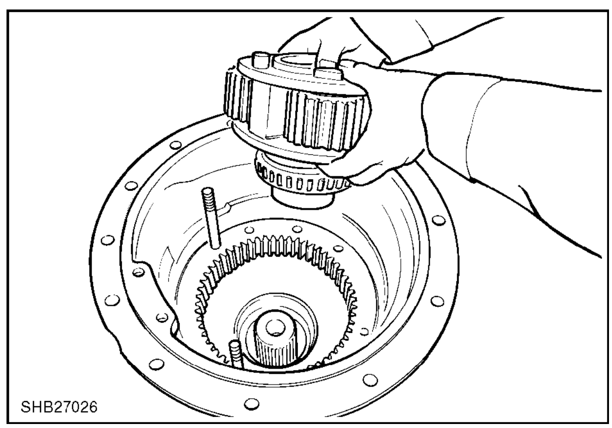
29

To remove the planetary gear (2) from the carrier (1) remove the lock washer (3) and retaining bolt (4).



30

Remove the planetary gear carrier.

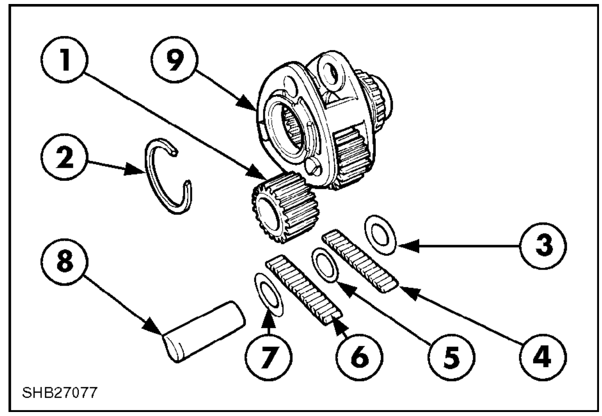


31

The planetary gear assembly can be disassembled by rotating the retaining ring (2) to allow the slot to align with the individual gear shafts (8) which allows them to be withdrawn from the body.

Carefully inspect the shafts, gears, bearings and washers and housing for wear, scoring or damage and ensure new are parts fitted or repairs performed.

1. Planetary Gear
2. Retaining Ring
3. Thrust Washer
4. Roller Bearings
5. Thrust Washer
6. Roller Bearings
7. Thrust Washer
8. Planet Gear Shaft
9. Carrier

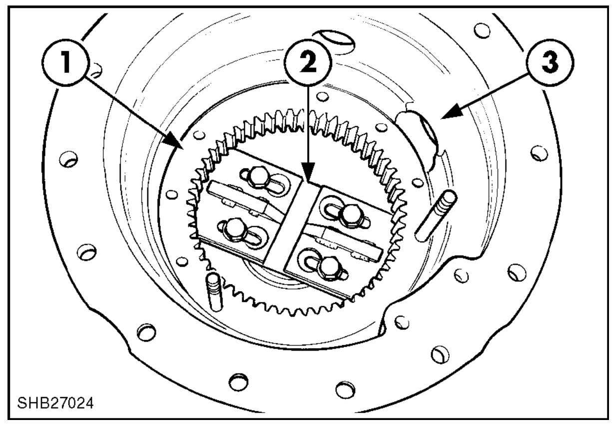


32

Position the axle housing to allow removal of the axle shaft.

The planetary ring gear (1) can be removed from the axle housing (3) with the aid of Tool (2), No 380000716. Position the tool beneath the ring gear, expand the plates and tighten the bolts. Invert the axle and press out the gear form the wheel hub side

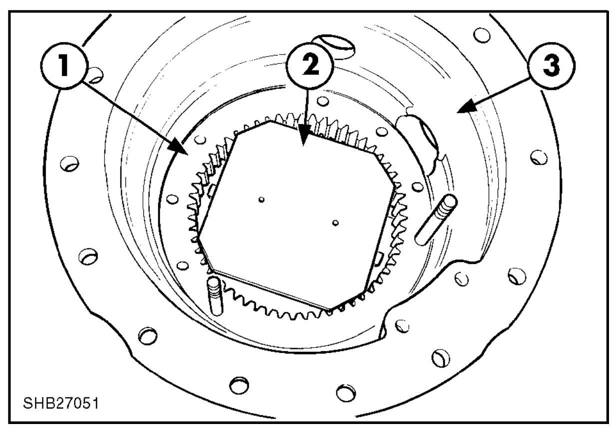
Inspect the gear for wear scoring or damage and repair or replace.



33

Refitting the ring gear (1) is the reverse procedure using Tool (2) the ring gear is pressed back into the axle housing (3) from the brake side. If fitting a new ring gear ensure the gear is seated equally in the axle housing (3) by placing a feeler gauge between the gear and housing.

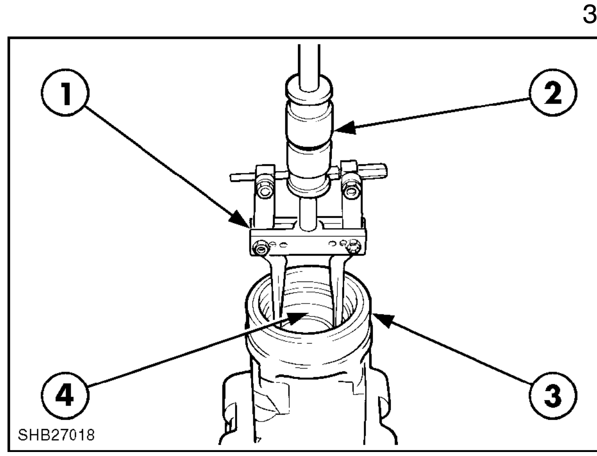
IMPORTANT: *If a new ring gear has been fitted in the left hand axle housing, the differential bearing pre-load must be checked.*



34

Axle housing bearing cup removal.

1. Puller Tool No 380000996
2. Slide Hammer Tool No 380000987
3. Axle Housing
4. Bearing Cup



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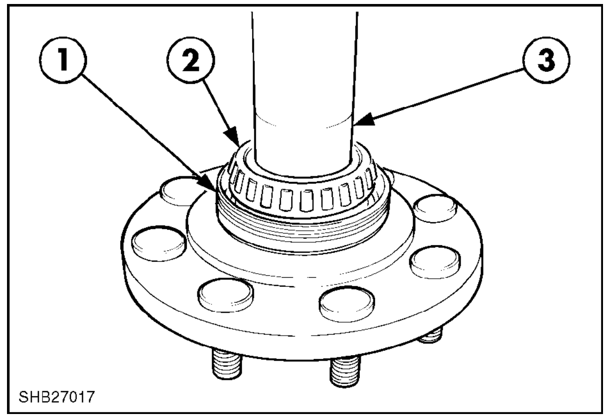
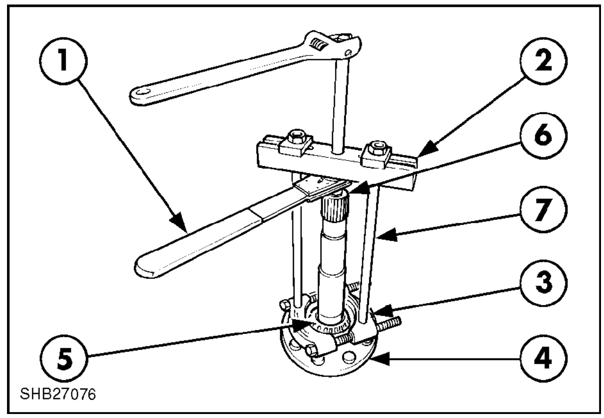
The half shaft axle seal (1) is retained in position by the axle bearing (2). To remove the seal it is necessary to remove the bearing.



36

To remove the bearing, stand the half axle (4) upright and attach the bearing removal tool as shown.

1. Ratchet Tool
2. Puller Tool
3. Pulling Attachment Tool
4. Axle Shaft
5. Bearing
6. Shaft Protector
7. Legs



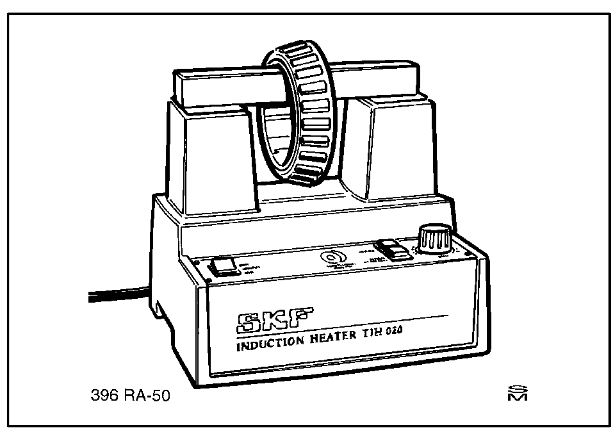
37

Applying gradual pressure to the puller tool the bearing will separate from the half axle.

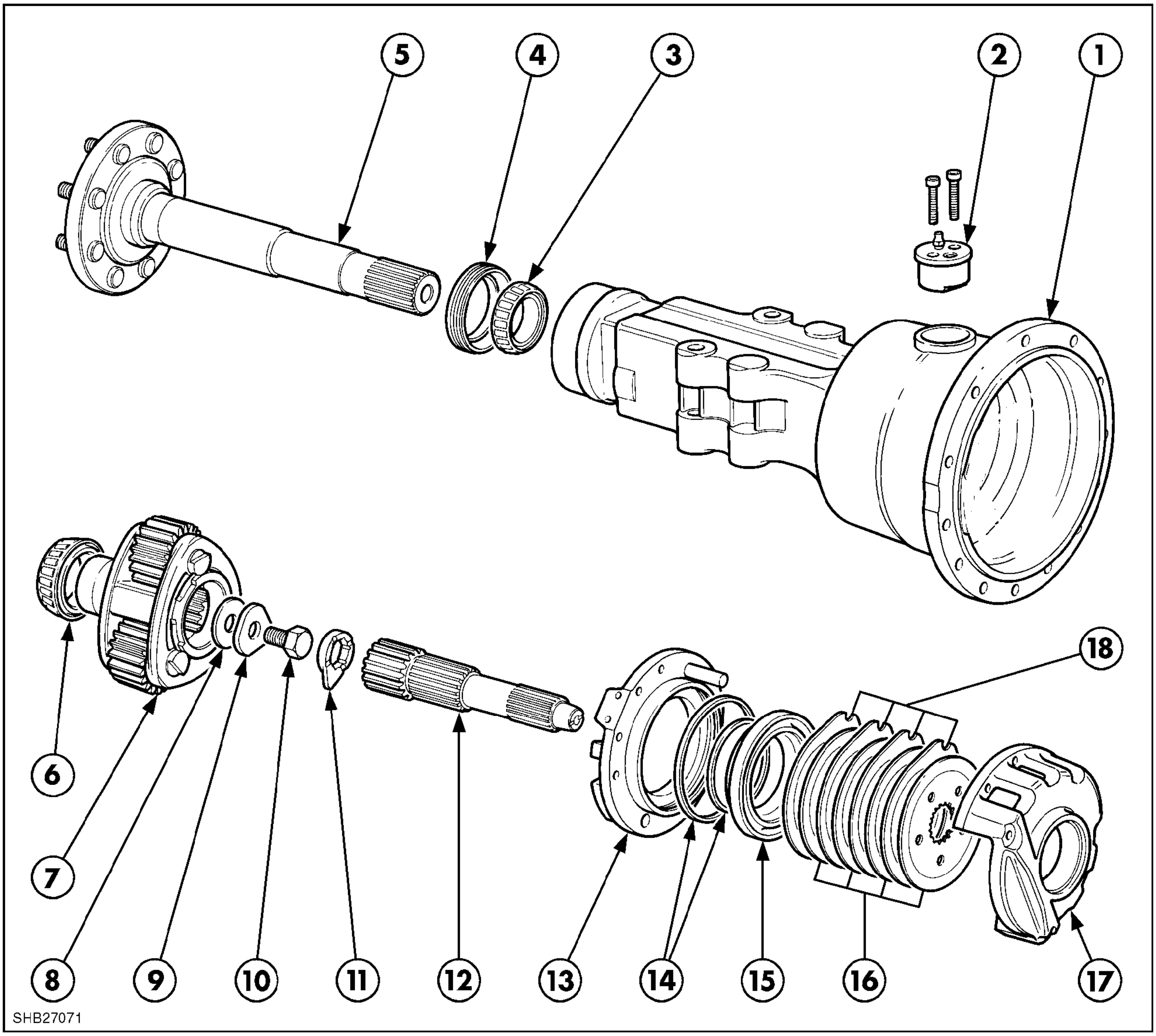
Inspect the bearing for wear, scoring or damage and replace if in any doubt.

IMPORTANT: *Always fit a new axle seal if the axle bearing is removed for any reason.*

Re-assembly of the seal and bearing is the reverse procedure. Locate the seal and using an induction heater, heat the bearing sufficiently to expand it enough to allow it to easily seat onto the half shaft.



38



39

Rear Axle Shaft Components

1. Axle Housing
2. Brake Fitting
3. Bearing
4. Seal
5. Half Shaft
6. Bearing
7. Planetary Reduction Assembly
8. Shim
9. Washer
10. Bolt
11. Lock Washer
12. Shaft
13. Inner Brake Housing
14. Seals
15. Brake Piston
16. Friction Discs
17. Outer Brake Housing
18. Discs

ADJUSTMENTS

Drive pinion preload

Axle shaft bearing preload

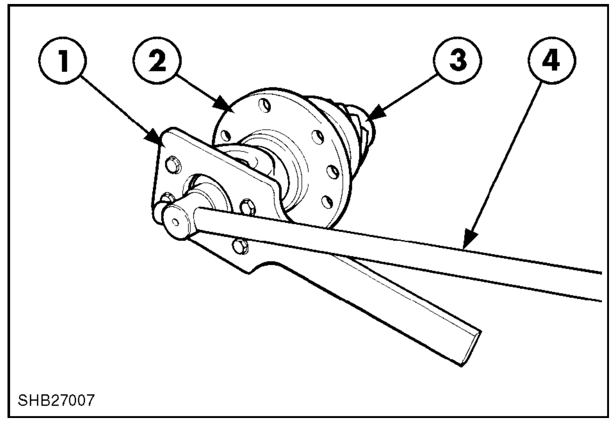
Differential bearing preload

NOTE: *Crown wheel to pinion backlash is preset by manufacturing tolerances in production.*

The pinion bearing preload is set by selecting the correct shim (spacer) which is placed between the bearings.

Re-assemble the pinion assembly, attach the fabricated spanner (1) to the assembly (2) and torque to 406-813 Nm (300-600 lbf ft) with spanner (4) to the locknut.

Shims Available:
From 2.5mm to 3.4mm, in increments of 0.1mm.



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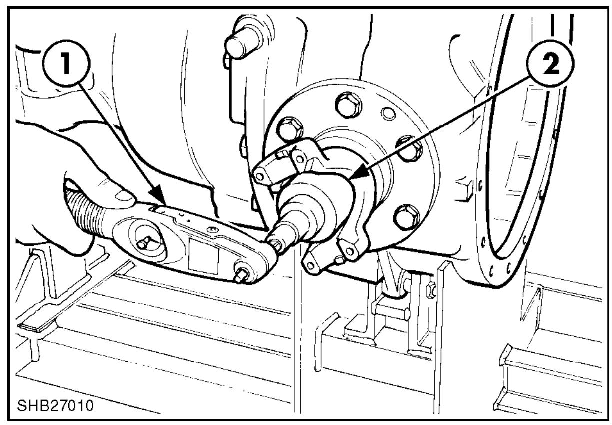
Use a torque meter (1) to check rolling resistance when the assembly is fitted back into the axle.
The rolling resistance should be: 1.3 Nm (10-40 lb in)

Leave pinion retainer bolts loose for this check.

If under specification, fit a smaller shim

If over specification, fit a larger shim

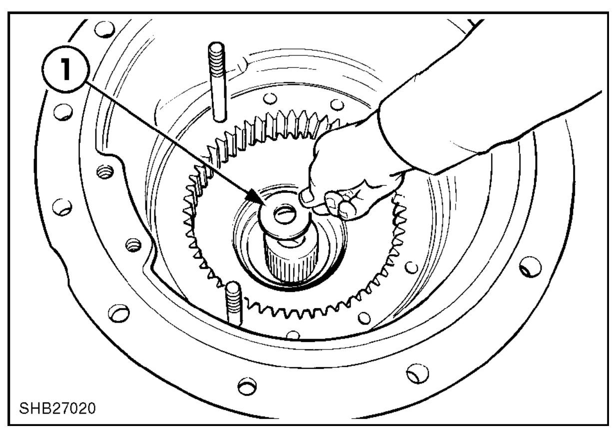
NOTE: *Make sure both bearings are well lubricated and, once preload is set, lock nut to pinion.*



41

Axle shaft bearing preload

Adjustable shims (1) are located between the inner end of the axle shaft and carrier retainer.



42

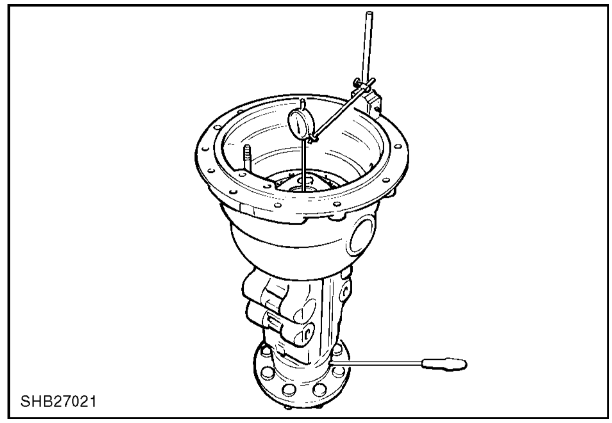
Adjustment procedure

To achieve the correct preload proceed through steps 1 to 7

1. Fit a shim 2.06mm (0.081in) thus reducing end float and possible damage to the seal.
2. Replace the planetary gear assembly.
3. Tighten the retaining bolt to 745 Nm (550 lb ft).
4. Position the dial gauge and measure end float eg. 0.562mm (0.022in).
5. To ensure correct preload, subtract endfloat from shims already fitted for example 2.06 - 0.562mm=1.498mm.
6. Select shim from table to provide specified preload of 1.72mm (0.067in).

IMPORTANT: *Increasing shim thickness will reduce preload.*
Decreasing shim thickness will increase preload.

7. Fit selected shim and re-tighten retained bolt to correct torque and allow lock plate to locate.



43

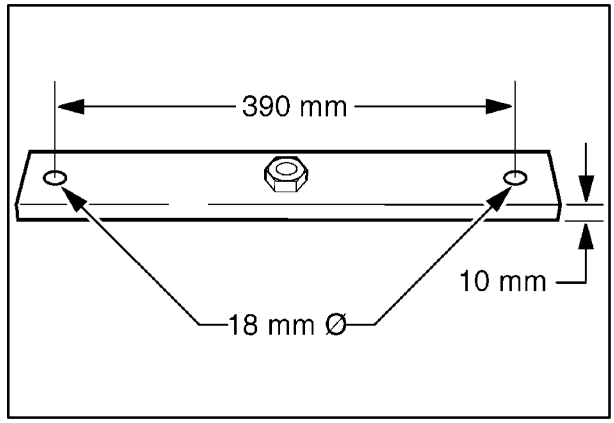
SHIM SELECTION TABLE

Resultant Figure	Shim to be Installed
1.24 - 1.32mm (0.049 - 0.052in)	A13 81803491 1.14mm (0.045in)
1.35 - 1.42mm (0.053 - 0.056in)	A13 81803502 1.24mm (0.049in)
1.45 - 1.54mm (0.057 - 0.060in)	A13 81803503 1.35mm (0.053in)
1.55 - 1.64mm (0.061 - 0.064in)	A13 81803504 1.45mm (0.057in)
1.65 - 1.74mm (0.065 - 0.068in)	A13 81803505 1.55mm (0.061in)
1.75 - 1.84mm (0.069 - 0.072in)	A13 81803506 1.65mm (0.065in)
1.85 - 1.94mm (0.073 - 0.076in)	A13 81803507 1.75mm (0.069in)
1.96 - 2.04mm (0.077-0.080in)	A13 81803508 1.85mm (0.073in)
2.06 - 2.14mm (0.081 - 0.084in)	A13 81803509 1.96mm (0.077in)
2.16 - 2.24mm (0.085 - 0.088in)	A13 81803510 2.06mm (0.081in)
2.26 - 2.34mm (0.089 - 0.092in)	A13 81803511 2.16mm (0.085in)

Axle Shaft Rolling Resistance

After fitting the correct shim to set the preload:

Manufacture a bridging bar to span opposing bolt holes to the dimensions shown.

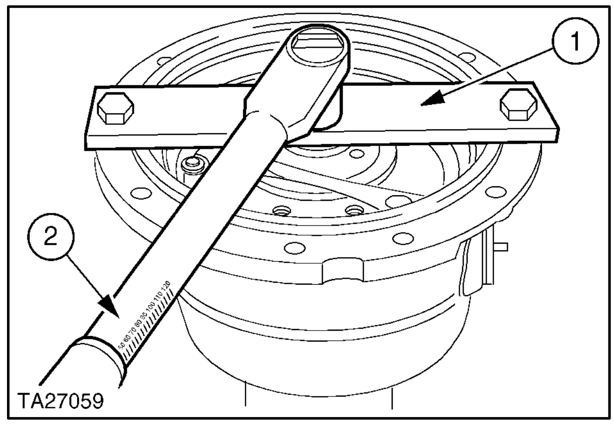


44

Fit bridging bar (1) across the rear axle housing flange and use a torque meter (2) to check rolling resistance which should be 2.3–10 Nm (20–80 lb in).

NOTE: *The brake housing, brake discs and 1/4 shaft should not be installed but all bearings well lubricated.*

If out of specification the shim should be adjusted and rolling resistance rechecked.



45

Differential bearing preload

This adjustment is made by shimming the right hand differential bearing cone using two methods:

If the right hand axle housing, ring gear or brake housing are replaced the following checks should be made:

Method 1

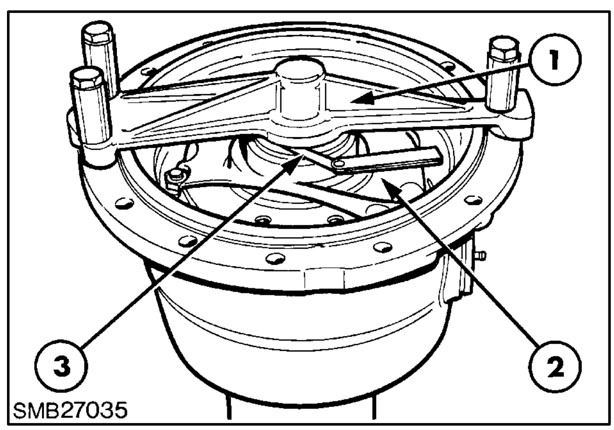
Remove the differential bearing cone and shim from the outer brake housing.

Place the gauge ring of tool **380000991** (1) into the vacant bearing location.

Bolt bridge tool **380000991** (1) across the rear axle housing flange with spacers (2) located between the axle housing flange and the tool.

Measure the gap between the bridge tool and the gauge ring using a feeler gauge (3).

Refer to the following table to determine the correct size shim which should be installed between the brake housing and bearing cone, thus preloading the bearing back to specifications.



46

Method 2

When the differential bearings are not changed the differential rolling resistance must be checked.

Remove the left hand axle bearing.

Remove the left hand axle housing and differential

Remove pinion.

Compress the differential Lock Spring and install shim stock to constantly engaged differential lock.

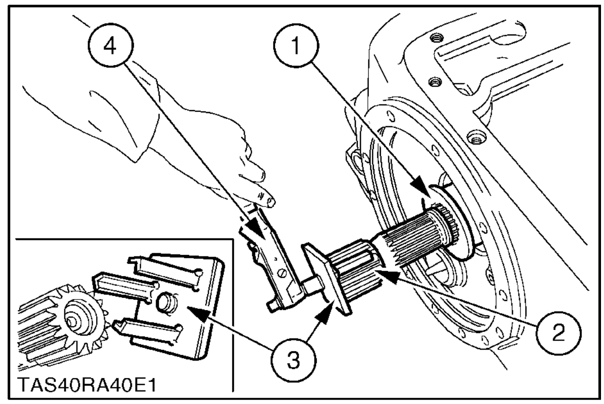
Refit differential and right hand axle housing but less the 1/4 shaft and brake discs.

Fit the 1/4 shaft in from the left hand side and fit adaptor tool onto shaft.

1. Differential Lock - Left Hand Brake Housing
2. 1/4 Shaft
3. Adapter Tool
4. Torque Meter

Check rolling resistance is between 2.3-10 Nm (20-90 lb in)

If out of specification the shim should be adjusted and bearing preload rechecked.



47

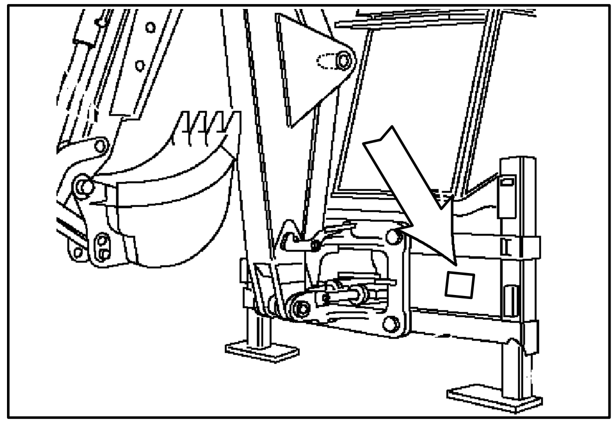
DIFFERENTIAL BEARING PRELOAD ADJUSTMENT SHIMS

Gap Reading	Part Number of Shim	Shim Thickness
0.86 - 0.99mm 0.034 - 0.039in	1803515	0.097 - 10.2mm 0.038 - 0.040in
1.02 - 1.14mm 0.040 - 0.045in	1803516	1.12 - 1.18mm 0.044 - 0.046in
1.17 - 1.13mm 0.046 - 0.051in	1803517	1.28 - 1.33mm 0.050 - 0.052in
1.32 - 1.45mm 0.052 - 0.057in	1803518	1.43 - 1.48mm 0.056 - 0.058in
1.47 - 1.60mm 0.058 - 0.063in	1803519	1.59 - 1.64mm 0.062 - 0.064in
1.63 - 1.75mm 0.064 - 0.069in	1803520	1.74 - 1.79mm 0.068 - 0.070in
1.78 - 1.90mm 0.070 - 0.075in	1803521	1.89 - 1.95mm 0.074 - 0.076in
1.93 - 2.06mm 0.076 - 0.081in	1803522	2.05 - 2.10mm 0.080 - 0.082in

Operating Solenoid Valve

The solenoid valve is located at the rear of the machine to the right of the backhoe valve block.

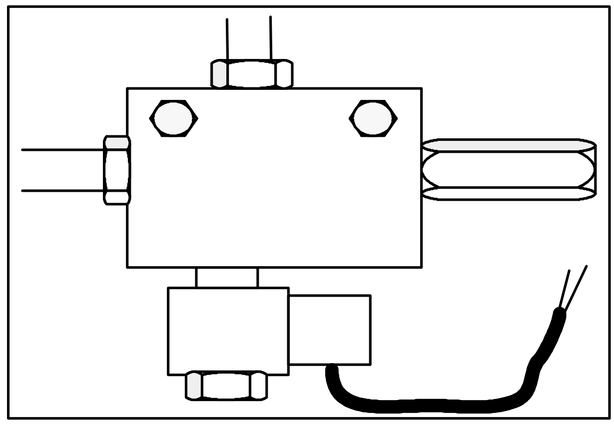
This valve is not serviceable, however if the valve operation is in question the coil can be tested and valve block cleaned.



48

Disconnect and plug the attaching hydraulic pipes and remove the valve from the machine.

Clean and flush the manifold block ports with a suitable cleaning fluid.

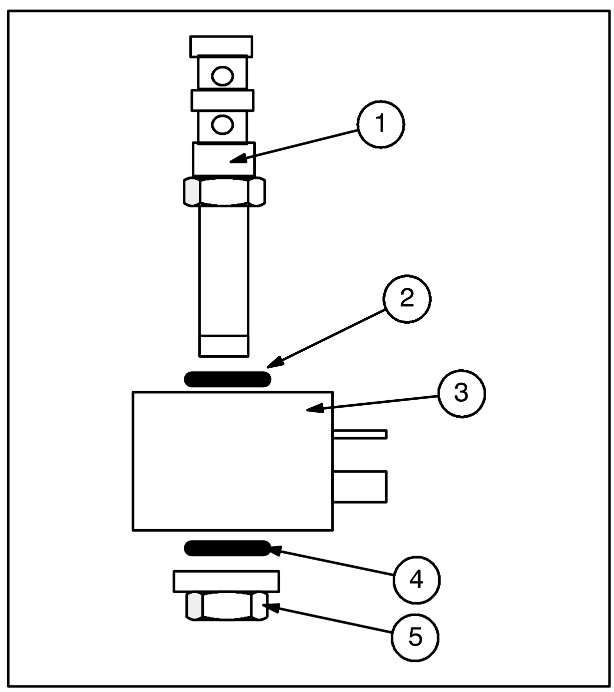


49

Remove the solenoid coil attaching knob and clean the parts with lint free cloth.

1. Spool
2. ‘O’ ring
3. Solenoid Coil
4. ‘O’ ring
5. Plastic Retainer

Upon reassembly apply 12 volts to the solenoid and observe its function if in any doubt replace with new parts.



50

SECTION 27 – REAR AXLES

Chapter 3 – Rear Axle for 4 Wheel Steer Only

CONTENT

SPECIFICATIONS

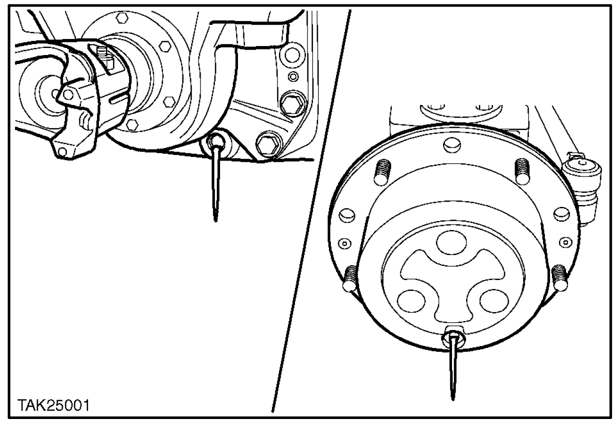
Component	
Axle Type	Modular
Planetary Reduction	6.923 : 1
Overall Ratio	18.5 : 1
Brake Operation	Hydraulic
Brakes	Wet Disc, Piston Operated
Brake Discs (per side)	3
Brake Disc Total Friction Area	2735 cm^2
Number of Planetary Gears	3
Load Carrying Capacity Dynamic	10000 kg (22000 lb) at 1890 mm track width
Overall Width	2304 mm
Oil Capacity	11 Litres (2.9 US. gals)
Oil Change Period	1 year or 1200 hours
Lubricants	Multi–G API GL4 ISO32/46

CLEARANCES AND ADJUSTMENTS

Drive pinion preload	9.2–13.8 N
Steering Sensor to steering rod disc	1.5mm – 1.6mm

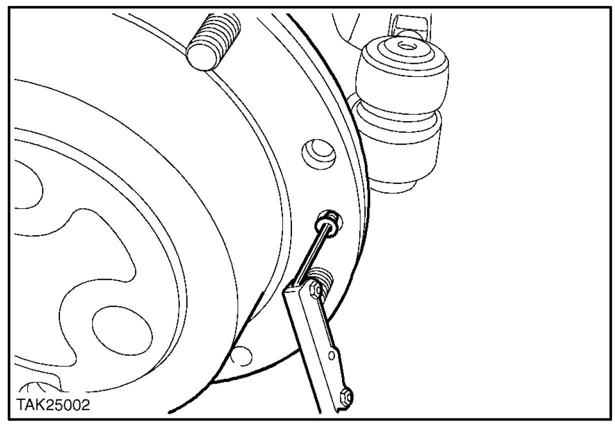
Axle Disassembly
Hub Disassembly

1. Remove the hub oil drain plug and drain the hub oil. Remove the differential plug and drain the oil from the centre housing.



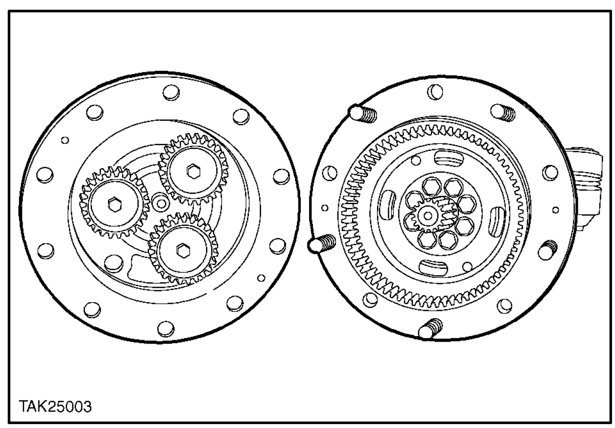
1

2. Remove the hub outer casing allen screws



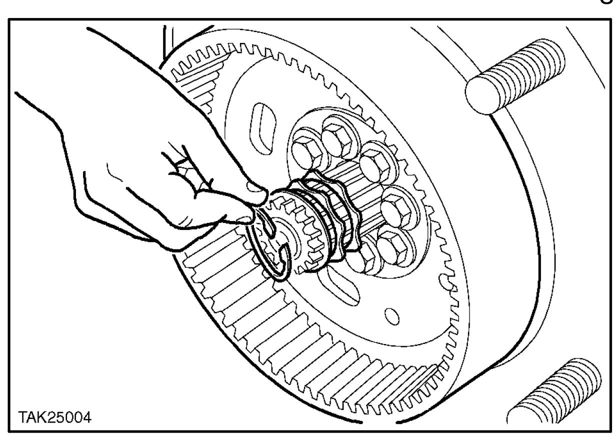
2

3. Remove the hub outer casing.



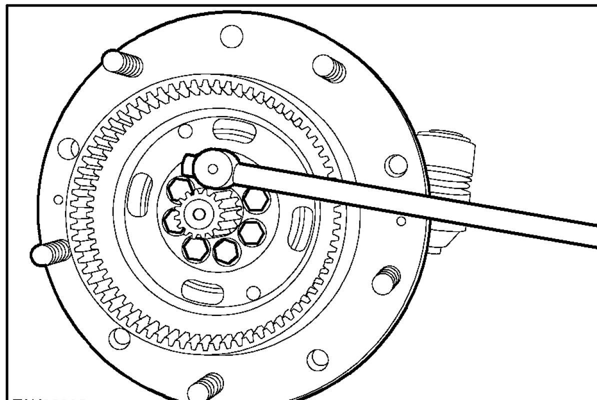
3

4. Remove the sun gear circlip and 3 spacers.



4

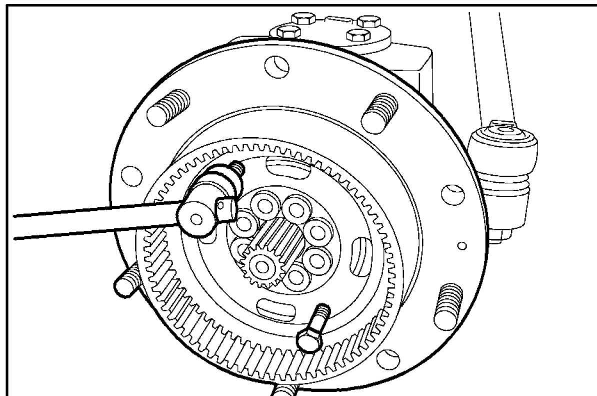
5. Remove the eight ring gear fixing bolts.



TAK25005

5

6. Using two of the fixing bolts, fit these to the outer threaded holes and tighten to push the ring gear away from the hub.



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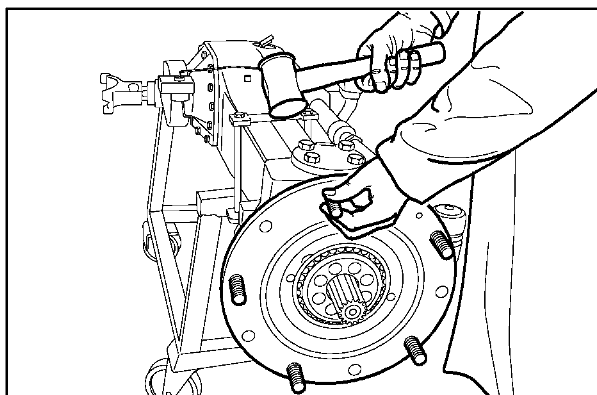
6

7. With a soft faced mallet hammer off the hub centre housing and also the outer conical bearing.



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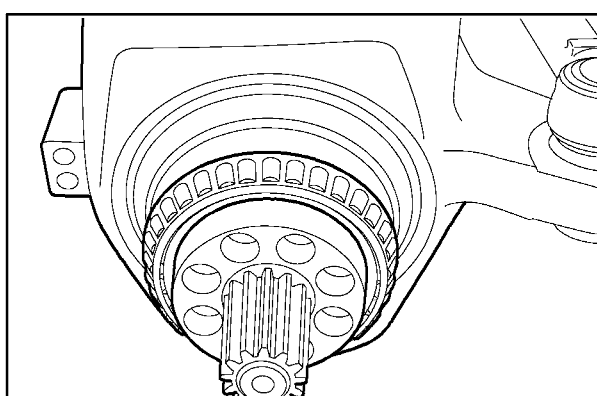
7

8. Then remove the inner conical bearing by hand.



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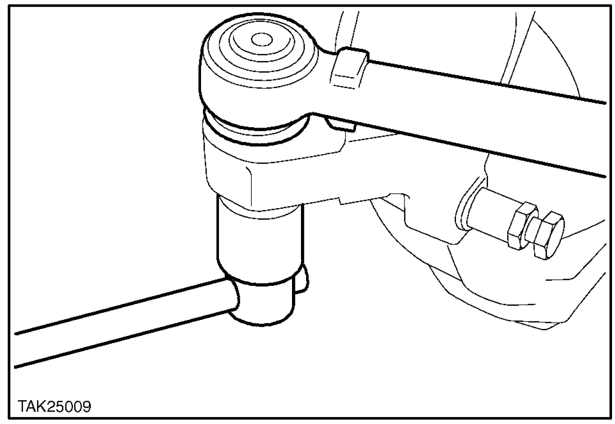
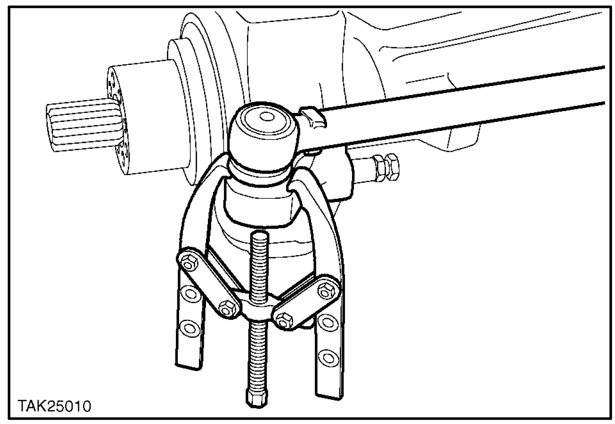
9. Undo the nut which holds the steering rod to the hub.



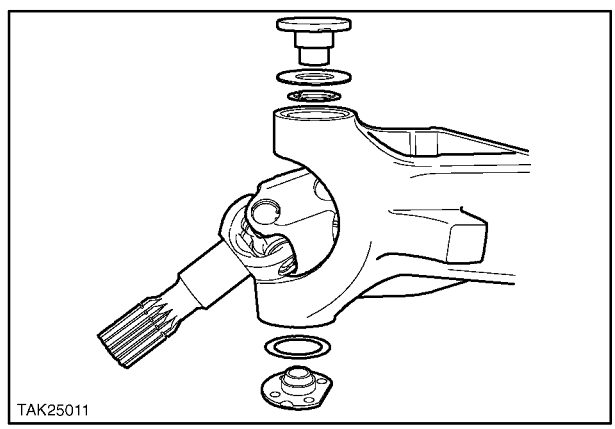
9

10. Use a set of bearing pullers to press the tapered shaft from the hub assembly



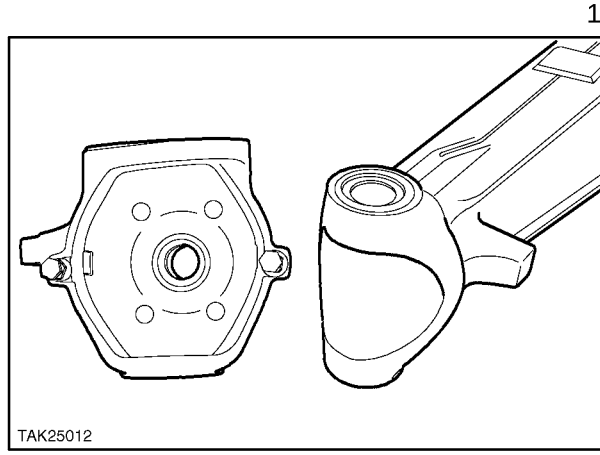
10

11. Undo the bolts holding the top and bottom pivot pins. Then remove the pivot pins and also the belleville washers and spacers.



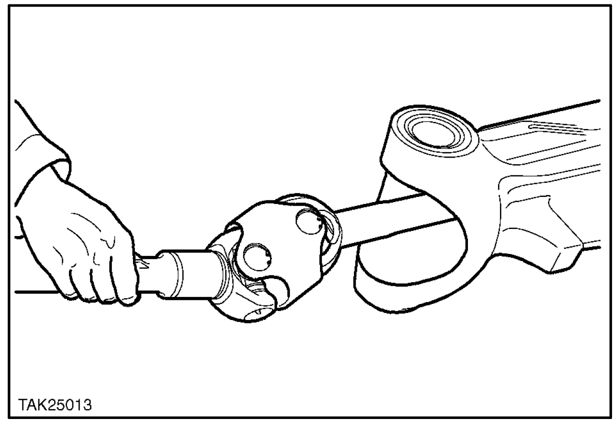
11

12. Remove the remainder of the hub assembly.



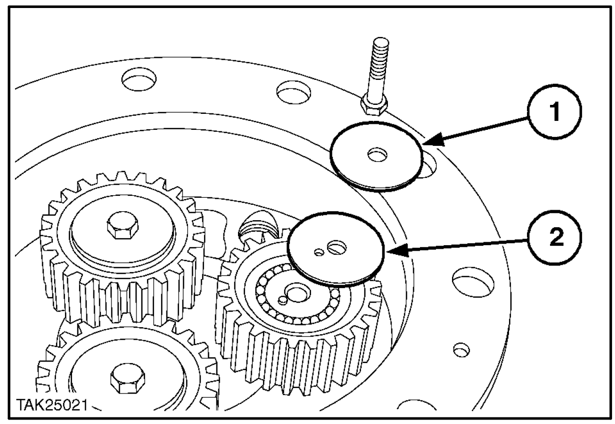
12

13. Remove the axle drive shaft from the centre housing.



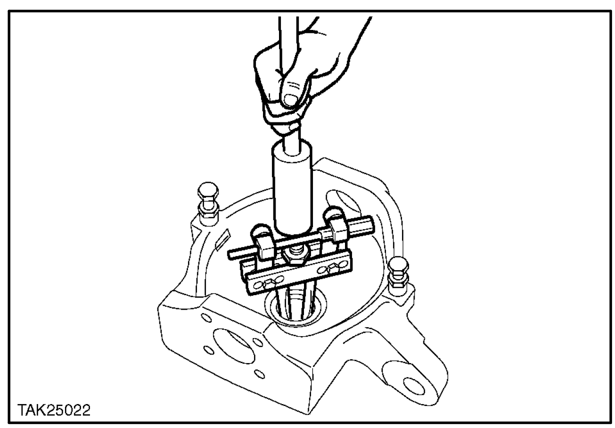
13

14. Disassembly of the planetary housing.
Remove the bolt from each of the planet gears. Then remove the Upper (1) and Lower (2) washer. The gear can then be removed and also the individual needle bearings.



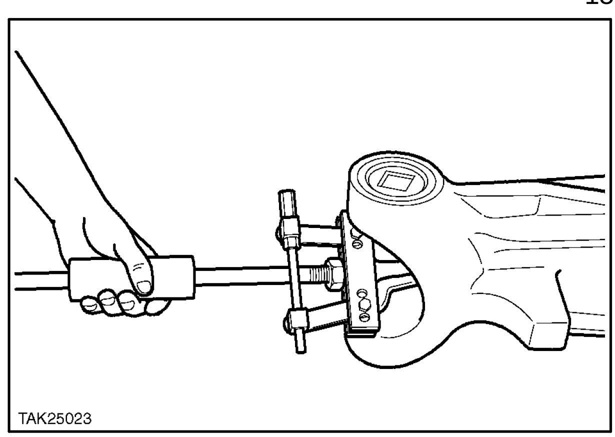
14

15. Swivel hub seal and bush removal.
Remove the shaft seal and bush using a suitable puller or drift.



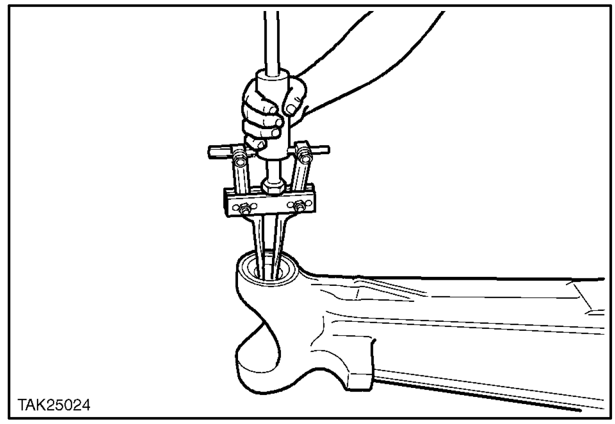
15

16. Axle shaft seal and bush removal.
Use an internal puller and slide hammer to remove the seal and bush.



16

17. Pivot bush removal.
    Remove the upper and lower pivot bushes using an internal puller and slide hammer.

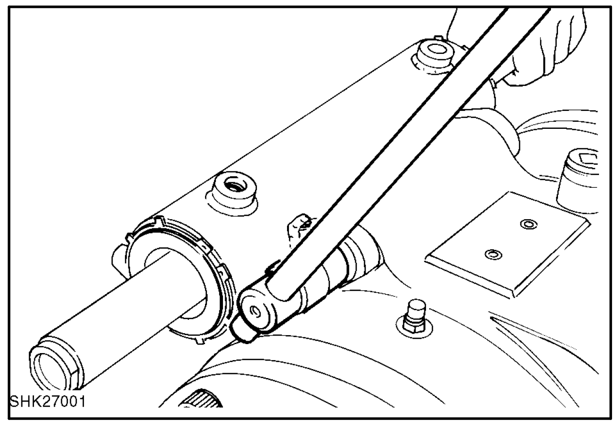


17

STEERING CYLINDER REMOVAL

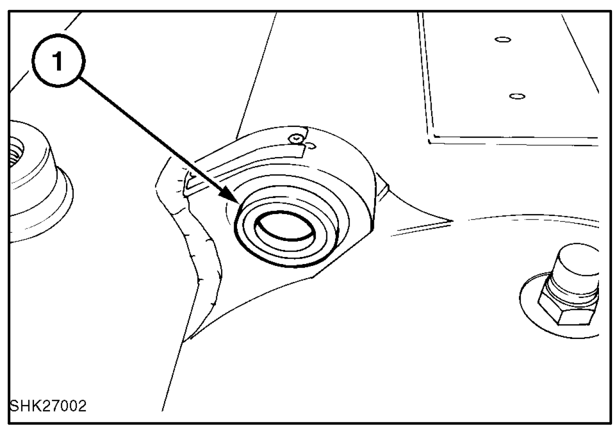
Undo the track rod ends from each side of the steering cylinder.

Remove the four retaining bolts.



18

Using a slide hammer with threaded end **M18**, remove the upper and lower bushes (1) on the left side.



19

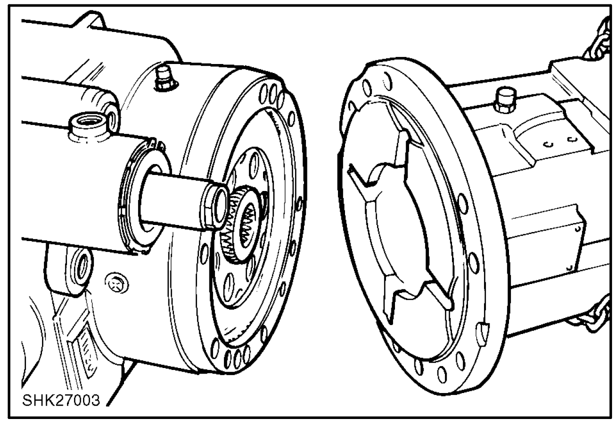
Lift off the complete assembly.

To disassemble the cylinder remove the circlip from each end then slide the piston to one end and tap out one gland, then slide it to the other end to remove the remaining gland block.

SIDE CASING REMOVAL

Undo the ring of bolts which hold the side casing to the centre housing.

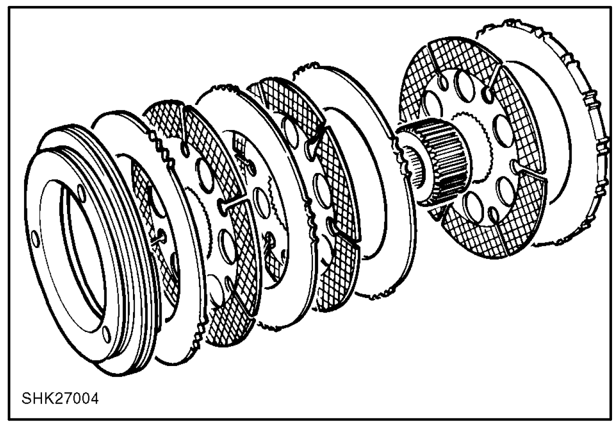
NOTE: *Ensure both the side casing and centre housing are held securely. Swing the side casing away from the centre housing.*



20

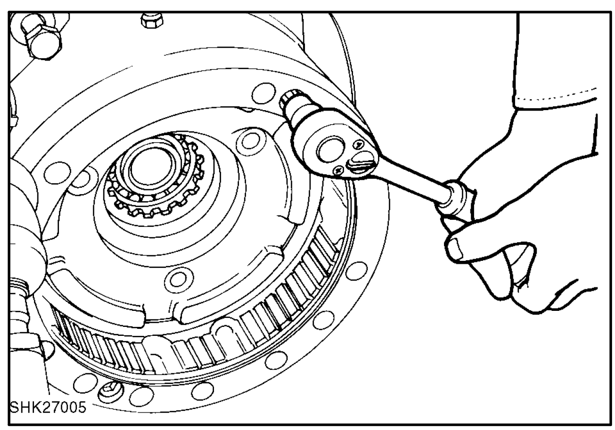
Remove the brake discs and central hub.

NOTE: *The radial holes in the surface of the discs should be aligned during re-assembly into the axle*



21

To disassemble the brake housing, remove the abler bolts which secure it to the central housing. Remove the complete brake housing.

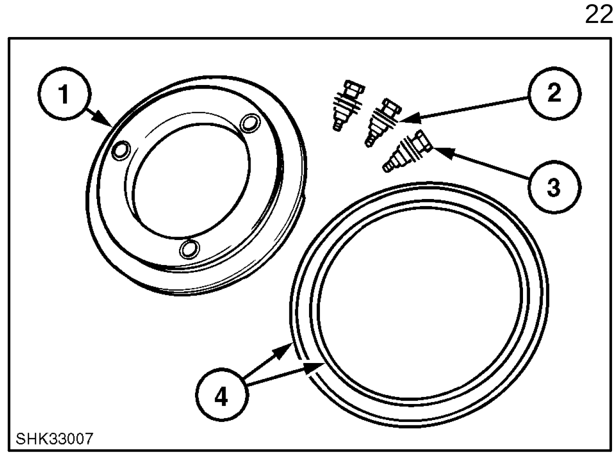


22

Remove the three piston retaining bolts.

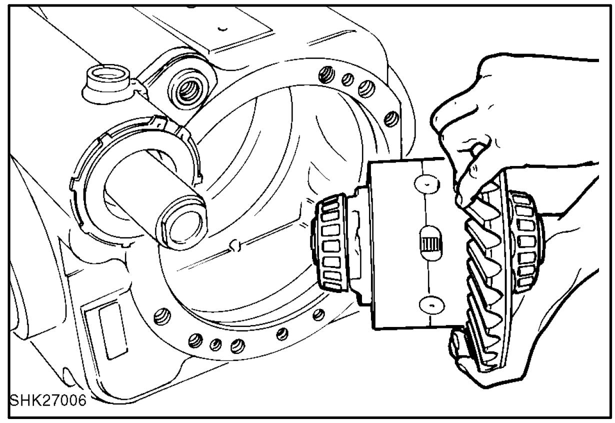
To assist in removing the brake piston from the housing, undo the brake bleed nipple and blow compressed air down to eject the piston.

1. Brake Piston
2. Return Belleville Washers
3. Piston Retaining Nuts
4. Piston Seals



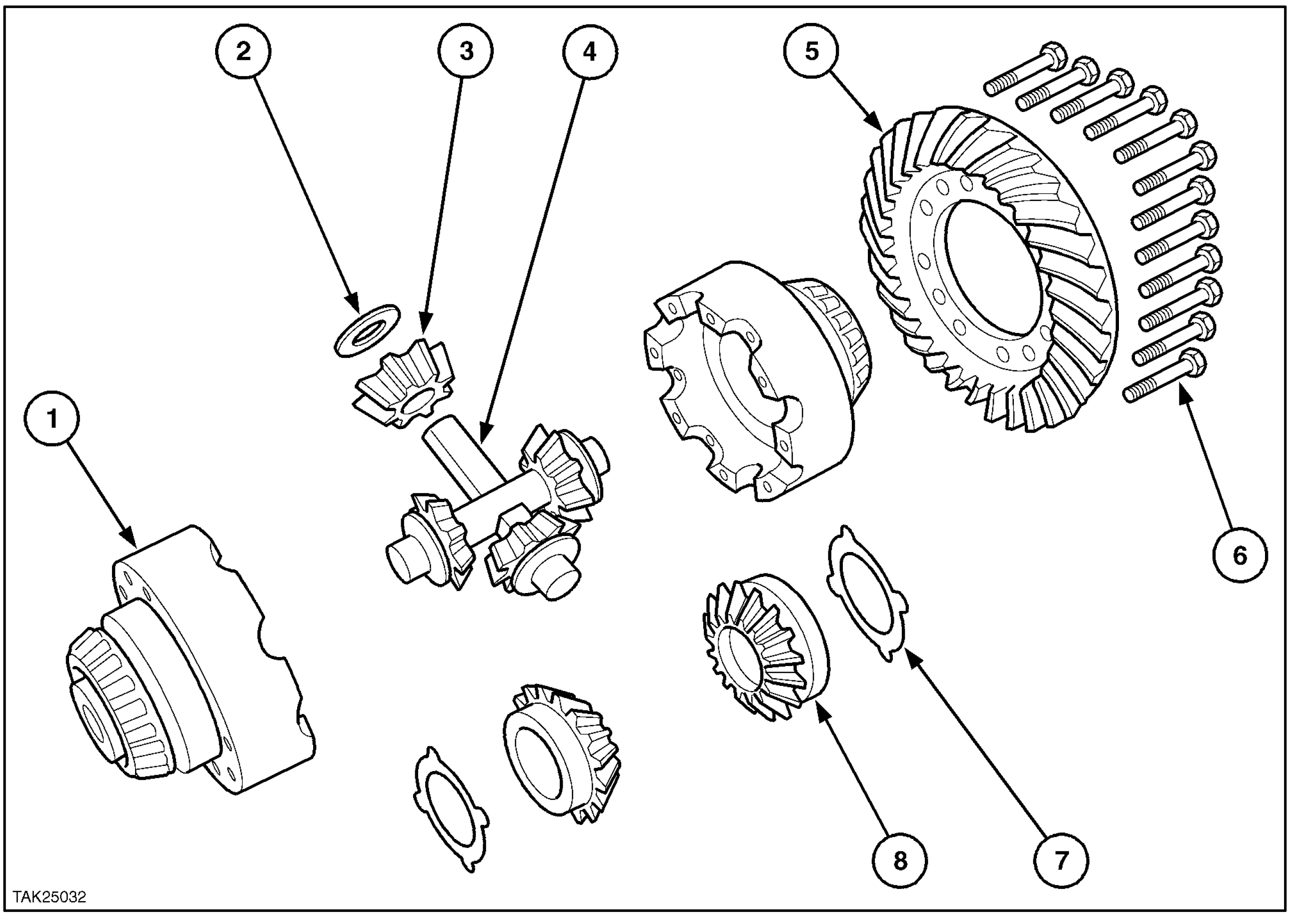
23

With both brake housings removed, the differential and crown wheel can then be removed.



24

CROWN WHEEL AND DIFFERENTIAL ASSEMBLY



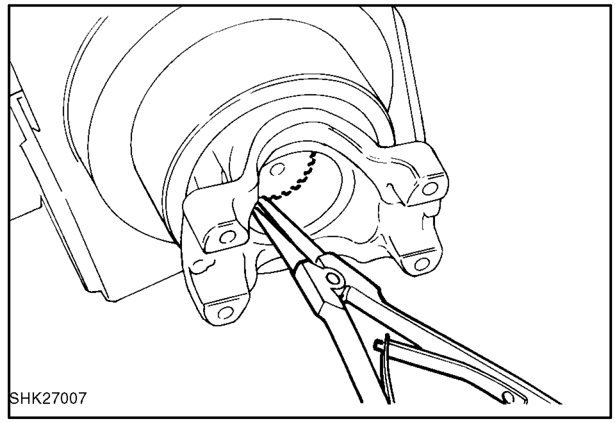
25

1. Differential Housing
2. Thrust Washer
3. Planet Gears
4. Shaft
5. Crown Wheel
6. Fixing Bolts
7. Thrust Washer
8. Side Gear

Before reassembly inspect all components for wear and damage.

PINION DISASSEMBLY

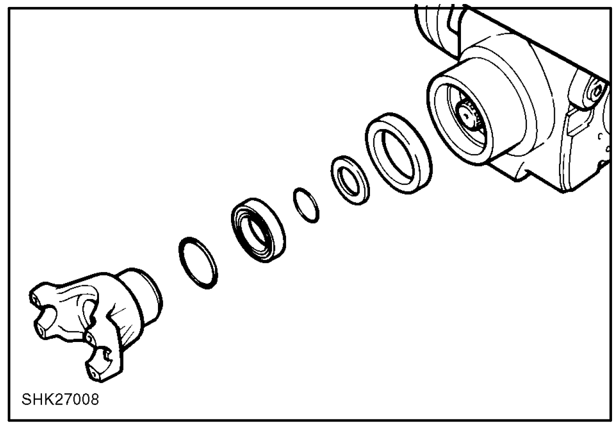
Remove the coupler retaining ring using suitable circlip pliers.



26

Then remove the coupler and ‘O’ ring.

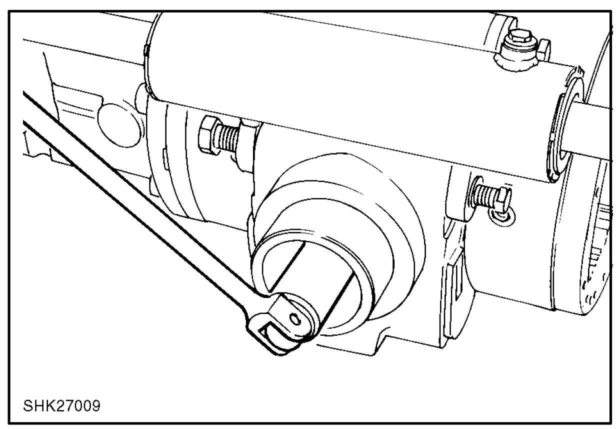
Lever out the oil seal and dispose of it. Then slide off the steel ring, ‘O’ ring and washer.



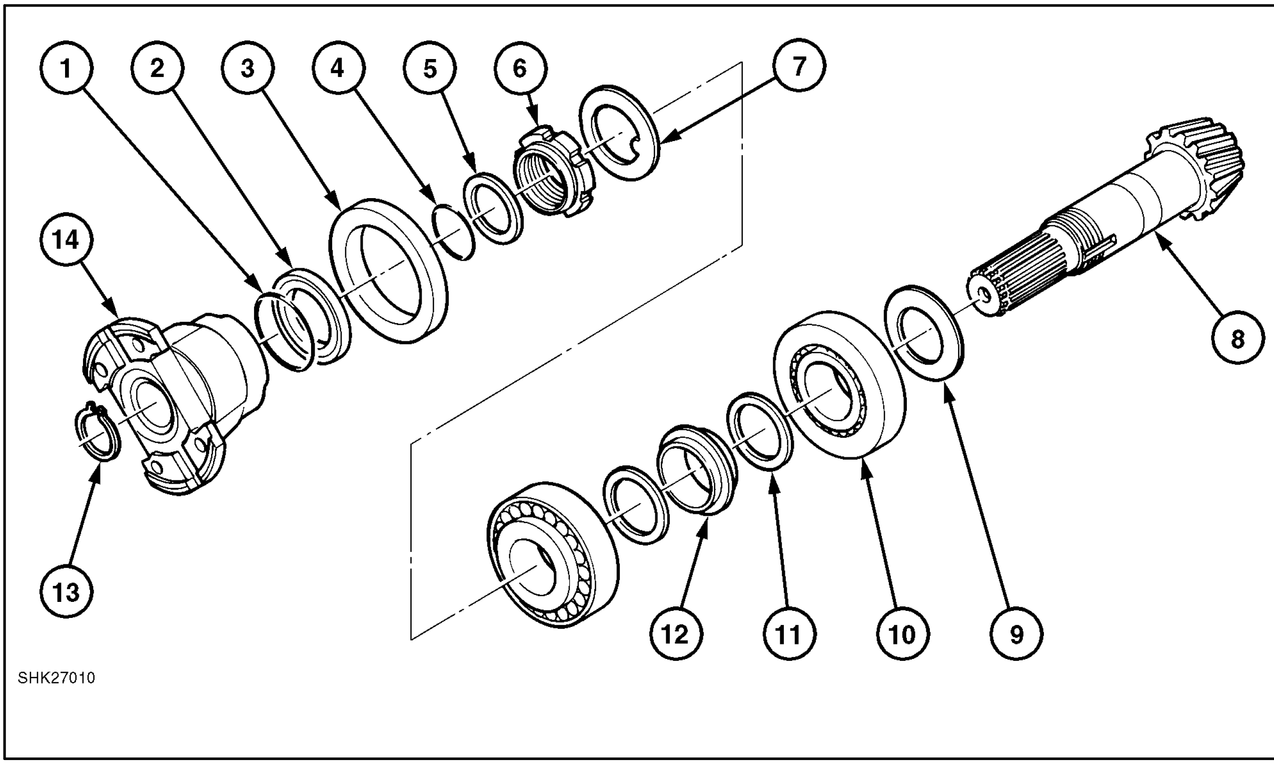
27

Using tool no. **297511** lock the shaft and undo the pinion nut.

Withdraw the pinion shaft and bearings.



28



29

heading

1. Ring
2. Inner seal
3. Outer Seal
4. Ring
5. Washer
6. Adjusting Nut
7. Tab Washer
8. Shaft
9. Washer
10. Bearing
11. Washer
12. Shaft Guide
13. Circlip
14. Coupling

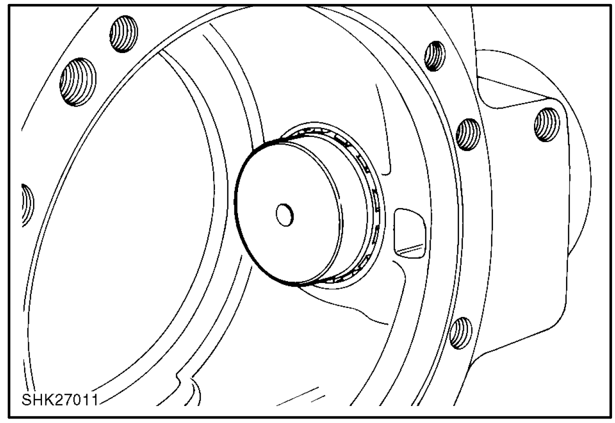
DIFFERENTIAL REASSEMBLY

Before reassembly, inspect all components for wear and damage.

If any components have been changed then the following set-up procedure must be followed.

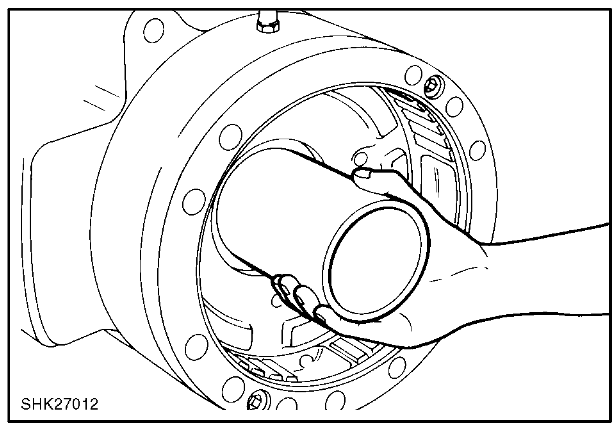
Correct set-up of the differential is only possible using tool no. **297414**.

Firstly insert the false pinion (**297414**) into the housing with the new bearings fitted. Tighten the lock nut so the bearings can still be rotated by hand.



30

Then fit the false differential (**297414**) with the housing complete with side brake housing.



31

Record the A dimension using a depth gauge.

X is the dimension needed to calculate the pinion shams.

Carry out the following calculation:

X = (A + C) – B

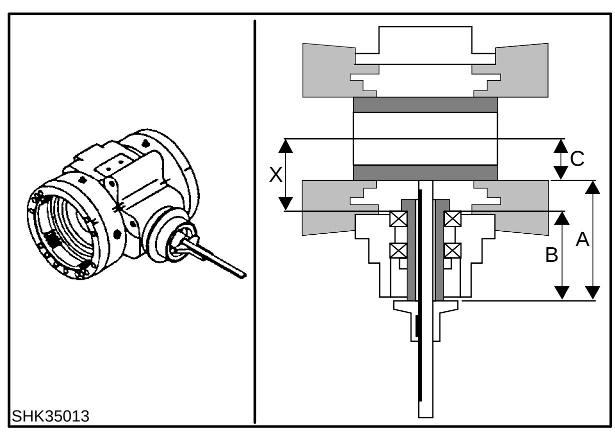
Example: A = 164.9

therefore X = (164.9 + 45) – 100

X = 109.9

B = 100 mm

C = 45 mm



32

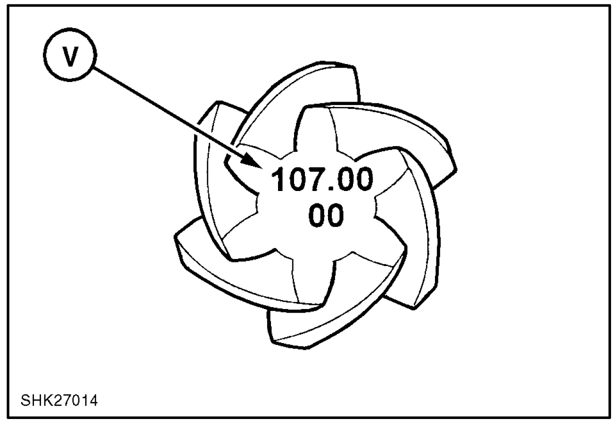
To determine the shims required, check the pinion dimension on the end of the pinion (V).

Shim thickness = X – V

Example:

Shim thickness = 109.9 – 107.00
= 2.9

Shim are available from 2.5 mm to 3.4 mm in 0.1 increments.

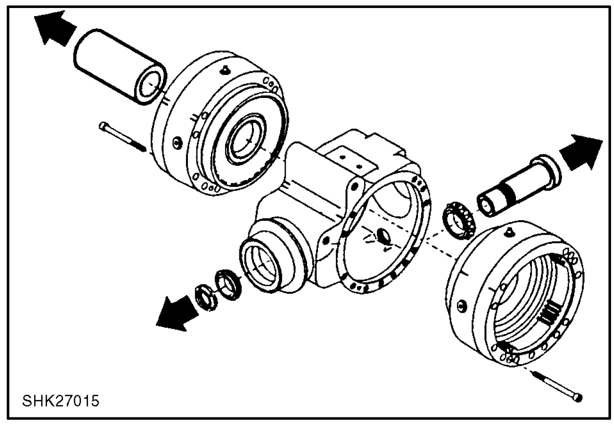


33

Remove the false pinion and differentials and also the side brake housings.

Reassemble the pinion with the calculated shim between the pinion head and conical bearing.

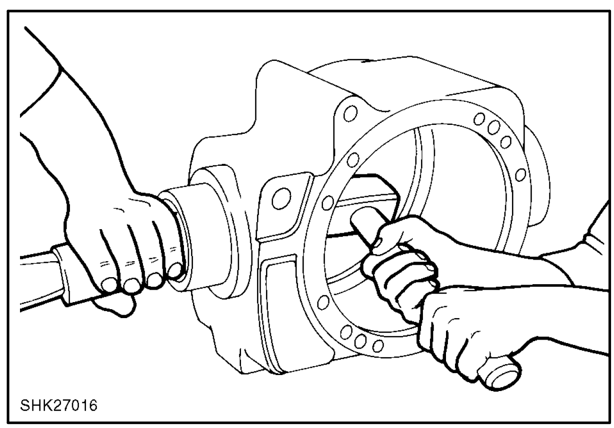
Ensure the chamfered side of the shim is toward the pinion head. Press on the first bearing.



34

Replace the pinion, shim and bearing into the housing complete with new collapsible bush and washers.

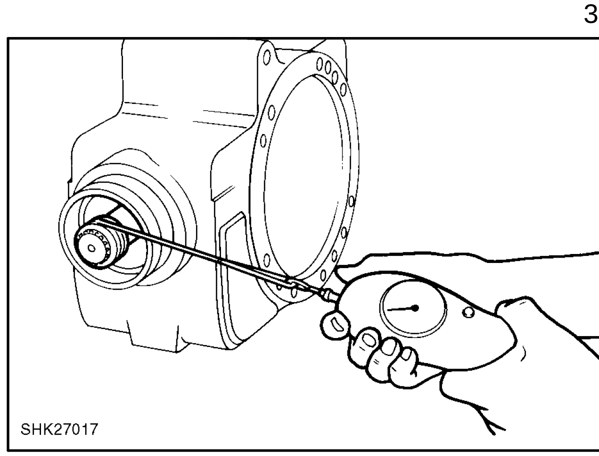
Fit the other bearing onto the end of the shaft and using a suitable drift hammer on the bearing. Oppose hammer force by holding a heavy hammer against the pinion head.



35

Fit the rest of the components to the shaft and tighten the pinion nut in incremented steps until the correct rolling pull is achieved:

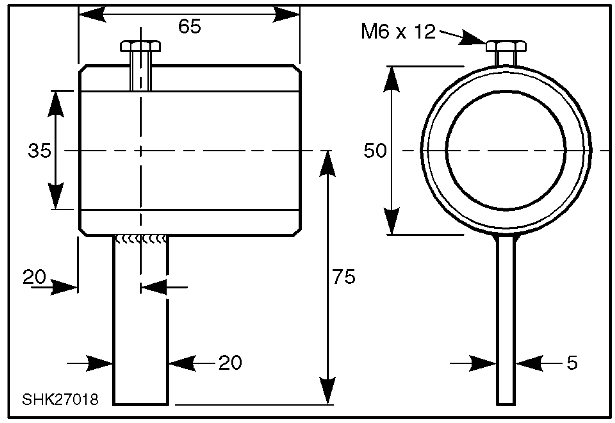
9.2 – 13.8 N



36

When the desired rolling resistance is achieved, hammer the locking tabs on the pinion nut so the nut cannot turn on the shaft.

Fit the differential and crown wheel into the housing and fit the locally made tool to the pinion shaft and tighten the locknut.



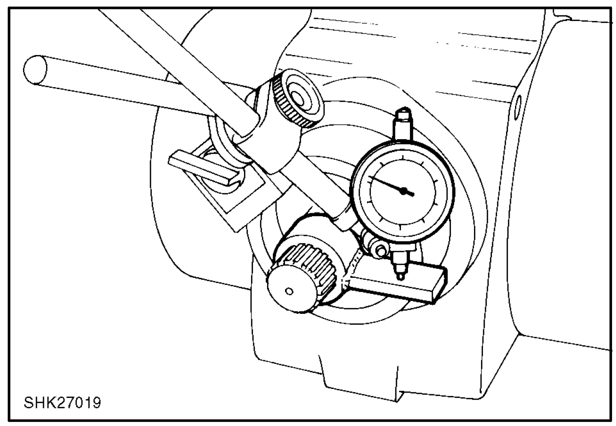
37

Measure the crown wheel to pinion backlash by placing the magnetic base of a dial gauge on the housing and placing the stylus of the dial gauge on to the flat surface of the tool. The stylus of the tool should be approximately 39mm from the pinions centre radius.

The backlash should be 0.17 – 0.22 mm.

If the measured backlash is too large, tighten the adjuster ring nearest the crown wheel and loosen the ring on the opposite side equal amounts.

If the backlash is too small, loosen the adjuster ring on the same side as the crown wheel and tighten the ring on the opposite side.



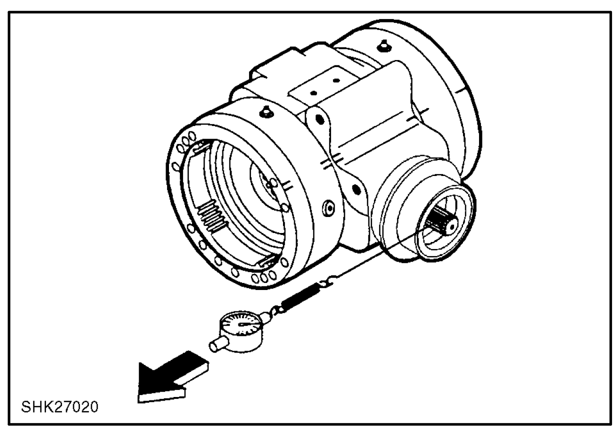
38

Recheck the rolling resistance of the pinion with the differential fitted.

The valve should now be the original pinion valve plus
(2.59 – 3.88) N.

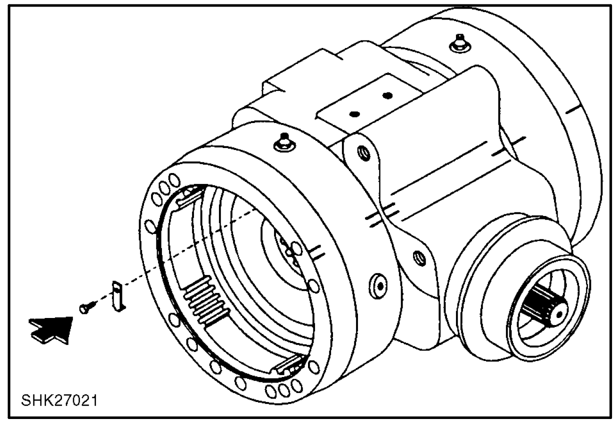
If the rolling resistance is too high then loosen each of the adjuster rings by equal amounts.

If the rolling resistance is too low then tighten both adjuster rings by equal amounts until the desired resistance is achieved.



39

Fit the adjusting ring locks when all backlashes and rolling resistances are correct.



40

SECTION 27 - REAR AXLE

Chapter 4 - Rear Axle

TABLE OF CONTENTS

IDENTIFICATION - SPECIFICATIONS

P/N **CNH**	**85824412**	**85824415**
P/N **Carraro**	146950	146951
Type of axle	26/32M	26/32M
Overall width (mm)	2349	2349
Planetary reduction	6.923/1	6.923/1
Crown wheel and pinion reduction	2.75/1	2.75/1
Total reduction	19.038/1	19.038/1
Differential lock	None	Limited slip
Steering lock stops	Angle of $21°\ ^{+0}_{-1°}$	Angle of $21°\ ^{+0}_{-1°}$

Number of satellites (per side) 3
Hub oil capacity........ 2 x 1.3 litres
Differential housing oil capacity .... 11 litres
Lubricants .... (see Driver's Manual)
New steel differential disc (worn) .... 1.3 ± 0.03 mm (1,2 mm)
New friction differential disc (worn) .... 1.6 ± 0.03 mm (1.45 mm)
New differential stop disc (worn) .... 2.7 ± 0.03 mm (2.6 mm)
New steel brake disc (worn)........ 00 mm (00 mm)
New friction brake disc (worn)........ 00 mm (00 mm)

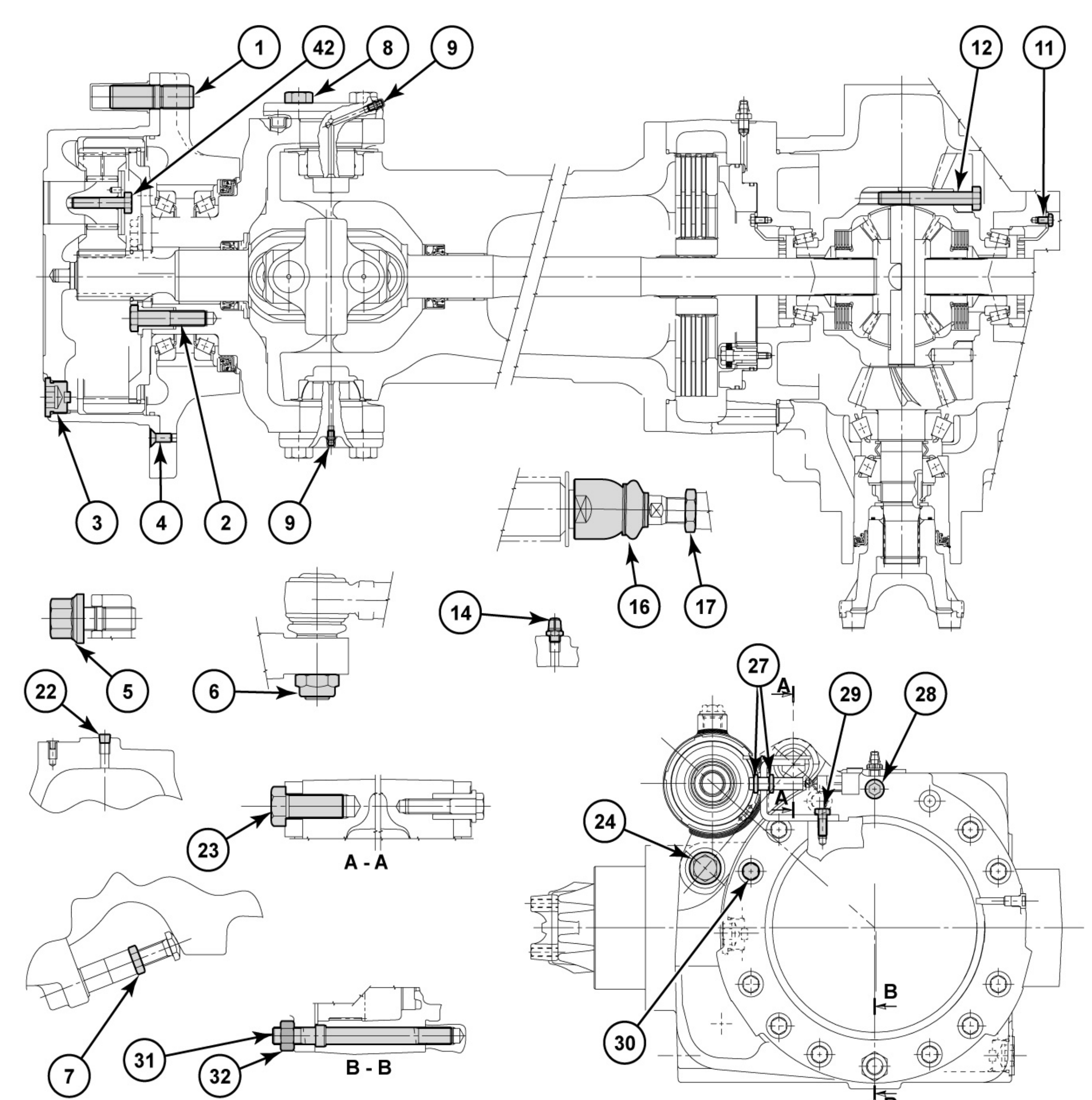
CLEARANCES AND ADJUSTMENTS

Backlash of drive pinion and ring gear........ 0.18 to 0.23 mm
Preload on drive pinion bearings .... P = 92 to 138 Nm
Total preload on crown wheel and pinion........ (P+ 25.9 Nm) to (P+ 38.8 Nm)
Preload on hub pivots .... Not adjustable, pre-defined in factory
Air gap clearance on steering lock detector........ 0.5 to 0.75 mm

SEALING AND ADHESIVE PRODUCTS

Loctite 510
Loctite 270
Loctite 638

SPECIAL TORQUE SETTINGS



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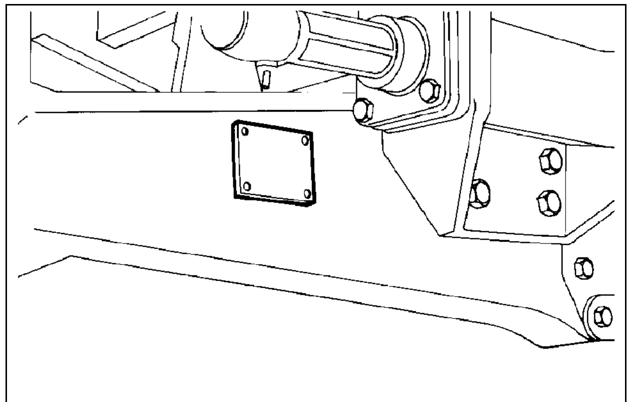
SPECIAL TORQUE SETTINGS

1	Wheel stud	70 Nm
2	Stub axle screw	230 Nm
3	Plug	60 Nm
4	Cover screw	25 Nm
5	Wheel nut	500 Nm
6	Steering ball-joint nut	260 Nm
7	Pivot stop lock-nut	150 Nm
8	Pivot shaft screw	300 Nm
9	Grease fitting	8 Nm
11	Set screw	13 Nm
12	Crown wheel screw	155 Nm
14	Vent	10 Nm
16	Cylinder ball-joint	300 Nm
17	Steering rod lock-nut	250 Nm
22	Plug	10 Nm
23	Cylinder retaining screw	660 Nm
24	Cylinder retaining screw	220 Nm
27	Detector adjustment nut	20 Nm
28	Screw	80 Nm
29	Cylinder retaining screw	23 Nm
30	Half-axle housing	320 Nm
31	Half-axle rod	120 Nm
32	Nut for rod	190 Nm
42	Satellite screw	79 Nm

The type of axle, the serial number, the transmission ratios, the reference number, the oil capacity and the type of grease are written on the plate.

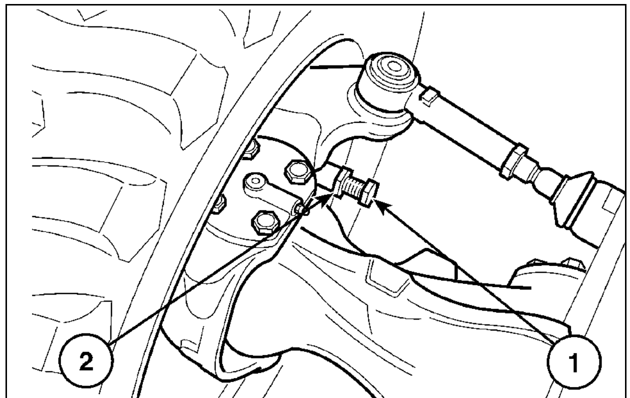


BBB10100

Toe-in adjustment

Steering stops (1) are mounted at either end of the axle.

These stops are adjustable to prevent the tires touching any part of the vehicle when the wheels are turned to the LH or RH steering lock. They are held by a nut (2).

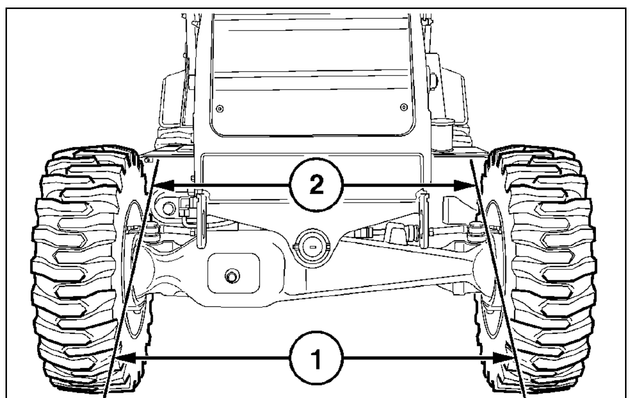


BRB0506C

The measurements to check the toe-in of the front wheels must be taken at the centre of the hub.

Measure the distance between the inner faces (wheel rim to wheel rim) at the front and rear of the front axle. The difference between (1) and (2) must lie within the following values:

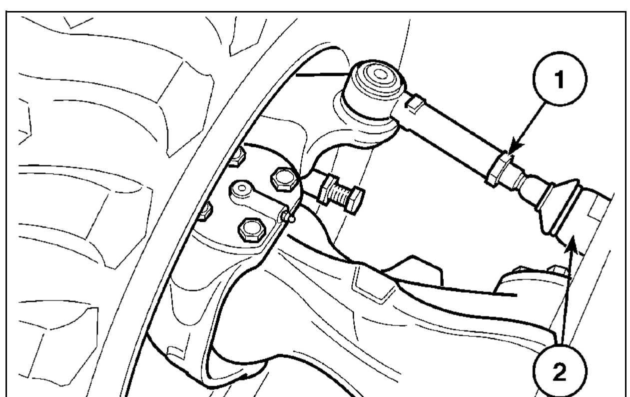
The toe-in must be ± 1 mm.



BRD0910B

To adjust the toe-in of the front wheels, loosen the lock-nuts (1), screw in or unscrew the cylinder rod (2). Retighten the lock-nuts (1).

1. Lock-nut
2. Cylinder rod



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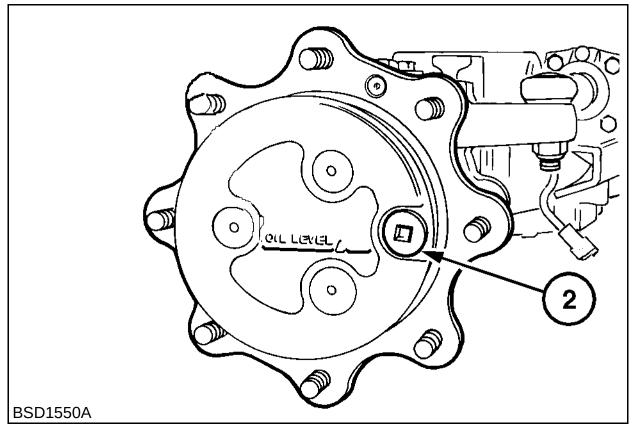
Hubs

Oil capacity: 1.3 litre

Level plug and drain plug (2)



SERVICING PARTS - without removing the axle

Steering cylinder

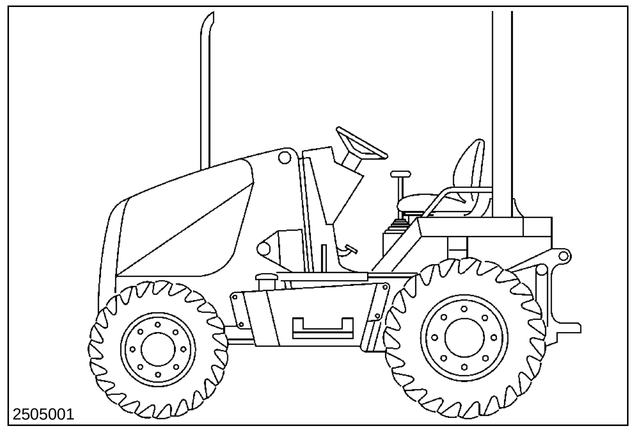
Hub and planetary reduction assembly

Stub axle pivot assembly

Stub axle casing

Shafts, seals and bushes

Drive pinion seal



SERVICING PARTS - with axle removed

Differential

Pinion gear assembly

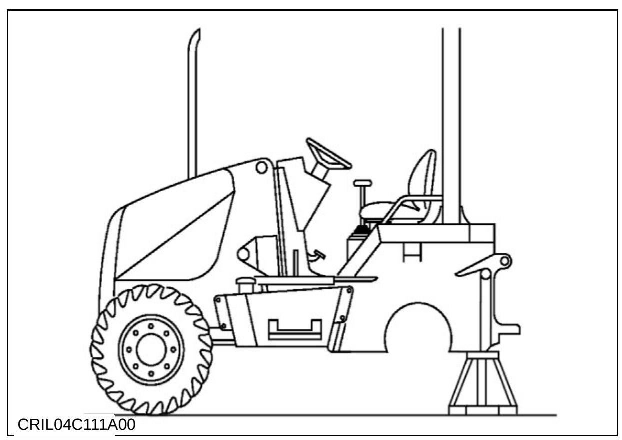
Adjustment of rear axle

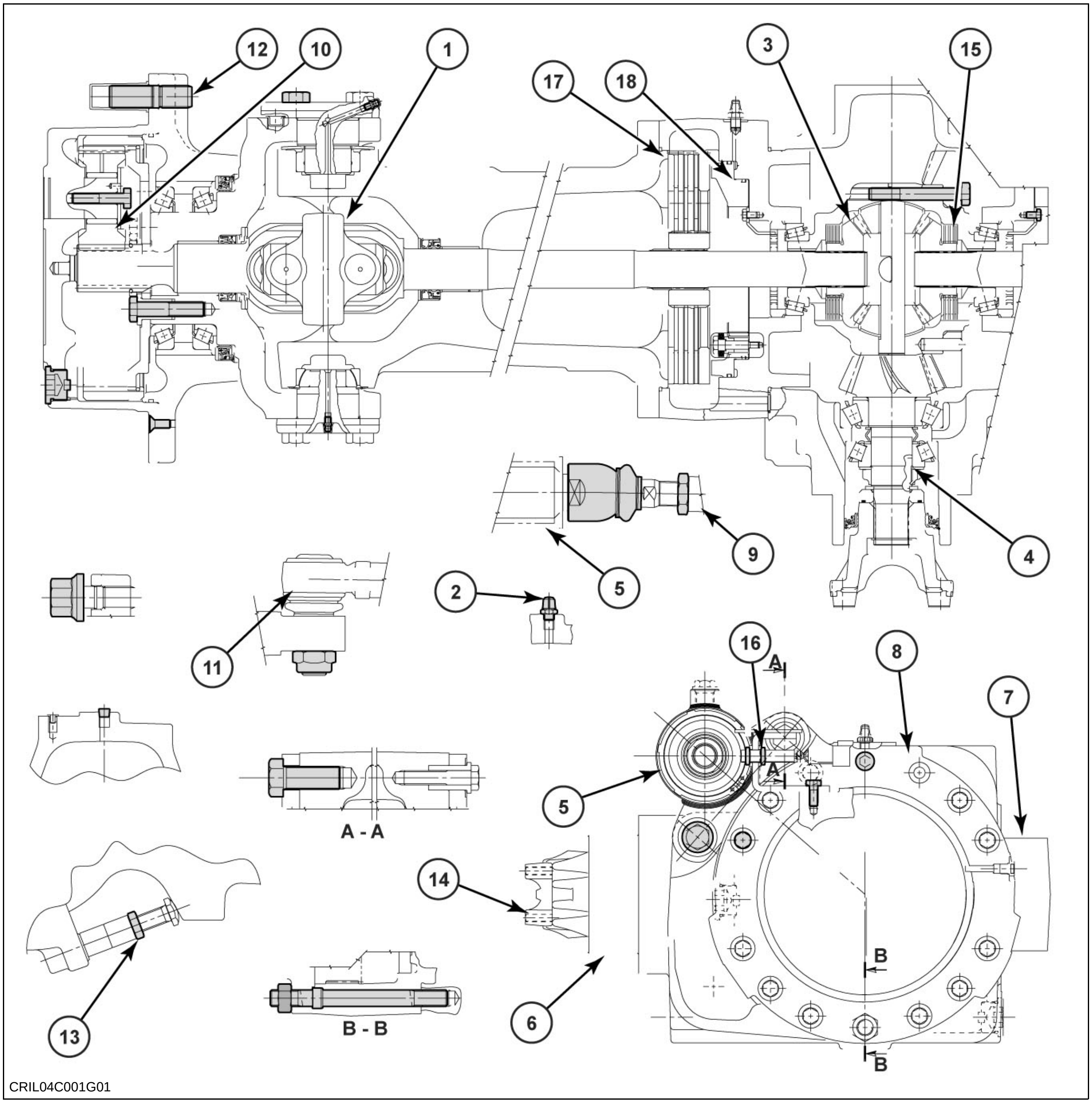
Drive pinion - ring gear tooth space

Drive pinion bearing preload

Clearance between teeth of ring gear and drive pinion

Differential bearing preload





Front axle - Cross-sectional view

1. Universal joint double seal
2. Central housing breather
3. Ring gear and differential
4. Drive pinion
5. Steering cylinder
6. Rear axle pivot
7. Front axle pivot
8. Axle central housing
9. Tie-rod
10. Hub and planetaries assembly
11. Steering ball joint
12. Stud bolt
13. Stop screw
14. Universal joint yoke
15. Friction discs (only on **85824415**)
16. Steering lock detector
17. Brake discs
18. Brake piston

TROUBLESHOOTING

IMPORTANT: *At each repair, always determine the cause of the problem and eliminate it to prevent it from occurring again.*

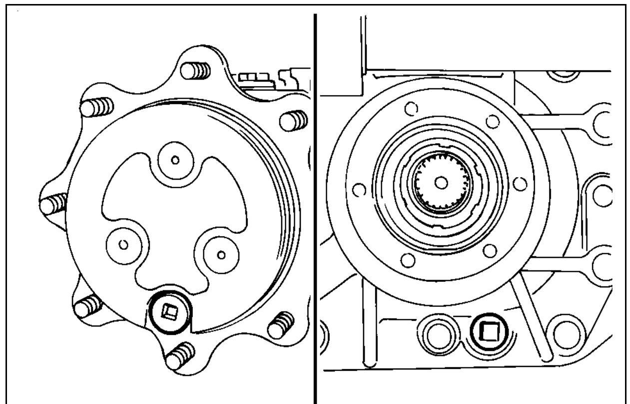
PROBLEM	POSSIBLE CAUSES	REMEDIES
The steering is blocked or is stiff.	1. Not enough oil in the tank. 2. Air present in the circuit. 3. Pump pressure limiter defective. 4. Pump worn. 5. Steering cylinder leak. 6. Control valve spool damaged. 7. Steering column broken or damaged. 8. Metering device worn or damaged.	1. Top up the oil level. 2. Check the tightness of the unions and the condition of the pipes, bleed the air from the circuit. 3. Check the circuit pressure. 4. Inspect and repair. 5. Inspect and repair. 6. Inspect and repair. 7. Inspect and repair. 8. Inspect and repair.
The steering goes off-centre.	1. Excessive play in the steering linkage ball joints. 2. Steering cylinder leak. 3. Control valve spool stuck or worn. 4. Torsion bar weak or broken. 5. Incorrect setting of control valve spool. 6. Metering device worn or damaged.	1. Inspect and replace. 2. Inspect and repair. 3. Inspect and replace. 4. Inspect and repair. 5. Check and adjust. 6. Inspect and replace.
Rear wheel steering movements are jerky.	1. Steering cylinder leak. 2. Control valve spool stuck. 3. Torsion bar weak or broken. 4. Metering device worn or damaged.	1. Inspect and repair. 2. Inspect and repair. 3. Inspect and replace. 4. Inspect and replace.
Pump noisy.	1. Not enough oil in tank. 2. Air present in the circuit. 3. Water in the oil.	1. Top up the oil level. 2. Check the tightness of the unions and the condition of the pipes, bleed the air from the circuit. 3. Drain and replace the oil.

DISASSEMBLY

Planetary reduction gear and wheel hub assemblies

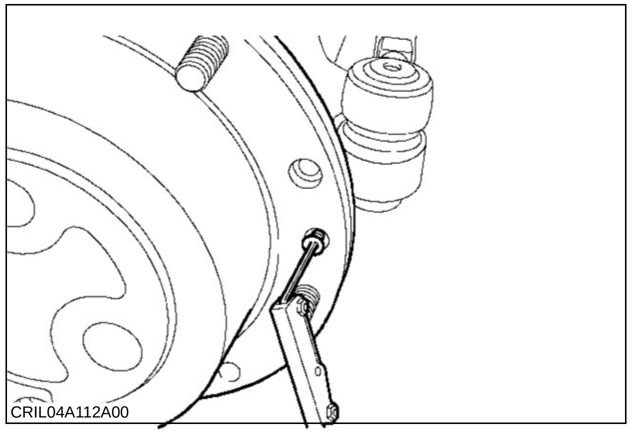
Position the hub filling/draining plug at the lowest possible level.

Drain the oil from the hub and the differential casing.



BSD1551A

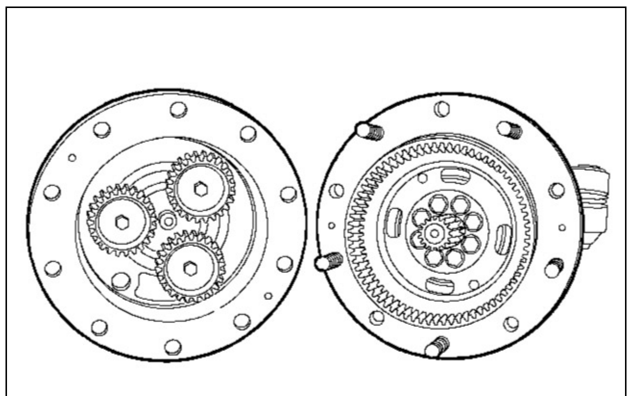
Remove the two Allen head satellite-carrier attaching screws with the hub.



CRIL04A112A00

Extract the hub using the extraction slots.

Remove and discard the seal.



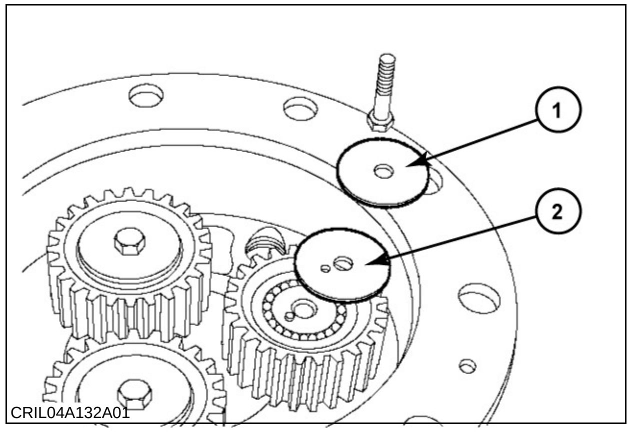
CRIL04A113A00

Disassemble the planetary gear train.

Remove the screws from all the satellites. Remove the upper washer (1) and the lower washer (2).

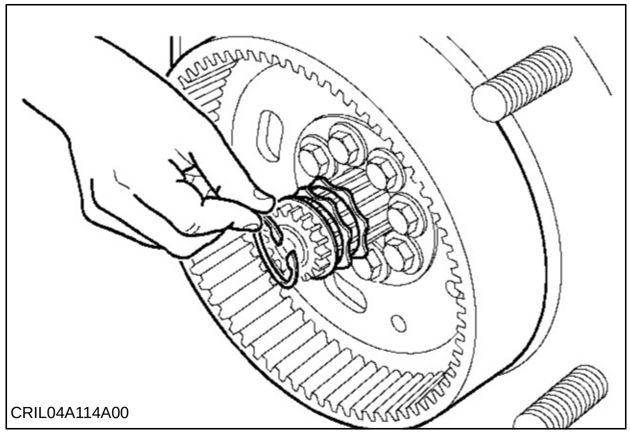
Now remove the satellites with their needle bearings.

Inspect the items, if they are worn or damaged, replace them before reassembling.

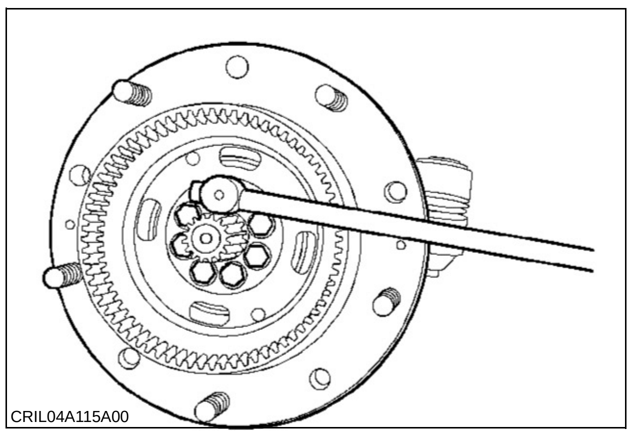


CRIL04A132A01

Extract the planetary retaining circlips and remove the planetary.

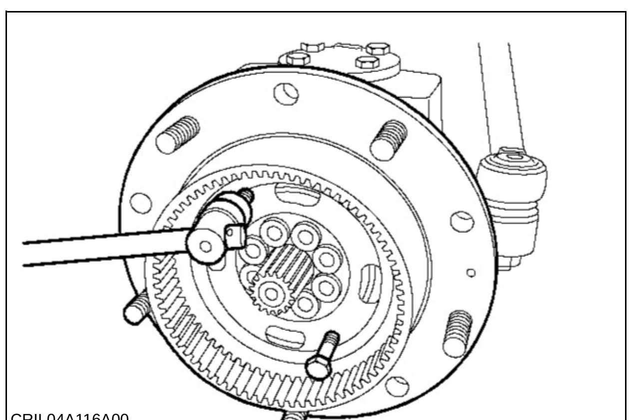

CRIL04A114A00

Remove the screws from the ring gear carrier.

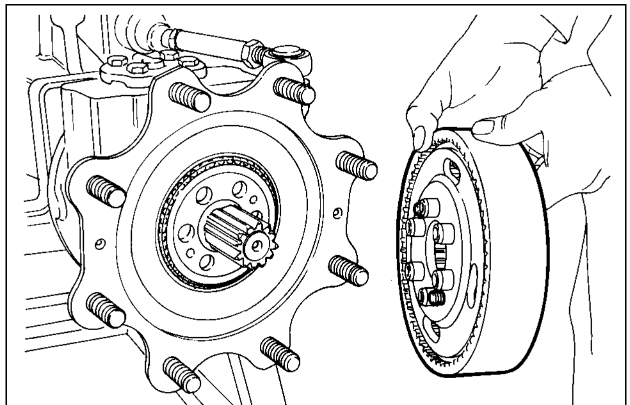

CRIL04A115A00

Remove the ring gear carrier by installing the extraction screws in the holes tapped in the ring gear.

Tighten the extraction screws uniformly.

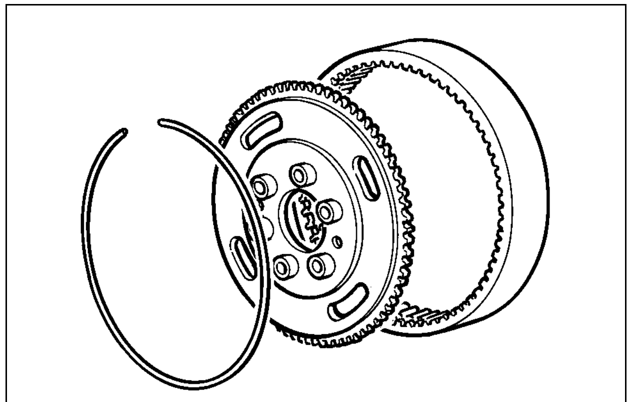

CRIL04A116A00

Remove the large ring gear from the hub.


BSD1559A

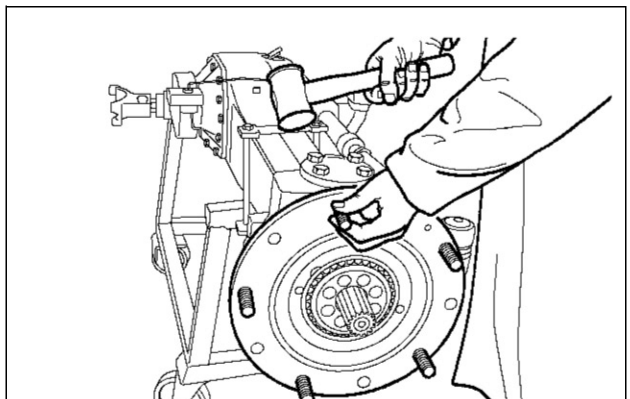
Remove the circlips and ring gear from the ring gear carrier.

Drive out the centring studs.


BSD1561A

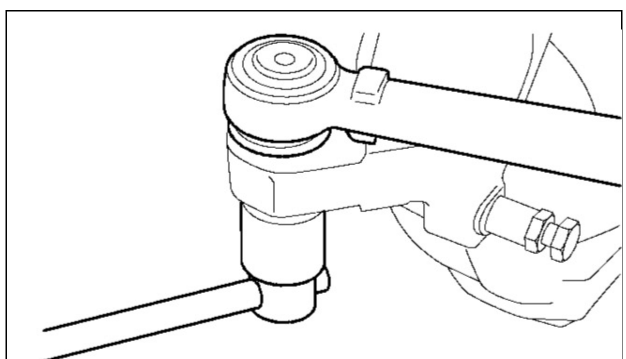
Remove the hub by striking it with a rubber-headed mallet.

Remove and discard the large seal of the stub axle pivot.


CRIL04A117A00

Unscrew the ball joint nut.

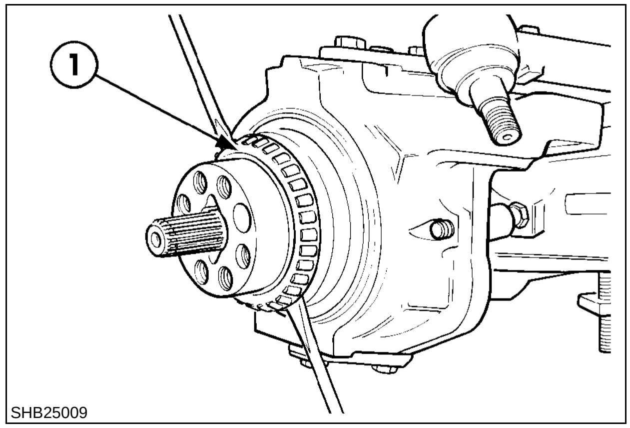
Use an extractor to separate the cone from the ball joint.


CRIL04A119A00

Hub bearing

Extract the inner cage (1) of the hub bearing by introducing two diametrically opposed levers under the bearing.

IMPORTANT: *Take care not to damage the bearing when extracting it.*

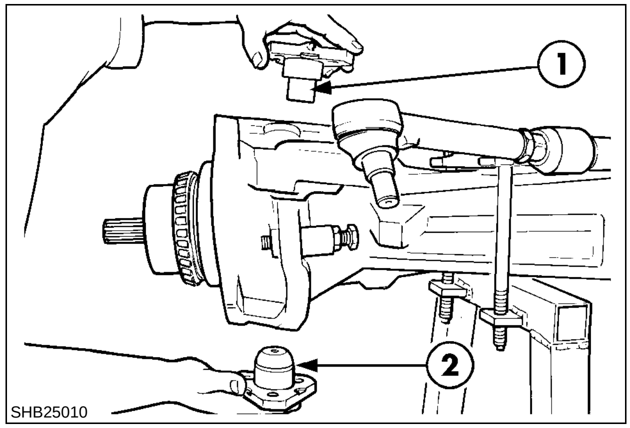


SHB25009

Stub axle pivots

Remove the upper king pin (1) and lower king pin (2) attaching screws. Remove the upper and lower king pins.

1. Upper king pin
2. Lower king pin

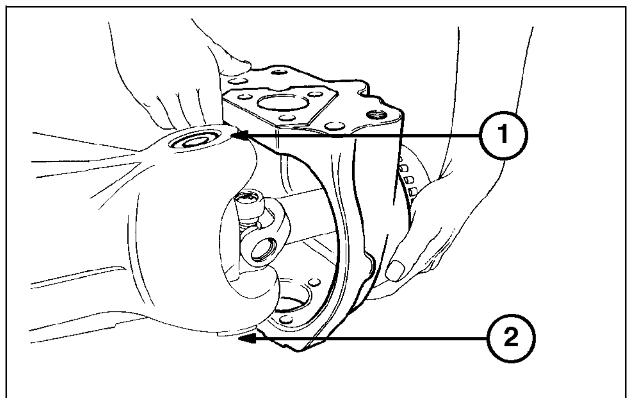


SHB25010

Stub axle

Carefully remove the stub axle from the half-axle housing.

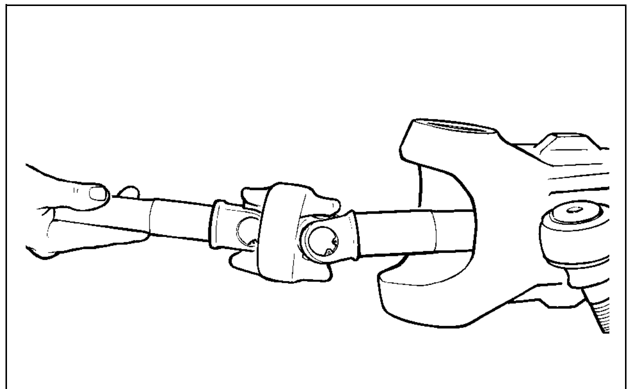
NOTE: *Two spring washers are situated between the half-axle housing and the stub axle, the larger (1) at the top and the smaller (2) at the bottom.*



TIB25038

Wheel shaft

Disengage the wheel shaft from the half-axle housing.

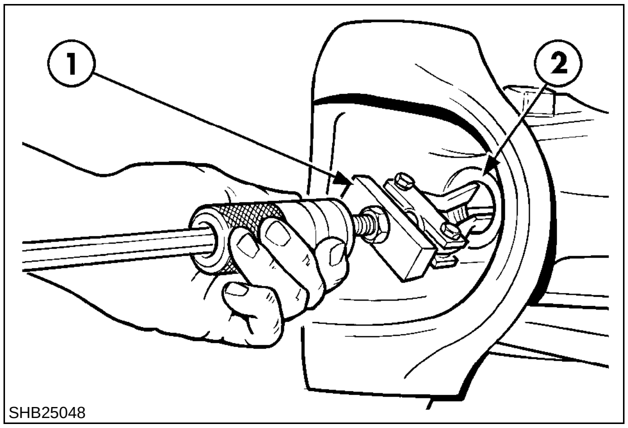


SHB25011

Remove the half-axle housing bush and seal

Use tool P/N **380000985** to extract the seal and bush from the half-axle housing.

1. Extractor
2. Oil seal

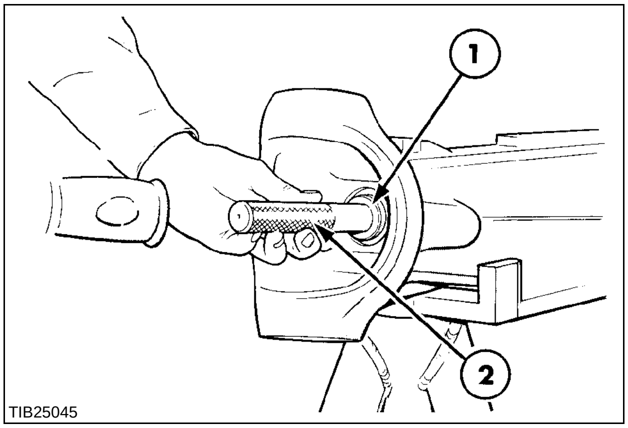


SHB25048

Reinstallation of stub axle bush and seal

Thoroughly clean the stub axle housing before installing a new seal and bush. Use tool kit P/N **380000563** and strike gently with a rubber-headed mallet.

1. Bush installation tool
2. Tool handle

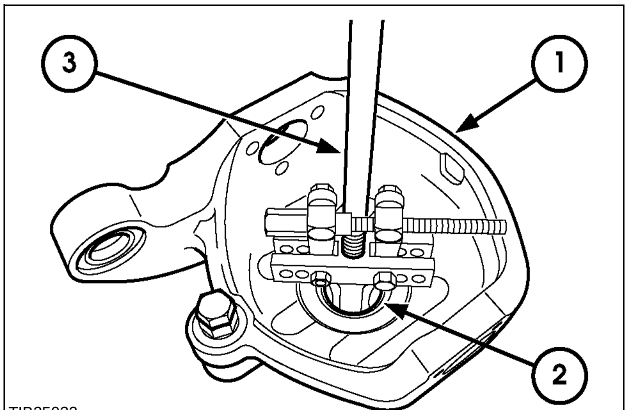


TIB25045

Removal of stub axle seal

Extract the seal and bush from the stub axle housing using tool P/N **380000986** and a hammer extractor P/N **380000987**.

1. Stub axle
2. Union
3. Hammer extractor

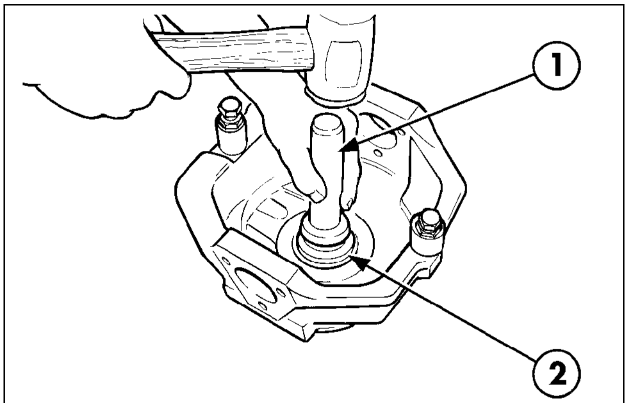


TIB25032

Reinstallation of the stub axle seal and bush

Reinstall the seal and bush in the stub axle housing using tool P/N **380000563**.

1. Tool handle
2. Installation tool

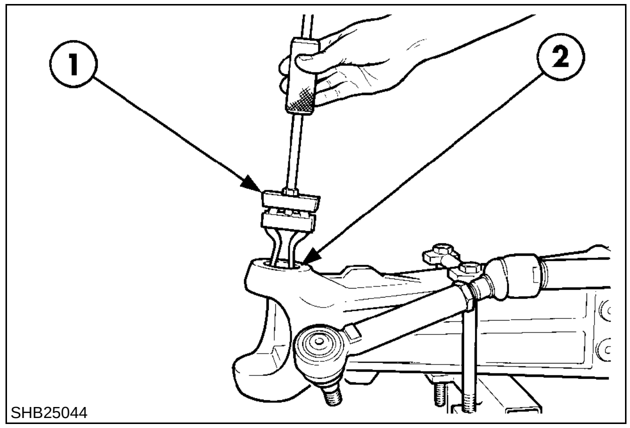


SHB25012

Removal of pivot bushes

Extract the pivot bushes using a hammer extractor P/N **380000985**.

1. Hammer extractor
2. Pivot bush

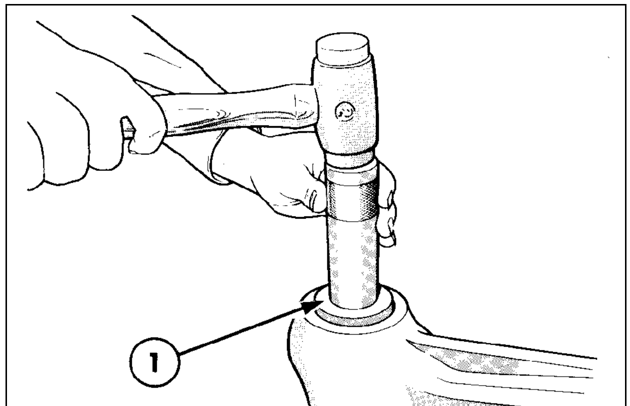


SHB25044

Reinstallation of pivot bushes

Before installing the bushes, ensure that their housing recesses are perfectly clean. Install the bushes using tool kit P/N **380000563**.

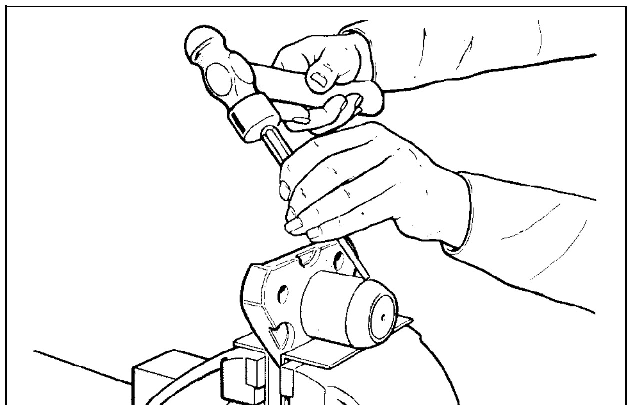
1. Installation tool



TIB25026

Removal of lower pivot shaft cone

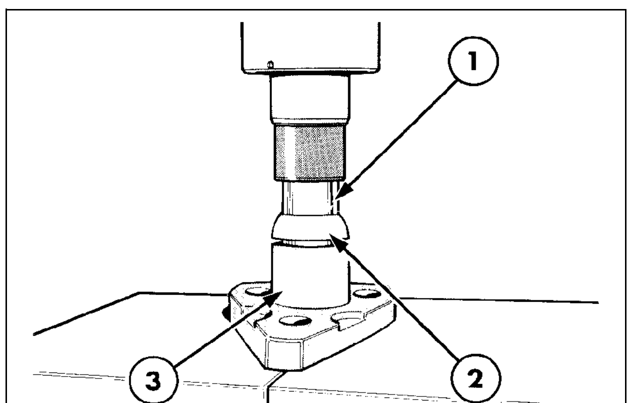
Grip the pivot shaft in a vice and drive out the cone with a pin drift.


TIB25046

Installation of lower pivot shaft cone

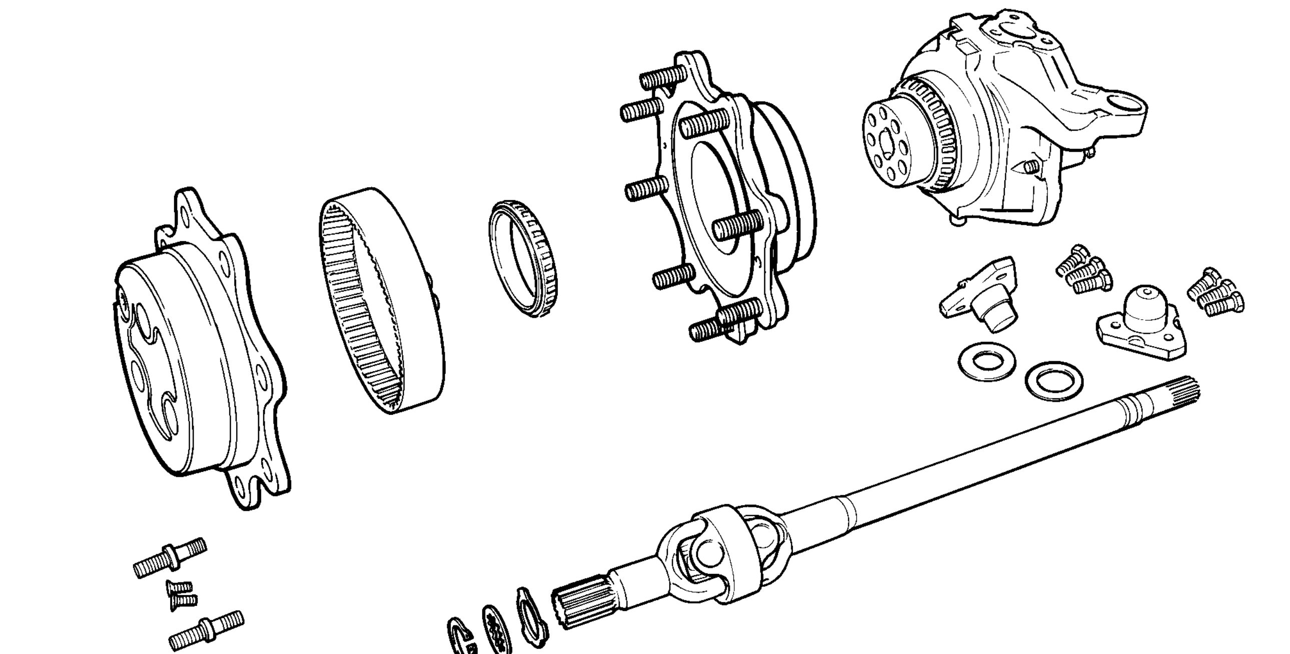
Carefully clean the pivot shaft and check that it is not damaged. Install the cone using a spacer placed under a press.

1. Spacer
2. Pivot shaft cone
3. Pivot shaft



TIB25047

Reassembly of reducing gear and wheel shaft assembly



BSD1562A

Reassembly of reducing gear assembly and wheel shaft

Reassemble proceeding in the reverse order of disassembly.

If the wheel stud is replaced, apply Loctite 270 to the threads.

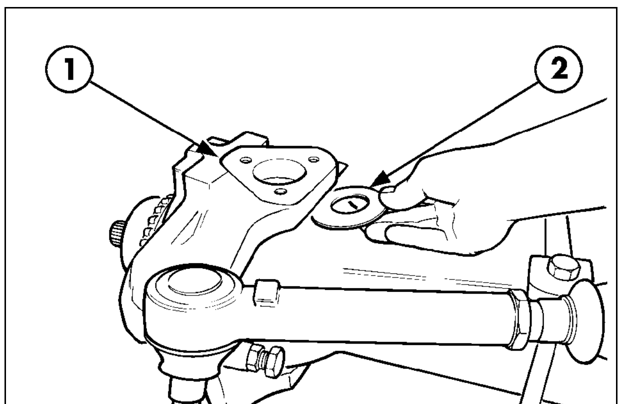
Install the wheel shaft before installing the stub axle.

Use tool P/N **380000610** to fit the large hub seal.

Fit a protective sheath over the wheel shaft splines for installation of the stub axle.

There is no need to adjust the stub axle clearance. The clearance is determined automatically by two spring washers. The smaller washer must be placed at the bottom of the stub axle and the larger washer at the top.

1. Stub axle casing
2. Spring washer

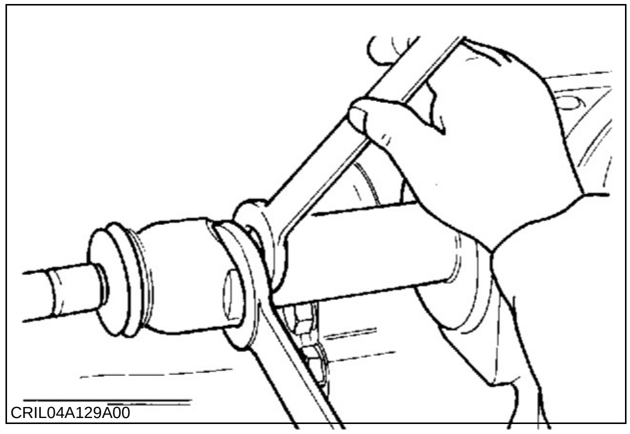


SHB25015

Removal of the steering cylinder

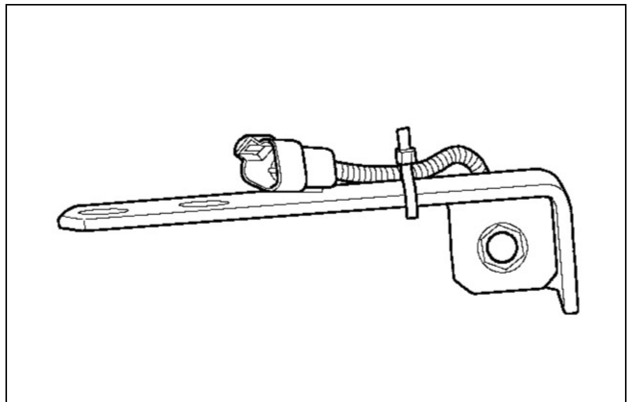
The steering cylinder is mounted on the axle housing and held by screws.

Disassemble the ends of the tie-rod from the cylinder rod.

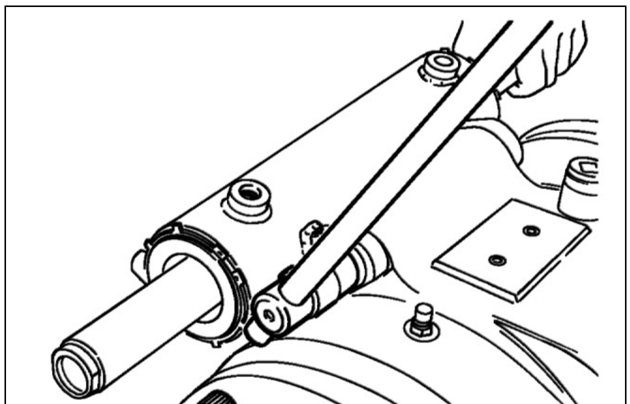

CRIL04A129A00

Unscrew and remove the steering angle detector attaching bolts.

Disconnect the hydraulic pipes and plug the unions.


CRIL04A130A00

Remove the cylinder attaching screws and remove the cylinder using a hoisting means.


CRIL04C115A00

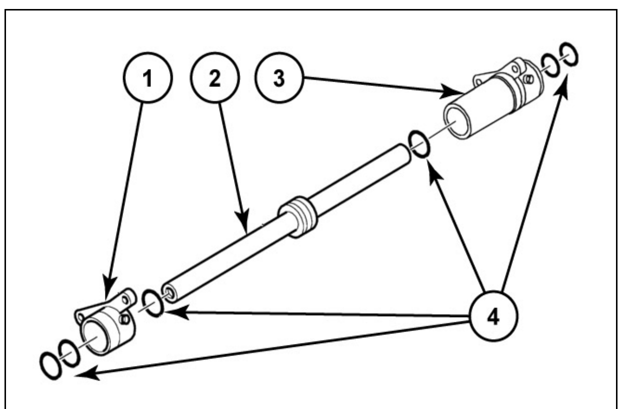
Disassembly of cylinder

Remove the circlips, extract the cylinder bearing (1), remove the rod (2) from the cylinder body (3).

Remove and discard the seals (4).

To reassemble, proceed in the reverse order to that of removal.

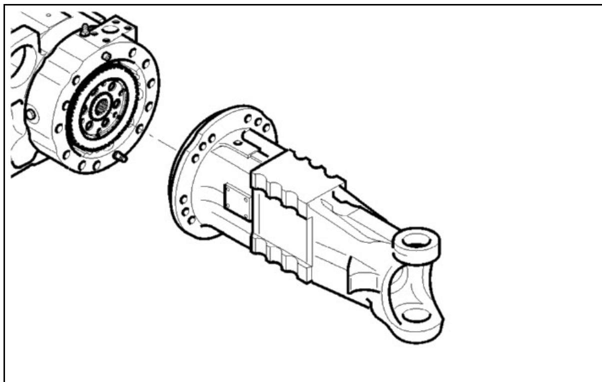
Install a kit of new seals (4).



CRIL04C110A01

Removal of the brakes

Disassemble the half-axle housing.



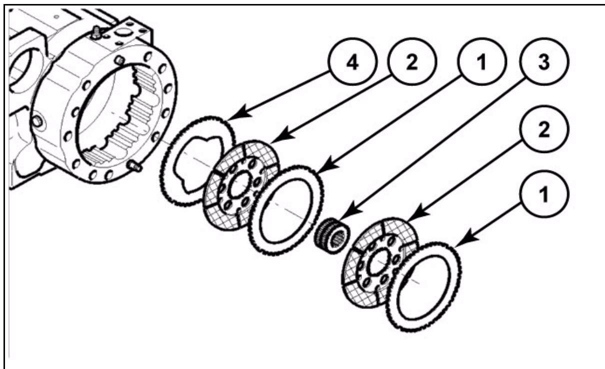
CRIL04C080A00

Braking system example

Mark the position of the brake discs.

Remove the steel discs (1), the sintered disks (2), the coupling sleeve (3) and the stop plate (4).

NOTE: *The brakes can have a different number of discs.*



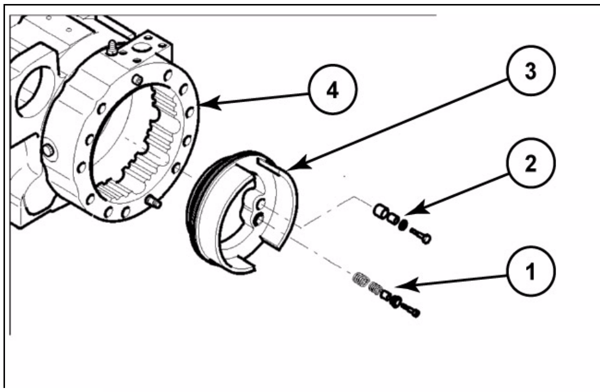
CRIL04C081A01

Removal of the brake piston

Remove the return system (1) and the guiding spacers (2).

Pull out the brake piston (3) and discard the seals.

Remove the brake housing attaching screws (4) and discard the seals. Proceed in the same manner for the other brake housing.



CRIL04C082A01

Removal of the differential

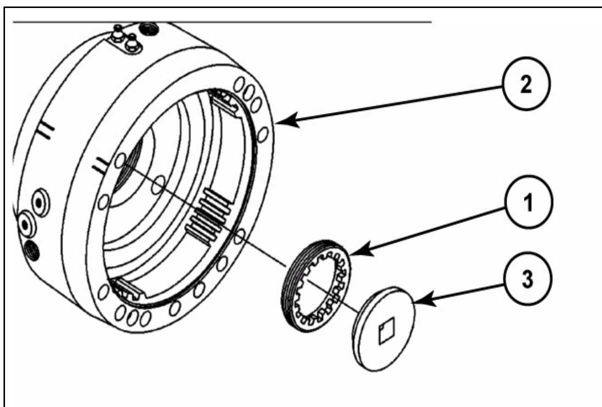
Remove the brake pad by removing the brake housing (2) attaching screw.

Remove the differential adjusting nut (1) from the brake housing (2) using wrench **380000406** (3).

Remove the bearing outer cage and mark its position.

Mark the position of the brake housing.

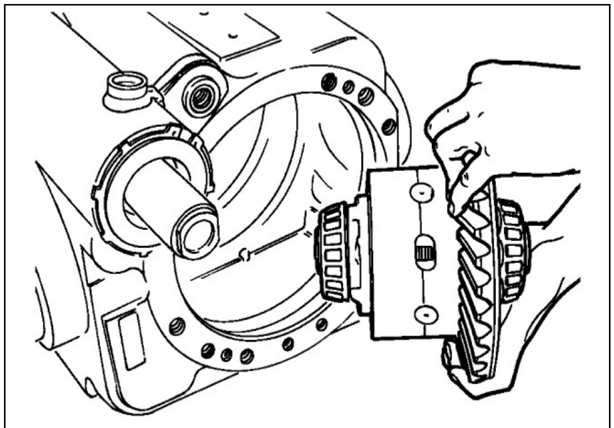
Remove the attaching screws and remove the brake housing (2).



CRIL04C086A01

Disassembly of the differential

Mark the position of the differential and remove it.



CRIL04C119A00

Differential housing (2) and ring gear (1)

Before disassembly, make a pencil mark (3) on the two sections of the differential housing to ensure correct reassembly later on.

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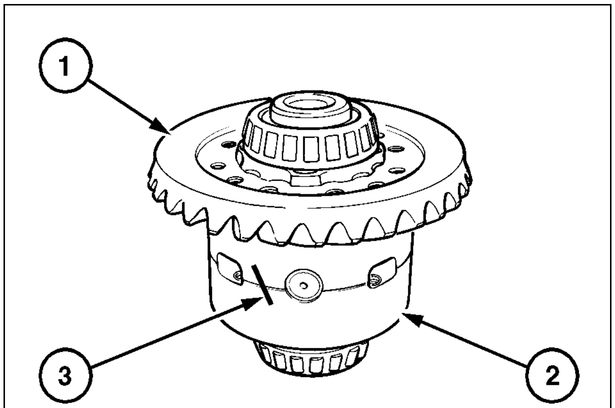
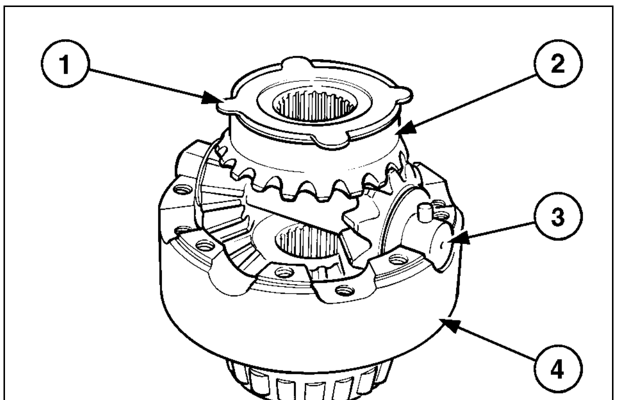


BSD1575A

Differential components

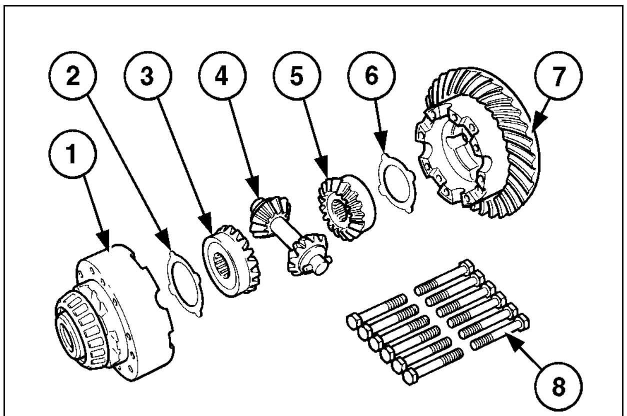
1. Thrust washer
2. Planetary
3. Satellite-carrier pin
4. Differential housing



BSD1576A

NOTE: *If the differential is not of the limited slip type, a single thrust washer is mounted on each side (2) and (6).*

1. Differential box
2. Thrust washer
3. Planetary
4. Satellite-carrier pin
5. Planetary
6. Thrust washer
7. Ring gear
8. Attaching screw



BSD1577A

With limited slip differential.

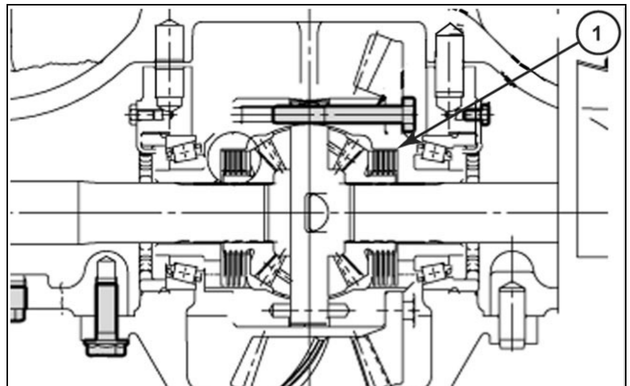
Mark the position of the friction discs (1) and remove them.

Check the thickness of the discs.

Steel disc, minimum thickness = 1.4 mm

Friction disc, minimum thickness = 1.45 mm

Stop disc, minimum thickness = 2.7 mm



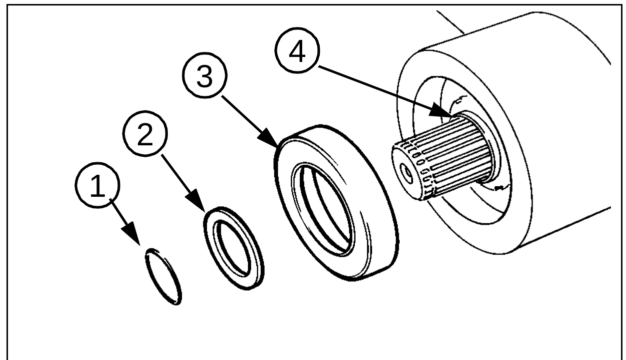
CRIL04B159A01

Disassembly of drive pinion

Remove the retaining ring and remove the universal joint yoke.

Remove seal (1), washer (2) and extract the lip seal box (3). Remove nut (4) using wrench P/N **380000021** holding the shaft stationary with wrench P/N **380000020**.

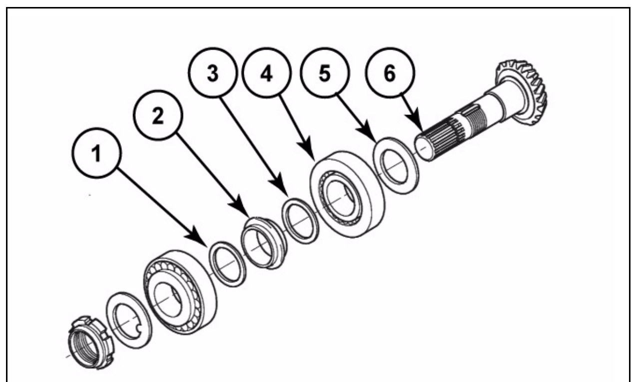
Drive out the drive pinion and recover the bearing inner cage.



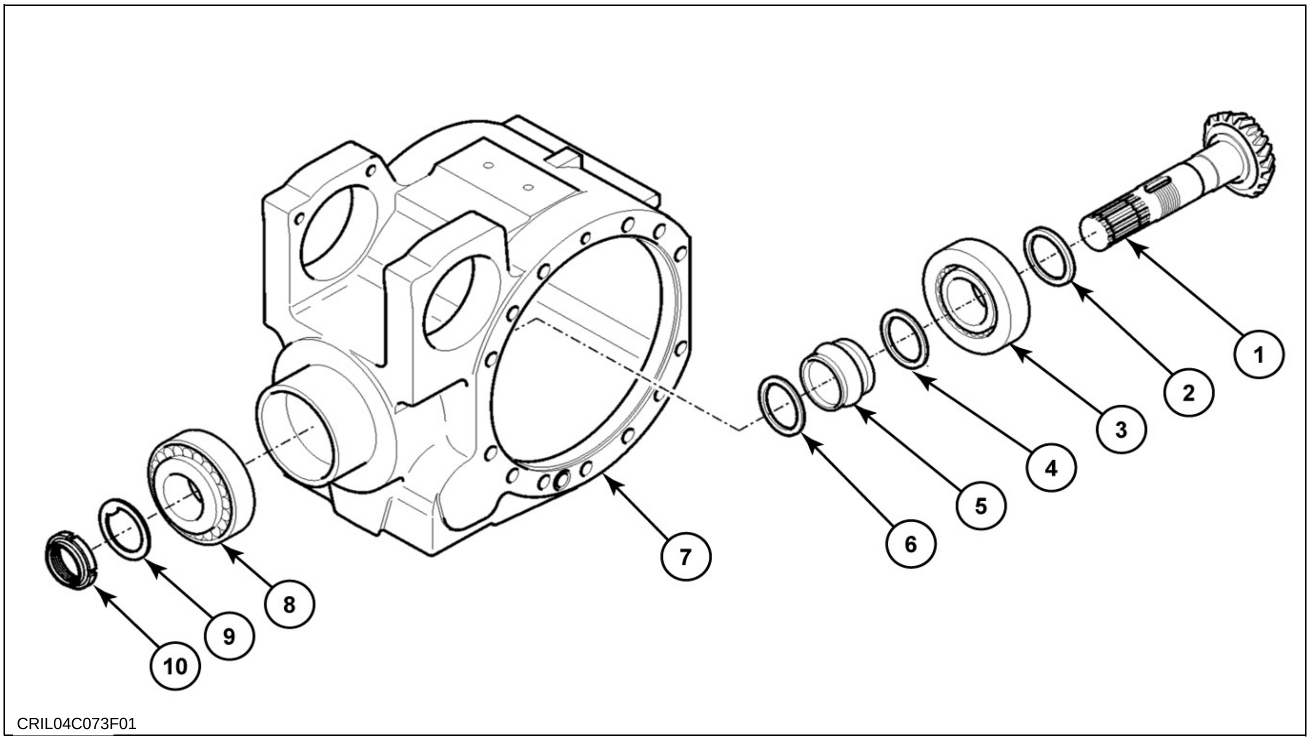
BSD1577A

Remove washer (1), collapsible spacer (2) and washer (3).

Extract the bearing (4), remove the shimming washer (5) from the drive pinion (6).



CRIL04C074A01



Drive pinion components

1. Drive pinion
2. Adjusting shim
3. Bearing
4. Washer
5. Collapsible spacer
6. Washer
7. Differential housing
8. Bearing
9. Washer
10. Nut

Inspection of differential components

In addition to the normal inspection of the bearings, pinions and ring gear, wear of the gear teeth and splines, inspect:

The thrust washer or differential discs.

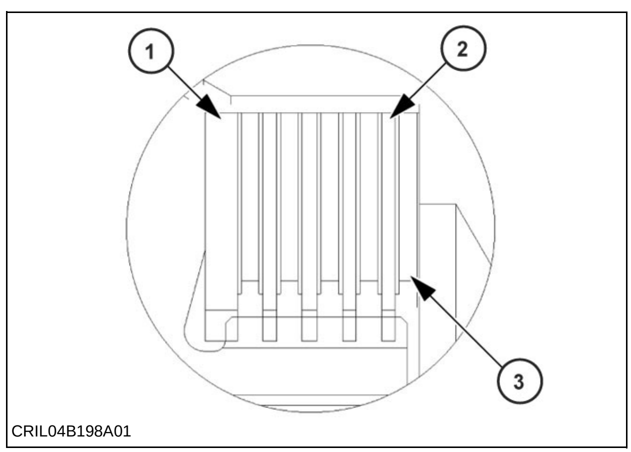
To reassemble the differential, proceed in the reverse order of disassembly. The following operations must nevertheless be performed:

If the ring gear and the drive pinion have to be replaced, adjust the crown wheel and pinion and the tooth spacing.

Replace the collapsible spacer at each disassembly.

Limited slip differential

Make sure that the steel discs (3), the friction discs (2) and the stop (1) are installed in the correct position.

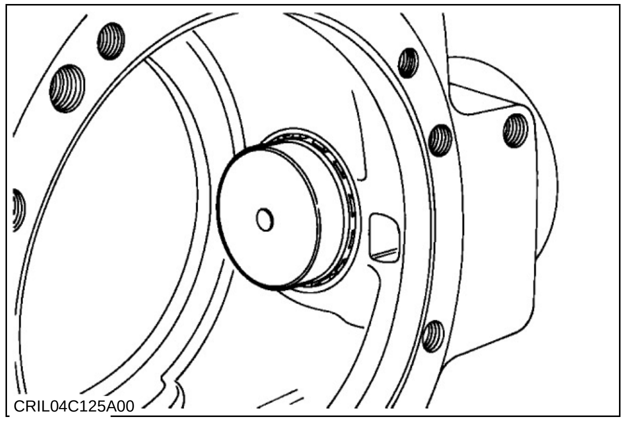


Crown and pinion adjustment

Adjustment of the crown wheel - pinion distance

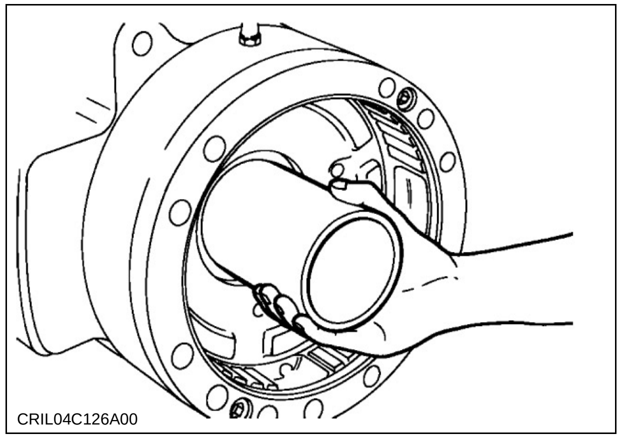
if components have to be changed, proceed as follows (example of adjustment):

Install the dummy pinion (**380000717**) in the differential housing after installing the new bearings. Tighten the nut without torquing it so that it is still possible to turn the bearings by hand.


CRIL04C125A00

Mount the brake housings equipped with seals on the differential housing.

Install the dummy differential (**380000717**) in the differential housing.


CRIL04C126A00

Measure dimension (**A**) using a depth gauge and note the value.

The dimension must be known (**X**) in order to calculate the thickness of the pinion shims.

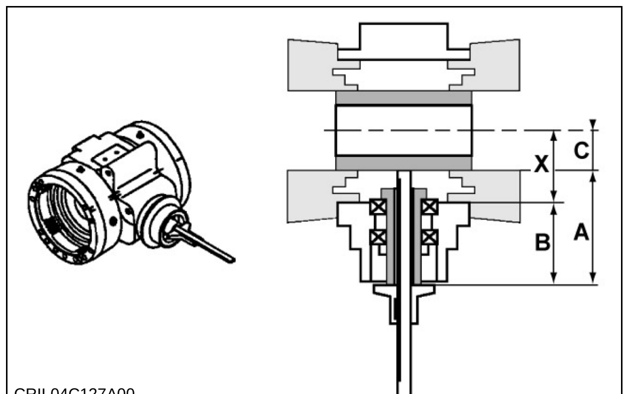
Calculation example

X = (A + C) - B

B = 100 mm

C = 45 mm

Dimension **A** = 164.9 mm
X = (164.9 + 45) - 100
X = 109.9 mm



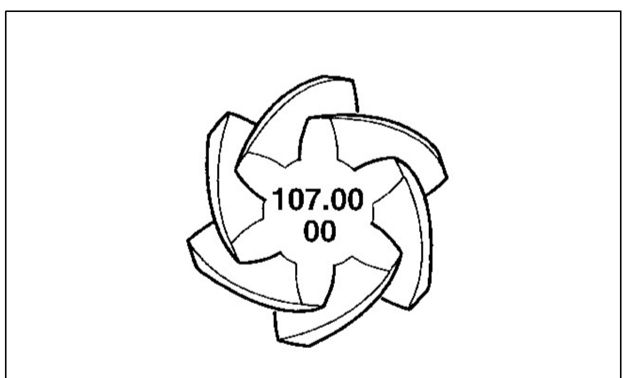
CRIL04C127A00

Calculating of adjusting shim thickness
Dimension of the pinion
= 107 mm
Correction value
= 00
(see end of pinion).

Calculation of adjusting shim thickness

Shim thickness
= 109.9 - 107 = 2.9 mm

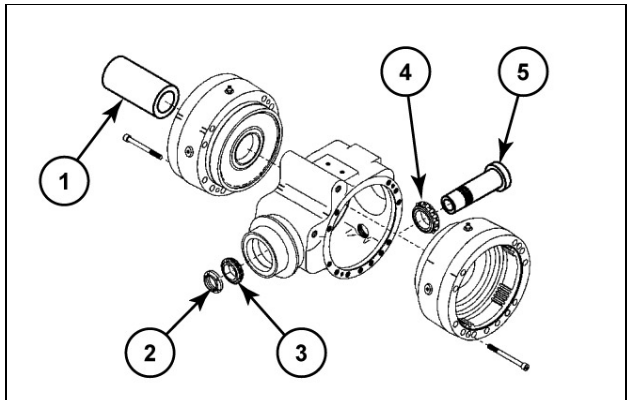
Shims available from 2.5 mm to 3.4 mm by 0.1 mm.



CRIL04A146A00

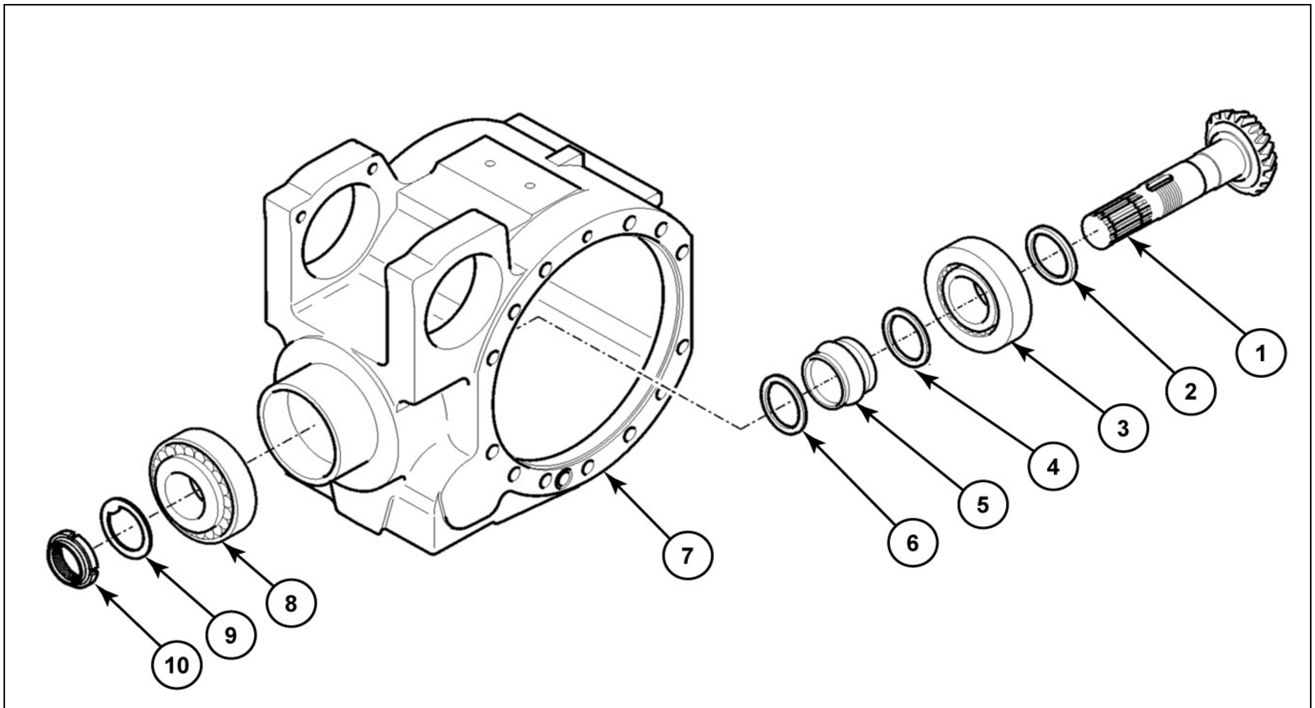
Disassemble the dummy differential (1), nut (2), washer (3), dummy drive pinion (5) and extract the bearing (4).

Remove the brake housings.



CRIL04C075A01

Reassembly of the drive pinion



CRIL04C073F01

1. Drive pinion
2. Adjusting shim
3. Bearing
4. Washer
5. Collapsible spacer
6. Washer
7. Differential housing
8. Bearing
9. Washer
10. Nut

Install the outer cage of bearing (3).

Install pinion (1) equipped with adjusting shim (2) and the inner cage of bearing (3) in the housing (7).

Fit washer (4), the new collapsible spacer (5) and washer (6).

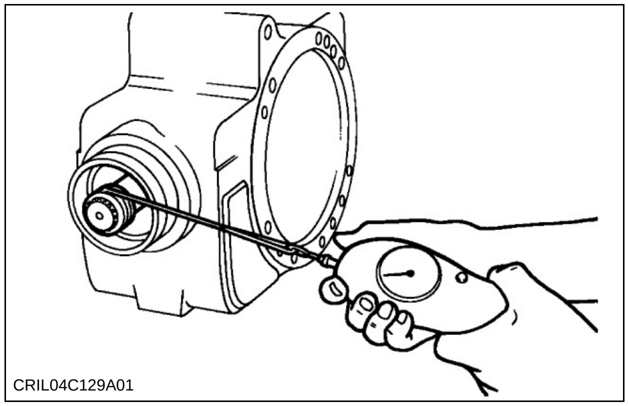
Install the inner cage of bearing (8), washer (10) and nut (9).

Drive pinion preload adjustment

NOTE: *This adjustment cannot be done until a new collapsible shim has been installed.*

Wind a rope around the drive pinion, install a torque meter, then pull the rope to rotate the pinion shaft and record the rotation torque value, tighten the drive pinion nut to obtain a torque P = **92** to **137** Nm.

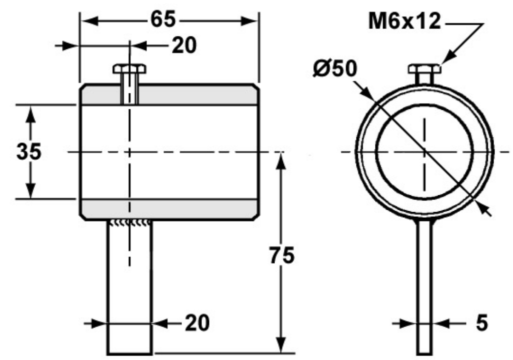
Use wrench P/N **380000021** to tighten the drive pinion nut, holding the shaft stationary with wrench P/N **380000020**.



CRIL04C129A01

Adjustment of ring gear and drive pinion backlash

TOOL TO BE MANUFACTURED LOCALLY (see drawing)



CRIL04C130A01

Position the differential equipped with the bearing inner cages in the housing and fit the brake housings with the bearing outer cages, install the two adjusting nuts and mount the tool on the drive pinion shaft.

Measurement of backlash, new parts **0.17** - **0.22 mm**.

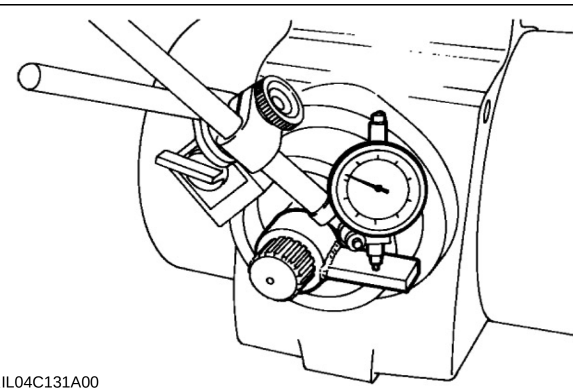
If reusing the drive pinion and gear ring, apply the value measured at disassembly.

Measure the backlash by placing the magnetic base of the dial gauge on the housing and its sensor on the flat surface of the tool. The tip of the sensor must be positioned about **39 mm** from the central axis of the drive pinion.

Tighten the adjusting bush (3) (with wrench P/N **380000406**) on the ring gear side to eliminate the play of the differential bearings.

Adjust the backlash of the ring gear and drive pinion by turning the adjusting bushes (3) by the same amount in the opposite direction.

Take measurements at 90° intervals; if the measurements are not identical, adjust the backlash to the position that give the smallest dimension.



CRIL04C131A00

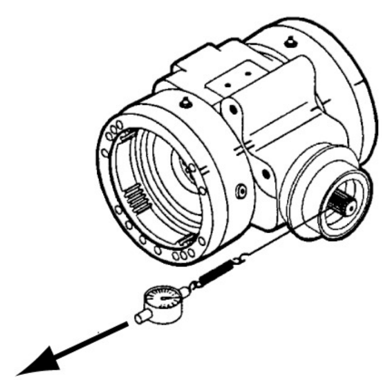
Preloading of the differential bearings

To determine the preload of the bearings of the differential (1), compare the rotation torque required to turn the drive pinion slowly at the same time as the differential with the rotation torque of the drive pinion bearings only (noted previously).

Gradually tighten bush (3) on the side opposite the ring gear until the rotation torque lies between the indicated values

Example:

Wind a rope around the drive pinion, install a torque meter, then pull the rope to rotate the pinion shaft and record the rotation torque value.



CRIL04C132A01

A. Drive pinion alone:

P = (**92** to **137 Nm**)

B. Drive pinion and differential:

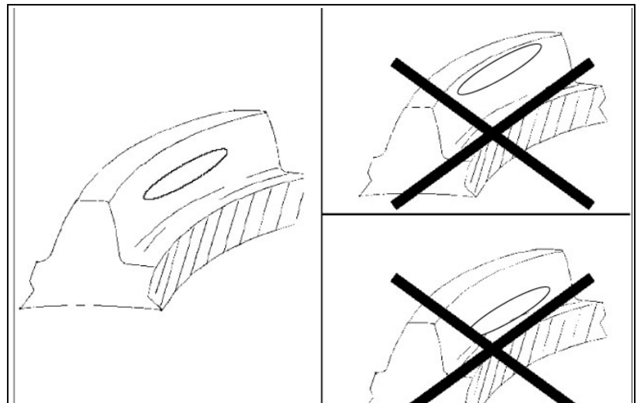
(P + **43 Nm** to P + **64 Nm**)

(= **135 to 201 Nm**)

When the required torque is obtained

Coat the screws with Loctite 270 and install the adjusting bush locking lugs.

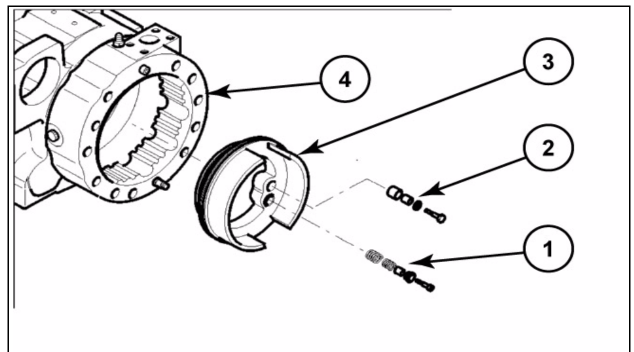
Coat the teeth of the ring gear with red hematite, then turn the drive pinion shaft while braking the ring gear to clearly mark the contact surfaces. The mark must be centred on the side a mid-height of the teeth.



CRIL04B158A00

Reassembly of the brake

Equip the brake piston (3) with new seals and install it in the housing (4), install the guiding assembly (2) and the return assembly (1).



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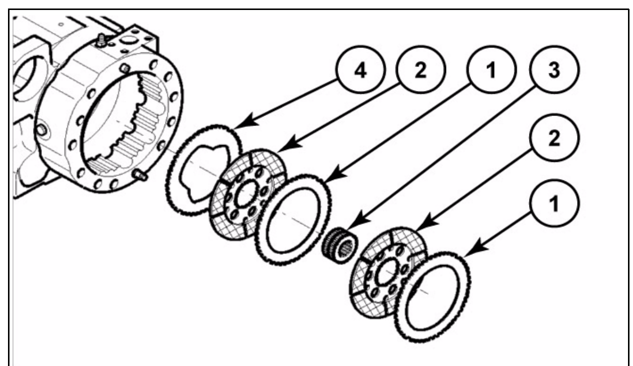
Install the stop plate (4), the sintered discs (2), the steel discs (1), then fit the coupling sleeve (3).



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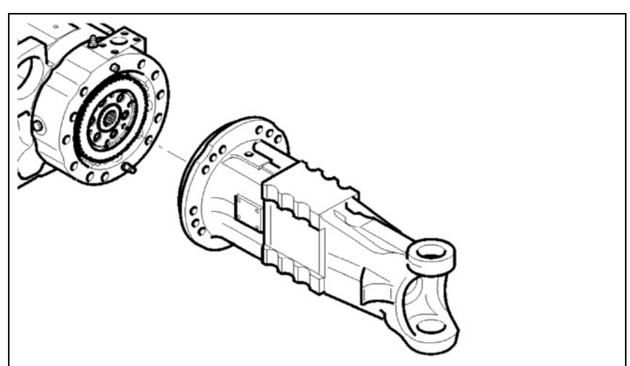
Fit a new seal on the half-axle housing.
Position the half-axle housing, install the screws and tighten them to the required torque.



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NOTES

SECTION 33 – BRAKE SYSTEMS

Chapter 1 – Brakes for 2 and 4 Wheel Drive Only

CONTENT

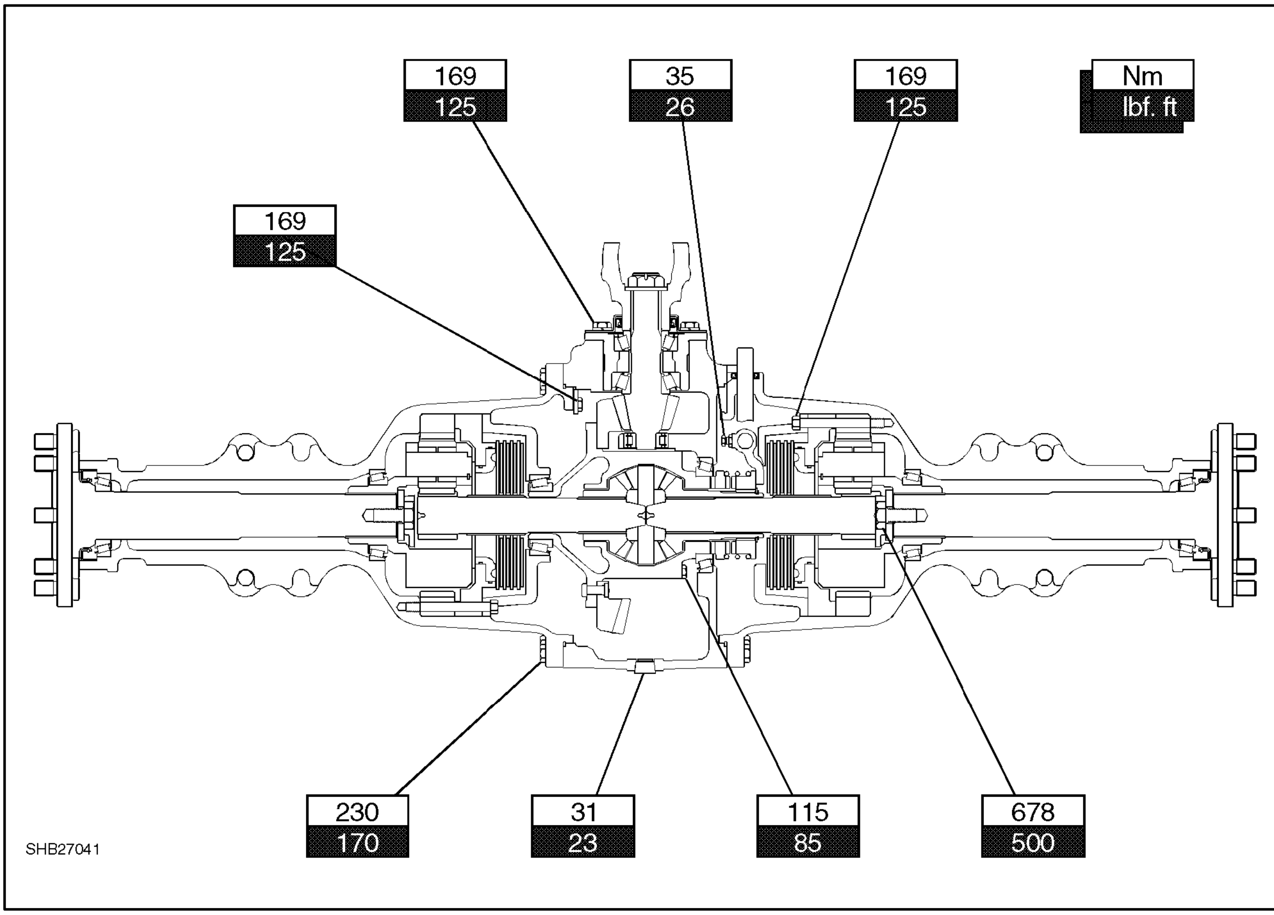
SPECIFICATIONS

Brake Operation	Hydraulic
Brakes	Wet Disc, Piston Operated
Brake Oil	Ambra LHM NH 610 A
Brake Discs (per side)	4
Brake Disc Total Friction Area	1440 cm^2

CLEARANCES AND ADJUSTMENTS

Drive pinion preload	10 – 40 lb in
Axle shaft bearing preload	1.72mm (0.067 in)
Differential bearing preload	0.09 – 0.11 mm (0.0035 – 0.044in)

TORQUE VALUES

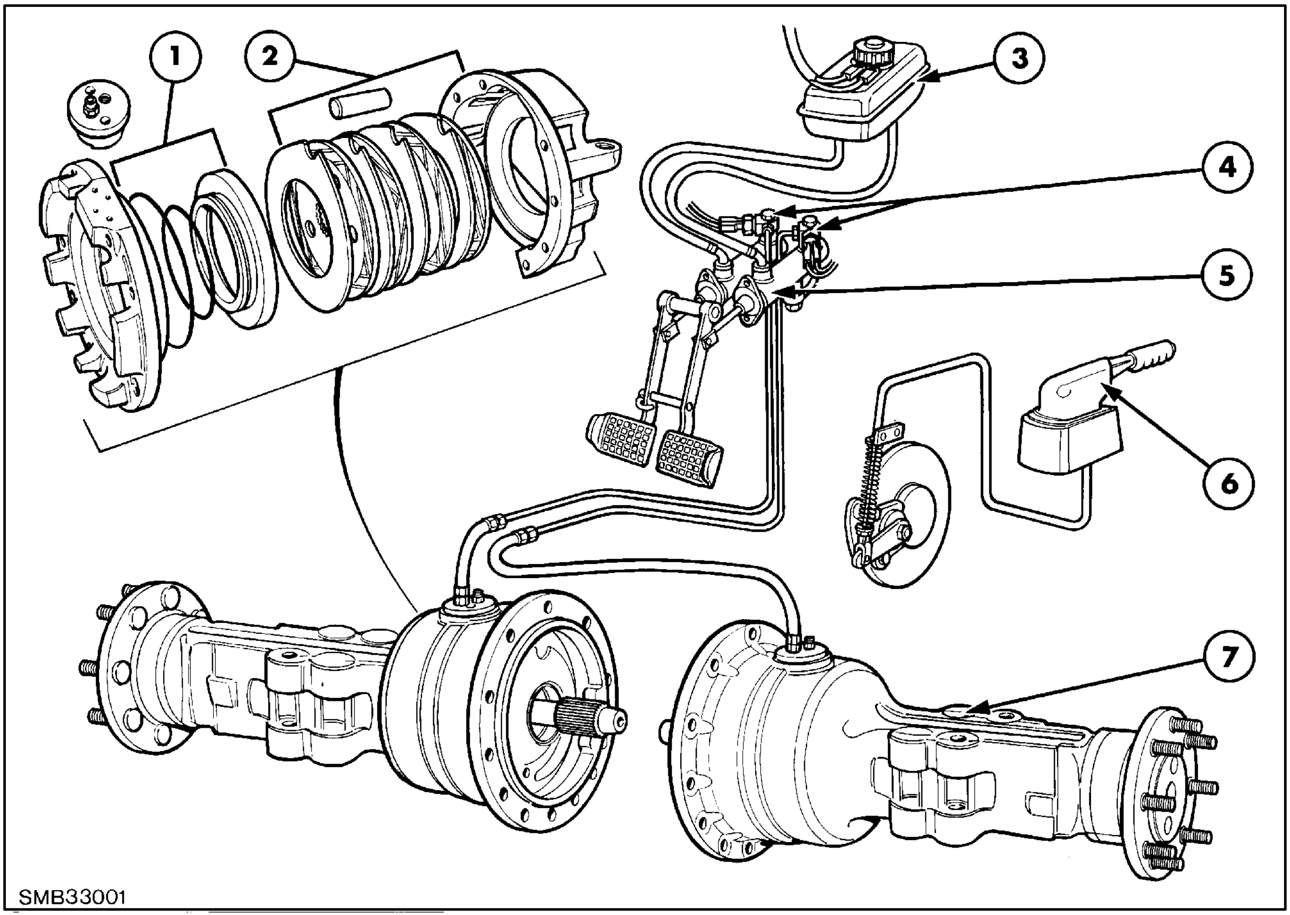


1

TOOL	APPLICATION
Splitting Tool No MS 2700 C	Axle removal
Half axle lifting bracket	Half shaft removal
Sliding Hammer	Axle bearing cup removal
Ratchet Tool P61	Axle housing bearing/seal
Puller Tool No 938	Axle housing bearing/seal
Pulling Attachment Tool No 952	Axle housing bearing/seal

SEALANTS

Code	Number	Name
82995768	Sealer	Anaerobic Low strength
82995776	Sealer	Silicone
82995774	Sealer	Polyester Urethane
82995773	Sealer	Anaerobic



2

Braking System

1. Brake Piston Assembly
2. Brake Discs
3. Brake Reservoir
4. Brake Pressure Switch
5. Master Cylinders
6. Hand Brake
7. Trumpet Housing

Description and Operation

The machines have two braking systems, a hand operated brake, braking the drive on the rear of the transmission, and hydraulically operated inboard wet disc brakes in the rear axle.

The rear axle brakes are hydraulically operated by two pistons thus improved performance and low pedal effort.

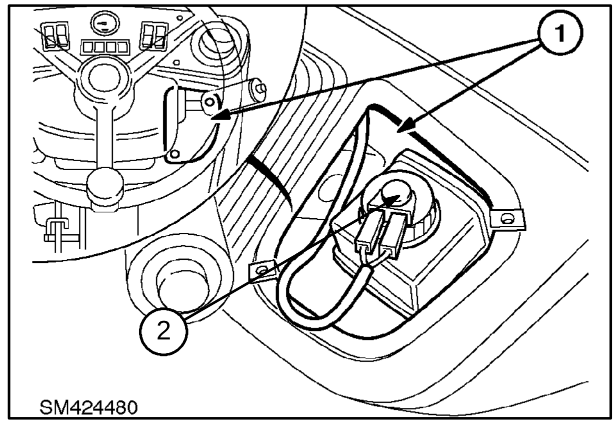
Four friction discs are fitted each side giving total brake disc area of $71992mm^2$ / side.

Brake Reservoir

1. Brake Reservoir
2. Low Level Test Switch

NOTE: *Depressing the low level switch test button mounted in the middle of the brake filler reservoir cap, the warning light circuit can be tested. The light that is illuminated is the handbrake warning light mounted on the right hand instument console, ensure handbrake is in the 'off ' position.*

Brake Master Cylinders (1) in situ are accessible from the engine compartment.



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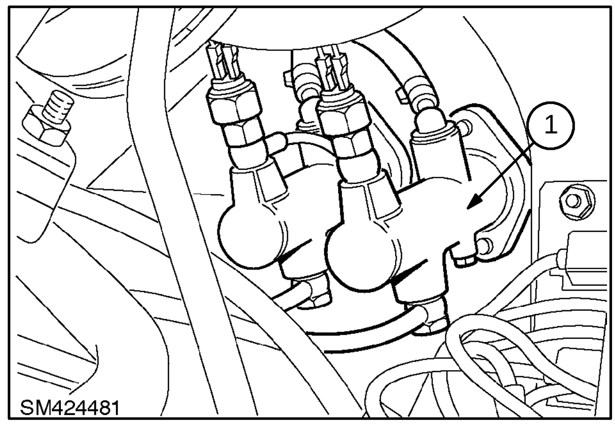
The brake cylinders are linked by a balance pipe (1) situated below the cylinders to maintain equal oil pressure between the two cylinders



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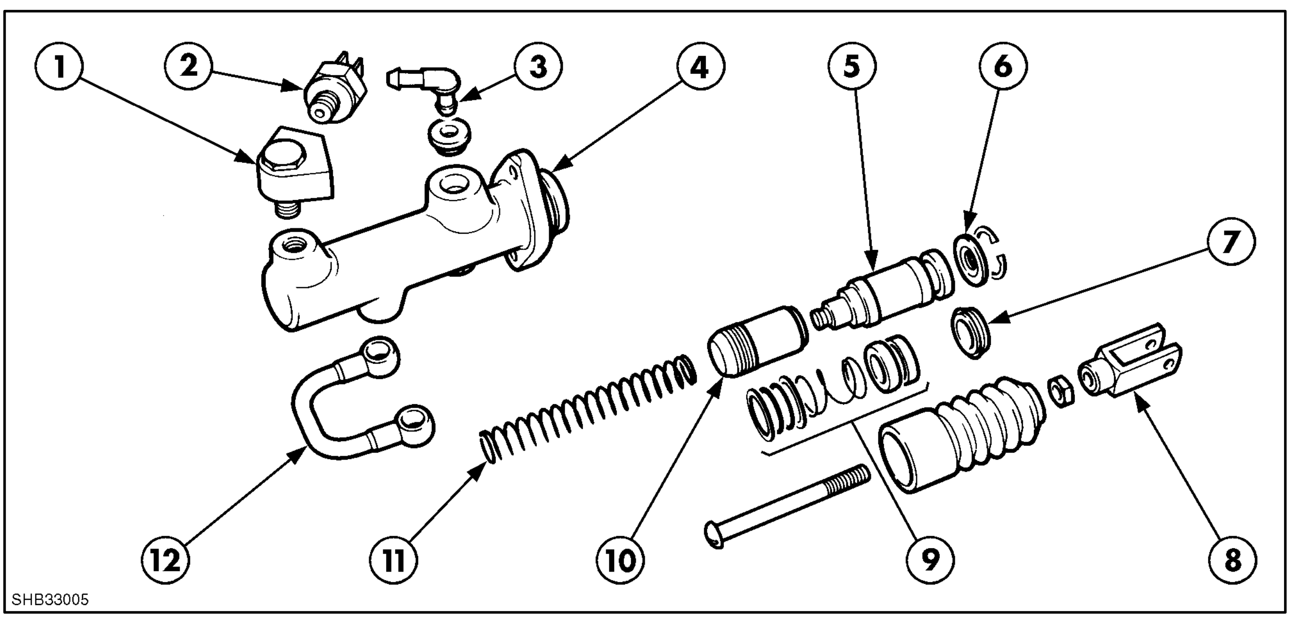

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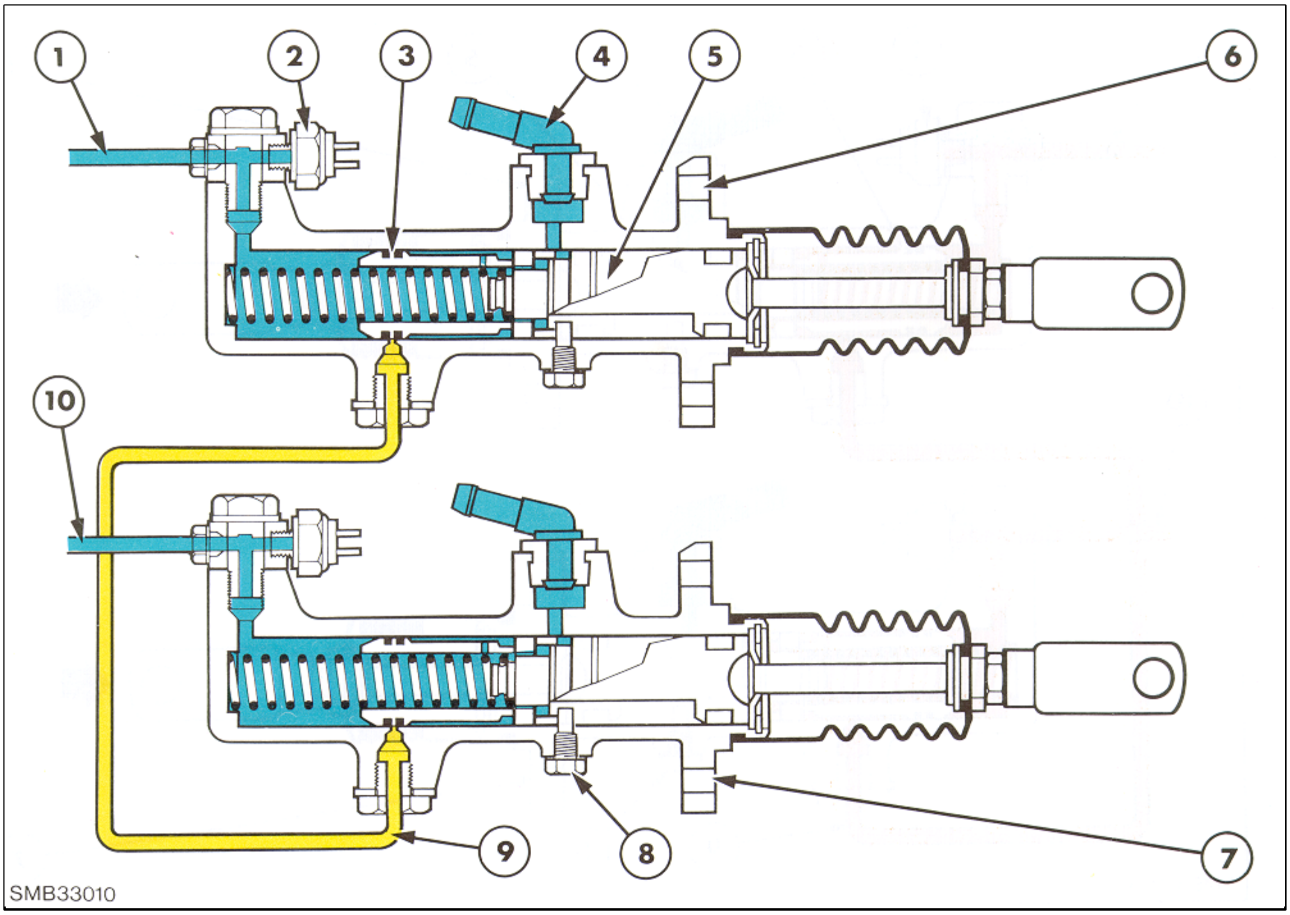
Master Brake Cylinder Exploded View

1. Fitting
2. Pressure Switch
3. Reservoir Adapter
4. Body
5. Main Spool
6. End Cap
7. Seal
8. Clevis
9. Seals
10. Second Spool
11. Spring
12. Balance Pipe



6

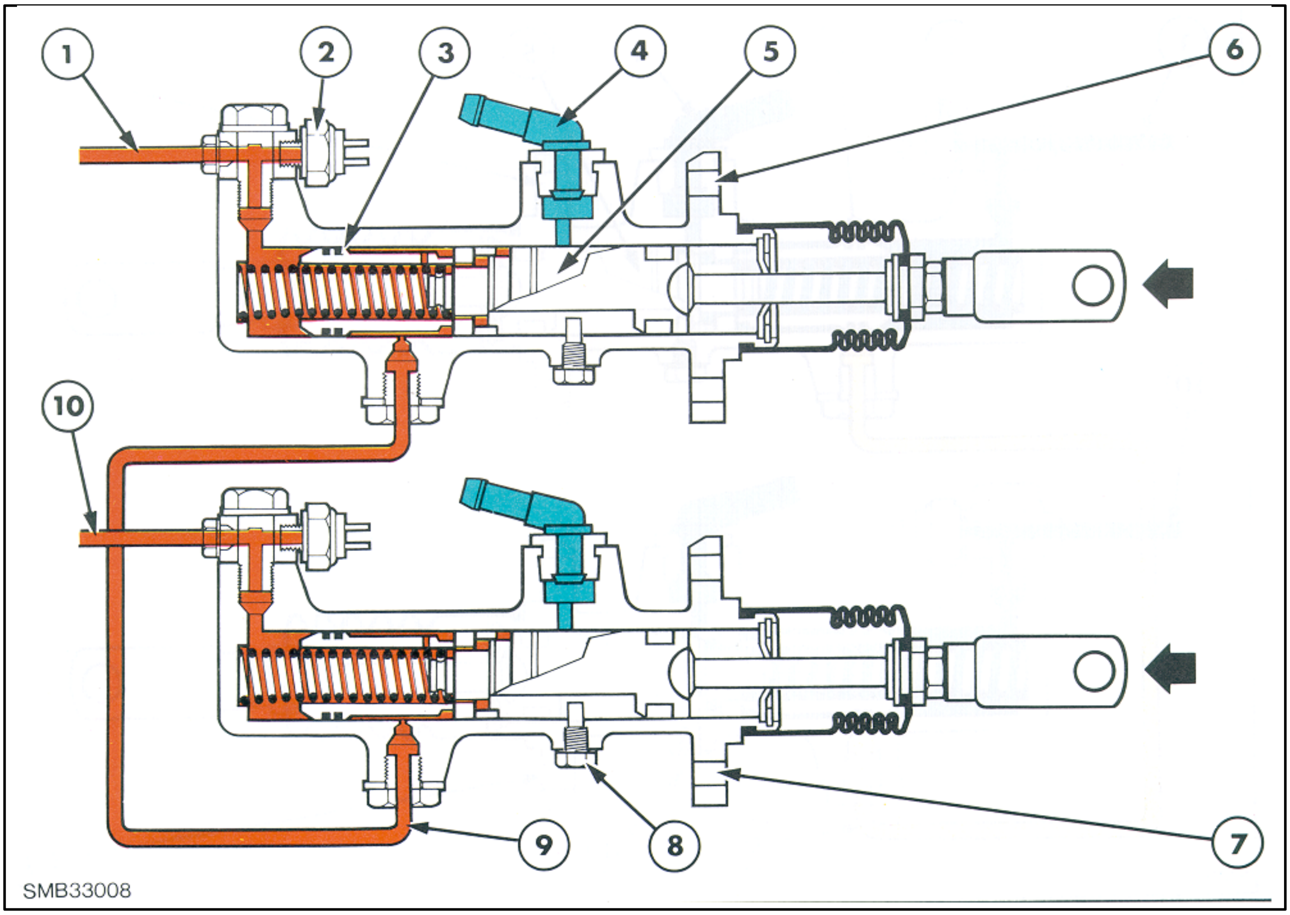
Master Cylinder With Brakes Released

Trapped Oil

Reservoir Oil (no pressure)

1. Oil To Brake Piston (Right Hand Side)
2. Pressure Switch
3. Second Spool
4. Reservoir Inlet
5. Main Spool
6. Master Cylinder Body
7. Master Cylinder Body
8. Main Spool Stop
9. Balancing Tube
10. Oil to Brake Piston (Left Hand Side)

With the brakes released the brake lines are open to the reservoir to allow the brakes to release. The master cylinders are also open to reservoir through the centre of the valve.



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Master Cylinder With Brake Pedals Depressed

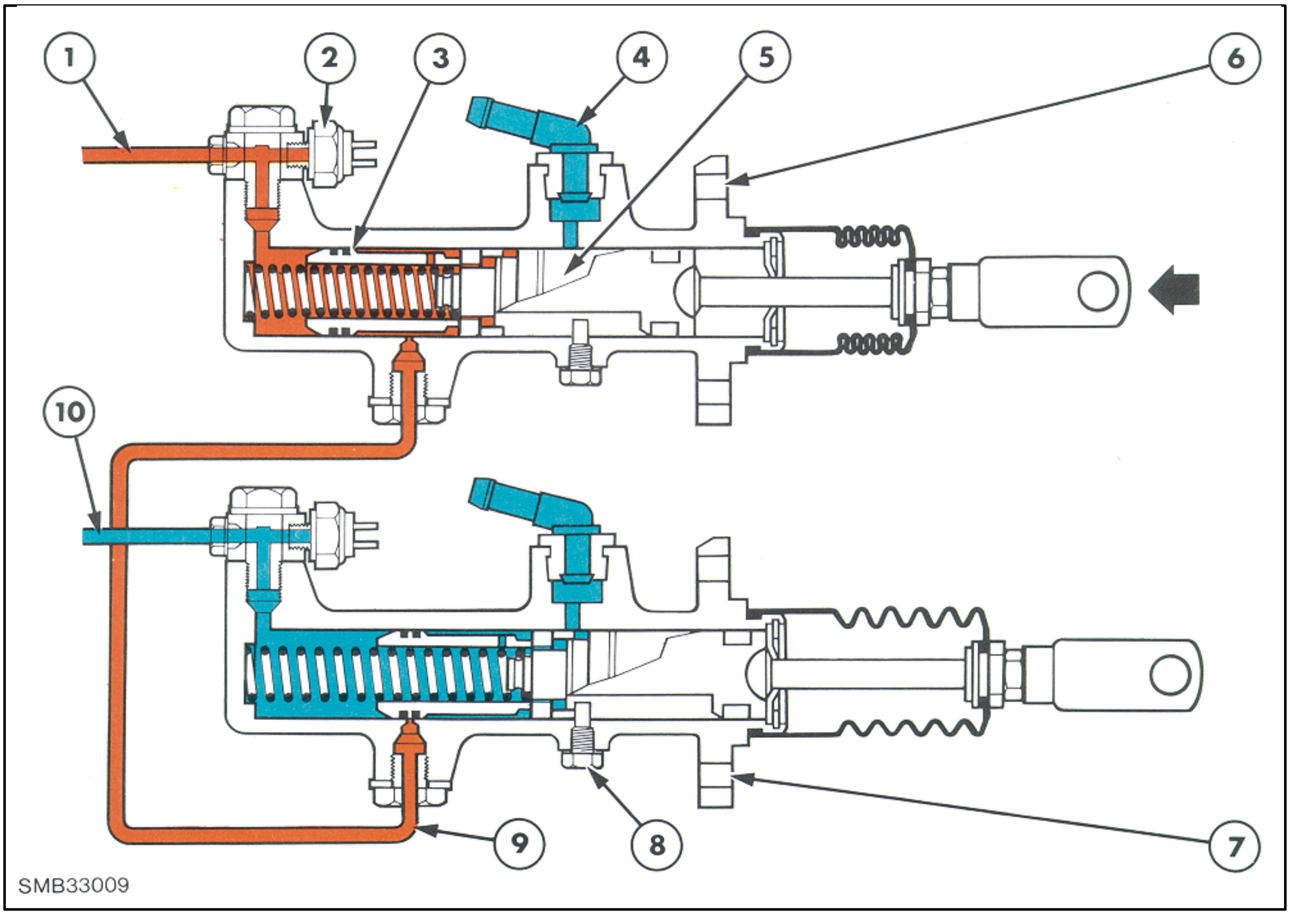
Pressurised Brake Fluid

Reservoir Oil (no pressure)

1. Oil To Brake Piston (Right Hand Side)
2. Pressure Switch
3. Second Spool
4. Reservoir Inlet
5. Main Spool
6. Master Cylinder Body
7. Master Cylinder Body
8. Main Spool Stop
9. Balancing Tube
10. Oil to Brake Piston (Left Hand Side)

As the brake pedals are depressed initial movement of the cylinder plunger closes the centre port to isolate the reservoir.

Further plunger movement creates brake fluid pressure to apply the brakes. The equal pressure ports are both open as the two seals on both master cylinders have exposed the two ports, therefore allowing equal pressure in both master cylinders.



8

Master Cylinder With One Brake Pedal Depressed

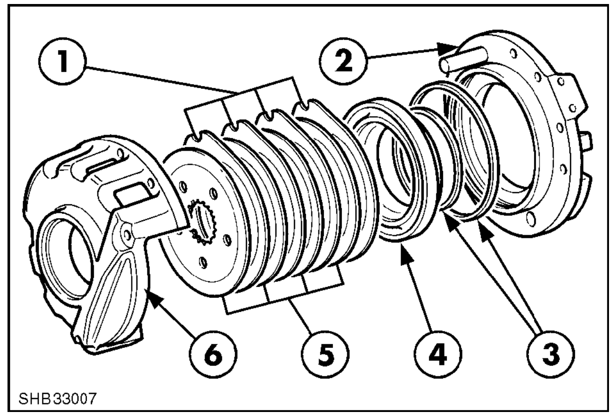
Pressurised Brake Fluid

Reservoir Oil (no pressure)

1. Oil To Brake Piston (Right Hand Side)
2. Pressure Switch
3. Second Spool
4. Reservoir Inlet
5. Main Spool
6. Master Cylinder Body
7. Master Cylinder Body
8. Main Spool Stop
9. Balancing Tube
10. Oil to Brake Piston (Left Hand Side)

When using one brake to assist turning, the brake master cylinder being applied operates only one brake. This is achieved by the equal pressure port being blocked by the two seals on the master cylinder not being operated.

Brake Discs and Piston Layout
1. Steel Plates
2. Outer Brake Housing
3. Seals
4. Brake Piston
5. Friction Plates
6. Outer Brake Housing



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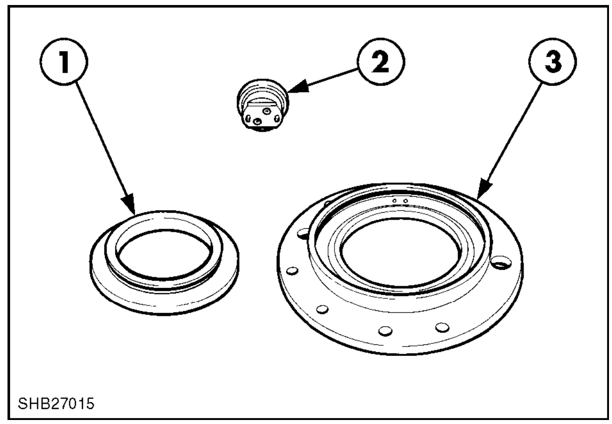
Brake Piston and Seals
1. Brake Piston
2. Brake Pipe fitting
3. Outer Brake Housing



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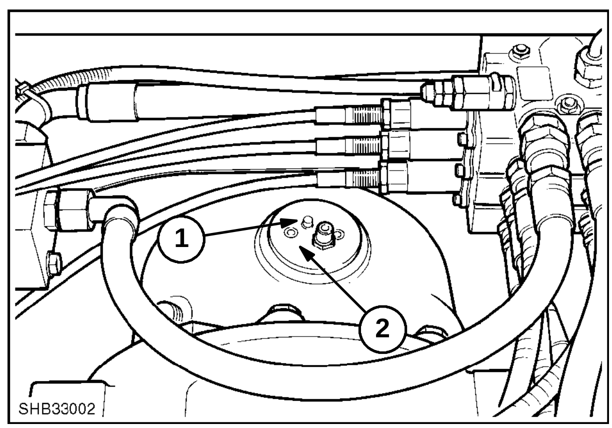
The brakes hydraulically operated are supplied oil from the brake pedal reservoir and into the axle by tubes into each half axle (1) through the mounted brake pipe fitting (2) which is sealed to the piston by two ‘O’ rings.



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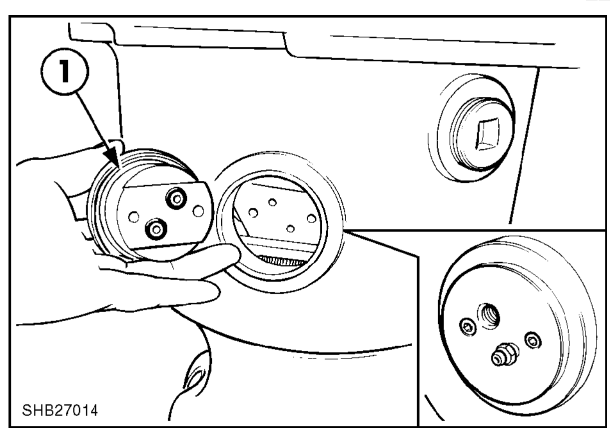
When the brake pipe fitting (1) is removed ensure the ‘O’ rings (2) are replaced with new



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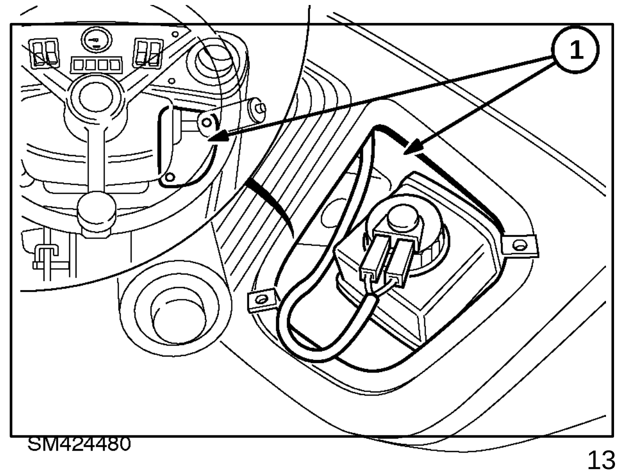
BRAKE BLEEDING PROCEDURE

1. Ensure reservoir is full (1)



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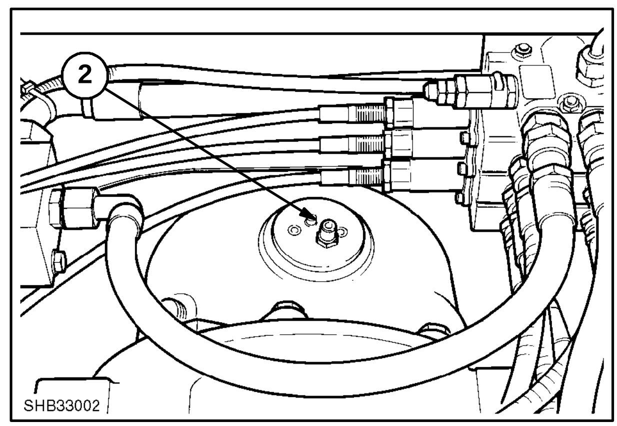
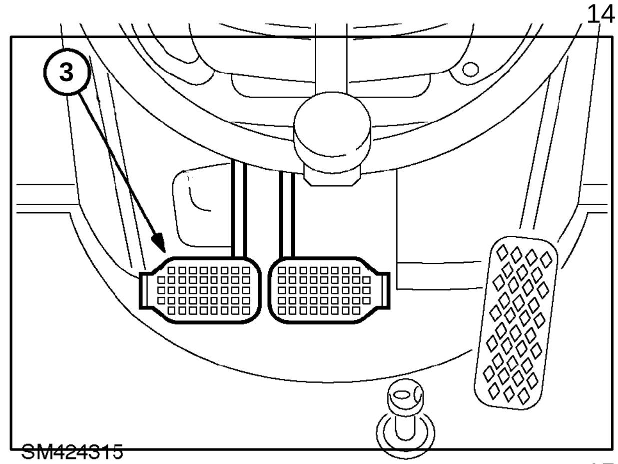
2. Open left hand brake bleed valve (2)



14

3. Pump both brakes to purge the system (3)
4. Hold pedals down
5. Lock bleed valve (2)
6. Release pedals
7. Repeat steps 3–7
8. Repeat steps 4–7 on right hand brake
9. Test brakes repeat if necessary



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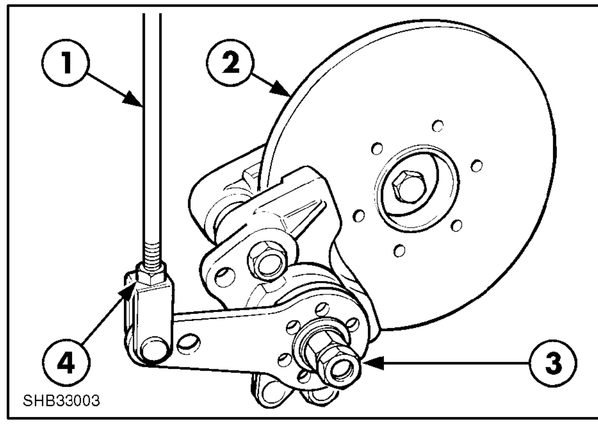
NOTE: When the brake pedals are operated, both together, the electrical supply to the front wheel drive switch is cut allowing the clutch to denergise thus engaging the front wheel drive, providing four wheel braking.

TRANSMISSION HAND BRAKE

The transmission hand brake is fitted to all models and incorporates two free floating friction pads. When operated the eccentric cam forces the friction pads against the disc, effecting a braking action on the output shaft from the transmission, locking the drive shaft to the rear and front axle.



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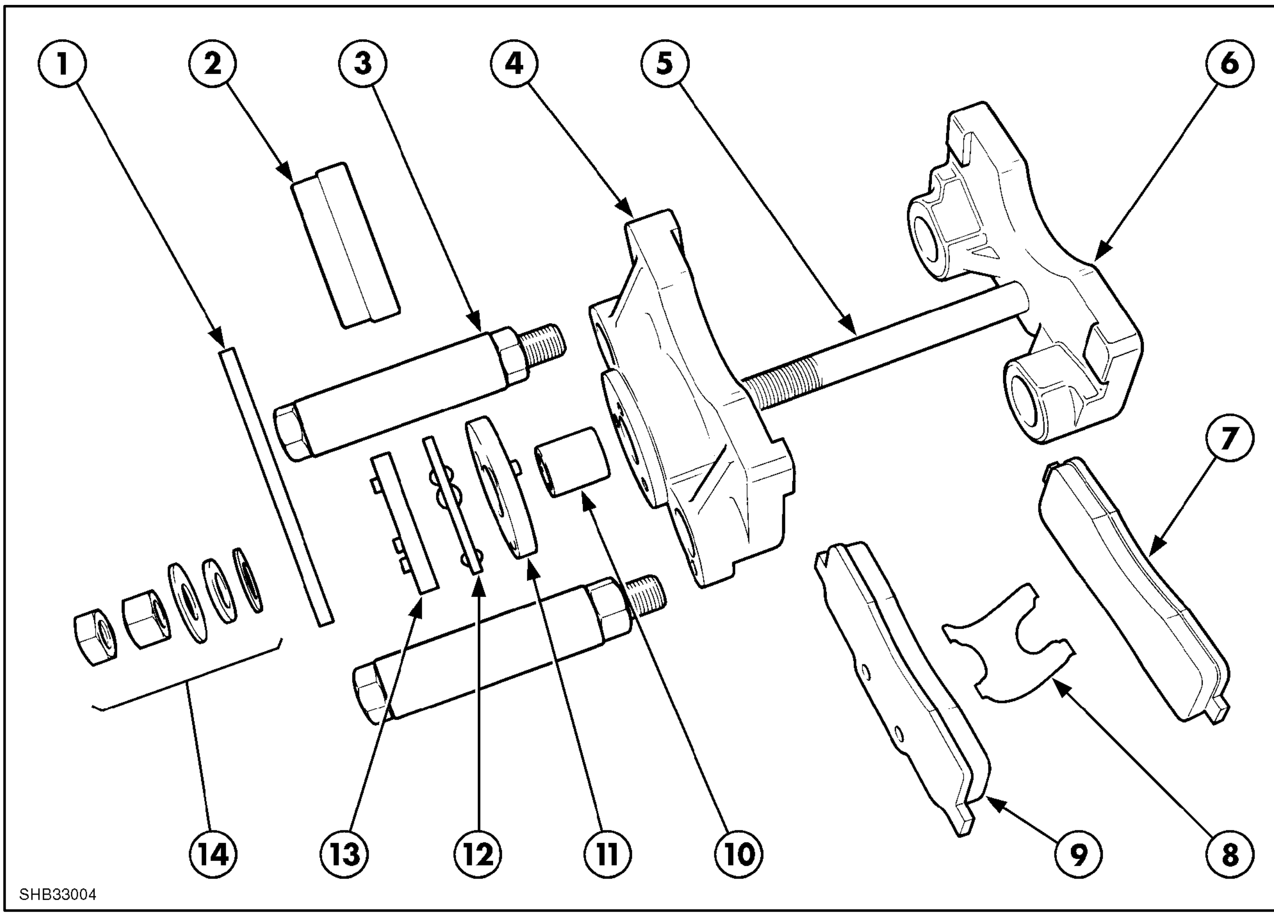


17

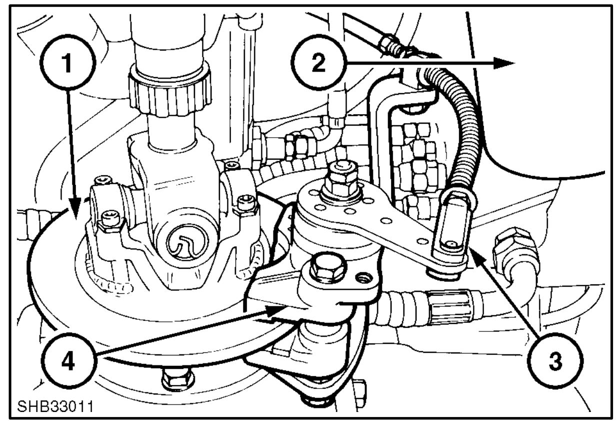
Component Layout

1. Lever
2. Cover
3. Fixing Bolts
4. Outer Caliper
5. Bolt
6. Inner Caliper
7. Inner Friction Pad
8. Fixing Spring
9. Outer Friction Pad
10. Spacer
11. Actuator Plate
12. Balls and Retainer Plate
13. Actuator Plate
14. Adjusting Nuts

HAND BRAKE ADJUSTMENT.

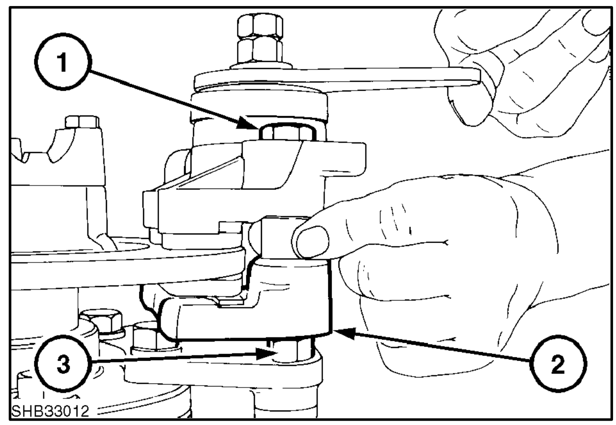
The transmission hand brake is located on the transmission out put shaft on 4x4 transmission and rear axle on the 4x2 transmission.

The 4x2 transmission hand brake is located on the rear axle brake disc splined to pinion shaft (1), hydraulic oil filter (2), hand brake cable (3), hand brake caliper (4).



18

When refitting the caliper unit (2) Insert the two bolts (1) through the caliper, it will be necessary to apply Loctite 270 to the locknuts (3). Tighten the bolts while holding the locknuts. Once the bolts are tightened down back them off by 3 bolt head flat, and then torque the locknuts to 150 Nm. Ensure that the tubes can move.



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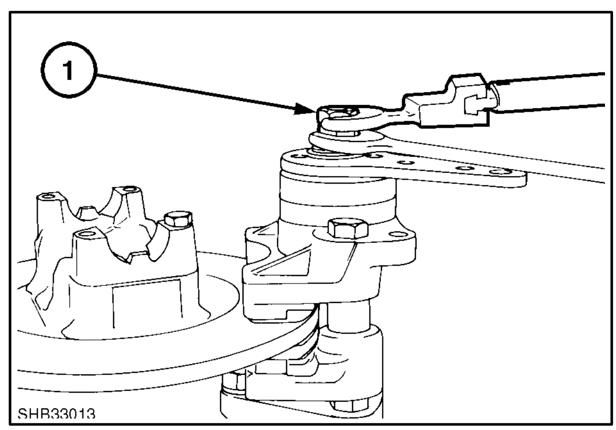
Adjust the clearance between the brake pads and disc to 0.5mm using the nut and lock nut (1).



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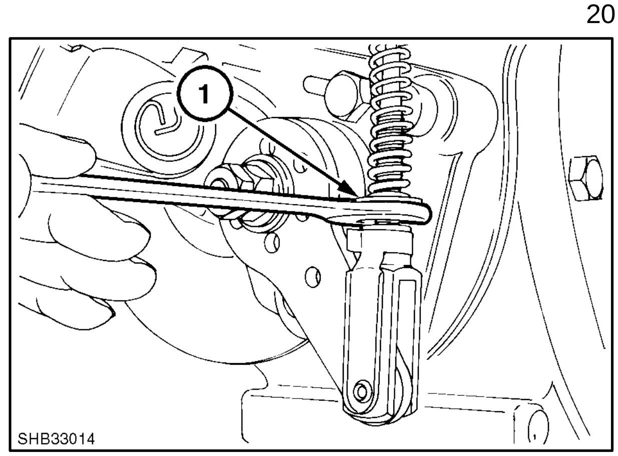
Adjust the cable clevis and lock the nut to get 4 to 5 clicks on the hand brake lever.



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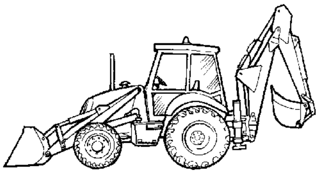

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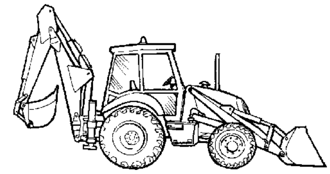


SECTION 33 – BRAKES SYSTEMS

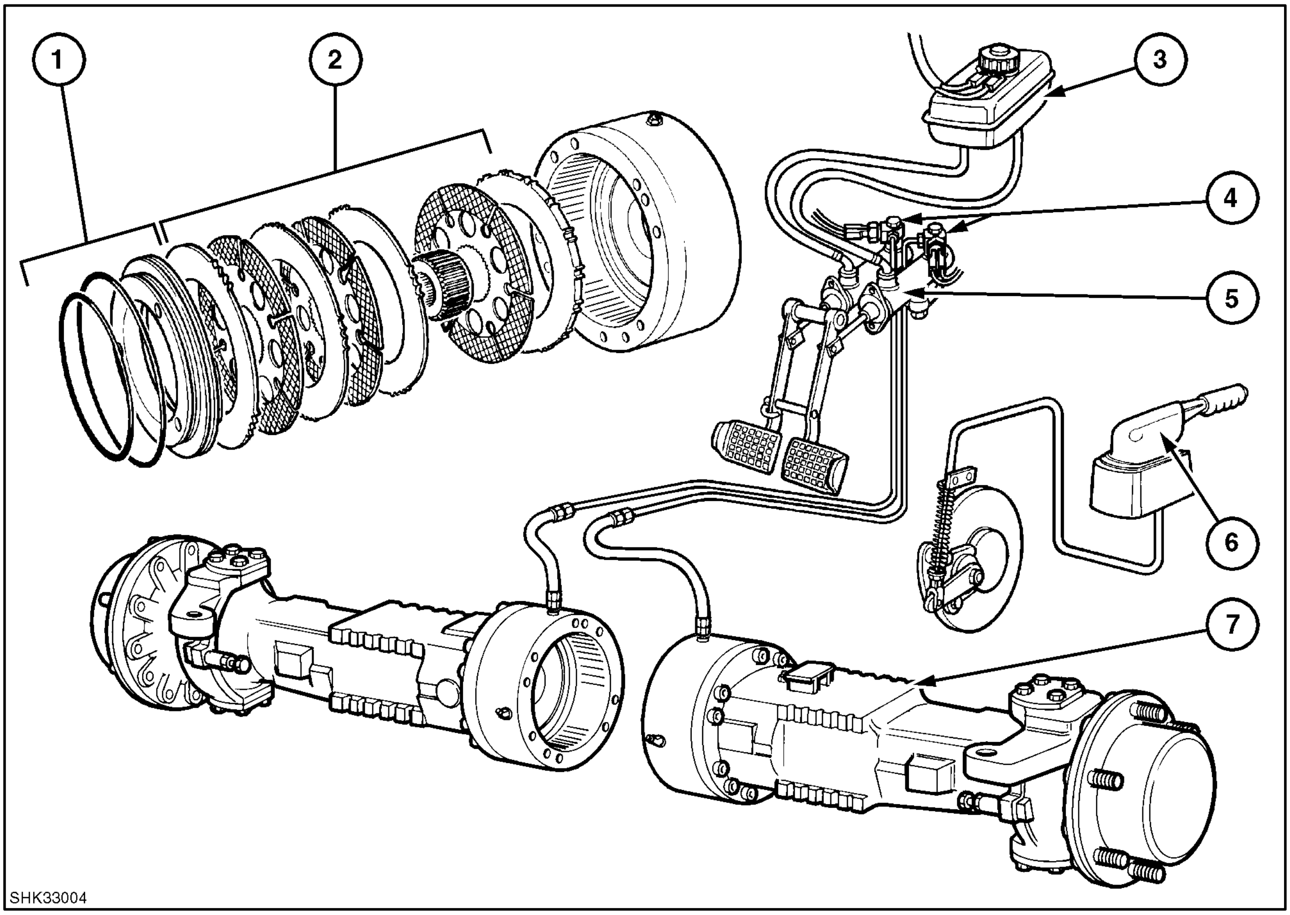
Chapter 2 – Brakes for 4 Wheel Steer Only

CONTENT

SPECIFICATIONS

Brake operation	Hydraulic
Brakes	Wet disc, piston operated
Brake oil	Ambra LHM NH 610 A
Brake discs, per side	3

DESCRIPTION AND OPERATION



1

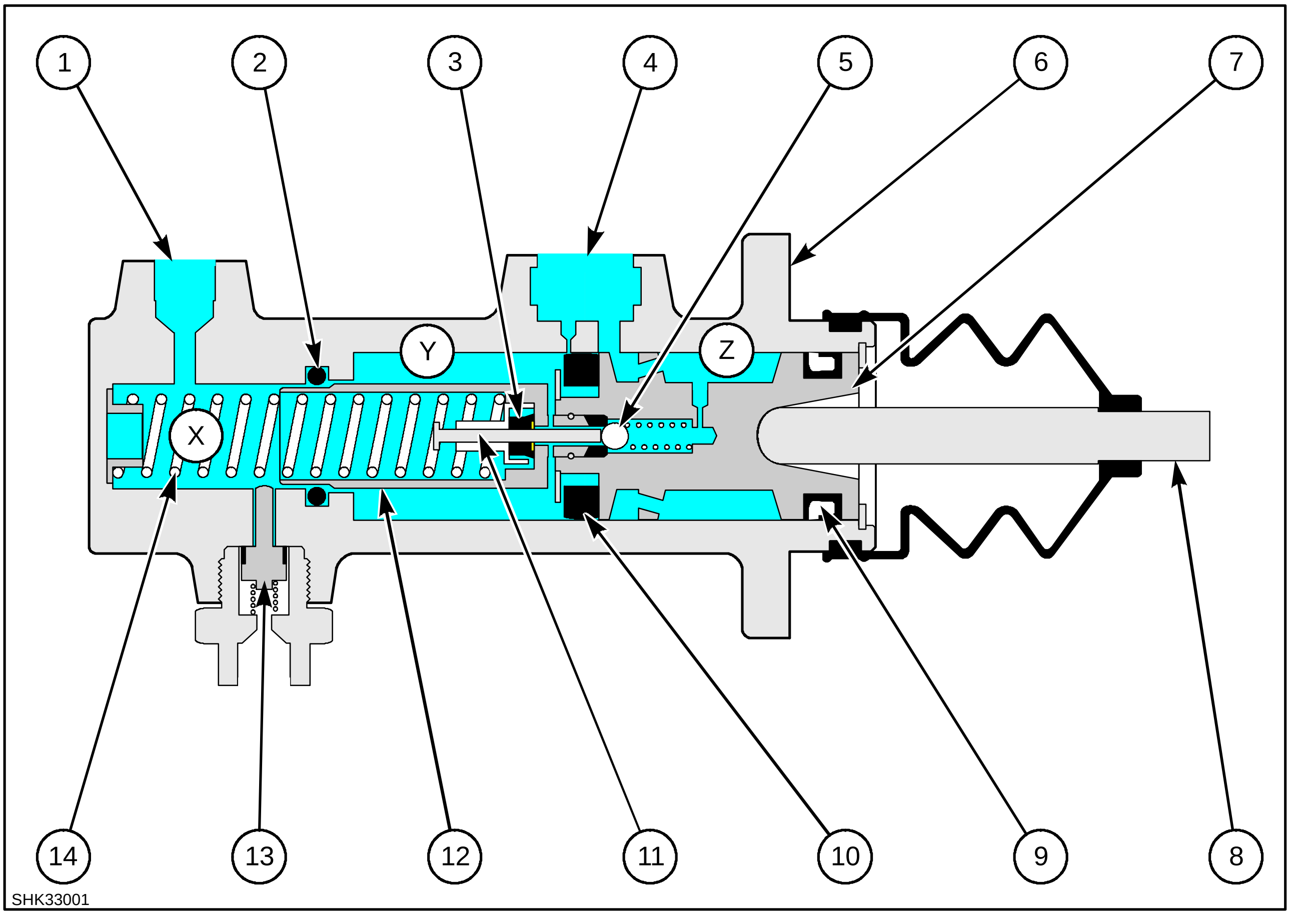
Braking System

1. Brake Piston Assembly
2. Brake Discs
3. Brake Reservoir
4. Brake Pressure Switch
5. Master Cylinder
6. Hand Brake
7. Trumpet Housing

Operation of the foot brake pressurises the brake fluid in the master cylinders which feeds the brake pistons in the axle housing. The brake pistons then compress the brake friction discs and seperator discs, which locks the axle shaft to the axle housing.

The hand brake, when pulled, locks the brake disc on the rear of the transmission.

NOTES



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Brake Cylinder in Neutral

12–80 bar Pressure

0–12 bar Pressure

Return to Reservoir

1. Pressure to Piston Port
2. 'O' Ring Seal
3. Seal
4. Reservoir Port
5. Relief Valve
6. Master Cylinder Body
7. Brake Piston
8. Actuator
9. Seal
10. Seal
11. Switch Over Pin
12. Brake Sleeve
13. One Way Valve
14. Piston Return Spring

Neutral

With the brake pedal released oil in the Y and Z gallery is free to go to the reservoir. Oil from gallery X also is free to flow to the reservoir past the 'O' ring (2) into gallery Y.

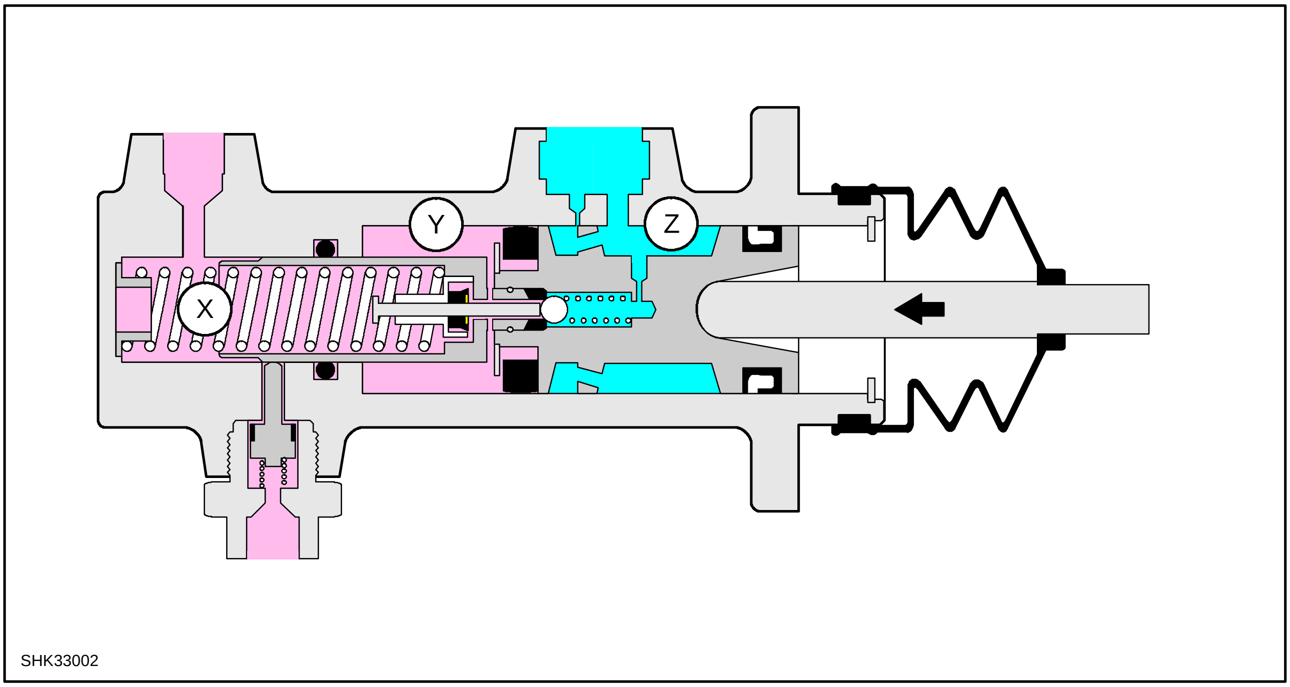
Braking (1st Phase)

Oil is compressed in galleries X and Y, the oil from gallery Y passing through the central part of the sleeve (12) and past seal (3). As the sleeve moves to the left it also opens up the one way valve (13) allowing the balancing system to operate if the other pedal is being used. Immediately the pedal is moved from the neutral position seal (10) blocks the reservoir from galleries X and Y.

Braking (2nd Phase)

When the pressure in the X gallery reaches 12 bar this pressure acts on the switch over pin (11) and pushes on the relief valve ball (5), opening gallery Y to reservoir.

During this phase the pedal pressure is acting on the smaller diameter sleeve creating maximum pressure of 80 bar.



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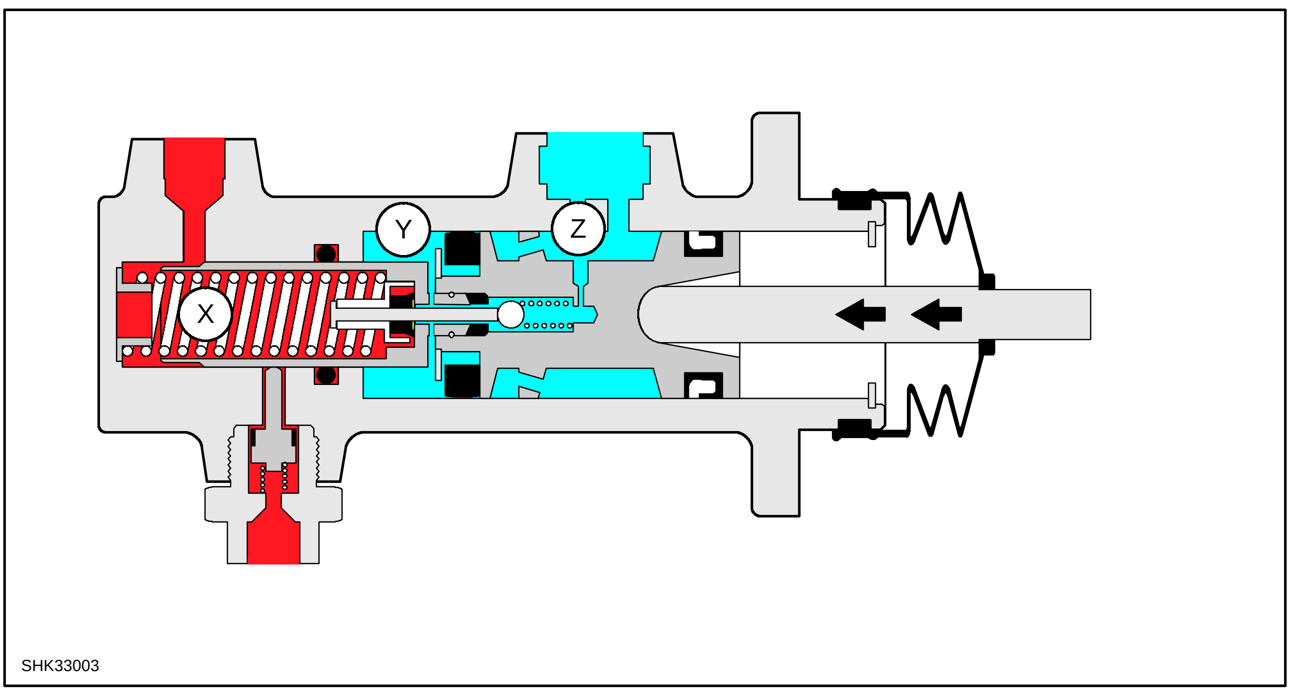
Braking (1st Phase)



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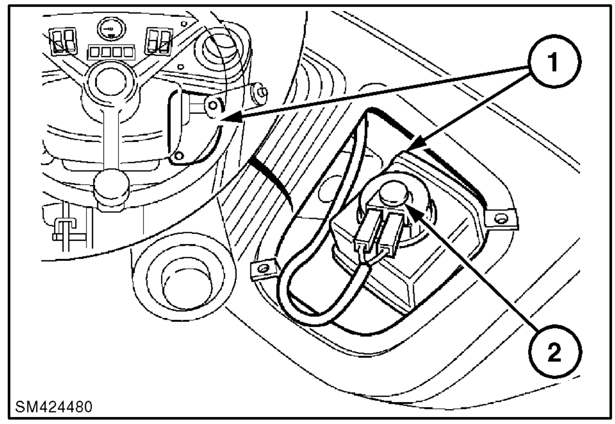
Braking (2nd Phase)

Overhaul

Brake Reservoir

1. Brake Reservoir
2. Low Level Test Switch

To test the low level switch on the reservoir cap place the handbrake in the OFF position and then press the button on the reservoir cap, the handbrake light should come on.



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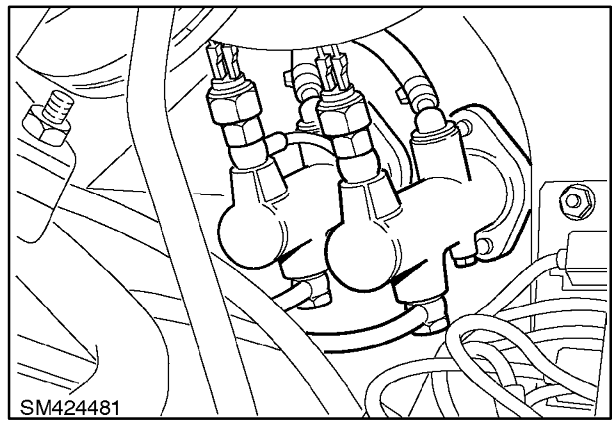
Brake master cylinders are accessible from the engine compartment.

The brake cylinders are linked by a balance pipe which supplies equal pressure to both brake pistons when both pedals are pressed.



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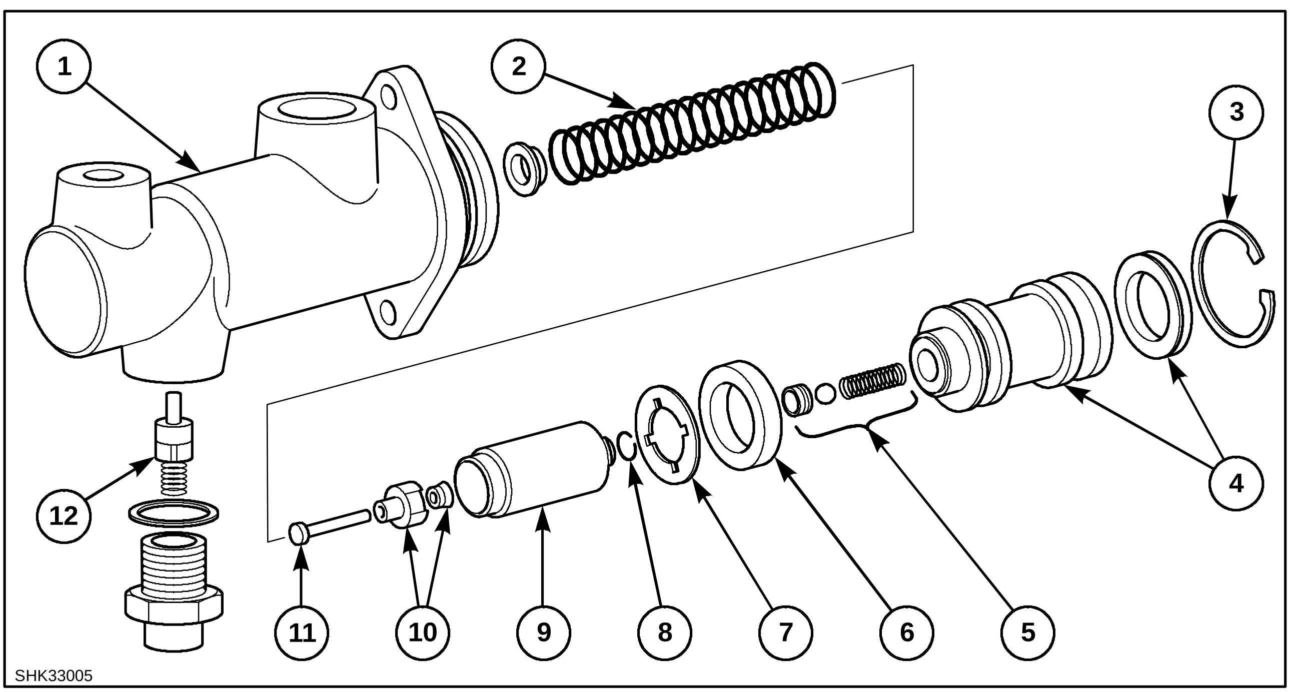
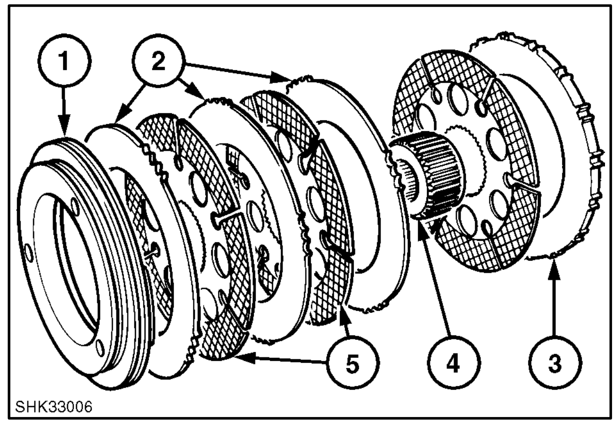


7

1. Master Cylinder Body
2. Piston Return Spring
3. Circlip
4. Piston and Lip Seal
5. Relief Valve Assembly
6. Piston Seal
7. Seal Retainer
8. Sleeve to Piston Retaining Ring
9. Sleeve
10. One Way Valve
11. Relief Valve Actuator
12. Balancer One Way Valve

Brake Disc and Piston Layout

1. Brake Piston
2. Steel Seperator Plates
3. Steel Back Plate
4. Sleeve
5. Brake Housing



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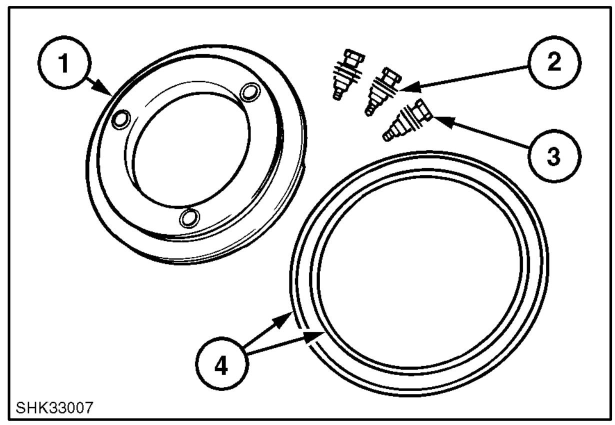
Brake Piston

1. Brake Piston
2. Return Belleville Washers
3. Piston Retaining Nuts
4. Piston Seals



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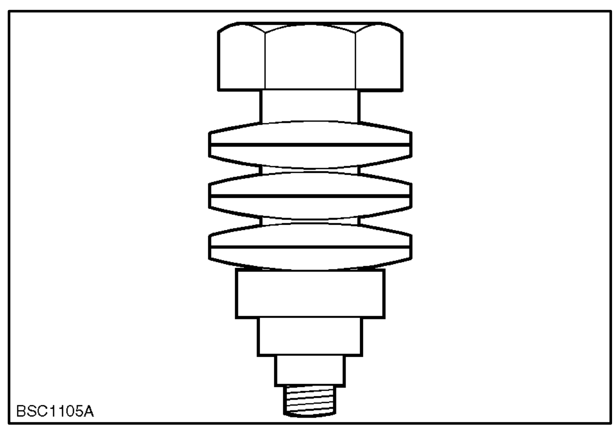
NOTE: *The belleville washers must always be fitted in pairs as shown.*



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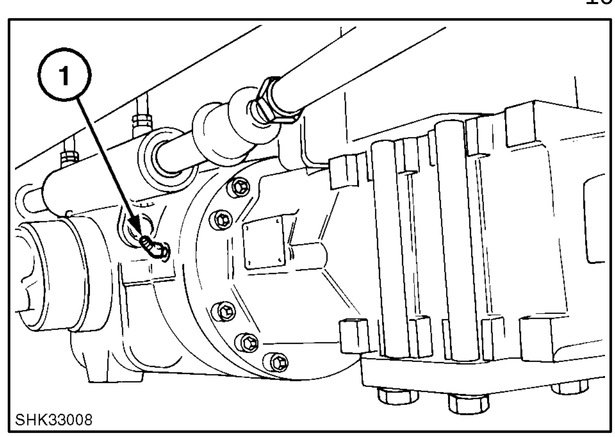
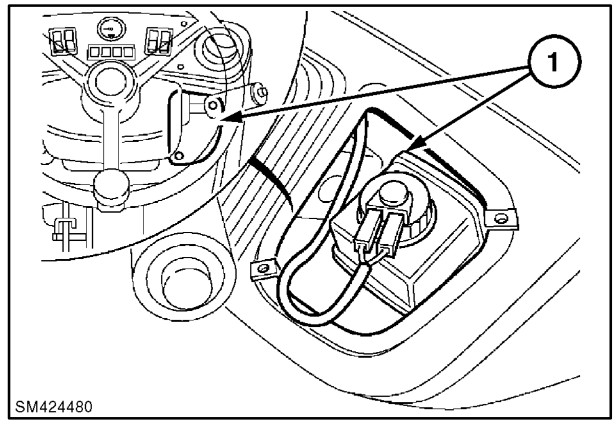
The brakes are operated by supply oil from the master cylinder which enters at fitting (1) on each side of the axle.



11

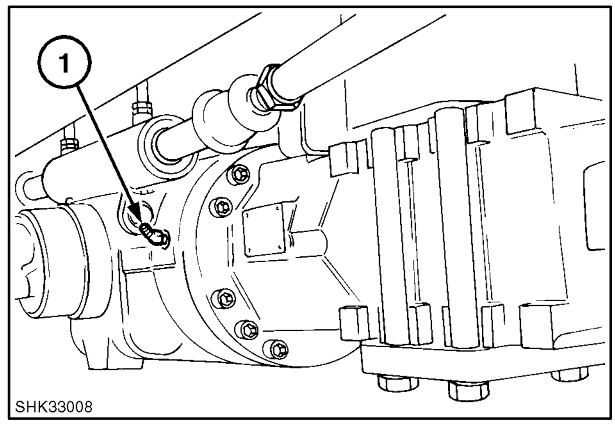
Brake Bleeding Procedure

10. Ensure the reservoir is full (1).



12

11. Open the left hand brake bleed valve (2).



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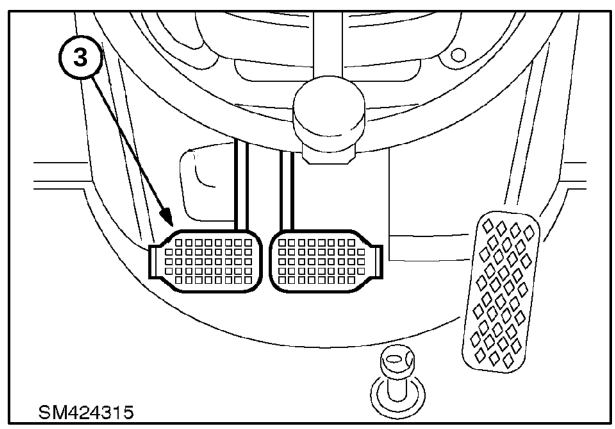
12. Pump both brakes to purge the system (3), ensuring the reservoir is kept topped up.

13. When the bubbles cease coming from the bleed screw hold both pedals down and lock the screw.



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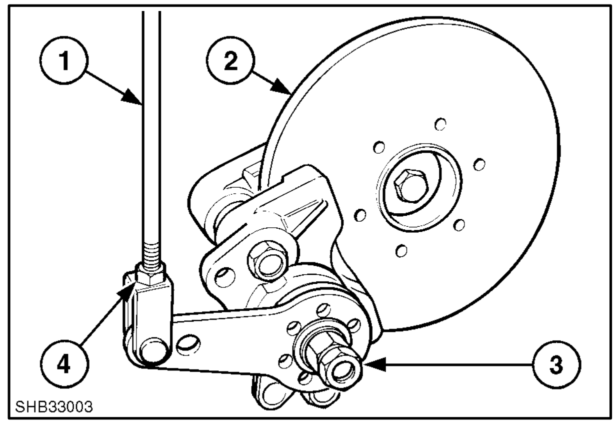
14. Release the pedals and repeat procedure items 1 to 4 for the right hand brake bleed valve.

15. Test the brakes and repeat if necessary.

TRANSMISSION HAND BRAKE

The transmission hand brake is fitted to all models and incorporates two free floating friction pads.

When operated the eccentric cam forces the friction pads against the disc, effecting a braking action on the output shaft from the transmission, locking the drive shaft to the rear and front axles.



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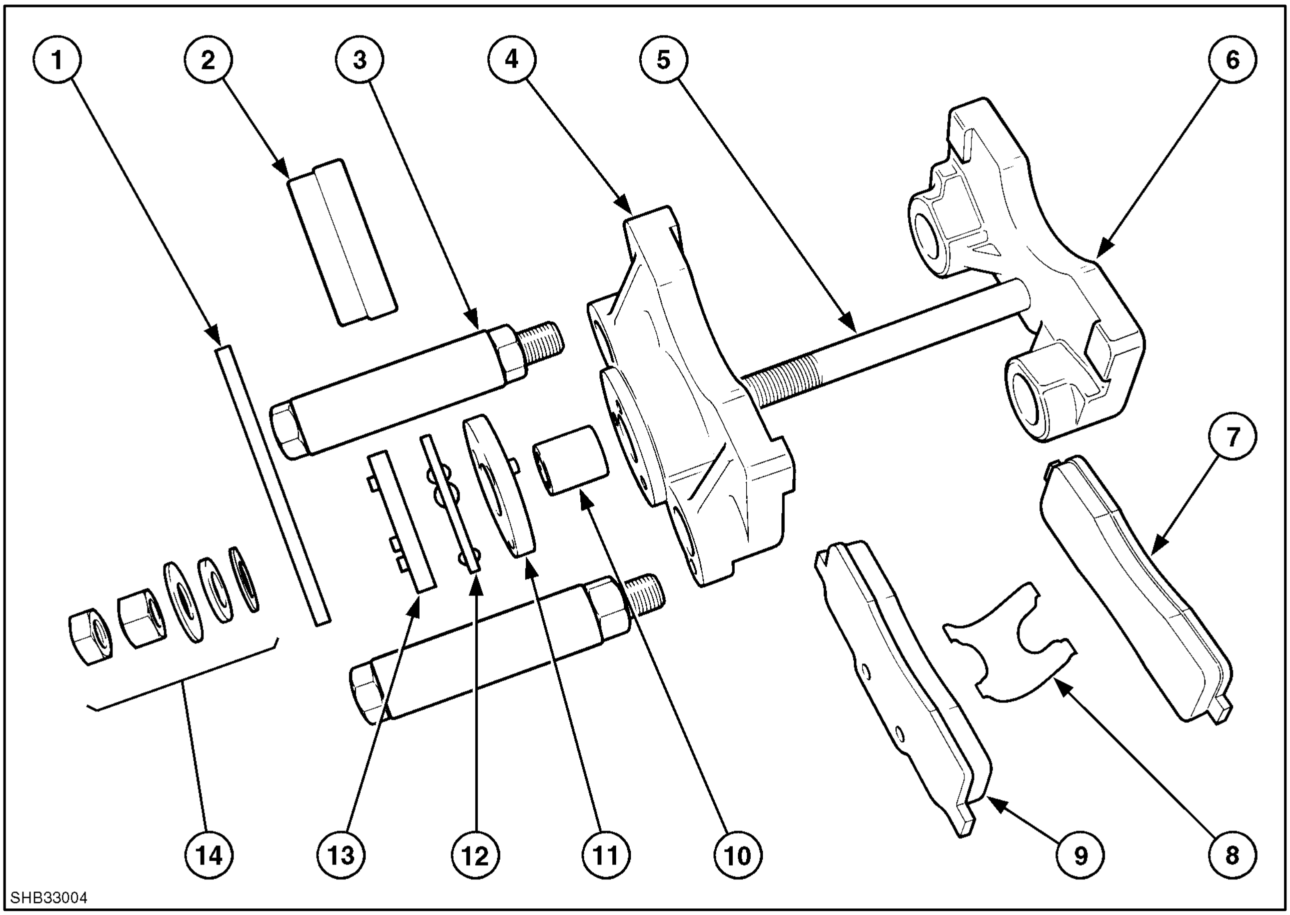


16

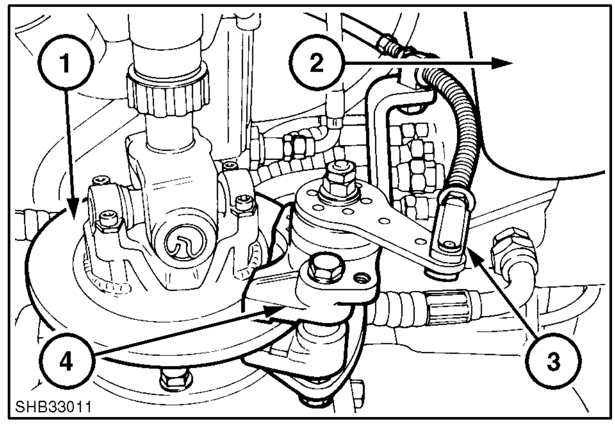
Component Layout

1. Lever
2. Cover
3. Fixing Bolts
4. Outer Caliper
5. Bolt
6. Inner Caliper
7. Inner Friction Pad
8. Fixing Spring
9. Outer Friction Pad
10. Spacer
11. Actuator Plate
12. Balls and Retainer Plate
13. Actuator Plate
14. Adjusting Nuts

HAND BRAKE ADJUSTMENT

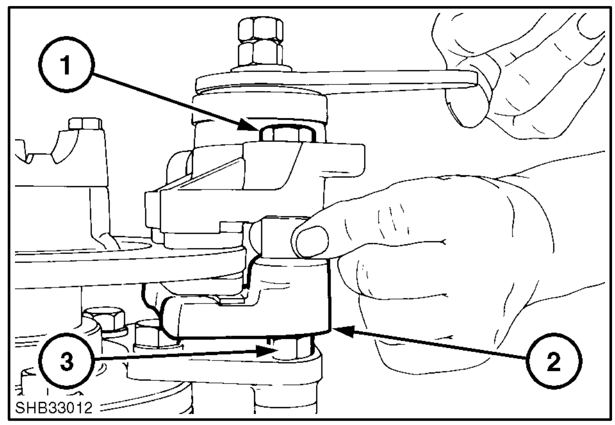
The transmission hand brake is located on the transmission output shaft on 4x4 transmission and on the rear axle on the 4x2 transmission.

The 4x2 transmission hand brake is located on the rear axle, brake disc splined to pinion shaft (1), hydraulic oil filter (2), hand brake cable (3), hand brake caliper (4).



17

When refitting the caliper unit (2), insert the two bolts (1) through the caliper, it will be necessary to apply Loctite 270 to the locknuts (3). Tighten the bolts while holding the locknuts. Once the bolts are tightened down back them off by 3 bolt heads flats, and then torque the locknuts to 150 Nm. Ensure that the tubes can move.



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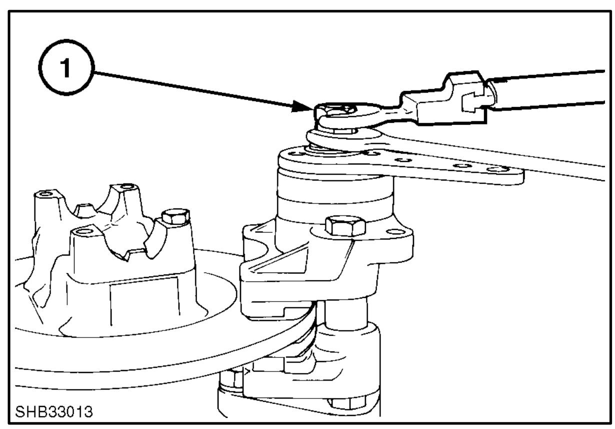
Adjust the clearance between the brake pads and disc to 0.5mm using the nut and lock nut (1).



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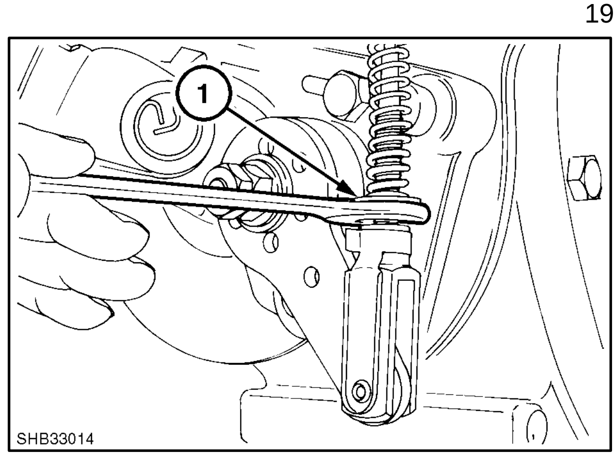
Adjust the cable clevis and lock the nut to get 4 to 5 clicks on the hand brake lever.



20

SECTION 35 – HYDRAULIC SYSTEMS

Chapter 1 – Hydraulic Circuits and Components for HUSCO Only

CONTENT

SPECIFICATIONS

PUMP – CASSAPA

Tandem Gear Pump Operating Steering and Hydraulic Circuits

Rear Pump (Steering Pump)

Output	New Pump	62.7 Ltrs/min (16.5 US. gals/min) @ 2200 rev/min @ Standby Pressure
	Worn Pump (minimum)	53.0 Ltrs/min (14 US. gals/min) @ 2200 rev/min @ Standby Pressure
	Steering Circuit Relief Valve	136.5 – 143.5 bar (1980 – 2080 psi)
	Steering Circuit Standby Pressure	7 bar (101.5 psi)
	Rear Pump Relief Valve Pressure (Located in Stabiliser Valve Section)	196 – 202 bar (2842 – 2929 psi)

Front Pump

Output	New Pump	81.4 Ltrs/min (21.5 US. gals/min) @ 2200 rev/min @ 175 bar (2500 psi)
	Worn Pump (minimum)	69.0 Ltrs/min (18.2 US. gals/min) @ 2200 rev/min @ 175 bar (2500 psi)
Front and Rear Pump Combined Output		144.1 Ltrs/min (38 US. gals/min) @ 2200 rev/min

Stabiliser and Extendible Dipper Control Valve

Type	Open Centre Sectional Valve Incorporating Rear Pump Relief Valve in Inlet End Cover

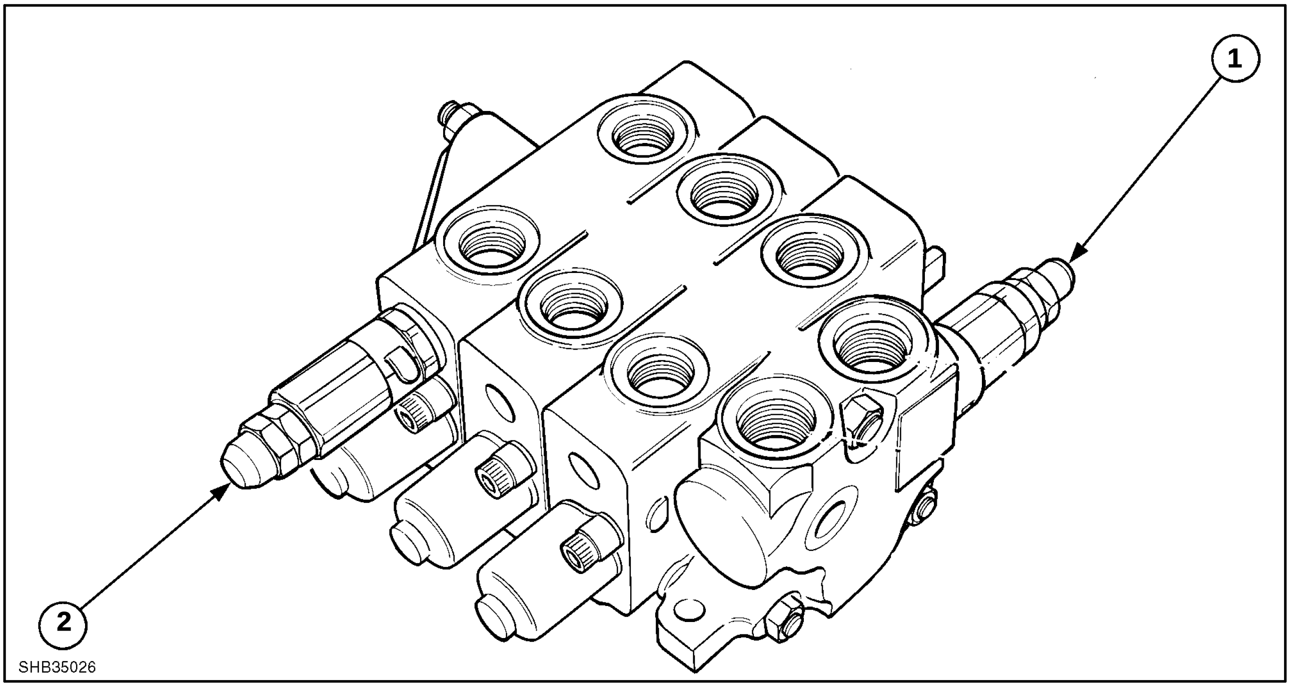
Loader Control Valve

Type	Open Centre Monoblock Valve Section Incorporating Main System Pressure relief valve Optional Auxiliary Valve Section available for Multi Function Bucket

Backhoe Control Valve

Type	Open Centre Sectional Valve

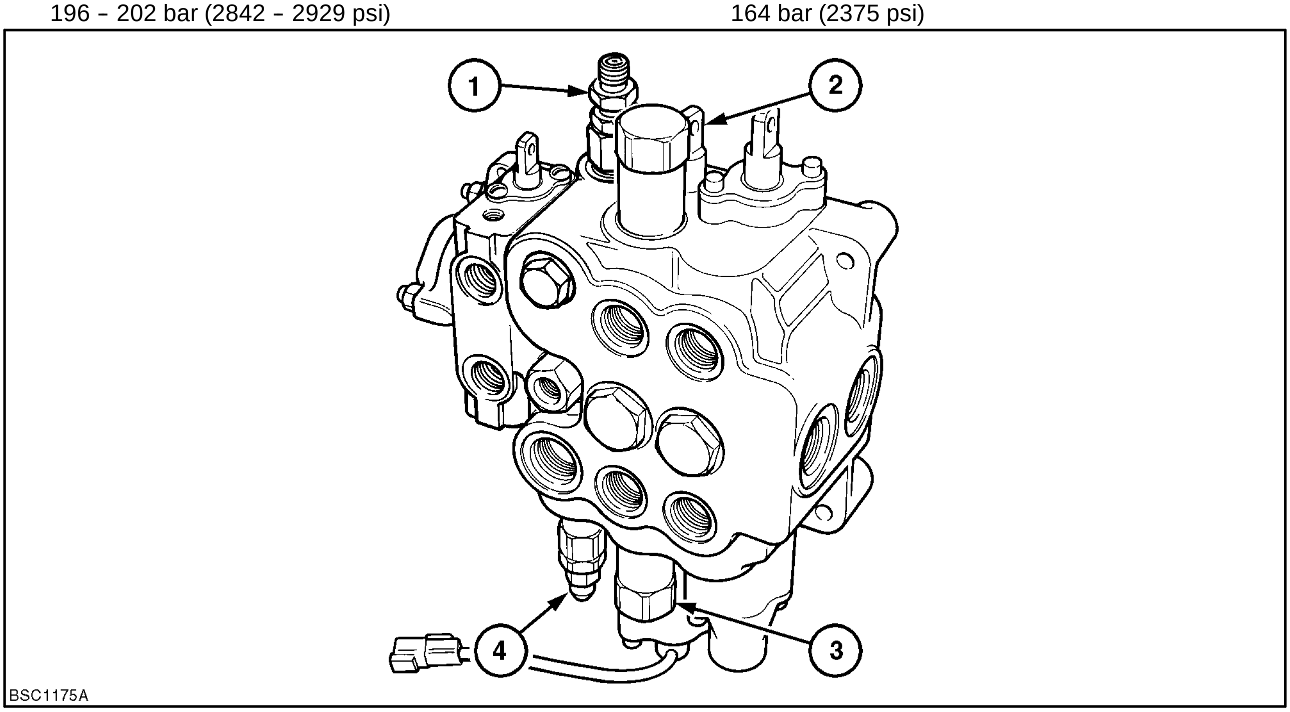
CIRCUIT RELIEF VALVES AND PRESSURE SETTINGS



1

Stabiliser and Extendible Dipper Control Valve Assembly

1. Rear Pump Relief Valve
   196 – 202 bar (2842 – 2929 psi)
2. Extendible Dipper (Piston End) Relief Valve
   164 bar (2375 psi)



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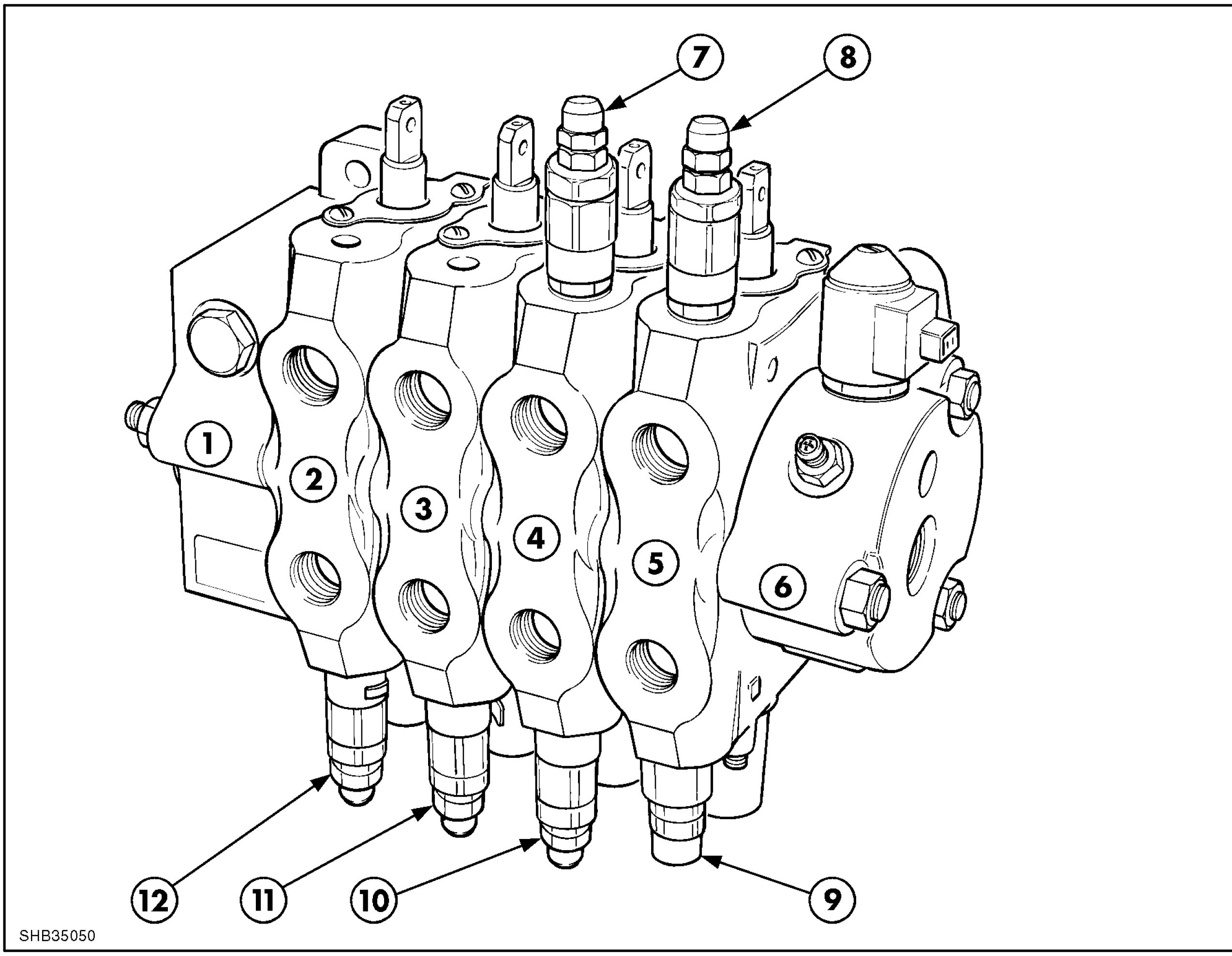
Loader Valve Assembly Relief Valve Location

1. Rear Pump Unload Valve (Where Fitted)
   170 bar (2465 psi)
2. Loader Bucket Relief Valve Rod End
   227 bar (3300 psi)
3. Loader Bucket Relief Valve Piston End
   160 bar (2300 psi)
4. System Pressure Relief Valve
   204 – 211 bar (2958 – 3059 psi)



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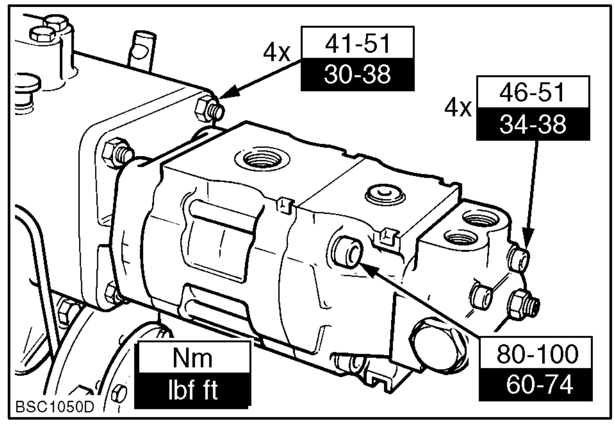
Backhoe Control valve Assembly

1.	Outlet End Cover	
2.	Dipper Valve Section	
3.	Bucket Valve Section	
4.	Swing Valve Section	
5.	Boom Valve Section	
6.	Inlet End Cover	
7.	Swing Cylinder Cushioning Circuit Relief Valve* (Left Swing)	207 bar (3000 psi)
8.	Lift Cylinder (Piston End) Circuit Relief Valve*	241 bar (3500 psi)
9.	Lift Cylinder (Rod End) Direct Acting Circuit Relief Valve	317 bar (4600 psi)
10.	Swing Cylinder Cushioning Circuit Relief Valve* (Right Swing)	207 bar (3000 psi)
11.	Bucket Cylinder (Rod End) Circuit Relief Valve*	207 bar (3000 psi)
12.	Dipper Cylinder (Piston End) Circuit Relief Valve*	241 bar (3500 psi)

*Pilot Operated with Anti Cavitation Feature

TIGHTENING TORQUES



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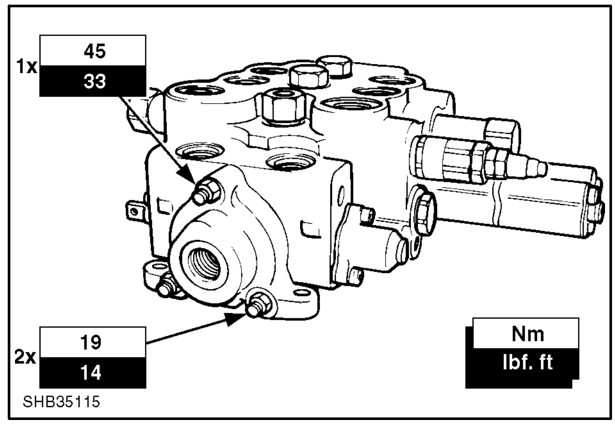

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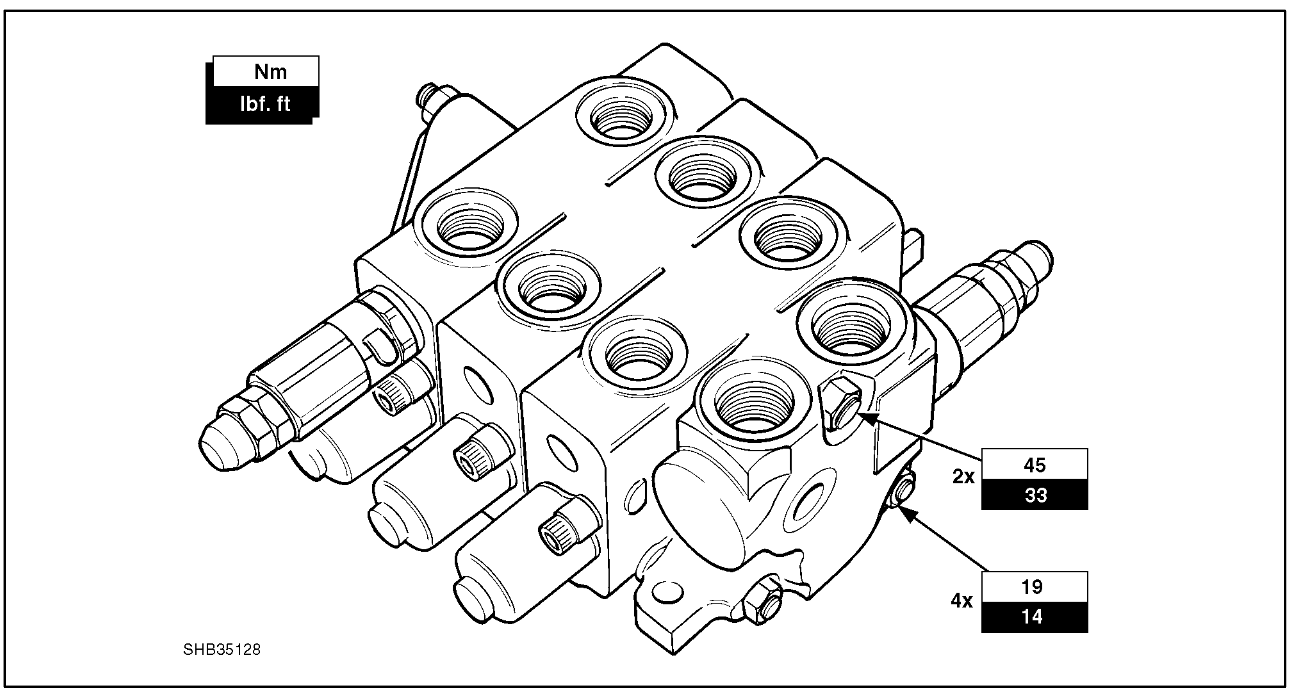

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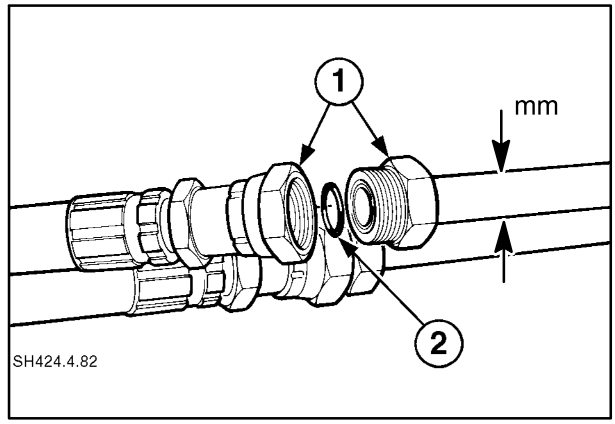
'O' Ring Face Seal (ORFS) Tightening Torques. Ensure that the correct 'O' ring seal (2) is properly placed in the face seal 'O' ring groove on the connector (1). Place the tube assembly against the fitting body so that the flat face of the sleeve comes in full contact with the 'O' ring. Thread the nut by hand and tighten to the specified torque.

Do Not Overtorque '0' Ring Face Seal Connectors'



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Steel Tube Outside Diameter (mm)	Nm	lbf ft
10	36	27
12	54	40
14-16	85	63
18-20	122	90
22-25	162	120

SPECIAL TOOLS

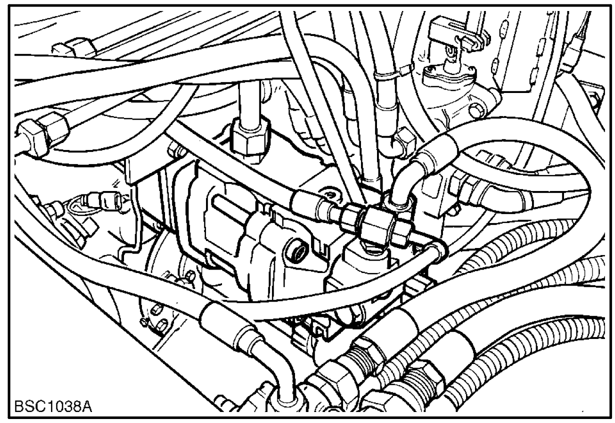
Description	V. L. Churchill Tool No
Circuit Relief Valve Test Block	297418
Control Valve Seal Insertion Tool	297419

HYDRAULIC CIRCUIT

The backhoe loader is manufactured with either a sideshift or centre pivot backhoe.

The hydraulic circuit schematic is shown in Figure 12 and the technical circuit diagrams for all models for both types of machine are shown in Figure13.

The description and operation of the Hydraulic pump and control valves are described in this Section. For further details on hydraulic cylinders, oil reservoir, filters, oil cooler and dealer installed accessories reference must be made to the appropriate Chapters in this Manual.



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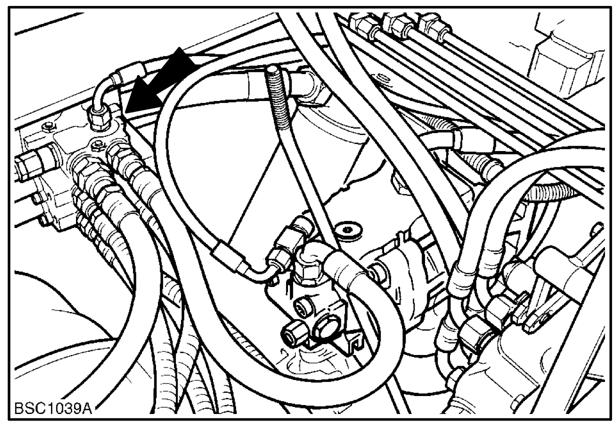
The hydraulic pump assembly, mounted on the rear of the transmission and comprises of two pumping elements.

A front pump suppling oil for operation of front loader and backhoe.

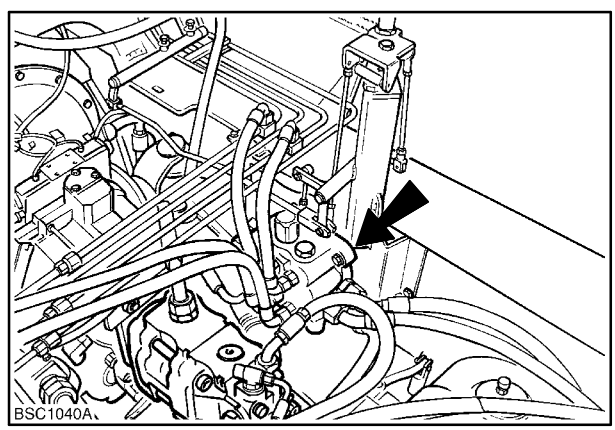
A rear pump with priority flow to the load sensed hydrostatic steering system and remaining output for operation of stabilizers and extendible dipper. Output from this pump also combines with the flow from the front pump for increased operating speed of the loader and backhoe.



9

Stabiliser Control Valve, mounted to the left hand side of the machine. The control valve for the backhoe extendible dipper where fitted is also fitted into this valve stack

Loader Control Valve, mounted on the right hand side of the machine provides oil flow to the loader boom and bucket. The valve assembly also contains the front pump system pressure relief valve



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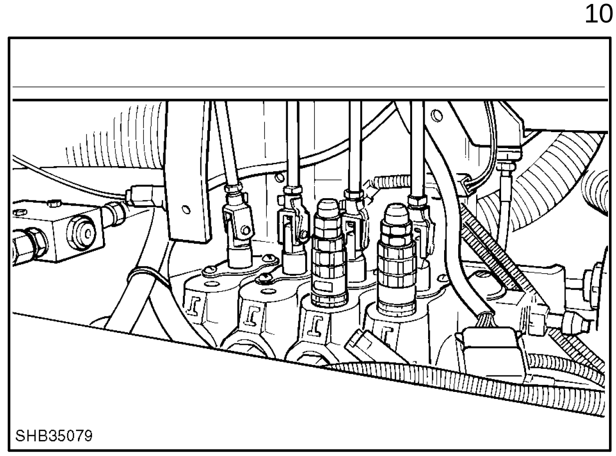
Backhoe Control Valve, located at the rear of the chassis provides oil flow for operation of the boom, dipper, bucket and swing and sideshift clamp elements of the backhoe assembly.



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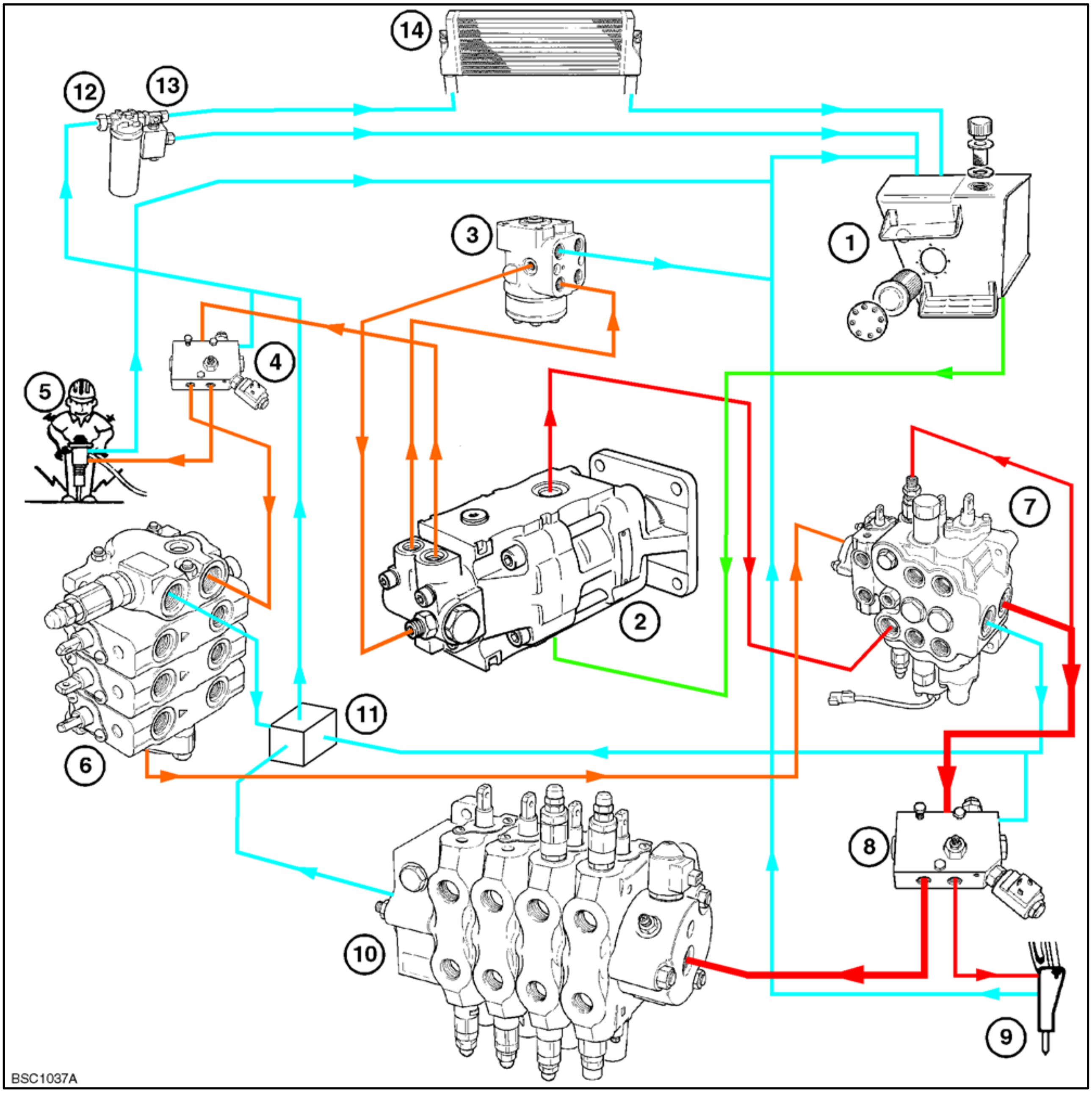


12

Hydraulic Circuit Schematic

Front Pump Oil

Rear Pump Oil

Suction Oil

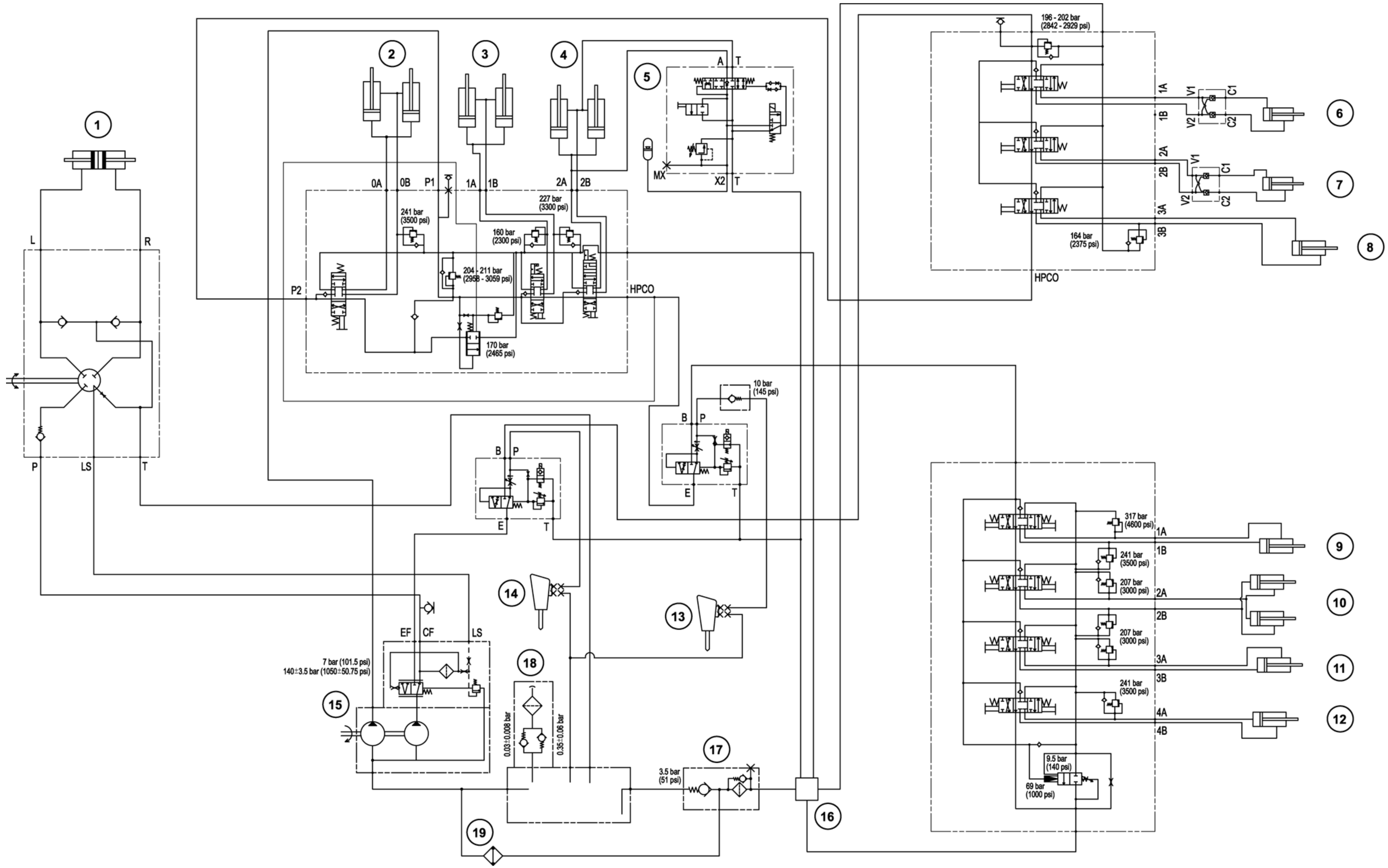
Return to Reservoir

1. Hydraulic Reservoir
2. Hydraulic Pump
3. Steering Motor
4. Hand Hammer Control Valve
5. Hand Hammer
6. Stabilizer and Extendible Dipper Control Valves
7. Loader Control Valves with Unload
8. Backhoe Hammer Control Valve
9. Backhoe Hammer
10. Backhoe Control Valves
11. Return Line Distributor Block
12. Filter
13. Oil Cooler By–Pass Valve
14. Oil Cooler

MAIN HYDRAULIC SYSTEM
2 AND 4 WHEEL DRIVE

MAIN HYDRAULIC SYSTEM (WITH OPTIONS)
2 AND 4 WHEEL DRIVE

1. Front Axle
2. Bucket 4x1 - 6x1
3. Boom
4. Crowd
5. Glide Control (Optional)
6. LH Stabiliser
7. RH Stabiliser
8. Telescopic
9. Boom
10. Swing
11. Bucket
12. Dipper
13. Backhoe Hammer
14. Hand Hammer (Optional)
15. Pump Output-
38+38 for Machine 110 HP Engine
34+34 for Machine with 95 HP Engine
16. Return manifold
17. Return filter with bypass
18. Breather
19. Cooler



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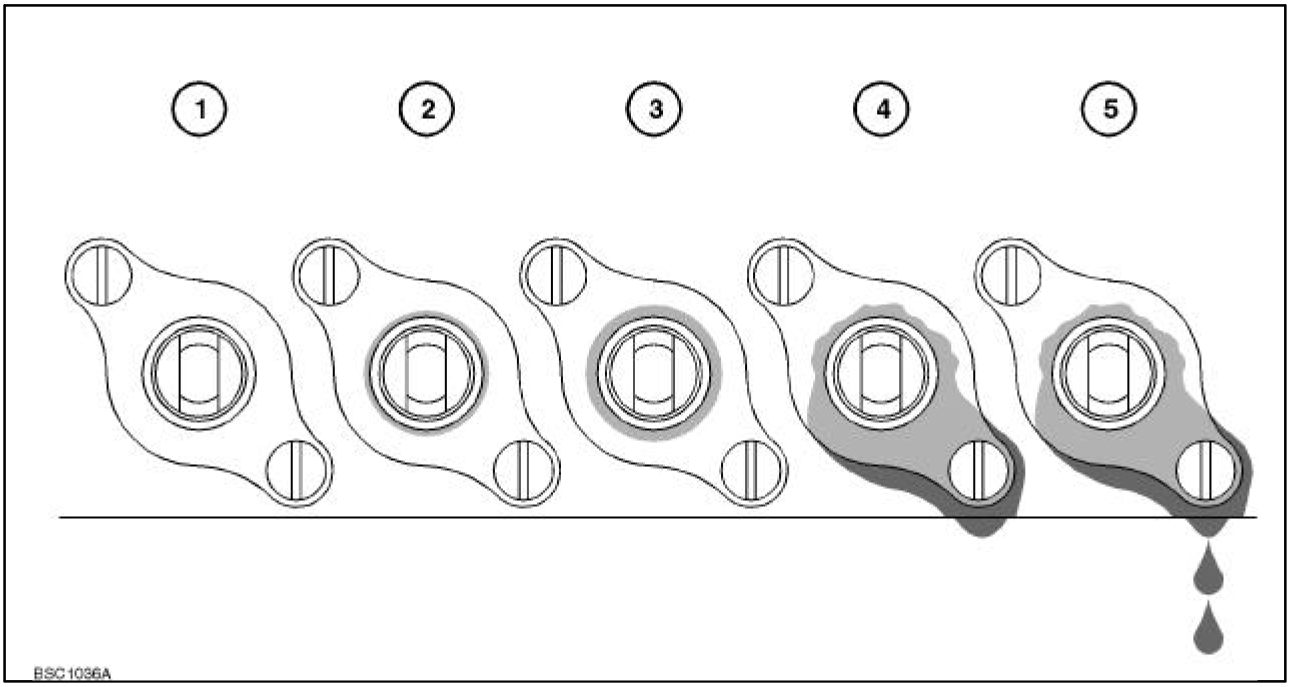
Main Hydraulic System - 2 and 4 Wheel Drive (with Options)

HYDRAULIC VALVE SPOOL SEALS



14

External Leakage Classification

1. Class 0 – No indication of moisture.
2. Class 1 – Dry dust collection which does not propagate.
3. Class 2 – Thin moist layer of dust (under 3 mm) which does not propagate.
4. Class 3 – Thick moist layer of dust (over 3 mm) with wetness around the spool which propagates over time.
5. Class 4 – Oil drips form at the edge of the valve. Pools of oil collect on horizontal surfaces.

Leakage Severity and Repair

New specifications for hydraulic valve spool leakage have been established to help determine the need for seal replacement in service. A revised seal installation procedure has also be developed.

A special tool **297419** is available from SPX which should be used, in all instances, to install the lip seals onto the hydraulic valve spools. The seal lip will almost inevitably be damaged if this tool is not used.

Leakage severity classification

Leakage classification and repair requirement can be determined as follows:

Class 0: There is no indication of moisture or dust around the seal area. No repair recommended.

Class 1: There is a collection of dry dust around the spool and seal which is not propagating. No repair recommended.

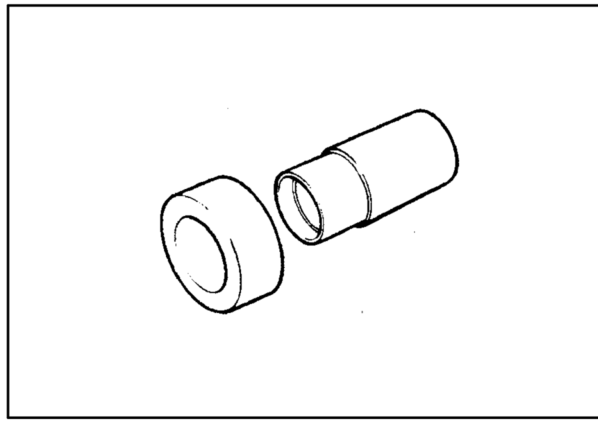
Class 2: There is a thin layer of moist dust around the seal area which is not propagating. No repair recommended.

Class 3: A thick layer (over 3 mm) of moist dust has accumulated around the spool. There may be a film of oil on the spool surface. This condition is propagating over a short period of time. Repair is recommended.

Class 4: Oil drips from the valve area and pools of oil gather on horizontal surfaces. Oil may also run down the valve and drip under the unit. Repair is recommended.

Seal replacement procedure:

1. Clean the machine thoroughly paying particular attention to the hydraulic valve area.
2. Ensure that the loader or backhoe is placed on the ground and operate each lever to relieve hydraulic pressure in the circuits.
3. Remove the operating linkage from the valve spools to be resealed.
4. Remove the two screws and the seal plate from the spool. (Items 11 and 10 Figure 17).
5. Remove the centring spring housing from the lower end of the valve spool by removing the two screws. (Items 1 and 19 Figure 17).
6. Remove the screw retaining the centring spring to the spool (Item 18 Figure 17). The spool can be prevented from turning by inserting a steel rod in the linkage hole on the upper end.
7. Remove the seal plate from the spool (Item 2 Figure 17) .
8. Remove the lip seal and wiper ring from either end of the spool (Items 3, 4, 8 and 9 Figure 17). It may be helpful to slide the spool to push the seals out. Care should be taken not to damage the spool or valve block during this operation. Be aware that the spool will be unsupported at this point and may slide out of the valve block. Support the spool as necessary.
9. Insert a new lip seal into the tapered end of the special tool ring, **297419.**



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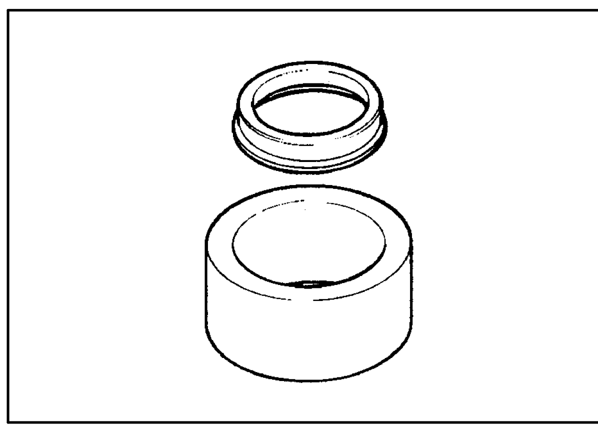

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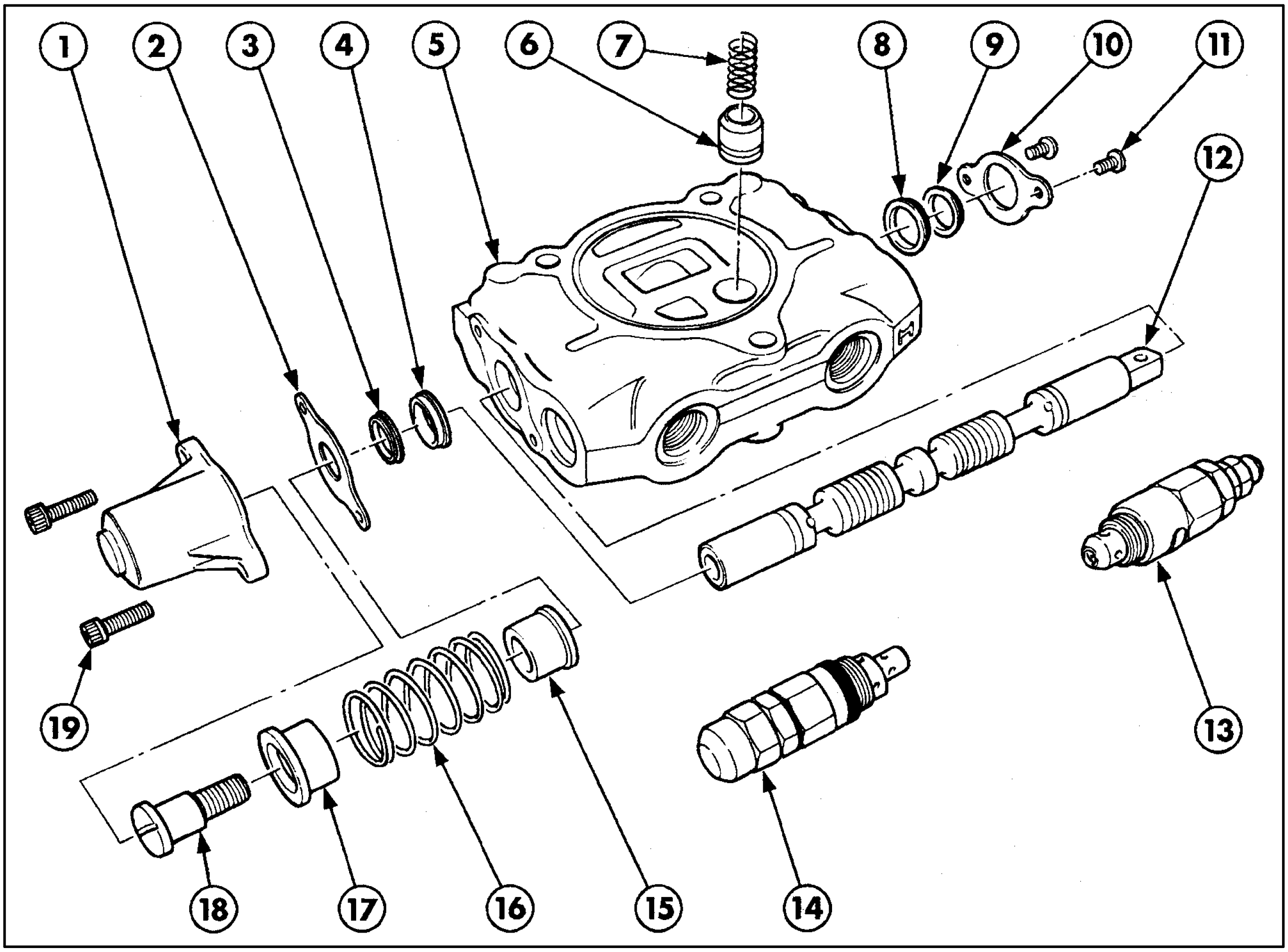
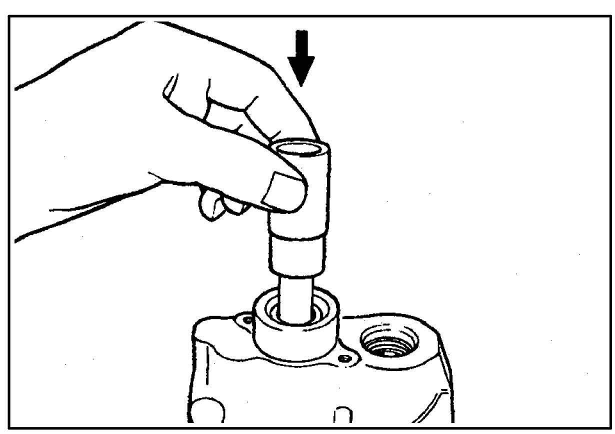


17

Typical Backhoe Valve Section – Boom Valve shown

1. Centring Spring Cover.
2. Seal Plate.
3. Wiper Ring.
4. Lip Seal.
5. Valve Block.
6. Check Valve.
7. Spring.
8. Lip Seal.
9. Wiper Ring.
10. Seal Plate.
11. Screws.
12. Spool.
13. Circuit Relief Valve.
14. Circuit Relief Valve.
15. Centring Spring Seat.
16. Centring Spring.
17. Centring Spring Seat.
18. Screw.
19. Retaining Screw

10. Carefully place the seal, in the ring tool, over end of the spool and use the plunger part of the tool to press the seal into position between the spool and the valve block recess. It may be helpful to lubricate the spool slightly with hydraulic oil to facilitate this operation. The trapped air behind the seal can be released by slightly pushing the spool into the valve block. This will allow the seal to locate correctly in its housing. Do not allow the spool feathering lands or balancing grooves to pass through the seal as damage will occur.

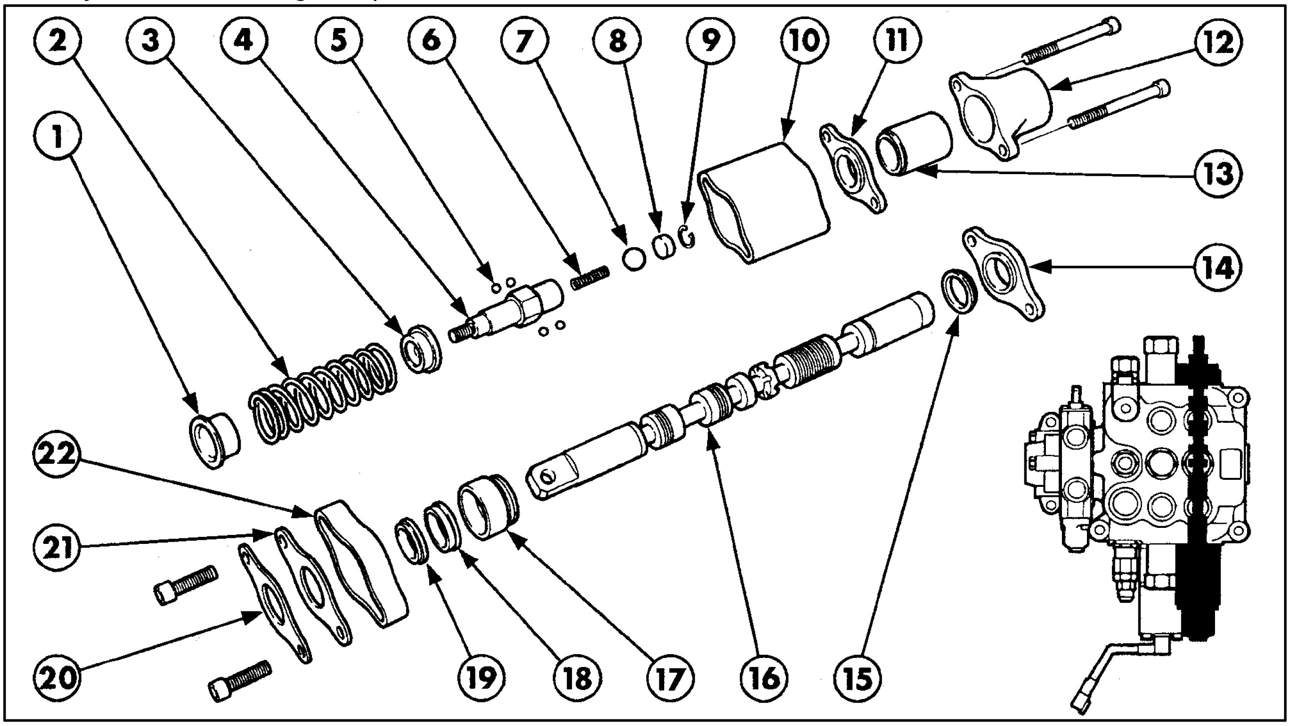


18

11. Fit a new wiper ring with the lip facing outwards away from the seal.
12. Fit the seal plate onto the valve block using the two screws. Tighten the screws to 10 Nm.
13. Repeat this operation – steps 9 to 12 – for the spring end of the spool.
14. Fit the centring spring with retaining bolt (Item 18 Figure 17) into the end of the spool. Use Loctite 242 on the bolt threads before tightening to 10 Nm.
15. Fit the spring cap and screws through the seal plate and tighten to 10 Nm.
16. Reconnect the linkage to the spool end.
17. All hydraulic valve spools are sealed in the same way with the following exceptions.

a). Loader lift spool linkage end: The lip seal and wiper ring are mounted in a spacer (Item 17) which is then sealed into the valve block with an O ring. The spacer should be removed to allow the seal to be pushed out and the O ring should be replaced to ensure a good seal.

b). Loader lift spool spring end: The spool end cap contains the detent mechanism. Seal replacement involves the removal of the detent mechanism from the spool using the hexagonal portion on the detent plunger (Item 4). There is no wiper ring between the seal (Item 15) and the seal plate (Item 14).

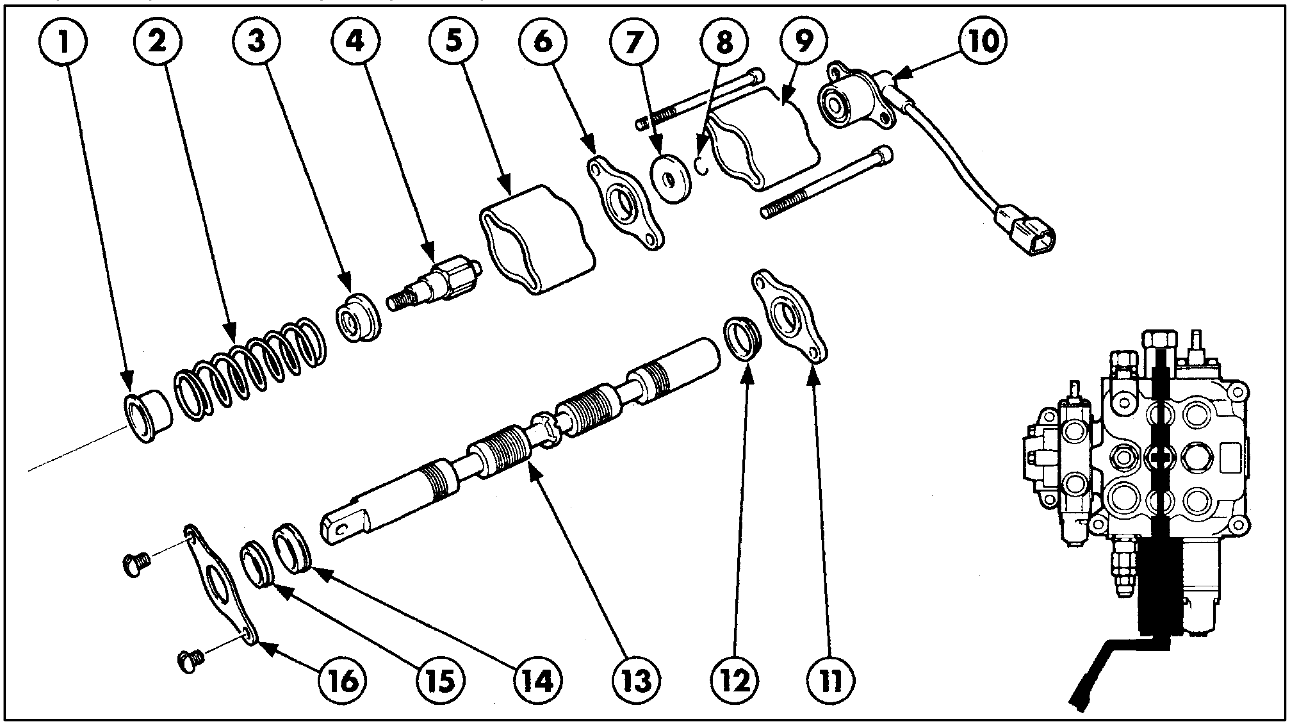


19

Loader Valve – Lift Spool Components

1. Centring Spring Seat.
2. Centring Spring.
3. Centring Spring Seat.
4. Detent Plunger.
5. Detent Balls (4).
6. Spring.
7. Steel Ball.
8. Cap.
9. Circlip.
10. Cover.
11. Spacer Plate.
12. End Cap.
13. Detent Collar.
14. Seal Plate.
15. Lip Seal.
16. Lift Spool.
17. Spacer.
18. Lip Seal.
19. Wiper ring.
20. End Cover.
21. Seal Plate.
22. Cover.

c). Loader bucket spool spring end: The spool end cap contains the 'return to dig' electro-magnet. The centring spring has to be removed using the hexagonal portion of the screw retainer (Item 4). There is no wiper ring between the seal (Item 12) and the seal plate (Item 11).



20

Loader Valve – Bucket Spool Components.

1. Centring Spring Seat.
2. Centring Spring.
3. Centring Spring Seat.
4. Screw Retainer.
5. Spring Cover.
6. Spacer Plate.
7. Clapper Washer.
8. 'C' Clip.
9. Electromagnet Cover.
10. 'Return to Dig' Electromagnet.
11. Seal Plate.
12. Lip Seal.
13. Bucket Spool.
14. Lip Seal.
15. Wiper Ring.
16. Seal Plate.

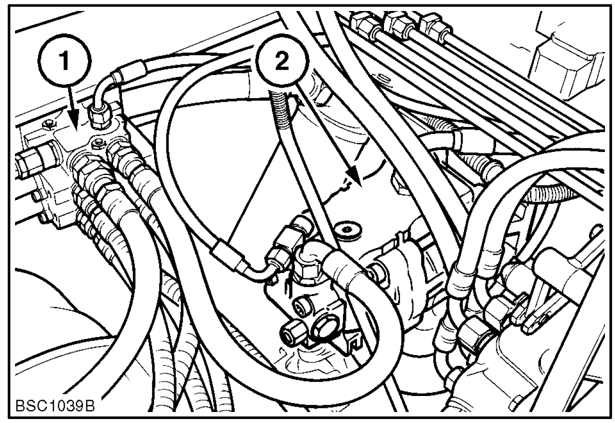
NOTES

STABILISER AND EXTENDIBLE DIPPER CONTROL VALVES

The stabiliser and extendible dipper control valve assembly (1) is located on the left hand side of the chassis adjacent to the hydraulic pump (2).

The valve assembly is a stack type made up of three valve sections together with an inlet and outlet end cover.

The pilot operated circuit relief valve is located in the inlet end cover for protection of the rear pump. There is also a pilot operated relief valve fitted in the extendible dipper valve section for protection of the piston end of the dipper cylinder from shock loadings.



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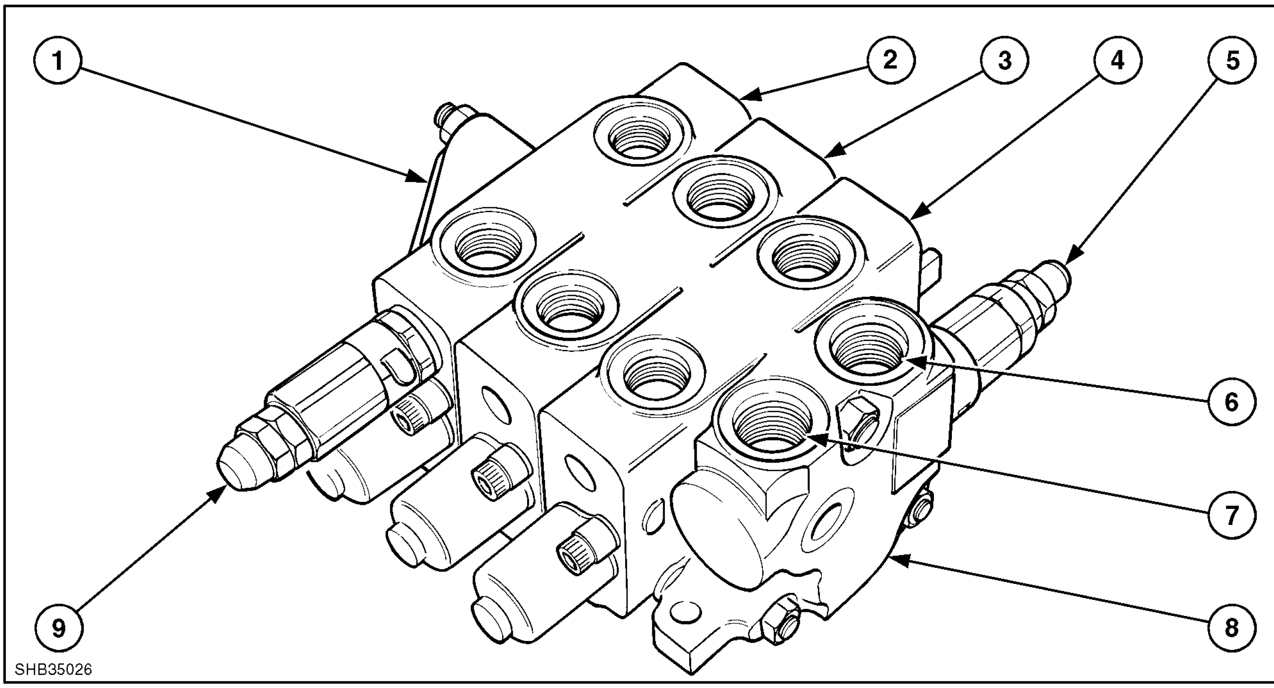
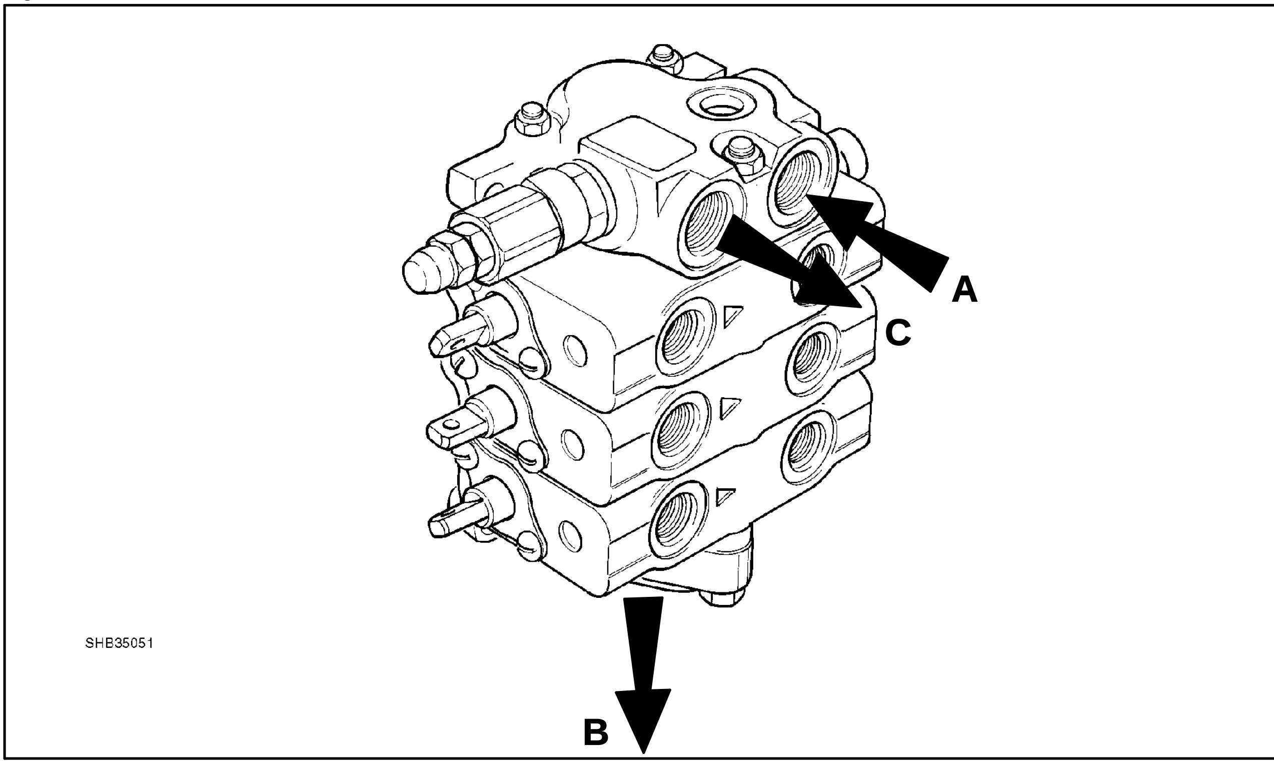


22

Stabiliser and Extendible Dipper Control Valve Assembly

1. Outlet End Cover – To Loader Control Valve Assembly
2. Extendible Dipstick Valve Section
3. Left Hand Stabiliser Control Valve
4. Right Hand Stabiliser Control Valve
5. Rear Pump Relief Valve – Pilot Operated @ 196 – 202 bar (2842 – 2929 psi)
6. Return to Reservoir from Stabilizer and Extendible Dipper Circuits
7. Inlet Port Flow from Rear Hydraulic Pump
8. Inlet End Cover
9. Extendible Dipper (Piston End) Relief Valve – Pilot Operated @164 bar (2375 psi)

Hydraulic Oil Flow



23

Stabiliser and Extendible Dipper Valve Section Ports

A. Inlet From Rear Hydraulic Pump
B. Outlet From Staggered Open Centre Gallery
C. Return to Reservoir From Control Valve Exhaust Galleries

With Reference to Figure 23.

Flow from the rear pump is controlled by the flow divider on the rear of the pump which diverts output to both the steering and hydraulic circuits.

Hydraulic circuit output from the rear pump enters the end cover in port **A** and flows down the staggered open centre gallery running through the stabiliser and extendible dipper valve assemblies.

If the valve sections are in neutral the flow continues out of port **B** and flows to the loader valve assembly where it merges with the output from the front pump.

When a valve section is operated, flow through the staggered open centre gallery is blocked by the spool.

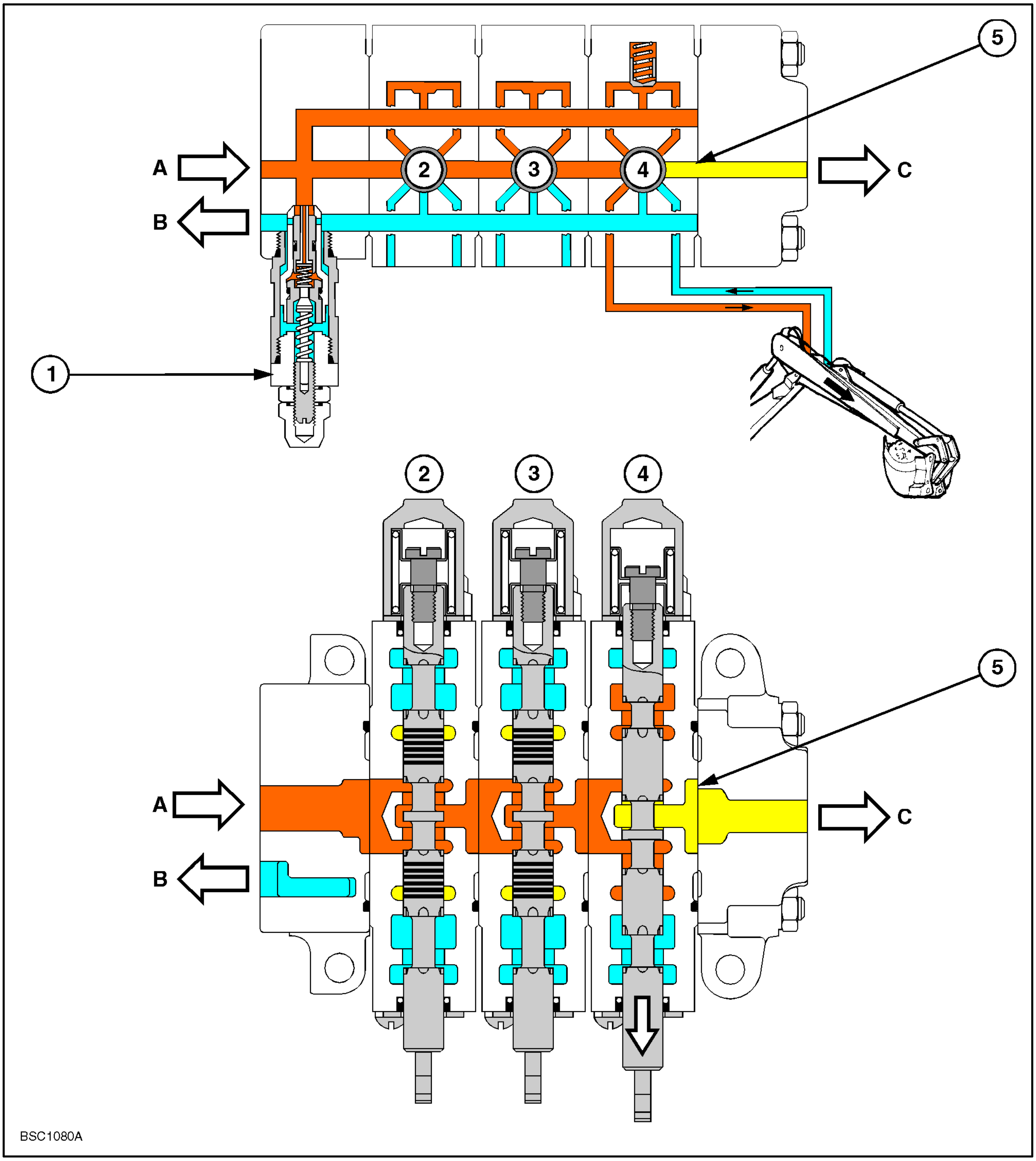
Flow through the outlet port **B** is now restricted and the oil flow to the loader valve becomes static until the valve is returned to neutral.

Pump pressure will now rise with a corresponding rise of pressure in the parallel gallery which is blocked at the outlet end cover

Oil can now flow from the parallel gallery over the control valve spool to operate the cylinder.

Exhaust oil from the cylinder returns to reservoir through Port **C**.

The oil flow through the stabiliser and extendible dipper valve sections are described on the following pages.



24

Oil Flow Through Extendible Dipper and Stabiliser Valve Sections

Rear Pump Flow

Return to Reservoir

Trapped/Static Flow Oil

Port A – Flow From Rear Pump

1. Rear Pump Circuit Relief Valve @ 192 – 202 bar (2842 – 2929 psi)

2. Left Hand Stabiliser Valve

Port B – Rear Pump Flow to Loader Control Valve

3. Right Hand Stabiliser Valve

4. Extendible Dipper Valve

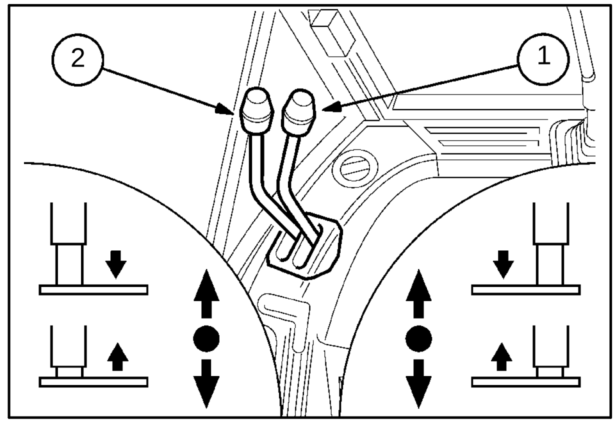
5. Staggered Open Centre Gallery

Oil Flow Through Stabiliser Control Valve Section

The stabiliser control valves are unique to all other valve sections.

The stabilisers are operated by two levers at the rear of the cab.

Each stabiliser circuit incorporates a pilot operated lock valve, Figure 26 which automatically prevents the leak down or collapse of a stabiliser should a hose burst, hydraulic system fail or the stabiliser levers are moved if the stabilisers are extended and the engine is turned off.



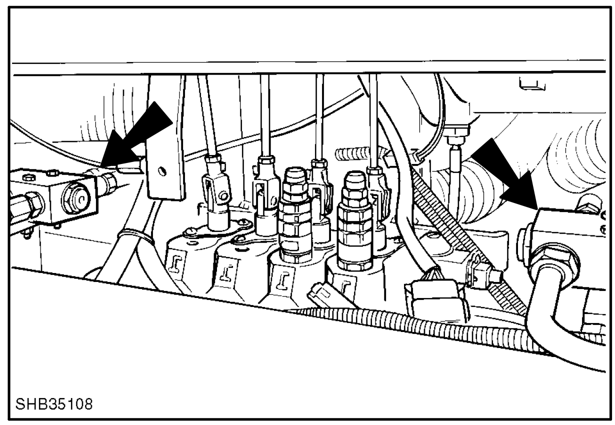
25

Control Valve In Neutral

When the stabiliser control valve is in neutral output from the rear pump can flow uninterrupted through the staggered open centre gallery and the lands on the spool prevent flow to the cylinder ports.

In Neutral the lands on the spool trap the oil between the outlet port of the valve and the lock valves .

With no pressure in these lines the lock valves assume the closed position and oil in the stabilisers is trapped, preventing leak down of the stabiliser cylinders.



26

Control Valve Operating

When the stabiliser circuit is operated the spool is moved to either the extend or retract position.

Oil flow through the staggered open centre gallery is blocked and system pressure rises in the parallel gallery.

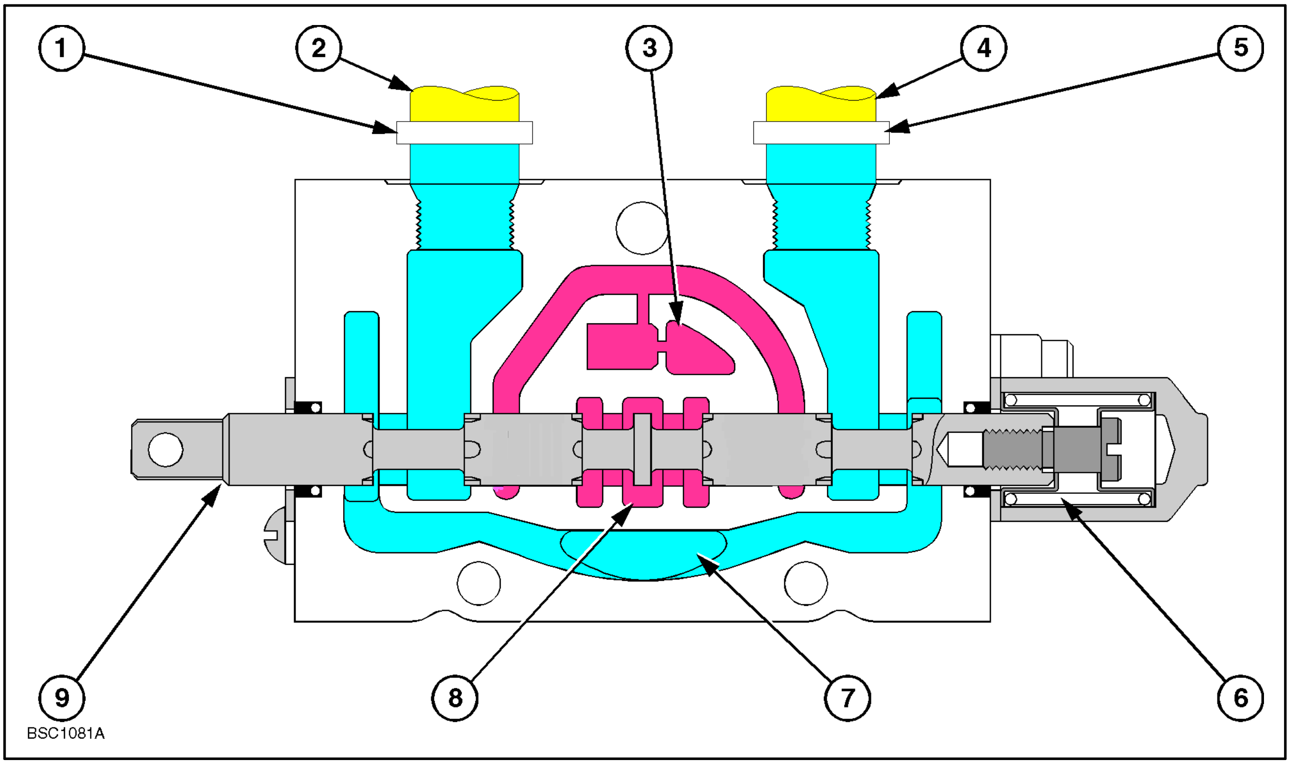
Pressure oil flows past the spool through the cylinder port to the check valve.

The load sense lines in the lock valves are now pressurised which opens the valve to allow oil flow to the stabiliser cylinder.

Return oil from the opposite end of the cylinder also flows through a lock valve and back to reservoir across the spool.

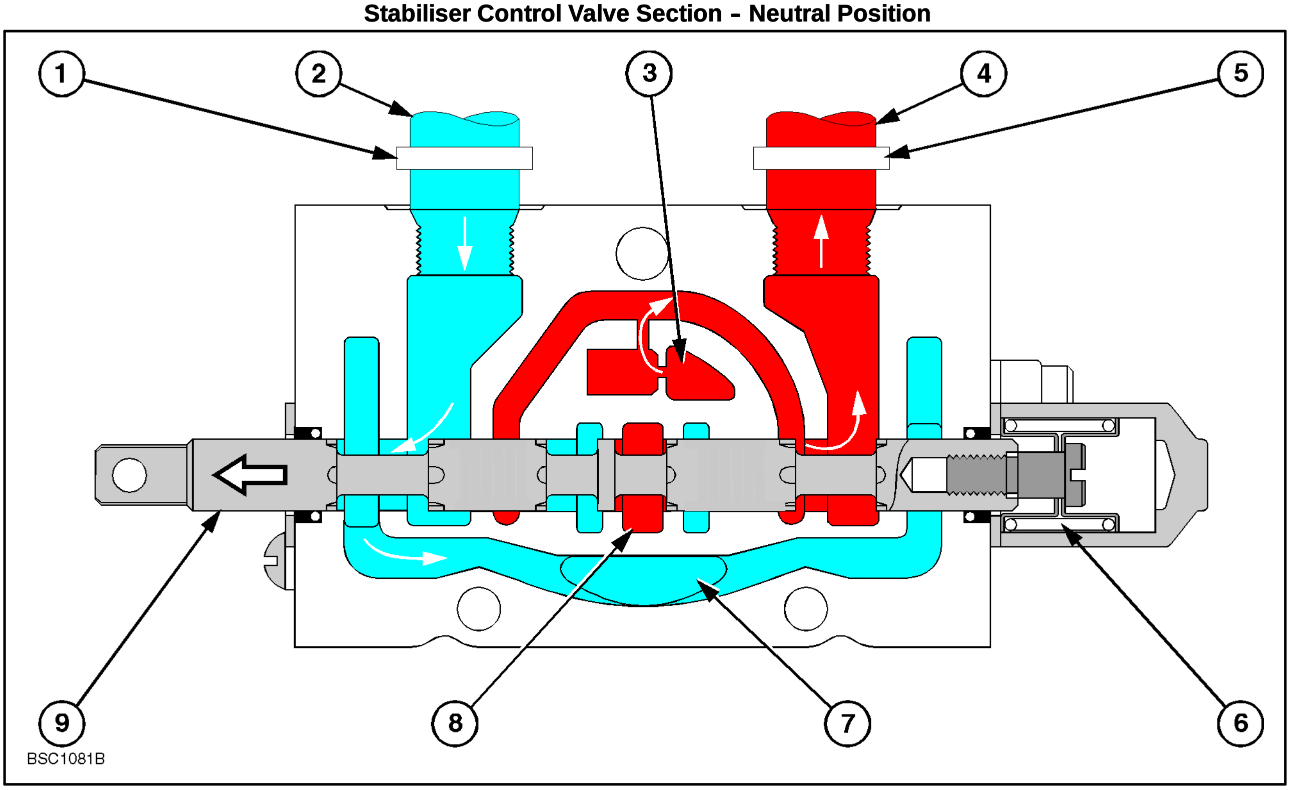
Stabiliser Control Valve Section

1. Stabiliser Lock Valve (centre pivot only)
2. To Stabiliser Cylinder
3. Parallel Gallery
4. To Stabiliser Cylinder
5. Stabiliser Lock Valve (centre pivot only)
6. Centering Spring
7. Exhaust Gallery
8. Staggered Open Centre Gallery
9. Spool



27

Stabiliser Control Valve Section – Neutral Position



28

Stabiliser Control Valve Section – Operating Position

Pump Pressure Oil

Return to Reservoir Oil

Trapped Oil

OIl Flow Through Extendible Dipper Valve Section

The extendible dipper valve section is different from that of the stabiliser valves and contains a built in check valve to prevent the back flow of oil into the parallel gallery.

These valves are not required in the stabiliser valve sections due to the external pilot operated ‘Fail Safe’ lock valves used in the stabiliser circuit.

Control Valve In Neutral

When a control valve is in neutral the oil in a cylinder is trapped by the spool and pump oil is allowed to flow through the staggered open centre gallery.

The pressure in the parallel galley is at pump pressure, however the oil is static as the gallery terminates at the outlet end cover.

The return to reservoir oil in the control valve exhaust gallery is static.

Oil to either end of the cylinder is trapped by the spool. Oil is also trapped in the ‘D’ shaped gallery behind the check valve.

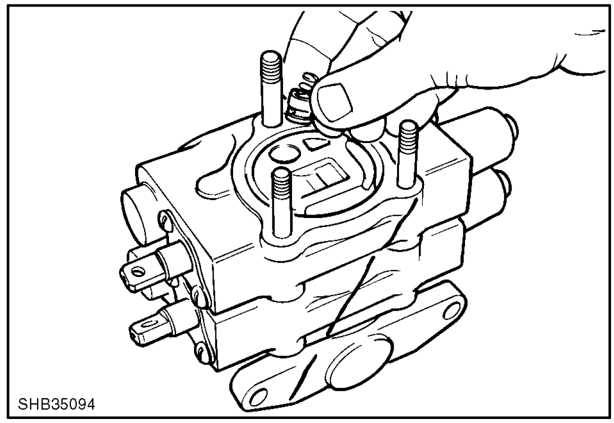
Control Valve Operating

When the valve spool is moved either left or right to extend or retract a cylinder, flow through the staggered open centre gallery is blocked.

Pump pressure in the staggered an parallel galleries will rise.

Moving the spool joins one cylinder port to reservoir and the other to the ‘D’ shaped gallery behind the check valve. As pump pressure rises in the parallel gallery the check valve will open and oil will flow through the ‘D’ shaped gallery to the cylinder port.

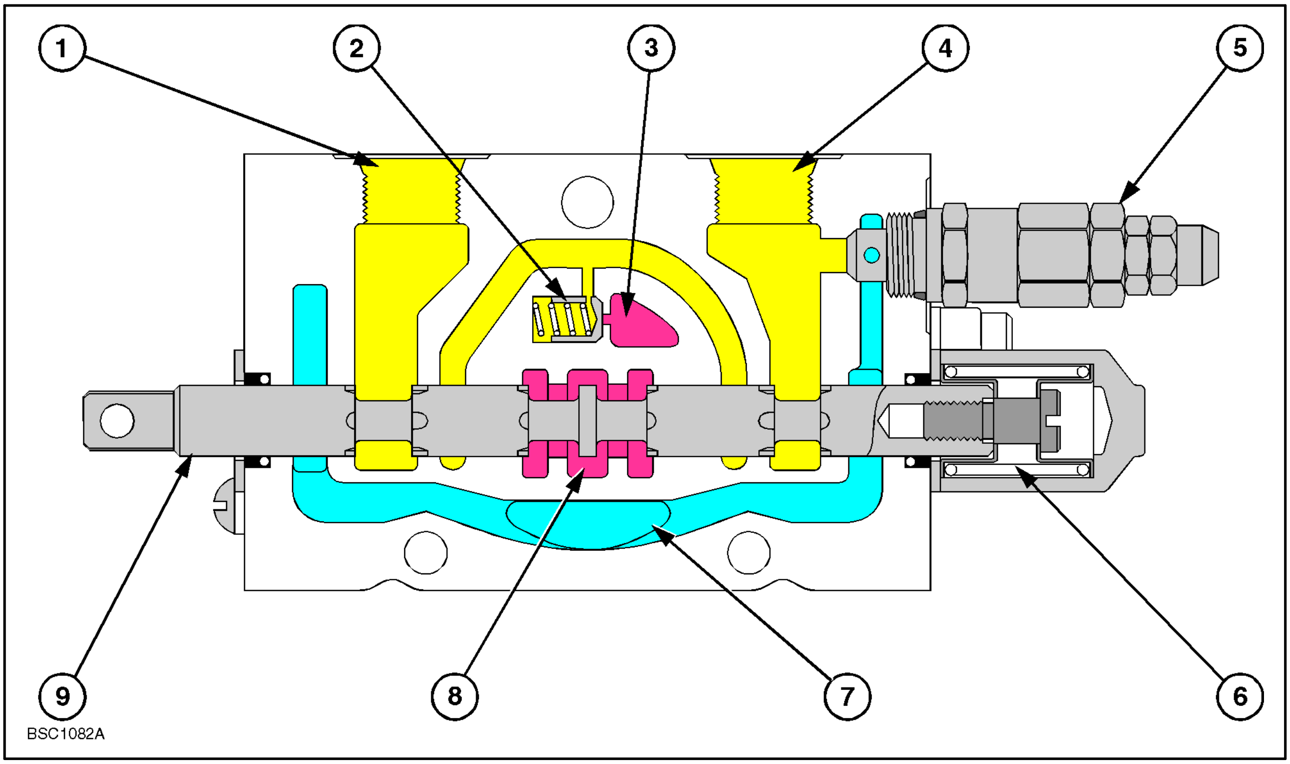
Exhaust oil from the cylinder flows from the exhausting port into the cylinder exhaust port and returns to reservoir.



29

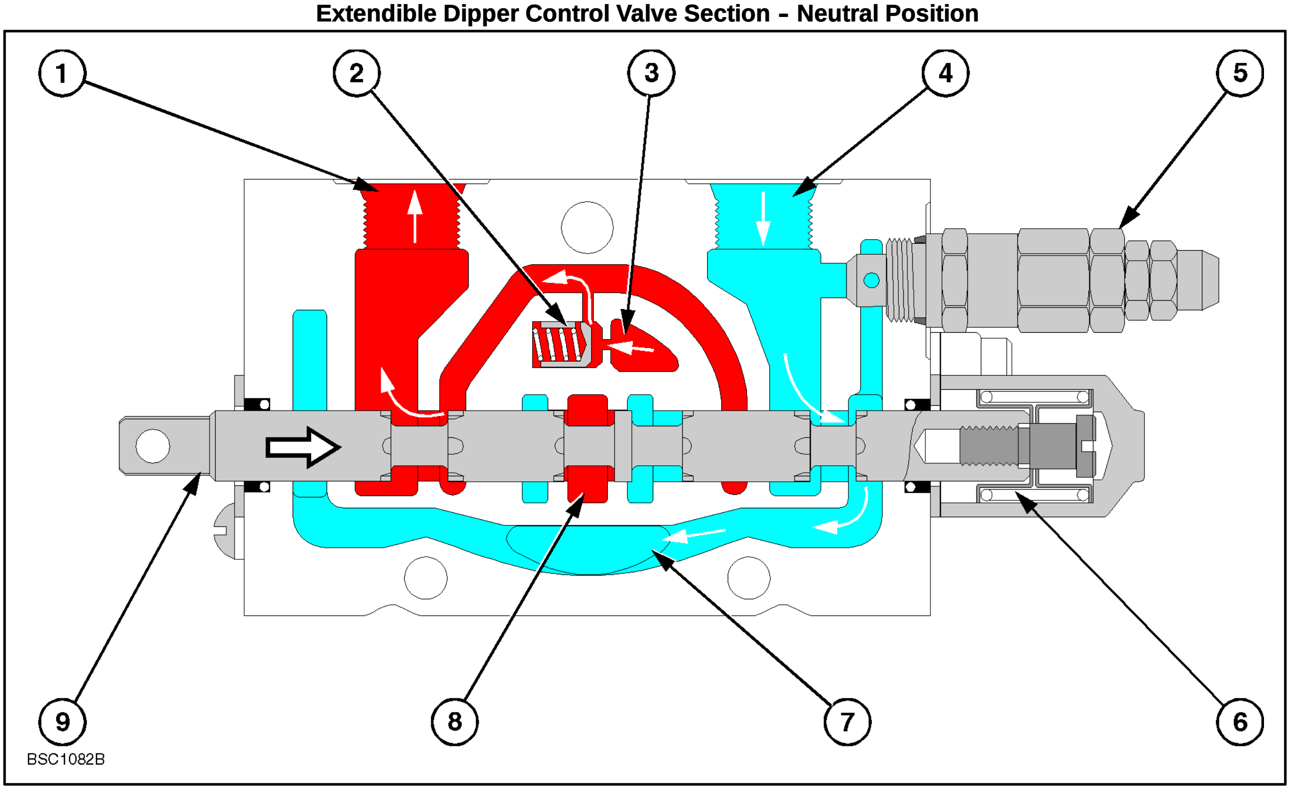
Extendible Dipper Control Valve Section

1. Cylinder Port
2. Check Valve
3. Parallel Gallery
4. Cylinder Port
5. Circuit Relief Valve
6. Centering Spring
7. Exhaust Gallery
8. Staggered Open Centre Gallery
9. Spool



30

Extendible Dipper Control Valve Section – Neutral Position



31

Extendible Dipper Control Valve Section – Operating Position

Pump Pressure Oil

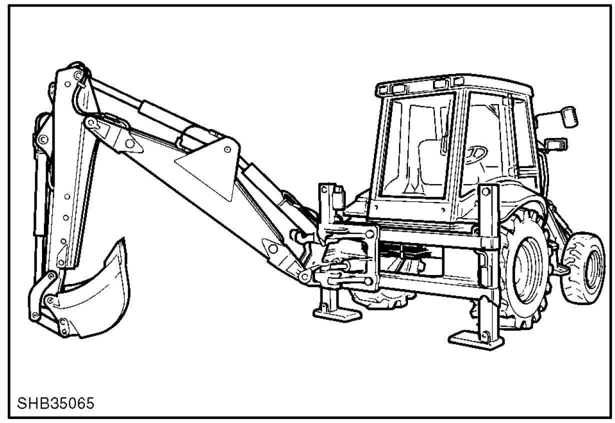
Return to Reservoir Oil

Trapped Oil

STABILISER AND EXTENDIBLE DIPPER CONTROL VALVE OVERHAUL (OP NO. 35 703)

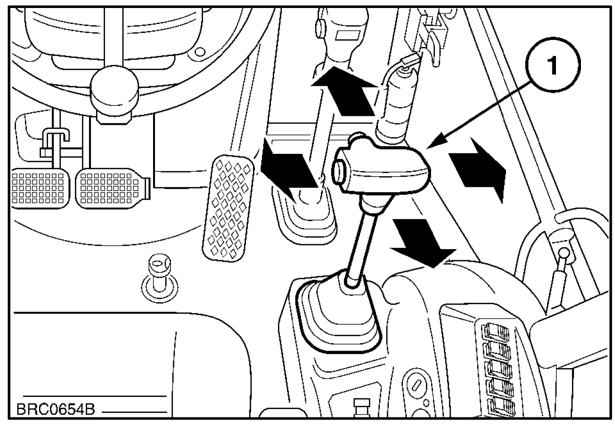
Removal

1. Lower loader to ground and position the dipstick in the vertical plane with bucket positioned firmly on the ground.



32

2. Stop the engine and relieve any residual pressure in the backhoe and loader circuits by moving the loader and backhoe control levers through all operating positions.



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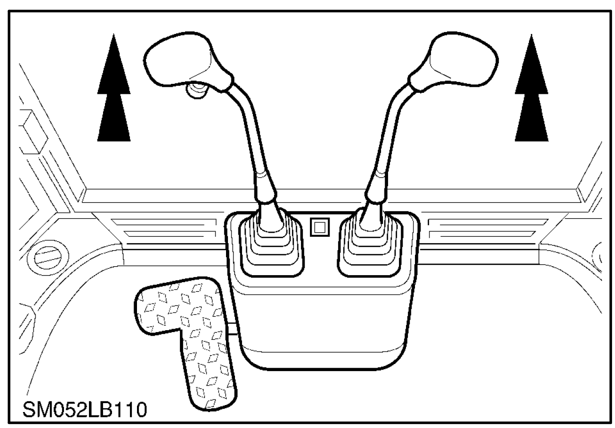
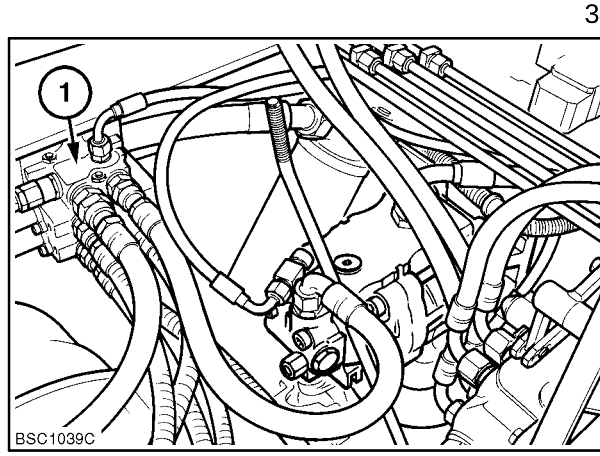


34

3. Disconnect the battery
4. Clean area around control valve
5. Disconnect each hose connection to the valve (1) and plug hose ends. The use of a drip tray will be required to catch oil draining from inside the hoses.

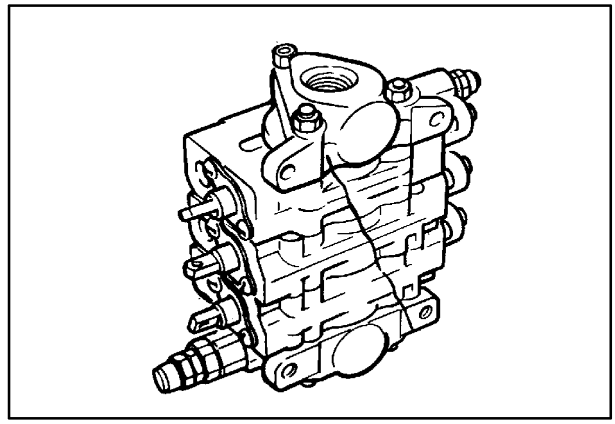


35

6. Remove valve from tractor.

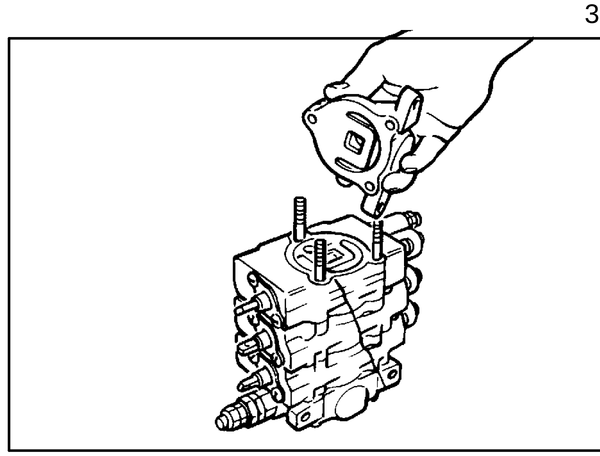
Disassembly

1. Prior to disassembly the valve should be thoroughly cleaned using an approved de–greasant.
2. Scribe a diagonal line across the valve sections to aid re–assembly.



36

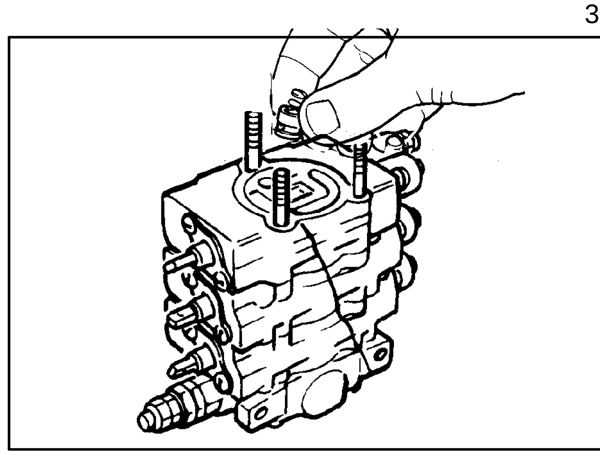
3. Remove outlet end cover and each valve section.



37

NOTE: *The check valve is only installed in the extendible dipper valve section.*

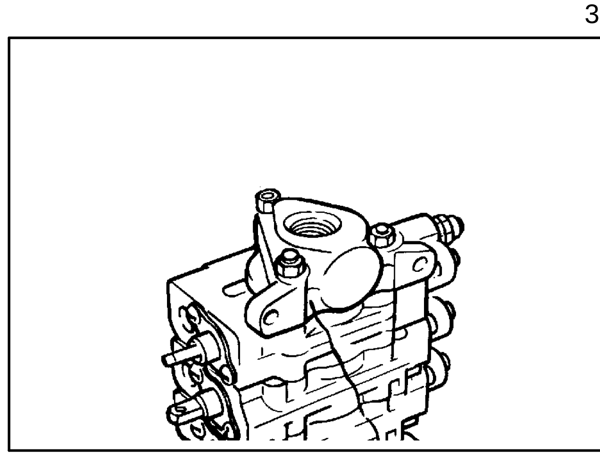
4. Disassemble the valve sections.



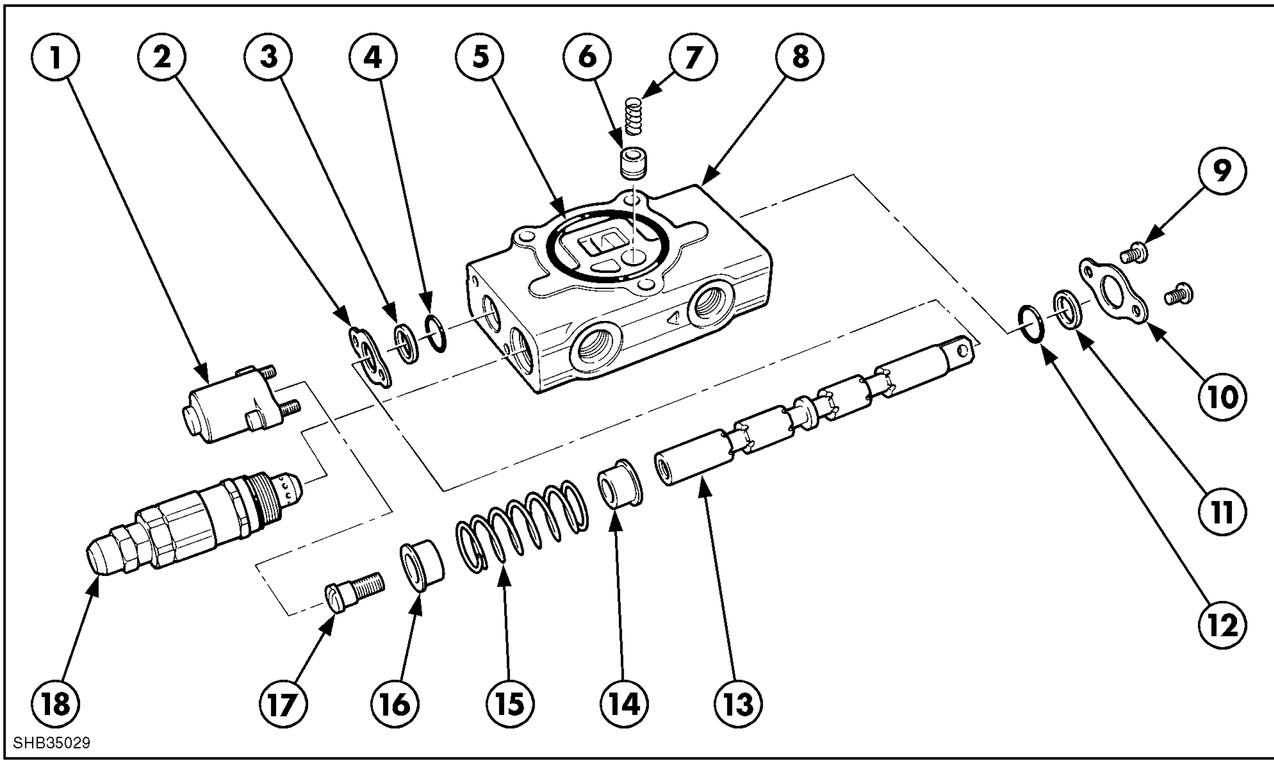
38

5. When re–assembling the valve stack progressively tighten the two smaller tie bar retaining nuts to a torque of 19 Nm (14 lbf.ft).

   Tighten the larger tie bar nut to a torque of 45 Nm (33 lbf.ft).



39



40

Extendible Dipstick Valve Components

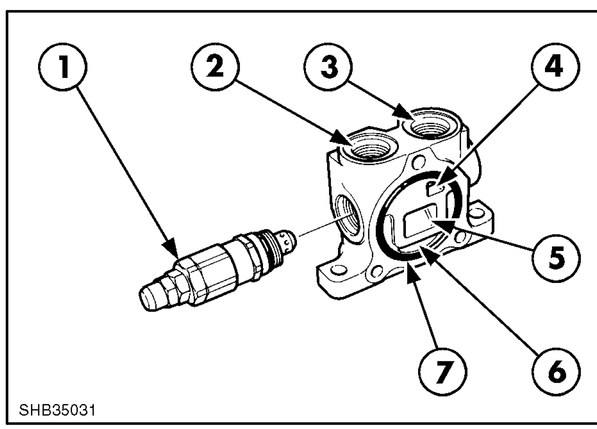
1. Spool Cap
2. Seal Plate
3. Wiper
4. 'O' Ring
5. 'O' Ring
6. Check Valve
7. Spring
8. Valve Body
9. Screws
10. Seal Plate
11. Wiper
12. O' Ring
13. Spool
14. Spring Seat
15. Spring
16. Spring Seat
17. Screw
18. Circuit Relief Valve

6. Disassemble the stabiliser and extendible dipper valve sections.

NOTE: *The stabiliser valve sections are not fitted with a check valve between each section.*

The rear pump relief valve and extendible dipper circuit relief valve can be serviced if required but must be re-adjusted prior to use.

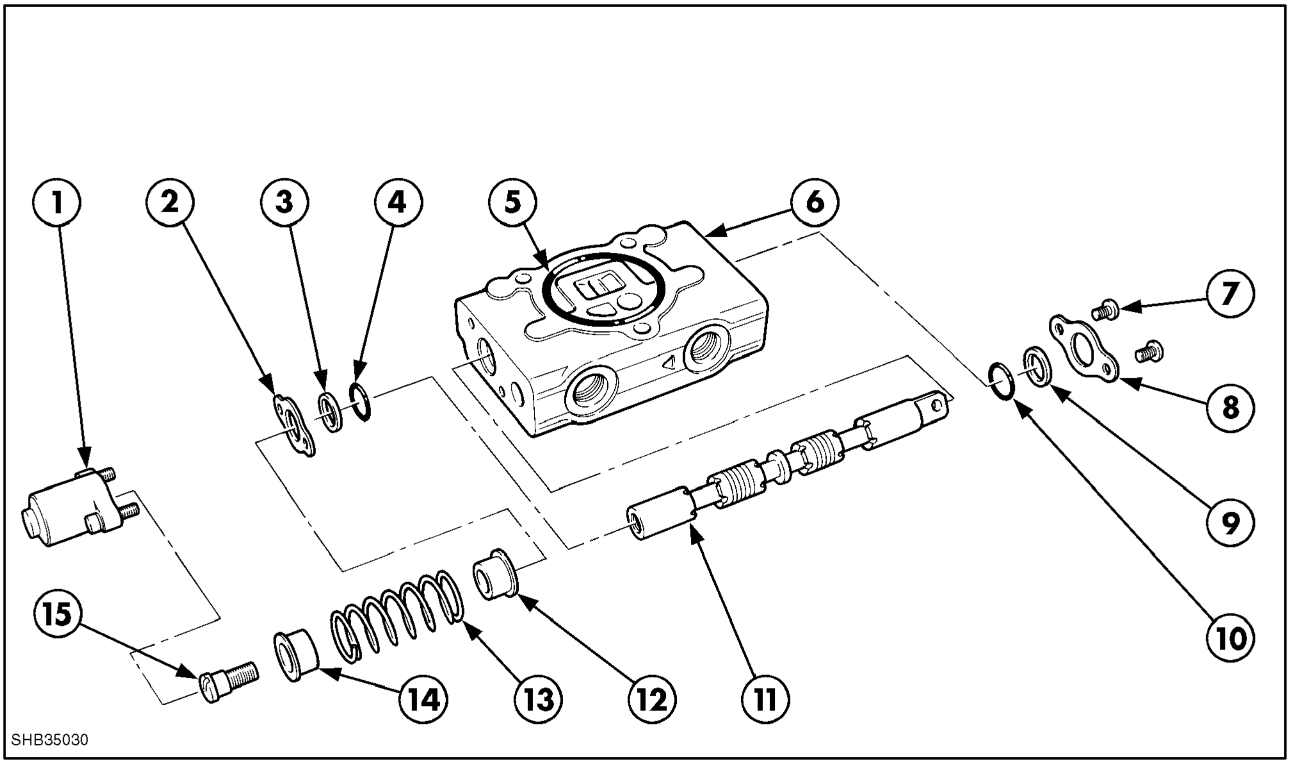
Refer to Circuit Relief Valve Overhaul and Pressure Testing Sections for further details.



41

Inlet End Cover

1. Rear Pump Relief Valve
2. Outlet From Exhaust Port
3. Inlet Port
4. Parallel Gallery
5. Open Centre Gallery
6. Exhaust Gallery
7. 'O' Ring



42

Stabiliser Valve Components

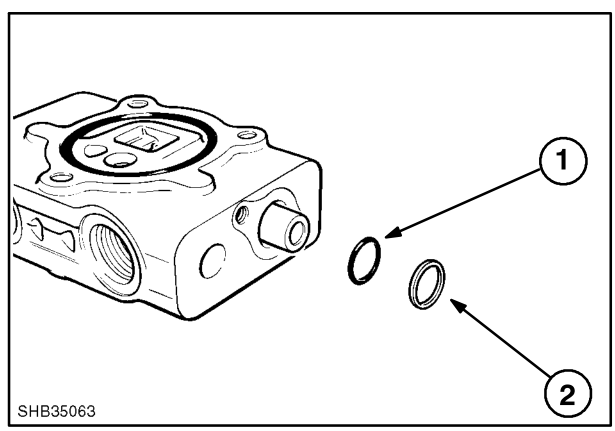
1. Spool Cap
2. Seal Plate
3. Wiper
4. 'O' Ring
5. 'O' Ring
6. Valve Body
7. Screws
8. Seal Plate
9. Wiper
10. 'O' Ring
11. Spool
12. Spring Seat
13. Spring
14. Spring Seat
15. Screw

Inspection

1. Wash components in an approved degreasant.
2. Inspect spool and bore for scoring and damage. If spool is baldly scored or worn the valve assembly must be replaced.

Re-assembly

1. Re-assembly follows disassembly procedure in reverse.
2. Lubricate spool before re-assembly.
3. To avoid damage to 'O' ring seals on either end of spools insert spool into valve housing before installing 'O' ring (1) and wiper (2).



43

NOTES

LOADER CONTROL VALVE

The loader control valve is located on the right hand side of the tractor and provides oil flow to the loader boom and bucket.

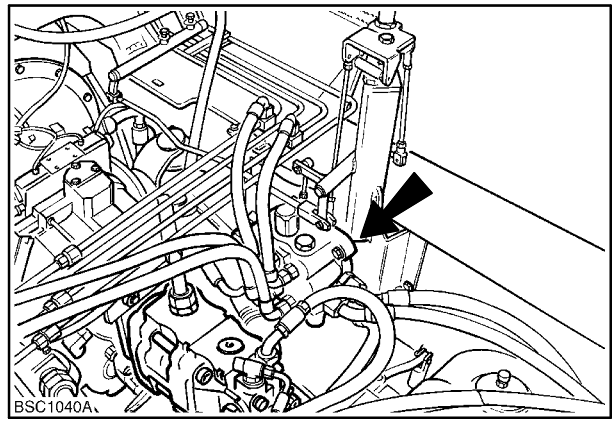
The control valve assembly is of the mono block design with a bolt on end cover.

Located within the mono block assembly are:–

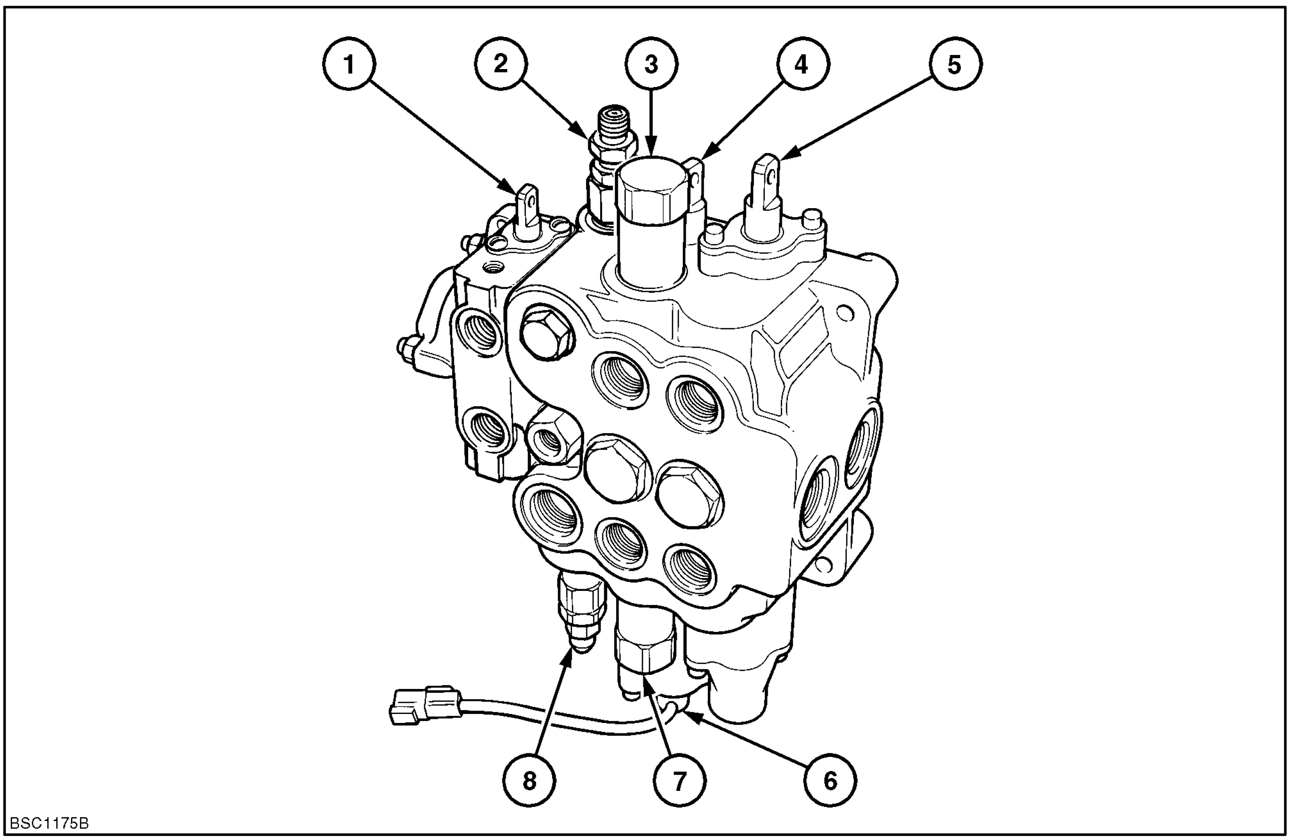
Loader Bucket Control Valve

Loader Arm Control Valve

The optional auxiliary valve section for operation of the multi function loader bucket may be installed between the inlet end cover and monoblock assembly as required.



44



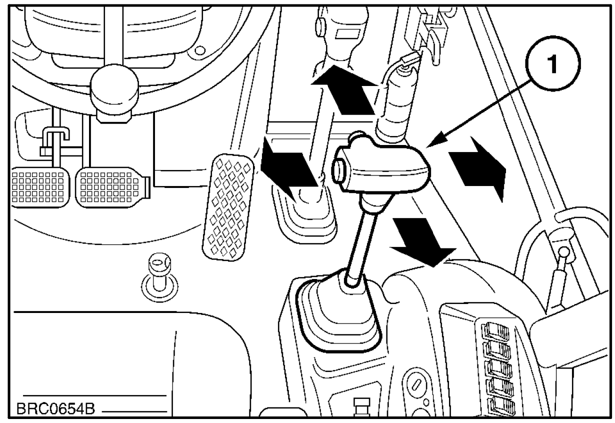
45

Loader Valve Assembly

1.	Auxiliary Multi Purpose Bucket Valve	
2.	Rear Pump Unload Valve	170 bar (2465 psi)
3.	Loader Bucket Relief Valve Rod End	227 bar (3300 psi)
4.	Bucket Control Valve Spool	
5.	Loader Control Valve Spool	
6.	Bucket Return To Dig Solenoid	
7.	Loader Bucket Relief Valve Piston End	160 bar (2300 psi)
8.	System Pressure Relief Valve	204 – 211 bar (2958 – 3059 psi)

The loader is operated using a single control lever (1) which is mechanically attached to the valve spools.

The button (2) on the side of the lever allows power to the transmission to be disconnected for increased power and loader control.



46

With the optional 4 in 1 bucket the loader lever is capable of 9 functions.

Lever back (1) – Loader arms lift

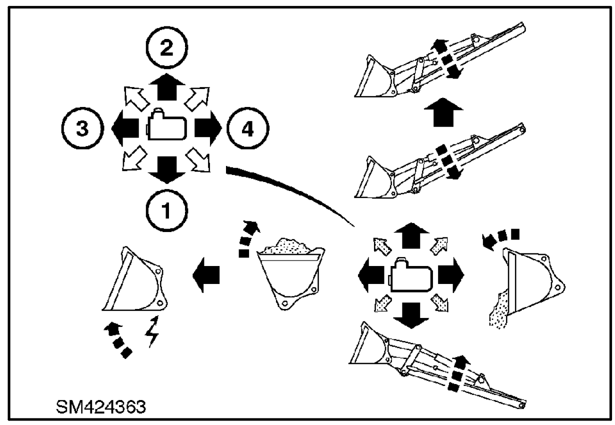
Lever forward (2) – Loader arms lower

Lever Fully Forward to detent – Loader arms float

Lever left (3) – Loader bucket roll back

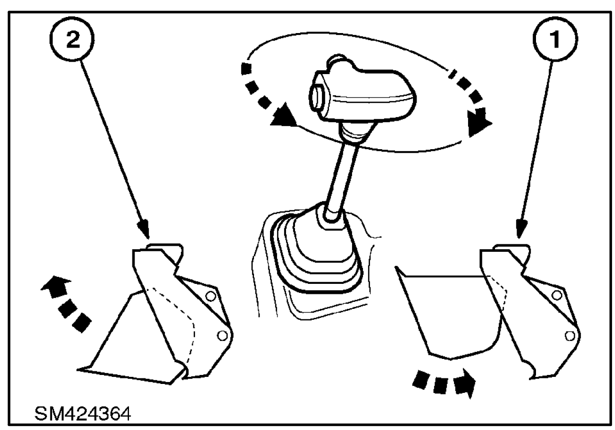
Lever right (4) – Loader bucket dumps

NOTE: *Combinations of loader lift arm and bucket action can be obtained by moving the lever in a diagonal direction*



47

When the optional multi purpose bucket is fitted the loader lever can be twisted clockwise to open the bucket clam or counter clockwise to close the clam.



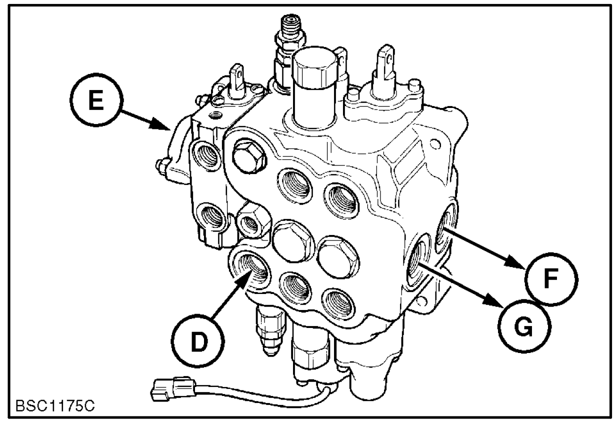
48

Hydraulic Oil Flow

Hydraulic oil supply to the loader valve comes from both the front and rear hydraulic pump assemblies.

Neutral

Oil supply from the front pump flows directly into the loader valve through port **D**. If the loader arm and bucket control valves are in neutral, oil flow continues through the staggered open centre gallery before exiting at port **F** to flow to the backhoe control valve at the rear of the machine.



49

Rear Pump Oil

Oil supply from the rear pump flows through port **E** and when the multi purpose valve is in neutral continues through the combined pump flow check valve to merge with the output from the front pump.

NOTE: *The unload valve shown in Figure 50 is not available for some markets and when not fitted is replaced with a solid shaft as shown in Figure 58.*

Spool Operation

When the bucket or loader control valves are operated, flow through the staggered open centre gallery is blocked by the operated spool and pump (system) pressure rises in the parallel gallery.

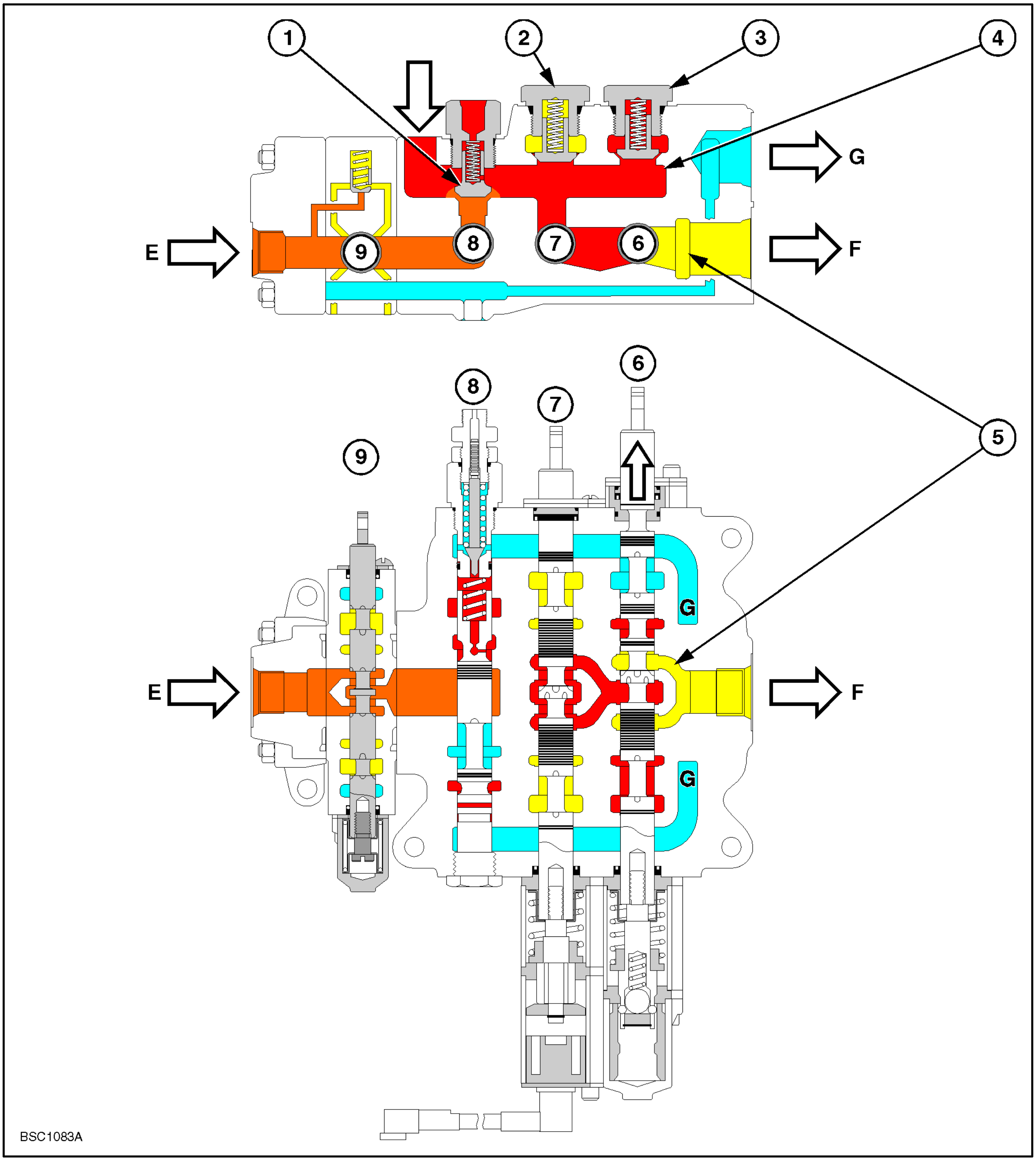
The rise in pressure in the parallel gallery lifts the circuit check valve of its seat and oil flows through the check valve and over the spool to operate the cylinder.

Exhaust oil from the operated cylinder returns through the control valve exhaust gallery and back to reservoir through port **G**.

NOTE: Because the parallel gallery feeds both the bucket and loader valve spools, simultaneous operation of the bucket and loader arm elements are possible.

Check Valve Operation

The circuit check valves prevent the reverse flow of oil if system pressure is insufficient to operate the cylinder. This can occur, for example, if the loader arms are raised with the bucket at full load while the engine is idling. Under this condition it is possible for system pressure to initially be too low to operate the cylinder and without the check valve the loader would slightly drop when the valve is operated until pump pressure rises.



50

Oil Flow Through Loader and Bucket Control Valve Assembly

Front Pump Flow	Trapped Oil
Rear Pump Flow	Return to Reservoir

Oil Flow Through Loader and Bucket Control Valve Assembly (refer to Fig 51)

Port D – Flow From Front Pump
Port E – Flow From Rear Pump
Port F – Flow to Backhoe Control Valve
Port G – Return to Reservoir From Bucket, Loader and Auxiliary Valves

1. Combined Pump Flow Check Valve
2. Bucket Circuit Check Valve
3. Loader Circuit Check Valve
4. Parallel Gallery
5. Staggered Open Centre Gallery
6. Loader Valve Spool
7. Bucket Valve Spool
8. Unload Valve (Where Fitted)
9. Auxiliary Multi Purposed 4 in 1 Valve Section

Loader Unload Valve Operation

An unload valve with sensing is installed to dump the rear pump flow when operating the loader, to provide more power to the transmission. The front pump is not affected, so the loader will have the same power, but will momentarily be slower. The operator may not notice the reduced speed, for as soon as the pressure drops below the preset limit, the rear pump flow is directed back to the loader.

System Pressure Below 170 bar (2465 psi)

Oil flow from the front pump enters the loader valve housing at port **D**.

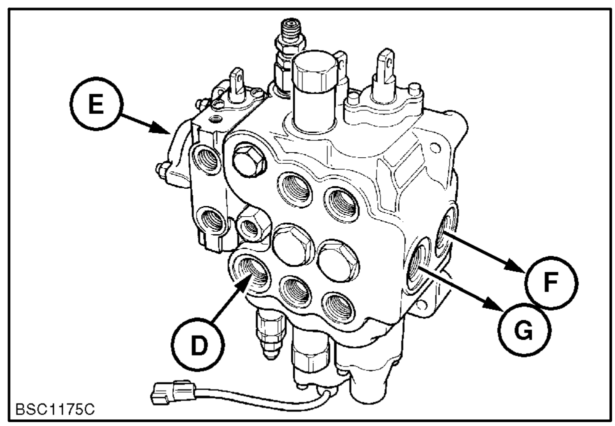
Oil flow from the rear pump enters the loader valve through the inlet end cover at port **E**.

When system pressure is less than 170 bar (2465 psi), the rear pump flow passes through the load check valve and merges with the flow from the front pump.

System Pressure above170 bar (2465 psi)

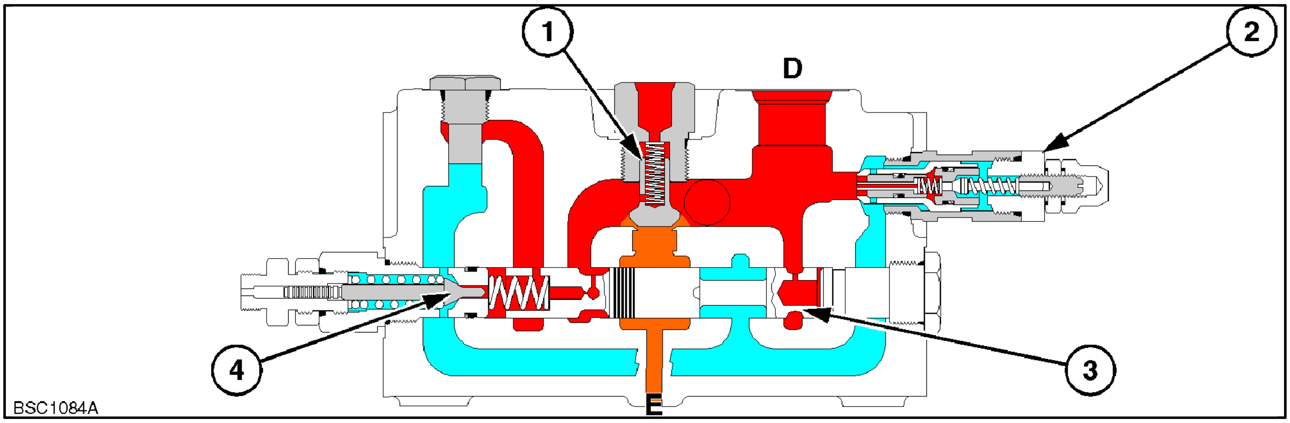
When system pressure rises to 170 bar (2465 psi), the rear pump flow back to reservoir through port **G**.

This reduced flow through the loader and backhoe control valves now allows a more precise control of the loader and backhoe elements.



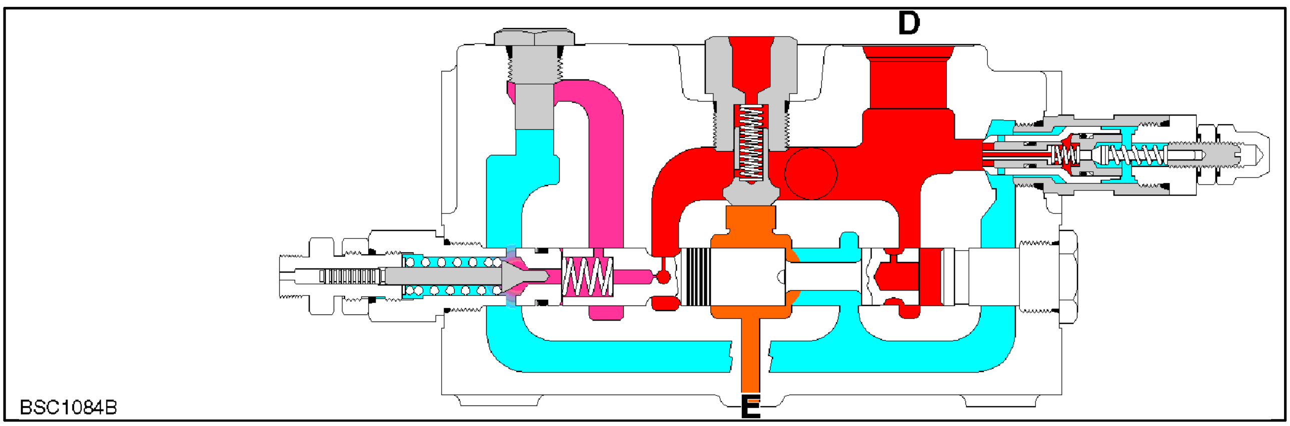
51

Unload Valve Operation



52

Oil Flow When Backhoe is in use



53

Oil Flow when Loader only is in use

(red)	Front Pump Flow	(pink)	Transfer Pressure
(orange)	Rear Pump Flow	(cyan)	Return to Tank

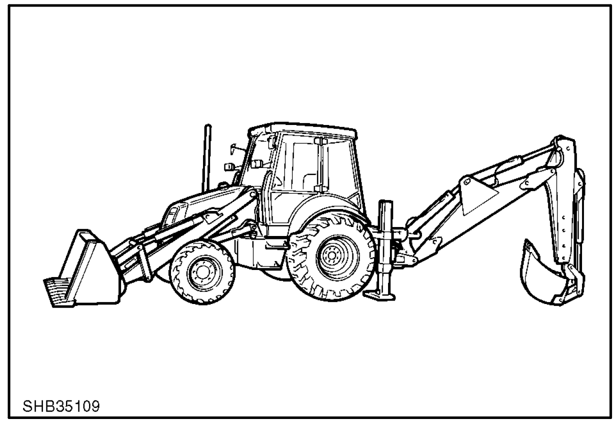
D. Flow From Front Pump
1. Unload Valve
2. Combined Pump Flow Load Check Valve

E. Flow From Rear Pump
3. System Pressure Relief Valve
4. Unload Spool

LOADER CONTROL VALVE OVERHAUL (OP NO. 35 701)

Removal

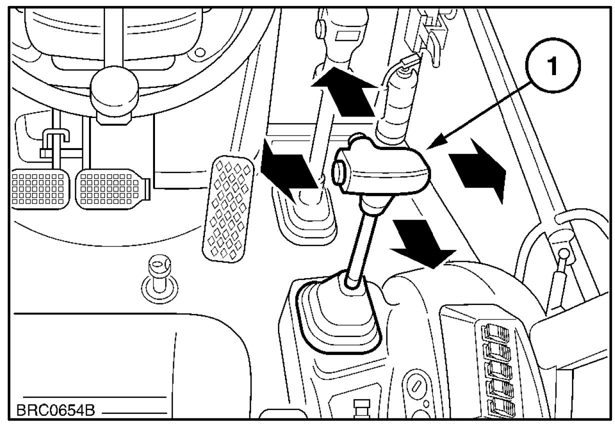
1. Lower loader to ground and position the dipstick in the vertical plane with bucket positioned firmly on the ground.



54

2. Stop the engine and relieve any residual pressure in the backhoe and loader circuits by moving the loader lever control levers through all operating positions.

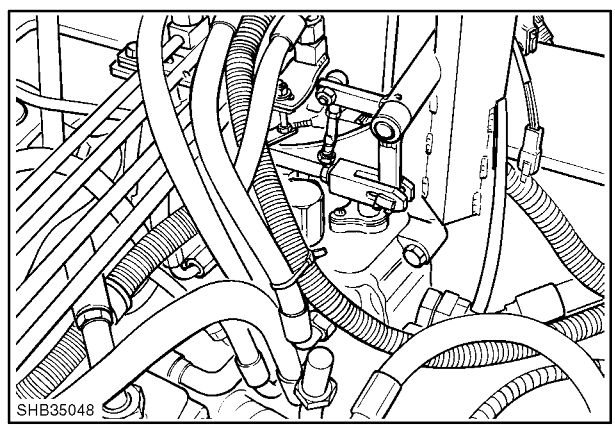
3. Disconnect the battery



55

4. Clean area around control valve

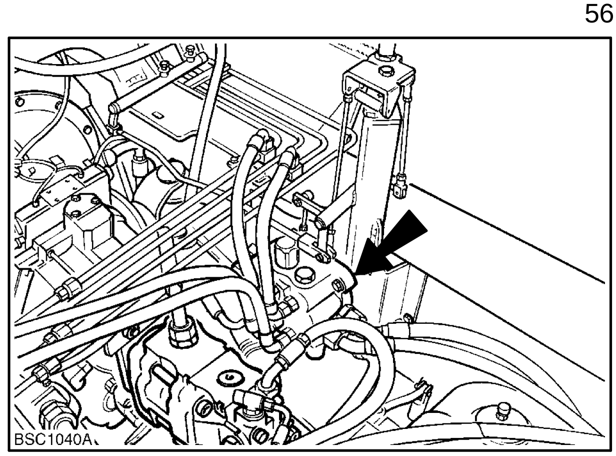
5. Disconnect control linkage.



56

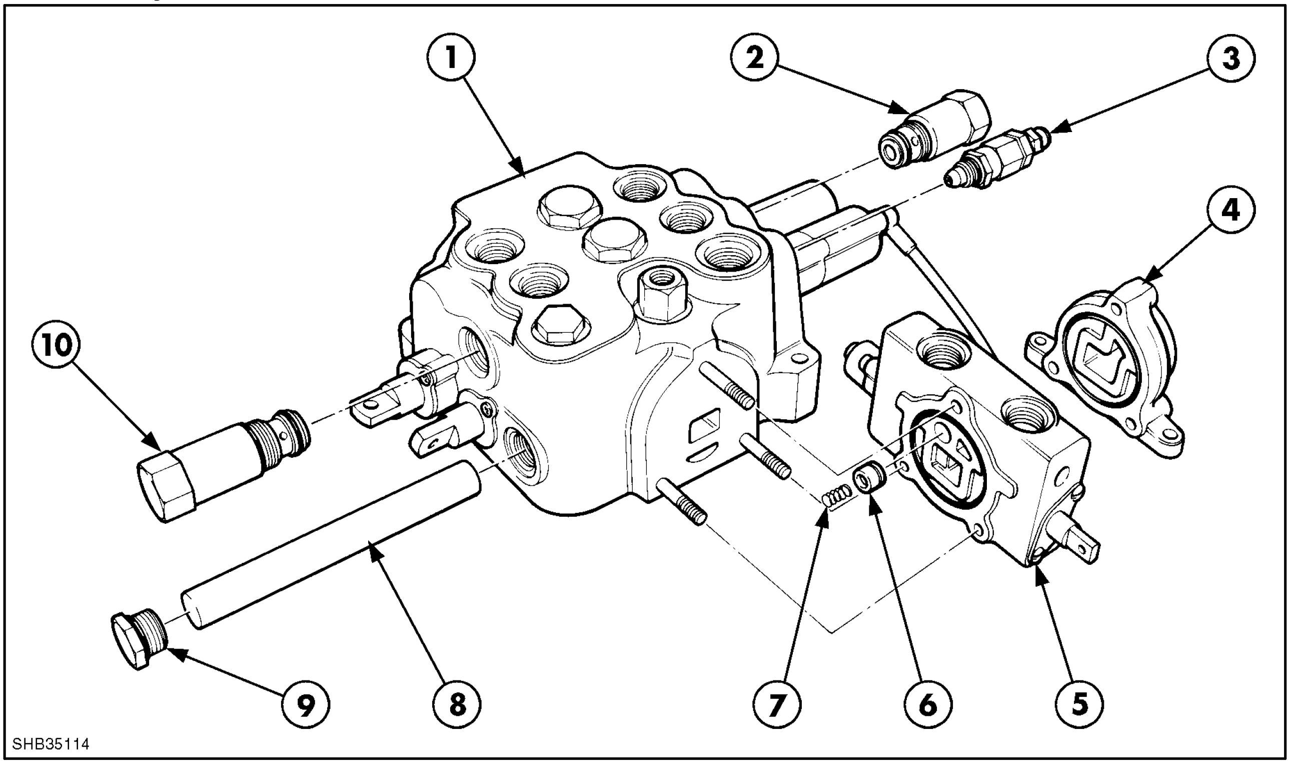
6. Identify, disconnect and cap hose connections to valve.

7. Remove valve from tractor.



57

Disassembly



58

Loader Control Valve Assembly Without Unload Valve Option

1. Housing
2. Loader Bucket Relief Valve (Piston End) 160 bar (2300 psi)
3. System Pressure Relief Valve @ 204 – 211 bar (2958 – 3059 psi)
4. End Cover
5. Auxiliary Multi Purpose Bucket Valve Section
6. Check Valve
7. Spring
8. Shaft
9. Plug
10. Loader Bucket Relief Valve (Rod End) @ 227 bar (3300 psi)

Prior to disassembly the valve should be thoroughly cleansed using an approved degreasent.

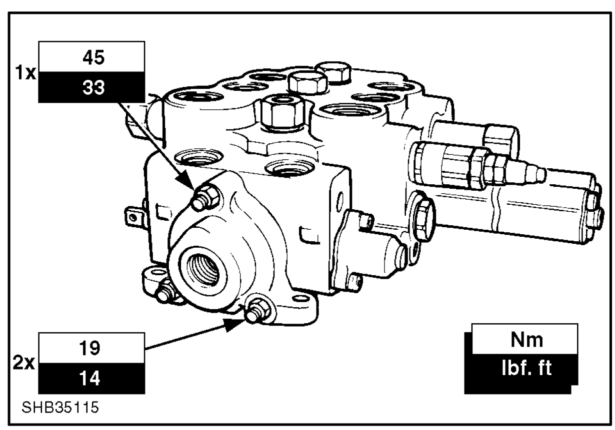
Disassemble inspect and overhaul with reference to Figures 59 to 66.

For details on the overhaul, pressure testing and adjustment of the circuit relief valves refer to Chapter 2.

When re–assembling the end cover progressively tighten the clamping bolts to following torques.

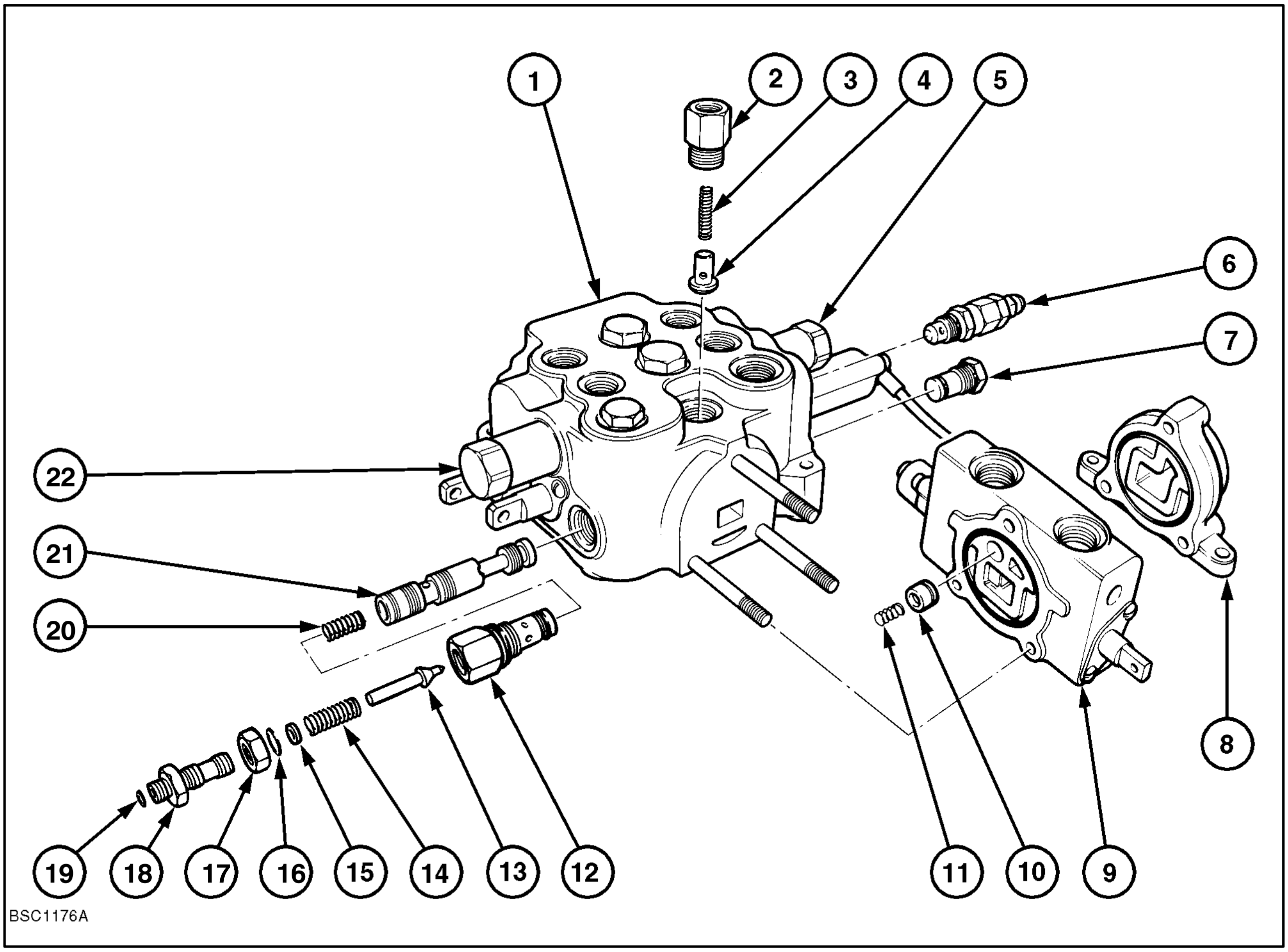
Larger clamp bolt	45 Nm (33 lbf/in^2)
Smaller clamp bolt	19 Nm (14 lbf/in^2)

Do Not over tighten.



59

Bucket and Loader Valve Sections



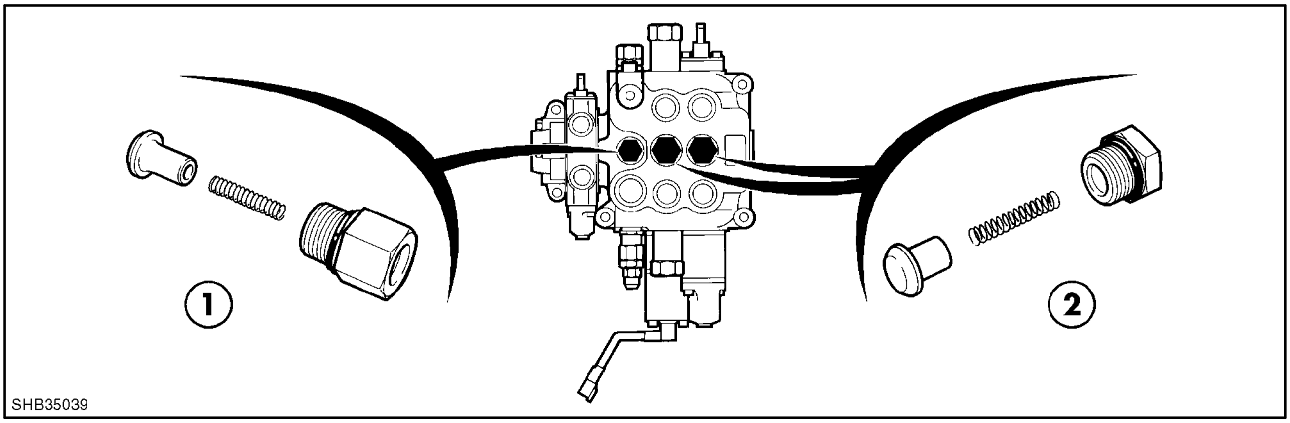
60

Loader Control Valve Assembly with Unload Valve

1. Housing
2. Connector
3. Spring
4. Check Valve
5. Loader Bucket Relief Valve – Piston End @ 160 bar (2300 psi)
6. Pilot Operated System Relief Valve @ 204 – 211 bar (22958 – 3059 psi)
7. Plug
8. End Cover
9. Auxiliary Bucket Valve Section
10. Check Valve
11. Spring
12. Unload Valve Housing
13. Poppet Valve
14. Spring
15. Shim
16. O ring
17. Locknut
18. adapter
19. O Ring
20. Spring
21. Unload Spool
22. Loader Bucket Relief Valve – Rod End @ 227 bar (3300 psi)
23.

NOTE: *The unload valve spool is selectively fitted to the valve bore and not serviced separately.*

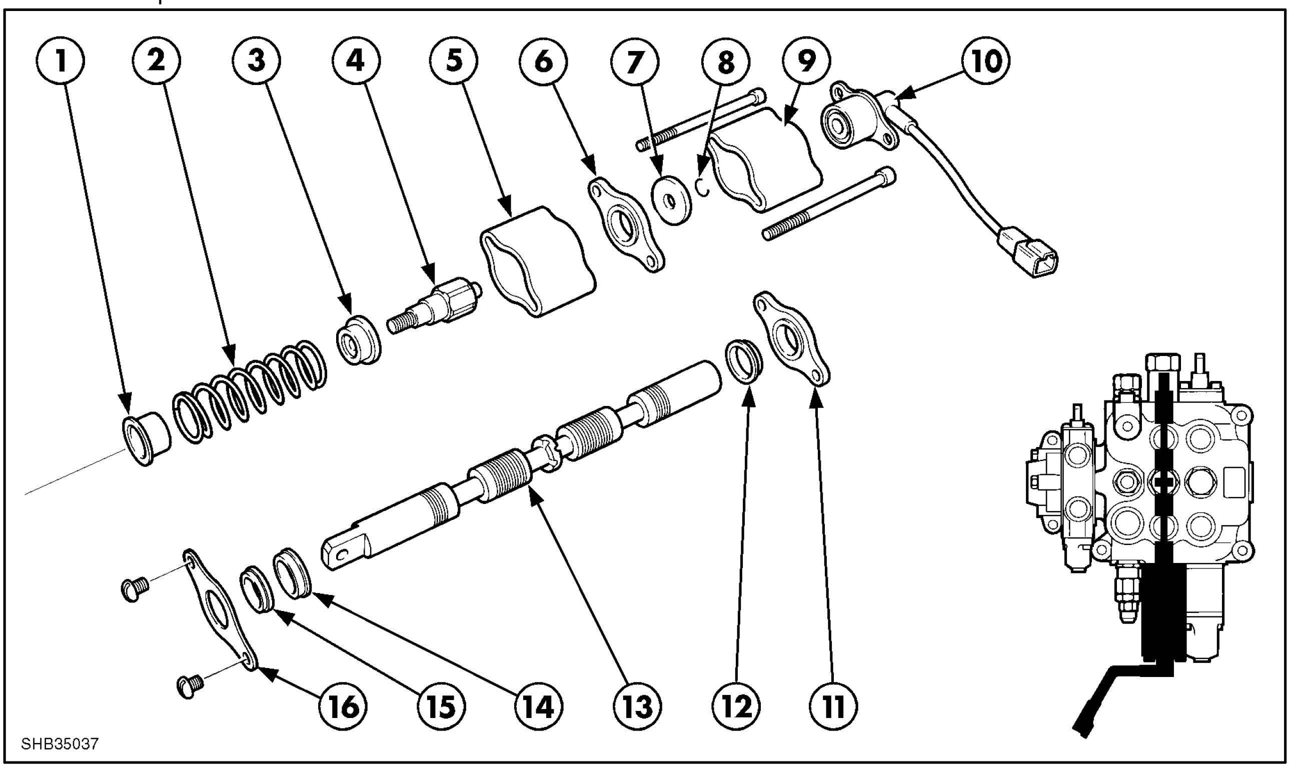
The operating characteristic of valves containing this modification is identical to loader valve assemblies containing components shown in Figure 59.



61

Load Check Valves

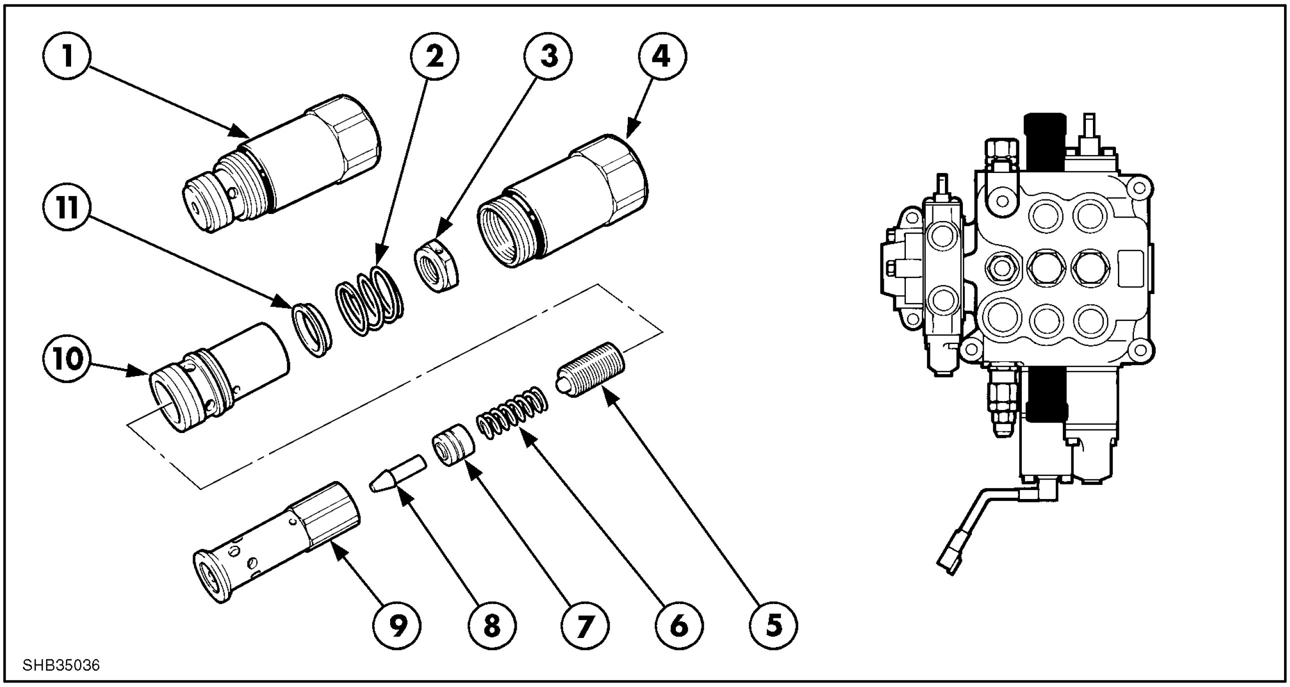
1. Main Pump Flow Check Valve
2. Bucket and Loader Valve Section Check Valves



62

Bucket Valve Components

1. Spring Seat
2. Spring
3. Spring Seat
4. Screw Retainer
5. Cover
6. Spacer
7. Washer
8. ‘C’ Clip
9. Cover
10. Return To Dig Electro Magnet
11. Seal Plate
12. Seal
13. Spool
14. Seal
15. Wiper
16. Seal Plate



63

Loader Bucket Circuit Relief Valves

1. Relief Valve Assembly
2. Spring
3. Lock Nut
4. Valve Body
5. Adjuster
6. Spring
7. Guide
8. Poppet
9. Poppet Sleeve
10. Valve Body Inner
11. Spring Seat

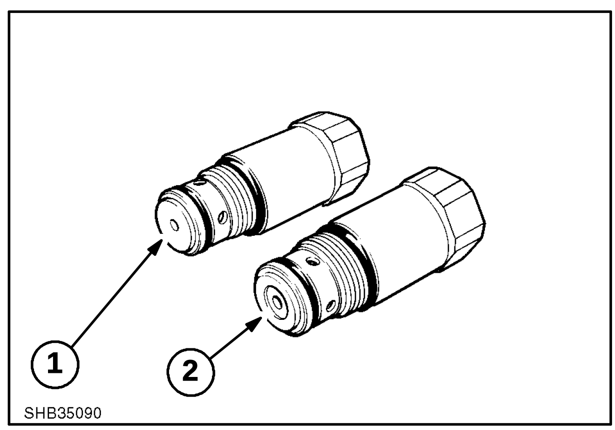
The piston and rod end loader bucket circuit relief valves are similar in operation but the end faces of some internal components are different.

Each relief valves can be identified by the size of hole in the centre of the plunger assembly.

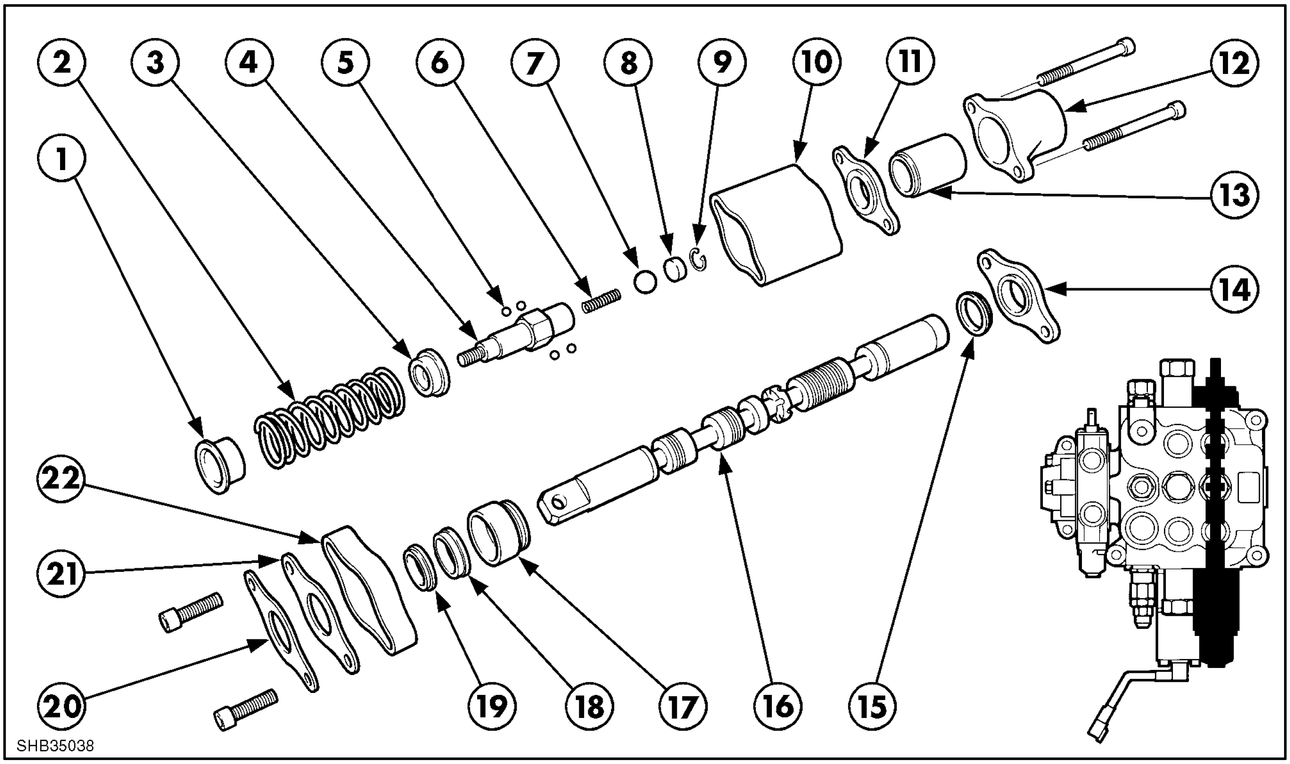
The bucket rod end relief valve (1) has the small hole and is set to a pressure of 227 bar (3300 psi).

The bucket piston end relief valve (2) has the larger hole and can also be identified by the recess on the face of the plunger assembly item. This valve is set to a pressure of 160 bar (2300 psi).

For further details on the operation, overhaul and adjustment of circuit relief valves used in the loader backhoe hydraulic system refer to Circuit Relief Valves principal of operation, Overhaul and adjustment.



64



65

Loader Valve Components

1. Spring Seat
2. Spring
3. Spring Seat
4. Detent
5. Detent Balls (4 off)
6. Spring
7. Ball Bearing
8. Cap
9. Circlip
10. Cover
11. Spacer
12. End Cap
13. Detent Collar
14. Seal Plate
15. Seal
16. Spool
17. Collar
18. Seal
19. Wiper
20. End Cover
21. Seal Plate
22. Cover

Inspection

The bucket and loader valve spools are selectively fitted to each valve bore and if damaged the mono block assembly must be replaced.

Inspect spool and bore for scores.

Re–Assembly

Re–assembly follows the disassembly procedure in reverse.

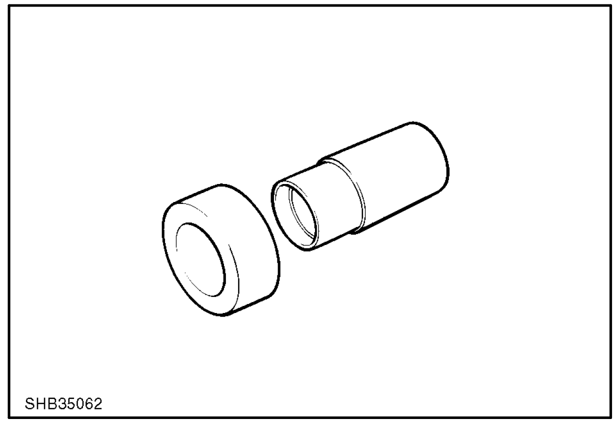
During re–assembly the seals on either end of the spools must be installed using seal insertion Tool **297419**.

If the tool is not used the lip seals will be damaged and subsequently leak.

The use of this tool is described on the following pages.

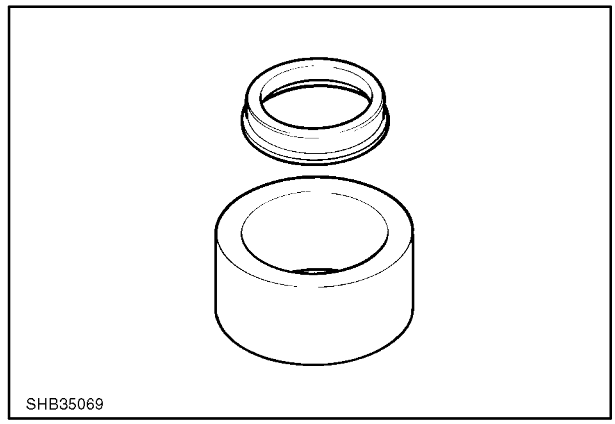
Re–Assembly of Bucket and Loader Spools

Re–assembly of the spools and seals requires special care and the use of Tool No **297419** must be used to prevent damage.



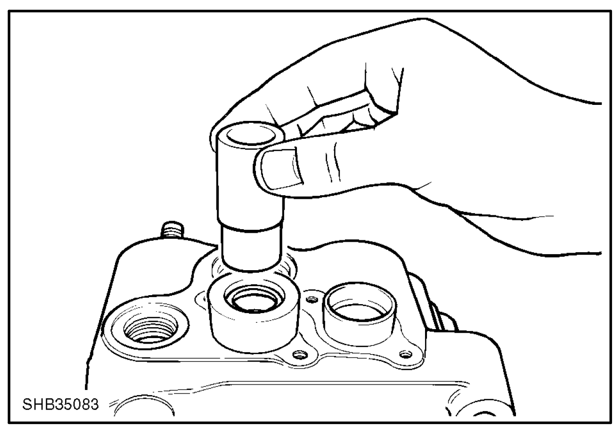
66

1. Insert oil seal into tool. Ensure lip on seals is facing outwards.



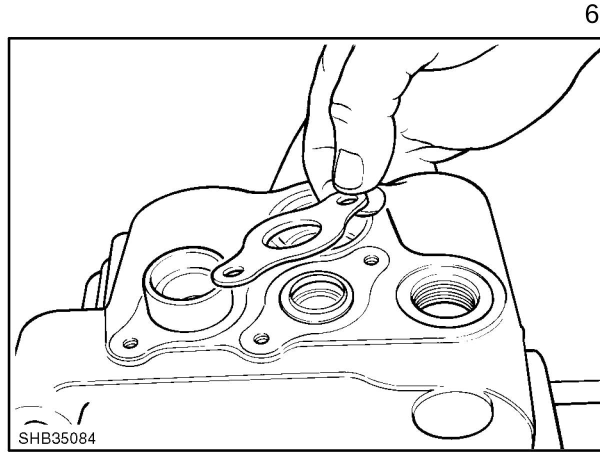
67

2. Position tool in counterbore on spool linkage side of valve housing and press seal into position.



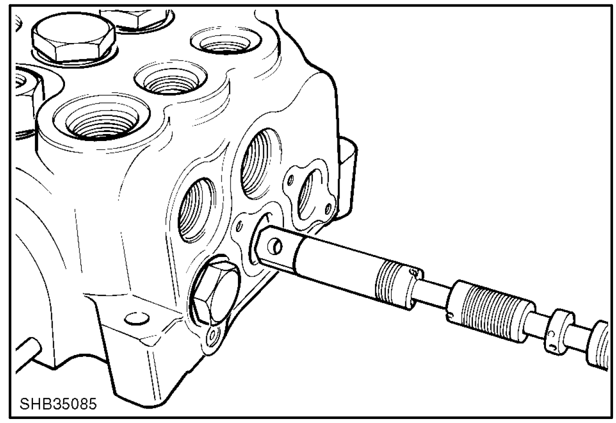
68

3. Install wiper seal and seal plate.



69

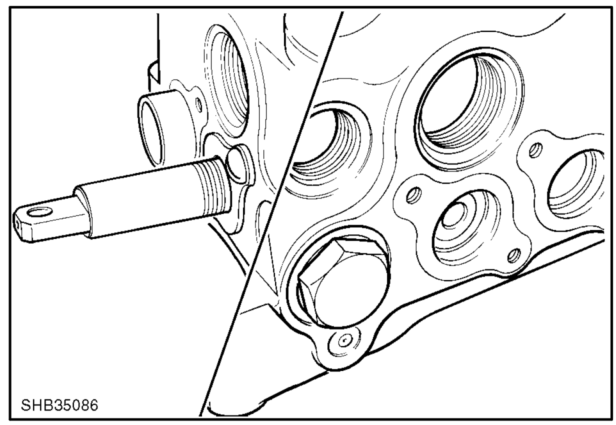
4. Lubricate spool and insert into end of bore which **has not** yet been installed with seals. Push spool through bore until end of spool passes through seal.



70

5. Continue pushing spool through bore until rear face of spool is just below the counterbore into which the remaining seal is to be installed.

NOTE: *When pushing seal through bore the feathering grooves on the spool will pass through the front seal. These will not damage the seal but* ***Do Not*** *allow the sharp metering lands to pass through the seal otherwise damage and leakage will occur.*

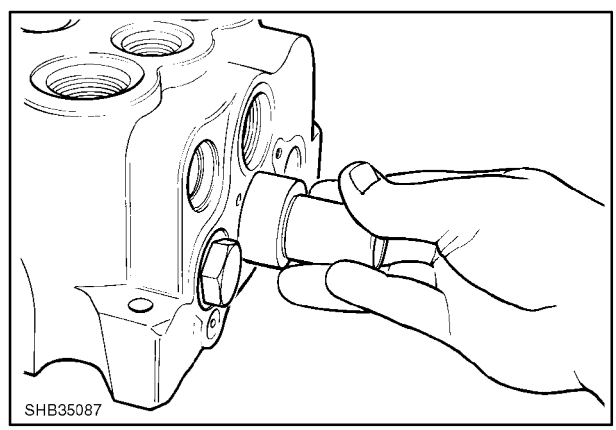


71

6. Install seal into counterbore on spool spring centered side of valve housing.

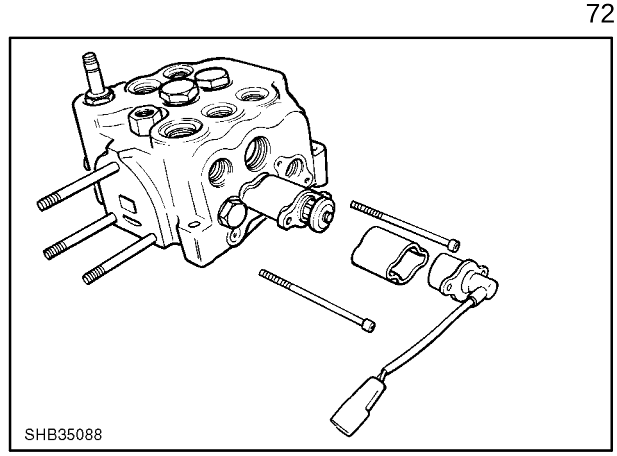
NOTE: *A dust seal is not fitted on the spring centred end of the loader and bucket spool bore.*

7. Use the metal portion of the seal installation tool to hold the seal in position and gently centre the spool in the housing.



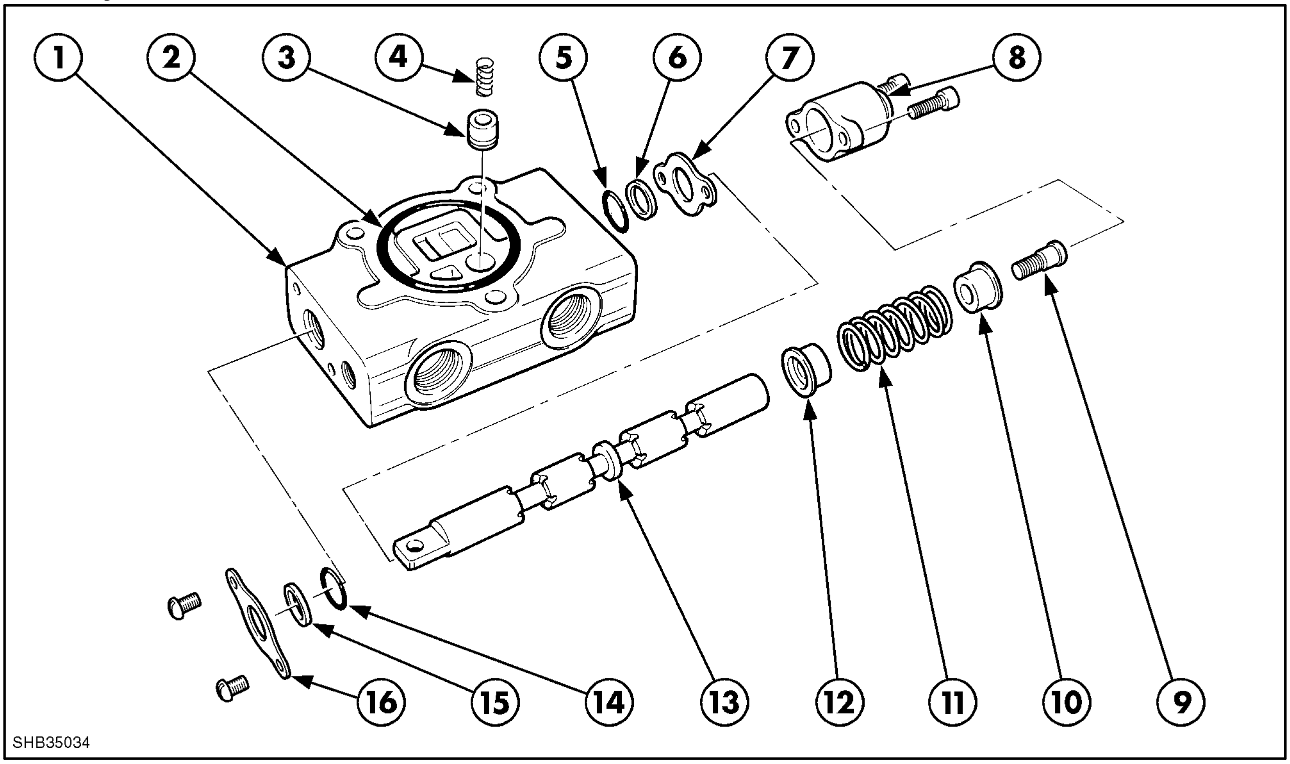
72

8. Assemble centering spring onto end of spool.



73

Auxiliary Valve Section



74

Auxiliary Multi Purpose Bucket Valve Section

1. Valve Housing
2. ‘O’ Ring
3. Check Valve
4. Spring
5. ‘O’ Ring
6. Wiper Seal
7. Seal Plate
8. Cap
9. Screw
10. Seat
11. Spring
12. Seat
13. Spool
14. ‘O’ Ring
15. Wiper Seal
16. Seal Plate

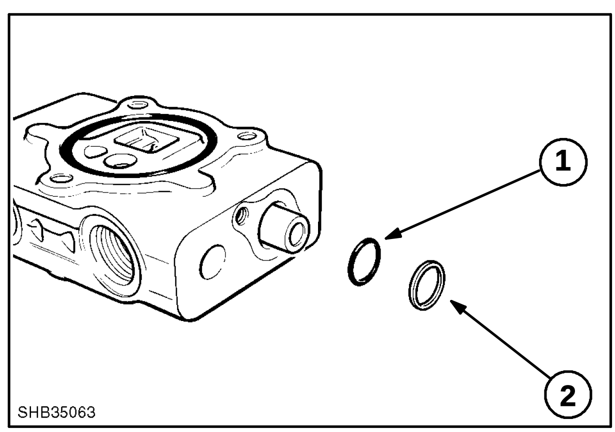
Inspection

The auxiliary valve section is also serviced as a complete assembly.

1. Wash components in an approved degreasent.
2. Inspect spool and bore for scoring and damage. If spool is baldly scored or worn the valve assembly must be replaced.

Re–assembly

1. Re–assembly follows disassembly procedure in reverse.
2. When re–assembling valve install spool into valve housing before installing ‘O’ ring (1) and wiper (2). If ‘O’ rings are installed before installation of spool damage to the ‘O’ rings and consequent leakage will occur.



75

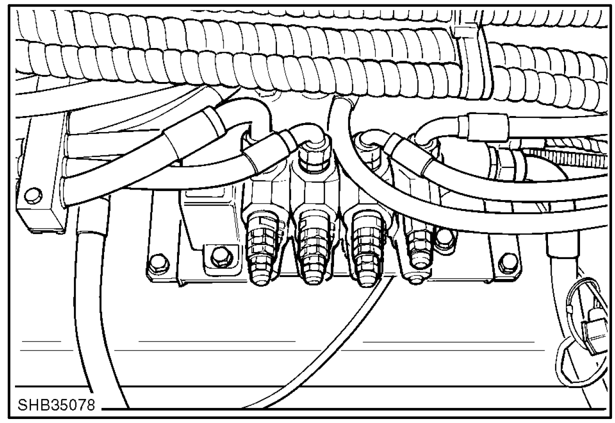
NOTES

BACKHOE CONTROL VALVES

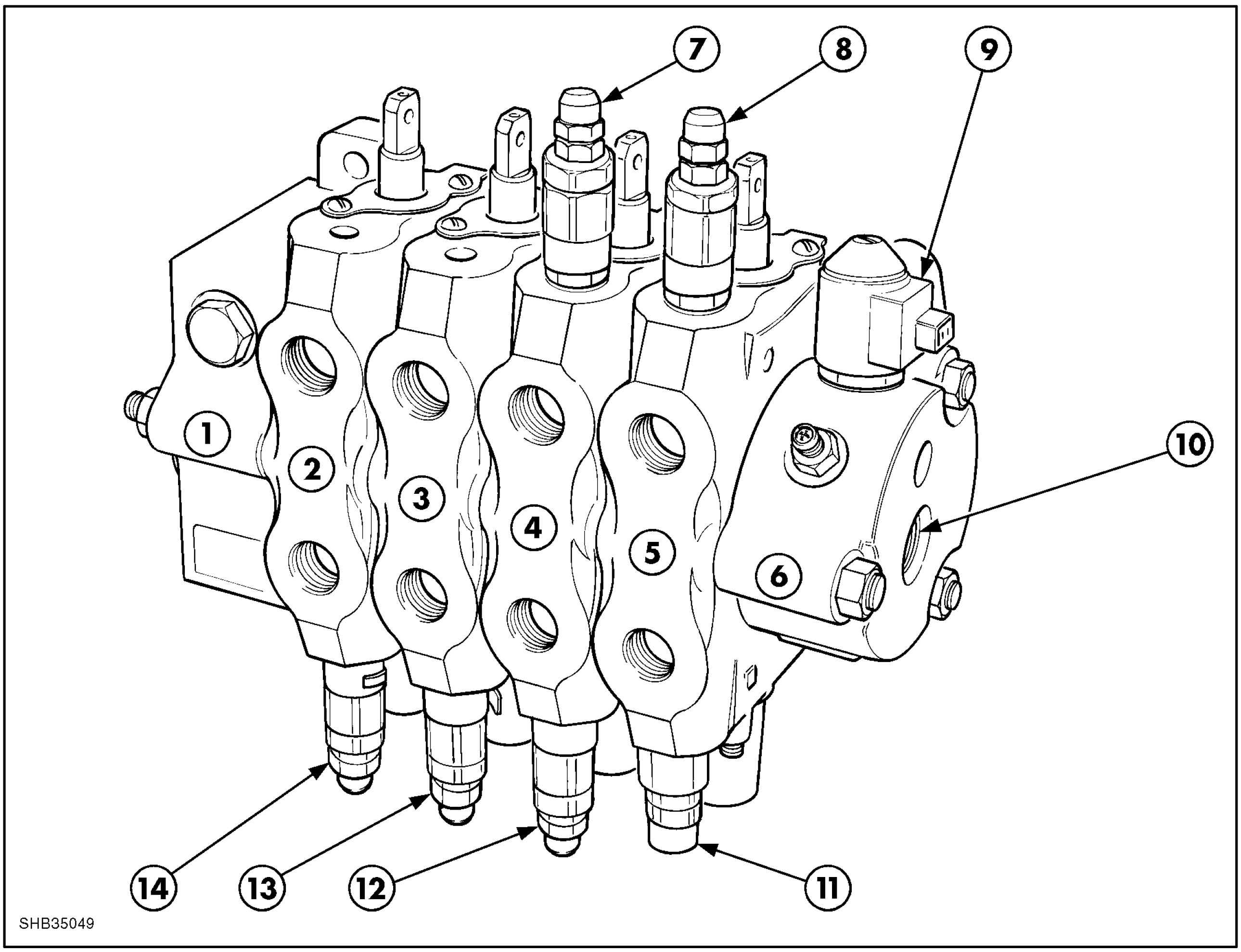
The backhoe control valve assembly located at the rear of the tractor is a stack type assembly containing four valve sections, together with an inlet and outlet end cover.

The valve assembly allows operation of the following functions

- Backhoe Sideshift Clamp System
- Boom Lift and lower
- Backhoe Swing
- Bucket
- Dipper



76



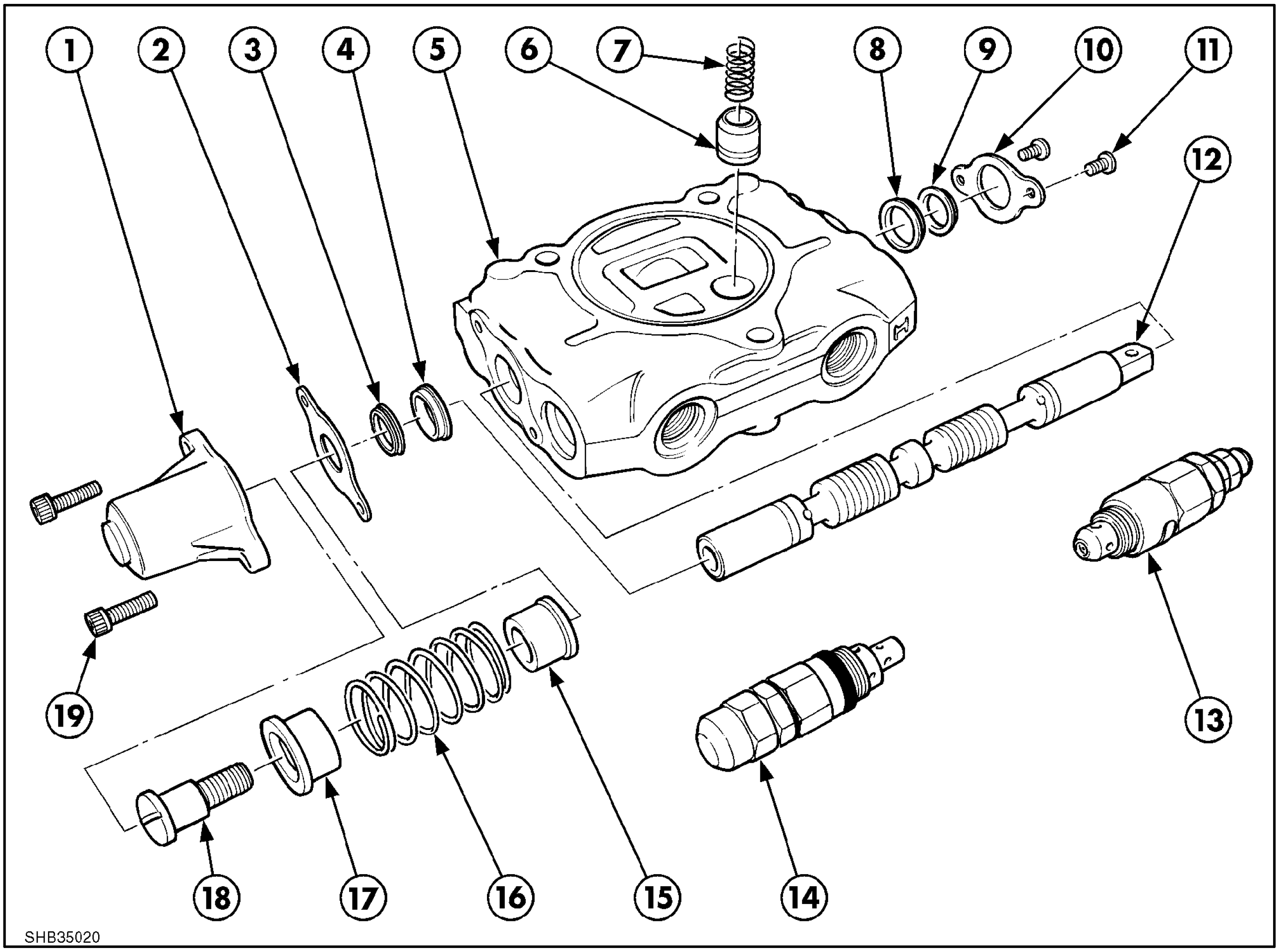
77

Backhoe Control Valve Assembly

1. Outlet End Cover
2. Dipper Control Valve
3. Bucket Control Valve
4. Swing Control Valve
5. Boom Control Valve
6. Inlet End Cover
7. Swing Cylinder Relief Valve*
8. Lift Cylinder Piston End Relief Valve*
9. Clamp Valve Dump Solenoid
10. Inlet End Cover (Flow From Loader Valve Assembly)
11. Lift Cylinder Rod End Direct Acting Relief Valve
12. Swing Cylinder Relief Valve*
13. Bucket Cylinder Rod End Relief Valve*
14. Dipper Cylinder Relief Valve*

* Pilot Operated With Anti-Cavitation Feature

Valve Sections



78

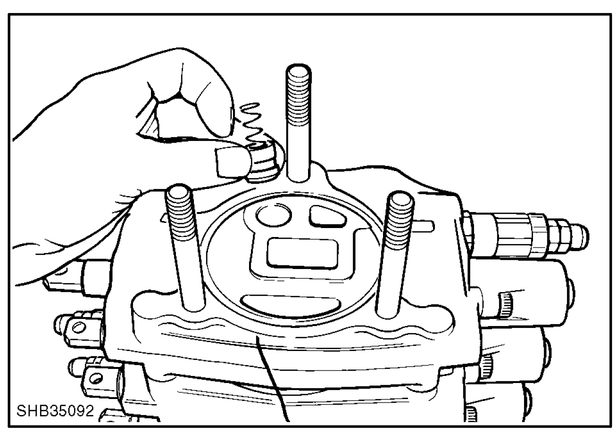
Typical Valve Section – Boom Valve Shown

1. Spool Cap
2. Seal Plate
3. Wiper
4. Seal
5. Housing
6. Check Valve
7. Spring
8. Seal
9. Wiper
10. Seal Plate
11. Screws
12. Spool
13. Circuit Relief Valve
14. Circuit Relief Valve
15. Spring Seat
16. Spring
17. Spring Seat
18. Screw
19. Allen Screw

The valve sections contain a manually operated spool which is non detented and sprung centered back to the neutral position.

The spool directs the flow of high pressure circuit oil to either the piston or rod end of the cylinder in the circuit it controls.

The spring loaded check valve located between each valve section prevents the back flow of oil from the cylinder to the pump pressure supply gallery.



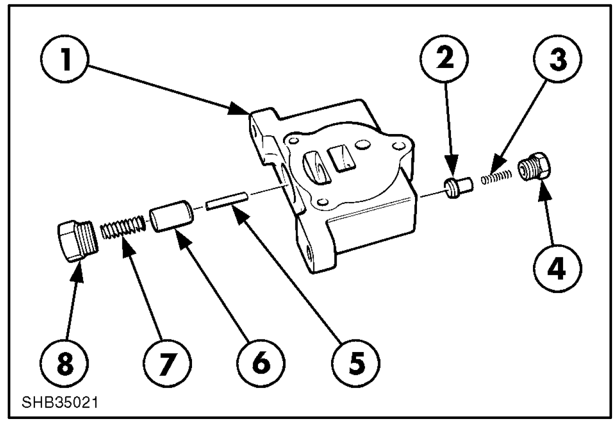
79

Outlet End Cover

The outlet end cover incorporates a back pressure valve and regenerative check valve for improved control of the digging elements.

Outlet End Cover

1. Outlet End Cover
2. Regenerative Check Valve
3. Spring
4. Plug
5. Plunger
6. Back Pressure Valve
7. Spring
8. Plug



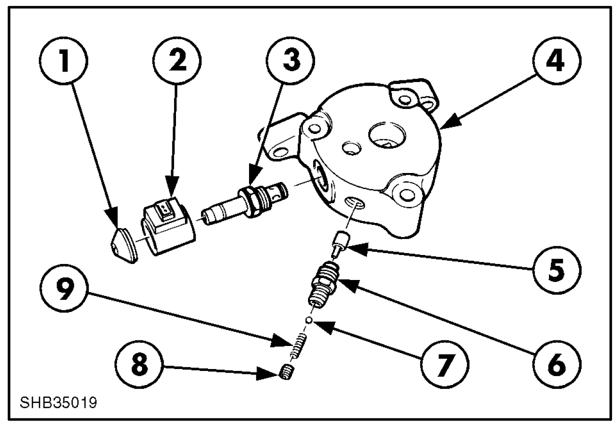
80

Inlet End Cover

On side shift models the inlet end cover contains the solenoid and clamp system check valve which enables the backhoe carriage to be clamped in position on the carriage frame.

Inlet End Cover

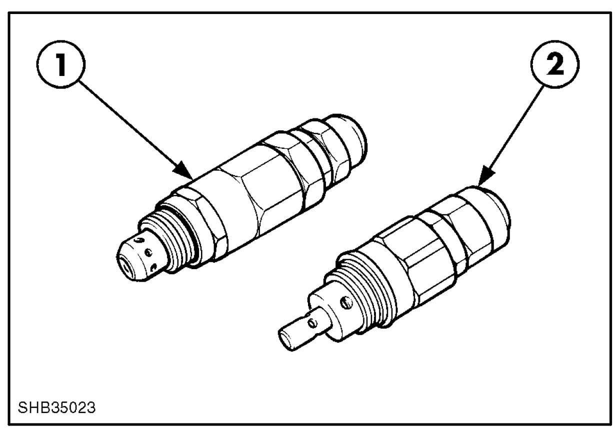
1. Cap
2. Solenoid Coil
3. Clamp Cylinder Dump Valve
4. Inlet End Cover
5. Plunger
6. Check Valve Housing
7. Ball
8. Retainer
9. Spring



81

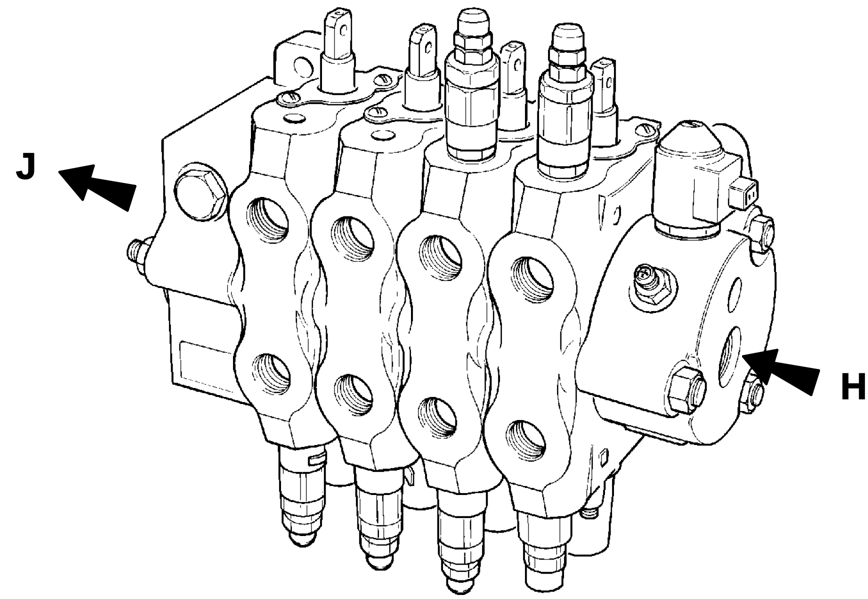
Circuit Relief Valves

Pilot operated with anti–cavitation feature (1) and direct acting circuit circuit relief valves (2) are installed in those circuits which through normal digging operations are subjected to unavoidable circuit overload.



82

Hydraulic Oil Flow



83

Flow from the loader control valve assembly enters the backhoe control valve at port **H**.

Neutral

When all control valve sections are in neutral pump oil flows through the staggered open centre gallery and returns to reservoir through port **J**.

Spool Operation

When a control valve spool is operated flow through the staggered open centre gallery is blocked.

Pump pressure will now rise with a corresponding rise of pressure in the parallel gallery which is blocked at the outlet end cover.

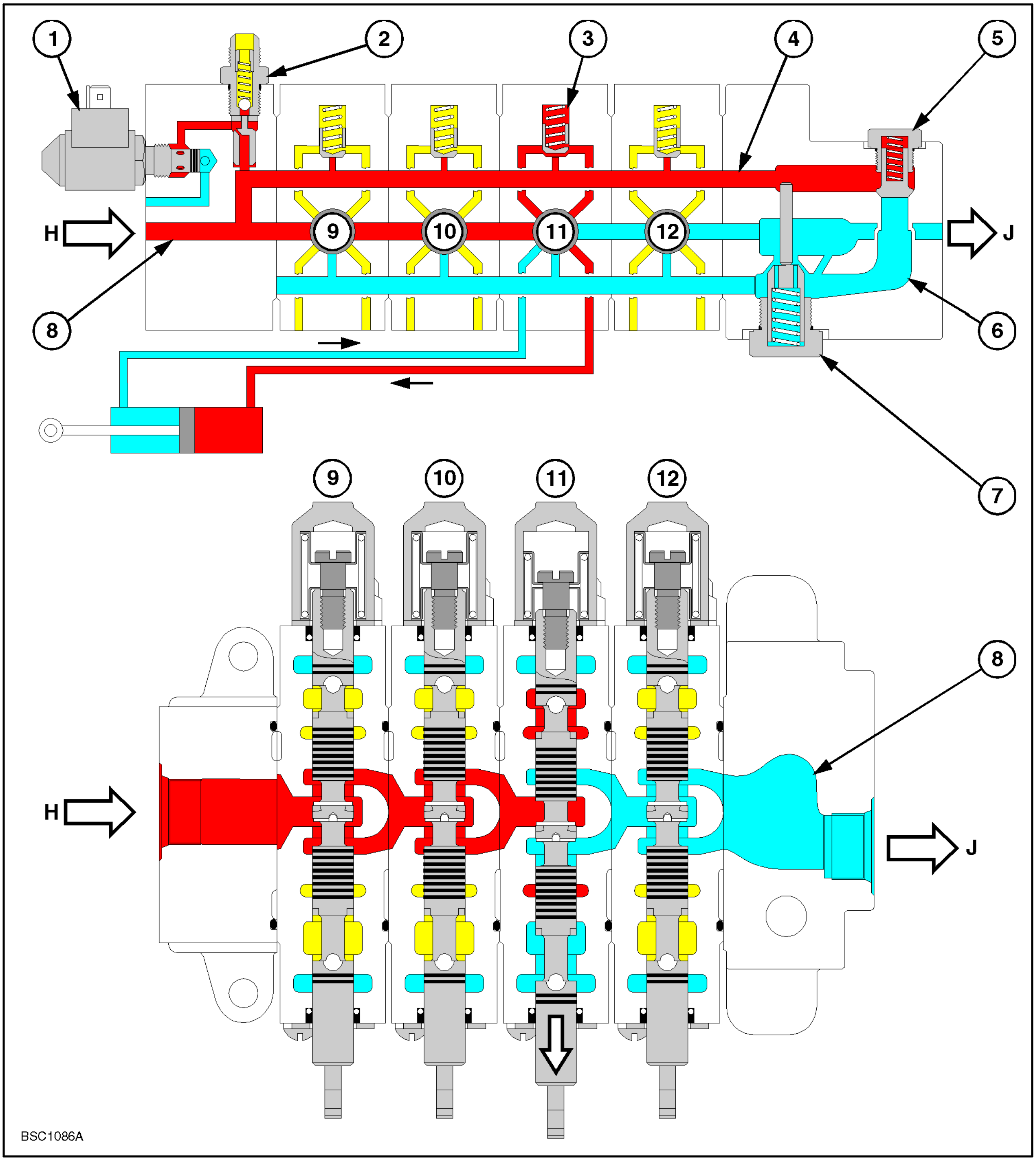
When a spool is operated the oil behind the circuit check valve is no longer trapped. The rise in system pressure in the parallel gallery lifts the check valve of its seat and oil flows through the valve to operate the cylinder.

Check Valve Operation

The check valve prevents the back flow of oil if pump pressure is insufficient to operate the cylinder. This could occur for example if the boom is raised when at full reach and full load while the engine is idling and pump pressure is initially to low to operate the cylinder. Under these conditions and without the presence of the check valve the boom would initially drop when the spool is operated.

Exhaust Oil

Exhaust oil from the cylinder returns via the spool through the control valve exhaust gallery and back to reservoir via the back pressure valve.



84

Oil Flow Through Backhoe Control Valve Sections

Pump Pressure Oil

Return to Reservoir

Port H – Pump Flow from Loader Valve

1. Clamp System Dump Solenoid
2. Clamp System Check Valve
3. Valve Section Check Valve
4. Parallel Gallery
5. Regenerative Check Valve
6. Control Valve Exhaust Gallery

Port J – Return to Reservoir

7. Back Pressure Valve
8. Staggered Open Centre Gallery
9. Boom Cylinder Control Valve
10. Swing Cylinder Control Valve
11. Bucket Cylinder Control Valve
12. Dipper Cylinder Control Valve

OIl Flow Through Backhoe Control Valve

Control Valve In Neutral

When a control valve is in neutral the oil in a cylinder is trapped by the spool and pump oil flows through the staggered open centre gallery.

Oil in the parallel gallery is at pump pressure.

The trapped oil in the ‘D’ shaped gallery holds the check valve on its seat.

There is no exhaust from the cylinder and the oil in the control valve exhaust gallery is static.

Control Valve Operating

When the valve spool is moved either left or right to extend or retract a cylinder flow through the staggered open centre gallery is blocked.

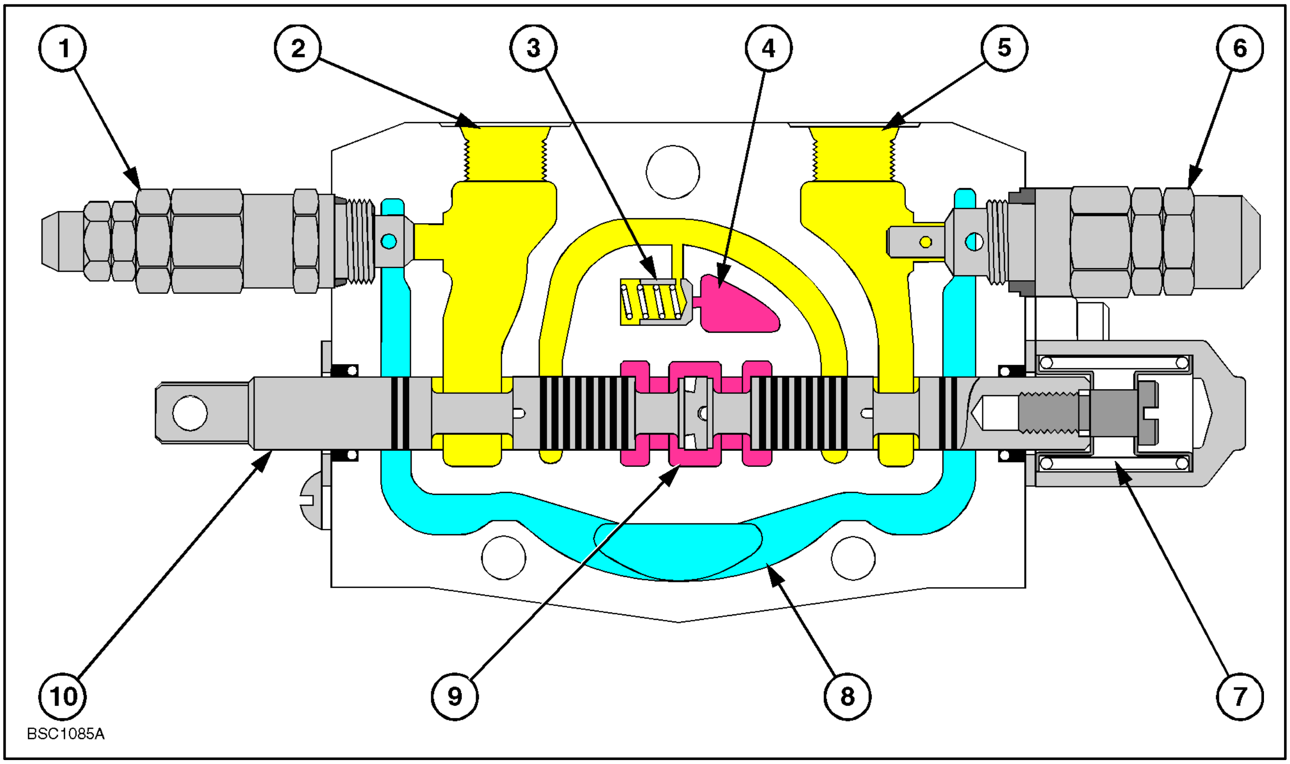
Pump pressure in the staggered and parallel galleries will rise.

Moving the spool joins one cylinder port to reservoir and the other to the ‘D’ shaped gallery behind the check valve. As pump pressure rises in the parallel gallery the check valve will open and oil will flow through the ‘D’ shaped gallery to the cylinder port.

Exhaust oil from the cylinder flows into the control valve exhaust gallery and returns to reservoir.

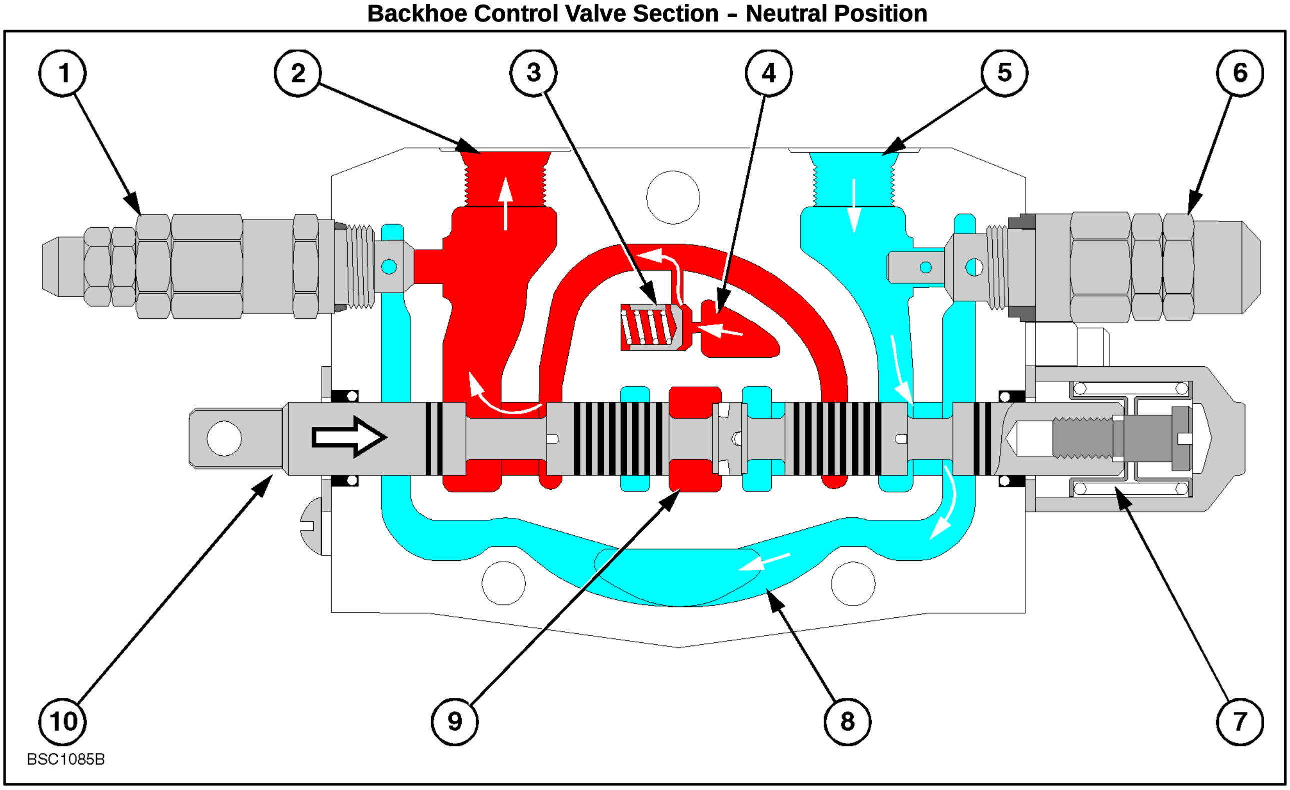
Backhoe Control Valve Section

1. Circuit Relief Valve
2. Cylinder Port
3. Check Valve
4. Parallel Gallery
5. Cylinder Port
6. Circuit Relief Valve
7. Centering Spring
8. Exhaust Gallery
9. Staggered Open Centre Gallery
10. Spool



85

Backhoe Control Valve Section – Neutral Position



86

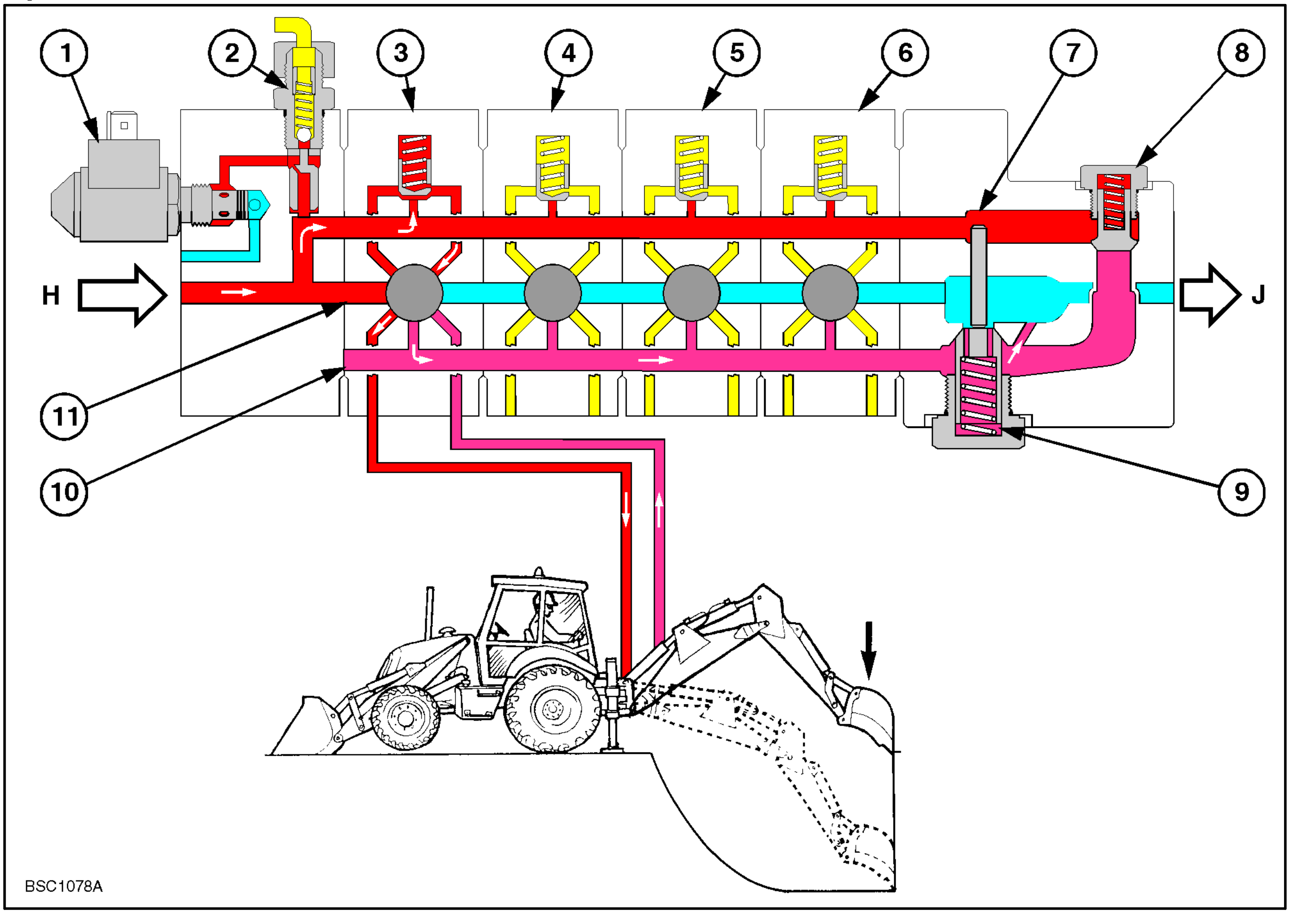
Backhoe Control Valve Section – Operating Position

Pump Pressure Oil

Trapped Oil

Return to Reservoir Oil

Operation Of The Back Pressure Valve



87

Back Pressure Valve Operation – Light Load Conditions

Red	Pump Pressure Oil @ less than 69 bar (1000 psi)	Yellow	Trapped Oil
Pink	Cylinder Exhaust Oil @ Back Pressure (9.5 bar (140 psi)	Cyan	Return to Reservoir

Port H – Pump Flow from Loader Valve

1. Clamp System Dump Solenoid
2. Clamp System Check Valve
3. Boom Cylinder Control Valve
4. Swing Cylinder Control Valve
5. Bucket Cylinder Control Valve
6. Dipper Cylinder Control Valve

Port J – Return to Reservoir

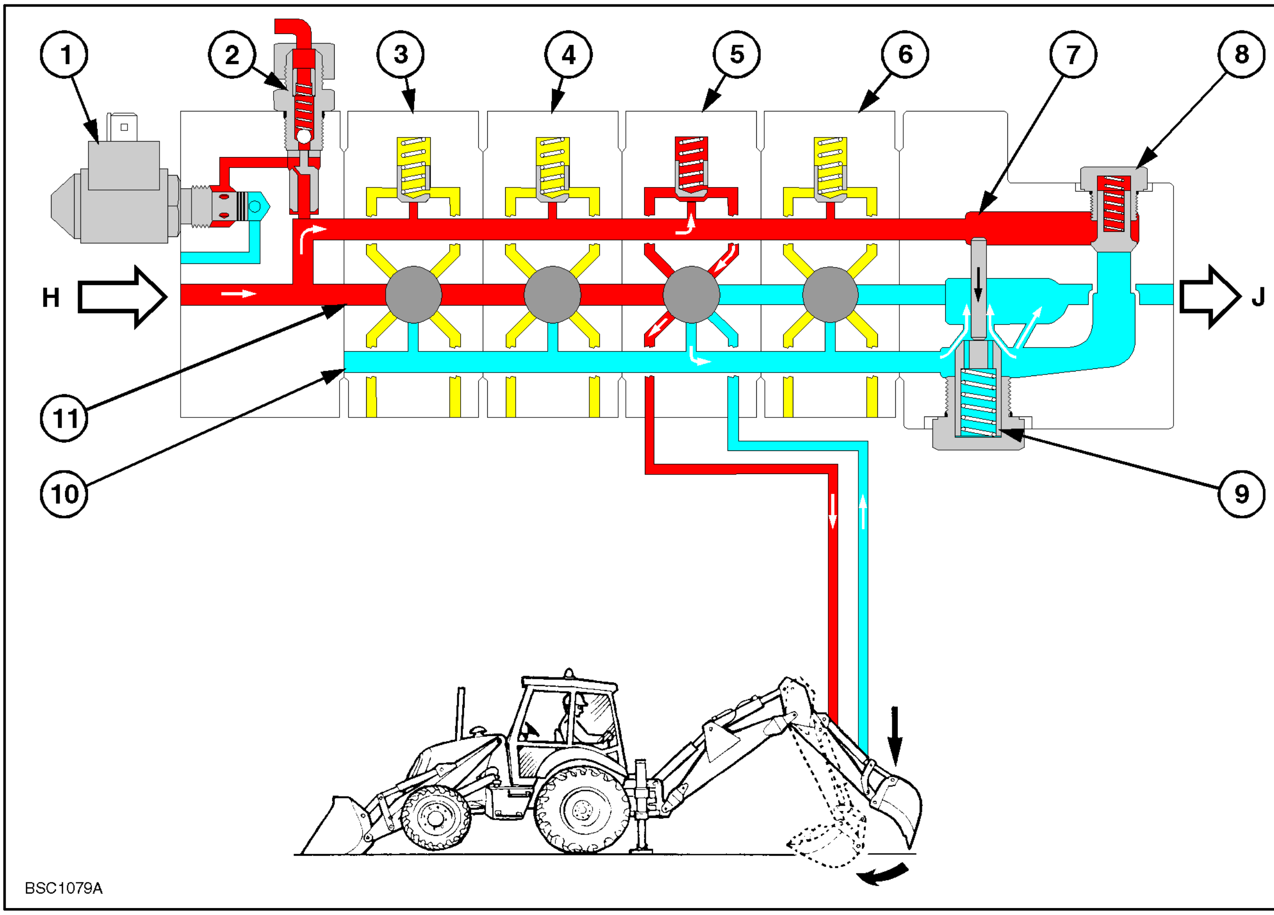
7. Parallel Gallery
8. Regenerative Check Valve
9. Back Pressure Valve
10. Control Valve Exhaust Gallery
11. Staggered Open Centre Gallery

Light Load Conditions

If the backhoe is operated under light load conditions, eg. slowly lowering the backhoe to the ground or into a trench, control of the elements can become less precise if a back pressure in the cylinder exhaust circuit was not present

To ensure precise control during this type of operation the back pressure valve maintains a cylinder exhaust back pressure of 9.5 bar (140 psi).

When pump (system) pressure is less than 69 bar (1000 psi) the valve remains closed and cylinder exhaust oil returns to reservoir through the small drilling connecting control valve exhaust and return to reservoir galleries. The restriction created by the drilling generates the back pressure in the control valve exhaust gallery required under light load conditions.



88

Back Pressure Valve Operation – Heavy Load Conditions

Pump Pressure Oil @ over 69 bar (1000 psi)

Trapped Oil

Cylinder Exhaust Oil Returning to Reservoir

Port H – Pump Flow from Loader Valve
1. Clamp System Dump Solenoid
2. Clamp System Check Valve
3. Boom Cylinder Control Valve
4. Swing Cylinder Control Valve
5. Bucket Cylinder Control Valve
6. Dipper Cylinder Control Valve

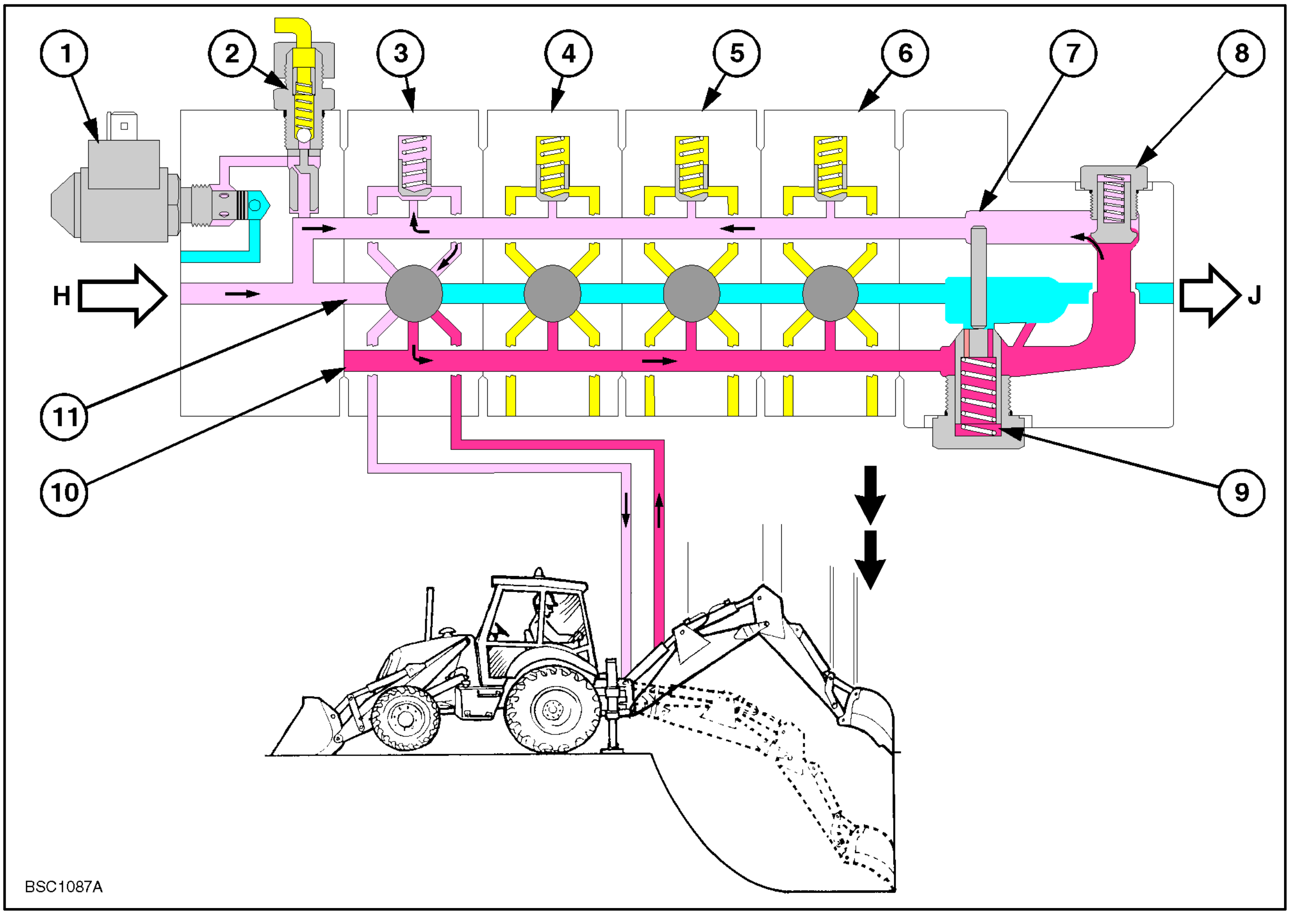
Port J – Return to Reservoir
7. Parallel Gallery
8. Regenerative Check Valve
9. Back Pressure Valve
10. Control Valve Exhaust Gallery
11. Staggered Open Centre Gallery

Heavy Load Conditions

When the backhoe is operated under heavy load conditions, eg. digging the spoil from a trench, a high exhaust back pressure will reduce hydraulic power.

To improve efficiency it is now necessary to reduce the back pressure in the system to a more acceptable level.

As pump pressure increases in the parallel gallery the back pressure valve pin is gradually forced downwards opening the back pressure valve. This allows cylinder exhaust oil to flow freely through gallery **J**.



89

Operation of Regenerative Check Valve

Pump Pressure Oil

Cylinder Exhaust Oil
@ Higher than Pump Pressure

Trapped Oil

Return to Reservoir

Port H – Pump Flow from Loader Valve

1. Clamp System Dump Solenoid
2. Clamp System Check Valve
3. Boom Cylinder Control Valve
4. Swing Cylinder Control Valve
5. Bucket Cylinder Control Valve
6. Dipper Cylinder Control Valve

Port J – Return to Reservoir

7. Parallel Gallery
8. Regenerative Check Valve
9. Back Pressure Valve
10. Control Valve Exhaust Gallery
11. Staggered Open Centre Gallery

Regenerative Check Valve Operation

When a digging element is rapidly operated, for example the boom is quickly lowered into a trench, the situation can arise where, if engine speed is too low, pump output is insufficient to meet demand of the cylinder and the cylinder will cavitate.

This will result in a hydraulic void occurring in the piston (extending) side of the cylinder.

To overcome this situation the regenerative check valve is installed.

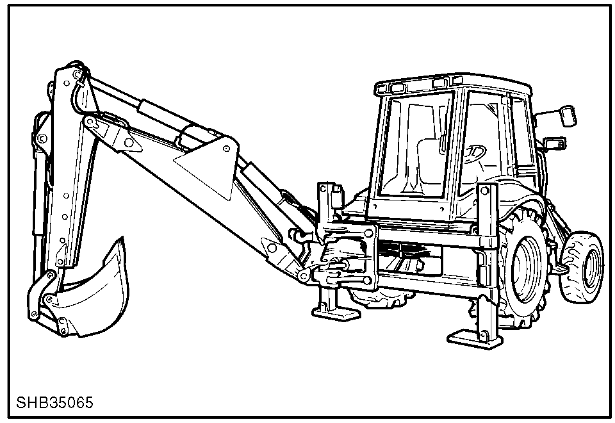
When cylinder exhaust pressure is higher than pump pressure, the flow of oil from the exhausting cylinder lifts the check valve of its seat allowing exhaust oil to flow past the check valve into the parallel gallery and supplement the insufficient flow from the pump to operate the cylinder and prevent the void from occurring.

The back pressure valve will remain closed in this operation.

BACKHOE CONTROL VALVE OVERHAUL (OP NO. 35 702)

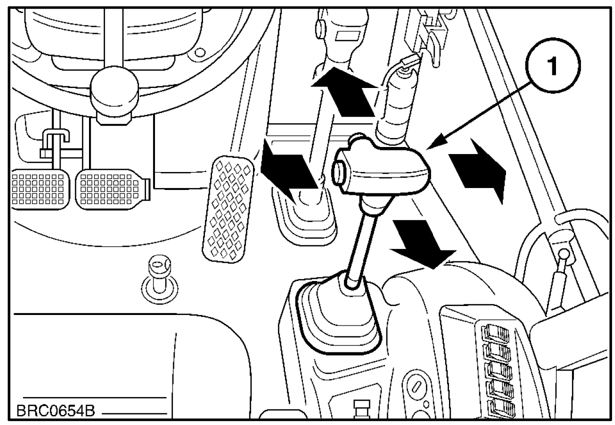
Removal

1. Disconnect the battery
2. Position the unit on hard level surface.
3. Lower loader to the ground
4. Lower stabilisers
5. Offset swing frame on sideshift models to the left or right.
6. Position dipstick in the vertical plane with bucket positioned firmly on the ground.

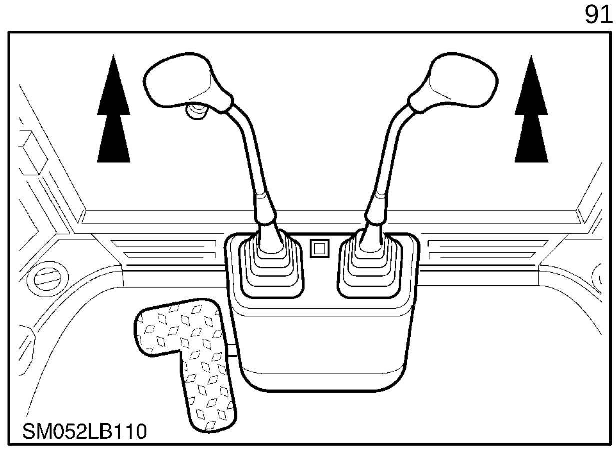


90

7. Stop the engine and relieve any residual pressure in the circuits by moving the backhoe loader and stabiliser control levers through all operating position.

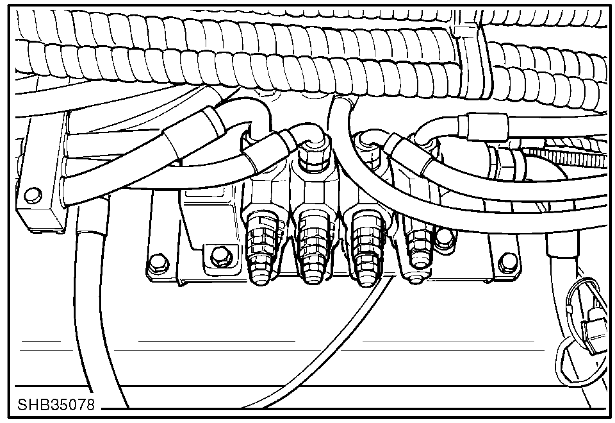


91



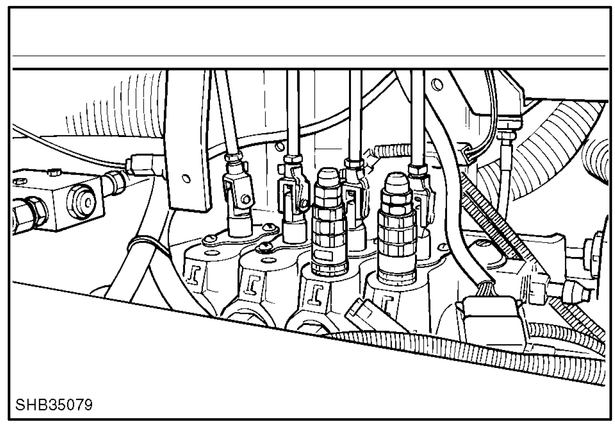
92

8. Clean area around control valve.
9. Tag and identify position of all hydraulic hoses.
10. Disconnect and cap hoses.



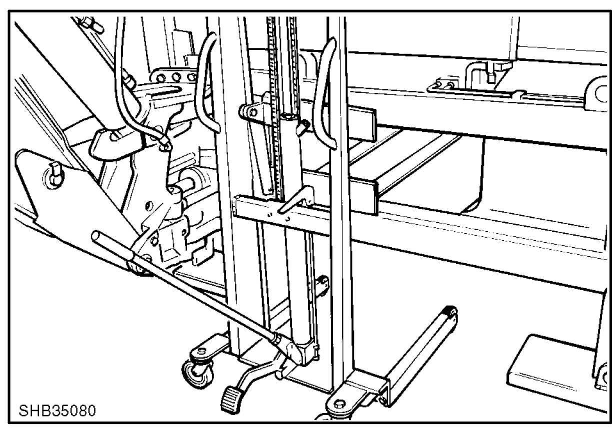
93

11. Disconnect control lever linkage (1)
12. On sideshift models disconnect connector to sideshift clamp solenoid (2).
13. Remove the two bolts securing the bottom of the valve assembly to the frame.



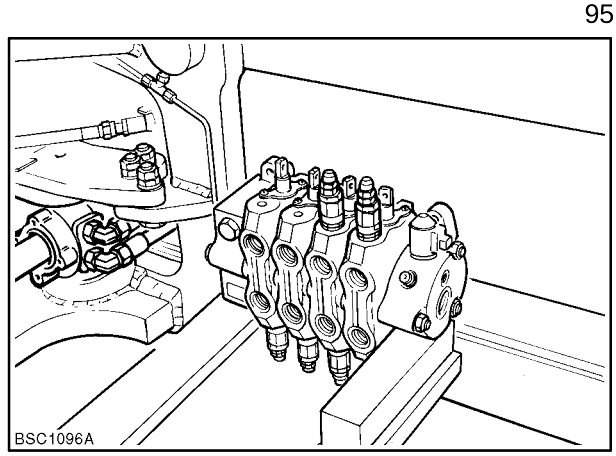
94

14. Position the forks of a suitable lift beneath the valve and support weight of valve.
15. Remove upper retaining bolts.



95

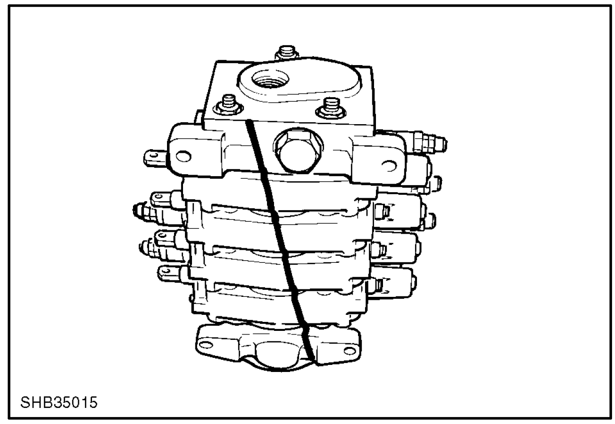
16. Carefully withdraw and lower valve from machine.



96

Disassembly

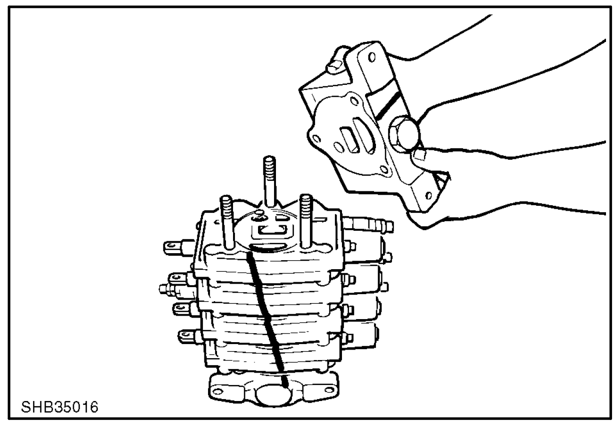
1. Prior to disassembly the valve should be thoroughly cleaned using an approved degreasant.
2. Scribe a diagonal line across the valve sections to aid re–assembly.



97

3. Remove outlet end cover and separate each valve section.
4. Disassemble valve sections and end covers

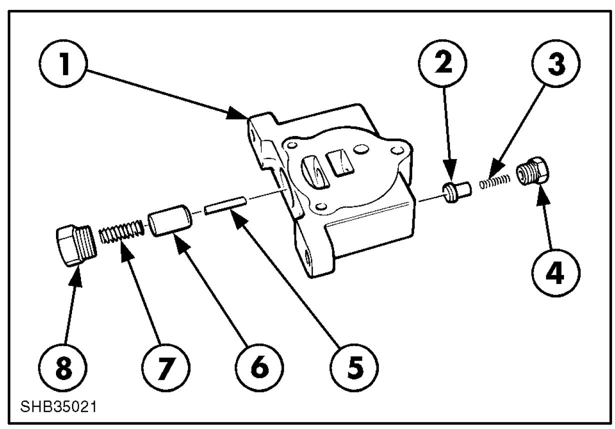
NOTE: *Retrieve check valves positioned between each valve section.*



98

Outlet End Cover

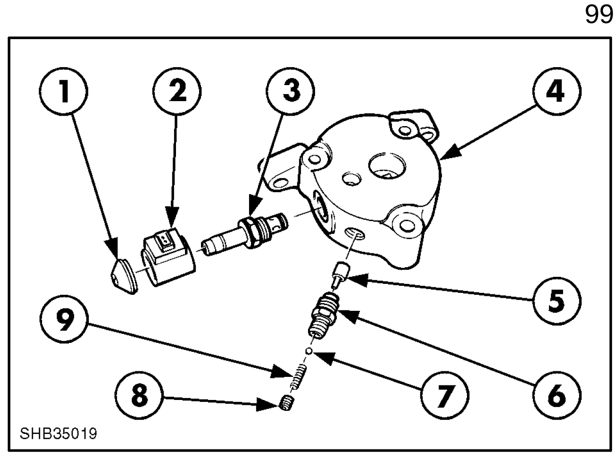
1. Outlet End Cover
2. Regenerative Check Valve
3. Spring
4. Plug
5. Plunger
6. Back Pressure Valve
7. Spring
8. Plug



99

Inlet End Cover

1. Cap
2. Solenoid Coil
3. Clamp Cylinder Dump Valve
4. Inlet End Cover
5. Plunger
6. Check Valve Housing
7. Ball
8. Retainer
9. Spring



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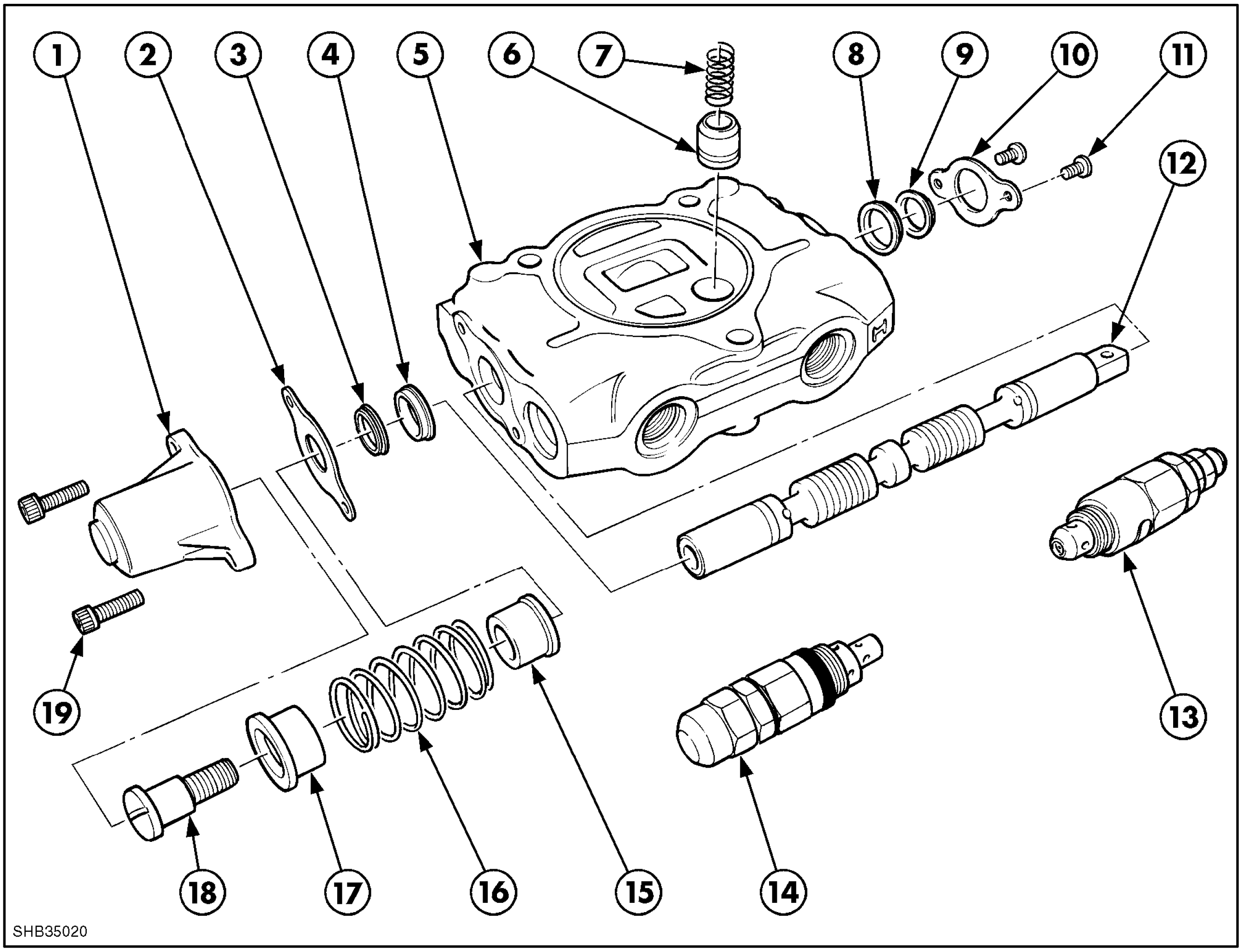


101

Boom Valve Components

1. Spool Cap
2. Seal Plate
3. Wiper
4. Seal
5. Housing
6. Check Valve
7. Spring
8. Seal
9. Wiper
10. Seal Plate
11. Screws
12. Spool
13. Circuit Relief Valve With Anti–cavitation
14. Direct Acting Circuit Relief Valve
15. Spring Seat
16. Spring
17. Spring Seat
18. Screw
19. Allen Screw

NOTE: *The components within the bucket, swing and dipper control valves are similar to the boom valve shown above.*

Overhaul the remaining valve sections using Figure 102 for reference.

The differences between each section are minimal and relate to the shape of the spool and type of relief valves installed.

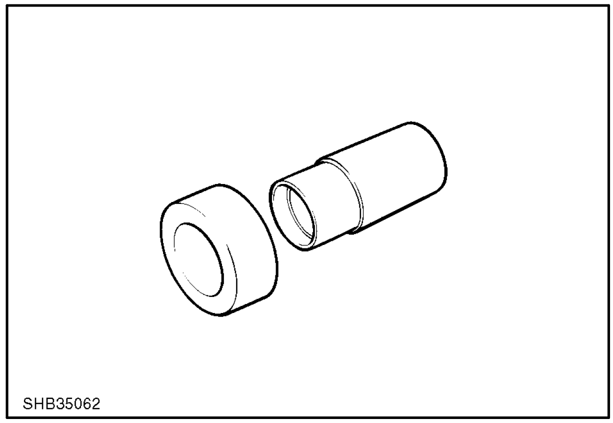
The circuit relief valves can be serviced if required but must be re–adjusted prior to use.

Inspection

1. Wash components in an approved degreasent.
2. Inspect spool and bore for scoring and damage. If spool is baldly scored or worn the valve assembly must be replaced.

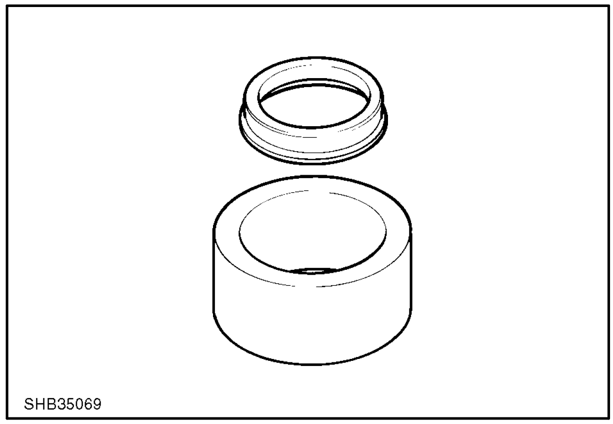
Re–Assembly

Re–assembly of the spool seals into each end of the valve housing requires special care and the use of Seal Insertion Tool No **297419** must be used to prevent damage.



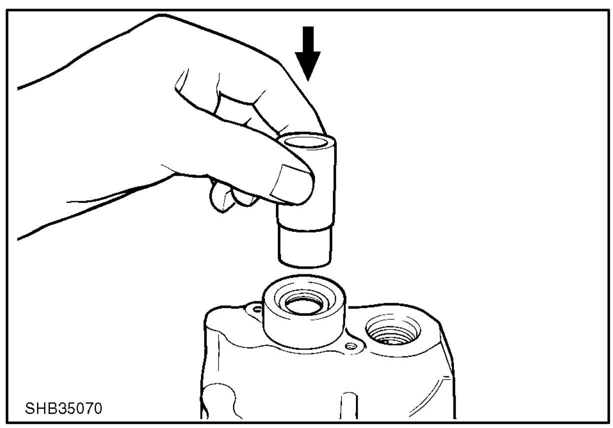
102

1. Insert oil seal into tool. Ensure lip on seals is facing outwards.



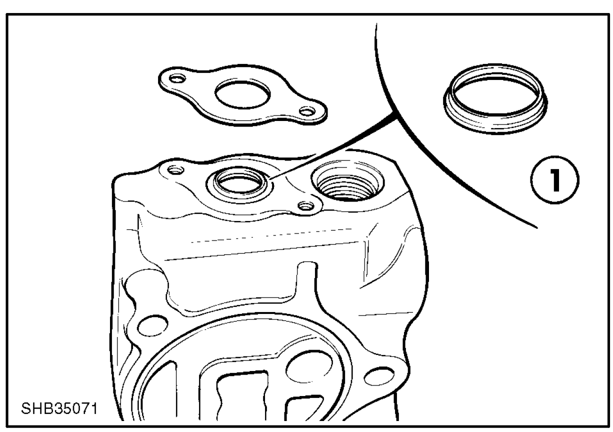
103

2. Position tool into counter bore on spool linkage end of valve housing and press seals into position.



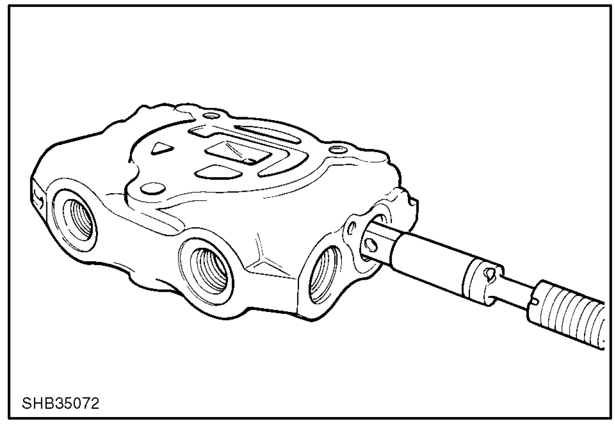
104

3. Install wiper (1) and seal plate.



105

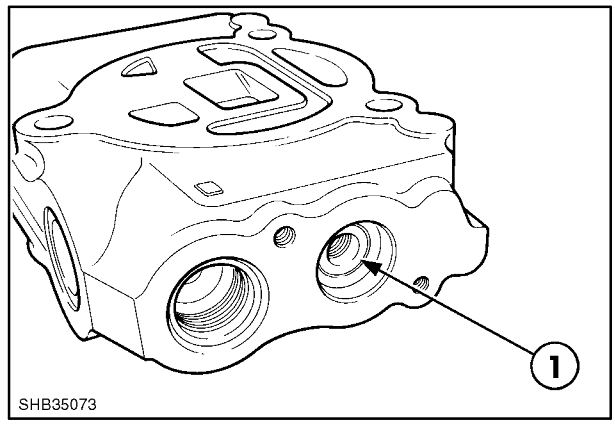
4. Lubricate spool and insert into end of bore which **has not** yet been installed with seals. Push spool completely through bore until it emerges through seal.



106

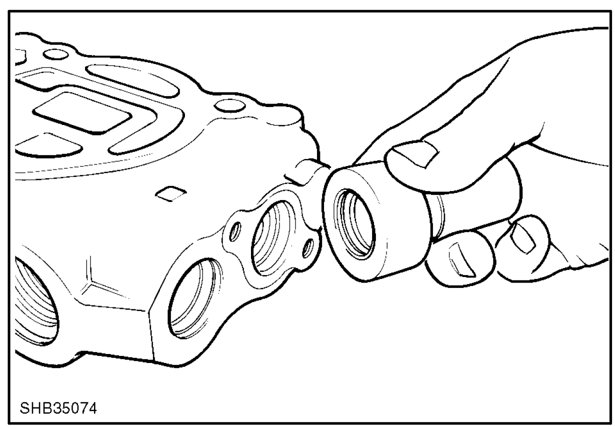
5. Continue pushing spool through bore until face of spool (1) is just below the counterbore into which the remaining seal is to be installed.

NOTE: *When pushing seal through bore the feathering grooves on the spool will pass through the seal. These will not damage the seal but* ***Do Not*** *allow the sharp metering lands to pass through the seal otherwise damage and leakage will occur.*



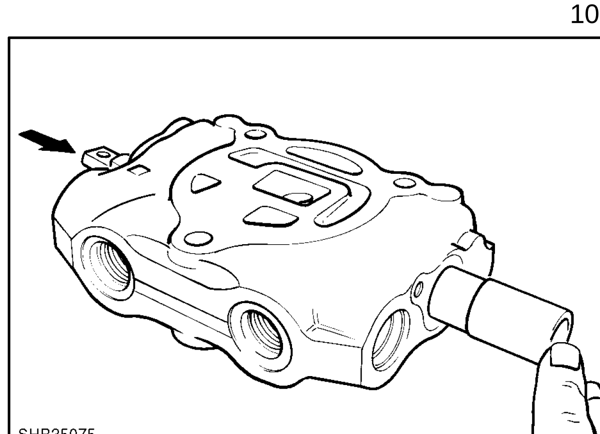
107

6. Install remaining seal into counterbore on spring centred end of valve.



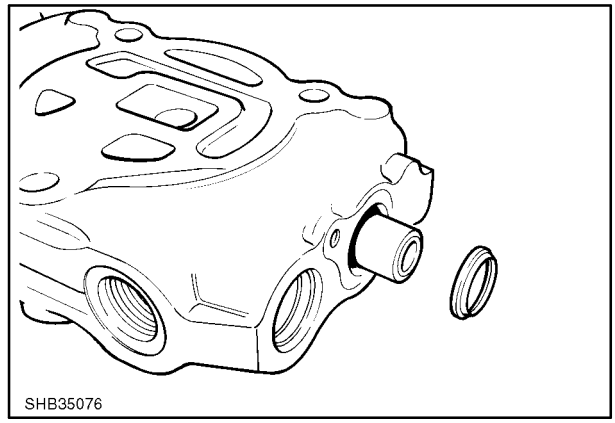
108

7. Using central portion of seal installation tool, hold seal in position gently centre the spool in the housing.



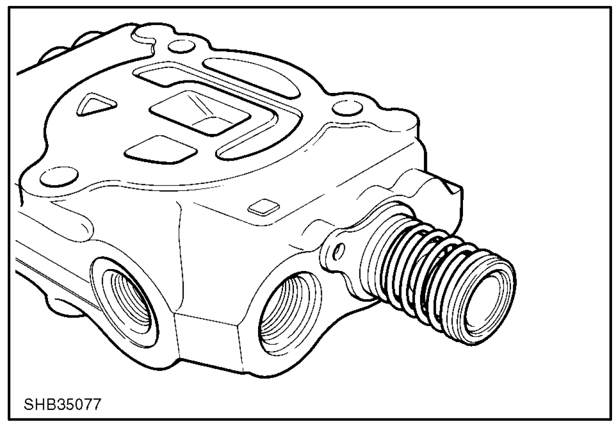
109

8. Install Wiper Seal



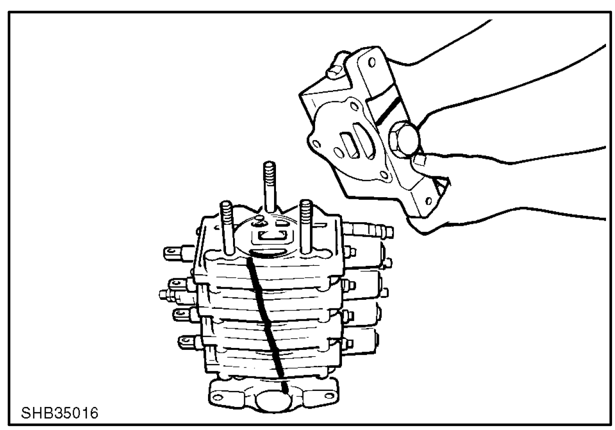
110

9. Install seal plate and centering spring assembly



111

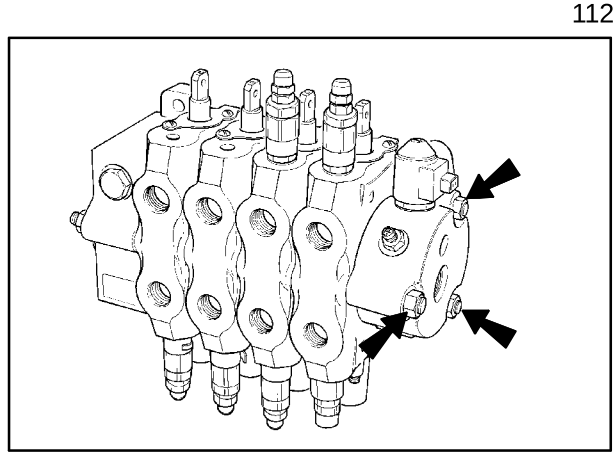
10. Reassemble valves into stack using alignment line to ensure correct re–assembly.



112

11. Progressively torque tie rods to the specified torque. **DO Not** over tighten.

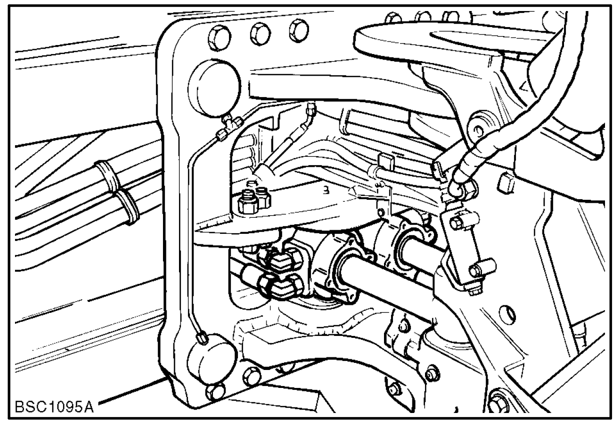
Small Dia Tie Rods	65 Nm	48 lbf. ft
Large Dia Tie Rods	100 Nm	74 lbf. ft



113

Sideshift Carriage Clamping System

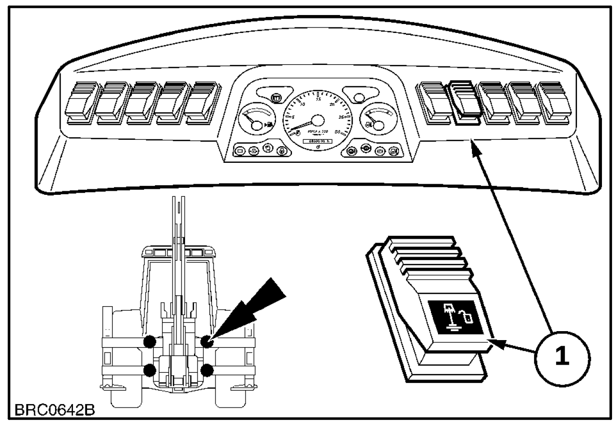
On sideshift machines the backhoe swing frame is hydraulically clamped to the main frame by four hydraulic cylinders.



114

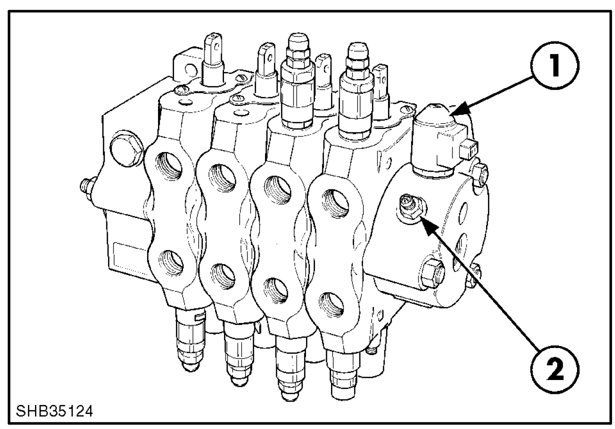
The carriage must be unclamped before sideshifting the backhoe by depressing the switch (1) on the side console instrument panel.

NOTE: *When light inside the switch is illuminated the clamping system is unlocked.*



115

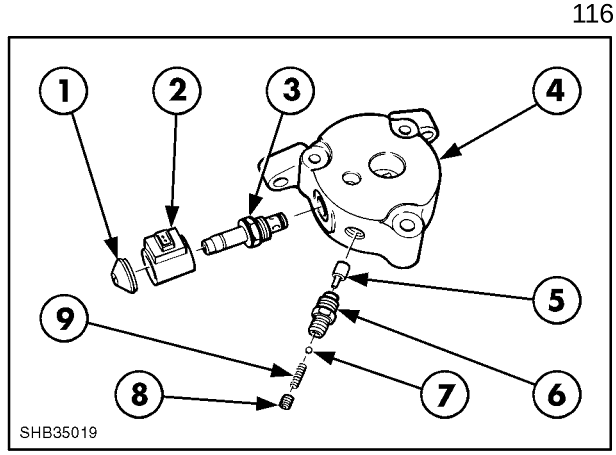
The solenoid (1) and clamp system check valve (2) which directs oil flow to the clamp cylinders is housed in the inlet end cover of the backhoe control valve.



116

Inlet End Cover

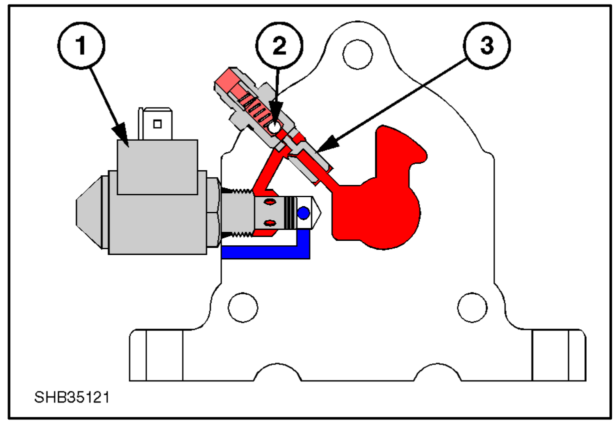
1. Cap
2. Solenoid Coil
3. Clamp Cylinder Dump Valve
4. Inlet End Cover
5. Unload Pin
6. Check Valve Housing
7. Ball
8. Retainer
9. Spring



117

Hydraulic Operation is as follows:–

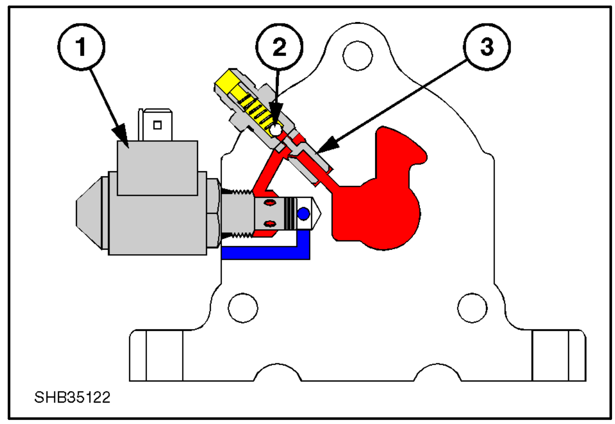
When the clamp switch is ‘Off’ the clamp solenoid (1) is not energised and oil is prevented from venting to reservoir.



118

If system pressure is greater than the pressure in the clamp cylinders the check valve ball (2) lifts of its seat allowing system pressure to be applied to the clamp cylinder circuit.

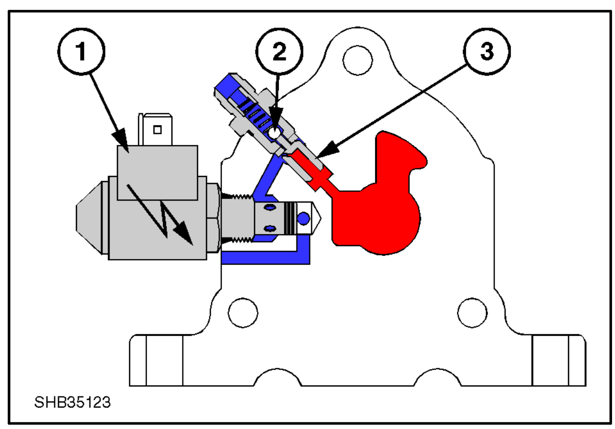
When system pressure reduces the spring in the check valve holds the ball on its seat trapping oil in the clamp circuit to maintain the cylinder clamping effort.



119

When the clamp switch is ‘ON’, the light is illuminated and the solenoid energised allowing oil on the check valve side of the unload pin (3) to be vented to reservoir.

Pump system pressure on the front face of the unload pin pushes the pin forward and unseats the check valve allowing oil in the clamp circuit to vent to reservoir and release the clamping effort in the cylinders.



120

Pump Pressure Oil (red)

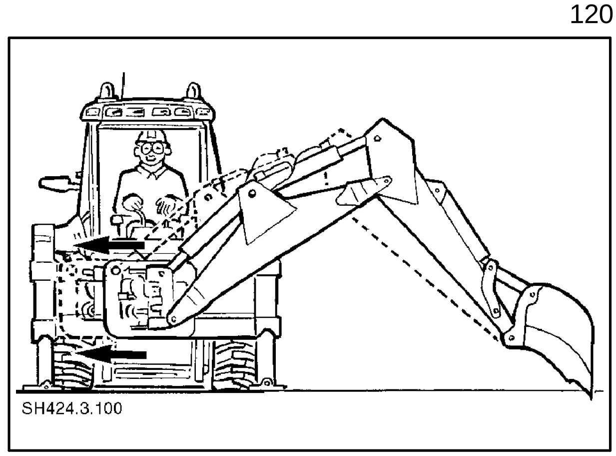
Trapped Oil (yellow)

Return to Reservoir Oil (blue)

The backhoe can now be repositioned on the sideshift frame by:–

Lowering the stabilisers.

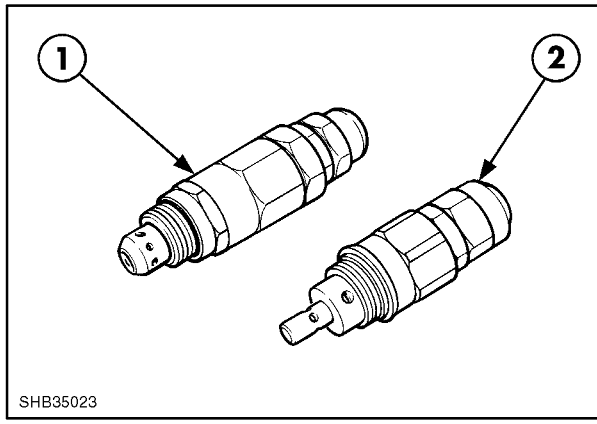
Positioning the boom at right angles to the tractor and using the bucket and dipper to push the swing frame across the frame.



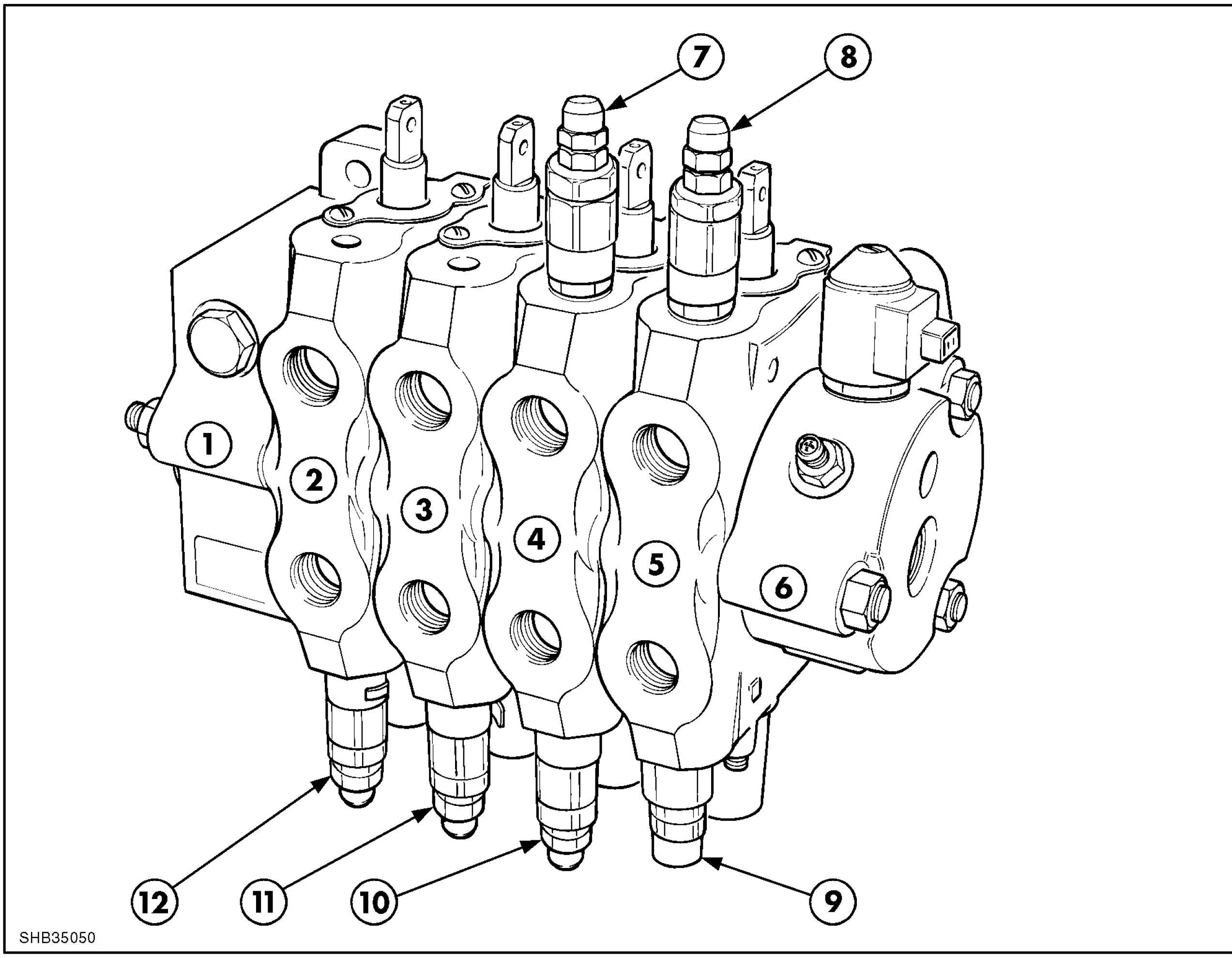
121

Circuit Relief Valves
Principle of Operation

The relief valves may be either pilot operated with anti–cavitation feature (1) or direct acting (2) and protect individual circuits from excessive pressure created by external cylinder overload.



122

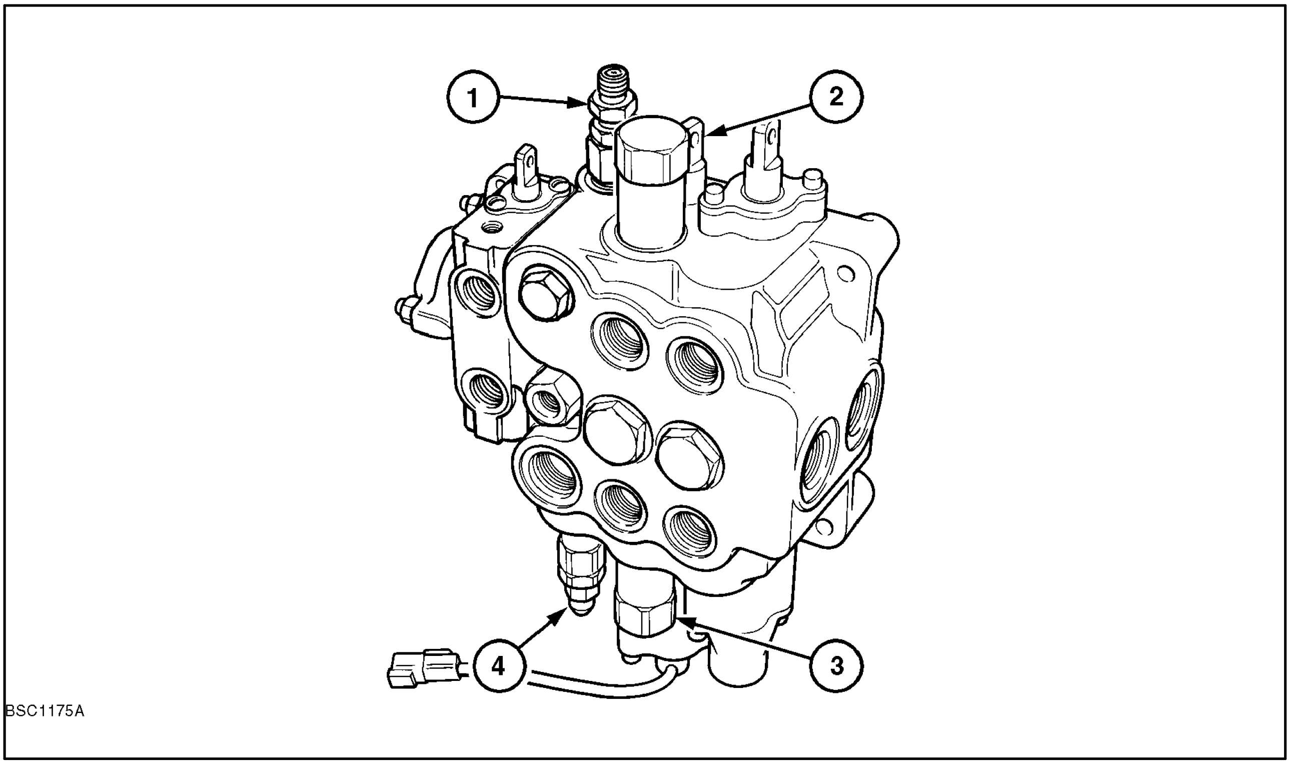


123

Relief Valve Identification

1. Outlet End Cover
2. Dipper Valve Section
3. Bucket Valve Section
4. Swing Valve Section
5. Boom Valve Section
6. Inlet End Cover
7. Swing Cylinder Cushioning Circuit Relief Valve* @ 207 bar (3000 psi)
8. Lift Cylinder Piston End Circuit Relief Valve* @ 241 bar (3500 psi)
9. Lift Cylinder Rod End Direct Acting Circuit Relief Valve @ 317 bar (4600 psi)
10. Swing Cylinder Cushioning Circuit Relief Valve* @ 207 bar (3000 psi)
11. Bucket Cylinder Rod End Circuit Relief Valve* @ 207 bar (3000 psi)
12. Dipper Cylinder Piston End Circuit Relief Valve* @ 241 bar (3500 psi)

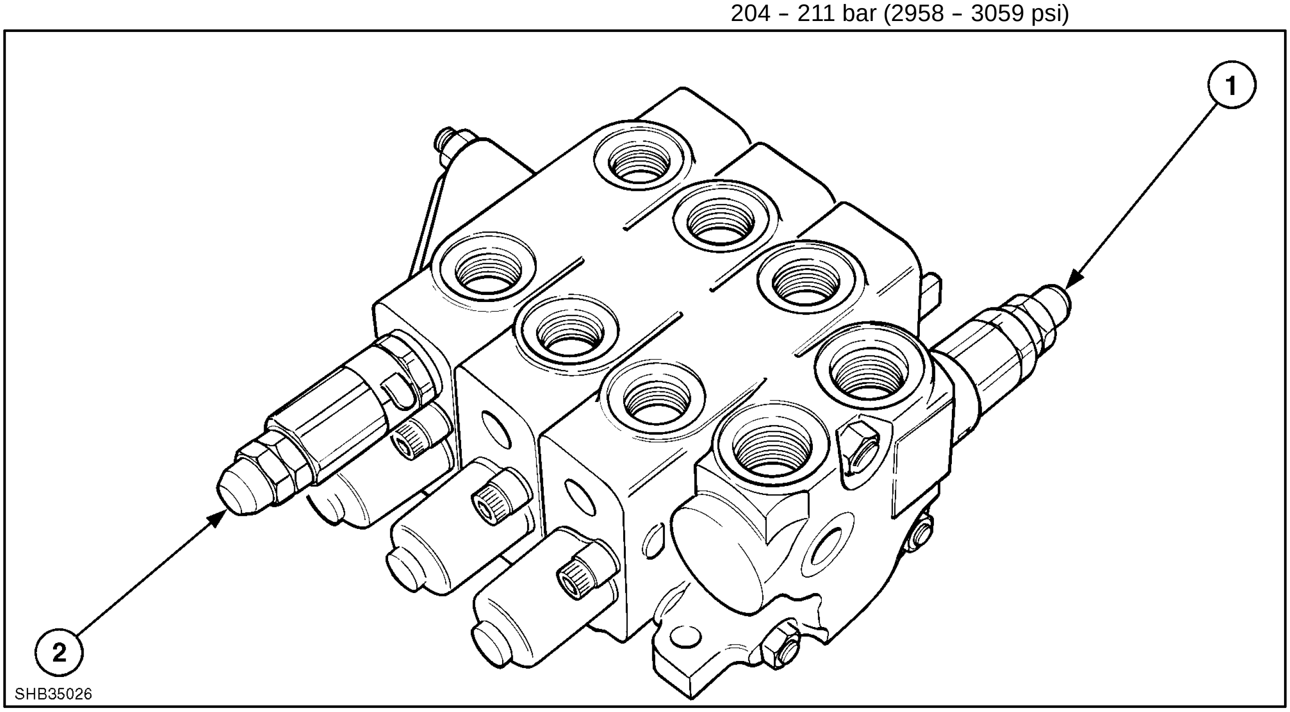
*Pilot Operated with Anti Cavitation Feature



124

Loader Valve Assembly Relief Valve Location

1. Rear Pump Unload Valve @ 170 bar (2465 psi)
2. Loader Bucket Relief Valve Rod End @ 227 bar (3300 psi)
3. Loader Bucket Relief Valve Piston End @ 160 bar (2300 psi)
4. System Pressure Relief Valve 204 – 211 bar (2958 – 3059 psi)

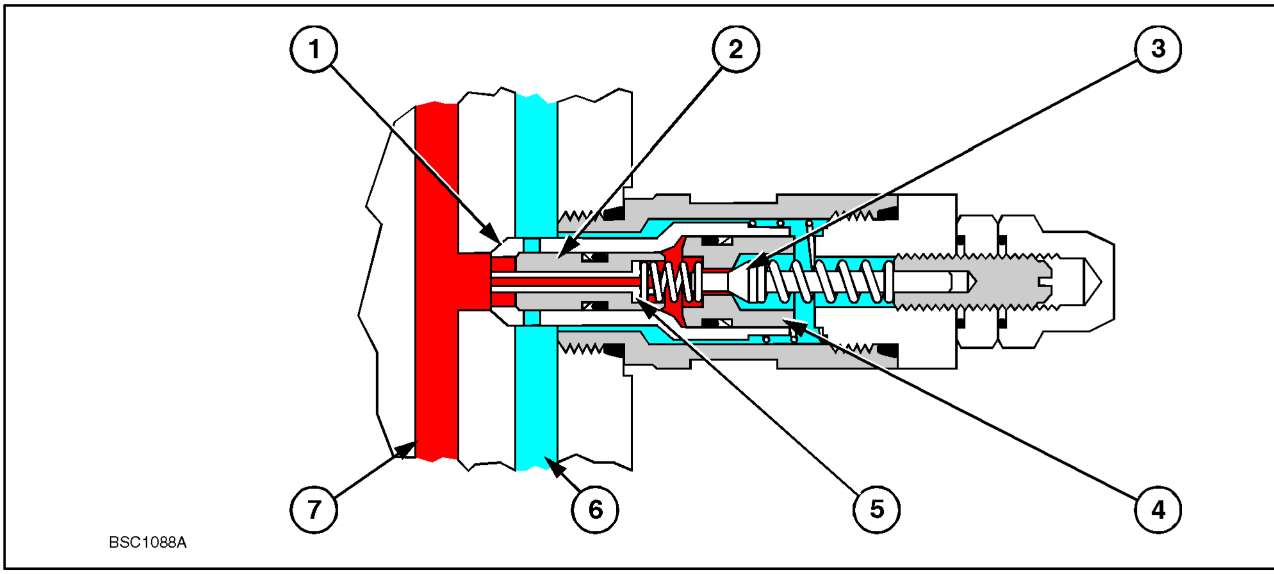


125

Stabiliser and Extendible Dipper Control Valve Assembly

1. Rear Pump Relief Valve– Pilot Operated @ 196 – 202 bar (2842 – 2929 psi)
2. Extendible Dipper (Piston End) Relief Valve– Pilot Operated @164 bar (2375 psi)

Pilot Operated with Anti- Cavitation Feature Circuit Relief Valves



126

Relief Valve Inoperative

High Pressure Oil

Exhaust Oil

1. Sleeve Poppet
2. Poppet Valve
3. Pilot Valve
4. Pilot Valve Body
5. Piston
6. Control Valve (Cylinder) Exhaust Gallery
7. Cylinder Supply Gallery

Relief Valve Inoperative

When the system is not subject to overload conditions pressure in the system is insufficient to overcome pilot valve spring pressure and move the valve of its seat.

System pressure sensed on the larger rear face of the poppet valve maintains the poppet and sleeve firmly on their seats.

Pilot Valve Operation

When the cylinder is subjected to shock forces the pressure increase in the cylinder supply gallery overcomes pilot valve spring pressure lifting the pilot valve off its seat.

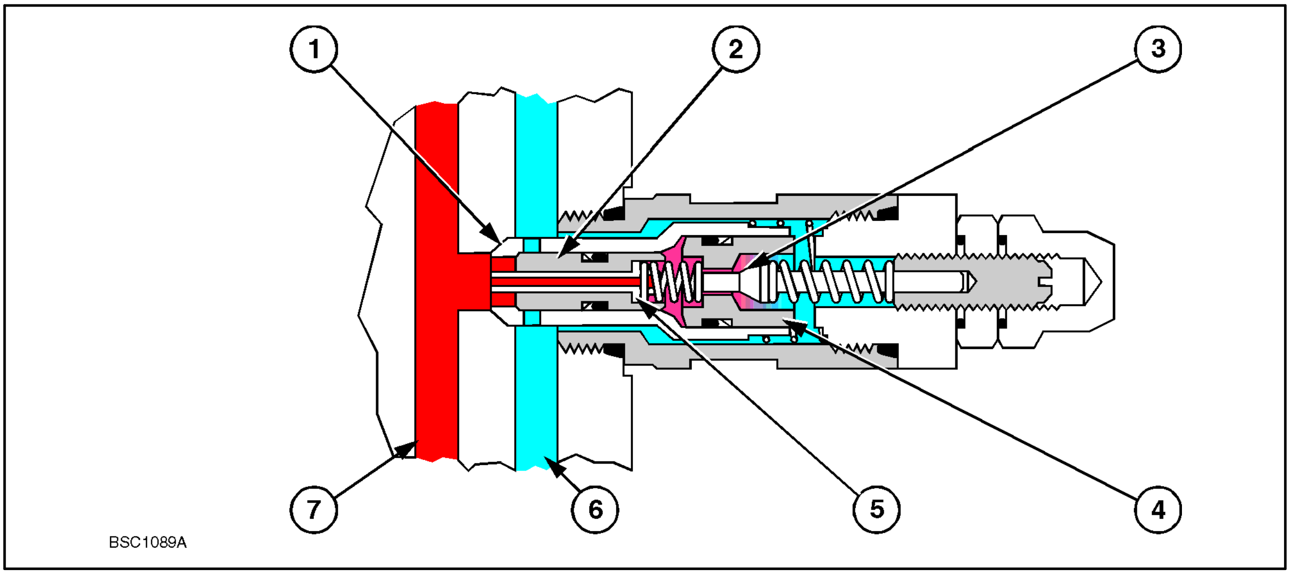
System pressure on the rear face of the poppet valve escapes to reservoir between the sleeve poppet and valve body causing a pressure differential between the front and rear face of the poppet valve.

The higher pressure in the cylinder supply gallery unseats the poppet valve and moves the piston to seat against the pilot valve.

Pilot and Poppet Valve Operation

The excessive system pressure in the cylinder supply gallery now flows past the poppet valve to the cylinder exhaust gallery and back to reservoir.

NOTE: *During this operation the sleeve poppet is held in the fully seated position by pressure oil.*



127

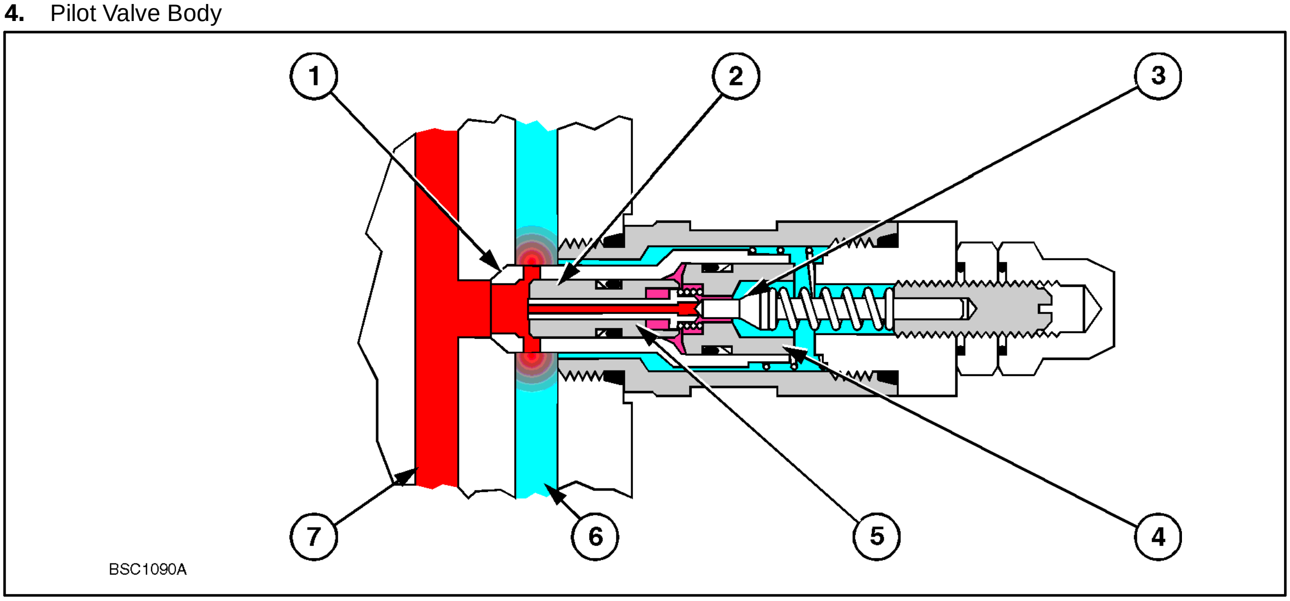
Relief Valve Operation (Stage 1) – Overload Condition – Pilot Valve Operating

High Pressure Oil

Exhaust Oil

Reduced Pressure Oil

1. Sleeve Poppet
2. Poppet Valve
3. Pilot Valve
4. Pilot Valve Body
5. Piston
6. Control Valve (Cylinder) Exhaust Gallery
7. Cylinder Supply Gallery



128

Relief Valve Operation (Stage 2) – Overload Condition – Pilot and Poppet Valve Operating

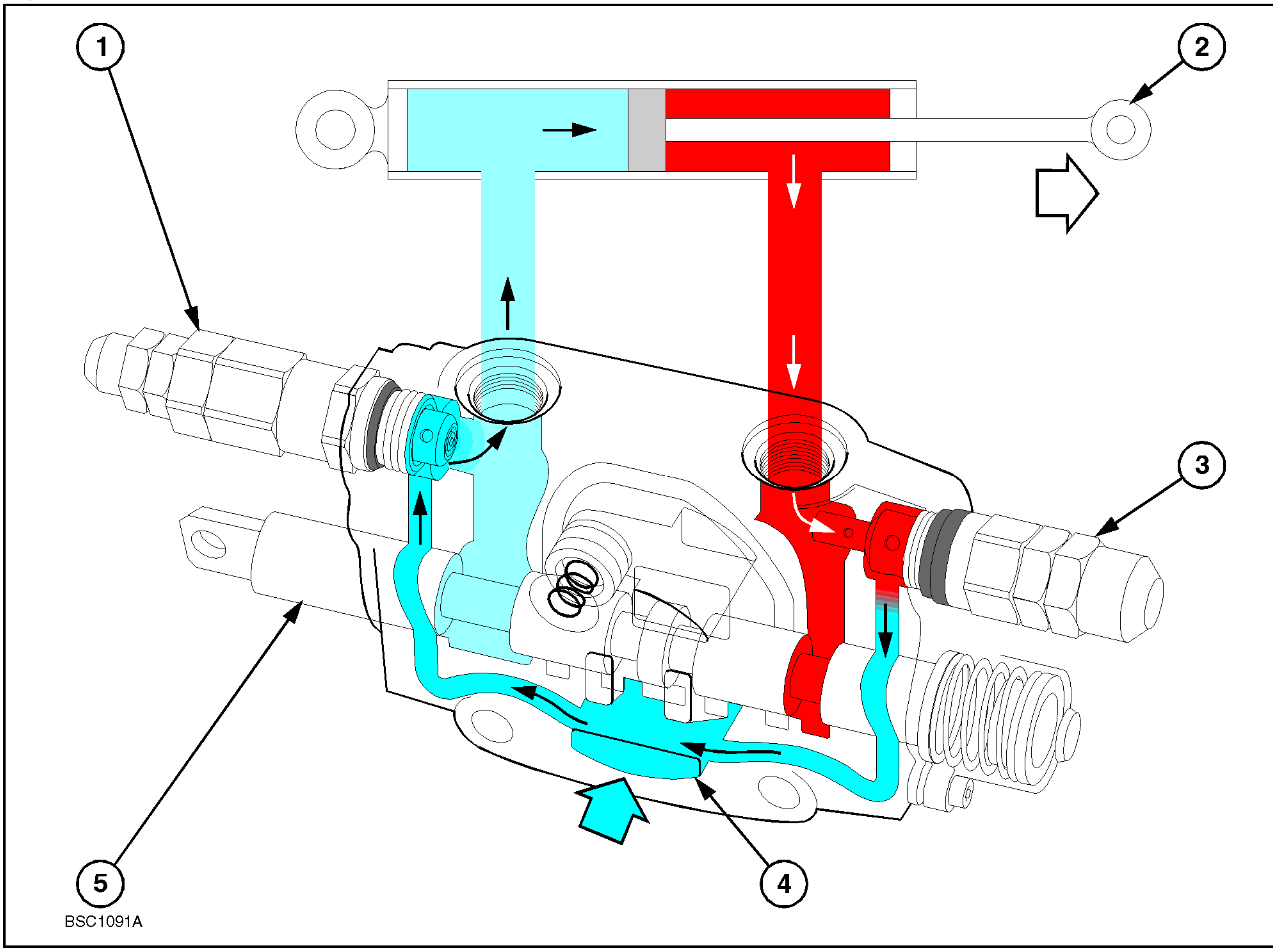
High Pressure Oil

Exhaust Oil

Reduced Pressure Oil

1. Sleeve Poppet
2. Poppet Valve
3. Pilot Valve
4. Pilot Valve Body
5. Piston
6. Control Valve (Cylinder) Exhaust Gallery
7. Cylinder Supply Gallery

Operation of Anti-Cavitation Feature



129

Operation of Circuit Relief Valve Anti-Cavitation Feature

High Pressure Oil

Relief Valve Exhaust Oil

Anti-cavitation Oil Supply to Cylinder

1. Anti-Cavitation Circuit Relief Valve
2. Cylinder Rod
3. Circuit Relief Valve
4. Control Valve Exhaust Gallery
5. Spool

Anti-cavitation Operation

Circuit relief valves with an anti-cavitation feature are fitted in circuits where rapid extension of the cylinder could create a void condition and permit the transfer of oil from the high pressure side of a cylinder to the lower pressure (void) end of the cylinder.

When for example the boom is rapidly lowered and the cylinder rod end circuit relief valve operates, Figure 130, oil has been removed from the rod end of the cylinder and a void created in the piston end. This oil is automatically replenished by the anti-cavitation device in the opposite circuit relief valve as follows:-.

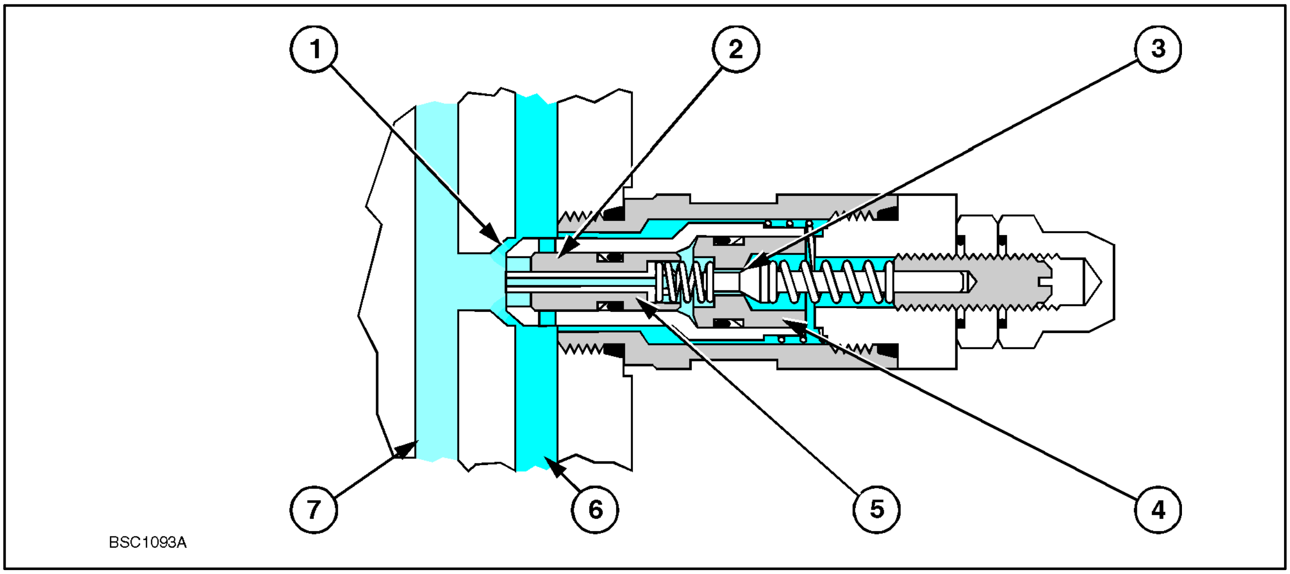
The void creates a pressure drop in the cylinder supply gallery (7), Figure 131 and back pressure in the control valve exhaust gallery (6) acts on the outer face of the sleeve poppet (1) moving it to the right. Exhaust oil is then directed into the cylinder supply gallery to stop cavitation.

Direct Acting Circuit Relief Valve Operation

With reference to Figures 132 and 133.

High pressure circuit oil is sensed in the cylinder supply gallery and acts on the face of the relief valve poppet.

When pressure in the circuit exceeds relief valve setting the oil pressure lifts the poppet allowing excess pressure in the overloaded cylinder to escape to the exhaust gallery.



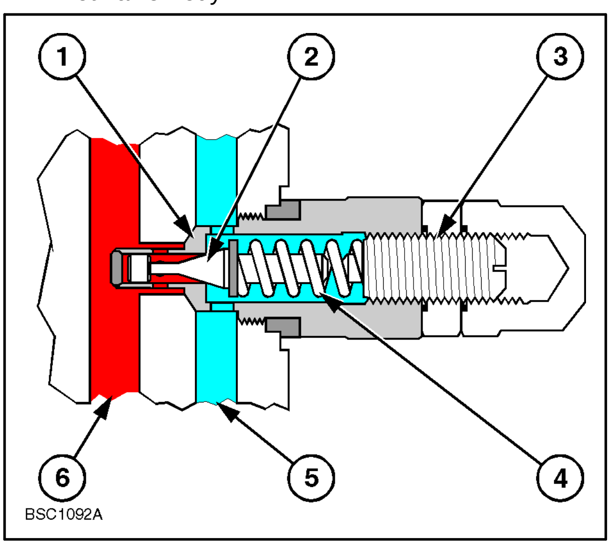
130

Pilot Operated with Anti–Cavitation Feature Circuit Relief Valve
Valve Subjected to Overload and Fully Relieving High Pressure Oil

Exhaust Oil

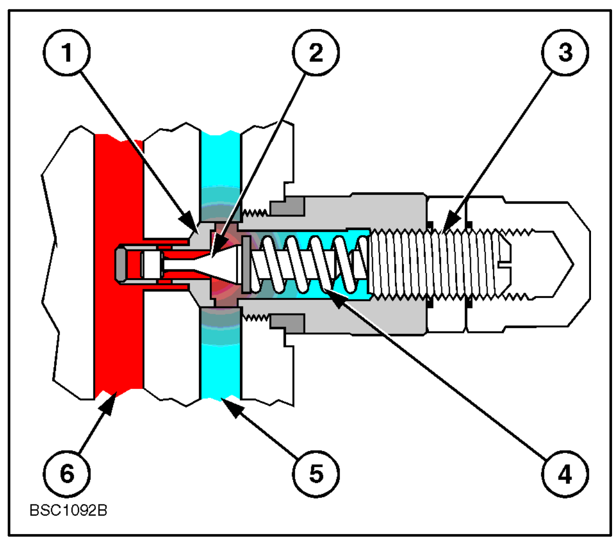
Anti–cavitation Cylinder Re–supply Oil

1. Sleeve Poppet
2. Poppet Valve
3. Pilot Valve
4. Pilot Valve Body
5. Piston
6. Control Valve (Cylinder) Exhaust Gallery
7. Cylinder Supply Gallery



131

Direct Acting Circuit Relief Valve
Valve Not Subjected To Overload Conditions



132

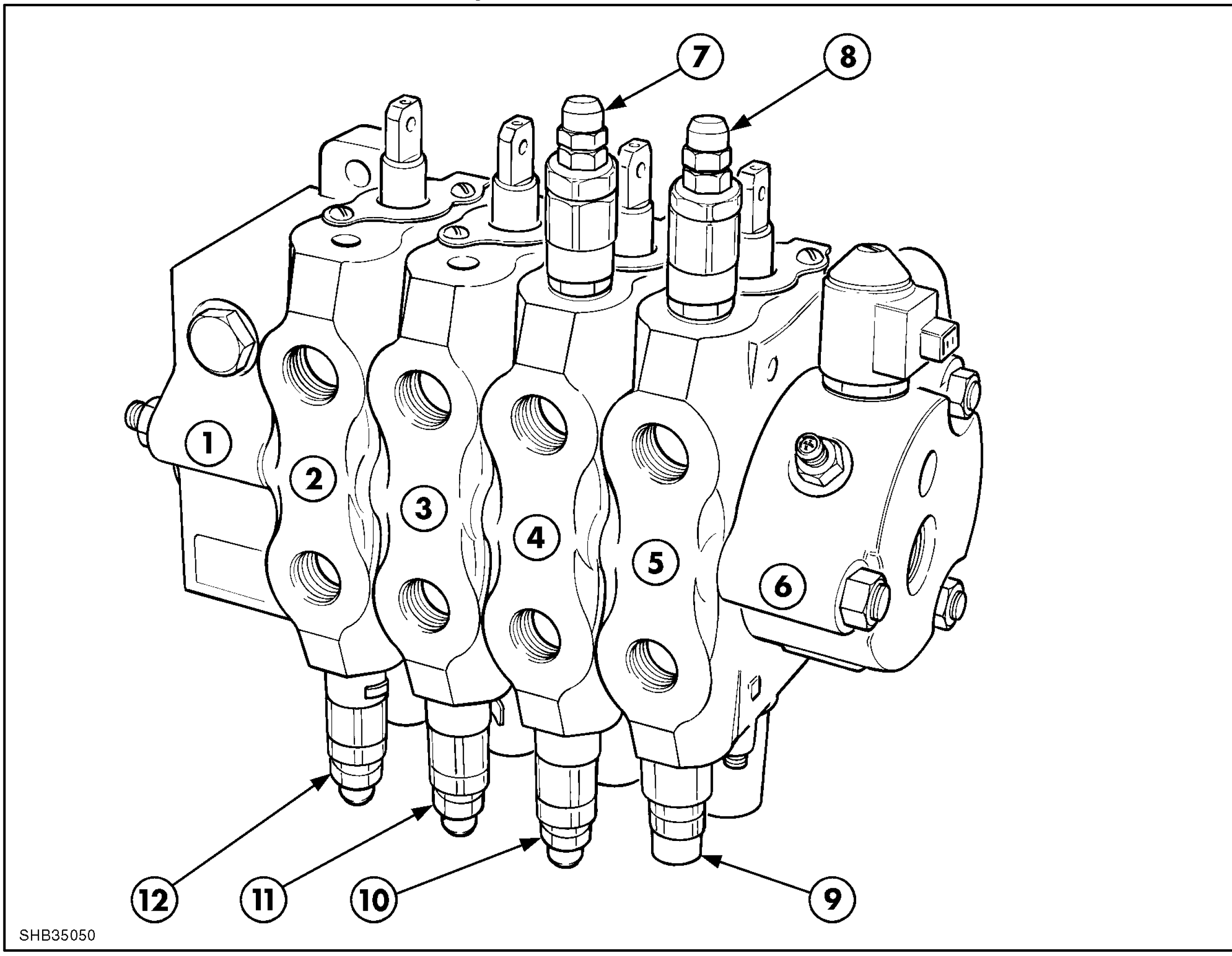
Direct Acting Circuit Relief Valve
Valve Subjected To Overload Conditions

High Pressure Circuit Oil

Exhaust Oil

1. Relief Valve Seat
2. Relief Valve Poppet
3. Valve Pressure Adjusting Screw
4. Spring
5. Control Valve Exhaust Gallery
6. Cylinder Supply Oil

Circuit Relief Valve – Overhaul and Adjustment



133

Backhoe Control Valve Assembly

1.	Outlet End Cover	
2.	Dipper Valve Section	
3.	Bucket Valve Section	
4.	Swing Valve Section	
5.	Boom Valve Section	
6.	Inlet End Cover	
7.	Swing Cylinder Cushioning Circuit Relief Valve* (Left Swing)	207 bar (3000 psi)
8.	Lift Cylinder (Piston End) Circuit Relief Valve*	241 bar (3500 psi)
9.	Lift Cylinder (Rod End) Direct Acting Circuit Relief Valve	317 bar (4600 psi)
10.	Swing Cylinder Cushioning Circuit Relief Valve* (Right Swing)	207 bar (3000 psi)
11.	Bucket Cylinder (Rod End) Circuit Relief Valve*	207 bar (3000 psi)
12.	Dipper Cylinder (Piston End) Circuit Relief Valve*	241 bar (3500 psi)

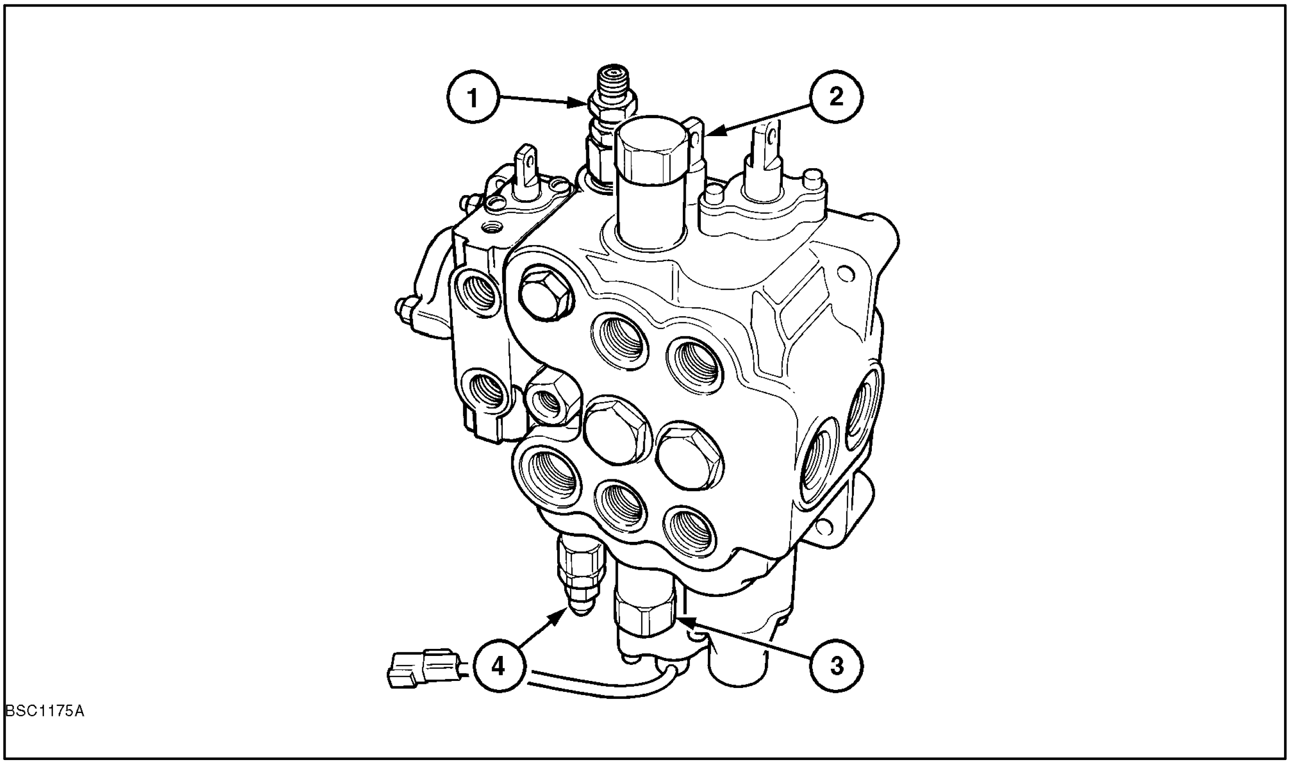
*Pilot Operated with Anti Cavitation Feature

IMPORTANT: *Before removing relief valves from the machine lower the loader and backhoe to the ground, switch of engine and relieve all pressure in circuits by moving the backhoe, loader, and extendible dipper controls through all operating positions.*

The circuit relief valves if suspected of contamination may be disassembled and inspected for wear but must be reset to the correct pressure.

The relief valves contain no serviceable components with the exception of the external ‘O’ rings and square section seals.

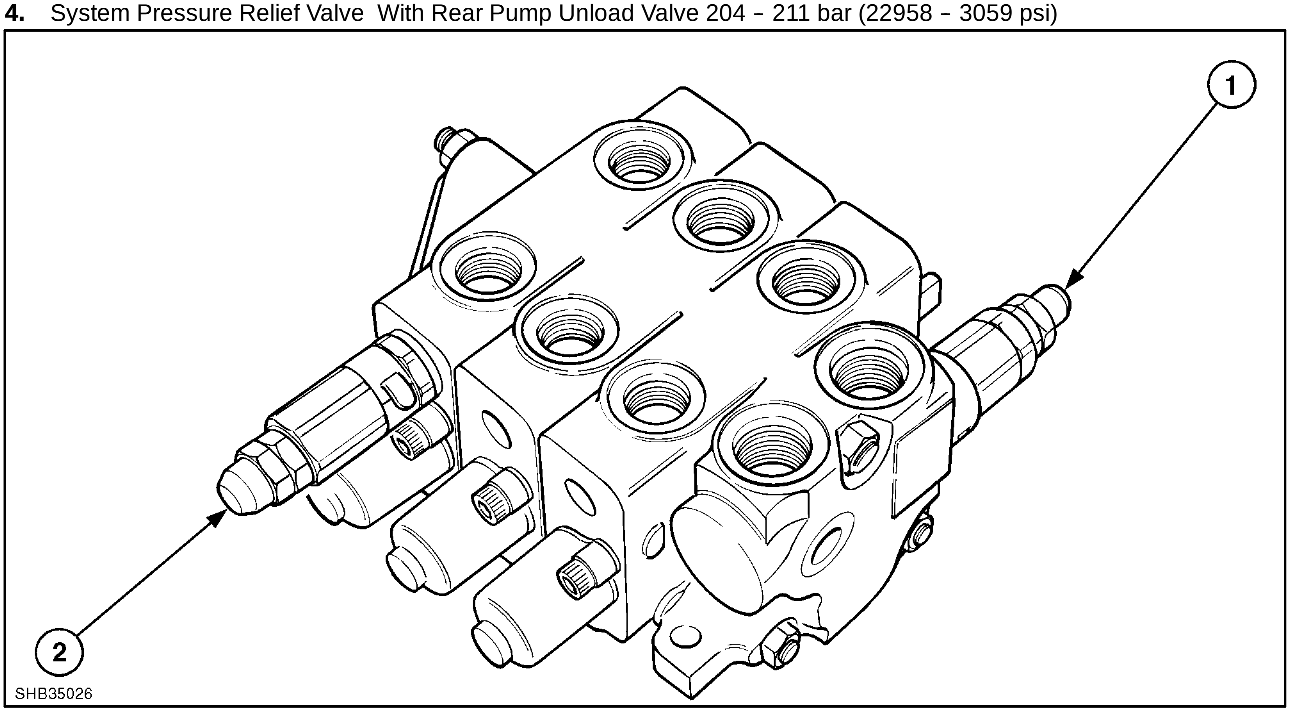
During disassembly examine the poppet and seat in the plunger assembly for a complete seating surface.



134

Loader Valve Assembly Relief Valve Location

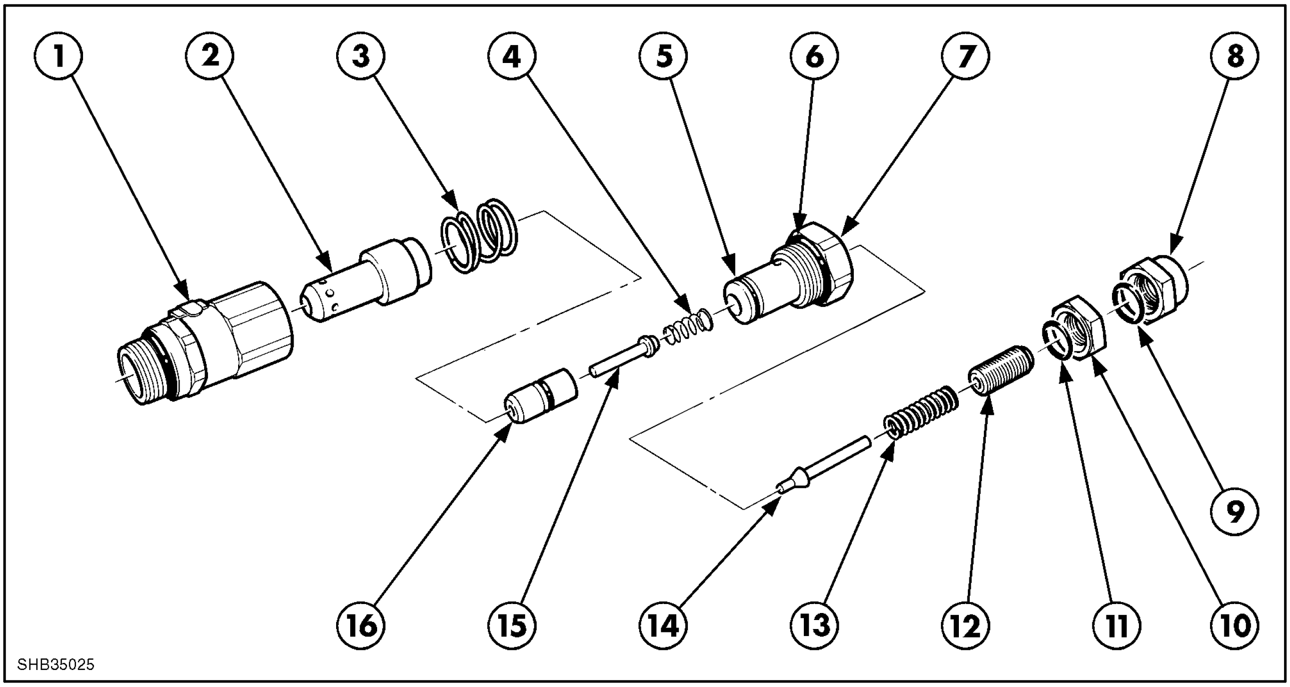
1. Rear Pump Unload Valve @ 170 bar (2465 psi)
2. Loader Bucket Relief Valve Rod End @ 227 bar (3300 psi)
3. Loader Bucket Relief Valve Piston End @ 160 bar (2300 psi)
4. System Pressure Relief Valve With Rear Pump Unload Valve 204 – 211 bar (22958 – 3059 psi)



135

Stabiliser and Extendible Dipper Control Valve Assembly

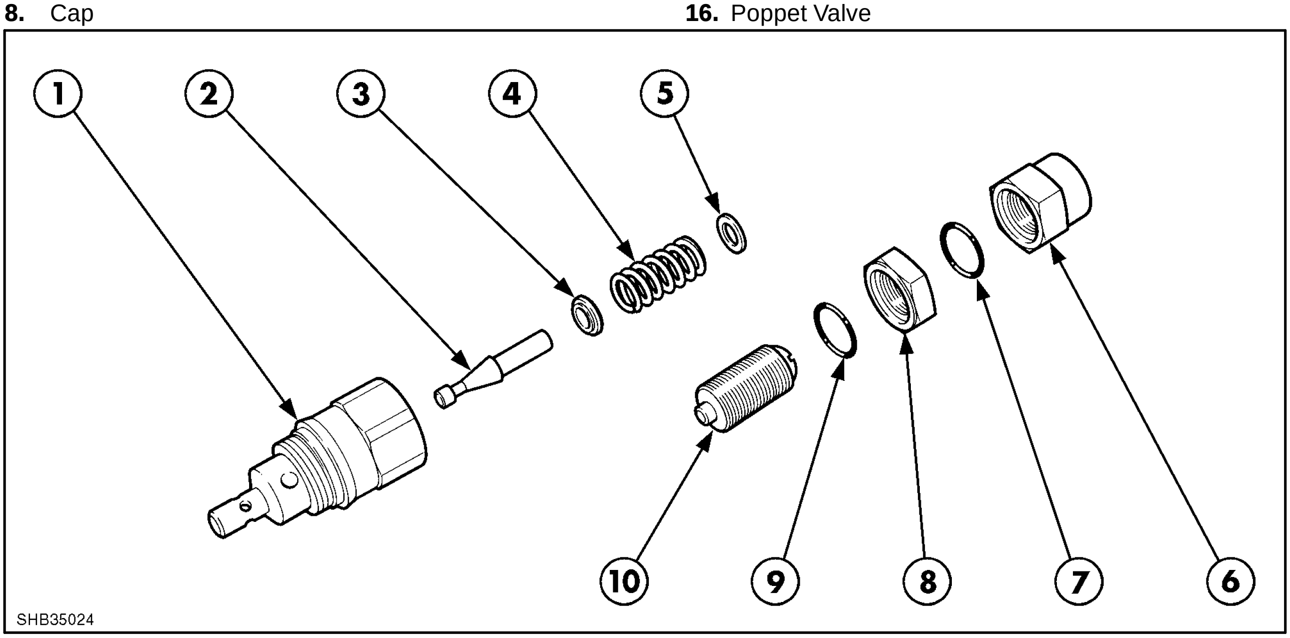
1. Rear Pump Relief Valve– Pilot Operated @ 196 – 202 bar (2842 – 2929 psi)
2. Extendible Dipper (Piston End) Relief Valve– Pilot Operated @164 bar (2375 psi)



136

Pilot Operated Relief Valve

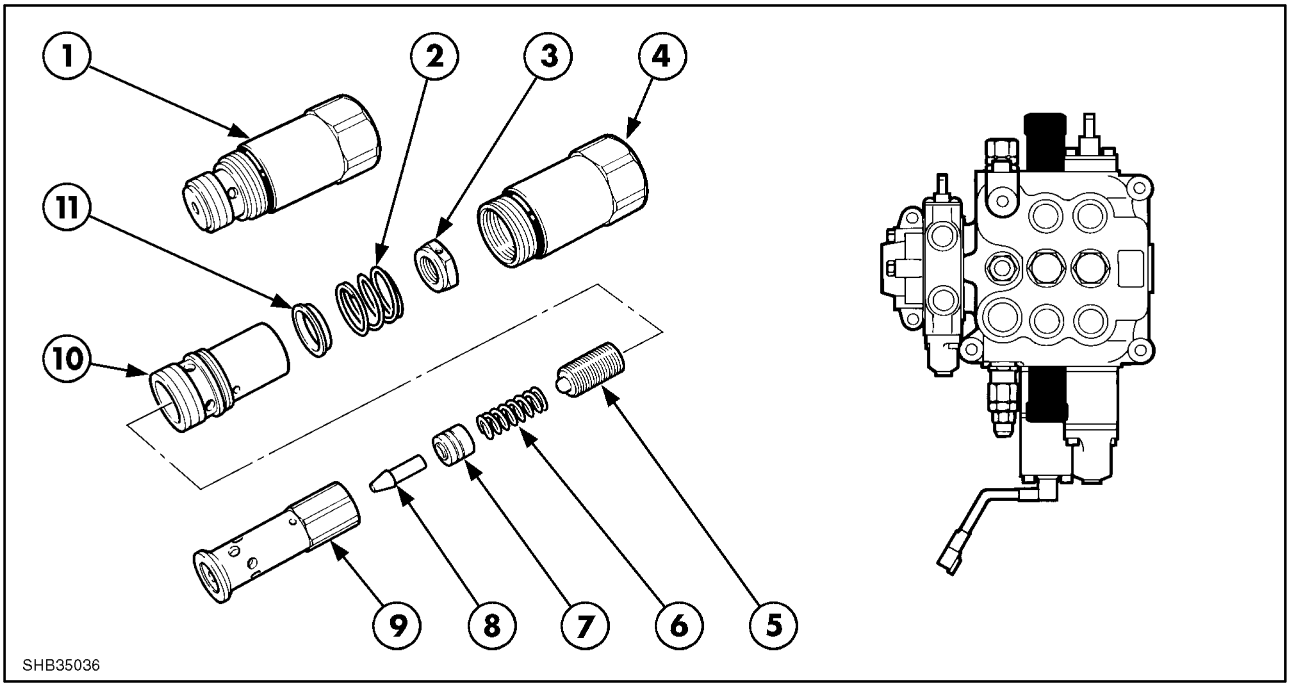
1. Body
2. Poppet
3. Spring
4. Spring
5. 'O' Ring
6. 'O' Ring
7. Fitting
8. Cap
9. 'O' Ring
10. Lock Nut
11. 'O' Ring
12. Adjuster
13. Spring
14. Pilot Valve
15. Piston
16. Poppet Valve



137

Direct Acting Relief Valve

1. Body
2. Poppet
3. Spring Seat
4. Spring
5. Shim
6. Cap
7. 'O' Ring
8. Locknut
9. 'O' Ring
10. Adjusting Screw



138

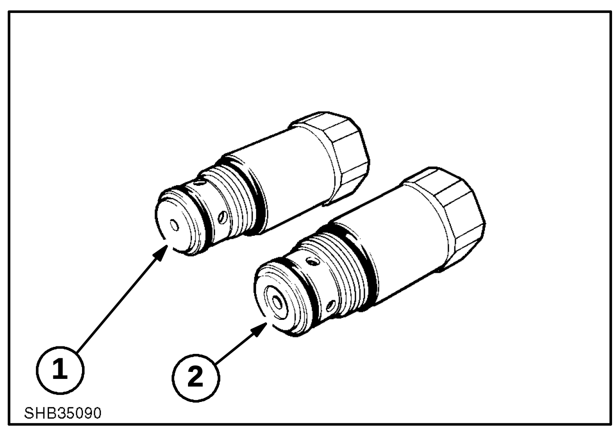
Loader Bucket Circuit Relief Valves

1. Relief Valve Assembly
2. Spring
3. Lock Nut
4. Valve Body
5. Adjuster
6. Spring
7. Guide
8. Poppet
9. Poppet Sleeve
10. Valve Body Inner
11. Spring Seat

The piston and rod end loader bucket circuit relief valves are set to different pressures and can be identified by the shape and size of orifice in the poppet sleeve.

The bucket dump relief valve (1) is set to a pressure of 227 bar (3300 psi) and has the small orifice. The valve is installed adjacent to the control valve linkage, item 2, Figure 134.

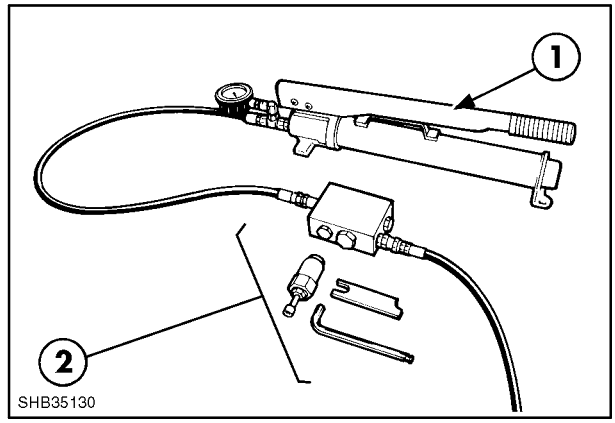
The bucket roll back relief valve (2) is set to a pressure of 160 bar (2300 psi) and can be identified by the larger sized orifice and and recess on the face of the poppet sleeve. The valve is installed adjacent to the return to dig solenoid, item 3, Figure 134.



139

Circuit Relief Valve Adjustments

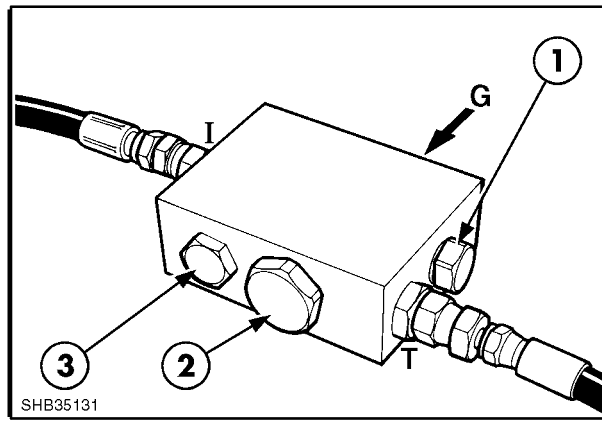
After overhaul the circuit relief valves must be tested and adjusted using a suitable hand pump (1), 275 bar (4000 psi) pressure gauge and V. L. Churchill test kit (2) Tool No **297418.**



140

12. The hand pump must be attached to inlet port **I** and the drain hose to the outlet port **T** of test block using suitable $^{1}/_{2}$ inch BSP (British Standard Pipe) adaptors.

    The pressure gauge may be connected to either the hand pump as shown or to the $^{3}/_{8}$ UNF threaded port **G** in the test block.

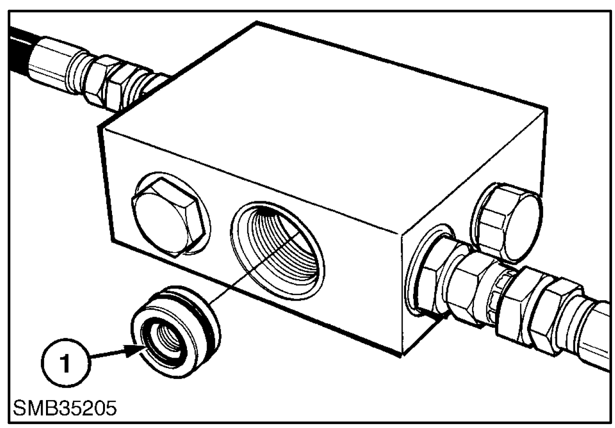


141

13. Remove plug and insert valve to be tested into the appropriate port in the test block as follows:–

1. Stabiliser and Backhoe Relief Valves
2. Loader Bucket Relief Valves
3. Unload Valve

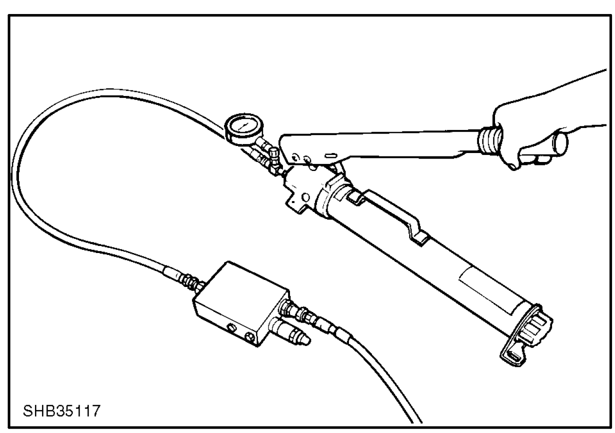
NOTE: *A special removable insert which, is part of the test block, is installed in the bottom of the port used for testing the loader valve. If difficulty is experienced in screwing the loader valve into the test block, check that the insert is fully seated and correctly installed. When correctly installed the 'O' ring (1) on the face of the insert should be visible.*



142

14. Operate hand pump and record maximum pressure reading on gauge. Compare pressure values with specifications shown in Figures 134, 135 and 136.

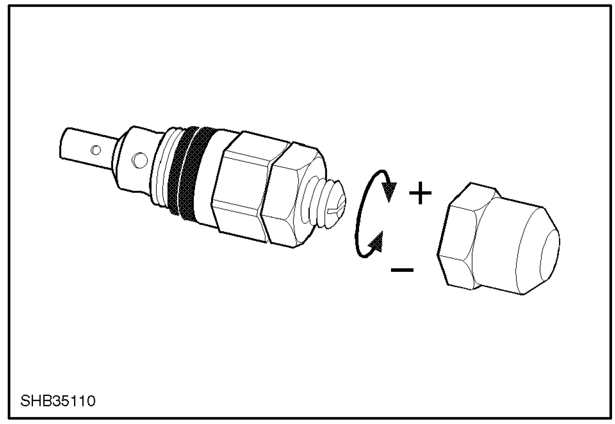
IMPORTANT: *Before removing valve from test block release pressure in circuit using the vent valve on the hand pump*



143

15. To adjust all relief valves with the exception of the loader bucket relief valve remove the valve cap, loosen lock nut and turn adjuster to obtain correct pressure.

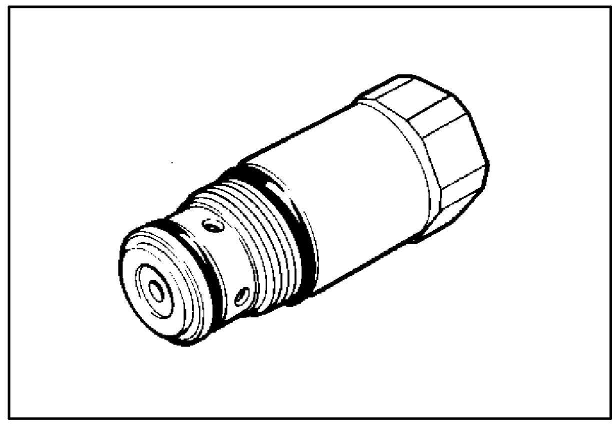
NOTE: *Relief Valves* ***Must Not*** *be set outside off the specified range.*



144

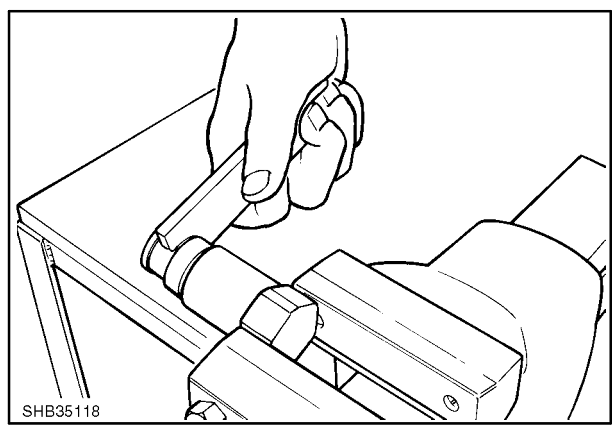
Loader Bucket Relief Valve Adjustment

NOTE: *If the loader bucket circuit relief valve requires adjustment, the special adjusting tool supplied with the test kit 297418 is required as described below.*



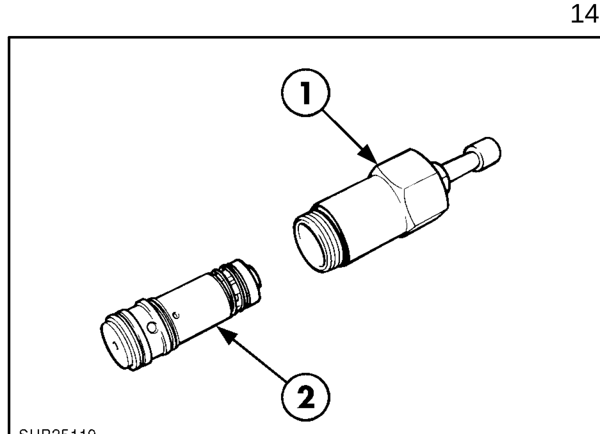
145

16. Hold relief valve in vice and using wrench supplied with tool, unscrew the internal valve assembly from the valve body.



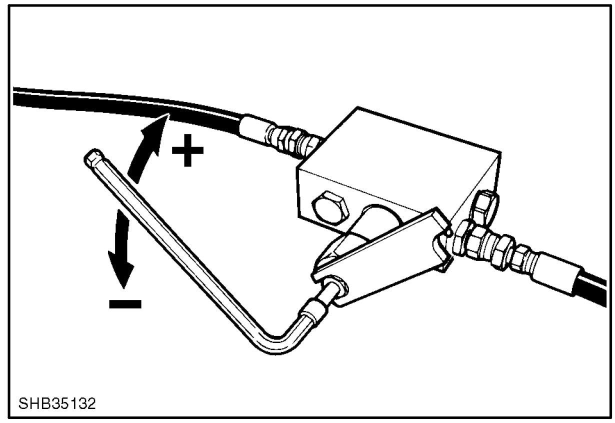
146

17. Screw the internal valve assembly (2) into the body of the adjusting tool (1).



147

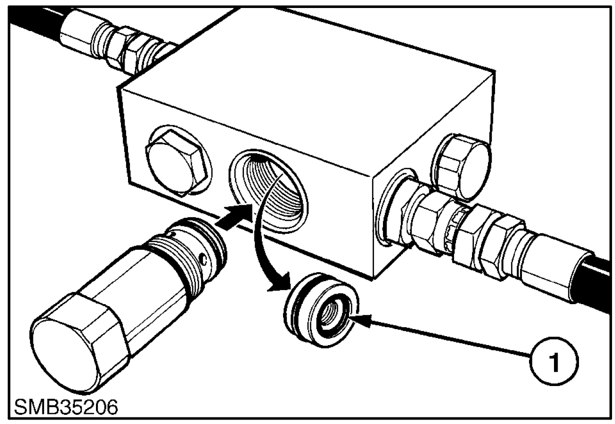
18. Install valve into test block and operate hand pump until valve is pressurised to 170 bar (2500 psi).
19. Using the special spanner supplied, loosen the lock nut on the end of the valve and adjust pressure setting using allen key.
20. Operate hand pump and recheck pressure.
21. When pressure setting is correct tighten locknut and release pressure in circuit using the vent valve on the hand pump.
22. Remove valve and using $^{3}/_{8}$ inch 16 UNC bolt remove insert, then re-assemble valve and install into test block.



148

23. Operate hand pump and recheck pressure.
24. If pressure is now lower than that recorded with the insert installed it is an indication that the anti-cavitation feature of the valve is leaking and the valve requires overhaul or replacement.

NOTE: *The insert isolates the anti-cavitation feature of the valve. When re-assembling the insert into the test block ensure it is installed correctly. When correctly installed the 'O' ring (1) on the face of the insert should be visible.*



149

SECTION 35 – HYDRAULIC SYSTEMS

Chapter 2 – Fault Finding, Pressure and Flow Testing for HUSCO Only

CONTENT

SPECIFICATIONS

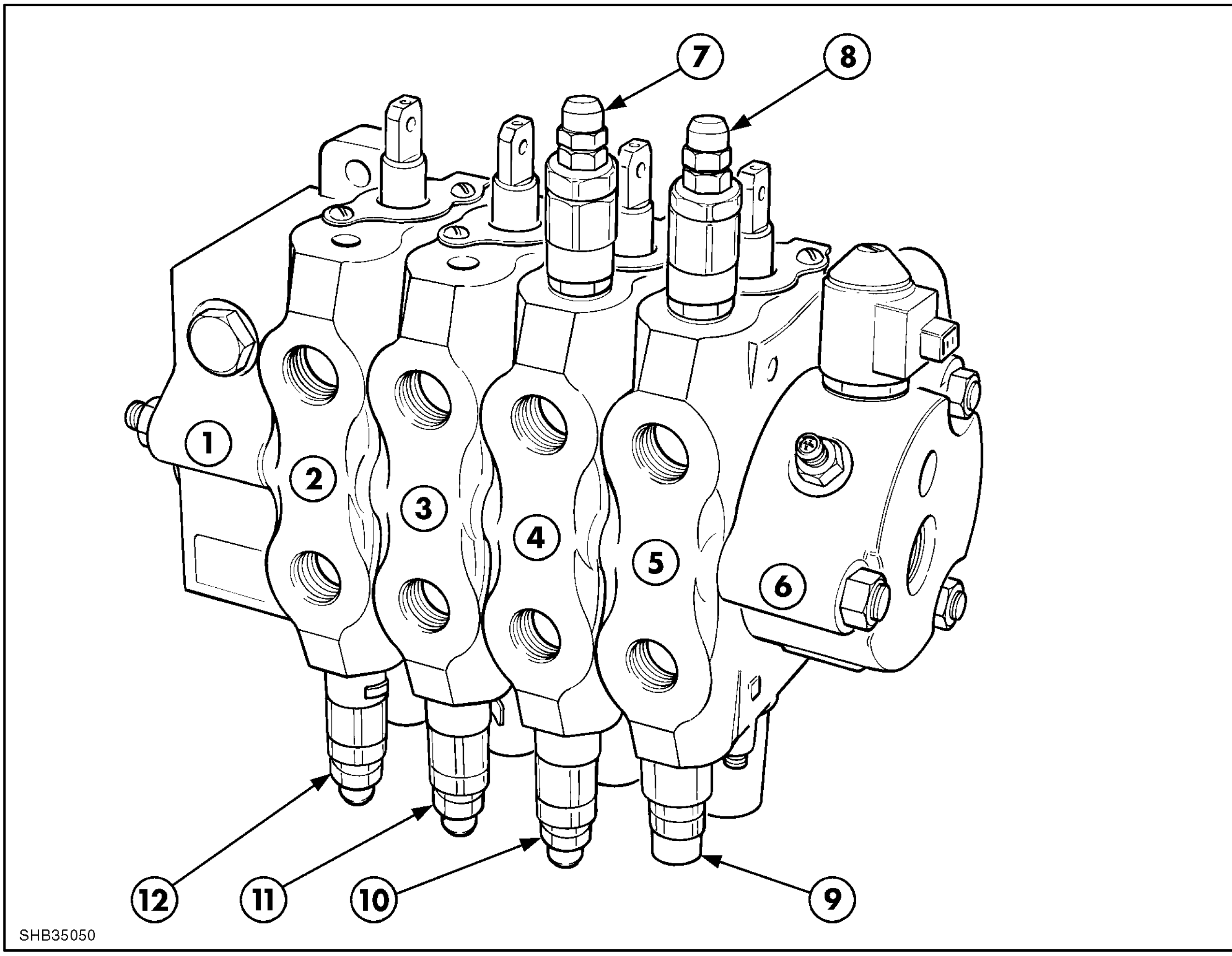
PUMP

Rear Pump (Steering Pump)			
	Output	New Pump	62.7 Litres/min (16.5 US. gals/min) @ 2200 rev/min @ Standby Pressure
	‘	Worn Pump (minimum)	53.0 Litres/min (14 US. gals/min) @ 2200 rev/min @ Standby Pressure
	Steering Circuit Standby Pressure		7 bar (101.5 psi)
	Steering Circuit Relief Valve		136.5 – 143.5 bar (999.25 – 1100.75 psi)
Front Pump			
	Output	New Pump	81.4 Litres/min (21.5 US. gals/min) @ 2200 rev/min @ 175 bar (2500 psi)
		Worn Pump (minimum)	69.0 Litres/min (18.2 US. gals/min) @ 2200 rev/min @ 175 bar (2500 psi)
Front and Rear Pump Combined Output			144.1 Litres/min 38 US. gals/min) @ 2200 rev/min

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOL NUMBER	NEW HOLLAND PART NUMBER
Circuit Relief Valve Pressure Test Kit	297418	291924
Quick Release Coupler	–	291924
Universal Pressure Test Kit		292870
Flowmeter 0–200 Litres/min	Procure Locally	
Hand Operated Hydraulic Pump	Procure Locally	
$^{1}/_{2}$ inch BSP (British Standard Pipe) Male Adaptors (Connects Hand Pump to Relief Valve Test Block)	Procure Locally	
$^{13}/_{16}$ inch ORFS Female Adaptor (Connects Hand Pump to Loader Piston Hose)	Procure Locally	

Circuit Relief Valves



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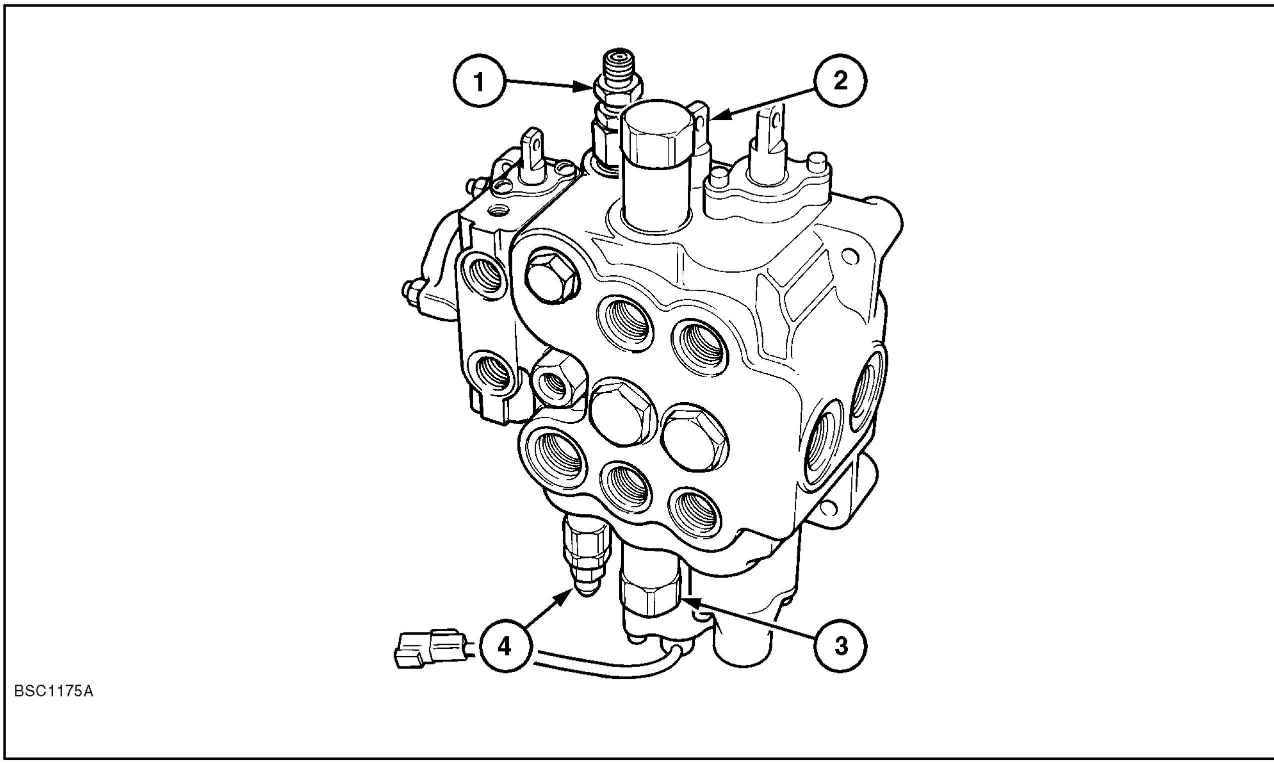
Backhoe Control Valve Assembly

1.	Outlet End Cover	
2.	Dipper Valve Section	
3.	Bucket Valve Section	
4.	Swing Valve Section	
5.	Boom Valve Section	
6.	Inlet End Cover	
7.	Swing Cylinder Cushioning Circuit Relief Valve* (Left Swing)	207 bar (3000 psi)
8.	Lift Cylinder (Piston End) Circuit Relief Valve*	241 bar (3500 psi)
9.	Lift Cylinder (Rod End) Direct Acting Circuit Relief Valve	317 bar (4600 psi)
10.	Swing Cylinder Cushioning Circuit Relief Valve* (Right Swing)	207 bar (3000 psi)
11.	Bucket Cylinder (Rod End) Circuit Relief Valve*	207 bar (3000 psi)
12.	Dipper Cylinder (Piston End) Circuit Relief Valve*	241 bar (3500 psi)

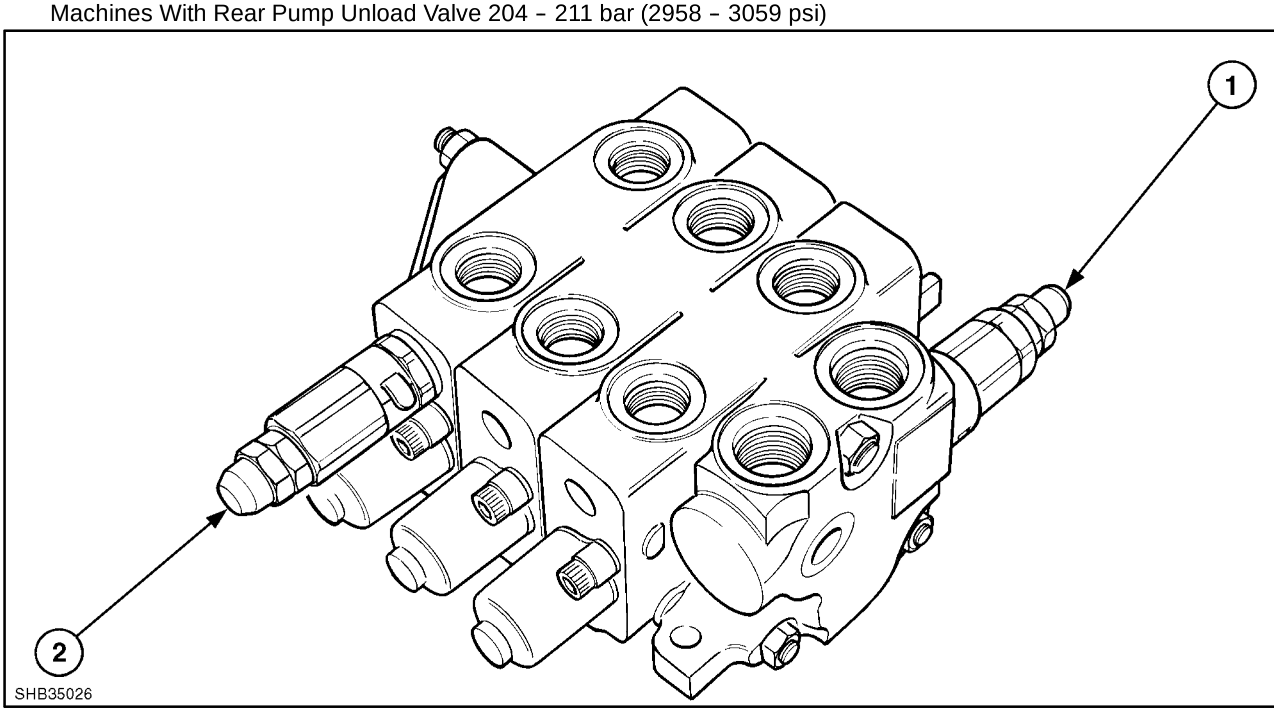
*Pilot Operated with Anti Cavitation Feature



2

Loader Valve Assembly Relief Valve Location

1. Rear Pump Unload Valve @ 170 bar (2465 psi)
2. Loader Bucket Relief Valve Rod End @ 227 bar (3300 psi)
3. Loader Bucket Relief Valve Piston End @ 160 bar (2300 psi)
4. System Pressure Relief Valve
   Machines With Rear Pump Unload Valve 204 – 211 bar (2958 – 3059 psi)



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Stabiliser and Extendible Dipper Control Valve Assembly

1. Rear Pump Relief Valve– Pilot Operated @ 196 – 202 bar (2842 – 2929 psi)
2. Extendible Dipper (Piston End) Relief Valve– Pilot Operated @164 bar (2375 psi)

PRELIMINARY CHECKS

If fault finding, pressure and flow testing is carried out in a systematic manner and the results analyzed, the malfunction can be readily and accurately identified. If short cuts, assumptions and guesses are made, unnecessary strip-down or component replacement could result. Follow the step-by-step procedures outlined below.

As a first step in the fault finding procedure, several preliminary checks should be made. These checks are important in that once performed, they need no longer be considered as a possible cause of the immediate or reported malfunction.

Check that the hydraulic oil is at the correct level and of the correct specification.

Check the loader, backhoe or any additional accessory such as hydraulic bucket, hammers etc., for correct assembly or installation and additionally for signs of external damage that might cause gross misalignment of structural members.

Check in more detail for other mechanical damage such as kinked, twisted, worn or decayed hoses, damaged cylinders and bent elements. Do not forget to check underneath the unit for damaged steel tubes, particularly if the unit has been known to have operated in arduous conditions, been grounded, or bogged down.

Ensure optimum operating temperature of the hydraulic oil is achieved.

Perform the system pressure and rear pump relief valve pressure tests.

The preceding preliminary checks assume that the engine performance is not in question. Having performed these checks and failed to locate the cause of the malfunction, the following procedures should be adopted:

If possible, operate the backhoe and make notes of the operating characteristics. Cycle each control lever to operate each of the cylinders to the fully extended and retracted positions.

Compare the operating characteristics in the preceding stage with the malfunctions listed in the "Fault Finding Chart".

EXAMPLE:

Backhoe lift circuit slow to raise, all other circuits appear to work normally.

Listed in the column under "Malfunction" in the "Fault Finding Chart", the description would be "lift fails to operate, is slow or has loss of power".

The column headed "Malfunction" lists the observed malfunctions when the backhoe or loader is operated.

The column headed "Possible Cause" lists all the items in the circuit which could cause the observed malfunction.

The column headed "Test/Repair" lists the test which should be used to determine the item causing the observed malfunction.

Refer to "Test/Repair" column and perform the recommended tests. Systematic and logical testing will reduce the time required in locating the cause of the malfunction and provide a more accurate indication of the malfunction. If adequate test equipment is not available, disassembly and inspection of the items listed under "Possible Causes" must be undertaken.

FAULT FINDING - GENERAL

PROBLEM	POSSIBLE CAUSES	CORRECTION
All circuits fail to operate.	Pump drive inoperative.	Investigate and repair as necessary.
	Low oil level.	Check and add oil.
	Restricted pump suction line.	Inspect suction line and reservoir, repair as necessary.
Slow operation or loss of power in all circuits.	Pump worn.	Perform pump performance test and replace/reseal as necessary.
	Restricted pump suction line.	Inspect suction line and reservoir, repair as necessary.
Backhoe and loader circuits fail to operate or operate slowly while extendible dipper and stabilisers operate correctly	Main system relief valve leaking or incorrectly adjusted	Perform main system relief valve pressure test
	Front pump worn	Perform pump performance and pressure test and overhaul as necessary
		Refer to loader and backhoe fault finding charts

FAULT FINDING - STABILISERS AND EXTENDIBLE DIPPER

PROBLEM	POSSIBLE CAUSES	CORRECTION
Stabiliser and extendible dipper circuits fail to operate, are slow or has loss of power.	Rear pump circuit relief valve leaking or incorrectly adjusted.	Perform rear pump circuit relief valve pressure test and overhaul as necessary.
	Rear pump worn	Perform pump performance pressure and flow test and replace/reseal as necessary.
Extendible dipper fails to operate or is slow to operate on extend cycle	Extendible dipper circuit relief valve leaking or incorrectly adjusted.	Pressure test extendible dipper circuit relief valve.
Extendible dipper slow to operate in extend and retract cycle.	Valve spool leakage	Examine extendible dipper valve section for wear or scoring
	Piston seal leaking or cylinder barrel damaged	Examine/reseal piston and gland.
Stabiliser leg leaks down	Stabiliser lock valve leaking	Examine/overhaul stabiliser lock valve.
	Piston seal leaking or cylinder barrel damaged	Examine/reseal piston and gland.

FAULT FINDING - BACKHOE

Refer to the following backhoe fault finding chart after first considering the preceding charts. The backhoe chart should only be referred to if the supply circuit is performing normally, thereby confirming that the pump and hydraulic supply circuits are functioning to specification. See also “Fault Finding Hydraulic Pump”.

PROBLEM	POSSIBLE CAUSES	CORRECTION
Lift fails to operate, is slow, has loss of power or is not holding.	Lift circuit relief valve stuck open, set too low or seat is leaking.	Pressure test lift circuit relief valve.
	Valve spool leakage.	Examine lift section of backhoe control valve assembly for wear and scoring.
	Piston seal leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Crowd fails to operate, is slow, has loss of power.	Crowd circuit relief valve (piston end) stuck open, set too low or seat is leaking.	Pressure test crowd circuit relief valve.
	Valve spool leakage.	Examine crowd section of backhoe control valve assembly for wear and scoring.
	Piston seal leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Bucket fails to operate, is slow, has loss of power.	Bucket circuit relief valve (rod end) stuck open, set too low, or seat is leaking.	Pressure test bucket circuit relief valve.
	Valve spool leakage.	Examine bucket section of backhoe control valve assembly for wear and scoring.
	Piston seal leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Extendible dipstick fails to operate, is slow, has loss of power or is not holding.	Refer to Extendible dipper fault finding chart.	
All backhoe circuits fail to operate, are slow or have loss of power.	Regenerative check valve in control valve outlet end cover stuck open or seat is leaking.	Examine regenerative check valve

FAULT FINDING - BACKHOE (CONT.)

PROBLEM	POSSIBLE CAUSES	CORRECTION
Right or left direction swing fails to operate, is slow, or has loss of power.	Swing circuit relief valves not seating, set too low or seat is leaking.	Swing circuit relief valve test.
	Valve spool leakage.	Examine swing section of backhoe control valve assembly for wear or scoring.
	Piston seal leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Swing fails to slow (cushion arrest) at end of travel.	Integral sliding restrictor damaged.	Disassemble and inspect.
	Piston seal leaking or cylinder barrel damage.	Examine/reseal piston and gland.
Swing continues to move when control lever returned to neutral (one direction only).	Circuit relief valve (return side) stuck open, set too low or seat leaking.	Swing circuit relief valve test.
	Valve spool leakage.	Examine swing section of backhoe control valve assembly for wear or scoring.
Swing drifts, slow to respond, hesitates.	Circuit relief valve anti-cavitation function stuck/seized.	Disassemble and inspect.
	Restrictors seized/incorrectly positioned.	Disassemble and inspect.
Cylinders leak down (spools in neutral).	Internal valve leakage.	Examine appropriate valve section of backhoe control valve assembly for wear or scoring.
	Piston seal leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Any one circuit drops momentarily when signalled to raise.	Load check valve between control valve sections damaged.	Disassemble and inspect.

FAULT FINDING - LOADER

PROBLEM	POSSIBLE CAUSES	CORRECTION
Lift fails to operate, is slow or has loss of power.	Valve spool leakage.	Examine lift section of loader control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Bucket fails to operate, is slow or has loss of power.	Circuit relief valves stuck open, set too low or seat leaking.	Bucket circuit relief valve test.
	Valve spool leakage.	Examine bucket section of loader control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Cylinder leak down (spools in neutral).	Piston barrel damaged.	Examine/reseal piston and gland.
	Internal valve leakage.	Examine appropriate valve section of loader control valve assembly for wear or scoring.
Hesitation in loader lift or bucket cylinders when control initially moved.	Load check valve between control valve sections damaged.	Disassemble and inspect.

FAULT FINDING - HYDRAULIC PUMP

PROBLEM	POSSIBLE CAUSES	CORRECTION
System noisy.	Worn or damaged pump gears or pressure plates.	Hydraulic pump performance test.
	Aeration: Air entering the systems at: suction tube, pump shaft, fittings, or cylinder glands.	Hydraulic pump performance test.
	Cavitation: Restrictions in the system at the suction line or at the suction screen in the reservoir.	Visual and/or hydraulic pump performance test.
	Water in the system.	Visual.
	System relief valve chatter.	Check system relief valve, adjust/overhaul as necessary.
	Tubing vibration.	Visual.
	Cold hydraulic oil.	Check hydraulic oil operating temperature.
	Wrong type oil being used.	Investigate/drain and refill.
Hydraulic oil exhausts from breather at the reservoir.	Reservoir overfilled.	Check hydraulic oil level.
	Aeration: Air entering the system at: suction tube, pump shaft, fittings, or cylinder glands.	Hydraulic pump performance test.
	Cavitation: Restriction in the system at the suction screen in the reservoir.	Visual and/or hydraulic pump performance test.
Oil heating.	Oil supply low.	Fill reservoir.
	Contaminated oil.	Drain reservoir and refill with clean oil.
	Setting of relief valve too high or too low.	Drain reservoir and refill with clean oil. Test relief valves.
	Oil in system too light.	Drain reservoir and refill with correct viscosity oil.
	Oil cooler fins blocked.	Clean oil cooler.
Shaft seal oil leakage.	Worn shaft seal.	Replace shaft seal and inspect pump.
Foaming oil.	Low oil level.	Fill reservoir.
	Air drawn into suction line.	Check/tighten suction line.
	Wrong oil grade.	Drain and refill with correct oil.

Pressure Testing

Before pressure testing the machine ensure the hydraulic oil is at normal operating temperature of 75°C.

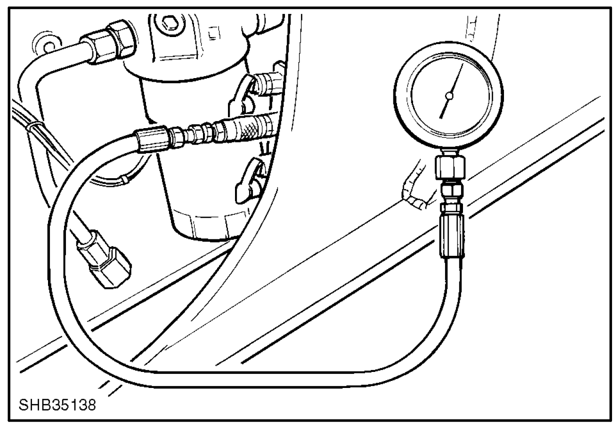
The following valves can be tested using the three pressure test ports on the left hand side of the machine.

- Main System Relief Valve
- Loader Bucket Relief Valve (Piston End)
- Rear Pump Unload Valve (Where Fitted)
- Rear Pump Relief Valve
- Extendible Dipper Relief Valve (Piston End)
- Steering Circuit Standby Pressure
- Steering Circuit Relief Valve

The middle test port is used solely for pressure testing the steering system.

Install 0–200 bar (0–3000 psi) pressure gauge in this port using quick release coupler, New Holland Part No 291924, when pressure testing the steering system.

The upper and lower test ports are used to pressure test relief valves related to the loader and backhoe hydraulic system.



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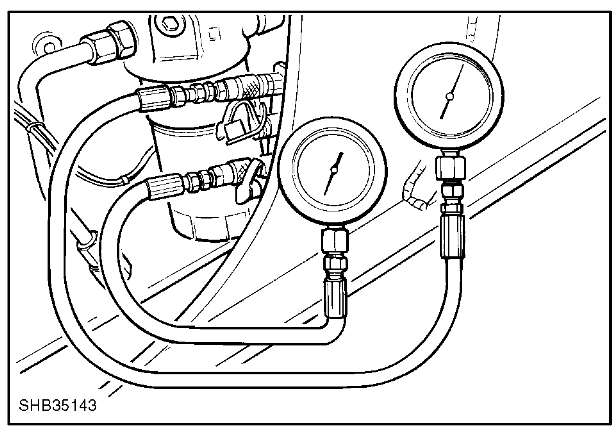
Install 0–250 bar (0–4000 psi) pressure gauges in these test ports using quick release couplers, Part No 291924, when pressure testing these circuits.



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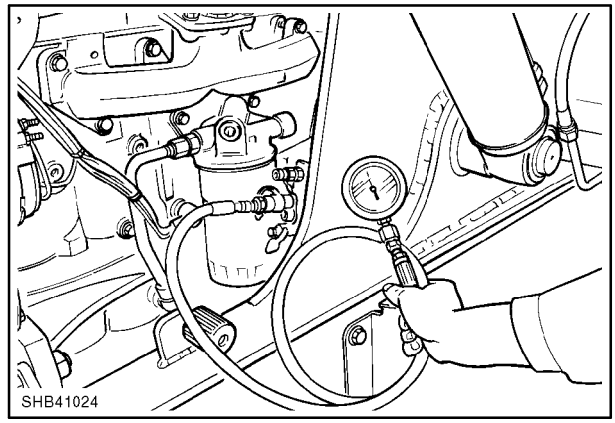
Steering Standby

1. install 0–200 bar (0–3000 psi) pressure gauge in middle test port on left hand side of machine.
2. Set engine speed to 1000 rev/min



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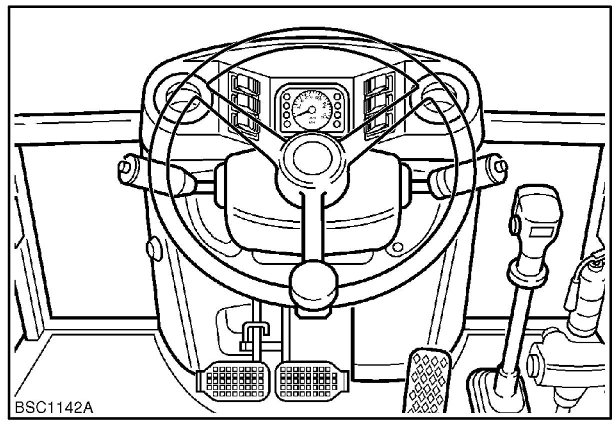
3. Ensure no turning force is being applied to the steering wheel and observe pressure on gauge. The pressure gauge should read approximately 7 bar (101.5 psi) and is the steering standby pressure.
4. If pressure incorrect remove and examine flow divider spool on end of pump. Refer to Chapter 1, Page 16.



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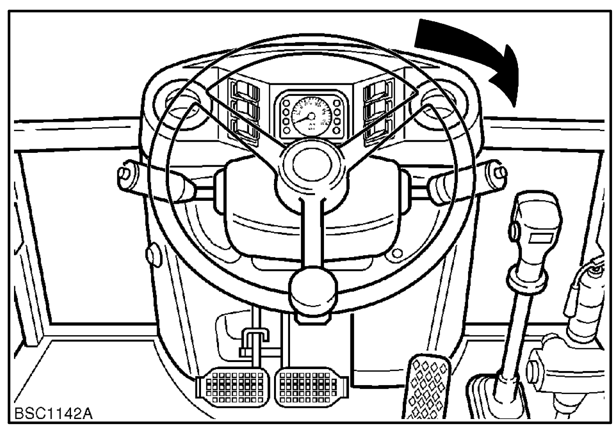
Steering Circuit Relief Valve

1. Set engine speed to 2000 rev/min and fully turn and hold steering on either full left or right hand turn and observe pressure gauge. The gauge reading should rise to 140 bar (1050 psi) and is the steering circuit relief valve setting.



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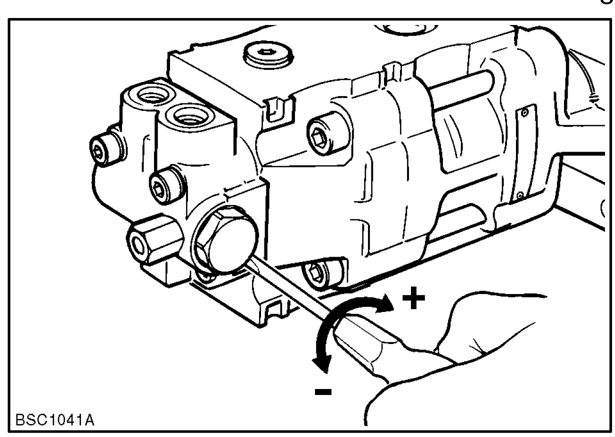
2. If reading is not to specification stop engine, remove blanking plug on pump flow divider and using screwdriver turn relief valve adjusting screw to increase or decrease setting.
3. Retest steering and when pressure correct peen end of adjuster to prevent movement and re-install blanking plug.



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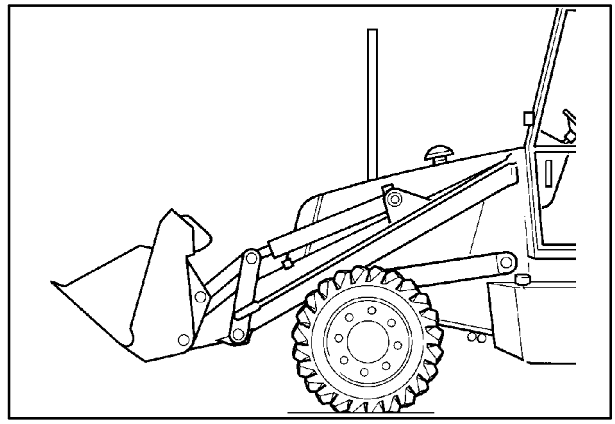
System Pressure Relief Valve

1. Set engine speed to 2200 rev/min.
2. Raise loader until bucket is approximately 0.5 metres from the ground. This ensures that self levelling device does restrict movement of bucket during this test.



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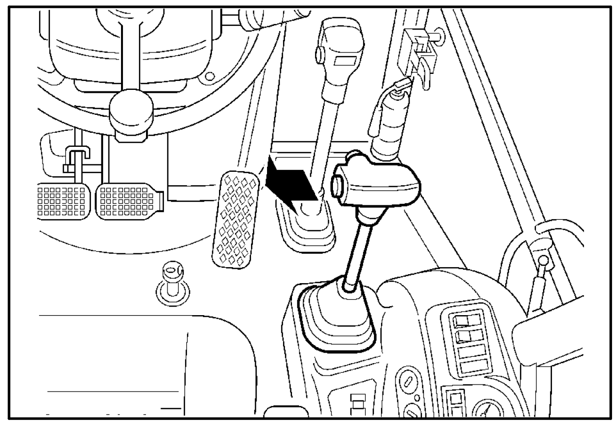
3. Hold the loader bucket control lever to the left causing the bucket to roll back.

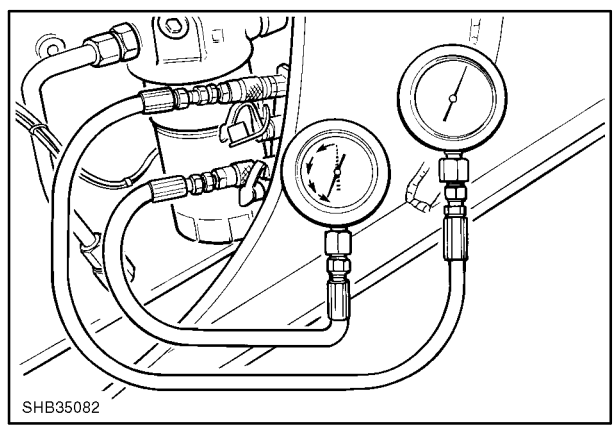


11

4. Observe the reading on the upper gauge which will display the system pressure relief valve setting.

Machine	System Relief Valve Setting
With rear pump unload valve	204 – 211 bar (2958 – 3059 psi)

5. If relief valve is away from specification the valve may be either adjusted on the machine or alternativeley, remove valve, retest and adjust using test block **297418**.

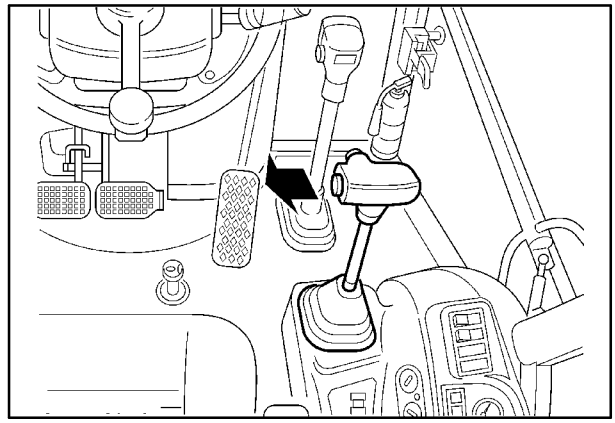


12

Rear Pump Unload Valve (Where Fitted)

1. Set engine speed to 2200 rev/min
2. Raise the loader until bucket is approximately 0.5 metres from the ground.
3. Slowly move the loader bucket control lever to the left causing the bucket to roll back and at the same time observe the pressure reading on the upper and lower gauges.

   The pressure at which the reading of the gauge in the lower test port suddenly drops to zero should be 156–162 bar (2250–2350 psi) and is the operating pressure of the unload valve.



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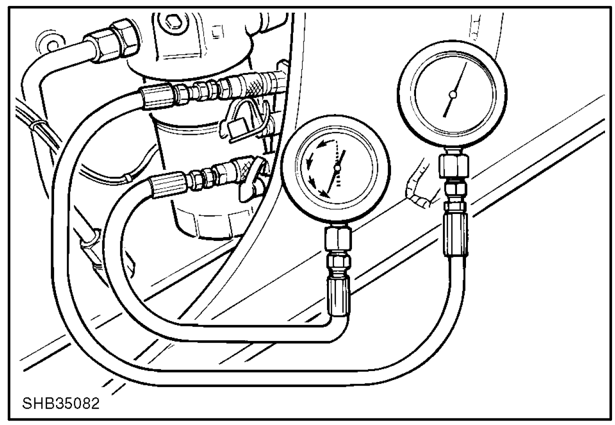
4. If unload valve is away from specification the valve may be either adjusted on the machine or alternativeley remove valve, retest and adjust using test block **297418.**



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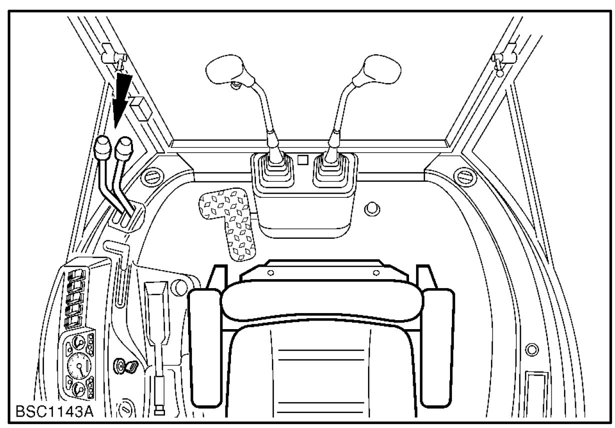
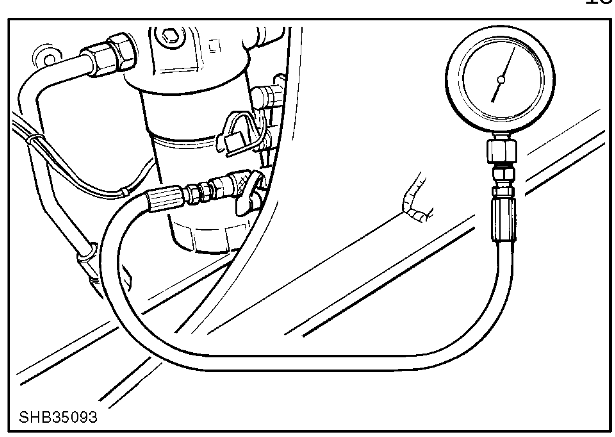
Rear Pump Relief Valve

1. Set engine speed to 2200 rev/min
2. Pull and hold stabiliser control lever in retract position



15

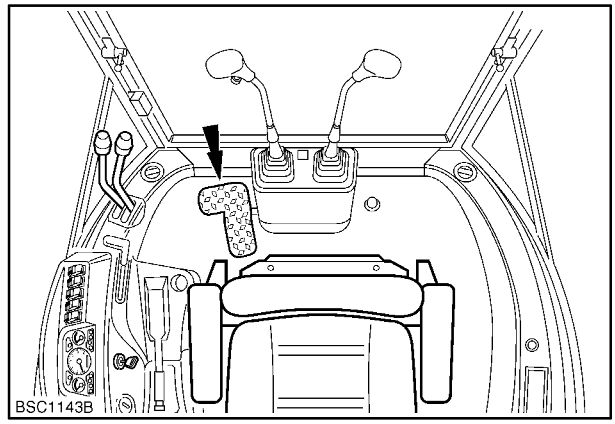
3. Pressure displayed on the gauge connected to the lower test port should read 170–177 bar (2500–2567 psi) and is the rear pump relief valve setting.
4. If relief valve is away from specification the valve may be either adjusted on the machine or alter-nativeley remove valve, retest and adjust using test block **297418**.



16

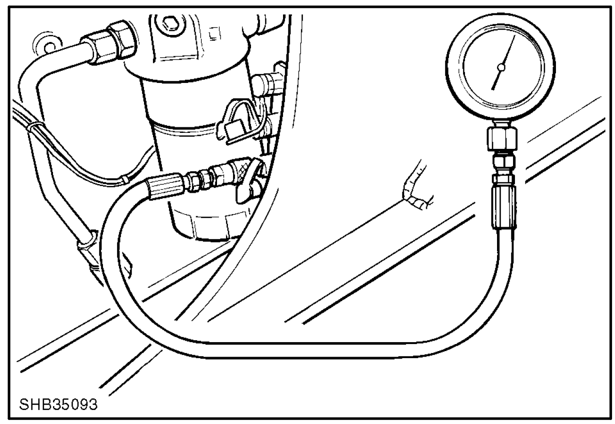
Extendible Dipper Relief Valve (Piston End)

1. Set engine speed to 2200 rev/min
2. Fully **extend** the extendible dipper and continue to depress the control pedal.



17

3. Observe the reading on the gauge in the lower test port (3).
4. Pressure recorded is the extendible dipper relief valve setting and should read 161–167 bar (2335–2422 psi).
5. If relief valve is away from specification the valve may be either adjusted on the machine or alternativeley remove valve, retest and adjust using test block **297418**.



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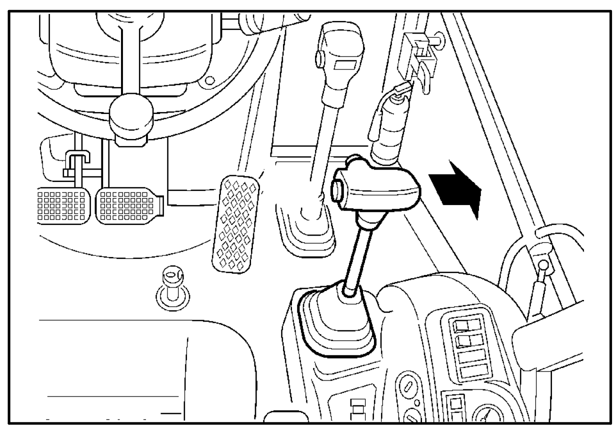
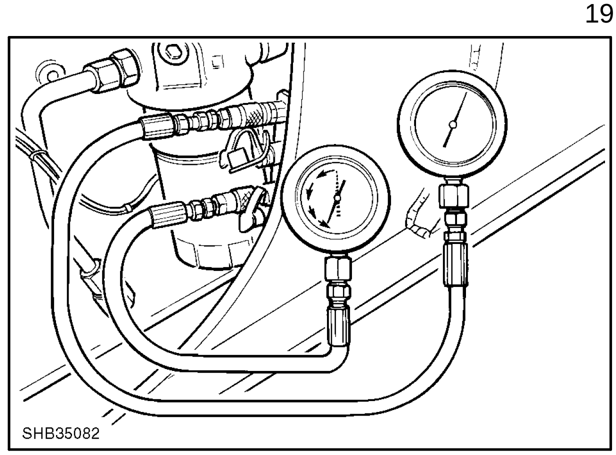
Loader Bucket Relief Valve (Piston End)

1. Set engine speed to 1000 rev/min
2. Hold the loader bucket control lever to the **right** causing the bucket to dump.



19

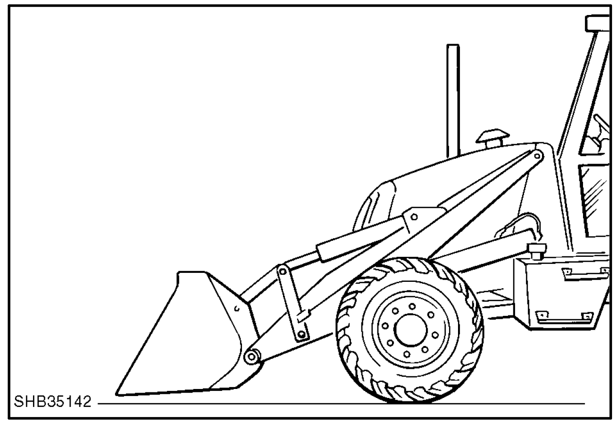
3. Observe the upper gauge which should read 160 bar (2300 psi). and is the operating pressure of the loader bucket, piston end, relief valve.
4. If valve is away from specification remove valve, retest and adjust using test block **297418**.



20

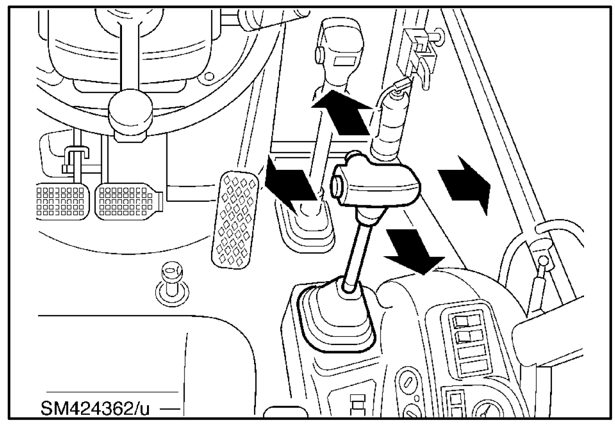
Loader Bucket Relief Valve (Rod End)

1. Lower loader to the ground.



21

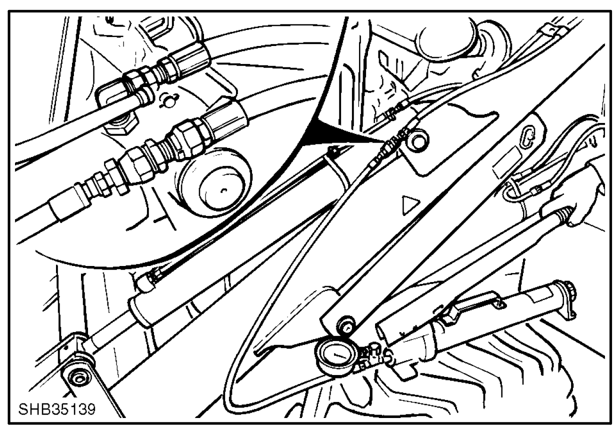
2. Relieve all pressure in the loader circuit by moving loader control lever through all operating positions.



22

3. Disconnect feed hose to rod end of bucket cylinder and collect any oil discharged from the hose into a suitable container.
4. Install 13/16 inch ORFS female connector into disconnected feed hose and attach suitable hand pump with pressure gauge which can generate 250 bar (3600 psi) of pressure.
5. Continually operate hand pump and observe maximum pressure recorded when relief valve operates.

NOTE: *The hand pump has to replenish the oil lost in the feed hoses during disconnection. It may therefore be necessary to continuously operate the hand pump for approximately 1 minute before any pressure n the system is generated.*



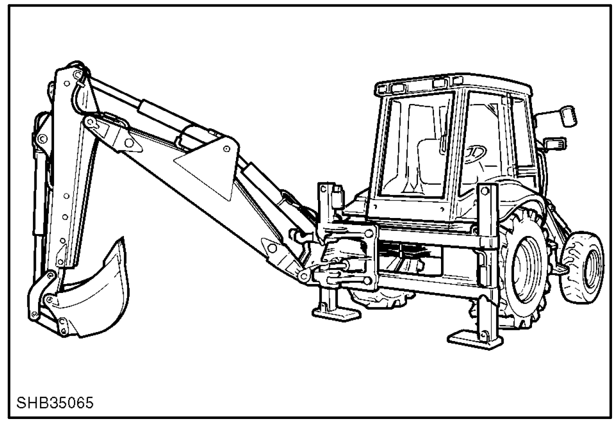
23

Backhoe Circuit Relief Valves

The backhoe circuit relief valves cannot be tested using the pressure test fittings located on the side of the machine. These valves are easily accessible from the rear of the machine and should be removed from the backhoe valve assembly for pressure testing using test block Tool No **297418** as described on the following page.

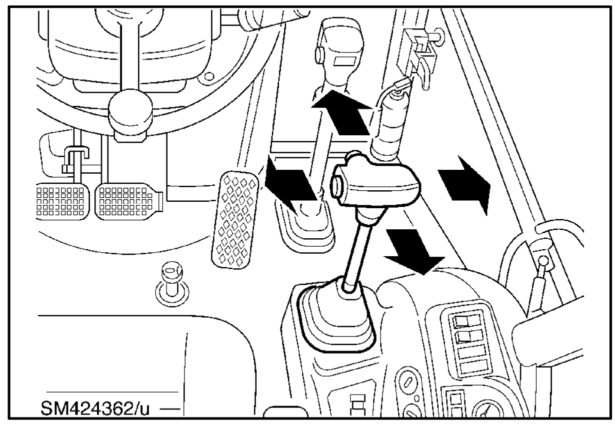
WARNING

When removing circuit relief valves from the machine observe the following procedure:–



24

1. Position the unit on hard level surface.
2. Lower loader to the ground
3. Lower stabilisers
4. Offset swing frame on sideshift models to the left or right.
5. Fully retract dipper and position dipstick in the vertical plane with bucket positioned firmly on the ground.
6. Stop the engine and relieve any residual pressure in the circuits by moving the backhoe loader and stabiliser control levers through all operating position.



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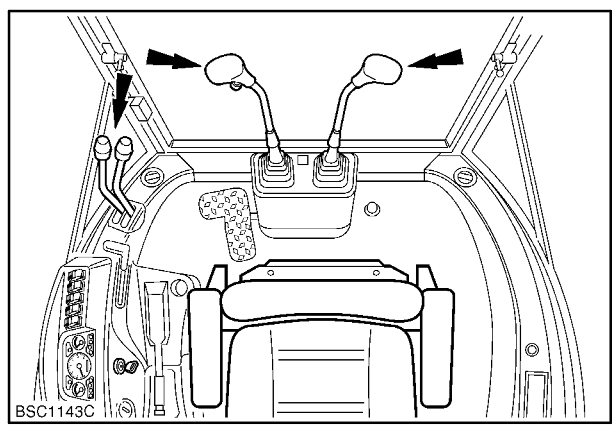

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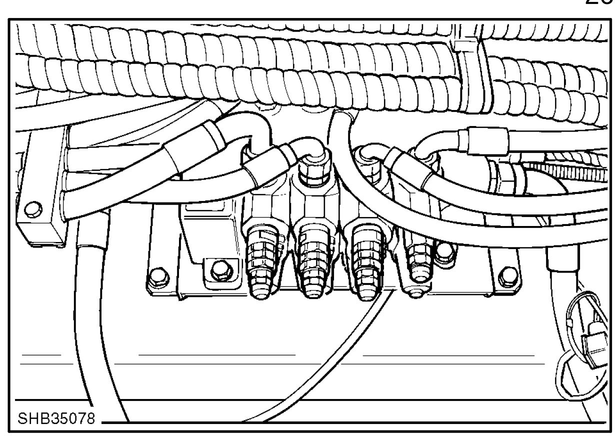
7. Individually remove and test each relief valve as described on the following page.

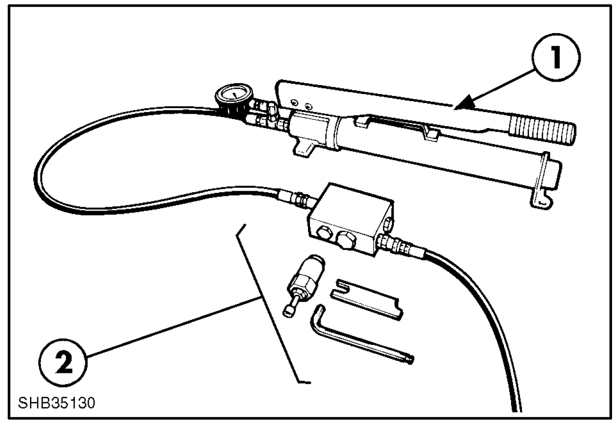
   To avoid installing valves in their incorrect location only remove and test one valve at a time.



27

Circuit Relief Valve Pressure Testing Using Test Block 297418

After overhaul the circuit relief valves must be tested and adjusted using a suitable hand pump (1), 275 bar (4000 psi) pressure gauge and test kit (2) Tool No **297418**.

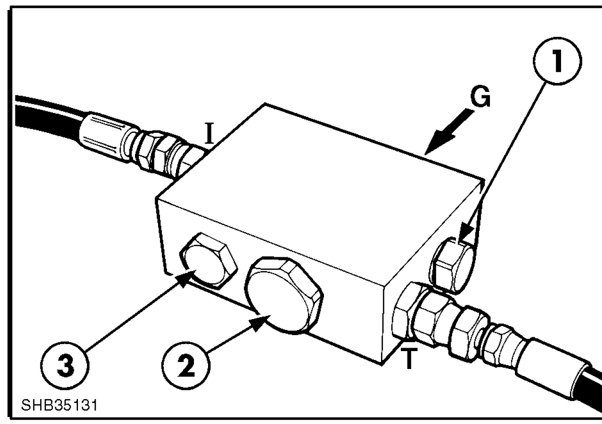


28

1. The hand pump must be attached to inlet port **I** and the drain hose to the outlet port **T** of test block using suitable $^{1}/_{2}$ inch BSP (British Standard Pipe) adaptors.

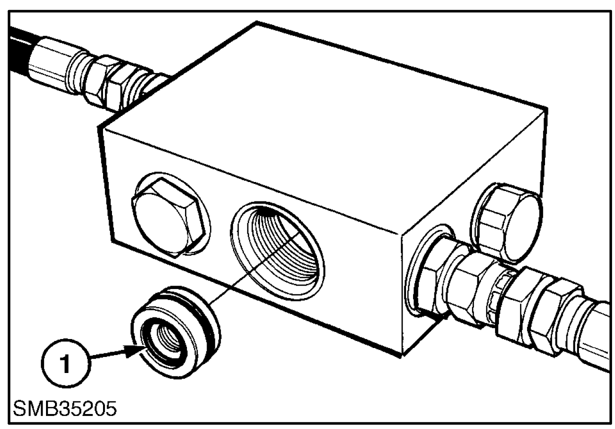
   The pressure gauge may be connected to either the hand pump as shown or to the $^{3}/_{8}$ UNF threaded port **G** in the test block.
2. Remove plug and insert valve to be tested into the appropriate port in the test block as follows:–

1. Stabiliser and Backhoe Relief Valves
2. Loader Bucket Relief Valves
3. Unload Valve



29

NOTE: *A special removable insert which, is part of the test block, is installed in the bottom of the port used for testing the loader valve. If difficulty is experienced in screwing the loader valve into the test block, check that the insert is fully seated and correctly installed. When correctly installed the 'O' ring (1) on the face of the insert should be visible.*



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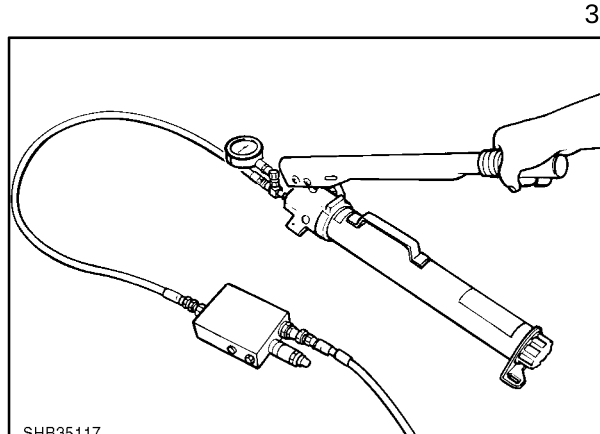
3. Operate hand pump and record maximum pressure reading on gauge. Compare pressure values with specifications shown in Figures 1, 2 and 3.

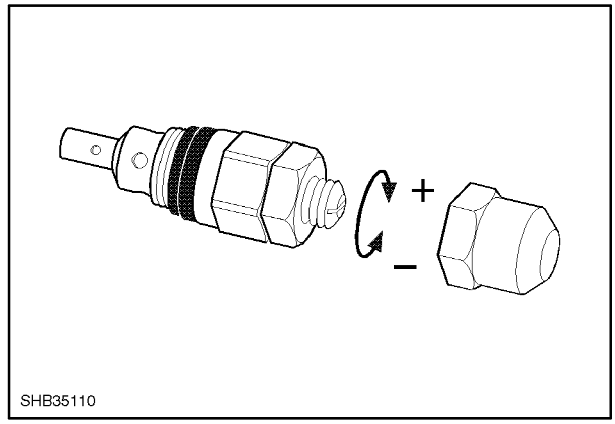
IMPORTANT: *Before removing valve from test block release pressure in circuit using the vent valve on the hand pump.*



31

4. To adjust all relief valves with the exception of the loader bucket relief valve remove the valve cap, loosen lock nut and turn adjuster to obtain correct pressure.

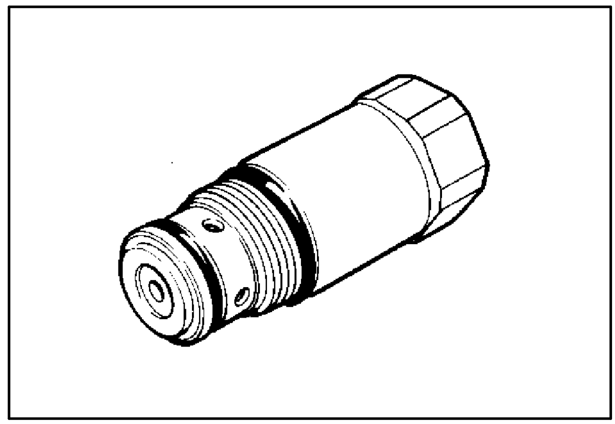
NOTE: *Relief Valves* ***Must Not*** *be set outside off the specified range.*



32

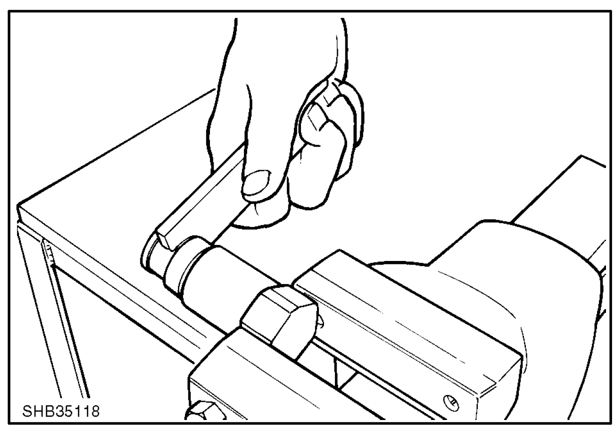
Loader Bucket Relief Valve Adjustment

NOTE: *If the loader bucket circuit relief valve requires adjustment, the special adjusting tool supplied with the test kit 297418 is required as described below.*



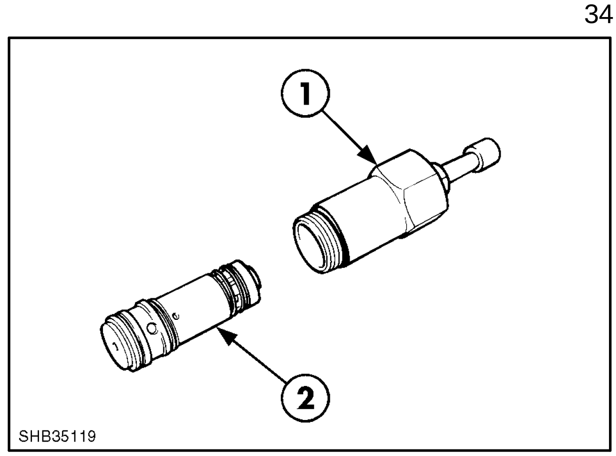
33

1. Hold relief valve in vice and using wrench supplied with tool, unscrew the internal valve assembly from the valve body.



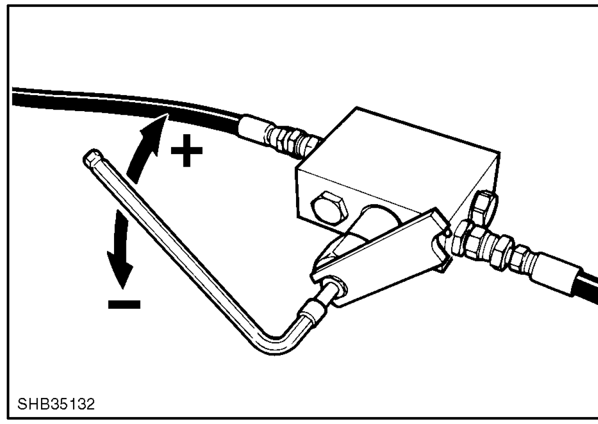
34

2. Screw the internal valve assembly (2) into the body of the adjusting tool (1).



35

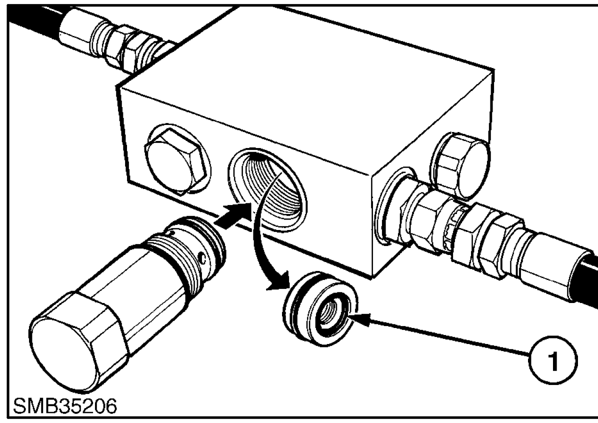
3. Install valve into test block and operate hand pump until valve is pressurised to 170 bar (2500 psi).
4. Using the special spanner supplied, loosen the lock nut on the end of the valve and adjust pressure setting using allen key.
5. Operate hand pump and recheck pressure.
6. When pressure setting is correct tighten locknut and release pressure in circuit using the vent valve on the hand pump.
7. Remove valve and using $^{3}/_{8}$ inch 16 UNC bolt remove insert, then re-assemble valve and install into test block.



36

8. Operate hand pump and recheck pressure.
9. If pressure is now lower than that recorded with the insert installed it is an indication that the anti-cavitation feature of the valve is leaking and the valve requires overhaul or replacement.

NOTE: *The insert isolates the anti-cavitation feature of the valve. When re-assembling the insert into the test block ensure it is installed correctly. When correctly installed the 'O' ring (1) on the face of the insert should be visible.*

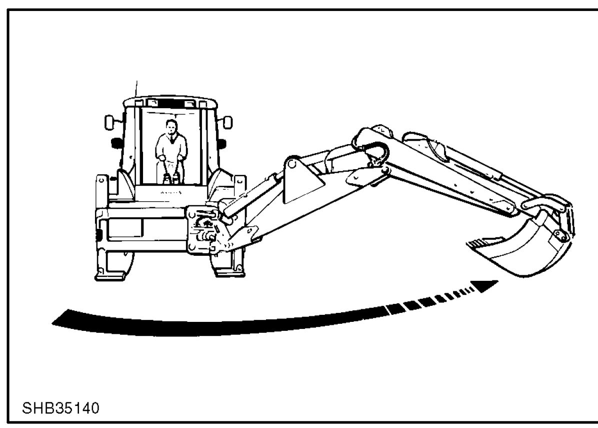


37

Swing System - Cushioning Test

Automatic cushioned arrest at the maximum swing position is provided by the sliding restrictors within the swing cylinders. Test the cushioning effect as follows:-

1. Position the backhoe on a hard level surface and lower the stabilizers.
2. With the backhoe elements at full reach, swing the boom fully to the right. During the last 20-25 degrees of the swing, the elements should slow automatically.
3. Any malfunction should be identified and the corresponding swing cylinder which when retracting does not automatically slow down should be removed, disassembled and inspected.



38

NOTE: *If the control levers are suddenly released in the middle of the swing cycle the momentum of the swing elements is controlled by the circuit relief valves. Any hesitancy of the swing system to re-start or reverse the swing direction could be caused by malfunction of the circuit relief valves anti-cavitation component. Should this be suspected, then the relief valve assembly should be removed, disassembled and inspected.*

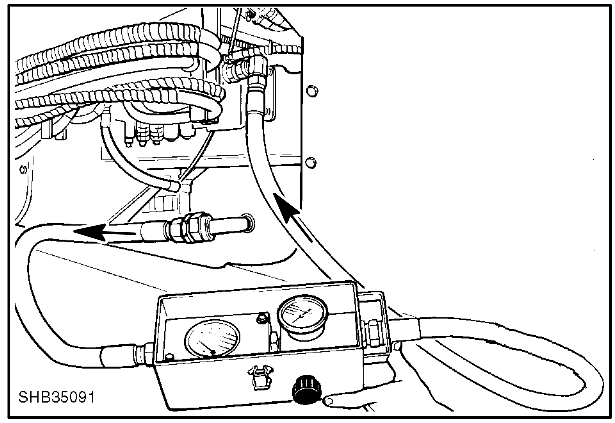
Flow Testing

Pump Performance Test

The following pump performance test must be performed after pressure testing the system and rear pump relief valves and when the hydraulic oil is at normal operating temperature of 75° C.

1. Disconnect inlet hose to backhoe control valve and install 0–200 Litres/min flowmeter.
2. Open flowmeter valve.
3. Set engine speed to 2200 rev/min and measure flow (A).
4. Slowly turn flow control valve and increase pressure to 175 bar (2550 psi), at which point the rear pump relief valve should operate. Measure pump flow (B) which should be 69–81 Litres/min. This is output of front pump.

NOTE: *On machines installed with the unload valve the pump flow will reduce when the pressure reaches 159 bar and the unload valve returns the rear pump flow to reservoir.*



39

Analysis

If flow (B) recorded in step 4 is less than 69 Litres/min the front pump is worn and requires overhaul.

Subtract the flow (B) recorded in step 4 from the flow (A) recorded in step 3. This is the flow from the rear pump under ‘no load’ conditions and should be greater than 53 Litres/min. If the flow is less than 53 Litres/min the rear pump is worn and requires overhaul.

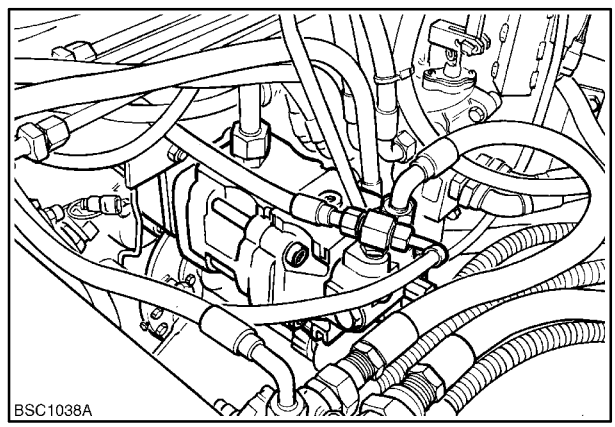
Example:–

Combined Pump Flow (No Load) = A

Front Pump Flow (Under Load) = A–B

Rear Pump Flow = B

NOTE: *If the machine has a history of poor service intervals replace the hydraulic system filter and clean pump intake filter in the reservoir.*



40

NOTES

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 3 - Hydraulic circuits and components for REXROTH only

CONTENTS

SPECIFICATIONS

PUMP

Tandem gear pump operating steering and hydraulic circuits

Rear pump

Output 95 HP engine

New pump .... 75.5 l/min at 2200 rpm at 175 bar
Worn pump (minimum) .... 63 l/min at 2200 rpm at 175 bar

Output 110 HP engine

New pump .... 79.5 l/min at 2070 rpm at 175 bar
Worn pump (minimum) .... 67 l/min at 2070 rpm at 175 bar
Steering circuit relief valve not 4WS .... 136.5 - 143.5 bar
Steering circuit relief valve 4WS .... 177 - 190 bar
Steering circuit standby pressure .... 7 bar

Front pump

Output 95 HP engine

N/ASP new pump .... 75.5 l/min at 2200 rpm at 175 bar
Worn pump (minimum) .... 63 l/min at 2200 rpm at 175 bar

Output 115 HP engine

New pump .... 79.5 l/min at 2070 rpm at 175 bar
Worn pump (minimum) .... 67 l/min at 2070 rpm at 175 bar

Combined output (minimum)

95 HP engine .... 151 l/min at 2200 rpm
115 HP engine .... 159 l/min at 2070 rpm

Loader control valve

Flow sharing sectional control valve with load detection incorporating the relief valve for the rear pump in the control valve inlet section.

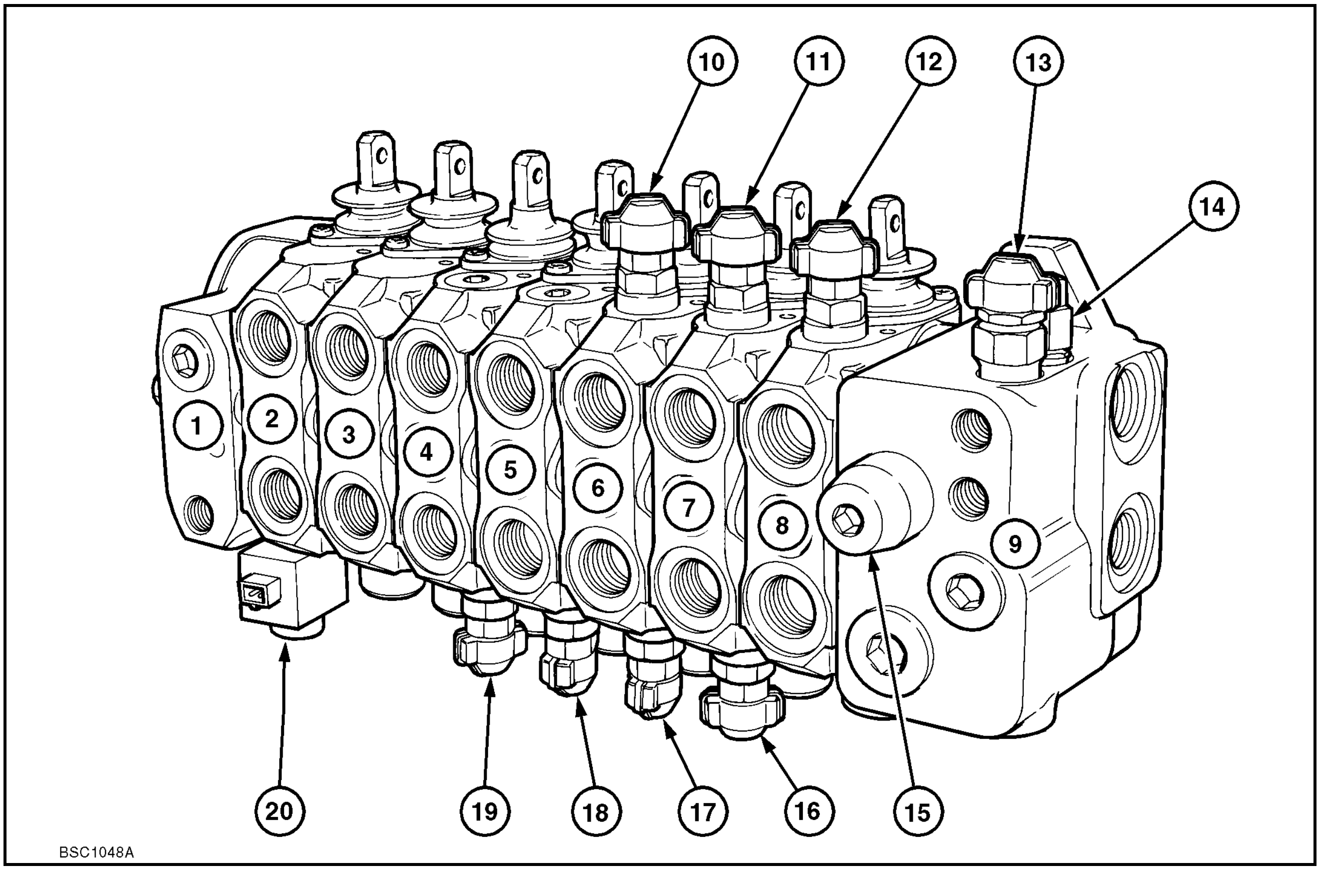
Backhoe control valve

Flow sharing sectional control valve with load detection, with mechanical or hydraulic control, incorporating the pressure relief valve for the load detection system in the inlet section of the control valve.

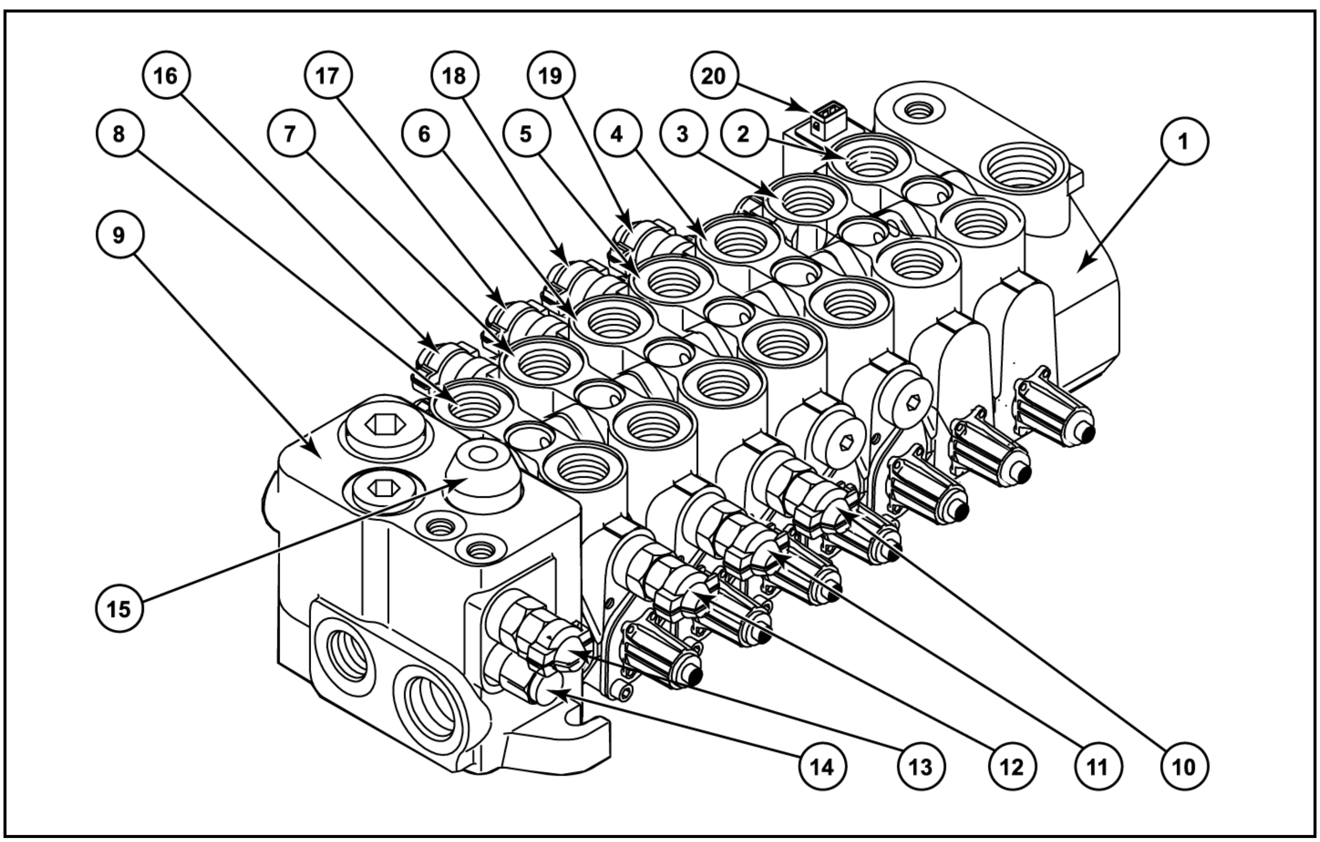
CIRCUIT RELIEF VALVES AND PRESSURE SETTINGS

Control valve sections and backhoe control assembly

1 Cover plate
2 RH stabiliser pilot valve section
3 LH stabiliser pilot valve section
4 Dipper control valve section
5 Bucket control valve section
6 Boom foot swing cylinders control valve section
7 Boom control valve section
8 Telescopic dipper control valve section
9 Control valve inlet section
10 Boom foot swing cylinder cushioning circuit relief valve (left swing) .... 205 bar
11 Boom cylinder (piston end) circuit relief valve .... 240 bar
12 Telescopic dipper cylinder (piston end) circuit relief valve .... 240 bar
13 Load sense limiter (system pressure relief valve) .... 210 bar
14 Load sense return to reservoir control orifice .... 1 l/min
15 Pump flow balancer valve .... 15 bar
16 Boom cylinder (rod end) circuit relief valve .... 315 bar
17 Boom foot swing cylinder cushioning circuit relief valve (right swing) .... 205 bar
18 Bucket cylinder (rod end) circuit relief valve .... 220 bar
19 Bucket cylinder (piston end) circuit relief valve .... 240 bar
20 Solenoid valve for lateral sliding locking cylinder control



Backhoe control valve assembly with mechanical controls



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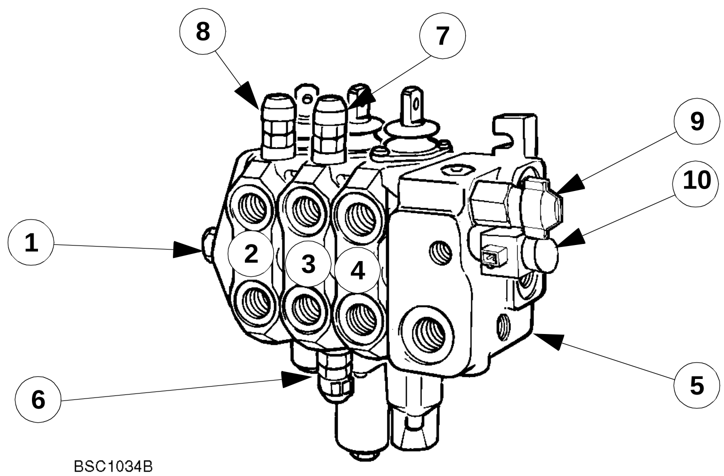
Backhoe control valve assembly with hydraulic controls

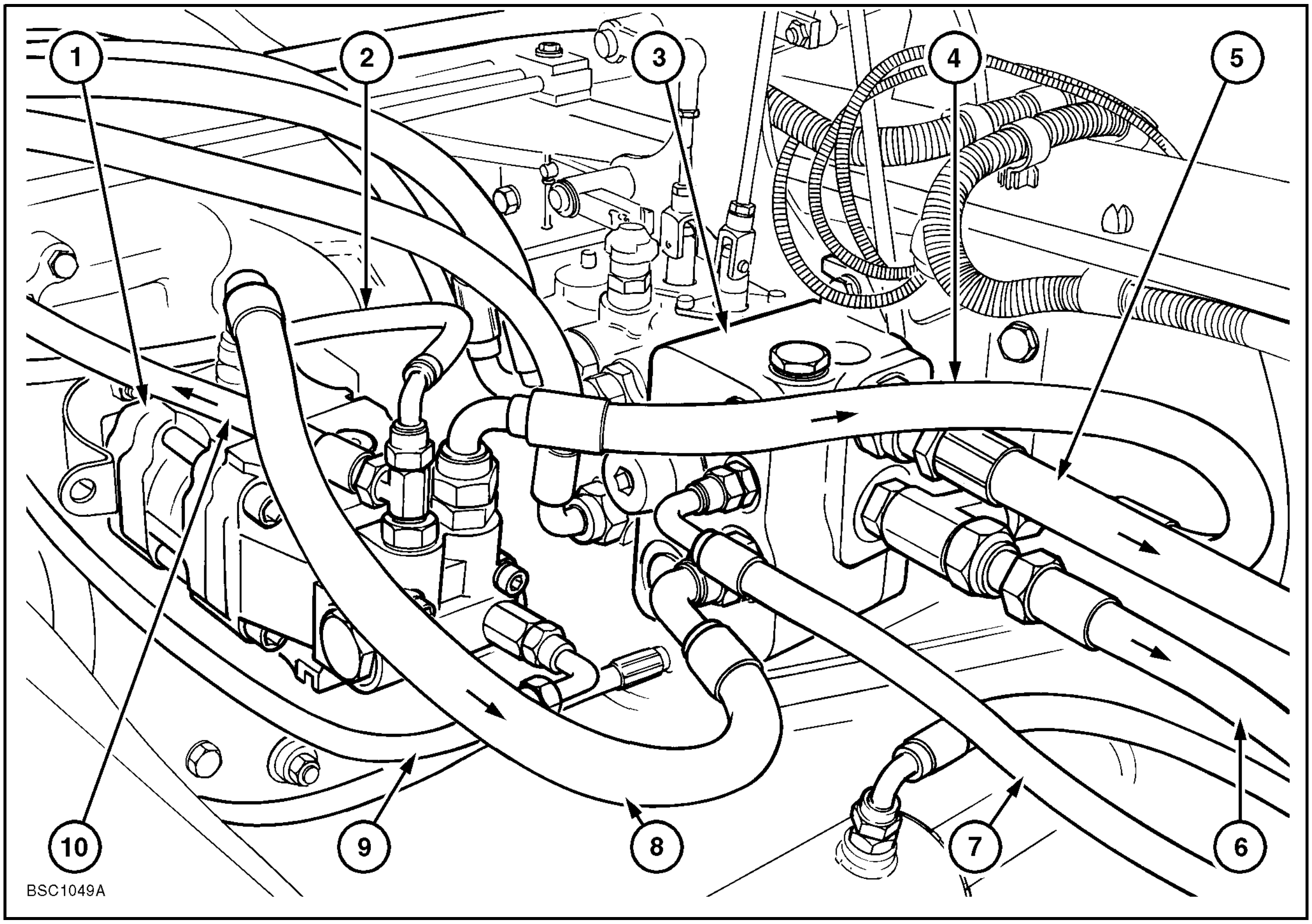


Loader control valve assembly

1 End cover
2 Auxiliary valve section (bucket 4x1 - 6x1 - where fitted)
3 Bucket (crowd) valve section
4 Boom valve section
5 Inlet section
6 Loader bucket relief valve (rod end)........ 230 bar
7 Loader bucket relief valve (piston end)........ 160 bar
8 Bucket 4x1 - 6x1 relief valve (piston end)........ 240 bar
9 Hydraulic speed control relief valve .... 170 bar
10 Hydraulic speed control solenoid valve

DESCRIPTION AND OPERATION

INTRODUCTION



Oil pump and loader control valve installation

1. Hydraulic pump
2. To steering test port
3. Loader control valve
4. Rear pump supply to hydraulic circuit
5. Return to reservoir
6. Backhoe control valve supply
7. Load sense line to backhoe control valve
8. Front pump supply to hydraulic circuit
9. Steering load sensing line
10. To steering motor

The location of the principal components shown in the hydraulic circuits are as follows.
A more detailed description and operation of each component follows the circuit diagrams.

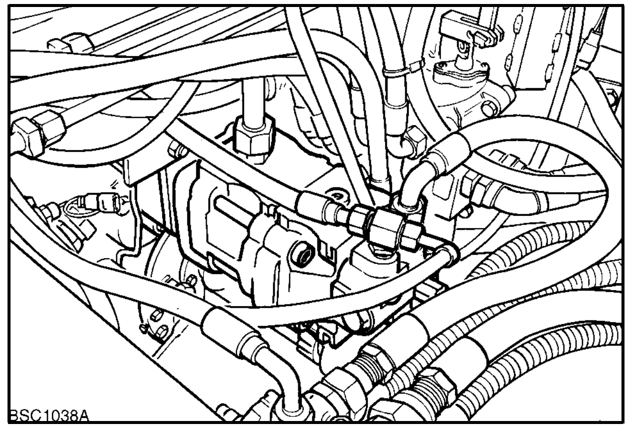
Hydraulic pump assembly
Mounted on the rear of the transmission, the pump consists of two pumping elements.
A front pump supplying oil to operate the front loader and backhoe.
A rear pump which incorporates a load sensing flow divider valve to direct priority flow to the load sensed hydrostatic steering system with remaining flow supplementing the output from the front pump to the loader and backhoe hydraulic circuits.

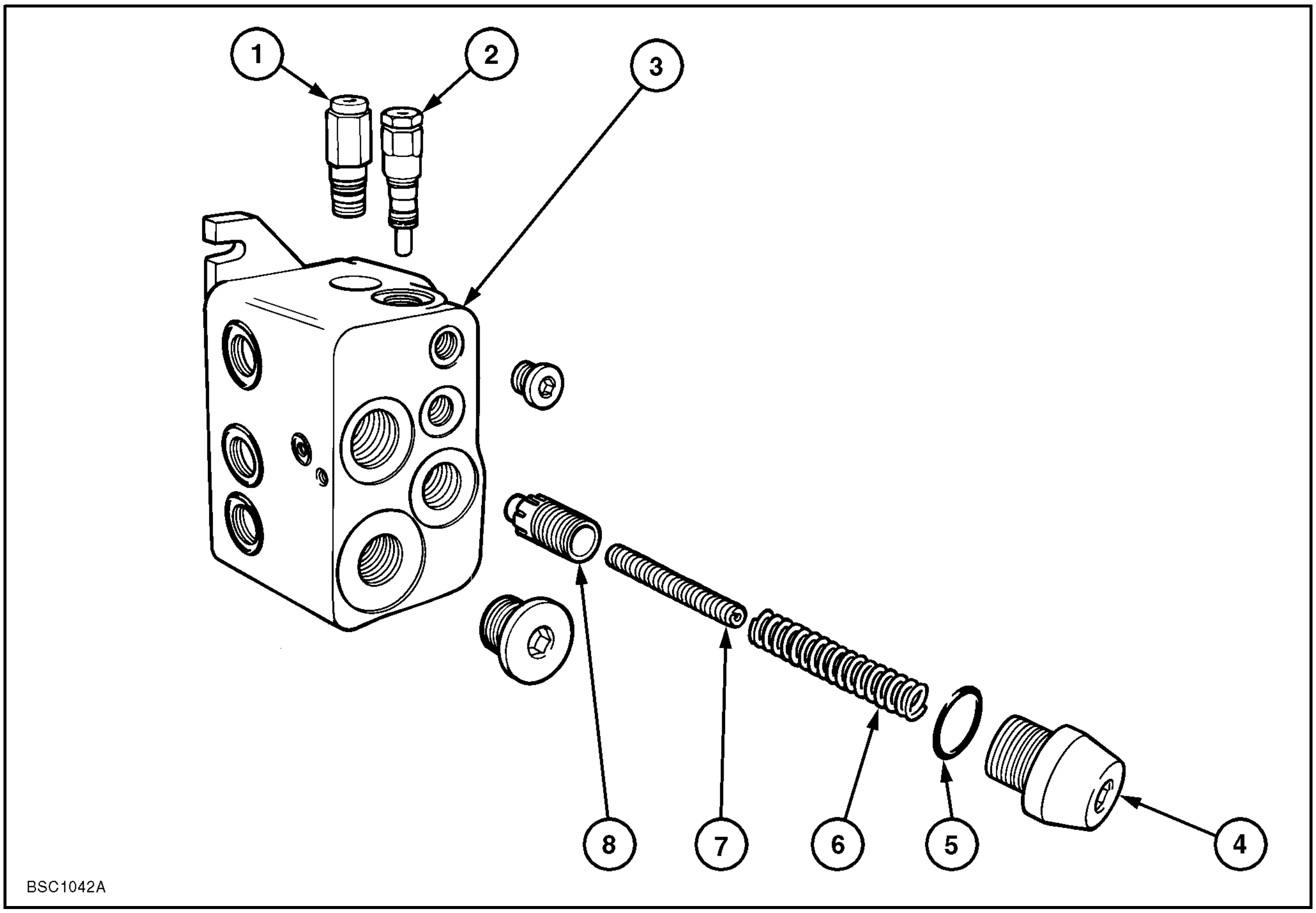
Loader control valve
The loader control valve is mounted on the right hand side of the machine adjacent to the pump.
The valve assembly consists of a maximum of three spool operated sections and provides oil flow to the loader boom, bucket and auxiliary services where fitted.

Backhoe control valve

The backhoe control valve is located at the rear of the chassis.

The control valve consists of a maximum of seven sections of spool control valves and provides the oil flow for operating the boom, the toothed scoop, the bucket, the upperstructure, the stabiliser and the lateral sliding clamping components of the backhoe assembly.





Inlet section of the backhoe control valve

Located within the inlet section (3) of the backhoe control valve are the load sense limiter (system pressure relief valve) (2) and load sense return to reservoir orifice (1) which allow load sense pressure to vent to reservoir when hydraulic circuits are in neutral or load sense pressure exceeds the 210 bar maximum value due to a malfunction in the system.

The pump flow balancer valve, items (4-8), controls the flow of oil from the hydraulic pump and diverts excess flow back to reservoir. The valve also maintains a back pressure of 17 bar in the circuit when all valve sections are in neutral and engine speed is 1000 rpm.

Back pressure in the hydraulic circuit will increase to 23 bar at an engine speed of 2200 rpm.

HYDRAULIC CIRCUIT

The hydraulic circuit is a load sensing flow sharing system working in conjunction with a fixed displacement gear type hydraulic pump. This system has the advantage that at any time the distribution of flow to the services being operated is in proportion to the openings of the control valve spools.

The flow distribution to the backhoe and loader control valves is independent of the load and it is therefore possible to operate two or more spools satisfactorily at the same time.

The principal components of the load sensing flow sharing system are the pressure compensator valves in each control valve section, together with the load sense line which connects all the spool sections in both the loader and backhoe control valve assemblies.

Because the hydraulic pump is a fixed displacement gear type pump it should be noted that the load sense line only connects the loader and backhoe control valve assemblies and does not have any connection to the hydraulic pump.

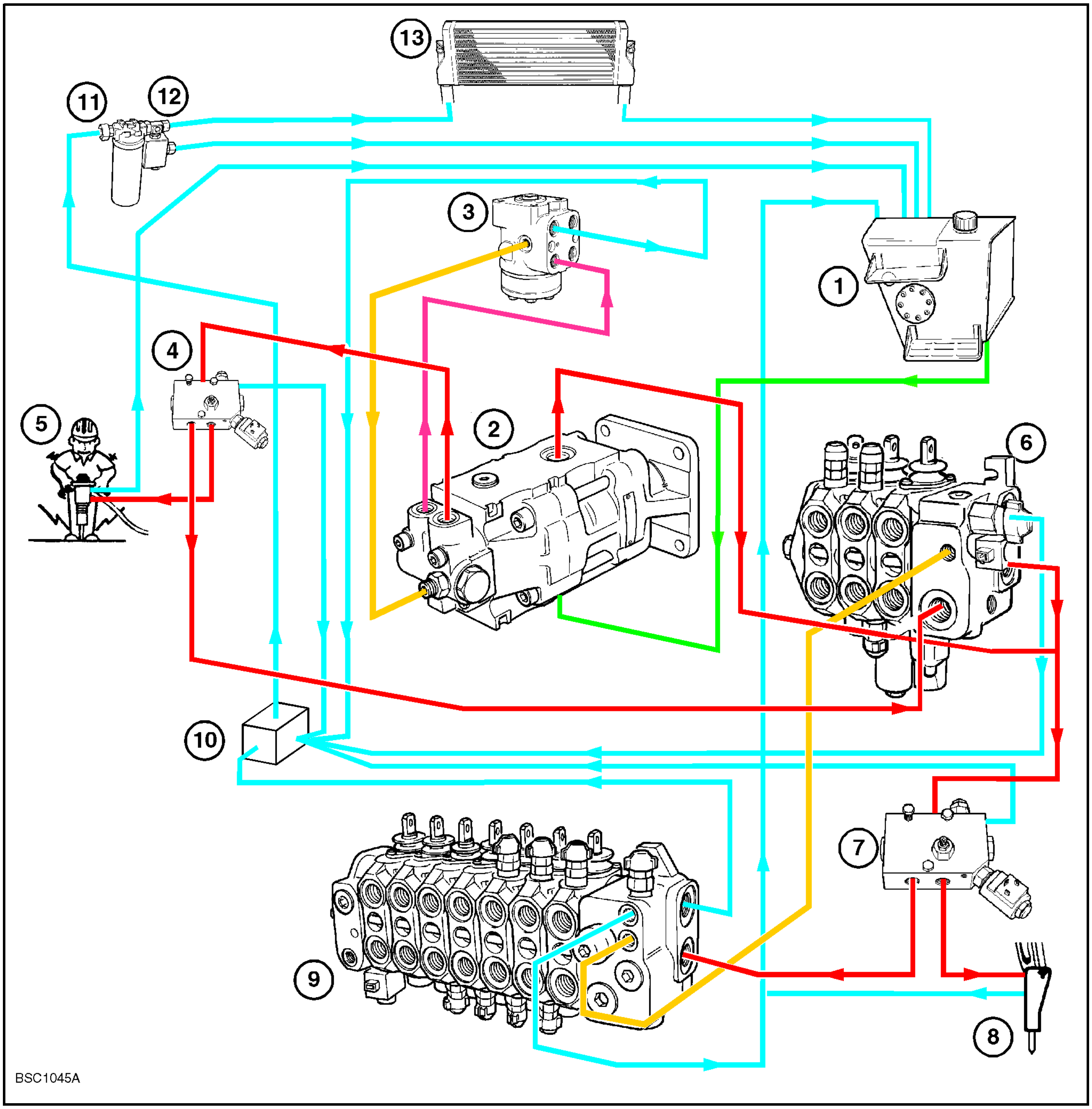
The hydraulic pump draws oil from the reservoir and flow from the front pump is directed to the centre galleries of the loader and backhoe control valves assemblies.

Flow from the rear section of the pump passes through the load sensing flow divider valve mounted on the pump and gives priority flow to the steering circuit with remaining flow directed to supplement the flow from the front pump for the loader and backhoe circuits.

The centre gallery of both the loader and backhoe control valves are blocked by the end plate. Pressure in the supply circuit is controlled by the pump flow balancer valve in accordance with the pressure in the load sense line.

Consequently the higher the load sense pressure the less flow is returned to reservoir with corresponding increase in flow/pressure to the hydraulic circuits.

Maximum system pressure is limited by the load sense pressure relief valve which relieves pressure in the load sense line when it reaches 210 bar. Because the pump flow balancer valve is influenced by load sense pressure the valve diverts sufficient flow back to reservoir to maintain the maximum system pressure of 210 bar.



Hydraulic circuit schematic

Hydraulic circuit oil	Suction oil
Steering circuit oil	Return to reservoir
Load sense oil	

1 Hydraulic reservoir
2 Hydraulic pump
3 Steering motor
4 Hammer control valve
5 Hammer
6 Loader control valve
7 Backhoe hammer control valve
8 Backhoe hammer
9 Backhoe control valve with mechanical or hydraulic controls
10 Return line distributor block
11 Filter
12 Oil cooler by-pass valve
13 Oil cooler

NOTES

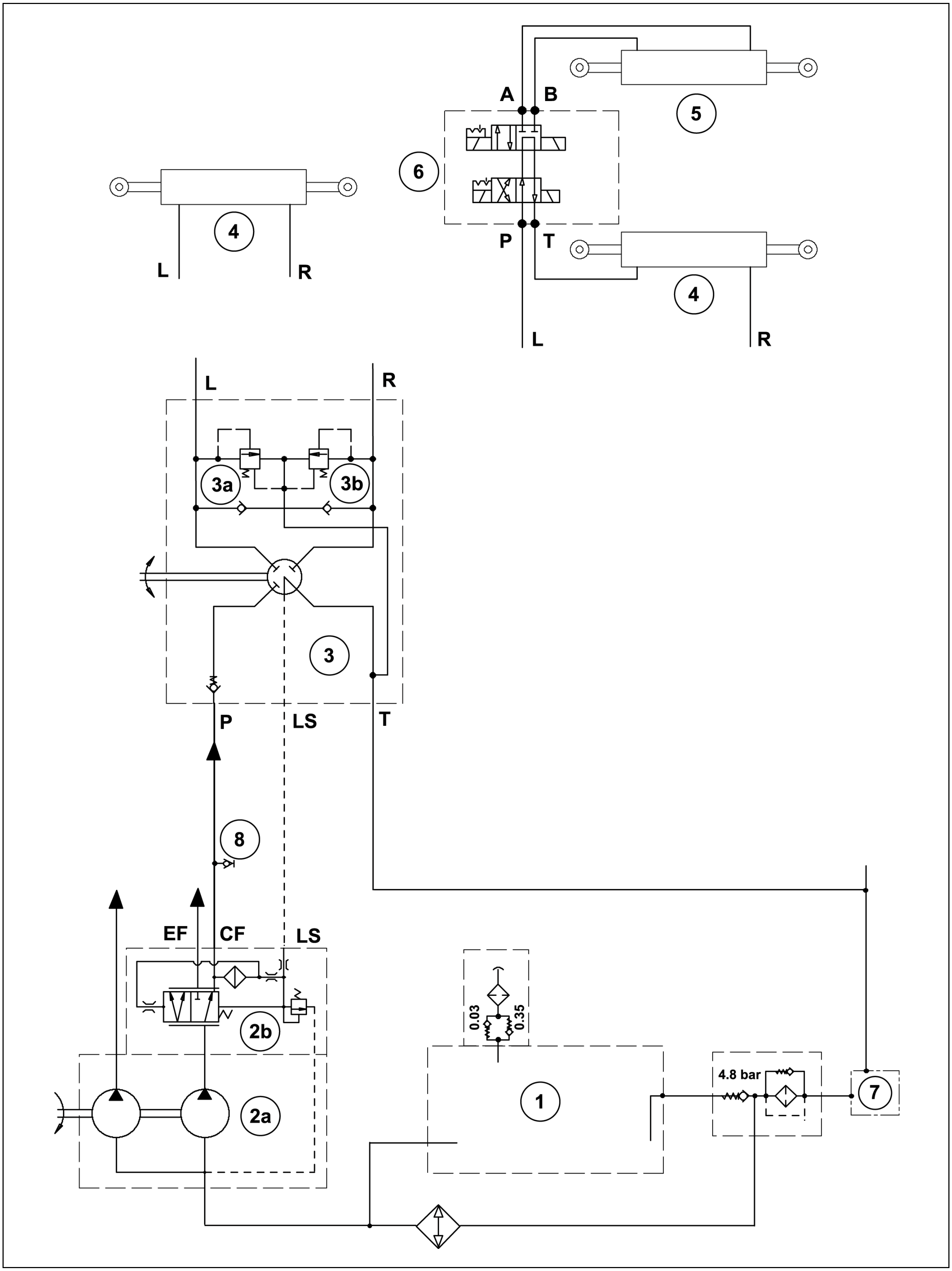
STEERING CIRCUIT

4 WHEEL STEERING

1 Hydraulic reservoir
2a Hydraulic pump
Front pump 38 cc
Rear pump 34 cc
2b Steering flow divider and LS valve
Standby pressure - 7 bar
Steering pressure - 177 to 183 bar
3 Steering motor (Type OSPC160LS)
3a Relief valve (left) - 240 bar
3b Relief valve (right) - 240 bar
4 Font axle steering cylinder
5 Rear axle steering cylinder
6 4 wheel steering selector valve
7 Manifold
8 Steering pressure test point

2 WHEEL STEERING

1 Hydraulic reservoir
2a Hydraulic pump
95 HP 2 x 34 cc,
110 HP - front pump 38 cc, rear pump 34 cc
2b Steering flow divider and LS valve
Standby pressure - 7 bar
Steering pressure - 137 to 143 bar
3 Steering motor (Type OSPC125LS)
3a Relief valve (left) - 200 bar
3b Relief valve (right) - 200 bar
4 Front axle steering cylinder
7 Manifold
8 Steering pressure test point



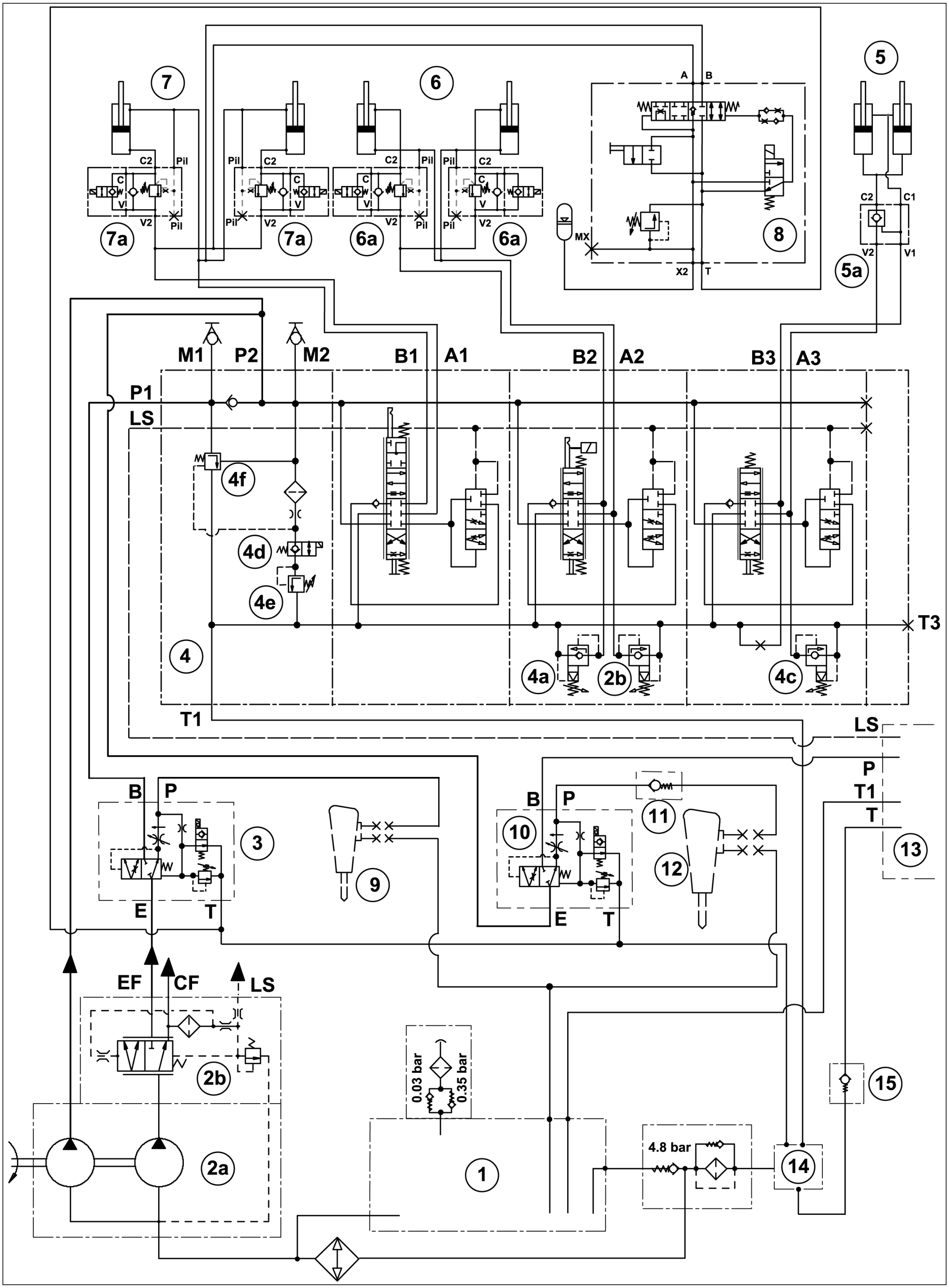
Steering circuit

LOADER CIRCUIT

1 Hydraulic reservoir
2a Hydraulic pump
2x34 cc with 95 HP engine
34 cc for rear pump and 38 cc for front pump with 115 HP engine
2b Steering flow divider and LS valve
3 Hammer control valve (optional)
4 Loader control valve
4a Crowd cylinder relief valve (rod end) - 230 bar
4b Crowd cylinder relief valve (piston end) - 160 bar
4c Bucket 4x1 - 6x1 cylinder relief valve (piston end) - 240 bar
4d Hydraulic speed control solenoid valve
4e Hydraulic speed control relief valve - 170 bar
4f Hydraulic speed control spool
5 Bucket 4x1 - 6x1 cylinders
5a Piloted check valve
6 Crowd (bucket) cylinders
6a Crowd (bucket) cylinder safety valve
7 Loader lifting cylinders
7a Loader lifting cylinders safety valve
8 Ride control valve
9 Hammer (optional)
10 Backhoe chisel control valve (optional)
11 Non-return valve - 10 bar
12 Hammer (optional)
13 Backhoe control valve
14 Manifold
15 Non-return check valve

PRESSURE TEST PORTS
M1 Cut-off pressure test point 170 bar
M2 Hydraulic attachments pressure test point

FLOW PORTS
A1 / B1 / A2 / B2 / A3 150 l/min
B3 120 l/min

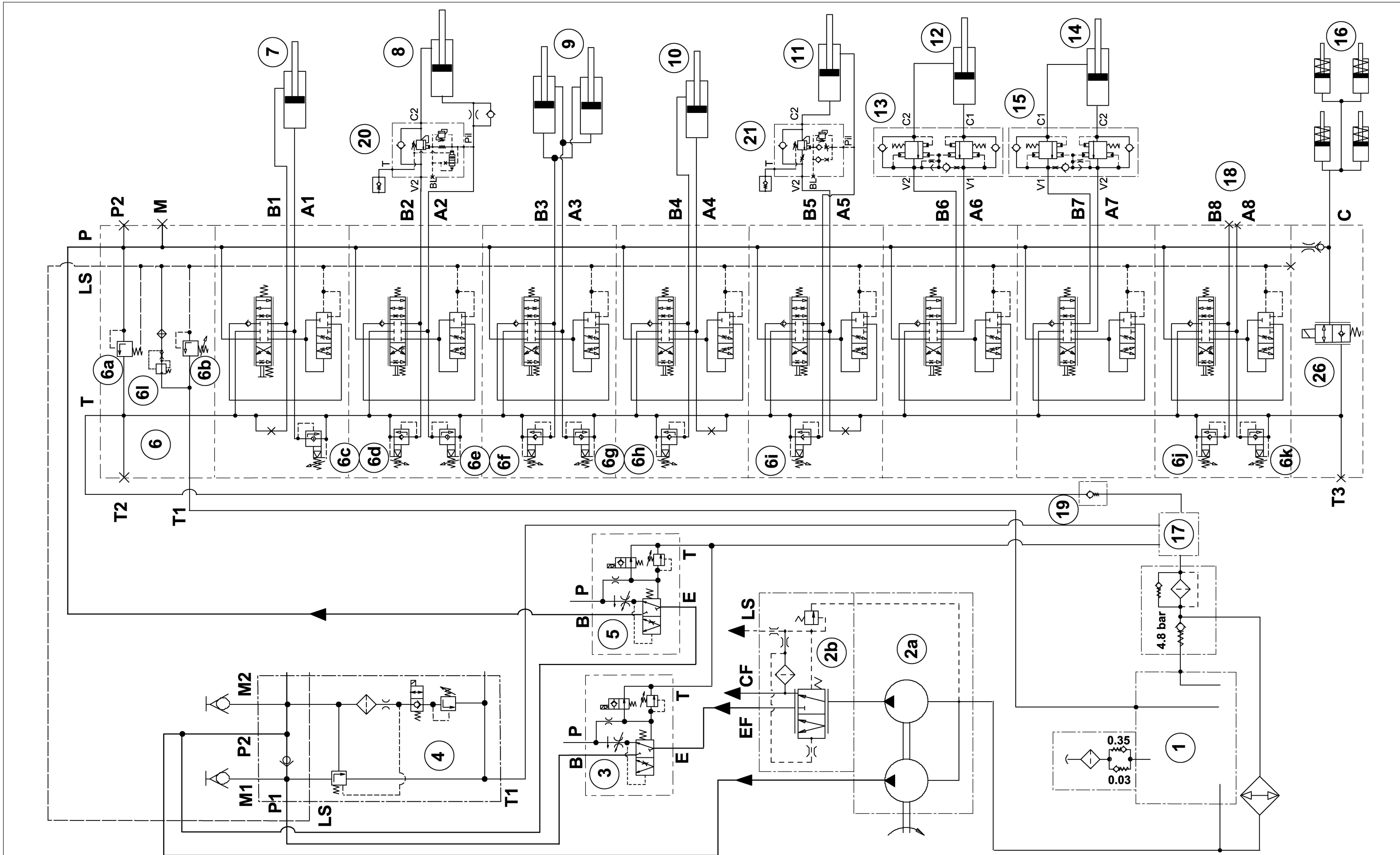


Loader circuit

BACKHOE CIRCUIT WITH MECHANICAL CONTROLS

1 Hydraulic reservoir
2a Hydraulic pump
2x34 cc with 95 HP engine
34 cc for rear pump and 38cc for front pump with 115 HP engine
2b Steering flow divider and LS valve
3 Hammer control valve (optional)
4 Loader control valve
5 Backhoe hammer control valve (optional)
6 Backhoe control valve
6a Pump flow balance valve (15 bar)
6b Load sense limiter (system pressure relief valve) (210 bar)
6c Telescopic dipper cylinder (piston end) circuit relief valve (165 bar)
6d Boom cylinder (rod end) circuit relief valve (315 bar)
6e Boom cylinder (piston end) circuit relief valve (240 bar)
6f Boom foot swing cylinder circuit relief valve (right swing) (205 bar)
6g Boom foot swing cylinder circuit relief valve (left swing) (205 bar)
6h Bucket cylinder (rod end) circuit relief valve (220 bar)
6i Dipper cylinder (rod end) circuit relief valve (240 bar)
6j Auxiliary hydraulic system relief valve (optional)
6k Auxiliary hydraulic system relief valve (optional)
6l Flow regulator
7 Telescopic dipper cylinder (optional)
8 Boom cylinder
9 Boom foot swing cylinders
10 Bucket cylinder
11 Dipper cylinder
12 Left stabilizer cylinder
13 LH stabiliser cylinder pilot valve (European model)
14 Right stabilizer cylinder
15 RH stabiliser cylinder pilot valve (European model)
16 Lateral sliding locking cylinders (European model)
17 Return manifold
18 Output to hydraulic auxiliary
19 Non-return check valve
20 Boom safety valve (optional)
21 Dipper safety valve (optional)
26 Solenoid valve for lateral sliding locking cylinder control (European model)
M1 Cut-off pressure test point 170 bar
M2 Hydraulic attachments pressure test point

FLOW PORTS
A1 / A4 / B4 / A5 / B5 150 l/min
B1 / A2 120 l/min
A3 / B3 80 l/min
A6 / B6 / A7 / B7 60 l/min (European model)

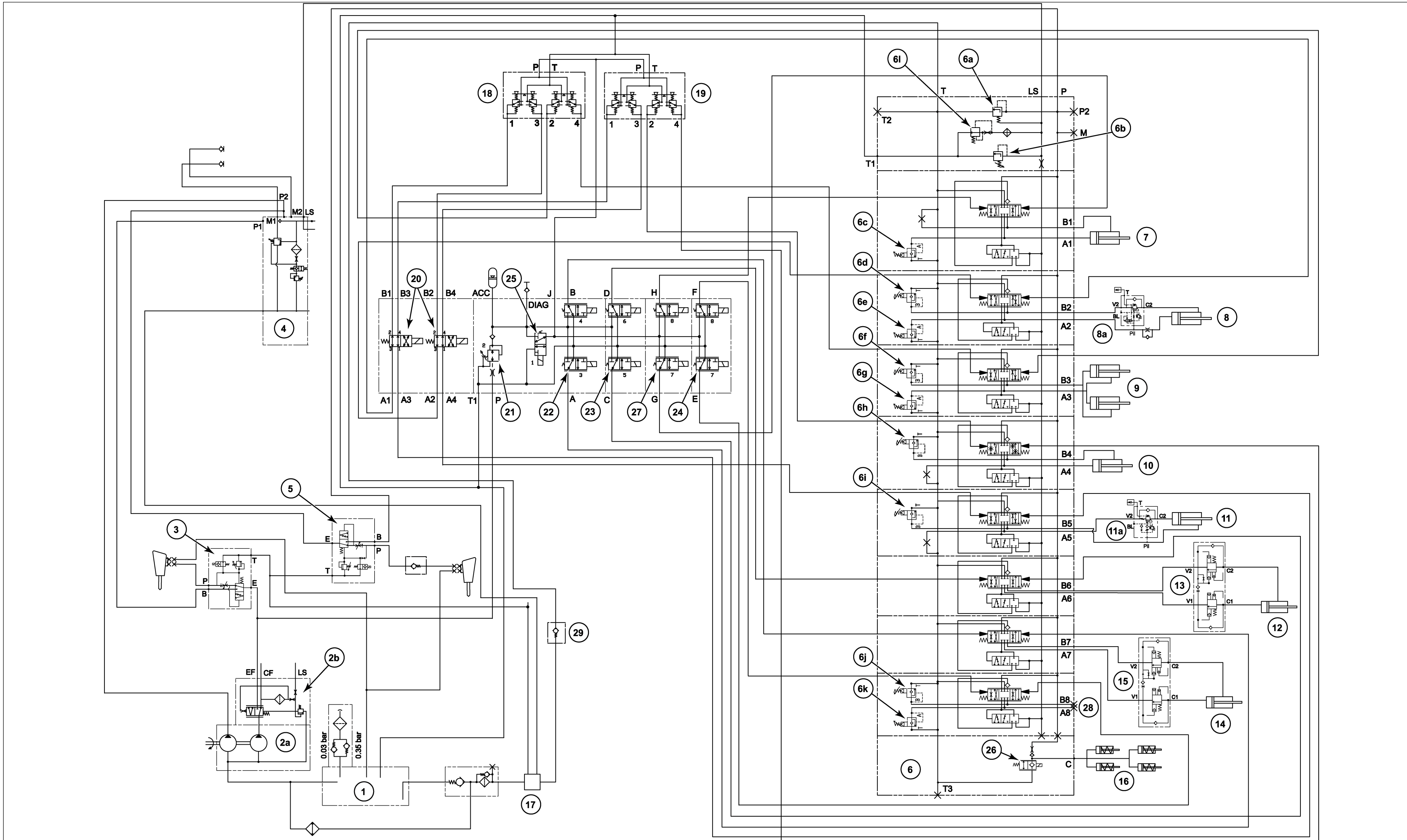


Backhoe circuit with mechanical controls

BACKHOE CIRCUIT WITH HYDRAULIC CONTROLS

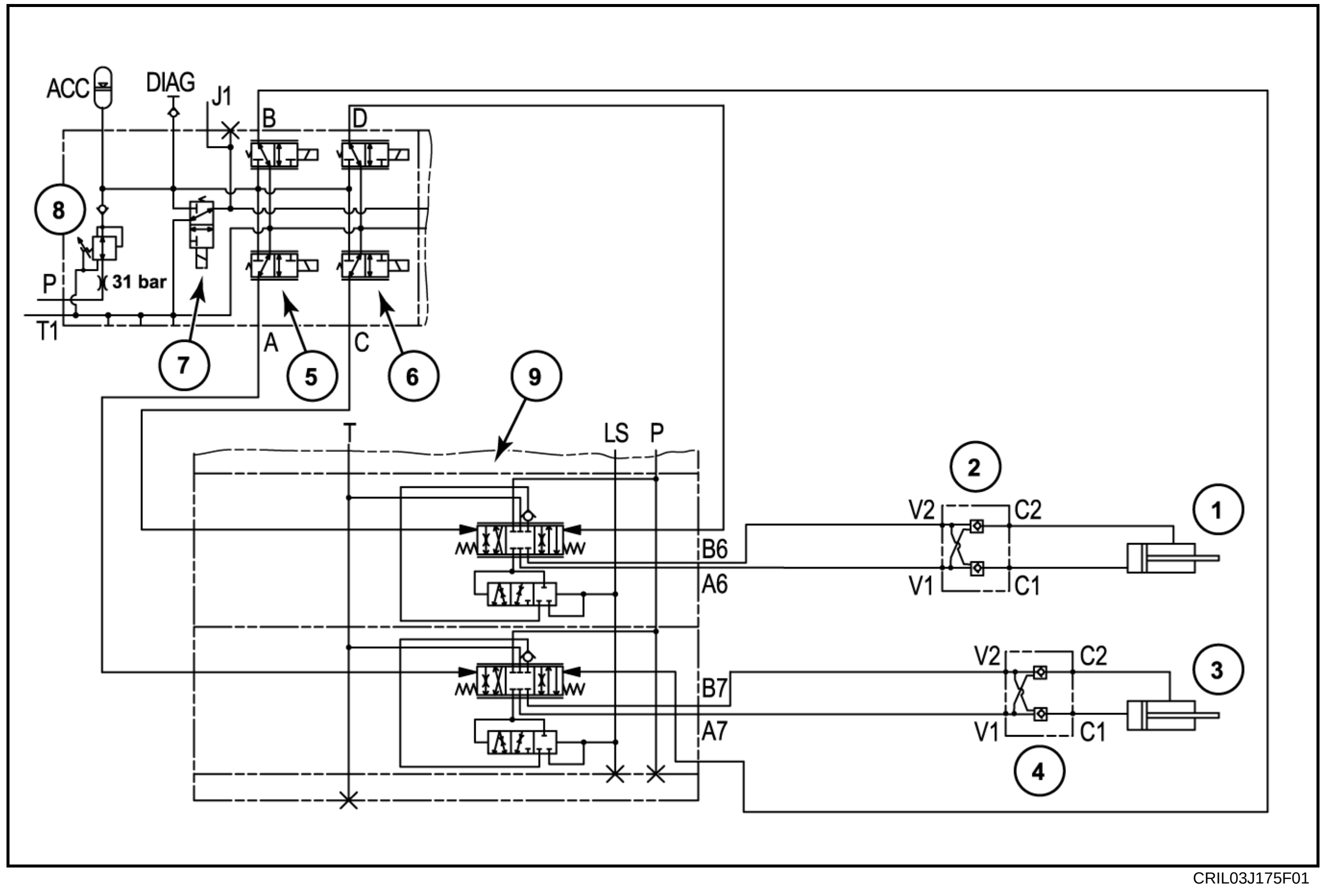
1 Hydraulic reservoir
2a Hydraulic pump
2x34 cc with 95 HP engine
34 cc for rear pump and 38 cc for front pump with 115 HP engine
2b Steering flow divider and LS valve
3 Hammer control valve (optional)
4 Loader control valve
5 Backhoe hammer control valve (optional)
6 Backhoe control valve
6a Flow pump balance valve (15 bar)
6b Load sense limiter (system pressure relief valve) (210 bar)
6c Telescopic dipper cylinder (piston end) circuit relief valve (165 bar)
6d Boom cylinder (rod end) circuit relief valve (315 bar)
6e Boom cylinder (piston end) circuit relief valve (240 bar)
6f Boom foot swing cylinder circuit relief valve (right swing) (205 bar)
6g Boom foot swing cylinder circuit relief valve (left swing) (205 bar)
6h Bucket cylinder (rod end) circuit relief valve (220 bar)
6i Dipper cylinder (rod end) circuit relief valve (240 bar)
6j Auxiliary hydraulic system relief valve (optional)
6k Auxiliary hydraulic system relief valve (optional)
6l Flow regulator
7 Telescopic dipper cylinder (optional)
8 Boom cylinder
8a Boom safety valve (optional)
9 Boom foot swing cylinders
10 Bucket cylinder
11 Dipper cylinder
11a Dipper safety valve (optional)
12 Left stabilizer cylinder
13 LH stabiliser cylinder pilot valve (European model)
14 Right stabilizer cylinder
15 RH stabiliser cylinder pilot valve (European model)
16 Lateral sliding locking cylinders (European model)
17 Return manifold
18 LH control lever
19 RH control lever
20 Configuration changing solenoid valves
21 Pilot pressure limiter
22 RH stabiliser control solenoid valves
23 LH stabiliser control solenoid valves
24 Telescopic dipper control solenoid valves
25 Pilot pressure solenoid valve
26 Solenoid valve for lateral sliding locking cylinder control (European model)
27 Hydraulic auxiliary control solenoid valve (optional)
28 Output to hydraulic auxiliary (optional)
29 Non-return check valve
M1 Cut-off pressure test point 170 bar
M2 Hydraulic attachments pressure test point

FLOW PORTS
A1 / A4 / B4 / A5 / B5 150 l/min
B1 / A2 120 l/min
A3 / B3 80 l/min
A6 / B6 / A7 / B7 60 l/min (European model)



Backhoe circuit with hydraulic controls

BACKHOE STABILISERS CONTROL CIRCUIT N/A MODEL

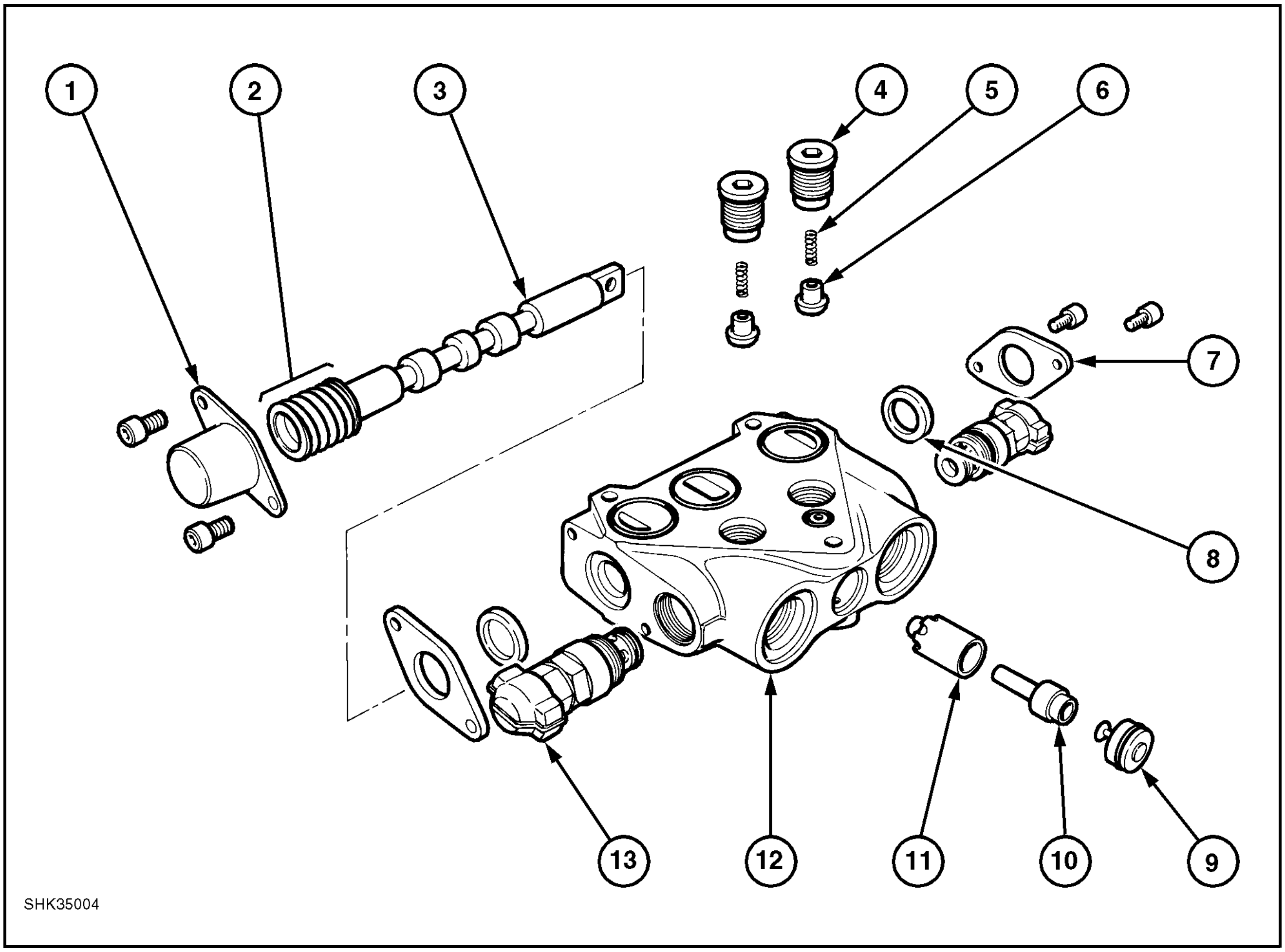


Backhoe stabilisers control circuit N/A model

1 Left stabilizer cylinder
2 LH stabiliser cylinder piloted check valve
3 Right stabilizer cylinder
4 RH stabiliser cylinder piloted check valve
5 RH stabiliser control solenoid valves
6 LH stabiliser control solenoid valves
7 Pilot pressure solenoid valve
8 Pilot pressure limiter
9 Backhoe control valve

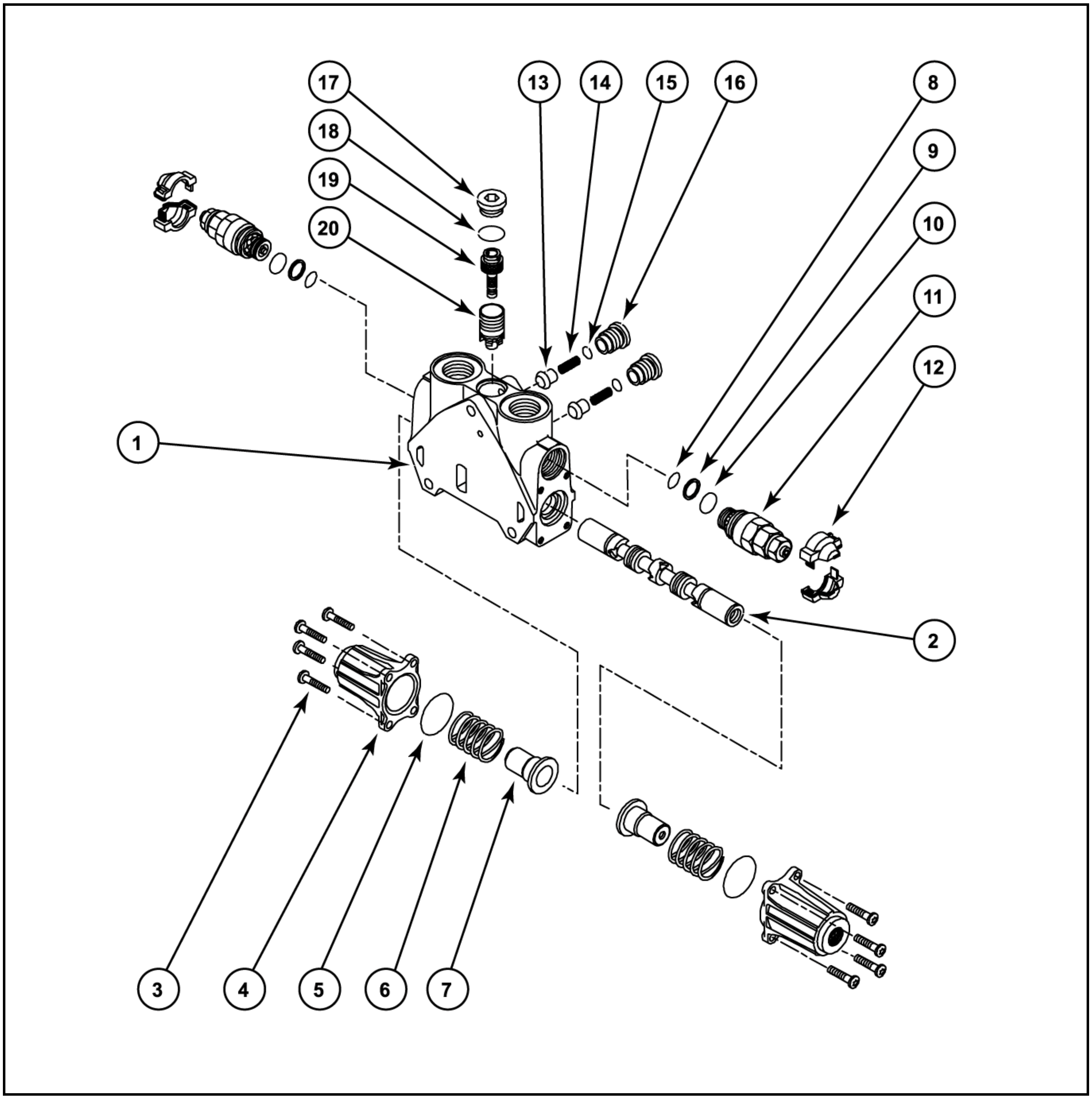
FLOW PORTS
A6 / B6 / A7 / B7 120 l/min

LOAD SENSING FLOW SHARING HYDRAULIC SYSTEM



Backhoe control valve section with mechanical control

1. Spool cap
2. Centralising spring
3. Spool
4. Plug
5. Spring
6. Non-return check valve
7. Plate
8. Lip seal
9. Plug
10. Pressure compensator spool
11. Pressure compensator metering element
12. Valve section
13. Relief valve



Backhoe control valve section with hydraulic control

1. Control valve housing
2. Spool
3. Spool cap retaining screw
4. Spool cap
5. O-ring
6. Spring
7. Spring guide
8. O-ring
9. Back up ring
10. O-ring
11. Main relief
12. Main relief adjusting screw protection
13. Non-return check valve
14. Spring
15. O-ring
16. Plug
17. Plug
18. O-ring
19. Pressure compensator spool
20. Pressure compensator metering element

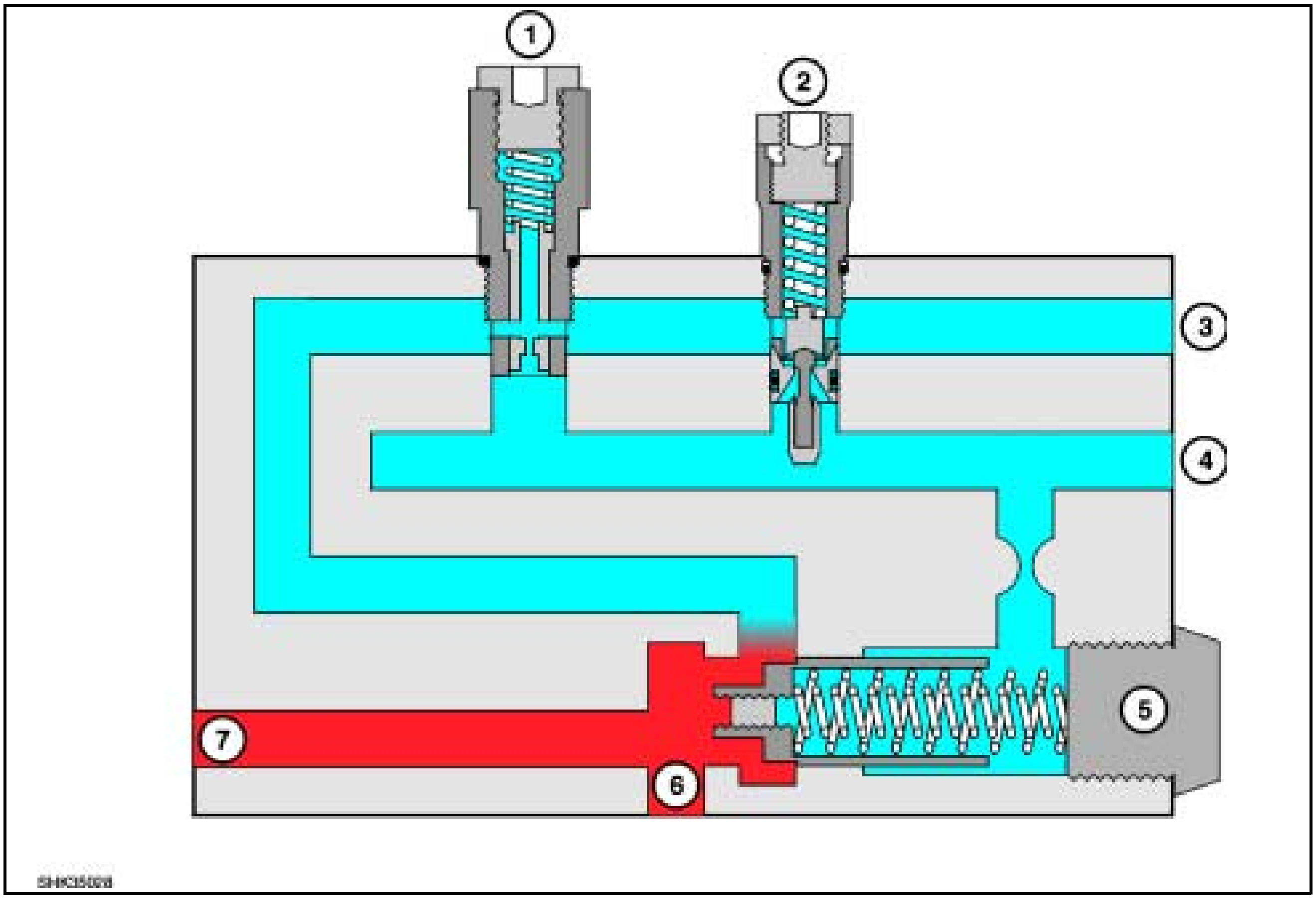
All loader/backhoe circuits in neutral

Each control valve section within the backhoe or loader control valve assemblies contains a spool, two check valves and a load sensing pressure compensator.

A load sense gallery connects the compensators in each control valve section.

When all control valves are in neutral the spools prevent the flow of oil in each circuit and pressure in the load sense line can bleed to reservoir through the 1 litre/min load sense return to reservoir orifice in the backhoe control valve inlet cover.

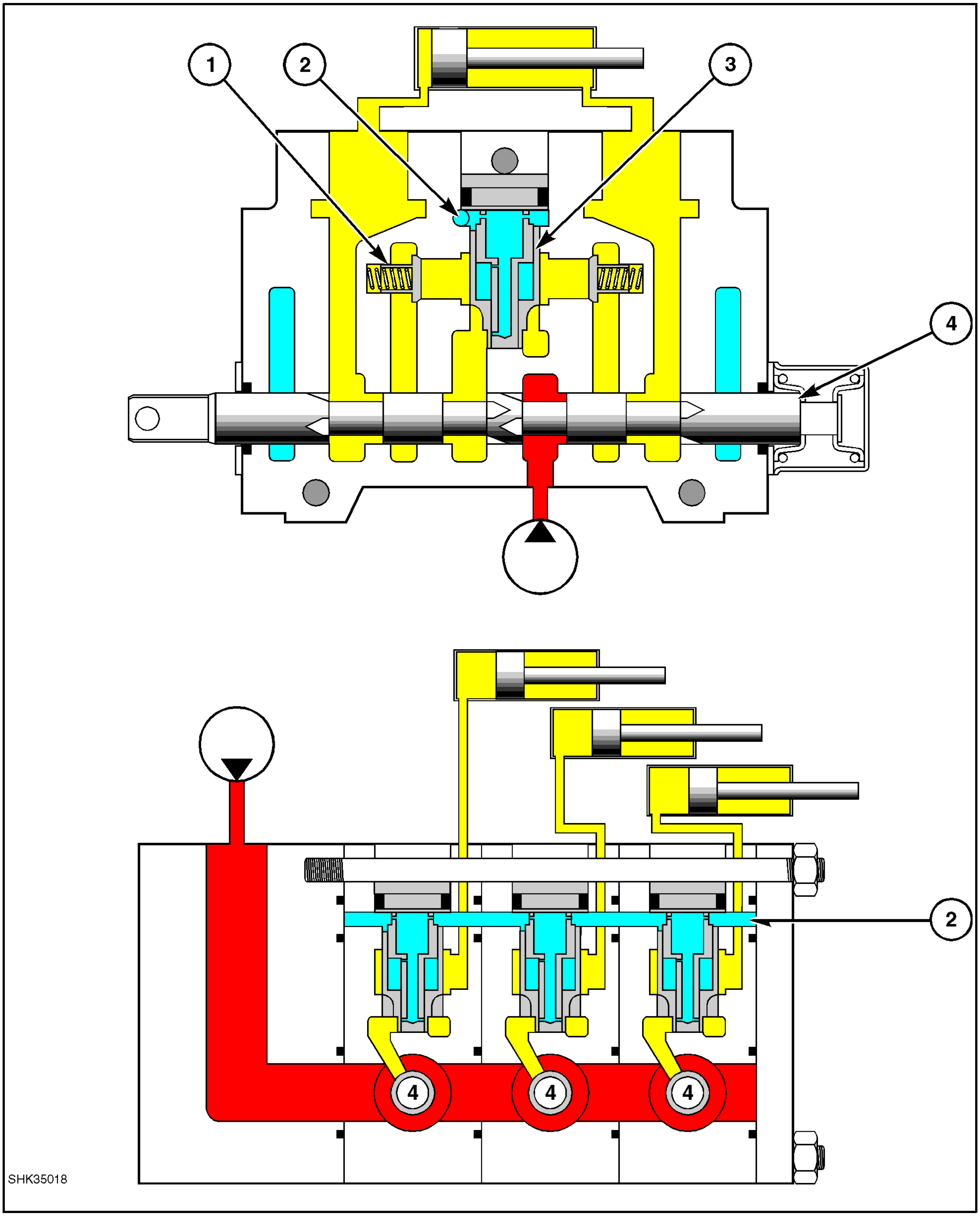
Because there is no load sense pressure being applied to the rear face of the flow balancer valve, the valve will move against the spring and off its seat when pump pressure reaches 15 bar. Pump flow is now diverted back to reservoir and the balancer valve maintains a standby pressure of 15 bar while the circuits are in neutral.



Flow balancer valve operation - All spools in neutral

Return to reservoir (cyan) — Pump standby pressure 15 bar (red)

1. Load sense bleed orifice 1 l/min
2. Load sense limiter (system relief valve)
3. Return to reservoir
4. Load sense line
5. Pump flow balancer (unload) valve
6. Pump flow IN
7. To backhoe control valves



Load sensing flow sharing - All spools in neutral

Pump pressure	Return to reservoir
Trapped oil	

1 Load non-return check valve
2 Load sense line
3 Pressure compensating valve
4 Spool

One hydraulic circuit operating

When a single hydraulic circuit is operated the spool in the control valve section is moved allowing oil to flow past the lands of the spool and apply pressure to the metering element of the pressure compensating valve.

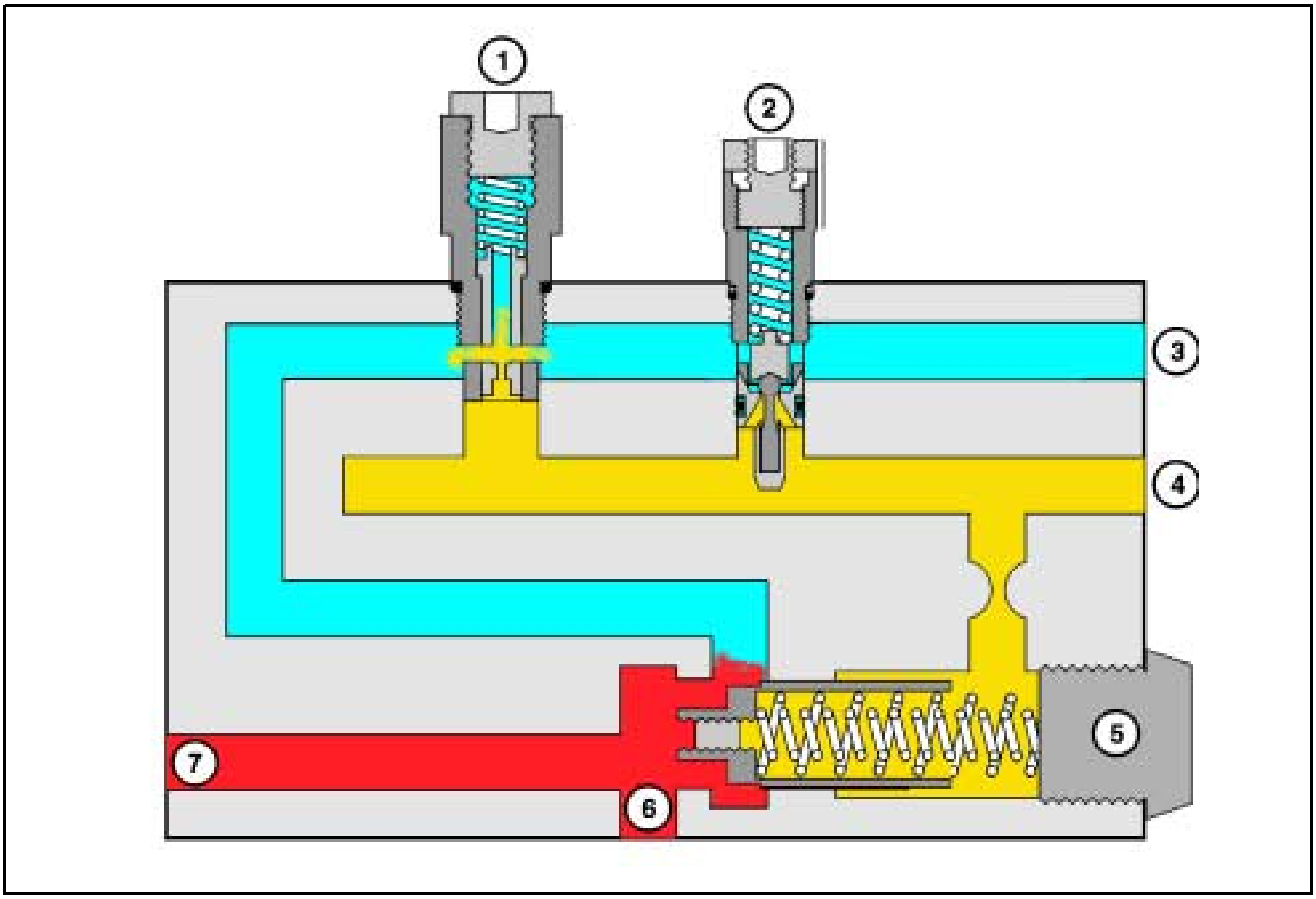
The metering element moves upwards to allow oil to flow to the load check valve and at the same time uncovers the drilling in the spool portion of the pressure compensator valve enabling operating pressure to be sensed in the load sense gallery.

As pressure increases to open the load check valve, load sense pressure is applied to the spring side of the flow balancer valve in the backhoe control valve end cover. A higher pressure is now required to operate the flow balancer valve and pump pressure increase accordingly.

When pump pressure overcomes the pressure behind the load check valve, the valve opens allowing oil to flow into the cylinder port.

Exhaust oil from the cylinder returns to reservoir through the other port in the control valve section.

If the load sense pressure in a circuit reaches 195 bar, the load sense relief valve in the backhoe control valve end cover will operate. Pump pressure is now limited to 210 bar. This is the pressure required to overcome the pressure of the flow balancing valve spring (15 bar) plus the load sensing pressure controlled at 195 bar.



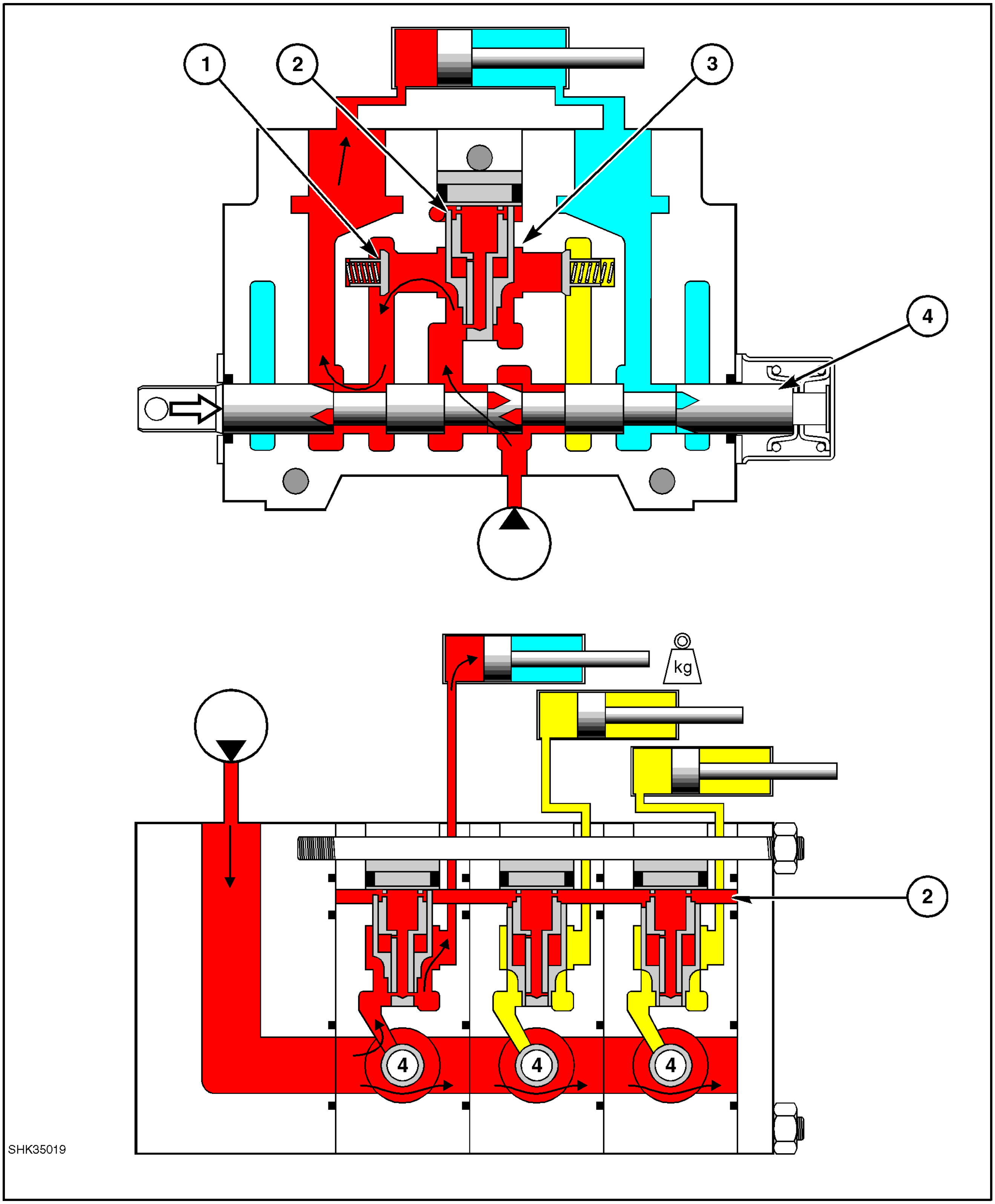
Flow balancer valve operation - Hydraulic circuits operating

Return to reservoir

Pump pressure

Load sense pressure

1. Load sense bleed orifice 1 l/min
2. Load sense limiter (system relief valve)
3. Return to reservoir
4. Load sense line
5. Pump flow balancer (unload) valve
6. Pump flow IN
7. To backhoe control valves



Load sensing flow sharing - One spool operating

Pump pressure

Return to reservoir

Trapped oil

1 Load non-return check valve
2 Load sensing line
3 Pressure compensating valve
4 Spool

Two or more hydraulic circuits operating

When two or more hydraulic circuits are operated each circuit will operate at a different pressure.

If pump flow to a specific circuit is not controlled the circuit requiring a lower operating pressure will work faster than that requiring the higher pressure because flow will take the path of least resistance.

To overcome this situation the pressure compensating valve regulates the flow of oil to the circuit operating at a lower load.

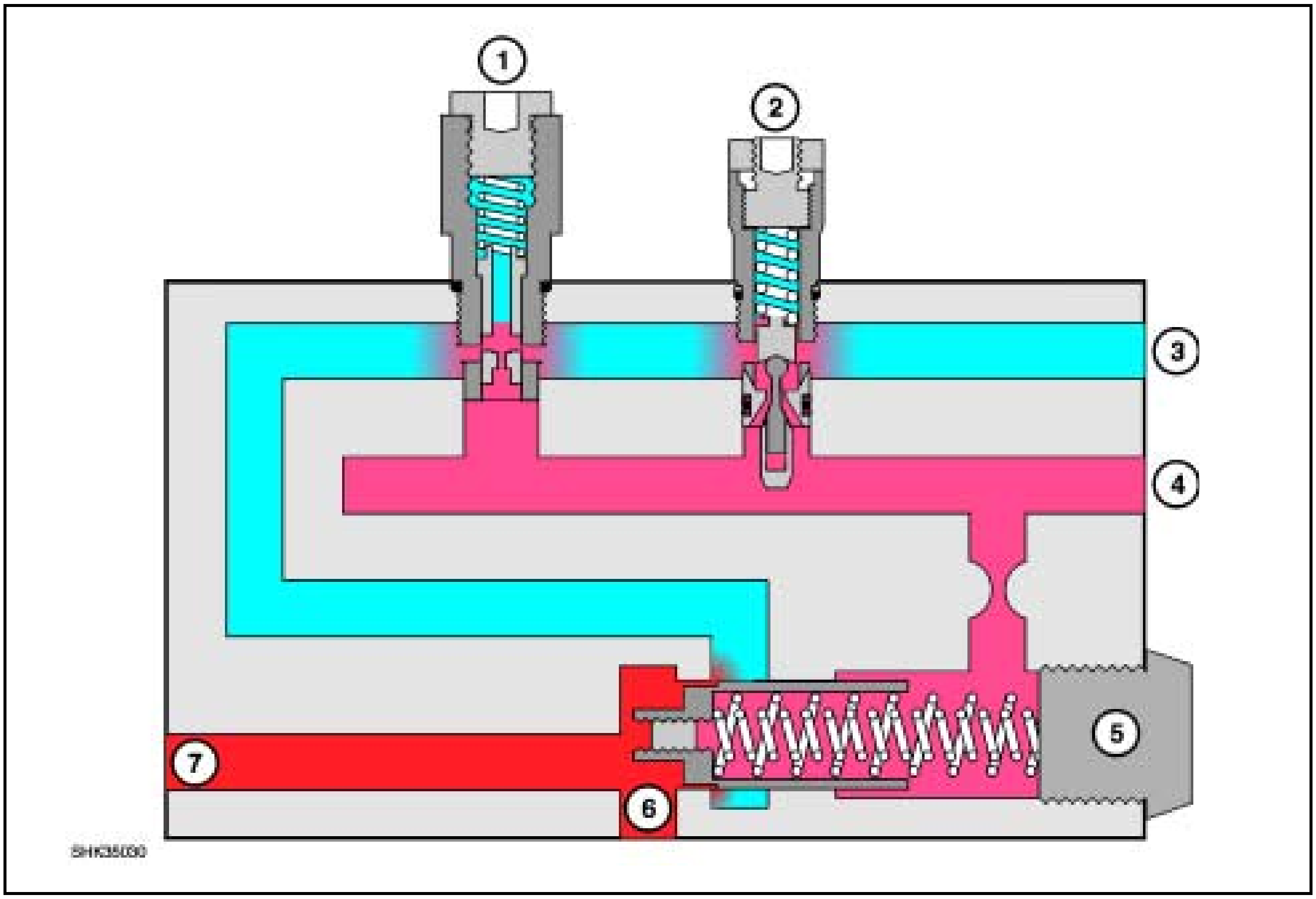
When two spools are operated simultaneously pump pressure is applied to the metering element of the pressure compensating valve in both valve sections. Both metering elements therefore move upwards allowing oil to flow to the load check valves. At the same time the aperture in the spool portion of the pressure compensating valve is uncovered to allow operating pressure to be sensed in the load sensing gallery.

Pump pressure will rise until it overcomes the pressure behind the load check valve of the heaviest loaded circuit and the pressure in the load sense line is similarly at this high pressure.

The pressure required to operate the lower loaded circuit is now too high and if not restricted will result in the lower loaded circuit operating in preference to and faster than the higher loaded circuit.

To compensate for this condition the load sense pressure moves the metering element of the pressure compensating valve in the lower loaded circuit downwards and restricts the flow to the circuit.

This balancing of flow and pressure according to load ensures that both circuits operate simultaneously and at a balanced flow rate.



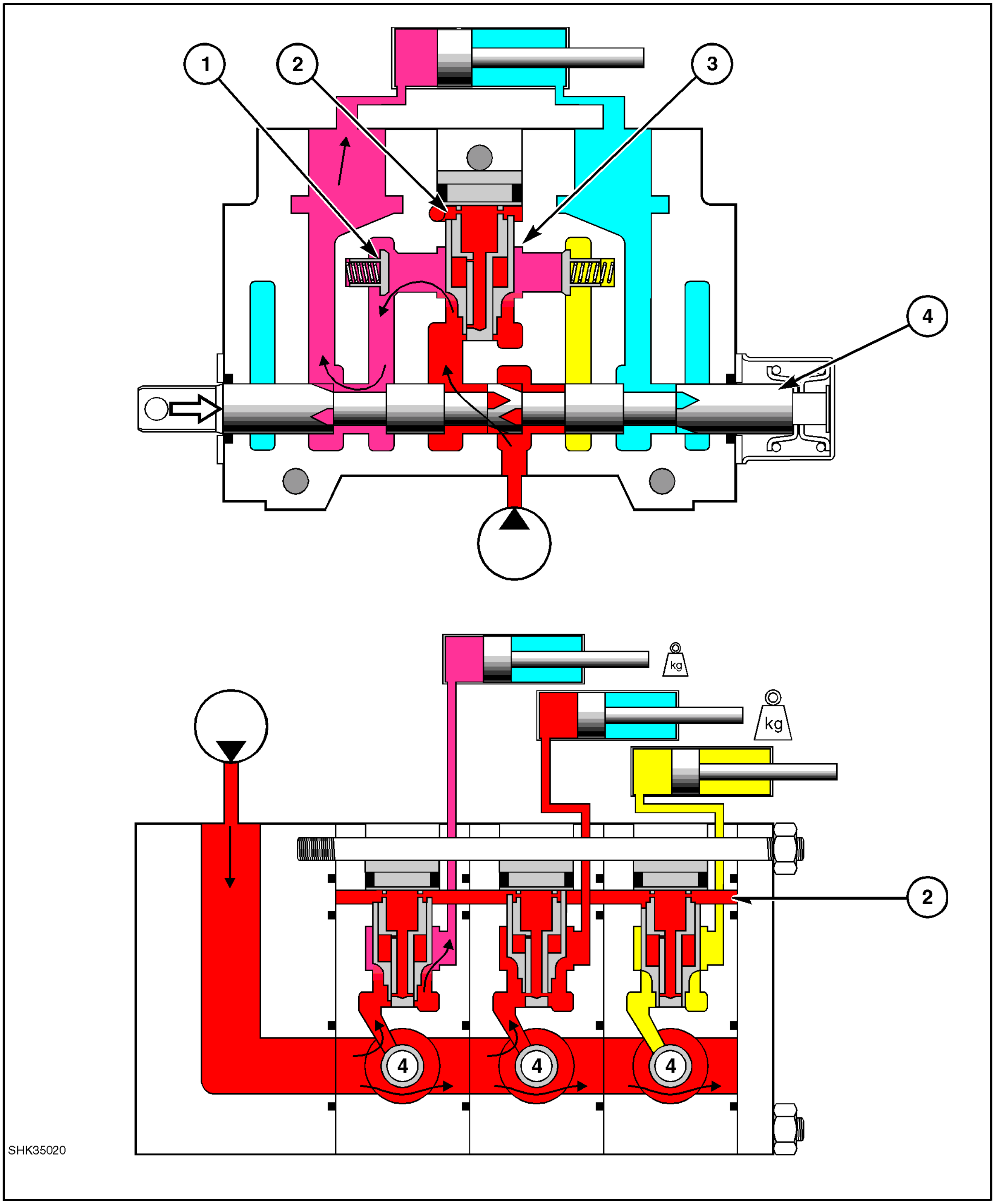
Load sense relief valve operating

Return to reservoir

Load sense pressure at 195 bar

Pump pressure at 210 bar

1. Load sense bleed orifice 1 l/min
2. Load sense limiter (system relief valve)
3. Return to reservoir
4. Load sense line
5. Pump flow balancer (unload) valve
6. Pump flow IN
7. To backhoe control valves



Load sensing flow sharing - Two spools operating

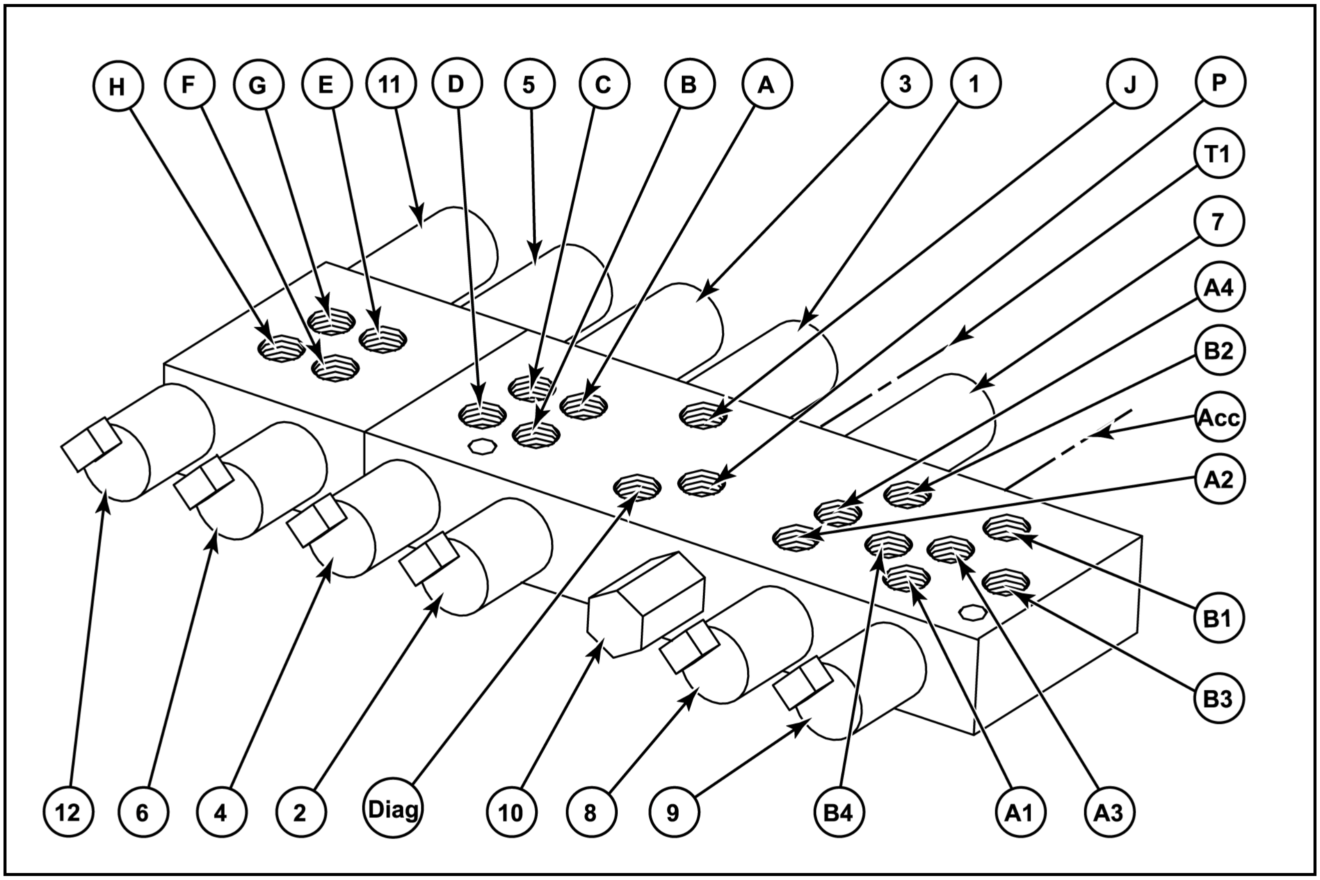
1st spool operating pressure	Trapped oil
2nd spool operating pressure	Return to reservoir

1 Load non-return check valve
2 Load sense line
3 Pressure compensating valve
4 Spool

NOTES

SOLENOID VALVES FOR PILOTING THE BACKHOE CONTROL VALVE WITH HYDRAULIC CONTROLS

1 RH stabiliser control solenoid valve (piston end)
2 RH stabiliser control solenoid valve (rod end)
3 LH stabiliser control solenoid valve (piston end)
4 LH stabiliser control solenoid valve (rod end)
5 Telescopic dipper control solenoid valve (piston end)
6 Telescopic dipper control solenoid valve (rod end)
7 Pilot pressure control solenoid valve
8 Solenoid valve for switchover between boom and dipper control
9 Solenoid valve for switchover between boom and dipper control
10 Pilot pressure limiter
11 Hydraulic auxiliary control solenoid valve
12 Hydraulic auxiliary control solenoid valve
A RH stabiliser control valve section (piston end)
B RH stabiliser control valve section (rod end)
C LH stabiliser control valve section (piston end)
D LH stabiliser control valve section (rod end)
E Telescopic dipper control valve section (piston end)
F Telescopic dipper control valve section (rod end)
G Hydraulic auxiliary control valve section
H Hydraulic auxiliary control valve section
J Pilot pressure supply for RH and LH control levers
P Pilot pressure supply for solenoid valves assembly
A1 Boom control valve section (rod end)
A2 Boom control valve section (piston end)
A3 Dipper control valve section (piston end)
A4 Dipper control valve section (rod end)
B1 LH control lever - boom control
B2 LH control lever - boom control
B3 RH control lever - dipper control
B4 RH control lever - dipper control
T1 Reservoir return
Acc Accumulator
Diag Pressure test point



Solenoid valves for piloting backhoe control valve sections with hydraulic controls

Torque setting

Port	Nm	lbs-ft
P, J, T1	35	25
A, B, C, D, E, F, G, H	20	14
A1, A2, A3, A4, B1, B2, B3, B4	20	14
ACC	45	32

NOTES

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 4 - Fault Finding, Pressure and Flow Testing for REXROTH Only

Contents

FAULT FINDING AND PRESSURE TESTING

Preliminary Checks

If fault finding, pressure and flow testing is carried out in a systematic manner and the results analyzed, the malfunction can be readily and accurately identified. If short cuts, assumptions and guesses are made, unnecessary strip-down or component replacement could result. Follow the step-by-step procedures outlined below.

As a first step in the fault finding procedure, several preliminary checks should be made. These checks are important in that once performed, they need no longer be considered as a possible cause of the immediate or reported malfunction.

- Check that the hydraulic oil is at the correct level and of the correct specification.
- Check the loader, backhoe or any additional accessory such as hydraulic bucket, hammers etc., for correct assembly or installation and additionally for signs of external damage that might cause gross misalignment of structural members.
- Check in more detail for other mechanical damage such as kinked, twisted, worn or decayed hoses, damaged cylinders and bent elements. Do not forget to check underneath the unit for damaged steel tubes, particularly if the unit has been known to have operated in arduous conditions, been grounded, or bogged down.
- Ensure optimum operating temperature of the hydraulic oil is achieved.

The preceding preliminary checks assume that the engine performance is not in question. Having performed these checks and failed to locate the cause of the malfunction, the following procedures should be adopted:

- If possible, operate the backhoe and make notes of the operating characteristics. Cycle each control lever to operate each of the cylinders to the fully extended and retracted positions.
- Compare the operating characteristics in the preceding stage with the malfunctions listed in the "Fault Finding Chart".

EXAMPLE:

Backhoe lift circuit slow to raise, all other circuits appear to work normally.

Listed in the column under "Malfunction" in the "Fault Finding Chart", the description would be "lift fails to operate, is slow or has loss of power".

- The column headed "Malfunction" lists the observed malfunctions when the backhoe or loader is operated.
- The column headed "Possible Cause" lists all the items in the circuit which could cause the observed malfunction.
- The column headed "Test/Repair" lists the test which should be used to determine the item causing the observed malfunction.

Refer to "Test/Repair" column and perform the recommended tests. Systematic and logical testing will reduce the time required in locating the cause of the malfunction and provide a more accurate indication of the malfunction. If adequate test equipment is not available, disassembly and inspection of the items listed under "Possible Causes" must be undertaken.

Before pressure testing the machine ensure the hydraulic oil is at normal operating temperature of 75°C (167°F).

Pressure testing is performed using the three pressure test ports on the left hand side of the machine.

The upper and the lower ports test the hydraulic system and the middle port tests the steering system.

Install 0-200 bar (0-3000 psi) pressure gauge in this port using quick release coupler, Part No 291924, when pressure testing the steering system.

FAULT FINDING - GENERAL

Problem	Possible causes	Correction
All circuits fail to operate.	Pump drive inoperative.	Investigate and repair as necessary.
	Low oil level.	Check and add oil.
	Restricted pump suction line.	Inspect suction line and reservoir, repair as necessary.
Slow operation or loss of power in all circuits.	Pump worn.	Perform pump performance test and replace/reseal as necessary
	Restricted pump suction line.	Inspect suction line and reservoir, repair as necessary.
	Load Sense Pressure Relief Valve incorrectly adjusted.	Pressure test system.
	Hydraulic Speed Solenoid Valve inoperative.	Pressure test system.

FAULT FINDING - LOADER

Problem	Possible causes	Correction
Lift fails to operate, is slow or has loss of power.	Valve spool leakage	Examine lift section of loader control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Bucket fails to operate, is slow or has loss of power.	Circuit relief valves stuck open, set too low or seat leaking.	Bucket circuit relief valve test.
	Valve spool leakage	Examine bucket section of loader control valve assembly for wear or scoring
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Cylinder leak down (spools in neutral).	Piston barrel damaged	Examine/reseal piston and gland
	Internal valve leakage.	Examine appropriate valve section of loader control valve assembly for wear or scoring.
Hesitation in loader lift or bucket cylinders when control initially moved.	Load check valve between control valve sections damaged	Disassemble and inspect.

FAULT FINDING - BACKHOE

Refer to the following backhoe fault finding chart after first considering the preceding charts. The backhoe chart should only be referred to if the supply circuit is performing normally, thereby confirming that the pump and hydraulic supply circuits are functioning to specification. See also "Fault Finding Hydraulic Pump".

Problem	Possible causes	Correction
Lift fails to operate, is slow, has loss of power or is not holding.	Lift circuit relief valve stuck open, set too low or seat is leaking.	Pressure test lift circuit relief valve.
	Valve spool leakage	Examine lift section of backhoe control valve assembly for wear and scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Crowd fails to operate, is slow or has loss of power.	Crowd circuit relief valve (piston end) stuck open, set too low or seat is leaking.	Pressure test crowd circuit relief valve.
	Valve spool leakage	Examine crowd section of backhoe control valve assembly for wear and scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Bucket fails to operate, is slow or has loss of power.	Bucket circuit relief valve (rod end) stuck open, set too low, or seat is leaking.	Pressure test bucket circuit relief valve.
	Valve spool leakage	Examine bucket section of backhoe control valve assembly for wear and scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Extendible dipstick fails to operate, is slow or has loss of power.	Extendible dipperstick relief valve (piston end) stuck open, set too low, or seat is leaking.	Pressure test extendible dipstick circuit relief valve.
	Valve spool leakage	Examine extendible dipperstick section of backhoe control valve assembly for wear and scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Stabiliser leg leaks down.	Stabiliser lock valve leaking	Examine/overhaul stabiliser lock valve.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.

FAULT FINDING - BACKHOE (CONT.)

Problem	Possible causes	Correction
Right or left direction swing fails to operate, is slow, or has loss of power.	Swing circuit relief valves not seating, set too low or seat is leaking.	Swing circuit relief valve test.
	Valve spool leakage	Examine swing section of backhoe control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Swing fails to slow (cushion arrest) at end of travel.	Integral sliding restrictor damaged.	Disassemble and inspect.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Swing continues to move when control lever returned to neutral (one direction only).	Circuit relief valve (return side) stuck open, set too low or seat leaking.	Swing circuit relief valve test.
	Valve spool leakage.	Examine swing section of backhoe control valve assembly for wear or scoring.
Cylinders leak down (spools in neutral).	Internal valve leakage	Examine appropriate valve section of backhoe control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged.	Examine/reseal piston and gland.
Any one circuit drops momentarily when signalled to raise.	Load check valves in control valve sections damaged.	Disassemble and inspect.

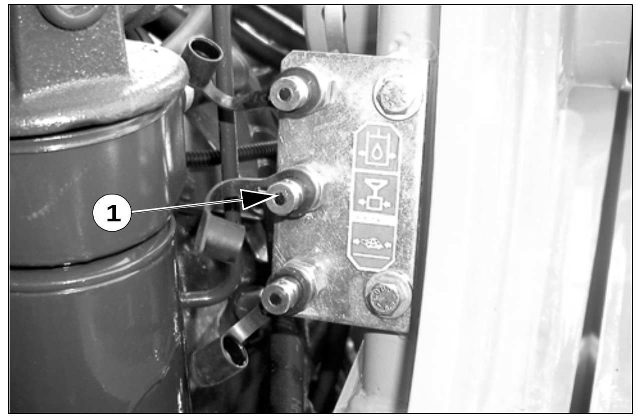
FAULT FINDING - PUMP

Problem	Possible causes	Correction
System noisy.	Worn or damaged pump gears or pressure plates.	Hydraulic pump performance test.
	Aeration: Air entering the systems at: suction tube, pump shaft, fittings, or cylinder glands.	Hydraulic pump performance test.
	Cavitation: Restrictions in the system at the suction line or at the suction screen in the reservoir.	Visual and/or hydraulic pump performance test.
	Water in the system.	Visual.
	Tubing vibration.	Visual.
	Cold hydraulic oil.	Check hydraulic oil operating temperature.
	Wrong type oil being used.	Investigate/drain and refill.
Hydraulic oil exhausts from breather at the reservoir.	Reservoir overfilled.	Check hydraulic oil level.
	Aeration: Air entering the systems at: suction tube, pump shaft, fittings, or cylinder glands.	Hydraulic pump performance test.
	Cavitation: Restrictions in the system at the suction line or at the suction screen in the reservoir.	Visual and/or hydraulic pump performance test.
Oil heating.	Oil supply low.	Fill reservoir.
	Contaminated oil.	Drain reservoir and refill with clean oil.
	Setting of relief valve too high or too low.	Drain reservoir and refill with clean oil. Test relief valves.
	Oil in system too light.	Drain reservoir and refill with correct viscosity oil.
	Oil cooler fins blocked.	Clean oil cooler.
Shaft seal oil leakage.	Worn shaft seal.	Replace shaft seal and inspect pump.
Foaming oil.	Low oil level.	Fill reservoir.
	Air drawn into suction line.	Check/tighten suction line.
	Wrong oil grade.	Drain and refill with correct oil.

PRESSURE TESTING

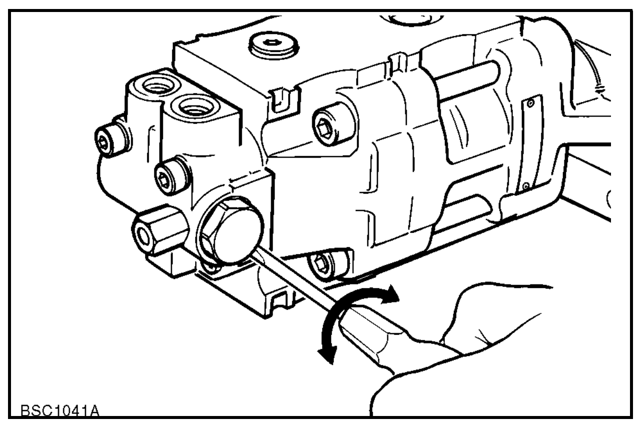
Steering Standby

1. Install 0-40 bar (0-600 psi) pressure gauge into the middle test port (1) on left hand side of machine.
2. Set engine speed to 1000 rev/min
3. Ensure no turning force is being applied to the steering wheel and observe pressure on gauge. The pressure gauge should read approximately 17 bar (250 psi) and is the steering standby pressure.
4. If pressure incorrect remove and examine flow divider spool on end of pump.



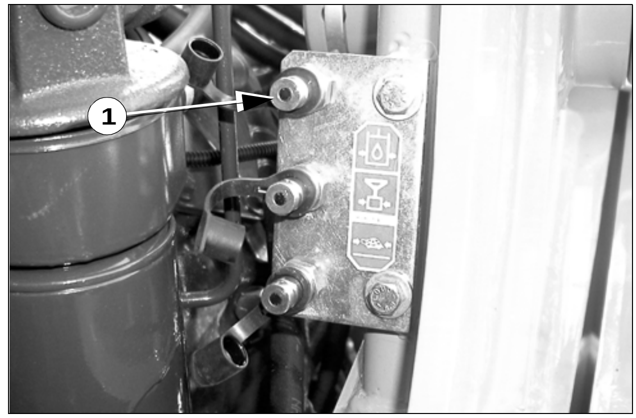
Steering Circuit Relief Valve

1. Install 0-200 bar (0-3000 psi) pressure gauge into the middle test port (1) on left hand side of machine.
2. Set engine speed to 2000 rev/min and fully turn and hold steering on either full left or right hand turn and observe pressure gauge. The gauge reading should rise to 175-183 bar (2560-2660 psi) and is the steering circuit relief valve setting.
3. If reading is not to specification stop engine, remove blanking plug on pump flow divider and using screwdriver turn relief valve adjusting screw to increase or decrease setting.
4. Retest steering and when pressure correct peen end of adjuster to prevent movement and re-install blanking plug.



System Pressure Relief Valve

1. Install 0-300 bar (0 - 4351psi) pressure gauge into upper test port.
2. Set engine speed to 2200 rev/min.
3. Raise loader until bucket is approximately 0.5 metres (19 in) from the ground. This ensures that self levelling device does restrict movement of bucket during this test.
4. Hold the loader bucket control lever to the left causing the bucket to roll back.
5. Observe the reading on the upper gauge which will display the system pressure relief valve setting. Pressure reading should be 210 bar (3040 psi)
6. If relief valve is away from specification adjust to Specification.



Loader Bucket Relief Valve (Piston End)

1. Set engine speed to 2200 rev/min
2. Hold the loader bucket control lever to the right causing the bucket to dump.
3. Observe the upper gauge which should read 160 bar (2300 psi) minimum and is the operating pressure of the loader bucket, piston end, relief valve. Values up to 190 bar are acceptable.
4. Adjust valve if not to specification.
5. To test rod end circuit relief valve hold lever to the left and curl in the bucket. If pressure reading is 210 bar the system relief valve is operating and it is an indication that relief valve which is set at 230 bar is set correctly.

Extendible Dipper Relief Valve (Piston End)

1. Set engine speed to 2200 rev/min
2. Fully extend the extendible dipper and continue to depress the control pedal.
3. Observe the reading on the gauge.
4. Pressure recorded is the extendible dipper relief valve setting and should read 165 bar (2375 psi) minimum. Values up to 200 bar (2900 psi) are acceptable.
5. Adjust valve if not to specification.

Swing System Relief Valves

1. Set engine speed to 2200
2. Hold dipperstick fully left until relief valve operates and blow relief valve.
3. Observe the upper gauge which should read 205 bar (3000 psi) minimum.
4. Repeat procedure with dipperstick held to the right.
5. Adjust valve if not to specification.
6. Observe the reading on the gauge in the lower test port (3).
7. Pressure recorded is the extendible dipper relief valve setting and should read 165 bar (2375 psi) minimum. Values up to 200 bar (2900 psi) are acceptable.
8. Adjust valve if not to specification.

Dipperstick Bucket and Boom Relief Valves Valves

These relief valve are set to a higher pressure than the main system relief valve setting of 210 bar (3045 psi).

To test these circuit relief valves operate each service until the corresponding relief valve operates.

If pressure reading in each incidence is 210 bar (3045 psi). the system relief valve is operating and it is an indication that relief valves are set correctly.

Dipperstick bucket circuit relief valve (rod end) secification is 220 bar (3190 psi).

Dipperstick boom circuit relief valve setting (piston end) is 240 bar (3480 psi).

To accurately test the dipperstick bucket (rod end) and boom (piston end) relief valves the main system pressure can be temporarily increased to 240 bar (3480 psi).

Do Not increase pressure setting to higher than 240 bar (3480 psi) and reset system relief valve to 210 bar (3045 psi) on completion of test.

NOTE: *Dipperstick boom circuit relief valve setting (rod end) is 315 bar (4568 psi) and can not be checked using this system. Replace this valve if considred faulty.*

Flow Testing

Pump Performance Test

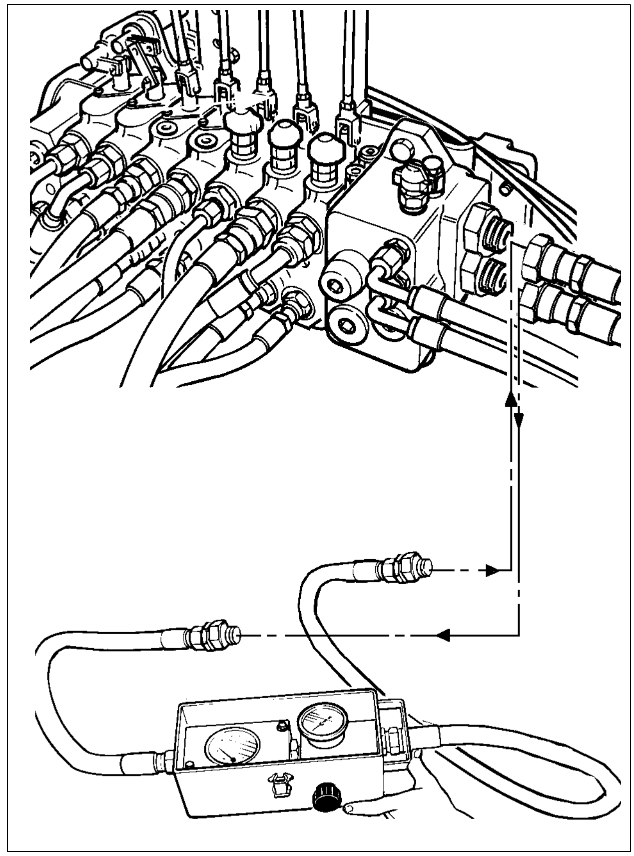
The following pump performance test must be performed after pressure testing the system and rear pump relief valves and when the hydraulic oil is at normal operating temperature of 75° C (167°F).

1. Disconnect inlet and outlet hoses to backhoe control valve and install 0-200L/min (0-53 gals/min) flowmeter.
2. Open flowmeter valve.
3. Slowly turn flow control valve and increase pressure to 175 bar (2550 psi). Measure pump flow which should be : 69-81 Litres/min (18.2 - 21.4 gals/min).

Analysis

If flow recorded in step 3 is less than 69 Litres/min the pump is worn and requires overhaul.

NOTE: *If the machine has a history of poor service intervals replace the hydraulic system filter and clean pump intake filter in the reservoir.*



SECTION 35 - HYDRAULIC SYSTEMS

Chapter 5 - Control valves for REXROTH with mechanical or hydraulic controls

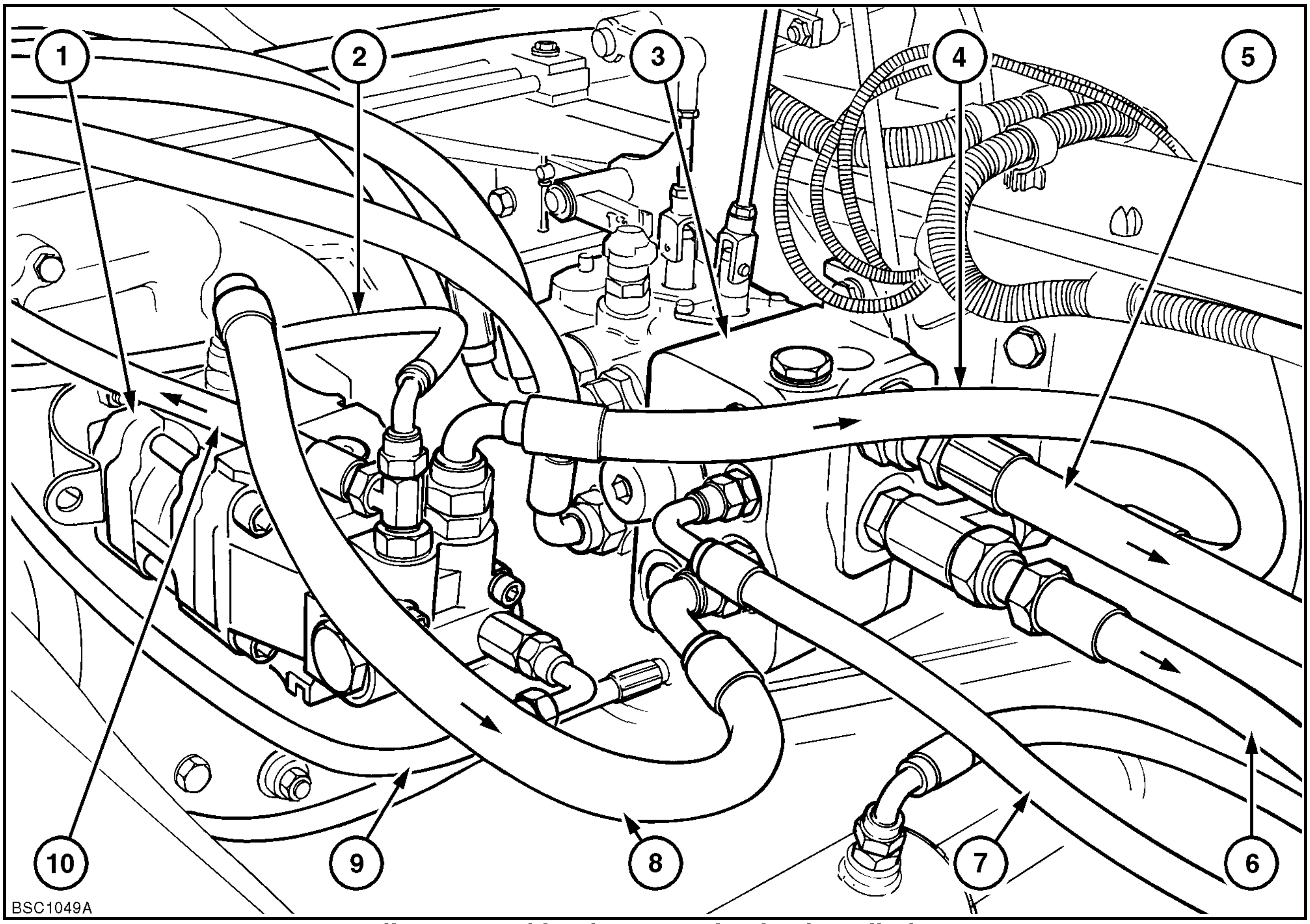
CONTENTS

SPECIFICATIONS

Mechanical spoolstroke	8 + 8 mm
Hydraulic spool stroke	8 + 8 mm
Side shift clamp solenoid resistances	7.6 Ω at 20°C
Hydraulic speed control solenoid resistances	7.6 Ω at 20°C
Electrical detent solenoid resistances	16.5 Ω at 20°C

For pressure specifications, refer to Hydraulic schematics section.

LOADER CONTROL VALVE OVERHAUL



Oil pump and loader control valve installation

1. Hydraulic pump
2. To steering test port
3. Loader control valve
4. Rear pump supply to hydraulic circuit
5. Return to reservoir
6. Supply to backhoe control valve
7. Load sensing line to backhoe control valve
8. Front pump supply to hydraulic circuit
9. Steering load sensing line
10. To steering motor

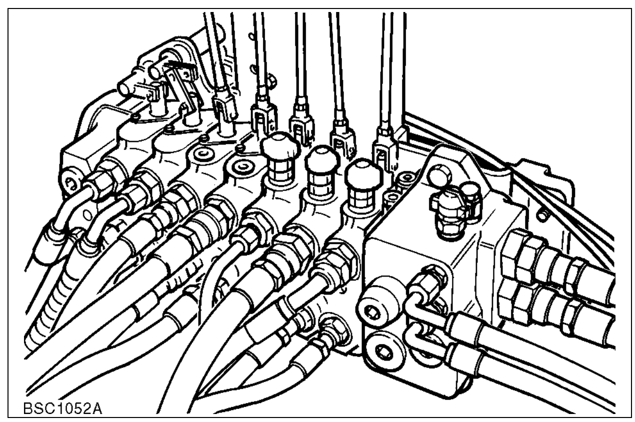
REMOVAL

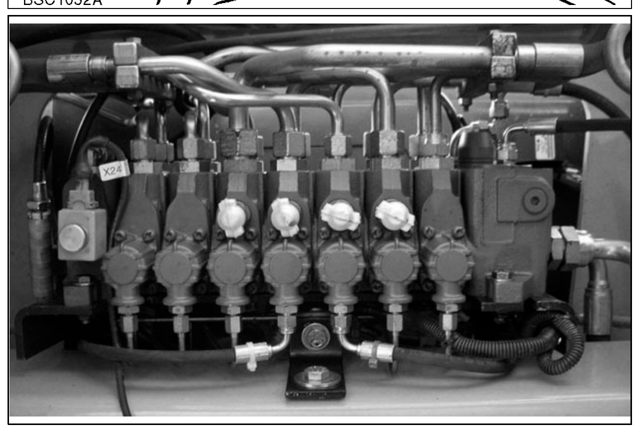
1. Lower the loader to the ground, with the bucket in a vertical position firmly placed on the ground.
2. Stop the engine and eliminate any residual pressure in the backhoe and loader circuits by moving the loader and backhoe control levers through all operating positions.
3. Disconnect the battery.
4. Clean the area around the control valve.
5. Identify and disconnect linkage, cables and each hose connection to the control valve (3) and plug the hose ends. A drip tray will be required to catch oil draining from inside the hoses.
6. Remove the valve assembly from the machine.
7. Installation is the reverse of the removal procedure.

BACKHOE CONTROL VALVE OVERHAUL

REMOVAL

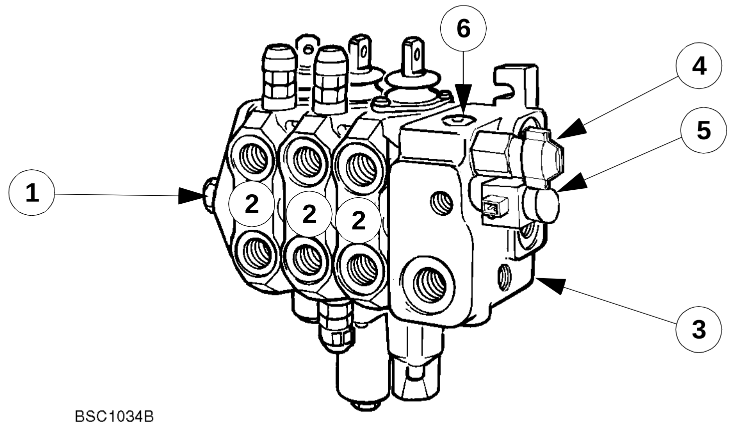
1. Position the unit on a hard level surface.
2. Lower the loader to the ground.
3. Lower the stabilizers.
4. Offset the swing frame on sideshift models to the left or right.
5. Position the dipper in the vertical position, with the bucket firmly placed on the ground.
6. Stop the engine and eliminate any residual pressure in the backhoe and loader circuits by moving the loader and backhoe control levers through all operating positions.
7. Disconnect the battery.
8. Clean the area around the control valve.
9. Tag and identify the position of all hydraulic hoses.
10. Disconnect and plug all the hydraulic hoses.
11. Disconnect the linkages of the manual control levers.
12. On sideshift models disconnect the connector to the sideshift clamp solenoid.
13. Support the weight of the valve using a suitable lifting device.





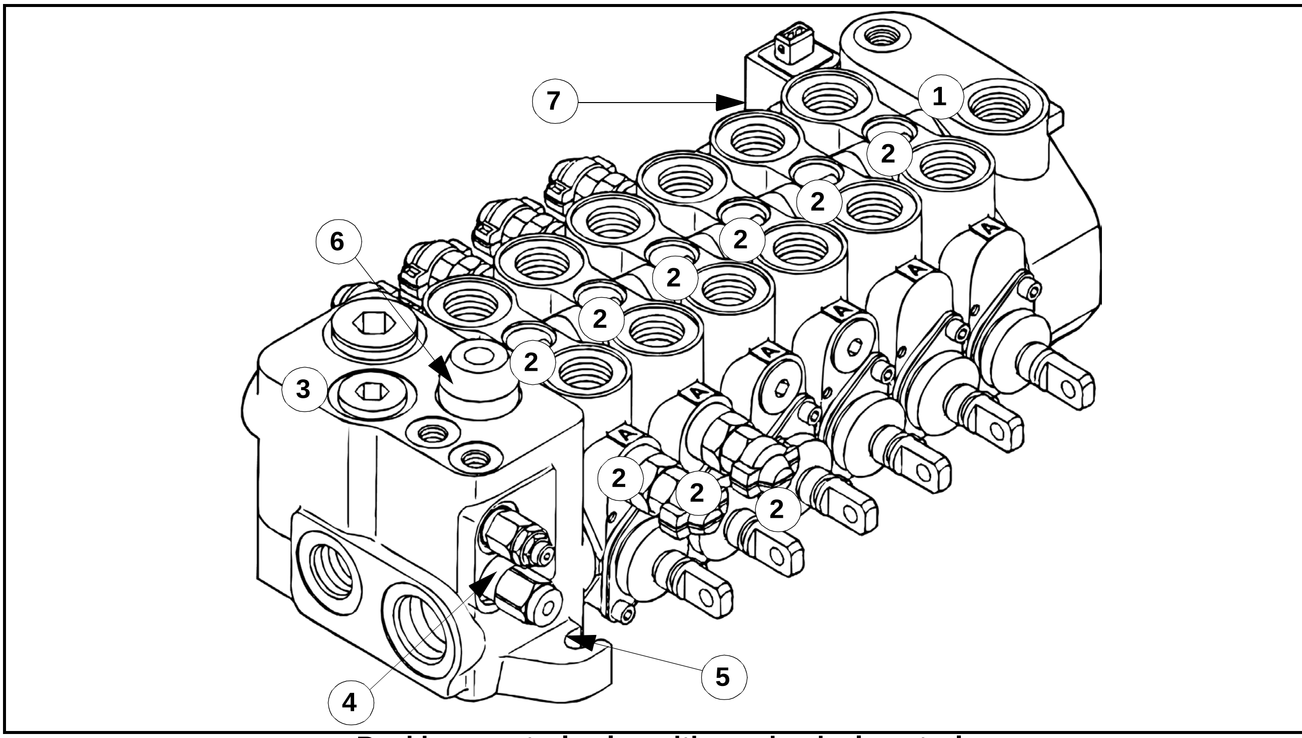
14. Remove the valve retaining bolts located on the rear of the control valve mounting plate and carefully withdraw and lower the valve from machine.
15. Installation is removal procedure in reverse.

DISASSEMBLY OF CONTROL VALVES

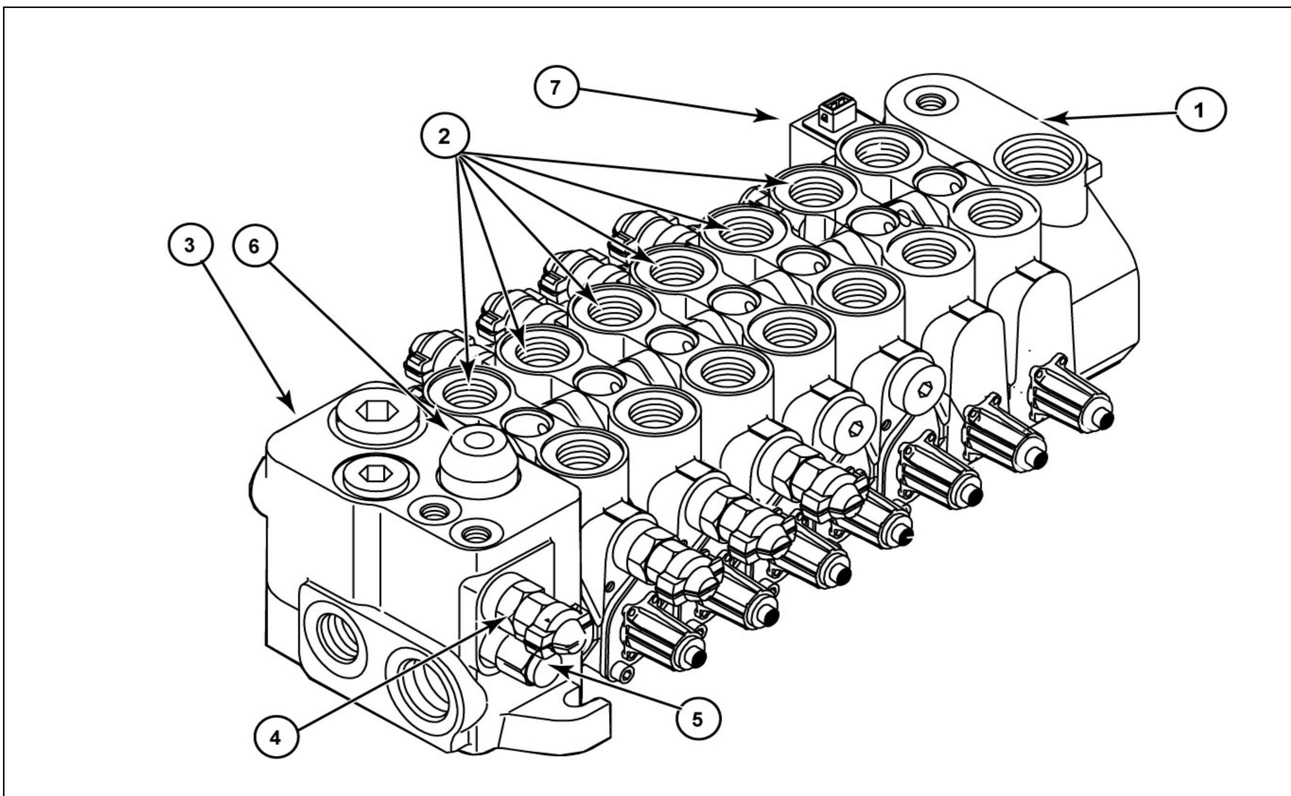


Loader control valve

1 End cover ....See page 6
2 Working sections ....See page 8
3 Inlet section ....See page 7
4 Hydraulic speed control relief valve (tightening torque **- 41 to 49 Nm**)
5 Hydraulic speed control solenoid ....See page 6
6 Hydraulic speed control spool and check valve ....See page 7



Backhoe control valve with mechanical control



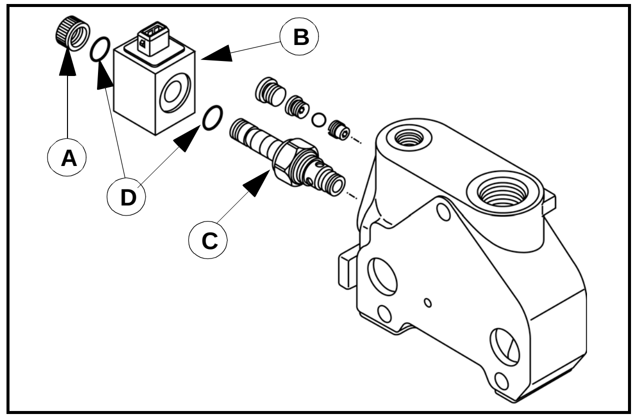
Backhoe control valve with hydraulic control

1 End plate with sideshift clamp cylinder solenoid ....See page 6
2 Working sections ....See page 8
3 Inlet section..See page 7
4 Load sensing limiter (tightening torque - **41 to 49 Nm**)
5 Load sensing return to reservoir control port (torque setting - **18 to 22 Nm**)
6 Pump flow balancer valve ....See page 6
7 Side shift clamp cylinder solenoid and shuttle valve ....See page 6

HYDRAULIC SPEED CONTROL AND SIDESHIFT CLAMP CYLINDERS SOLENOIDS

Removal

1. Unscrew the knurled knob (A).
2. Pull the solenoid (B) off the stem of the 2 way valve (C).
3. Unscrew the 2 way valve (C).

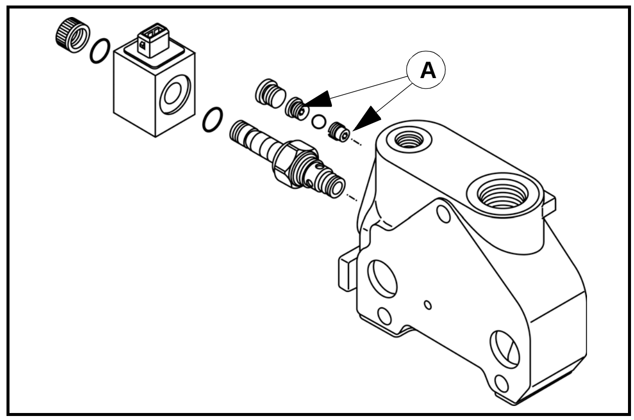


Reassembly

1. Reassemble parts in reverse order.
2. Replace the O-ring (D).
3. Torque setting of the 2-way valve (C) - **41 to 49 Nm**.

SHUTTLE VALVE

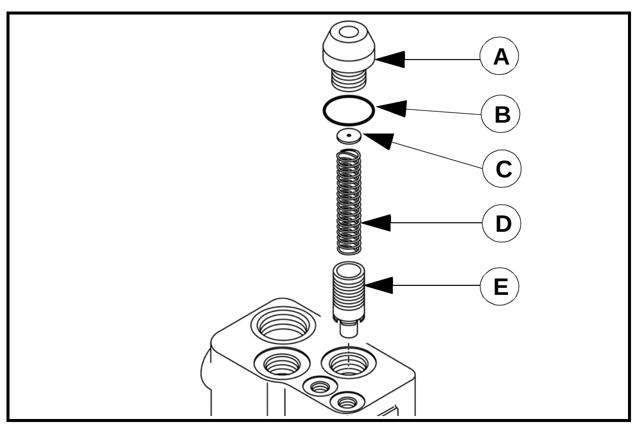
1. For reassembly, apply Loctite 542 sealant on the upper seat and lower seat (A).
   Tightening torque (A): **18 to 22 Nm**.



PUMP FLOW BALANCER VALVE

Removal

1. Remove plug (A), shim (C), spring (D) and piston (E).



Reassembly

1. Reassemble parts in reverse order.
2. Replace the O-ring (B).
3. Torque setting for plug (A) - **90 to 110 Nm**.

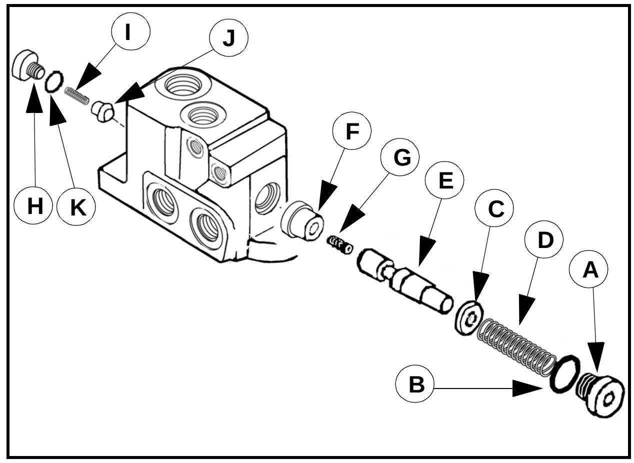
HYDRAULIC SPEED CONTROL SPOOL AND NON-RETURN CHECK VALVE

Removal

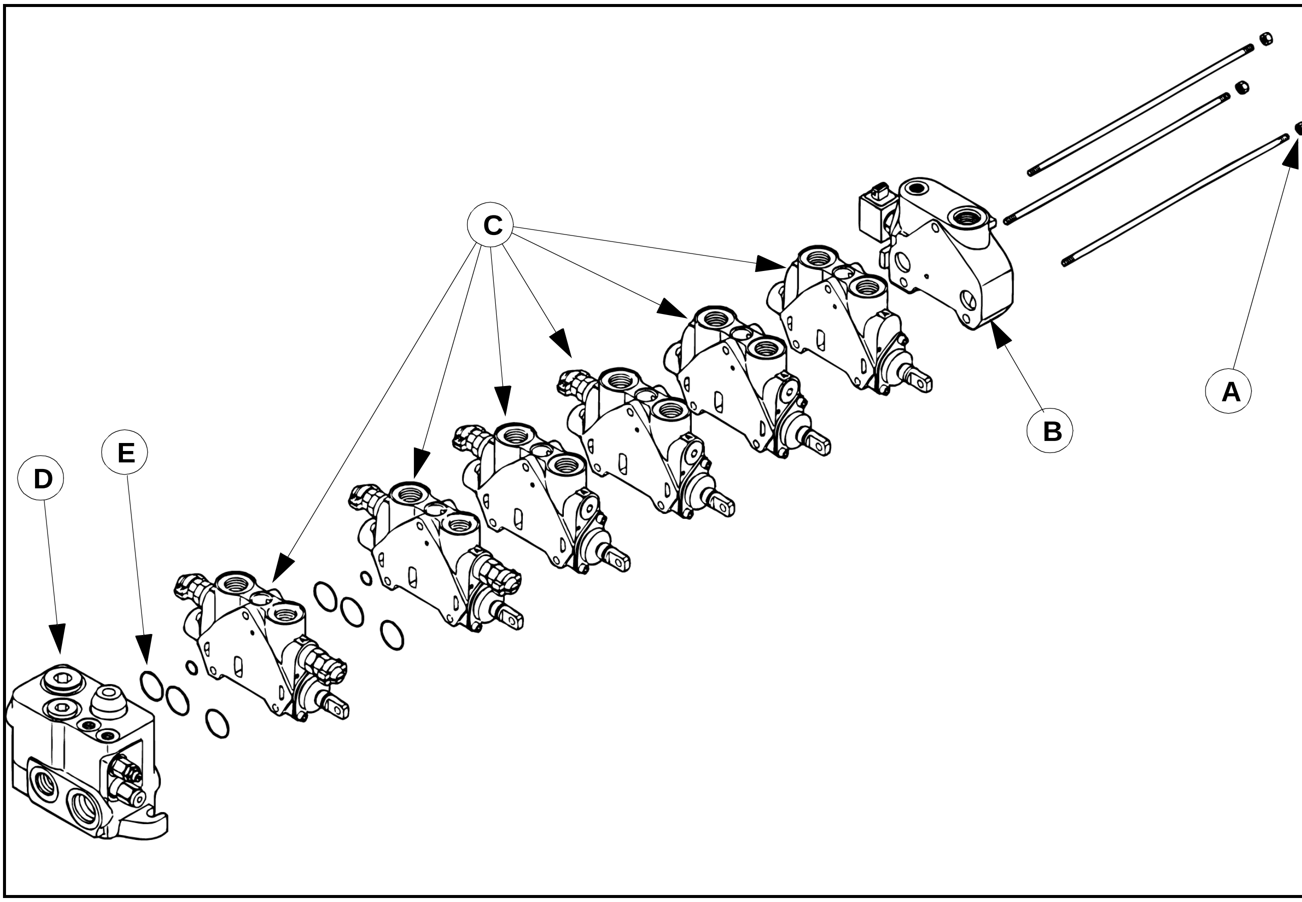
1. Remove plug (A), shim (C), spring (D) and piston (E).
1. Remove seat (F) and restrictor (G).
1. Remove plug (H), spring (I) and clapet (J).

Reassembly

1. Reassemble parts in reverse order.
2. Replace the O-rings (B) and (K).
3. Tightening torque:
   Plug (A) **- 60 to 70 Nm**.
   Restrictor (G) **- 9 to 11 Nm**.
   Plug (H) **- 27 to 33 Nm**.



DISASSEMBLY OF THE CONTROL VALVE



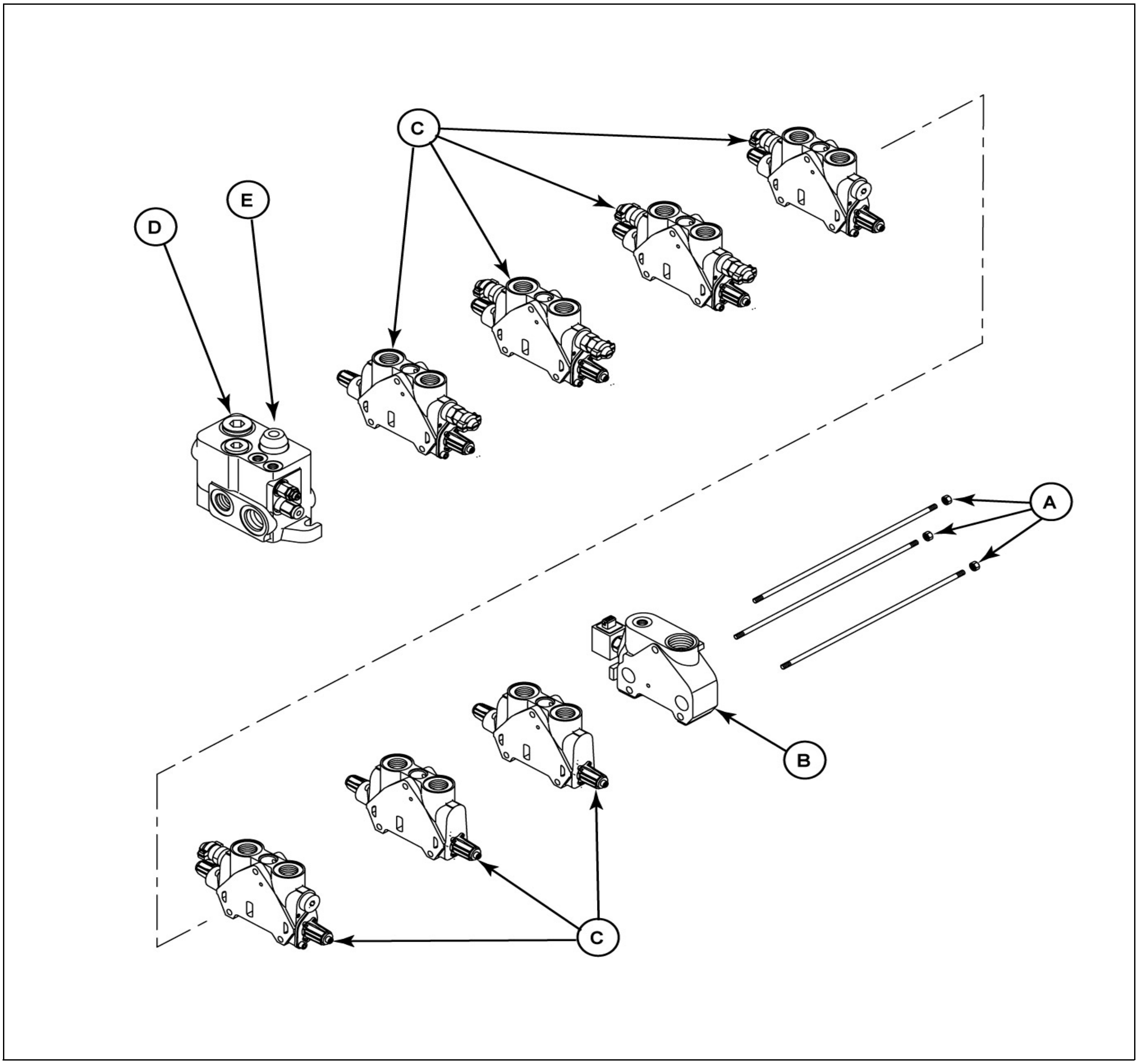
Backhoe control valve with mechanical control

Disassembly

1. Remove the nuts (A).
2. Remove the outlet section (B).
3. Separate the working sections (C) from the Inlet section (D).
4. Replace the O-rings (E) located between the working sections, the inlet section and the outlet section.

Reassembly

1. Check the cleanliness of the section faces prior to reassembly.
2. Reassemble parts in reverse order.
3. Tighten nuts (A) from **32 to 38 Nm.**



Backhoe control valve with hydraulic control

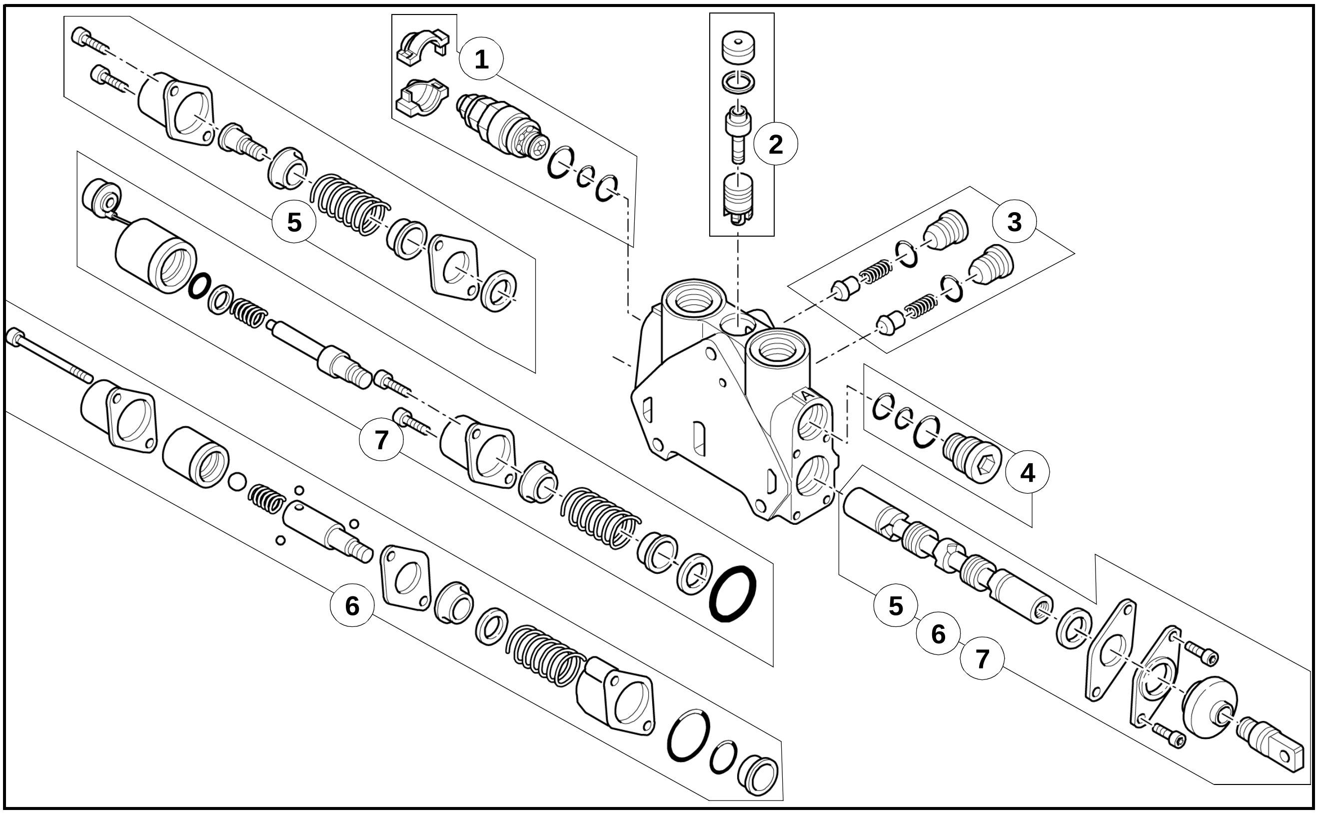
Disassembly

1. Remove the nuts (A).
2. Remove the outlet section (B).
3. Separate the working sections (C) from the inlet section (D).
4. Replace the O-rings (E) located between the working sections, the inlet section and the outlet section.

Reassembly

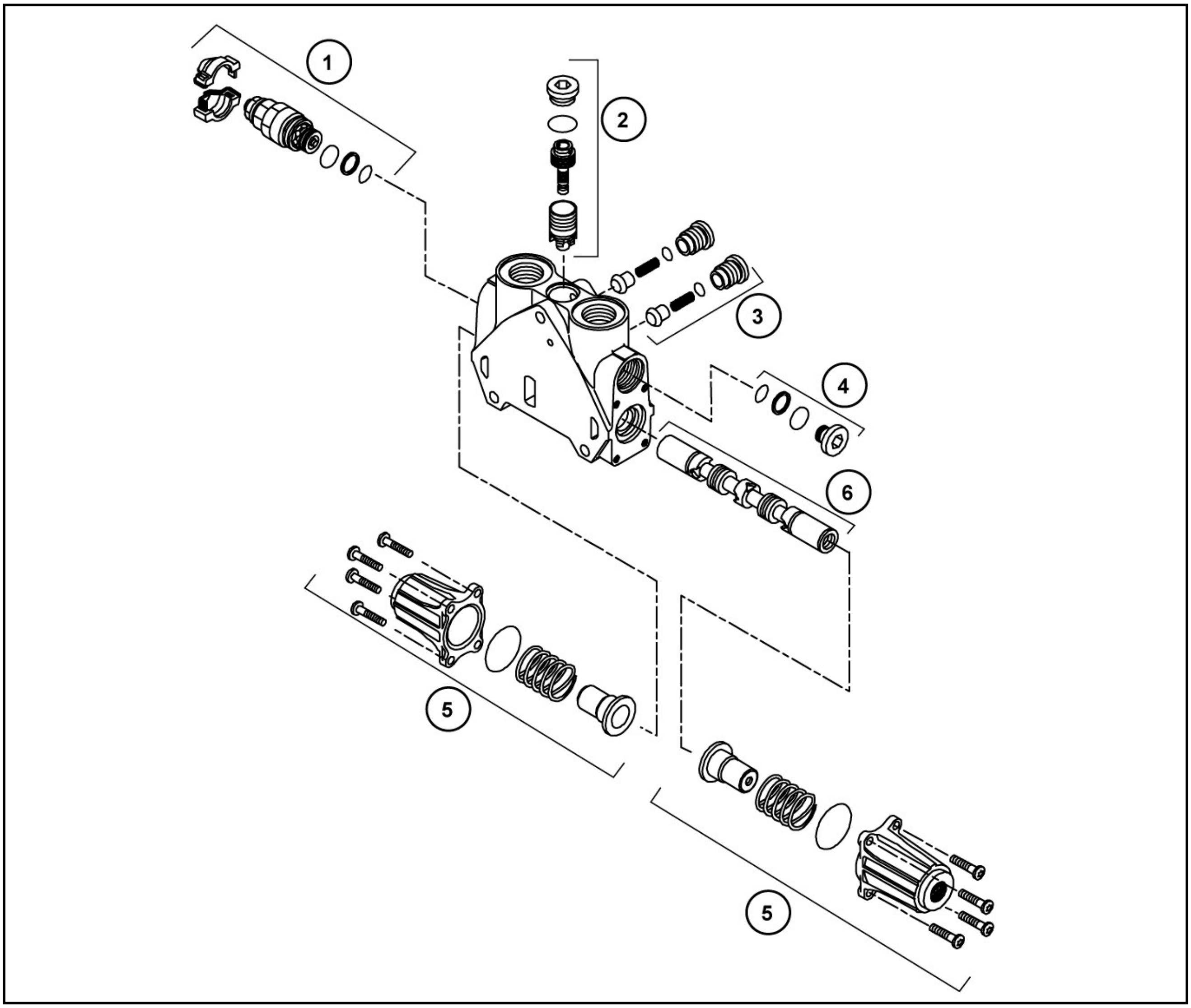
1. Check the cleanliness of the section faces prior to reassembly.
2. Reassemble parts in reverse order.
3. Tighten nuts (A) from **32 to 38 Nm**.

DISASSEMBLY OF CONTROL VALVE SECTIONS



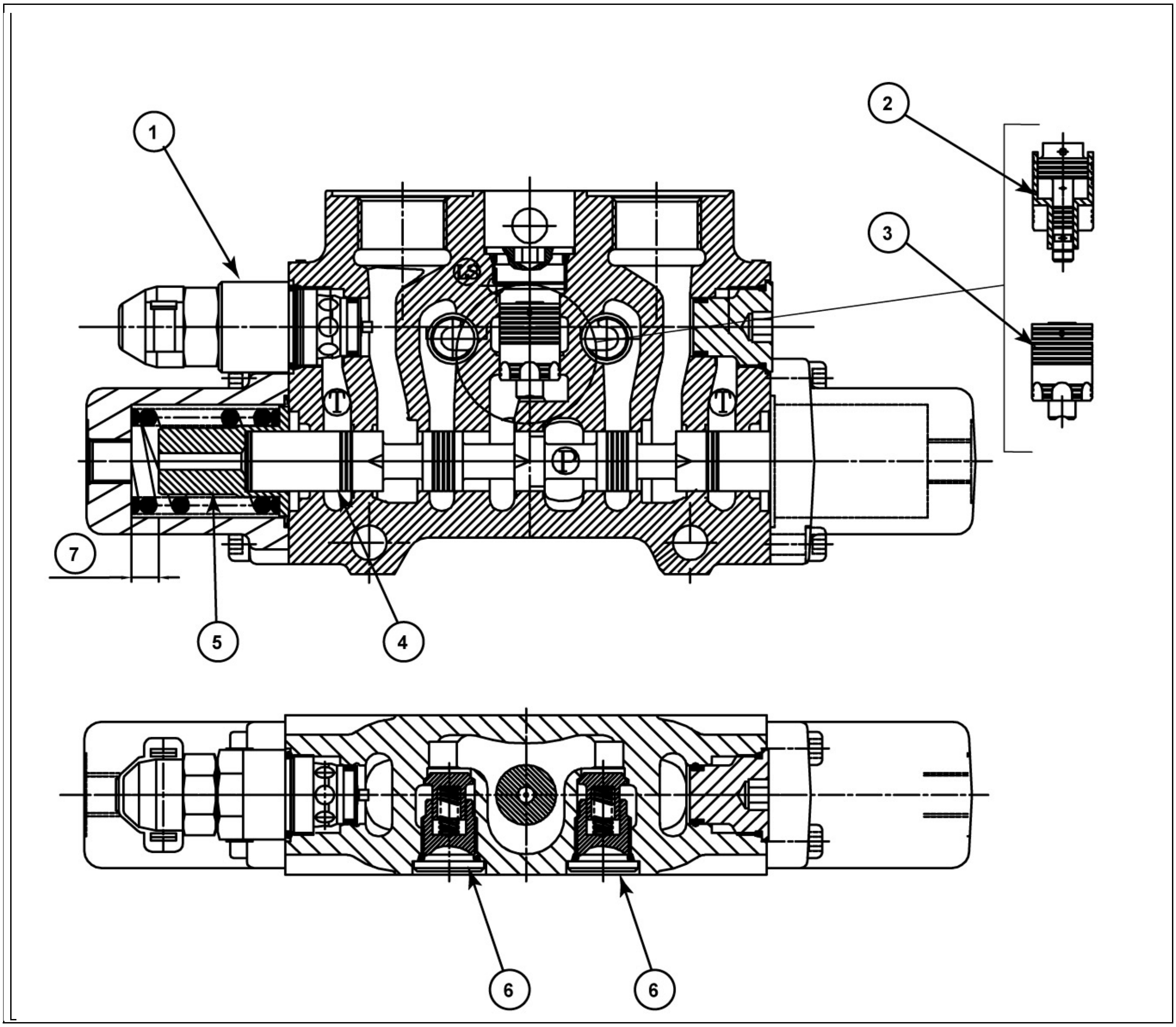
Control valve sections with mechanical control

1 Secondary relief valve
2 Pressure compensator
3 Check valves
4 Plug
5 Spool with spring return system
6 Spool with mechanical detent system (loader boom element)
7 Spool with electrical detent system (loader bucket element)



Control valve sections with hydraulic control

1. Secondary relief valve
2. Pressure compensator
3. Non-return check valve
4. Plug
5. Spring return system
6. Spool



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Cross-sectional view of the hydraulic control section

1. Secondary relief valve
2. Pressure compensator with shock absorber
3. Fixed pressure compensator
4. Spool
5. Spring guide
6. Non return check valve
7. Spool stroke **8 + 8 mm**

REPLACING THE SECONDARY RELIEF VALVE (1)

1. Replace the secondary relief valve by a part of the same value tightened to a torque of **63 to 77 Nm**.

FLOW COMPENSATOR (2)

Removal

1. Unscrew the compensator plug.
2. Remove the compensator piston and clean the piston nozzle with compressed air.
3. Check the condition of the bore in the valve section body.

Reassembly

1. Replace the O-ring of the plug and tighten to a torque of **54 to 66 Nm**.

CHECK VALVES (3)

Removal

1. Unscrew the check valve plug.
2. Visually check the condition of parts and replace the assembly if necessary.

Reassembly

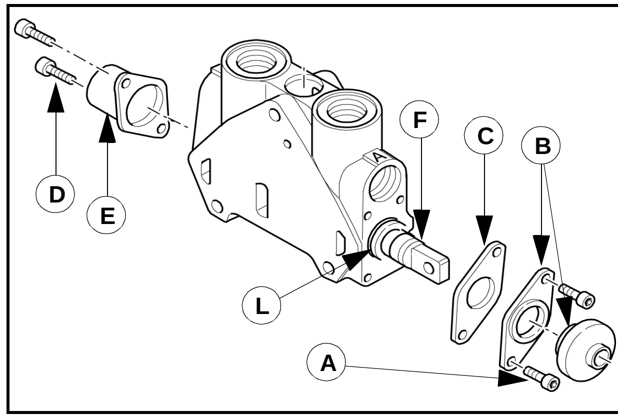
1. Replace the plug O-ring.
2. Tighten the plug from **27 to 33 Nm**.

PLUGS (4)

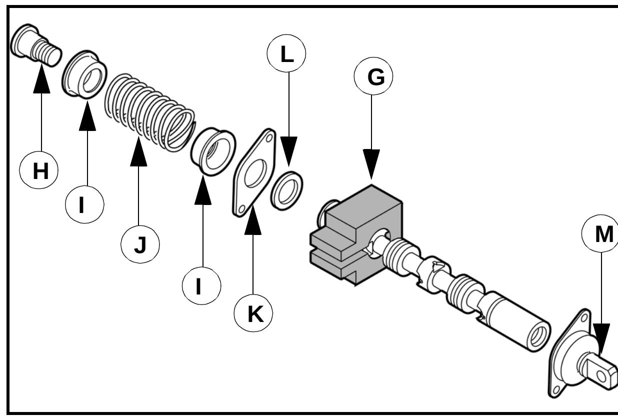
1. Replace the plug O-ring.
2. Tighten the plug from **63 to 57 Nm**.

Removal

1. Remove the screws (A) (Torx Tx30 screwdriver), the boot along with its plate (B) and the plate (C).
2. Remove the mounting screws (D) (Torx Tx30 screwdriver) and the cover (E).
3. Remove the spool (F) from the working section.
4. Remove the lip seal (L).

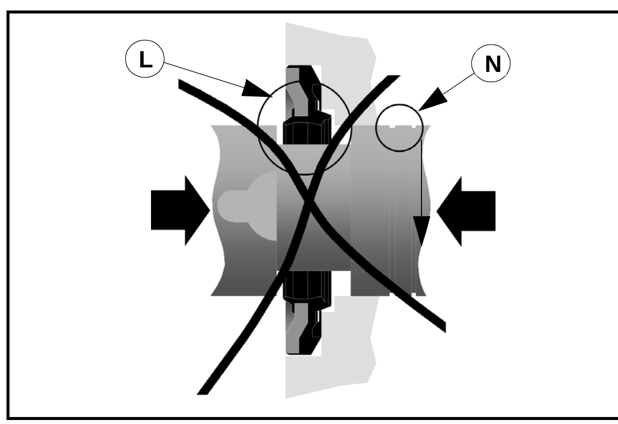


5. Use a spool clamp (G) and a vice to secure the spool.
6. Heat the spool to 200°C in an oven or with a heat gun.
7. Remove the adapter (H), the retainers (I), the spring (J), the plate (K) and the lip seal (L).
8. Remove the tongue (M) if necessary.



Reassembly

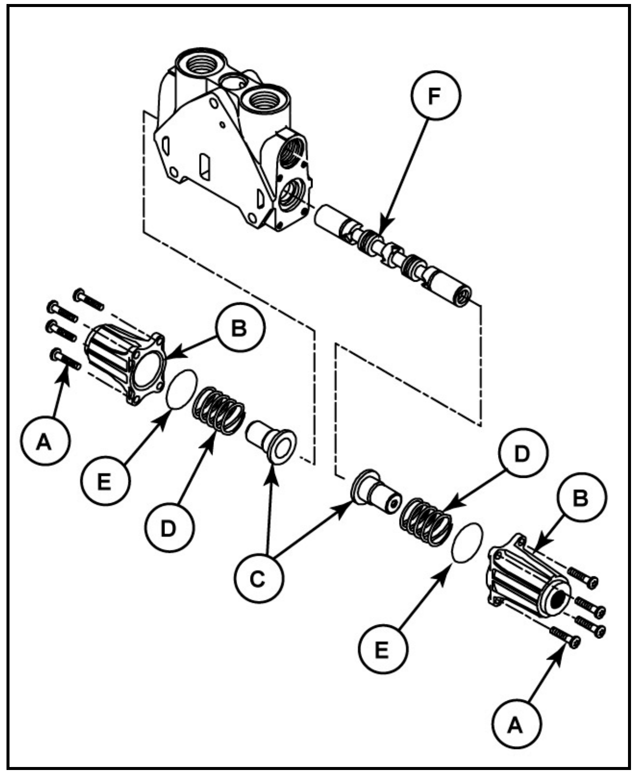
1. Reassemble parts in reverse order after greasing the spring.
2. Position the metal part of the lip seal (L) on the outside of the spool.
   THE LIP SEAL MUST BE FITTED ON THE END OF THE SPOOL SO THAT IT IS NOT DAMAGED BY THE SPOOL GROOVES (N) AND ITS TIGHTNESS IS NOT DAMAGED.
   SLIDE THE LIP SEAL PERPENDICULARY ONTO THE SPOOL.
3. Tighten the screws (A and D), the adapter (H) and the tongue (M) from **9 to 11 Nm.**



HYDRAULIC CONTROL SPOOL

Removal

1. Remove the screws (A) and the cap (B).
2. Extract the spring guides (C) and the springs (D).
3. Discard the seals (E).
4. Remove the spool (F) from the working section.



Reassembly

5. Grease and install the spool (F) in the working section.
6. Install the springs (D) in the caps (B).
7. Install the spring guides (C) in the springs (D).
8. Install new seals (E).
9. Install the cap assemblies on the working section, install and tighten the screws (A) to a torque of **9 to 11 Nm**.

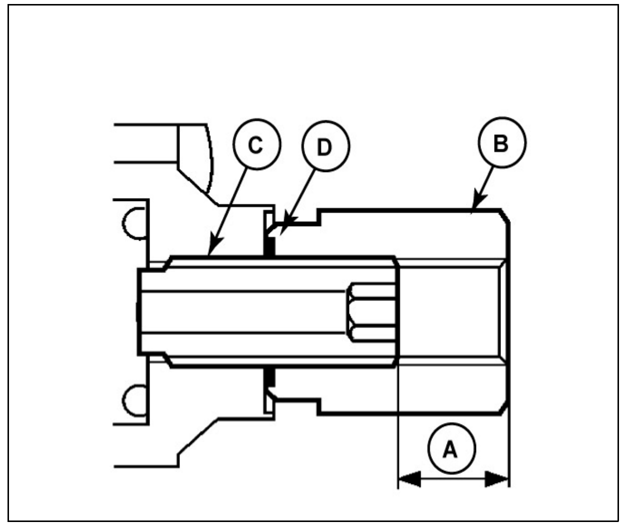
SPOOL STOP

Removal

1. Measure the dimension (A) using a depth gauge.
2. Unscrew the spacer (B), while holding the thrust bearing (C).
3. Unscrew the thrust bearing (C).
4. Remove and discard the seal (D).

Reassembly

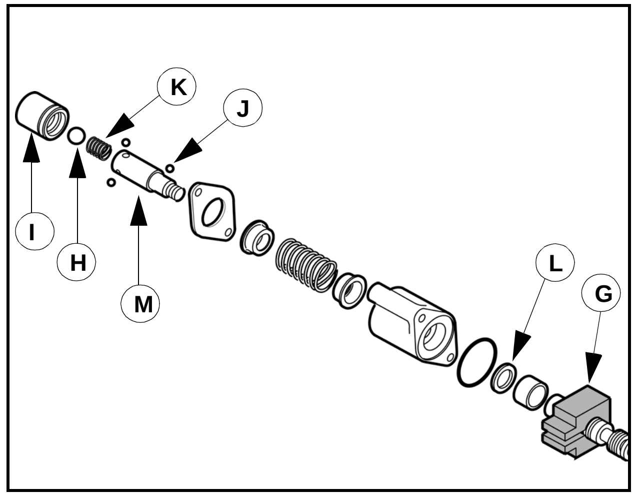
1. Screw in the thrust bearing (C).
2. Install a new seal (D) on the thrust bearing (C).
3. Screw the spacer (B) on the thrust bearing (C).
4. Adjust the dimensions (A) and tighten the spacer **40 to 45 Nm**.



MECHANICAL DETENT SYSTEM SPOOL (6)

Removal

1. Remove the tongue and the cover sides (**see spool with spring return (5)**).
2. Use a spool clamp (G) and a vice to secure the spool.
3. Using a metal rod (min. length = 80 mm, dia. 6) push the central ball (H) while extracting the detent bush (I).
   Mark the orientation of the detent bush for the reassembly.
4. Remove the balls (J) and the spring (K) from the adapter (M).



Reassembly

1. Introduce the spring (K) into the adapter (M).
2. Place the 3 balls (J) into the radial holes of the adapter (M) and use grease to prevent them from falling.
3. Position the central ball (H) against the spring (K).
4. Slip the detent bush (I) onto a metal rod.
5. Using the metal rod, press the central ball (H) into the adapter (M), then slide the detent bush (I) onto the adapter, making sure that the 3 balls are still in place.
   Note: Make sure that the orientation of the detent bush is respected.

ELECTRICAL DETENT SYSTEM SPOOL (7)

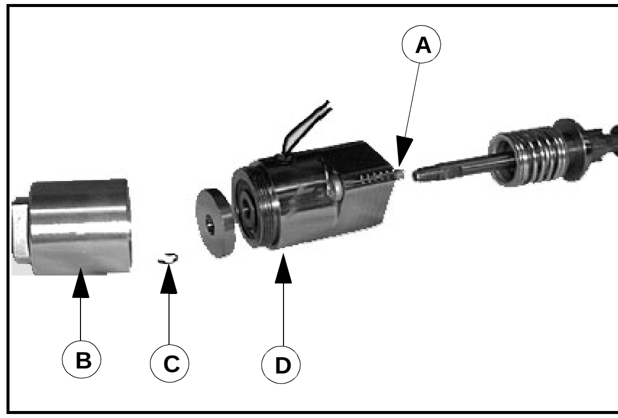
Removal

1. Remove the tongue and the cover sides (**see spool with spring return (5)**).

Solenoid replacement

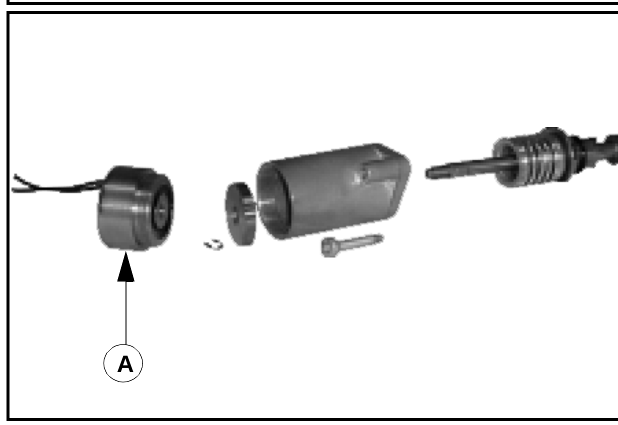
(Spool pulled out)

1. Remove the 2 mounting screws (A) and the detent system.
2. Unscrew the rear housing (B).
3. Remove the circlip (C), the spring and the coil.
4. Install a new solenoid (D).
5. Reassemble parts in reverse order.
   Tightening torque:
   Screws (A) - **9 to 11 Nm.**
   Rear housing (B) - **1,8 to 2,2 Nm**.



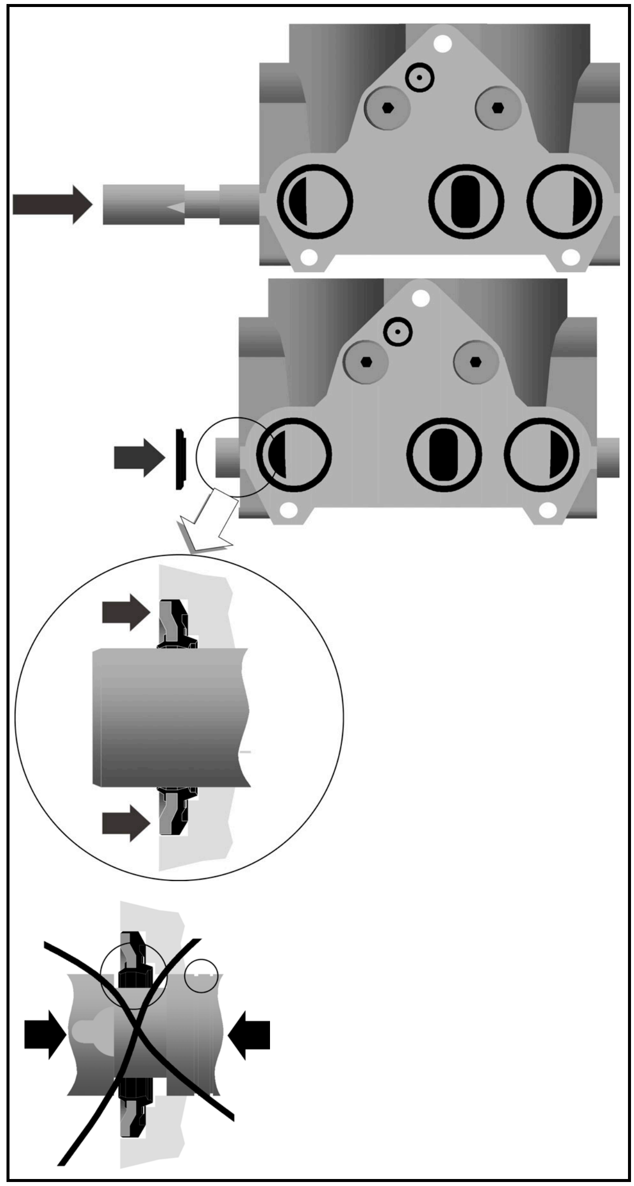
(Spool pushed in)

1. Remove the solenoid (A).
2. Install a new solenoid.
   Tightening torque - **18 to 22 Nm**.



PRECAUTIONS TO BE TAKEN FOR REPLACING THE SPOOL LIP SEAL

1. Place the spool in the working section.



2. Slide the lip seal perpendicularly onto the spool, positioning the metal part of the lip seal on the outside of the spool.

THE LIP SEAL MUST BE FITTED ON THE END OF THE SPOOL SO THAT IT IS NOT DAMAGED BY THE SPOOL GROOVES (N) AND ITS TIGHTNESS IS NOT DAMAGED.

NOTES

SECTION 35 – HYDRAULIC SYSTEMS

Chapter 6 – Swing System and Hydraulic Cylinders

CONTENT

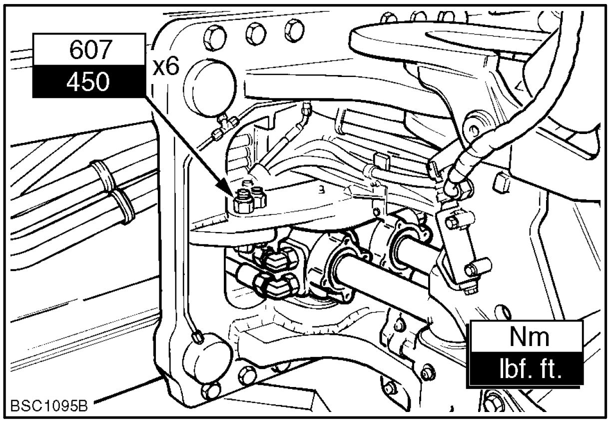
SPECIFICATIONS

Grease	Ambra GR9 – NH710 A
Thread Sealant	Part No 82995773137

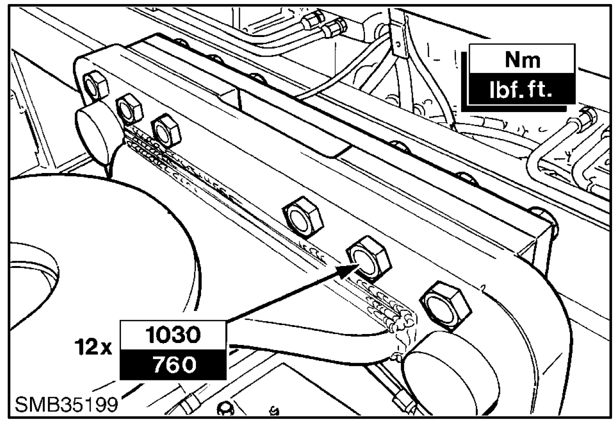
TORQUES

Cylinder	Piston Bolt Torque		Gland Torque	
	Nm	lbf. ft	Nm	lbf. ft
Loader Lift Cylinder/	705–855	520–630	670–830	500–600
Loader Bucket Cylinder	705–855	520–630	Wired Gland	Wired Gland
Backhoe Lift Cylinder	1930–2075	1425–1530	670–830	500–600
Backhoe Crowd Cylinder	1930–2075	1425–1530	670–830	500–600
Backhoe Bucket Cylinder	1430–1570	1050–1150	670–830	500–600
Extendible Dipper Cylinder	705–855	520–630	Wired Gland	Wired Gland
Sideshift Stabiliser Cylinder	705–855	520–630	Wired Gland	Wired Gland
Centre Pivot Stabiliser Cylinder	1430–1570	1050–1150	670–830	500–600
Swing Cylinder	1430–1575	1050–1150	670–830	500–600

TORQUES Continued



1



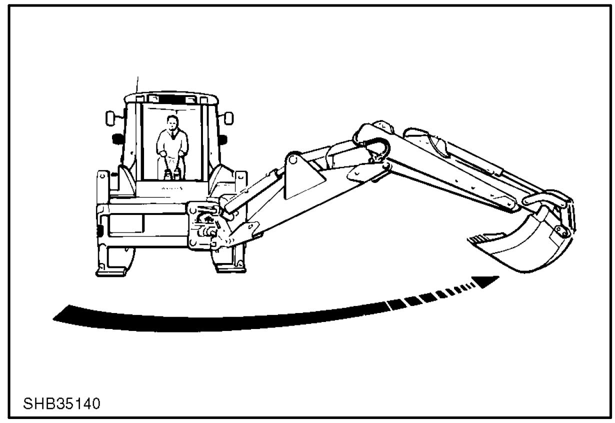
2

SPECIAL TOOLS

Tool No.	Application
297190 (Peg wrench)	Backhoe Lift Cylinder Gland
297190 (Peg wrench)	Backhoe Crowd Cylinder Gland
297191 (Peg wrench)	Backhoe Bucket Cylinder Gland
297191 (Peg wrench)	Swing Cylinder Gland
297191 (Peg wrench)	Loader Lift Cylinder Gland
297192 (Peg wrench)	Centre Pivot Stabiliser Cylinder Gland
297188 (“C” wrench)	Loader Bucket Cylinder Gland
297185 (“C” wrench)	Sideshift Stabiliser Cylinder Gland
297185 (“C” wrench)	Extendible Dipper Cylinder Gland

SWING SYSTEM
– DESCRIPTION AND OPERATION

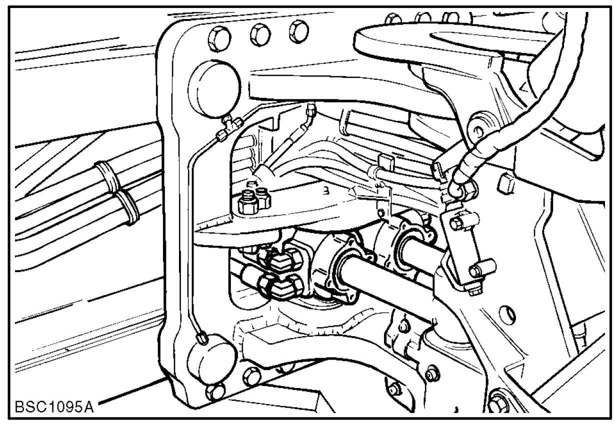
The backhoe boom and digging elements can be moved in an arc about the mainframe of 180 degrees.



3

This movement is obtained by the use of two interconnected hydraulic cylinders coupled between the mainframe and swing post.

The cylinders act directly on the swing post, without the use of any connecting links or bellcranks.

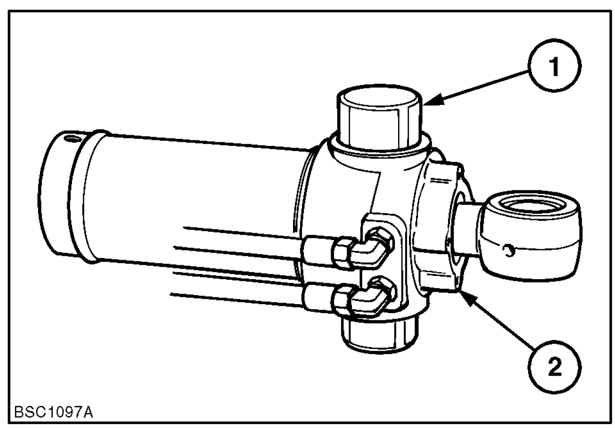


4

Each cylinder incorporates a headstock consisting of two large trunnions (1) positioned near the gland carrier (2).

As each cylinder extends or retracts and the swing post rotates, the cylinders turn in a horizontal plate, pivoting on the headstocks within the carriage.

Each cylinder is double acting and as hydraulic oil is fed to a cylinder to turn the swing post, one cylinder pushes and the other cylinder pulls to perform the swing cycle.



5

Hydraulic Oil Flow through Swing System

Hydraulic feed to the swing cylinders is controlled by the swing section of the backhoe control valve which contains pilot operated relief valves with anti cavitation feature to protect the circuit and cylinders should an overload condition occur.

Figure 156 illustrates operation of the swing circuit when retracting the right hand cylinder (4) and extending the left hand cylinder (5) in order to swing the backhoe to the right.

When swinging the backhoe to the left the oil flows are reversed and exactly the same principal of operation applies.

Oil flow for a right hand swing is as follows:–

When the swing control is operated the control valve directs oil flow to the rod end of the right hand cylinder. The flow of oil at pump pressure lifts the one way restrictor (2) of its seat allowing the flow to continue unrestricted to the inlet port of the piston end of the left hand cylinder.

System pressure increases causing the right hand cylinder to retract and the left hand cylinder to extend.

As the cylinders move, displaced oil on the piston side of the left hand cylinder flows towards the one way restrictor (7) in the inlet port on the rod end of the right hand cylinder.

The oil flow moves the restrictor to the restrict position which limits the flow of oil and creates a back pressure (1st stage restricted return oil) in the right hand cylinder.

The restricted flow of oil passes through restrictor (7) into the rod end of the left hand cylinder before returning to the control valve and back to reservoir.

The spool in the swing control valve assembly (1) is designed such that during operation oil can flow freely through the port directing oil flow to the swing cylinders but restricts the flow returning oil back to reservoir.

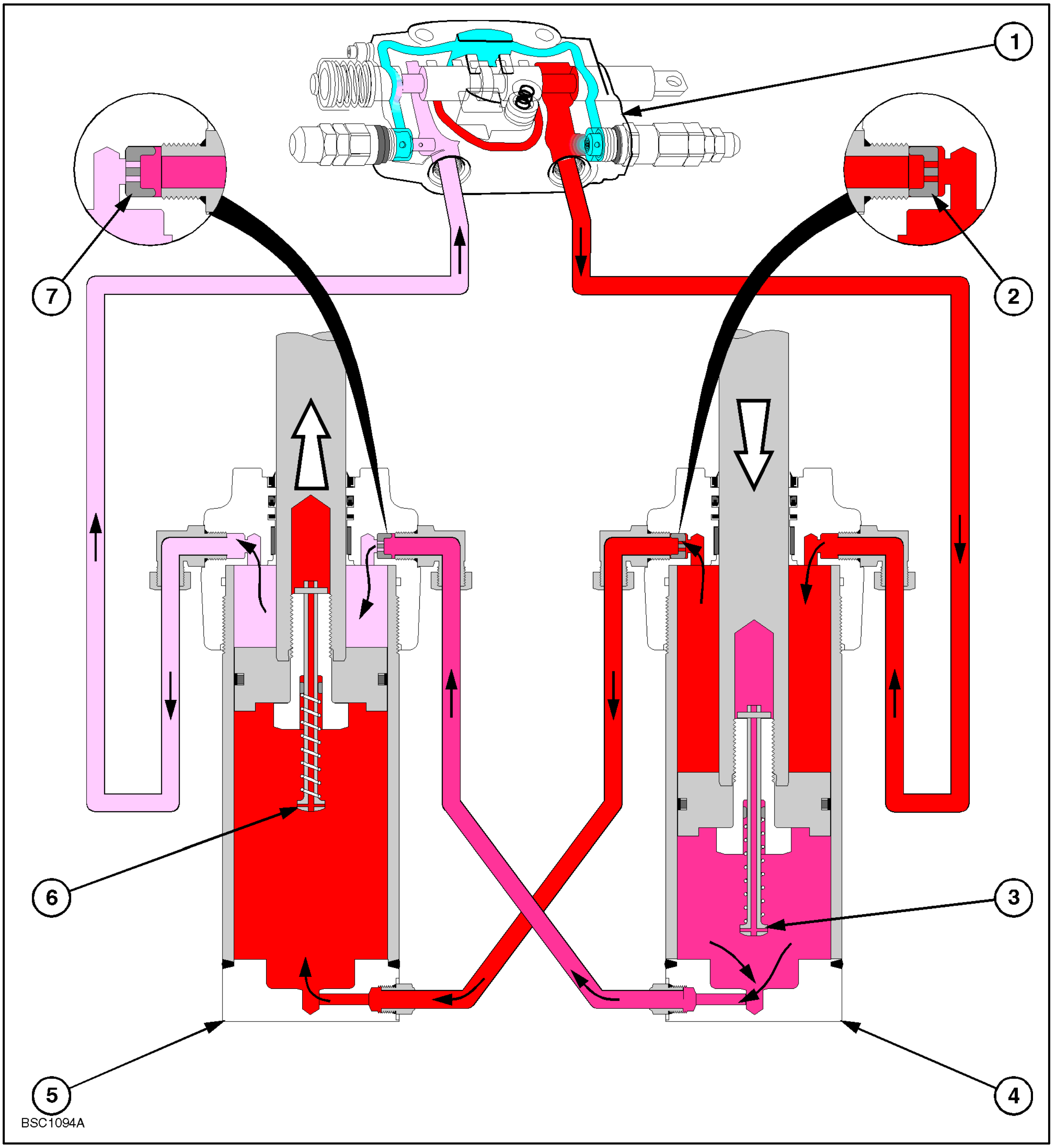
This restriction is achieved using metering lands machined into the lands of the spool and creates a secondary back pressure (2nd Stage Restricted Return Oil) in the rod end of the cylinder.

By allowing oil to flow unrestricted to the power side of the cylinder and be restricted on the exhaust side a smooth controlled swing of the backhoe at optimum speed is achieved.

When the swing system reaches the last 20–25° of travel the sliding restrictor in the end of the piston rod touches the outlet port in the cylinder barrel. This further restricts the flow of oil exhausted from the cylinder and as the piston moves towards the end of its stroke the sliding restrictor is gently pushed down the centre of the cylinder rod allowing a progressive and controlled halt to the swing cycle.

If the swing control valve is suddenly returned to neutral mid–way through a full power swing the supply and exhaust ports in the main control valve are totally blocked.

The momentum of the swinging backhoe assembly if not controlled will make the machine extremely unstable. To prevent this from occurring the circuit relief valves operate and dumps oil to exhaust until the excess pressure is relieved. When the relief valve operates the cylinder rod will move and a void will be created in the low pressure side of the cylinder. The anti–cavitation feature in the relief valves prevent the void from occurring by transferring exhaust oil from the excess pressure side of the circuit to the low pressure side. For further details on the operation of the anti–cavitation circuit relief valves refer to Circuit Relief Valves Principle of Operation in Chapter 1.



6

Swing Cylinder Operation – Right Hand Swing

Pump Pressure Oil

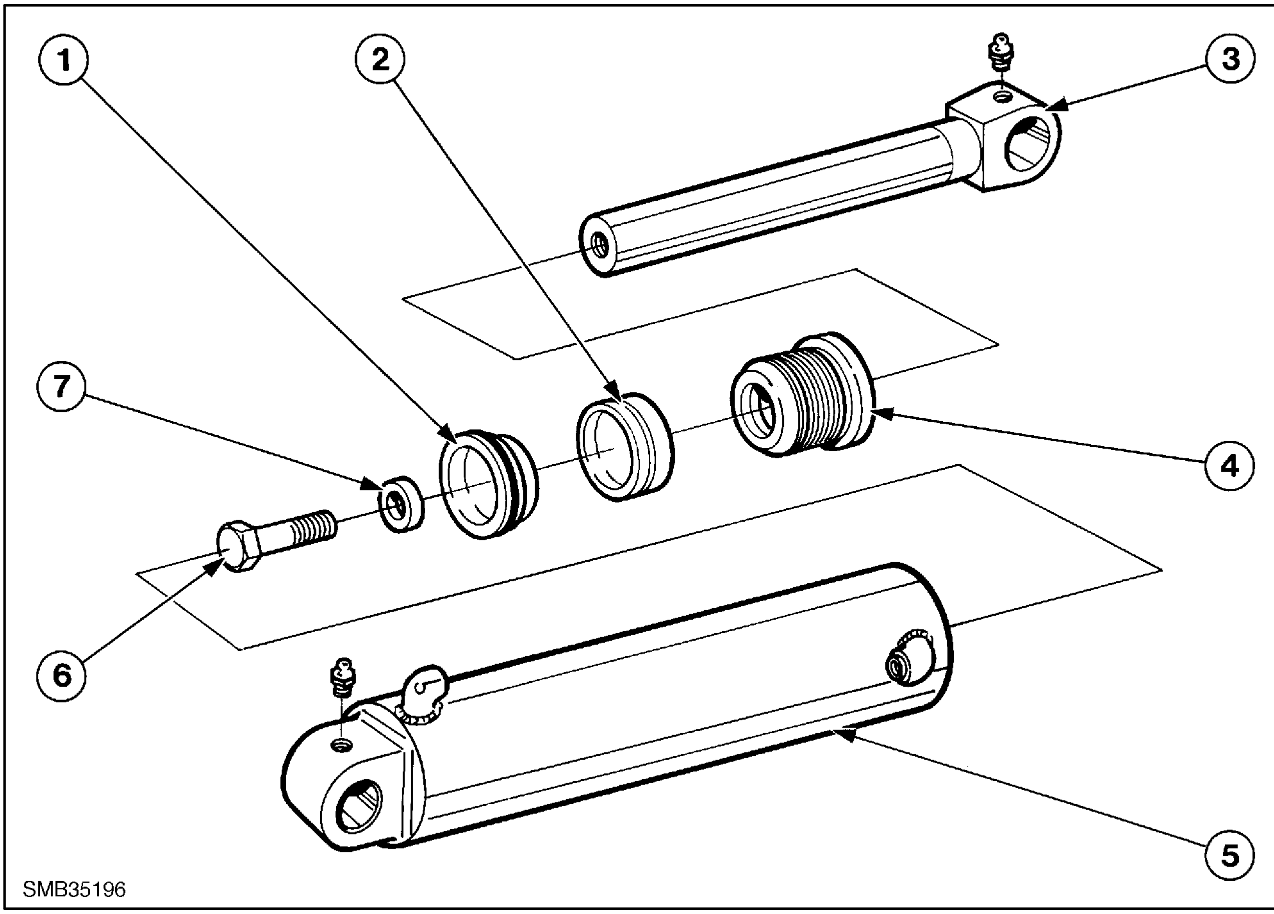
2nd Stage Restricted Return Oil

1st Stage Restricted Return Oil

Return to Reservoir Oil

1. Control Valve Swing Section
2. One Way Restrictor
3. Cushioning Rod
4. Right Hand Cylinder
5. Left Hand Cylinder
6. Cushioning Rod
7. One Way Restrictor

HYDRAULIC CYLINDERS
– DESCRIPTION AND OPERATION



7

Typical Double Acting Cylinder Assembly (Backhoe Lift Cylinder Shown)

1. Decelerator*
2. Piston
3. Rod
4. Gland Assembly
5. Barrel
6. Piston Bolt
7. Washer *

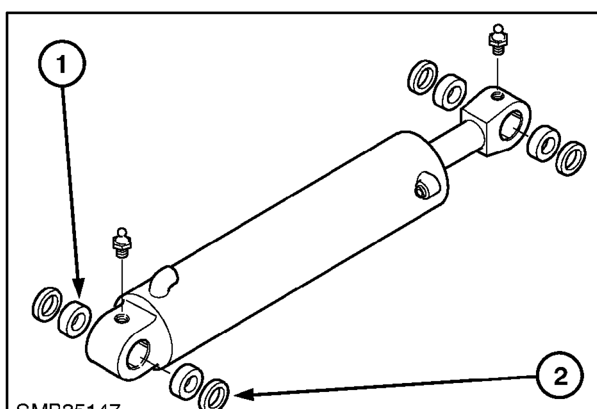
*Only Fitted on specific cylinders refer to Figure 161 for further details.

All cylinders with the exception of the sideshift backhoe clamp cylinders are double acting, designed to extend and retract under hydraulic pressure.

The decelerator installed in the backhoe lift cylinder, restricts flow from the cylinder to act as a cushioning device when the cylinder is fully retracted.

The piston component and type of gland differs according to application and are further described on the following pages.

The grease retention seals (2), are only fitted to the backhoe cylinders and the combination of barrel and rod bushings (1) differs according to cylinder application. Refer to the spare parts catalogue for further details.



8

Cylinder Glands

Rod sealing on all cylinders is achieved using a a “snap-in” polyurethane “U” cup seal facing the internal pressure and positioned in a machined groove in the cylinder gland.

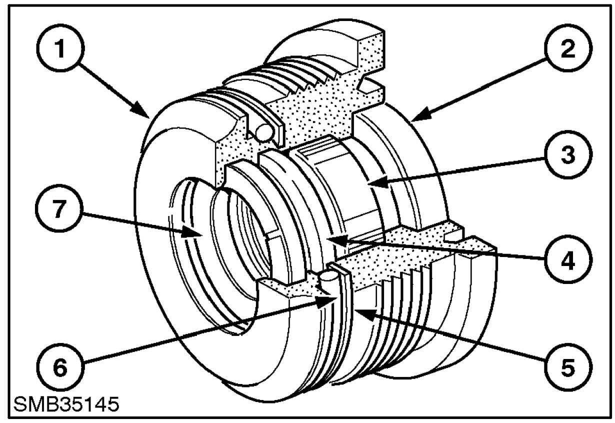
A loose fitting polyurethane buffer seal is fitted in a groove immediately in front of the “U” seal and protects the seal during operating pressures. A single small groove moulded across the face of one side of the buffer seal and positioned facing the pressure side of the cylinder permits the escape of oil from between the buffer and “U” seal during cylinder retraction to prevent ballooning and leaking of the seals.

To prevent the entrance of foreign material to the cylinders, a wiper seal is positioned in the outer edge of the gland.

The cylinder gland is attached to the cylinder barrel using either a threaded or wired method of retention.

The threaded gland is used on:–

Swing Cylinders
Backhoe Lift Cylinder
Bucket Crowd Cylinder
Backhoe Bucket Cylinder
Loader Lift Cylinder
Centre Pivot Stabiliser Cylinder



9

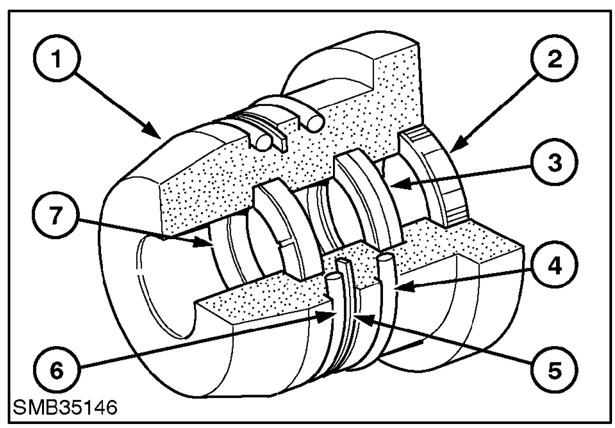
Threaded Type Gland Assembly

1. Gland
2. Wiper Seal
3. Rod Bearing Sleeve
4. ‘U’ Seal
5. Back-up Ring
6. O’ Ring
7. Buffer Seal

The wire retained gland uses a locking wire which is fed into a mating semicircular annuli machined into the barrel and gland. Installation of this locking wire is achieved by rotating the gland within the barrel while feeding the wire into the groove at the same time. A short piece of wire is left exposed on the cylinder barrel outer surface, to be pulled while the gland is counter-rotated during removal of the gland.

The wire retained gland is used on:–

Loader Bucket Cylinder
Sideshift Stabiliser Cylinder
Extendible Dipper Cylinder.

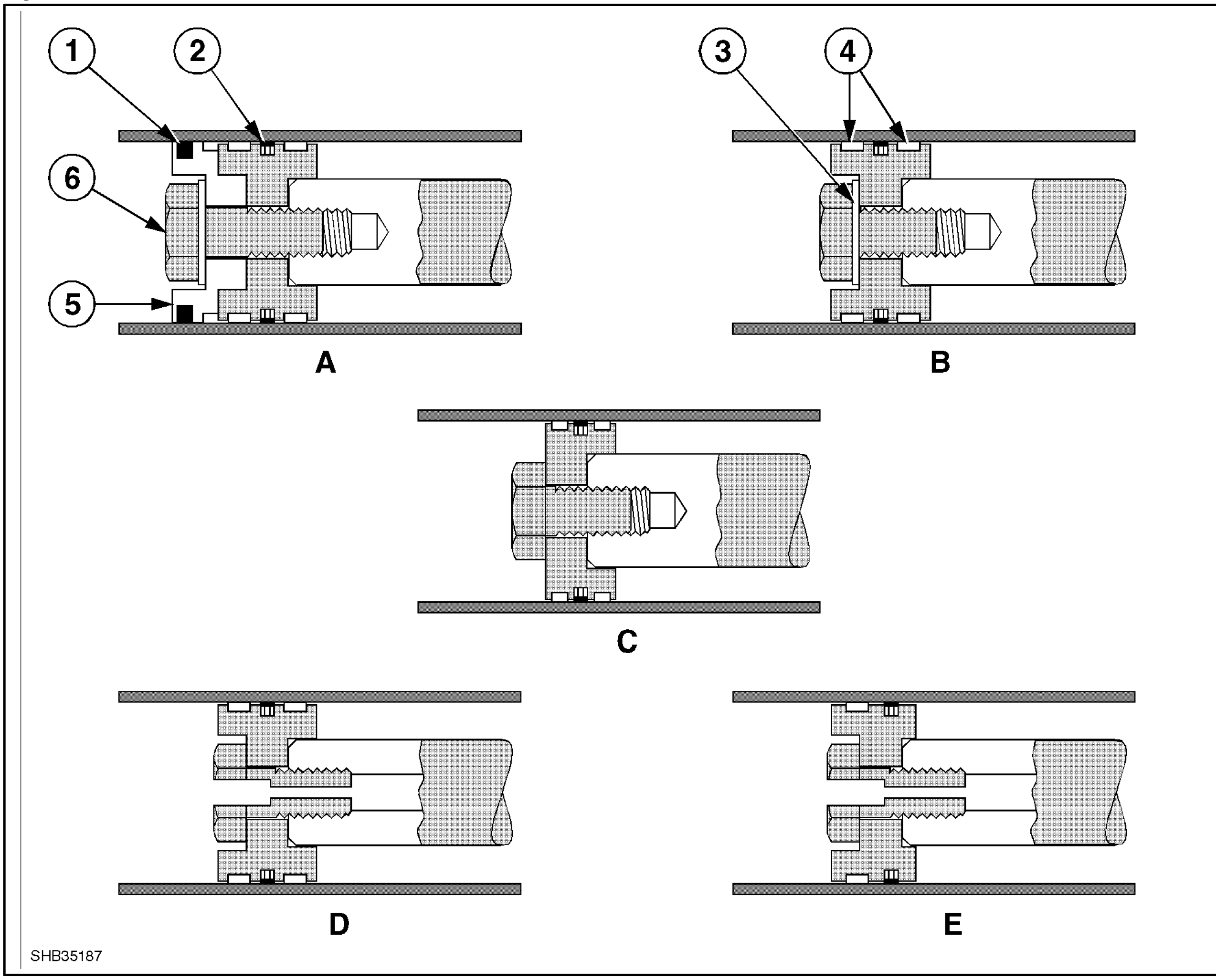


10

Wired Type Gland Assembly

1. Gland
2. Wiper Seal
3. ‘U’ Seal
4. Locking Wire
5. Back-up Ring
6. ’O’ Ring Seal
7. Buffer Seal

Cylinder Pistons



11

Hydraulic Cylinder Piston design and Application

1. Decelerator Ring
2. Piston Seals
3. Washer
4. Nylon Bonded Coated Bearing
5. Decelerator
6. Bolt

All cylinder pistons utilize a one piece leaded steel piston with either one or two glass filled nylon bonded coating bearings on the outer diameter to prevent metal-to-metal contact with the cylinder barrel. The piston bearings are not serviced separately, if damaged the piston must be replaced.

Piston sealing is accomplished using two ring seals positioned on top of each other. The bottom, or inner seal, is soft rubber and has pre-determined side play within the ring groove. When the cylinder is pressured, oil acts on the seal and expands it against the outer, rigid, glass-filled PTFE seal, forcing it outward against the barrel wall and against the piston groove, ensuring efficient sealing with minimum friction.

Figure 161 illustrates the various pistons used together with the appropriate method of attaching the piston to the cylinder rod.

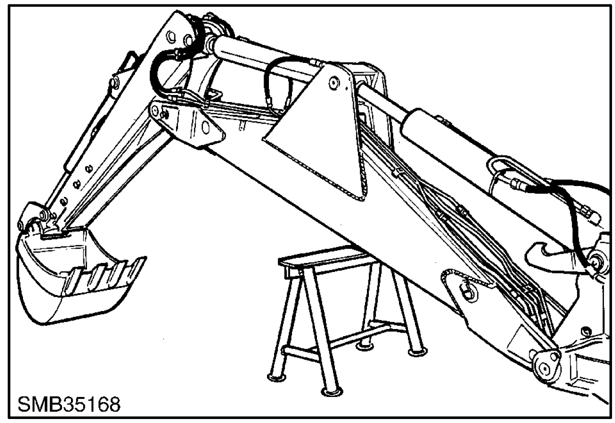
Piston Design	Cylinder
A	Backhoe Lift
B	Backhoe Crowd
C	Backhoe Bucket
D	Loader Bucket Loader Lift Extendible Dipper Sideshift Stabiliser Centre Pivot Stabiliser
E	Backhoe Swing

CYLINDER REMOVAL AND INSTALLATION

Backhoe Lift, Crowd And Bucket Cylinders

The principal of cylinder removal is similar for all three backhoe cylinders

1. Park the machine on a level, firm surface and position the backhoe on the ground. Support the backhoe elements for cylinder removal using a suitable stand.

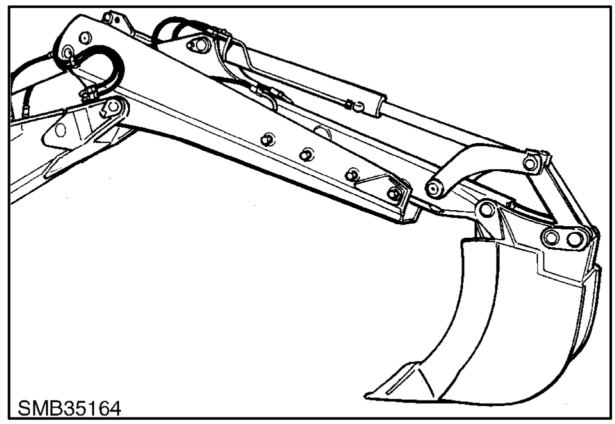


12

WARNING

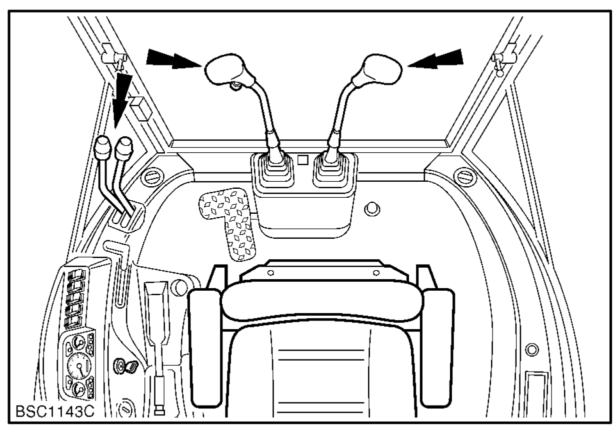
Always support the structural members so that they will be stable and safe to work around.

2. If the bucket cylinder is to be removed ensure the bucket is firmly positioned on the ground.



13

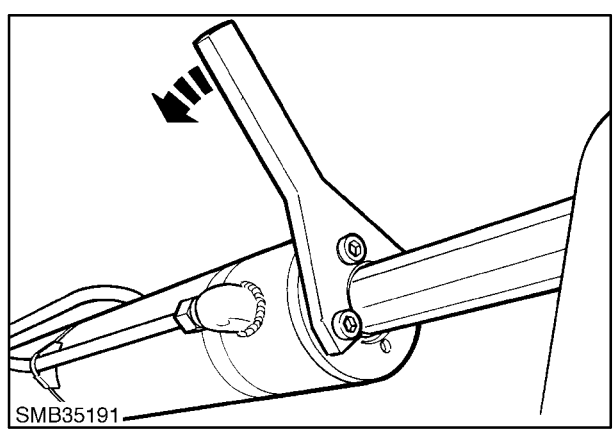
3. Stop the engine and move the backhoe control levers through all operating positions to relieve all residual pressures in the system.



14

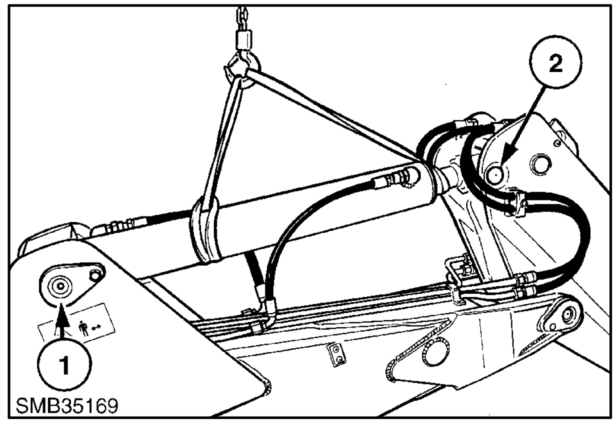
4. If the cylinder is to be disassembled following removal loosen the cylinder gland approximately 1/4 of a turn using the special peg wrench listed under special tools on Page 1. **DO Not** completely unscrew the gland. This operation will assist in removing the gland during subsequent cylinder disassembly.

   If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.



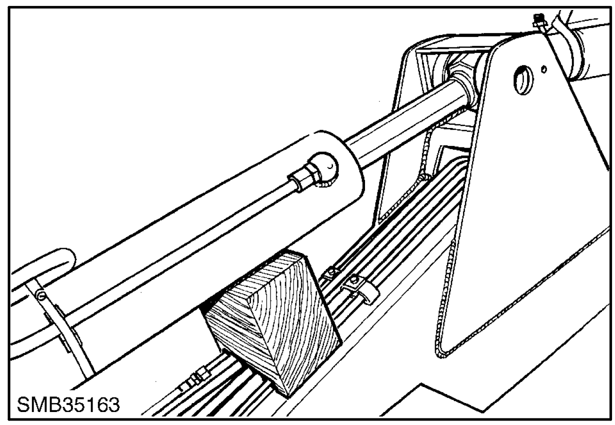
15

5. Position a sling or other suitable lifting equipment around the cylinder to be removed.
6. Remove the cylinder rod end pivot pin (2) and if necessary use hydraulic power to very slowly retract the cylinder so that the rod comes clear of the attaching point.



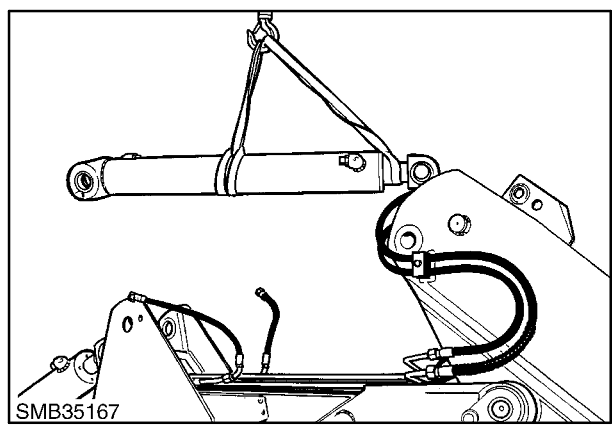
16

NOTE: *The rod end of the crowd cylinder and piston end of the lift cylinder use a common attaching pin. When either cylinder is being removed, the other cylinder must be securely supported and the dipstick positioned in such a way that no movement is possible.*



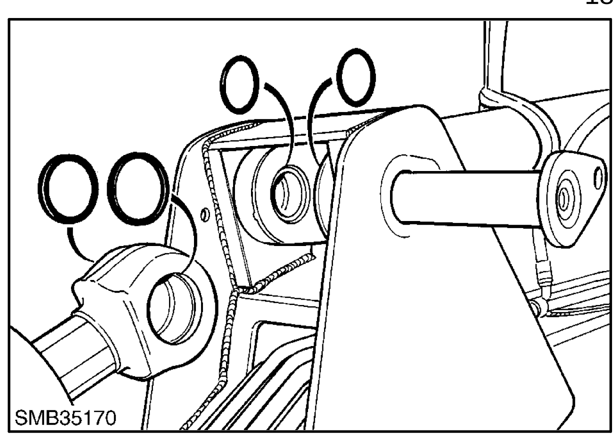
17

7. Disconnect the hydraulic connections to the cylinder ports and cap or plug all openings.
8. Remove the cylinder pivot barrel pivot pin (1) and remove the cylinder.
9. Drive the attaching pins from the cylinder using a brass drift and hammer. Accurate positioning of the cylinder prior to hose disconnection will aid pin removal.
10. Remove the cylinder, drain the contained oil and recap the openings.



18

11. Installation follows the removal procedure in reverse.
12. If necessary carefully use hydraulic power to extend or retract cylinder and align cylinder for pivot pin installation.
13. During installation ensure the grease retention seals are correctly fitted.
14. Grease the pivot points with the specified grease.



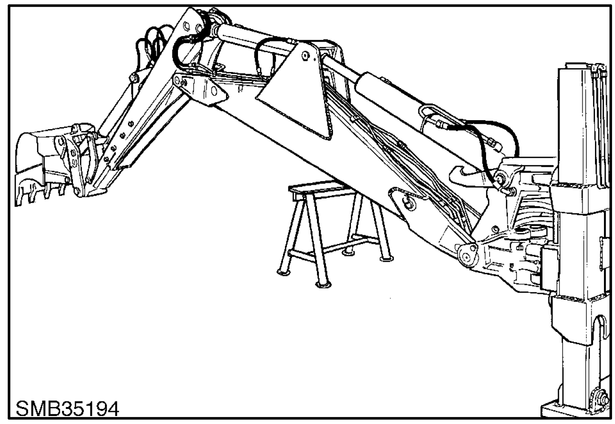
19

Extendible Dipstick Cylinder

1. Park machine on a firm level surface and extend dipper sufficiently to gain access to the cylinder rod end pivot pin and position backhoe backhoe as shown. Support the backhoe elements for cylinder removal using a suitable stand.

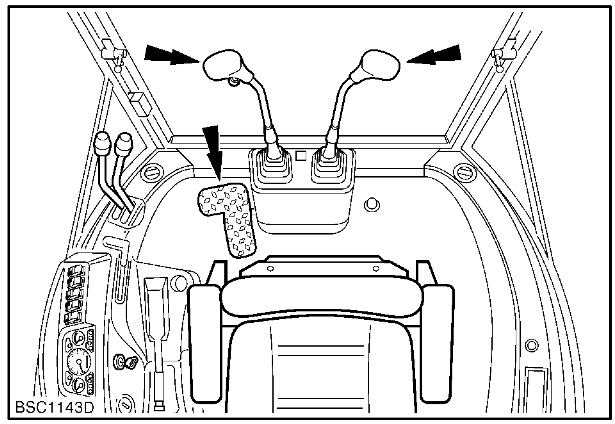
WARNING

Always support the structural members so that they will be stable and safe to work around.



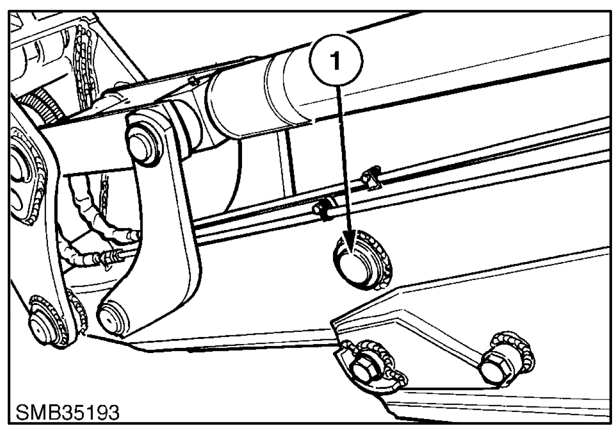
20

2. Stop the engine and move the backhoe control levers and extendible dipper control pedal through all operating positions to relieve all residual pressures in the system.



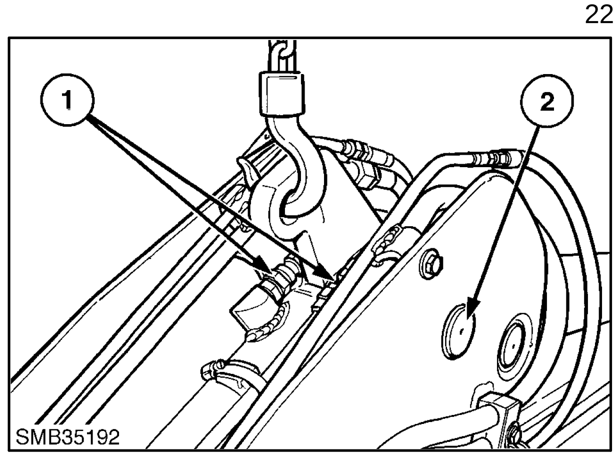
21

3. Remove pivot pin (1) from dipper using a suitable drift.



22

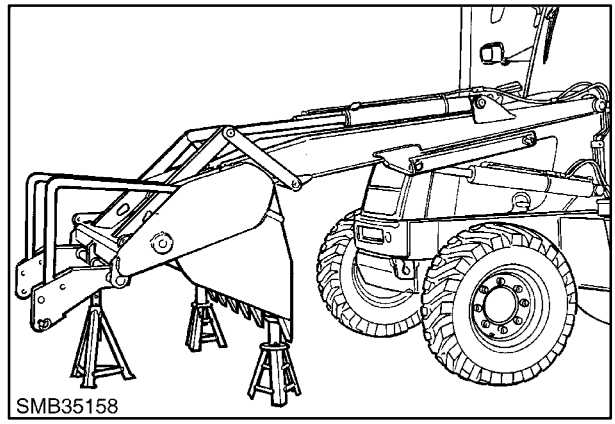
4. Disconnect hydraulic connections (1), at dipper cylinder and support cylinder using suitable hoist.
5. Remove pivot pin (2) at top of cylinder and carefully withdraw cylinder.
6. Installation follows removal procedure in reverse. Use an additional strap around the barrel of the cylinder to hold the cylinder in position when installing the lower pivot pin.
7. If necessary carefully extend or retract the cylinder using hydraulic power to align cylinder for pivot pin installation.



23

Loader Lift Cylinder

1. Park machine on a firm level surface and position the bucket as for bucket dump.
2. Raise the loader sufficiently to allow the lift cylinder pivot pin to be removed and using axle stands securely support the front and rear of bucket to prevent the loader arms lowering when the cylinder is disconnected

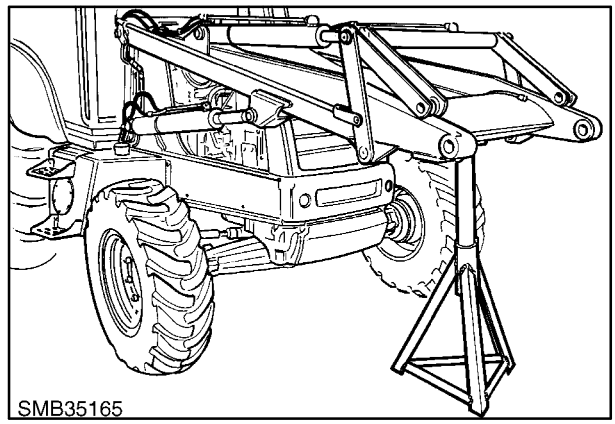


24

IMPORTANT: *If the bucket cannot be safely supported it must be removed and the loader arms supported using a suitable stand or hoist.*

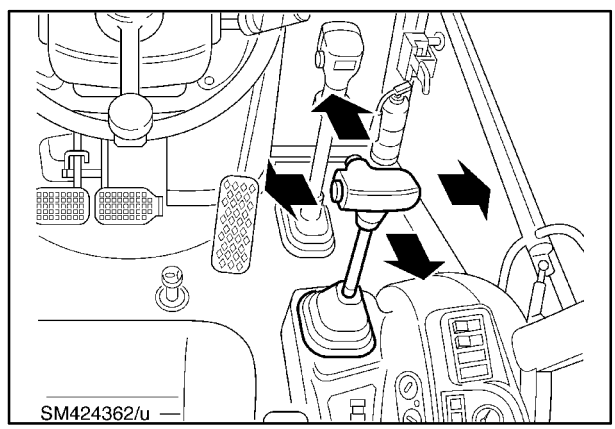
WARNING

Always ensure loader is fully supported. **Do Not** work under or near an unsupported loader or personal injury may occur



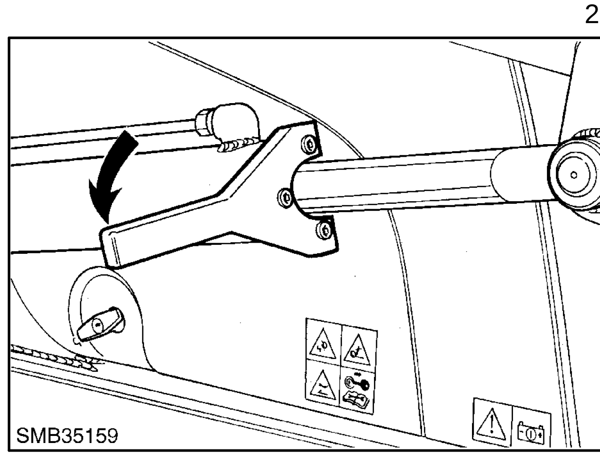
25

3. Relieve the residual pressure in the system by moving the loader control lever through all operating positions and recheck loader is fully supported.



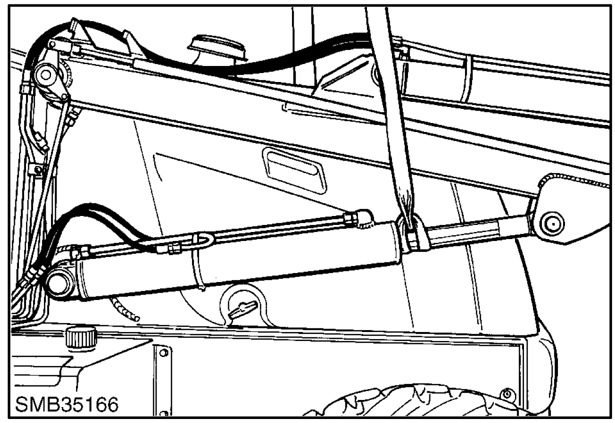
26

4. If cylinder is to be overhauled use peg wrench 297191 to loosen cylinder gland by approximately $^1/_4$ of a turn and break the thread seal. **Do Not** completely unscrew the gland.
5. If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.



27

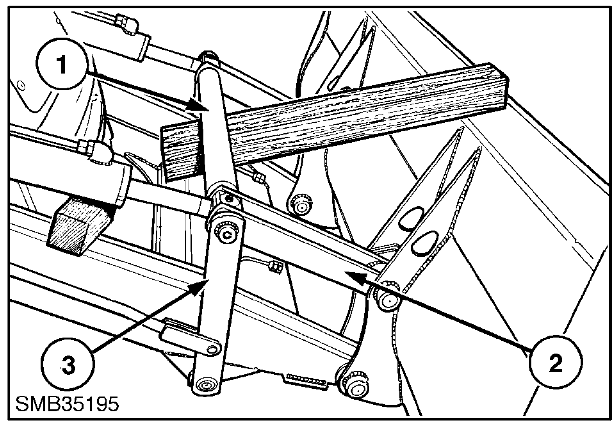
6. Support the cylinder using sling and suitable hoist.
7. Disconnect the hydraulic hoses. Cap or plug all exposed openings.
8. Remove cylinder rod end retaining pin and lower cylinder from pivot point.
9. Remove the snap ring and washer from the cylinder barrel pivot point and remove cylinder.
10. Installation follows removal procedure in reverse.



28

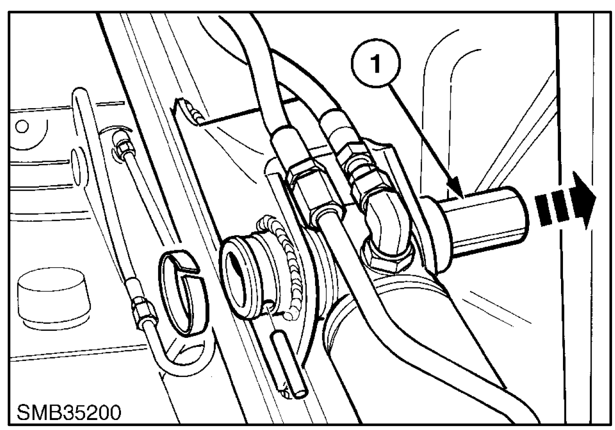
Loader Bucket Cylinder

1. Position loader bucket firmly on the ground and position a suitable support below the bucket cylinder tie rod (1).
2. Use a suitable block to support the cylinder remove idler (2) and tipping link (3).



29

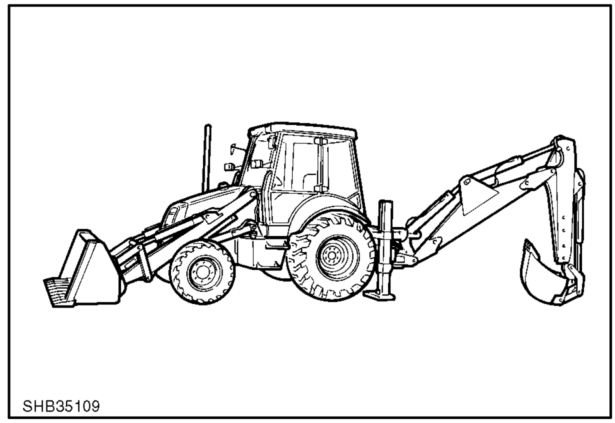
3. Remove engine side cover and withdraw cylinder barrel pivot pin (1).
4. Remove the cylinder.
5. Installation follows removal procedure in reverse. If necessary carefully use hydraulic power to extend or retract cylinder to align cylinder for pivot pin installation.



30

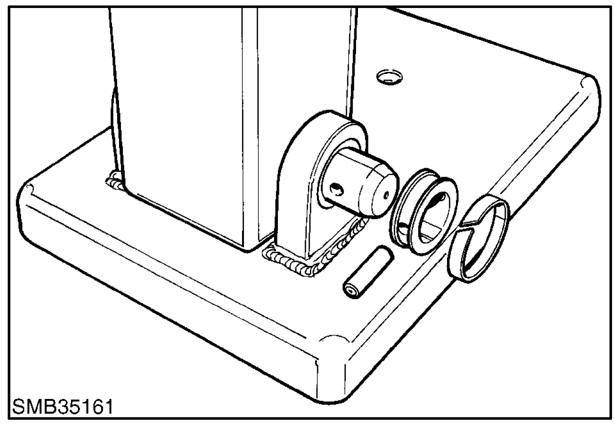
Stabiliser Cylinder - Side Shift

1. Position the unit on a hard level surface and rest the digging elements on the ground in a safe position.



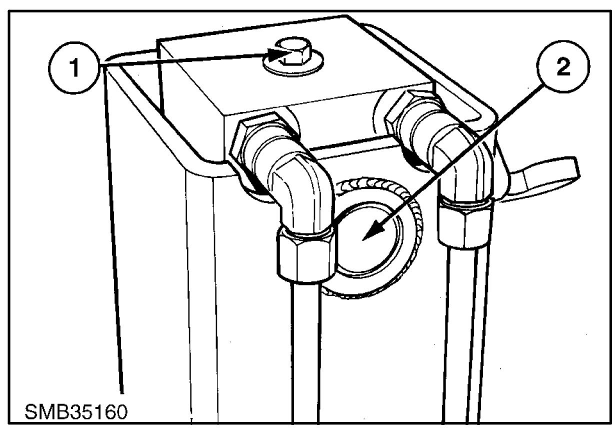
31

2. Remove the stabiliser pad. Lower the stabiliser to the ground and with the engine stopped, relieve residual pressures.
3. Disconnect the hydraulic feed tubes at the top of the stabiliser leg



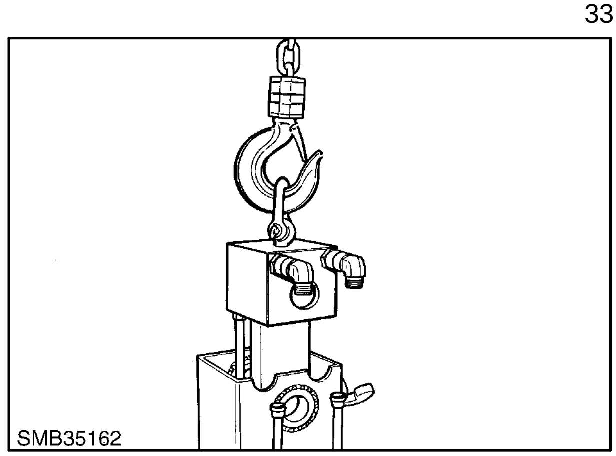
32

4. Remove the cylinder pin locking bolt (1).
5. Fit a $^{1}/_{2}$ inch–13 x 1.50 threaded eye bolt and shackle in the threaded hole on the top of the cylinder. Ensure that the threaded portion of the eye bolt does not screw into the waisted section of the locating pin (2)



33

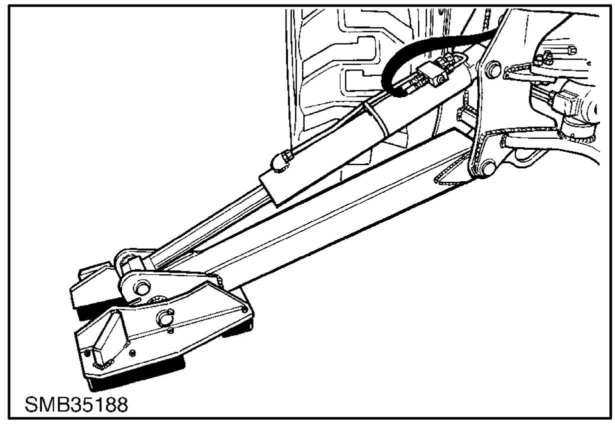
6. Drive out the locating pin and lift the cylinder from the casing.
7. Installation follows removal procedure in reverse. Tighten locking bolt to a torque of 108–130 Nm (80–96 lbf ft).



34

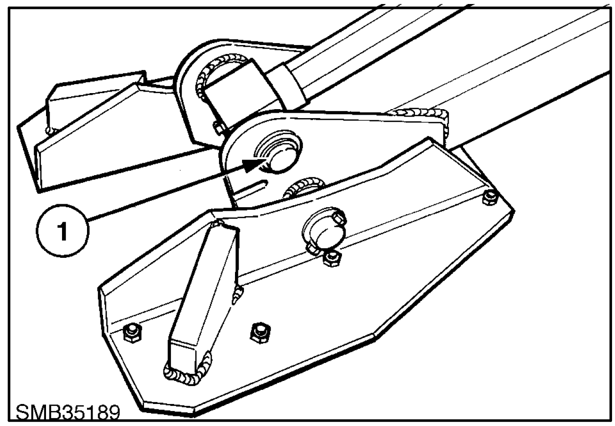
Stabiliser Cylinder - Center Pivot

1. Ensure the backhoe is locked in the transport position or positioned on the ground in a safe working position.
2. Lower the stabilisers to the ground



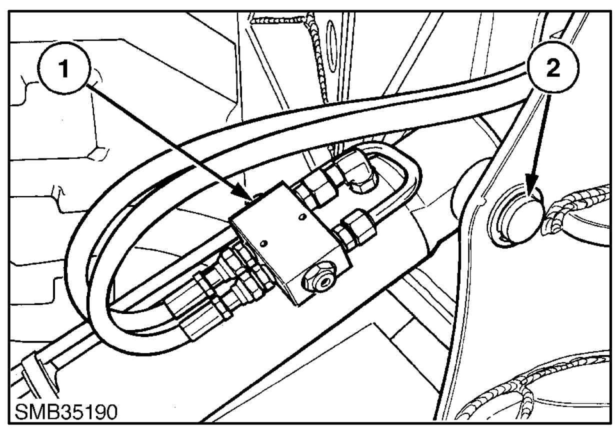
35

3. If cylinder is to be overhauled after removal use peg wrench 297192 to loosen cylinder gland nut.
4. Securely support the cylinder using a suitable strap and hoist.
5. Remove the cylinder rod end pivot pin (1) and using hydraulic power very slowly retract the cylinder.
6. With the engine stopped, relieve any residual pressures by moving the stabiliser control levers.



36

7. Disconnect and cap the hydraulic hoses at the lock valve (1).
8. Remove the cylinder barrel pivot pin (2) and remove cylinder.



37

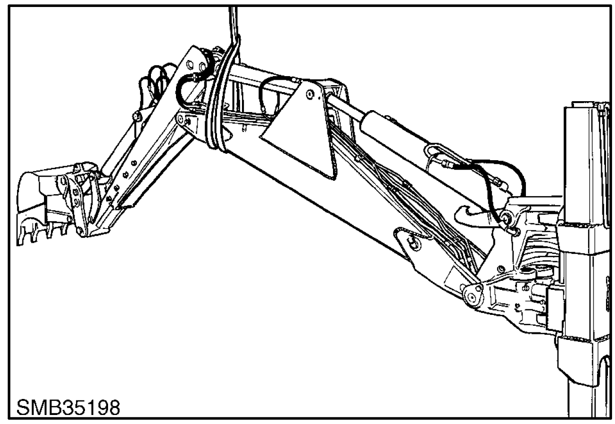
Sideshift Clamp Cylinder

***IMPORTANT:** The following procedure describes overhaul of the clamp cylinders without removing the boom and dipper from the carriage. If the workshop does not have adequate lifting equipment to securely support both the bakhoe assembly and carriage the boom and dipper must be removed before attempting to separate the carriage from the frame. See Section 84.*

1. Park the machine on a level, firm surface. Position the carriage in the centre of the machine and the backhoe on the ground.
2. Support the backhoe elements using a suitable stand and hoist capable of carrying 1500 Kg.

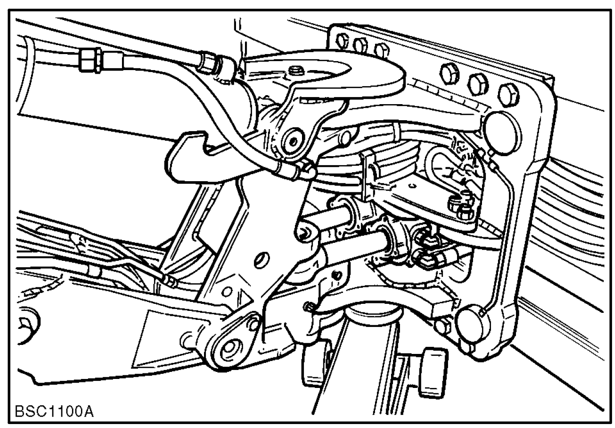
WARNING

Always support the structural members so that they will be stable and safe to work around.



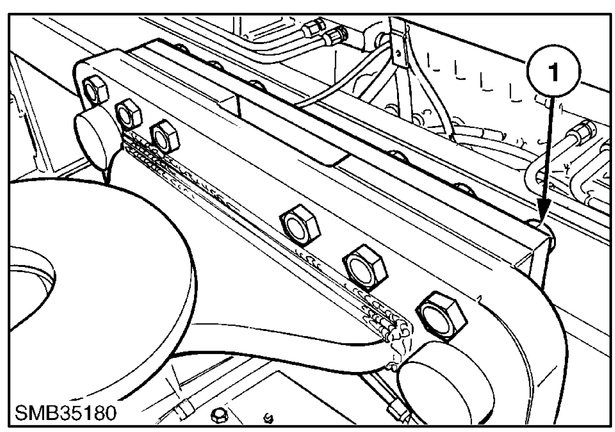
38

3. Position a trolley jack beneath the carriage.



39

4. Remove the 6 clamp bolts on the bottom of the carriage followed by the 6 bolts (1) on top of the carriage.



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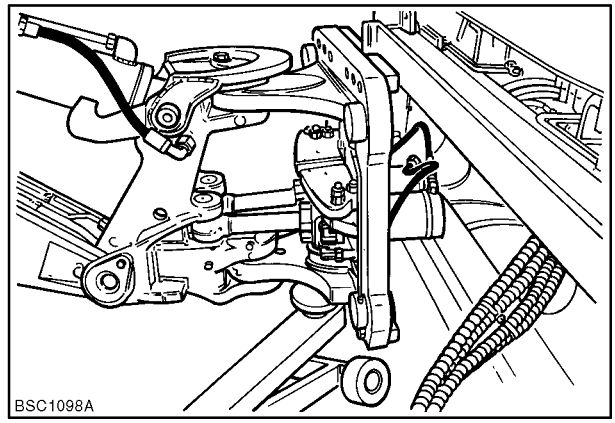
5. Use the trolley jack to raise the carriage from the frame and **carefully** move the machine forward sufficiently to allow access to the clamp cylinders. Do not allow the hydraulic hoses to be stretched when moving the machine forward.

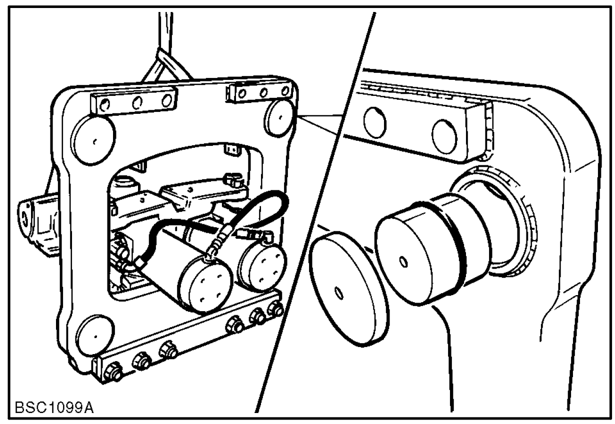
WARNING

Before moving machine forward check that backhoe is still fully supported by the hoist and remains stable.



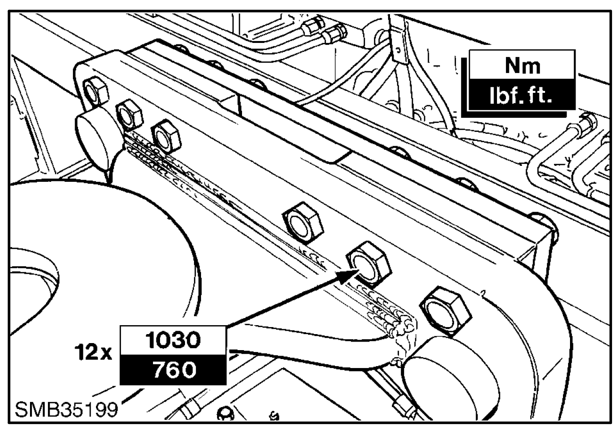
41

6. Using an M10 bolt or adaptor and slide hammer remove piston (1) from bore.
7. Replace piston seals (2) and examine cylinder bore. The cylinder is spot welded to the carriage but can be replaced if damaged.
8. Installation follows the disassembly procedure in reverse. When installing carriage onto frame ensure piston cups (3) are fitted.



42

9. Torque all carriage clamp bolts to a torque of 1030 Nm (760 lbf ft).



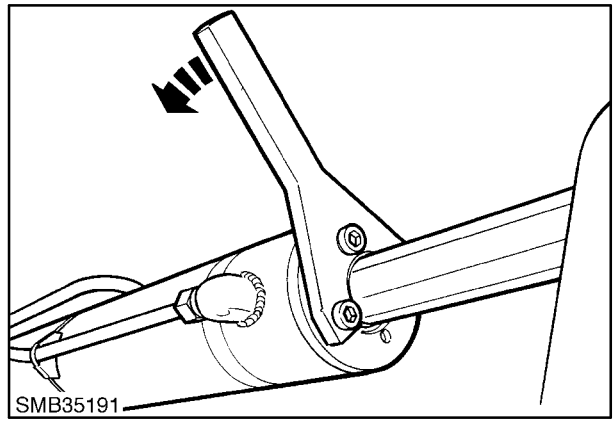
43

CYLINDER OVERHAUL

Backhoe and Loader Cylinders

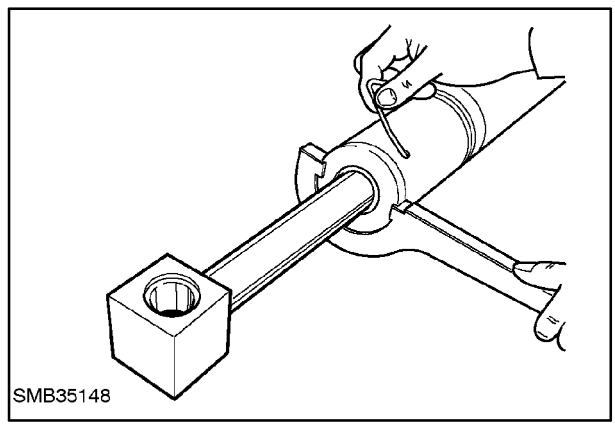
1. Thoroughly drain oil from cylinder. Cap the ports and thoroughly clean the exterior so that the internal parts will not become contaminated.
2. Using the correct wrench as detailed on Page 1 remove the cylinder gland.

NOTE: *A high torque is required to loosen the threaded type gland, It is therefore recommended that the attaching points on the machine are used to secure the cylinder when loosening the gland as described in cylinder removal*



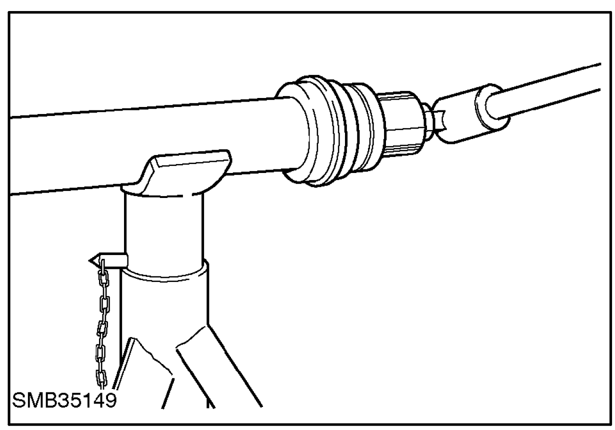
44

3. If the gland is the wired type rotate rotate the gland and withdraw the locking wire.

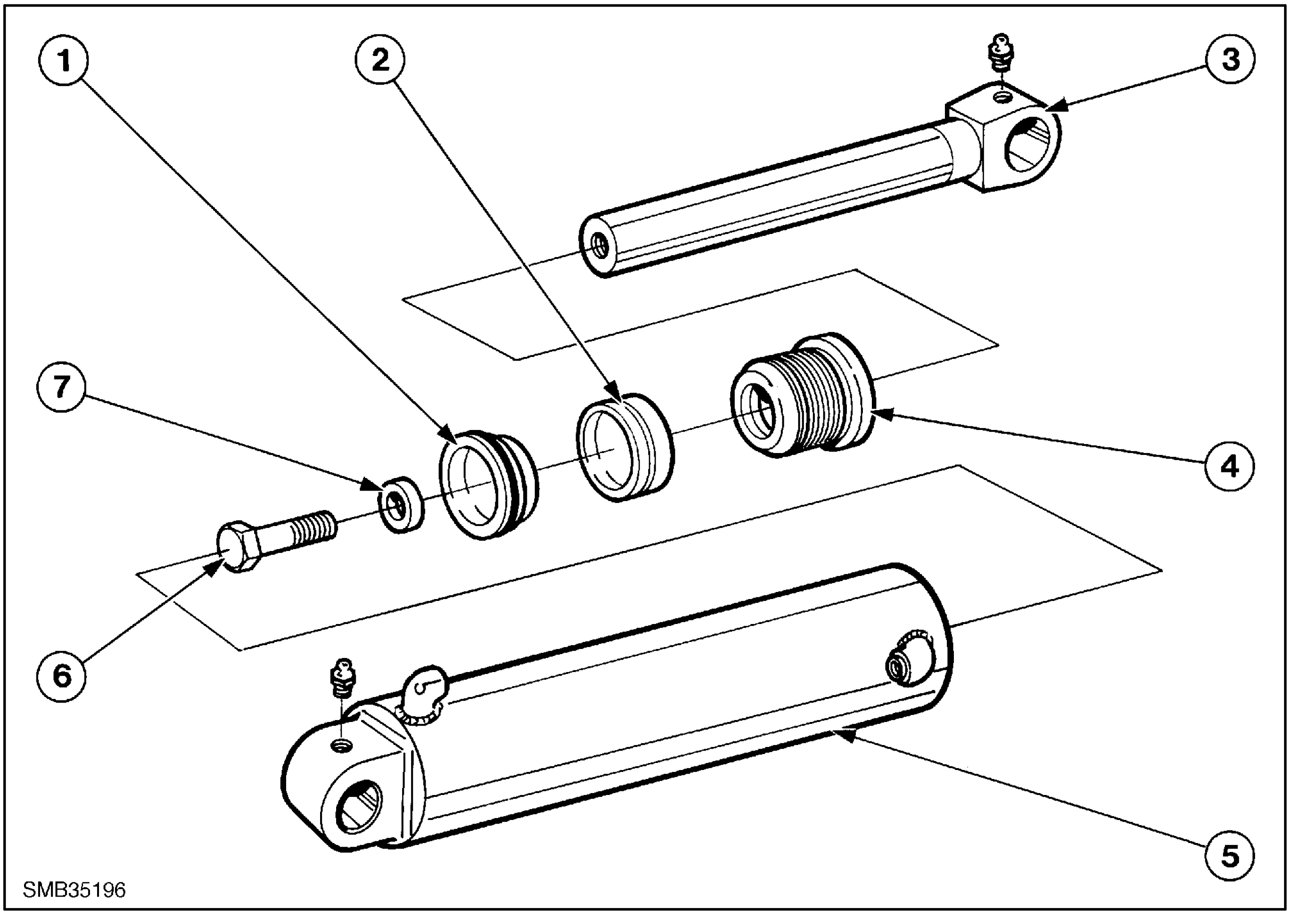


45

4. Pull the cylinder rod gland and piston assembly from the barrel.
5. Secure the cylinder rod trunnion in a vice or preferably secure to the cylinder anchor point on the machine and using a high quality socket and drive system unscrew the piston retaining bolt. A considerable torque may be required to loosen the bolt.



46



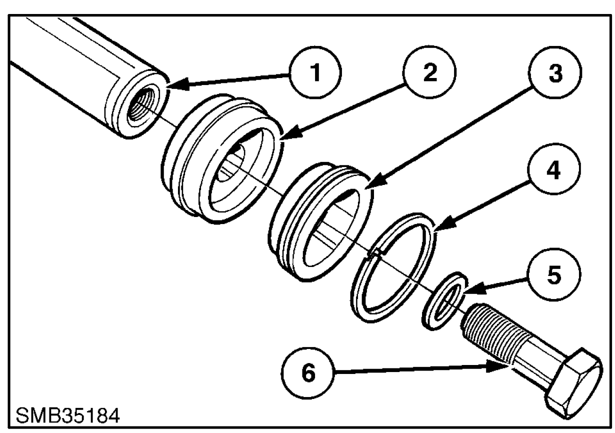
47

Typical Double Acting Cylinder Assembly
(Backhoe Lift Cylinder Shown)

1. Decelerator*
2. Piston
3. Rod
4. Gland Assembly
5. Barrel
6. Piston Bolt
7. Washer *

*Only Fitted on specific cylinders refer to Figure 161 for further details.

6. Separate piston components. The piston design and components vary according to application and reference should be made to Figure 161 on Page 8 for further details.
7. The decelerator is only installed on the backhoe lift cylinder and is assembled as shown.



48

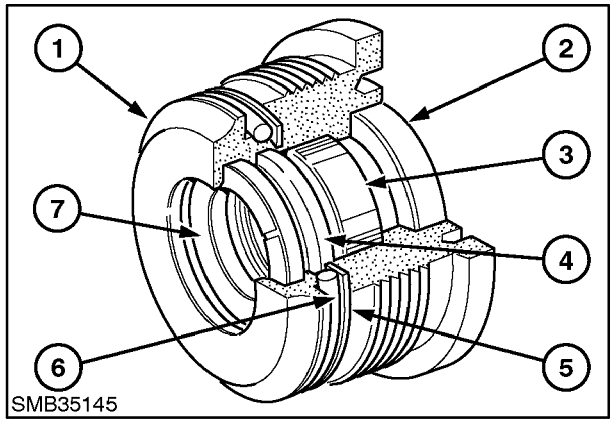
Backhoe Lift Cylinder
Piston and Decelerator Assembly

1. Cylinder Rod
2. Piston Assembly
3. Decelerator Spacer
4. Decelerator Ring
5. Washer
6. Retaining Bolt

8. Thoroughly clean all parts in an approved cleansing agent and inspect for damage.
9. Small nicks, burrs or other damage may be hidden by oil film. It is therefore essential that a thorough cleaning process be adopted.
10. Replace the gland seals.

Threaded Type Gland Assembly

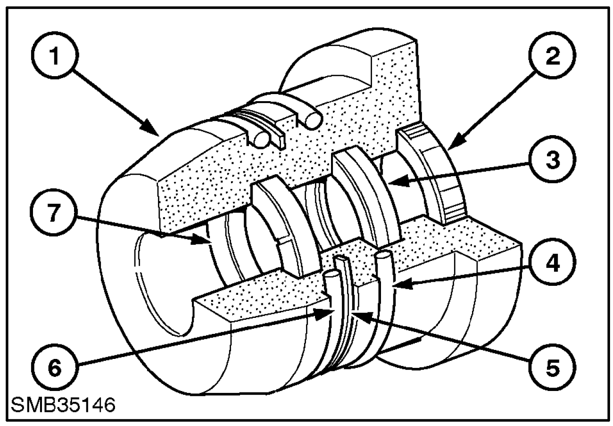
1. Gland
2. Wiper Seal
3. Rod Bearing Sleeve
4. 'U' Seal
5. Back-up Ring
6. O' Ring
7. Buffer Seal



49

Wired Type Gland Assembly

1. Gland
2. Wiper Seal
3. Buffer Seal
4. Locking Wire
5. Back-up Ring
6. 'O' ring seal
7. 'U' Seal

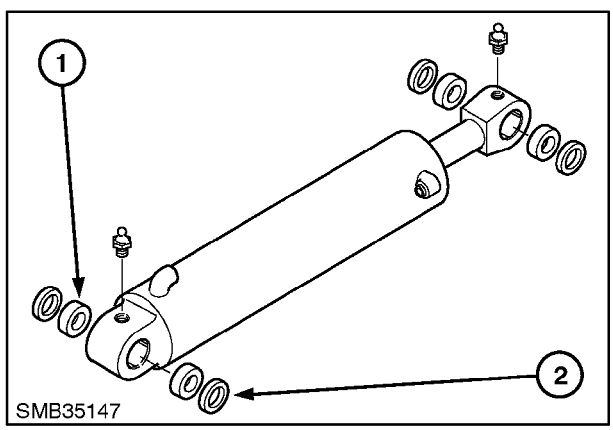


50

11. When re–assembling the gland assemblies ensure that:–

    The concave face of the back–up ring touches the 'O' ring.

    The groove moulded in the face of the buffer seal is positioned towards the cylinder barrel.
12. Inspect the piston wear rings. These rings are not removable and if damaged a new piston assembly must be installed.
13. If damage on cylinder rods cannot be repaired by buffing with a very fine abrasive a new rod should be installed.
14. Inspect cylinder bushes (1) for wear and replace seals (2).

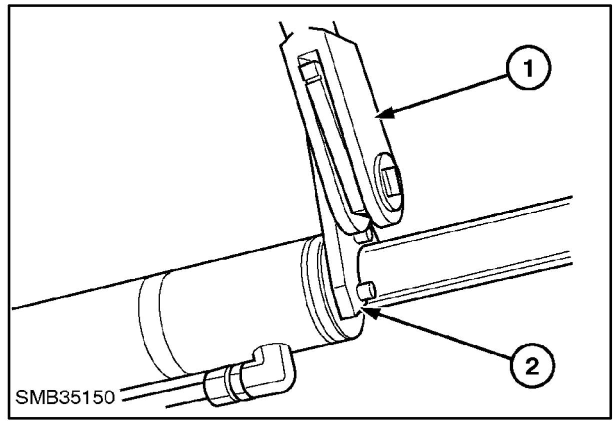


51

Re–Assembly and Installation

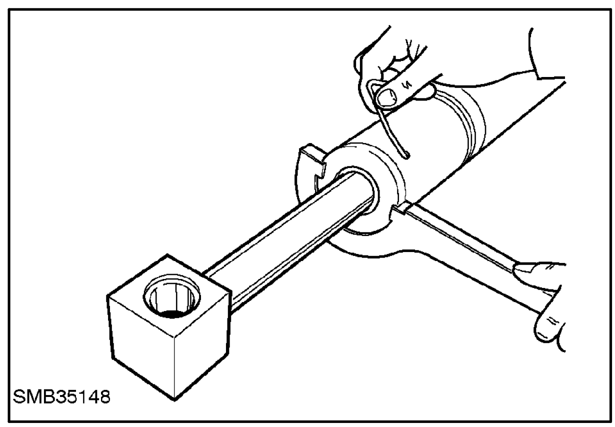
Re–assembly follows disassembly procedure in reverse while observing the following.

1. Apply 4 drops of thread seal to the piston retaining bolt before installing and tightening to specified torque.
2. Threaded Glands
   Apply 6 drops of thread seal, New Holland Part No 82995773, to the threads of the gland and tighten gland nut to the specified torque using torque meter (1) and peg wrench (2). Use a suitable vice or the attaching point on the machine to hold the cylinder pivot point while tightening the gland nut.



52

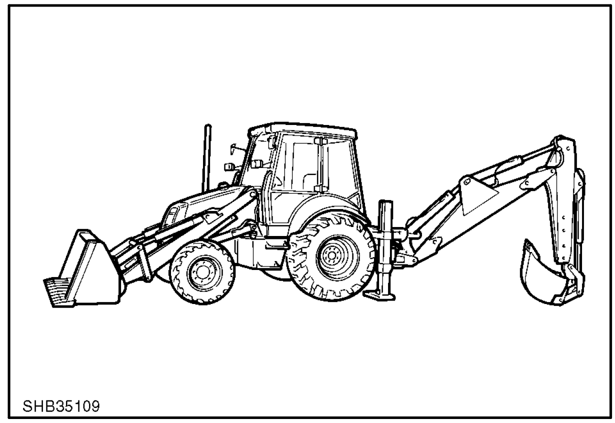
3. Wired Glands
   On wire retained glands lightly coat the outer surface of the gland and lead in area of the cylinder barrel with a lithium base high melting point type grease and gently tap the gland into the barrel.
4. Slowly rotate the gland until the small hole in the locking wire groove aligns with the hole in the barrel. Install the short right angled bend of the locking wire into the gland hole and rotate the gland in a clockwise direction until the wire has been installed . Ensure 8 mm of wire is exposed for future disassembly.
5. Apply sealant New Holland Part No 82995776 to the wire entry hole to prevent the ingress of wire.



53

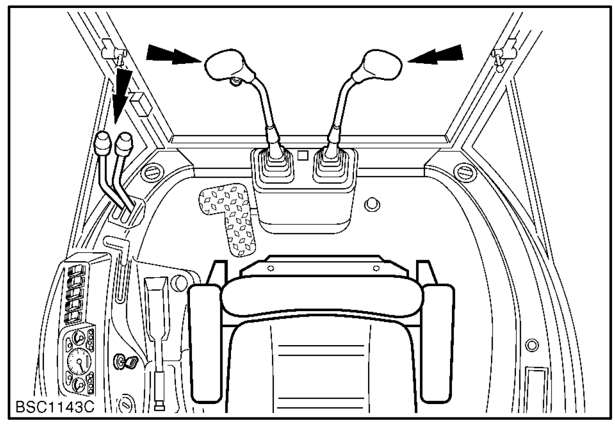
Swing Cylinder – Removal and Overhaul

1. Position the unit on a hard level surface and rest the digging elements on the ground in a safe position.



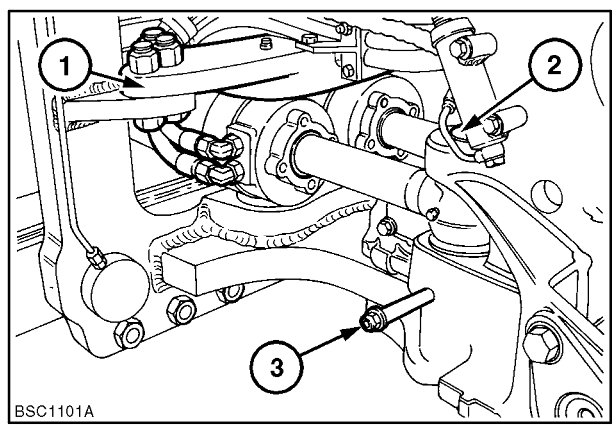
54

2. With the engine stopped, relieve residual pressures by moving all control levers in all directions.



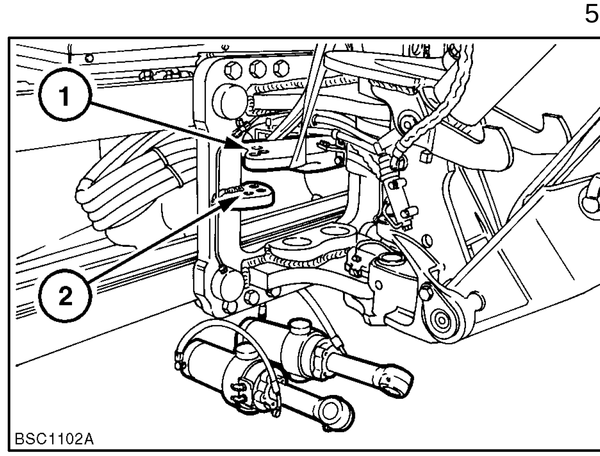
55

3. Disconnect the feed and return hose to the cylinders and cap all exposed openings.
4. Remove the locking pin (3) and pivot pin (2).
5. Remove bolts securing the retaining plate (1).



56

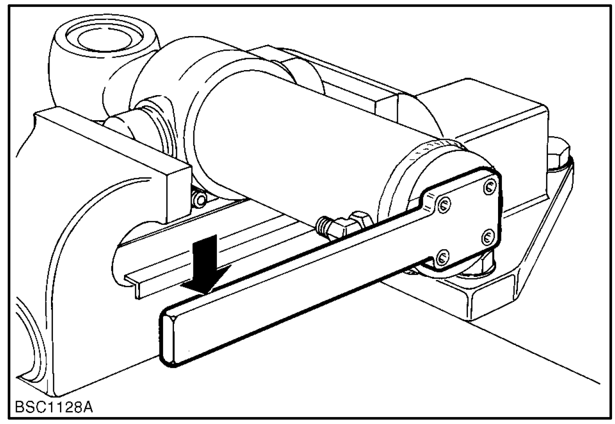
6. Using a suitable sling lift the plate from the swing cylinder trunnions. Retrieve and identify the shims (2) used on each side of the plate to ensure correct re-assembly.
7. Carefully lift the cylinder from the swing post.



57

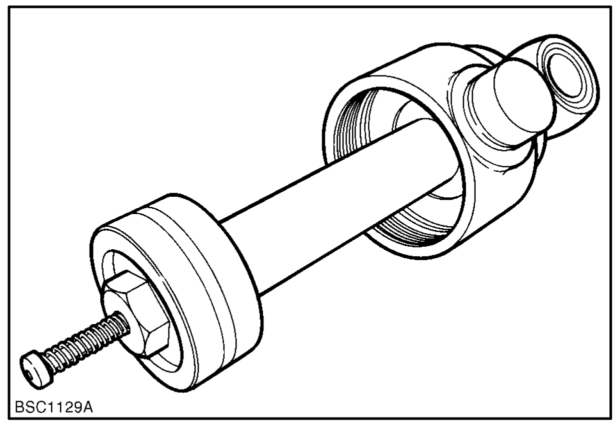
Disassembly

1. Release locking tab on the headstock
2. Position the headstock/gland trunnion in a vice. and using Tool 297191, unscrew barrel from the headstock.



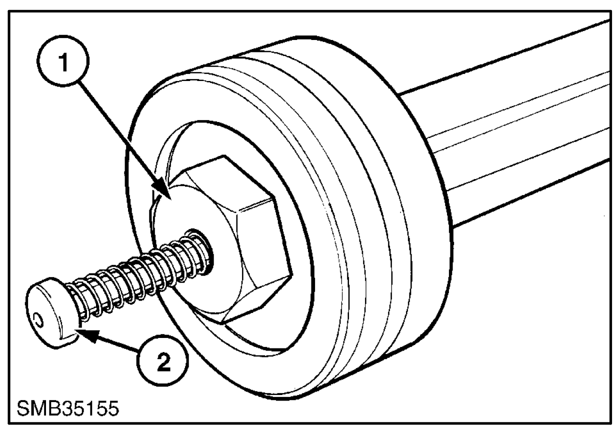
58

3. Remove Piston and rod assembly from barrel.



59

4. Secure end of cylinder rod in a vice and using high quality deep welled socket and drive system unscrew piston retaining bolt (1), taking care not to damage the sliding restrictor (2).
5. Remove piston and withdraw rod from headstock.

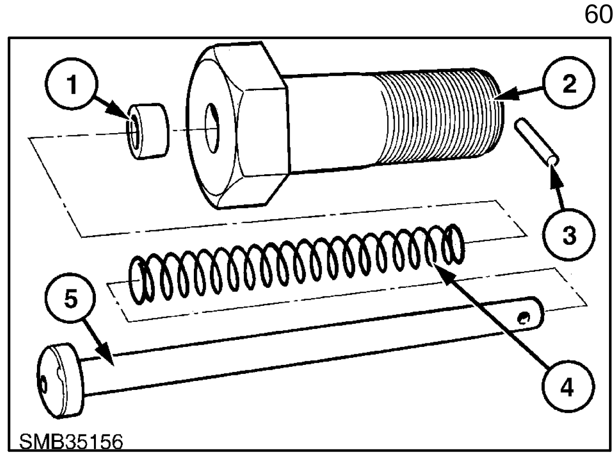


60

6. Disassemble sliding restrictor.

Sliding Restrictor

1. Bush
2. Piston Bolt
3. Retaining Pin
4. Spring
5. Sliding Restrictor



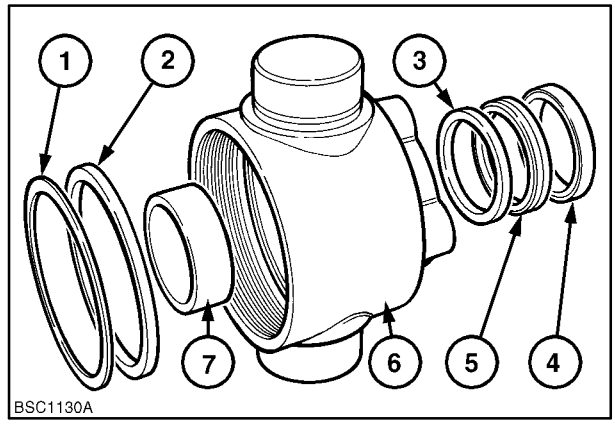
61

7. Remove seals from headstock

Swing Cylinder Gland Assembly

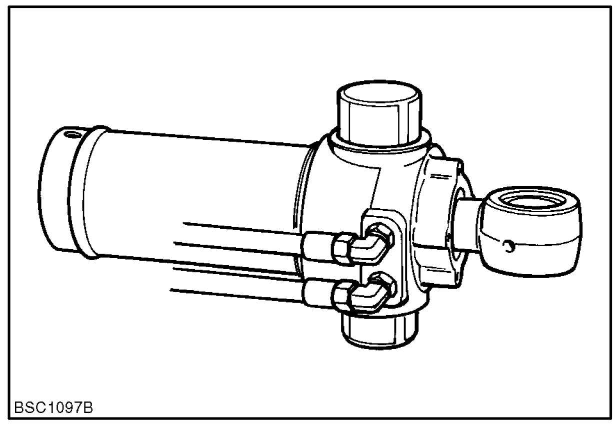
1. Back up ring
2. 'O' ring seal
3. Buffer seal
4. Wiper seal
5. Rod seal
6. Trunnion
7. Wear ring

When installing new seals ensure the groove moulded in the face of the buffer seal is positioned towards the cylinder barrel.



62

8. Examine piston and if damaged or worn replace the piston assembly.
9. Examine trunnion bushes and grease retaining seals on headstock and mating bushes in the swing cylinder retaining plate and carriage.

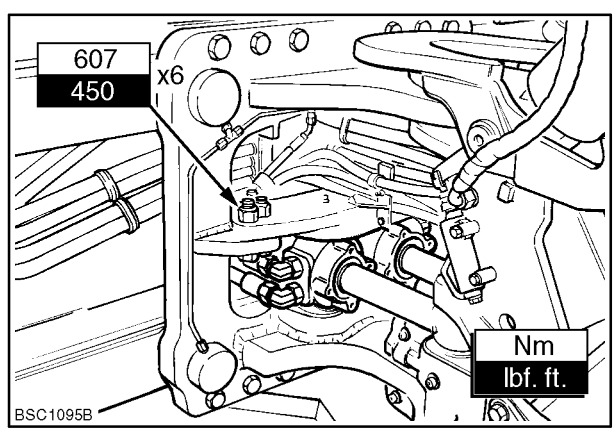


63

Re–assembly and Installation

Re–assembly follows the disassembly procedure in reverse while observing the following.

1. Tighten the piston retaining bolt to a torque of 1470–1570 Nm (1084–1157 lbf ft.)
2. Apply 6 drops of thread sealant New Holland Part No 82995773 to the gland threads and tighten to a torque of 670–830 Nm (494–612 lbf ft).
3. Bend locking tab into groove in the gland.
4. Tighten swing cylinder plate retaining bolts to a torque of 607 Nm .



64

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 7 - Hydraulic Pump

CONTENTS

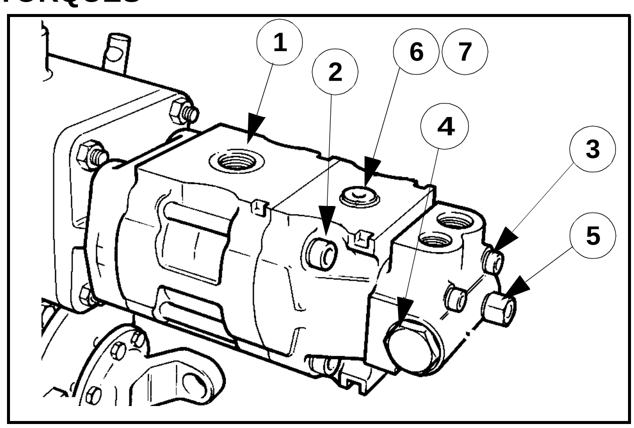
SPECIFICATIONS

Combined Output (minimum)

95HP ENGINE .... 151 L/min (40 US. gals/min) @ 2200 rev/min
115HP ENGINE .... 159 L/min (42 US. gals/min) @ 2070 rev/min

TIGHTENING TORQUES

1. Pump fastening bolts, **4 x 45 Nm (34 lbf ft)**
2. Rear Pump fastening bolts, **4 x 140 Nm (104 lbf ft)**
3. Flow divider fastening bolts, **4 x 70 Nm (52 lbf ft)**
4. Caps, **2 x 50 Nm (37 lbf ft)**
5. LS restrictor, **20 Nm (15 lbf ft)**
6. Inlet plug, **55 Nm (41 lbf ft)**
7. Outlet Plug, **35 Nm (26 lbf ft)**



HYDRAULIC PUMP ASSEMBLY

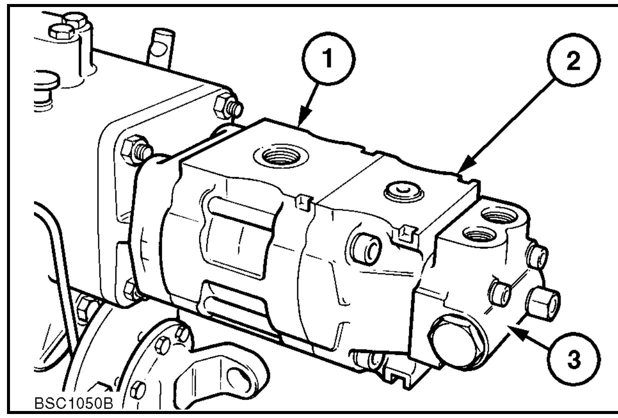
The gear type hydraulic pump assembly is mounted on the rear of the transmission and driven by a shaft directly connected to the engine flywheel splined to the torque convertor housing.

The pump comprises of two pumping elements, the front pump (1) rear pump (2) and load sensing steering flow divider control valve (3).

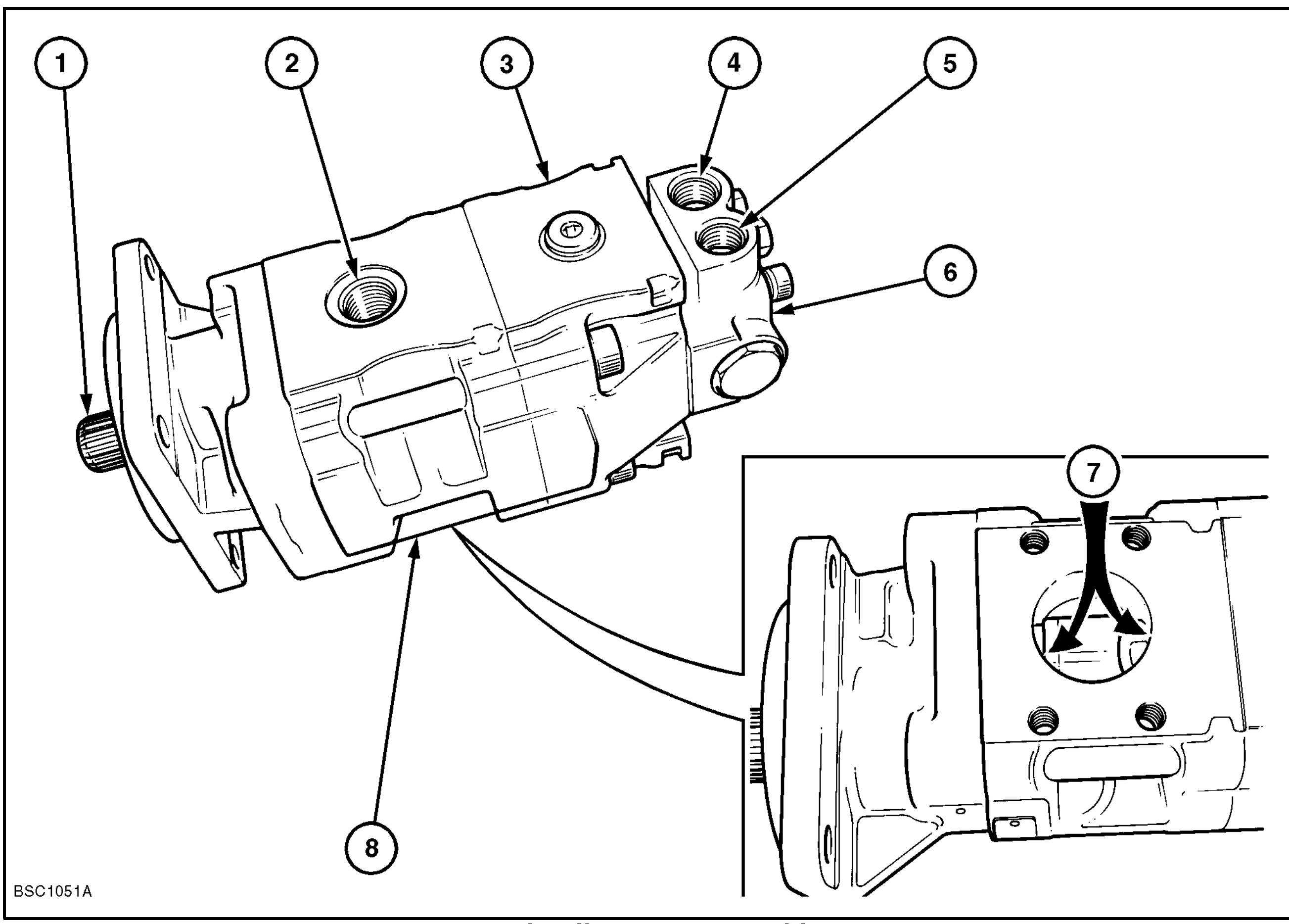
Oil is drawn through the common inlet port into both pumping elements.

Front pump flow is directed to the loader and backhoe control valves and sideshift clamping system.

Rear pump flow passes through the flow divider valve which maintains priority oil flow to the steering system with remaining flow directed for operation of stabilizers, loader and backhoe elements.



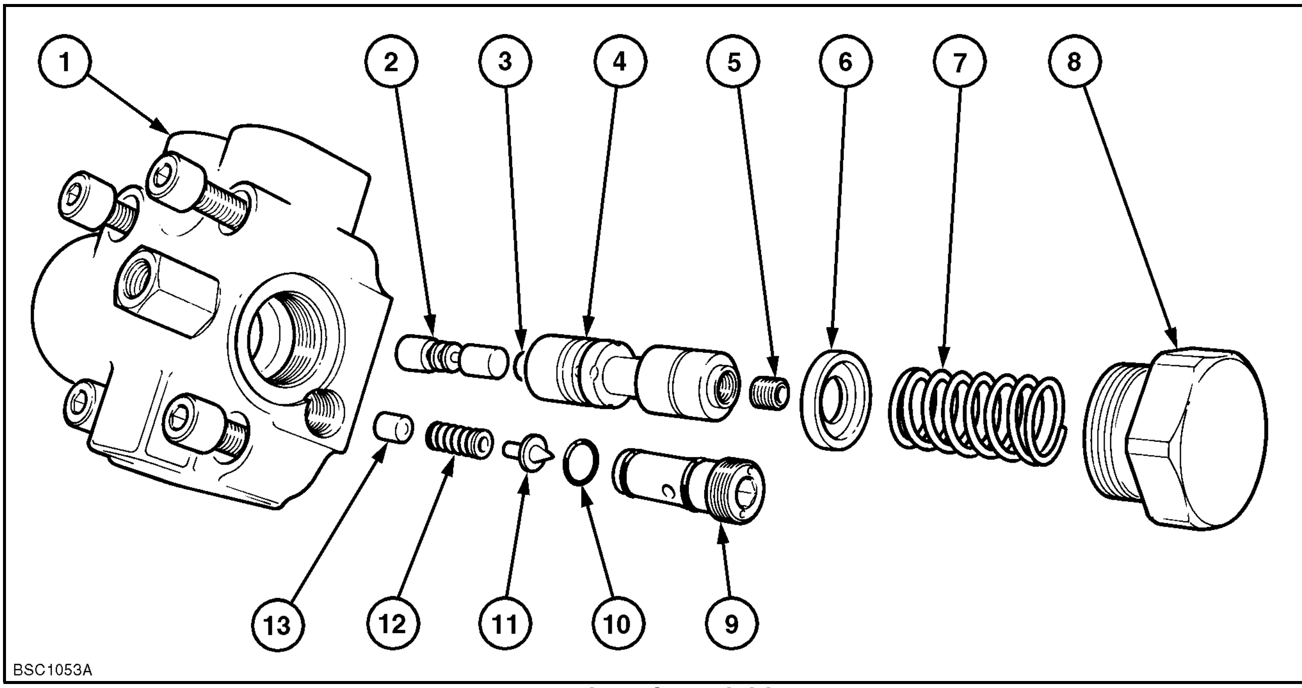
HYDRAULIC PUMP



Hydraulic Pump Assembly

1. Pump Drive Shaft
2. Front Pump Outlet Port
3. Rear Pump
4. Rear Pump Outlet to Steering Motor
5. Rear Pump Outlet to Control Valves
6. Steering Circuit Flow Divider
7. Pump Intake Port
8. Front Pump

FLOW DIVIDER



Steering Flow Divider

1. Housing
2. Valve
3. O Ring
4. Spool
5. Adjuster
6. Spring Seat
7. Spring
8. Cap
9. Adjuster
10. O Ring
11. Relief Valve
12. Spring
13. Seat

The flow divider located on the rear of the pump comprises of a load sensed priority valve and steering system pressure relief valve.

The load sense valve ensures that a priority oil flow to the steering system is maintained while steering the vehicle, with remaining flow directed to the stabiliser, loader and backhoe circuits.

Operation (Page 4)

Flow from the rear pump enters the flow divider at inlet port (7).

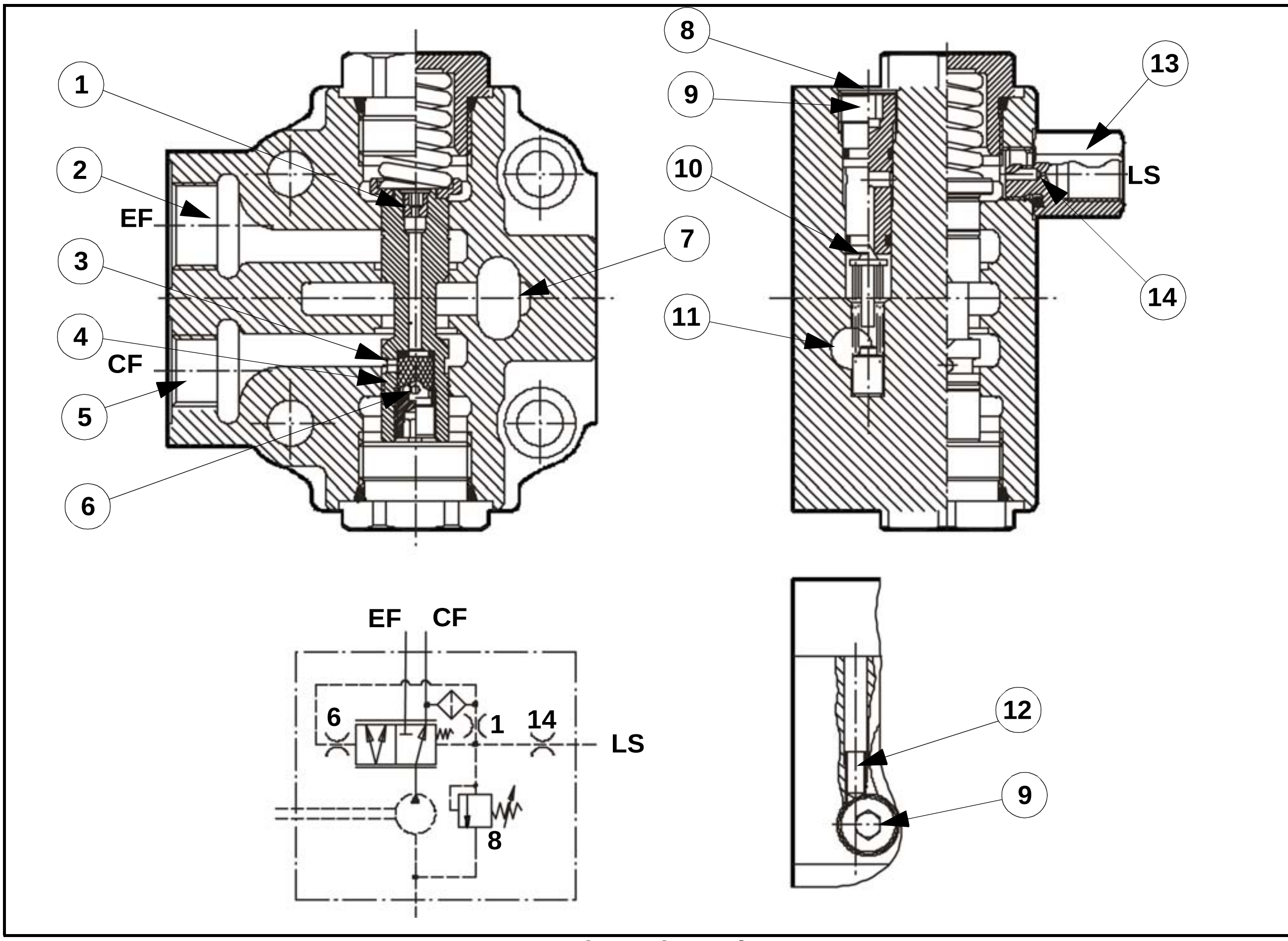
The spring force on the end of the spool holds the spool to the left enabling flow to pass into steering port (5).

Pump flow also passes into centre of spool enabling pump pressure to be sensed through the orifice (6) on the left hand end of the spool. A smaller orifice (1) in the right hand end of the spool also senses pump pressure but acts as a damper to prevent erratic movement of the spool.

When the steering system is in neutral the spring holds the spool to the right until pump pressure reaches 7.5 bar (108 psi). The pump pressure sensed through orifice (6) can now overcome spring pressure and move the spool to the right restricting flow to the steering motor (5).

Flow from the rear pump is now directed to the stabiliser and loader/backhoe circuits through port (2) whilst maintaining the 7.5 bar (108 psi) standby pressure to the steering circuit.

LOAD SENSING VALVE

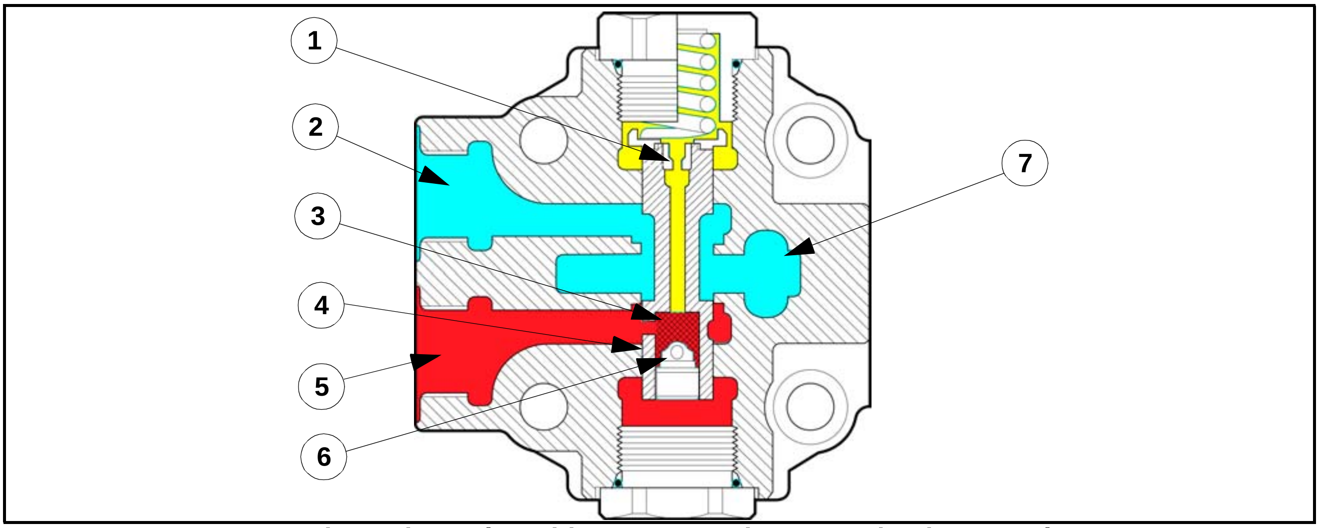


Load sensing valve

1. Orifice
2. Backhoe Circuits (EF)
3. Filter
4. Spool
5. To steering priority flow (CF)
6. Orifice
7. Inlet Port from Rear Pump (IN)
8. Steering Relief Valve
9. Relief Valve Adjuster
10. Poppet
11. Return to Inlet Pump Port
12. Lock Plug
13. Load Sensing Signal (LS)
14. Orifice

When the steering is in neutral the LS port is connected to the unload (through the steering) and the steering inlet port (CF) is open.

LOAD SENSING VALVE



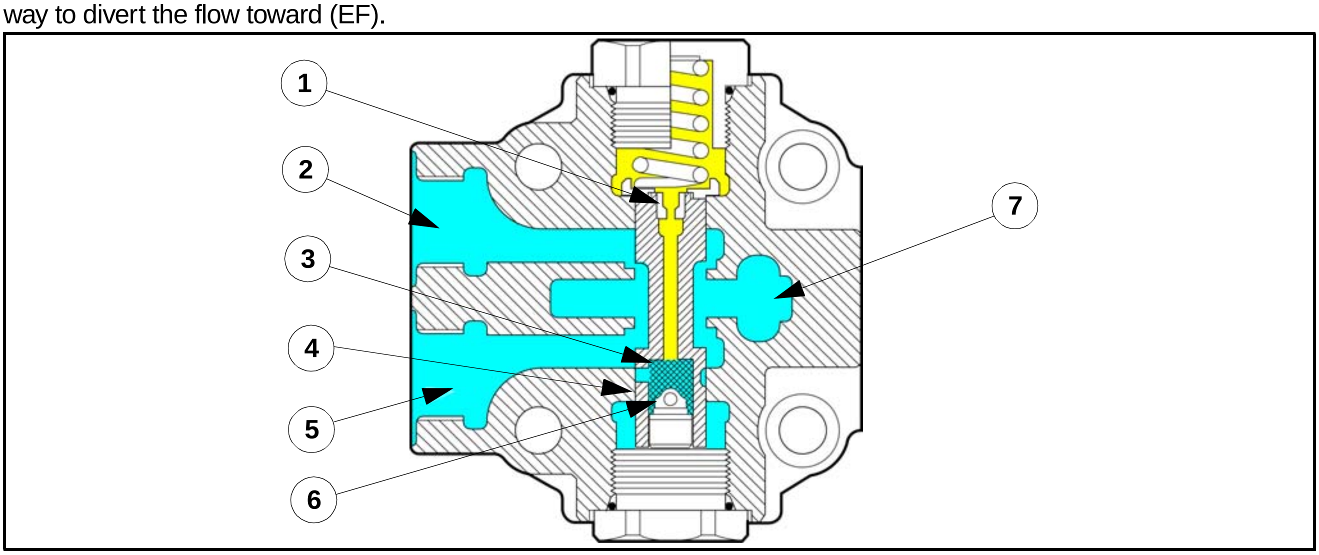
Load Sensing Valve with Pump Running - Steering in Neutral

Pressure Oil — Return to Reservoir Oil

Trapped Oil

1. Orifice
2. Backhoe circuits (EF)
3. Filter
4. Spool
5. To steering priority flow (CF)
6. Orifice
7. Inlet Port (from rear port)

The pressure on (CF) increases until the pressure value (standby pressure) is sufficient to move the spool valve in a way to divert the flow toward (EF).



Load Sensing Valve with Pump Running - Steering working

Trapped Oil — Return to Reservoir Oil

1. Orifice
2. Backhoe circuits (EF)
3. Filter
4. Spool
5. To steering priority flow (CF)
6. Orifice
7. Inlet Port (from rear port)

During steering two actions are performed:

1. The fluid moves to the steering through (CF)

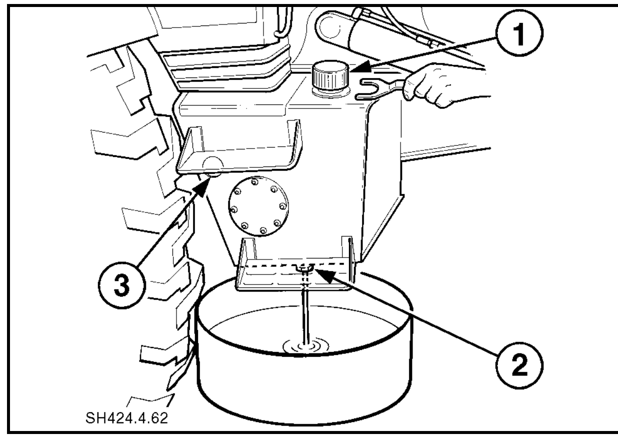
2. The (LS) signal is in communication to the steering

PUMP OVERHAUL

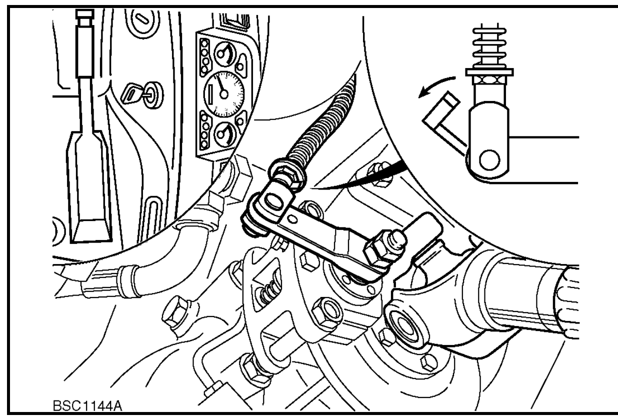
If the pump assembly is suspected of wear pressure and flow test the pump prior to removal and disassembly. refer to the Trouble Shooting chapter, Pressure and Flow Testing.

Removal

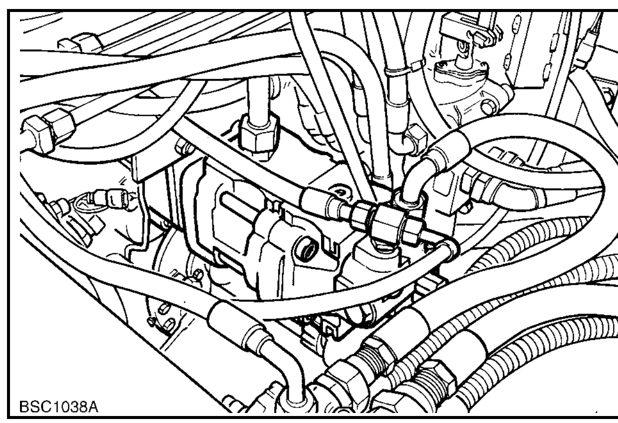
1. Drain hydraulic reservoir into a container capable of holding up to 75 litres (20 US. gals).



2. Disconnect handbrake cable and transmission to rear axle drive shaft.

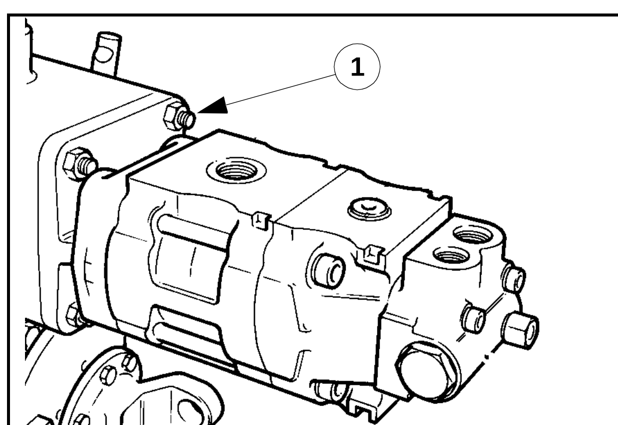


3. Disconnect and plug pump inlet and pressure hoses.
4. Remove pump flange mounting bolts and remove pump.



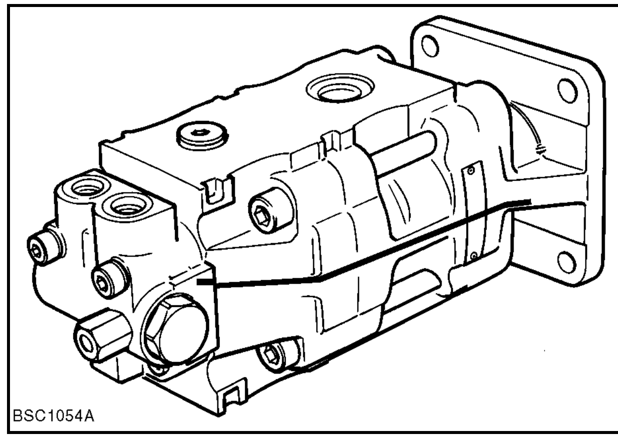
Installation.

1. Installation follows removal procedure in reverse.
2. Tighten retaining bolts (1) to a torque of 41-51 Nm (30-38 lbf ft).
3. Refill reservoir until oil reaches level of sight glass with backhoe and loader in transport position.

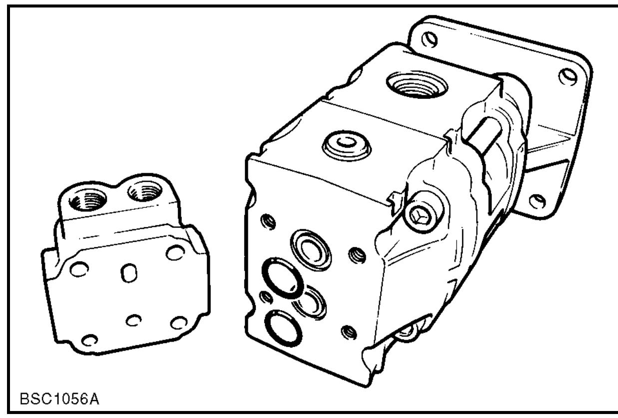


Disassembly

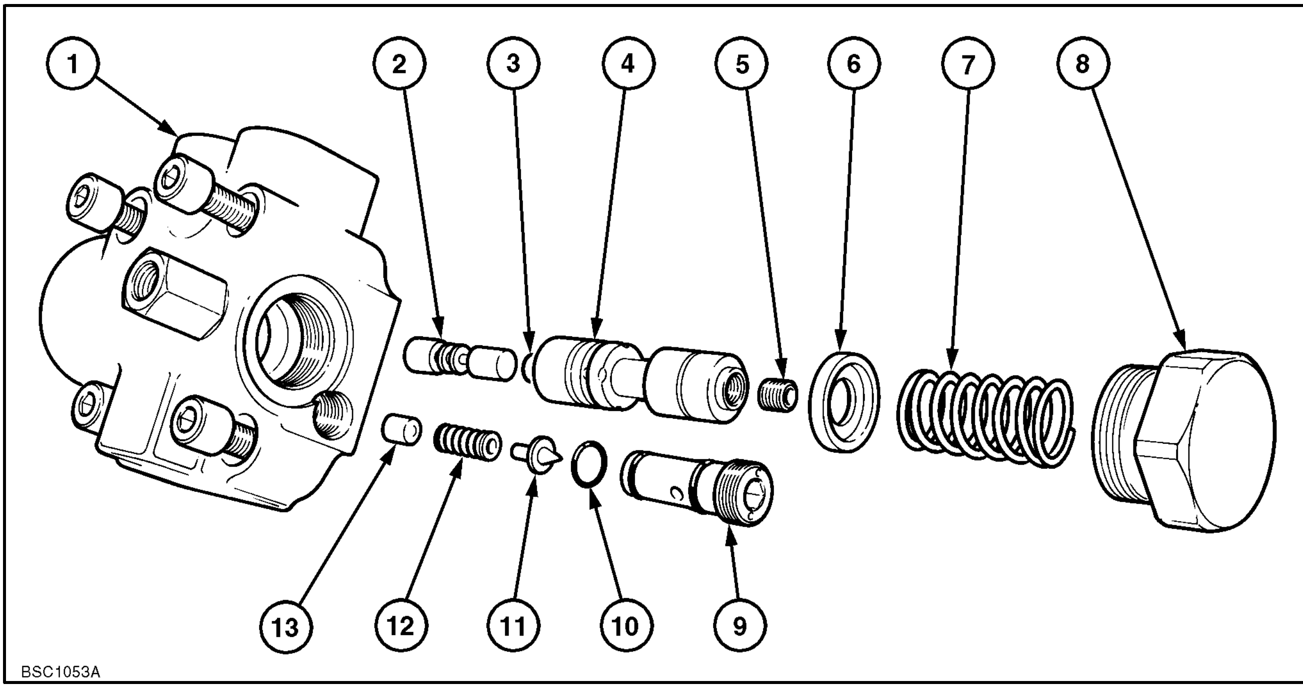
1. To aid re-assembly draw an alignment line along the total length of the pump assembly.



2. Remove rear pump retaining bolts and separate flow divider and rear pump assembly.



FLOW DIVIDER OVERHAUL



Steering Flow Divider

1. Housing
2. Valve
3. O Ring
4. Spool
5. Adjuster
6. Spring Seat
7. Spring
8. Cap
9. Adjuster
10. O Ring
11. Relief Valve
12. Spring
13. Seat

1. Disassemble the flow divider. Do not disassemble the steering system relief valve if the steering circuit relief valve pressure was to Specification when pressure testing the pump prior to overhaul.

NOTE: *If the steering system relief valve is disassembled then the valve must be reset as described in theTrouble shooting Pressure and Flow testing Chapter before the vehicle is recommissioned.*

2. Remove orifice from flow divider spool and withdraw filter.

3. Wash all components in an approved degreasant and inspect for the following.

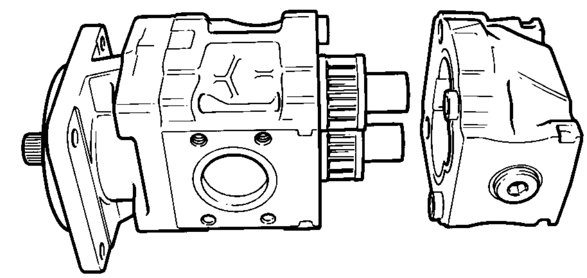
- Valve bore must be free from scoring and damage to metering edges.
- The spool should slide freely in the bore and be free of scoring and damage.
- Ensure all orifices are clean.
- The relief valve seat should be free from pitting and damage. A small chamfer on the mouth of the bore is permissible.
- Examine the filters which fit inside the unload and relief valves. The filters **must** be replaced if contaminated.

4. Re-assemble using disassembly procedure in reverse.

5. Pressure and flow test the pump.

Rear Pump Overhaul

IMPORTANT: *Prior to disassembly and to ensure correct re-assembly identify the position of each bearing block in the pump body as described below.*



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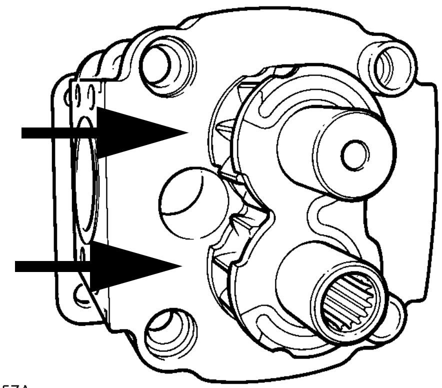
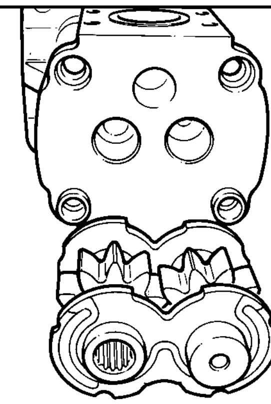
1. Scribe an identifying letter 'A' and 'B' 'C' and 'D' on the pump housing and in the channel of each bearing block.

NOTE: *Orientation of bearing block seals relative to oil port.*



BSC1057A

2. If scribe is not available take care to keep bearing blocks in pairs.



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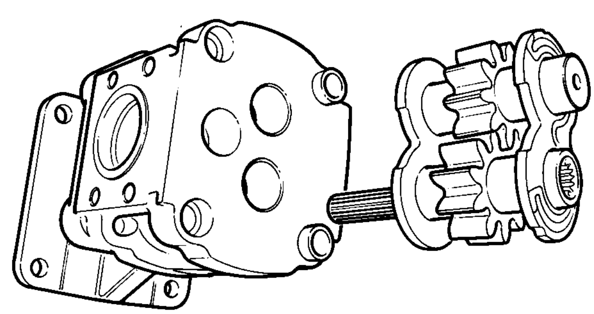

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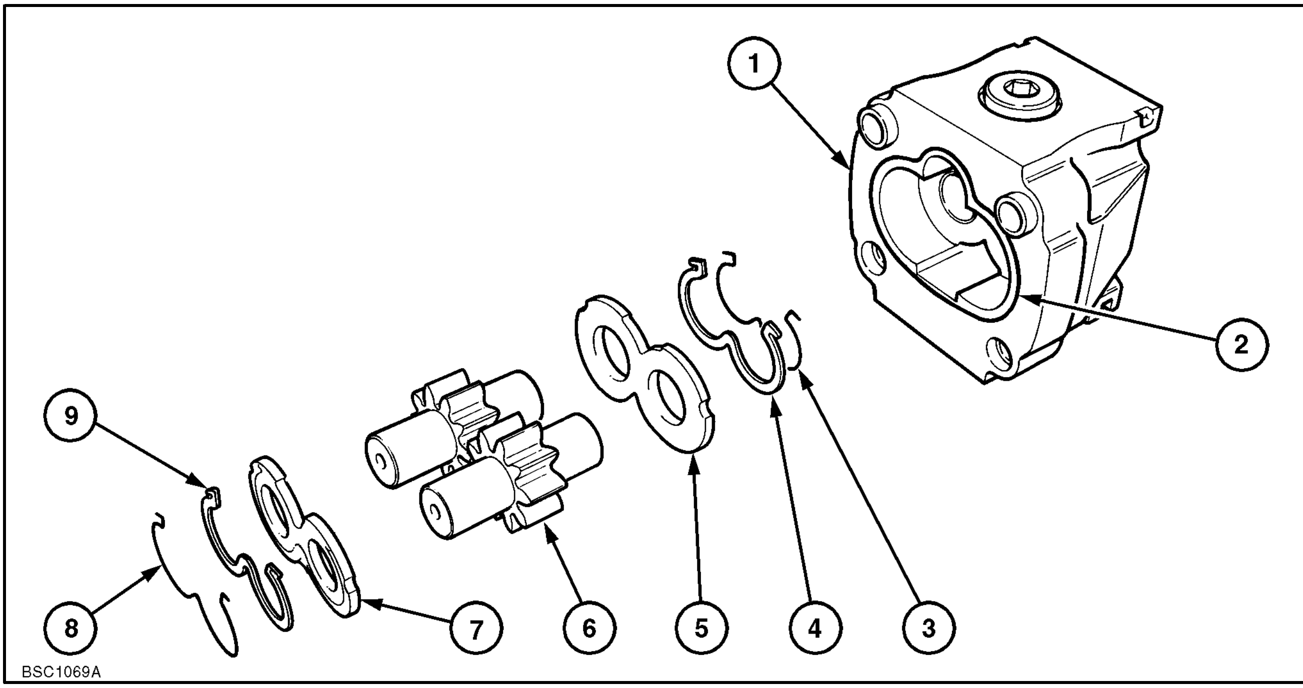


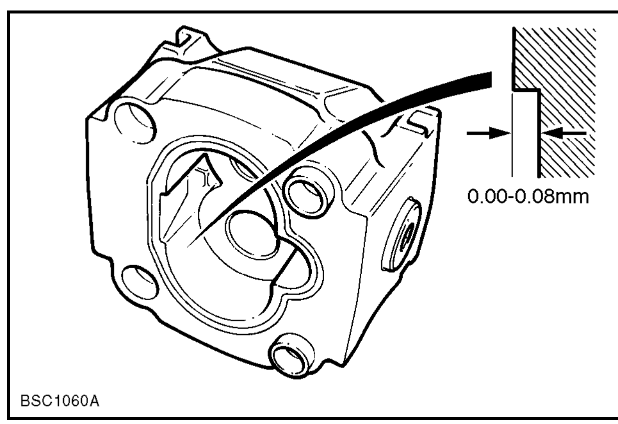
Rear Pump Assembly

1. Pump Body
2. 'O' Ring Seal
3. Back-up Seal
4. Pressure Seal (Rubber)
5. Bearing Block
6. Pump Gears
7. Bearing Block
8. Back-up Seal
9. Pressure Seal (Rubber)

Disassembly and Inspection

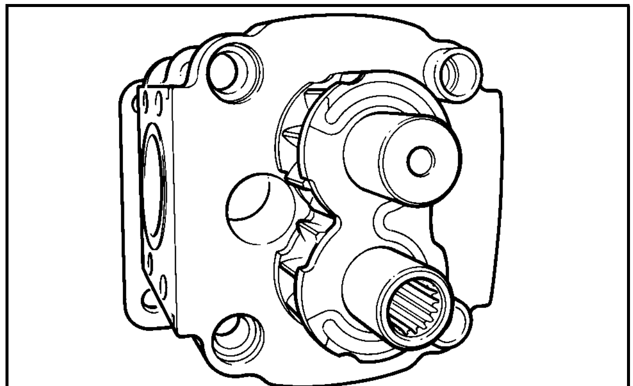
1. Disassemble gears, seals and bearings.
2. Wash all components in approved degreasant.
3. Inspect the wear track cut by the gears in pump body. The body can be re-used if the track is bright and polished and does not exceed 0.08 mm (0.003 in) in depth.
4. Examine bearing block faces for scoring and flatness paying particular attention to the face which abuts the gears.
5. Examine bearing block bushes for scoring.
6. Examine pump gears for scored or worn side faces, journals and damaged teeth.

If pump block, gears or bearing blocks are worn and require replacement the pump assembly must be replaced.



Re-assembly

1. Re-assembly follows the disassembly procedure in reverse whilst observing the following:-
   - Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid.
   - Replace all seals and `O' Rings.
   - Install bearing blocks into the same positions from which they were removed using identification letters scribed during disassembly.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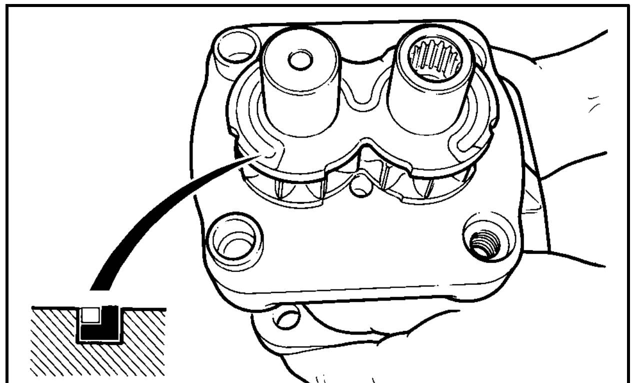
- Ensure plastic back-up seals are correctly positioned in the rubber seal.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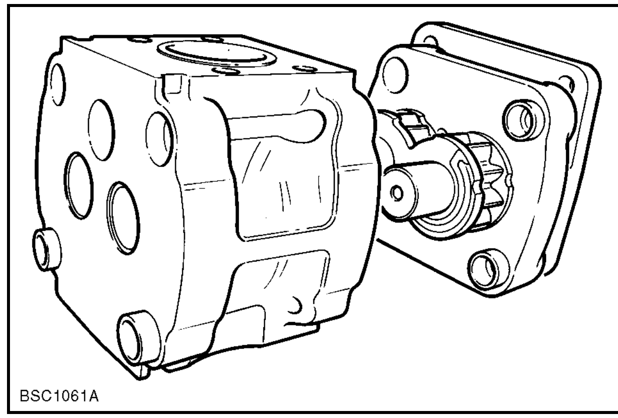
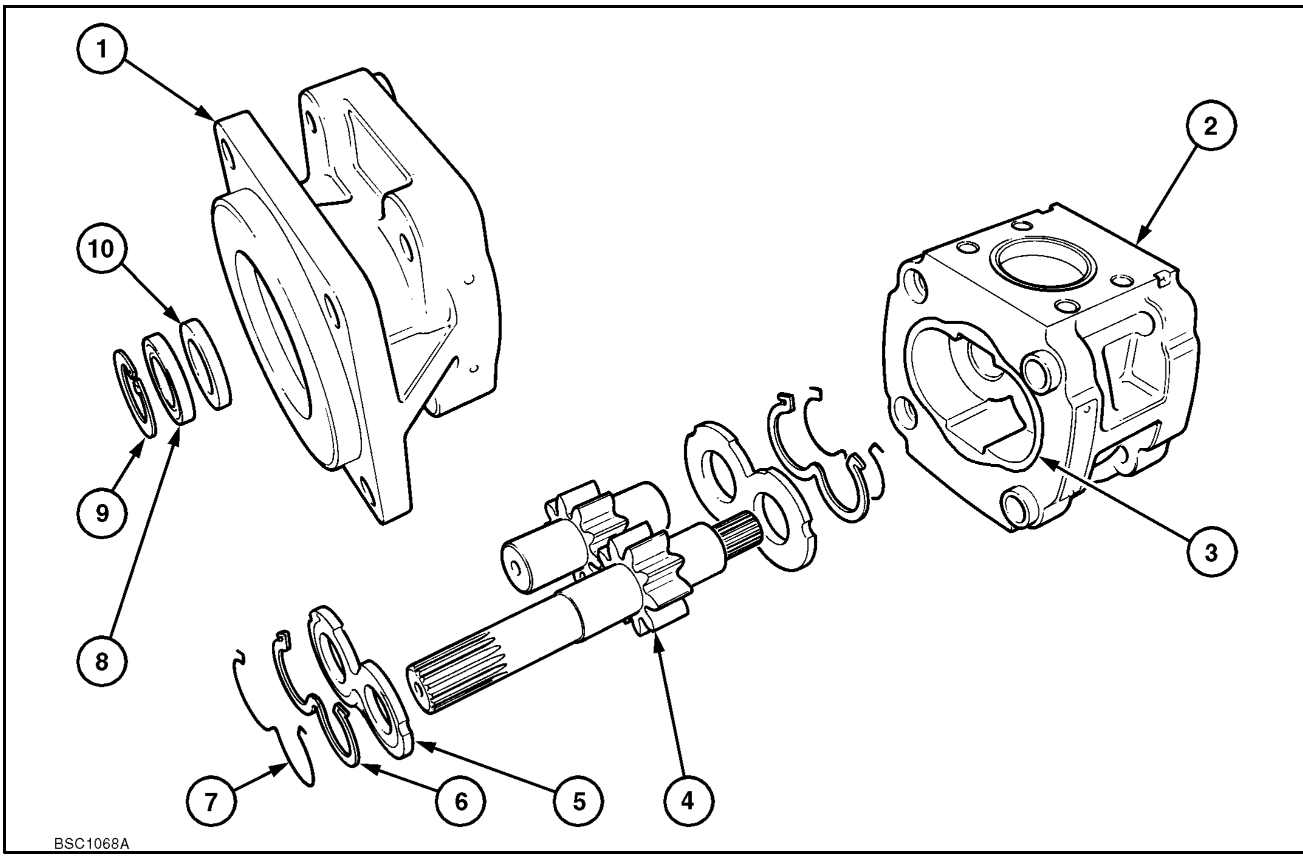
Front Pump Overhaul

1. Remove bolts securing pump body to flange and remove pump assembly.
2. Identify and note the position of each bearing block to ensure correct re-assembly.
3. Disassemble gears, seals and bearings.
4. Remove and replace flange seals.



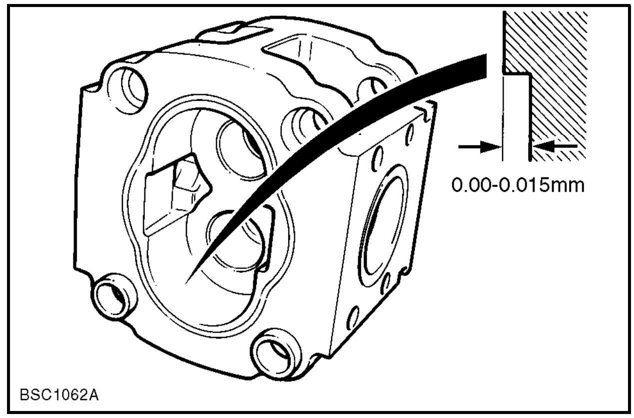


Front Pump Assembly

1. Flange Mounting
2. Pump Body
3. O Ring Seal
4. Pump Gears
5. Bearing Block
6. Pressure Seal (Rubber)
7. Plastic Back-up Seal
8. Seal
9. Circlip
10. Seal

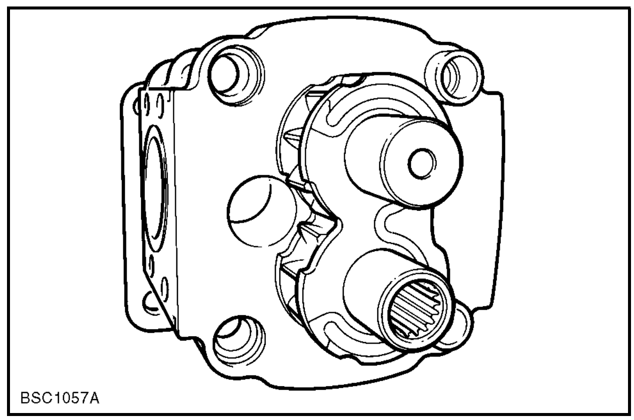
Inspection

1. Wash all components in approved degreasant.
2. Inspect the wear track cut by the gears in the inlet side of the pump body. The body can be re-used if the track is bright and polished and does not exceed 0.15 mm (0.006 in) in depth.
3. Examine bearing block faces for scoring.
4. Inspect PTFE coated bearings in body or flange for wear. If bearings are worn the bronze backing will be revealed.
5. Examine pump gears for scored or worn side faces, journals and damaged teeth.
6. Examine flange seal contact area on driveshaft. If pump block, gears, bearing blocks or drive shaft are worn the pump assembly must be replaced.

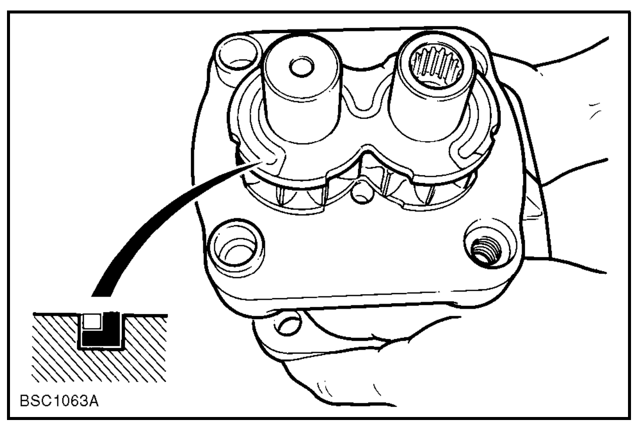


Re-assembly

1. Re-assemble using disassembly procedure in reverse whilst observing the following:
   - Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid.
   - Replace all seals and `O' Rings.
   - Install bearing blocks into the same positions from which they were removed.



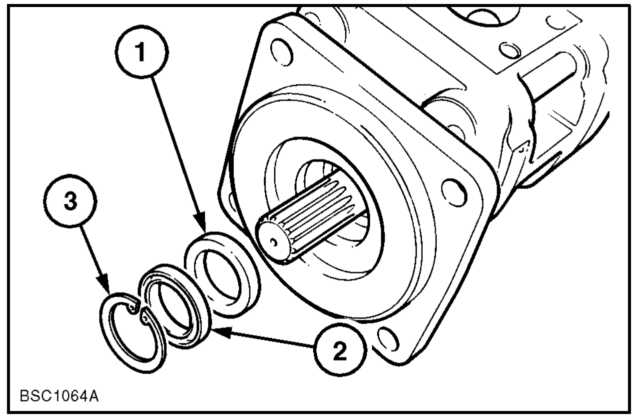
   - Ensure back-up seals are correctly positioned in the seal.



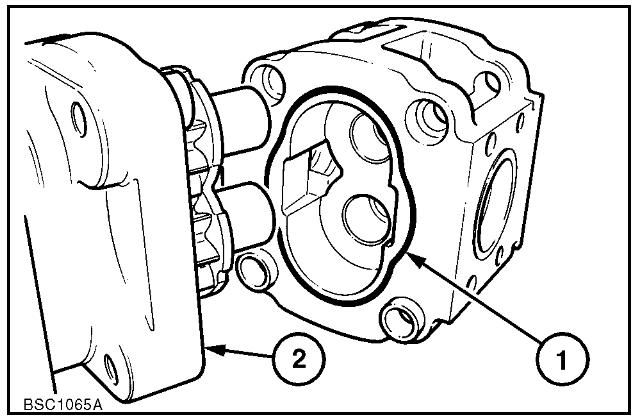
2. Assemble inner flange seal, (1), with spring and lip facing into pump. Install outer seal, (2), with garter spring and lip facing outwards and re-fit circlip (3).
3. Coat seals with high melting point grease.

NOTE: *Ensure seals are fitted back to back.*

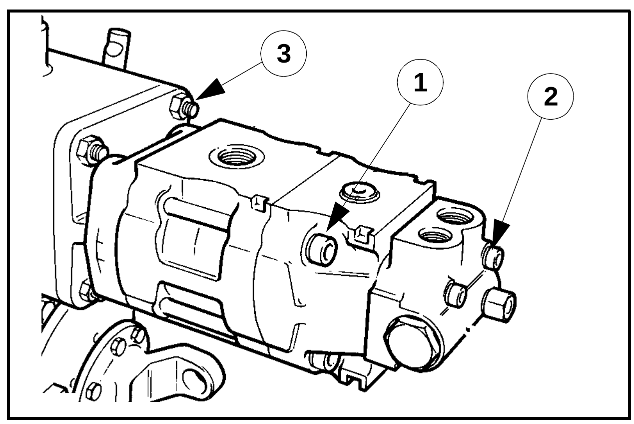
NOTE: *If the seal recess has been scored during seal removal coat outside diameter of seal with flexible gasket sealant 82995770 to prevent leakage.*



4. Install ‘O’ ring (1) in groove on body face.



5. Assemble pump sections and tighten bolts to specified torque.
   Bolts (1), **4 x 140 Nm (104 lbf ft)**
   Bolts (2), **4 x 70 Nm (52 lbf ft)**
6. Install pump and tighten retaining bolts to specified torque.
   Bolts (3), **4 x 45Nm (34 lbf ft)**



SECTION 35 - HYDRAULIC SYSTEMS

Chapter 8 - REXROTH control blocks

CONTENTS

SPECIFICATIONS

Weight .... 5.2 kg
Spool stroke .... 7.55 mm
Maximum permissible torque on the control lever .... 80 Nm

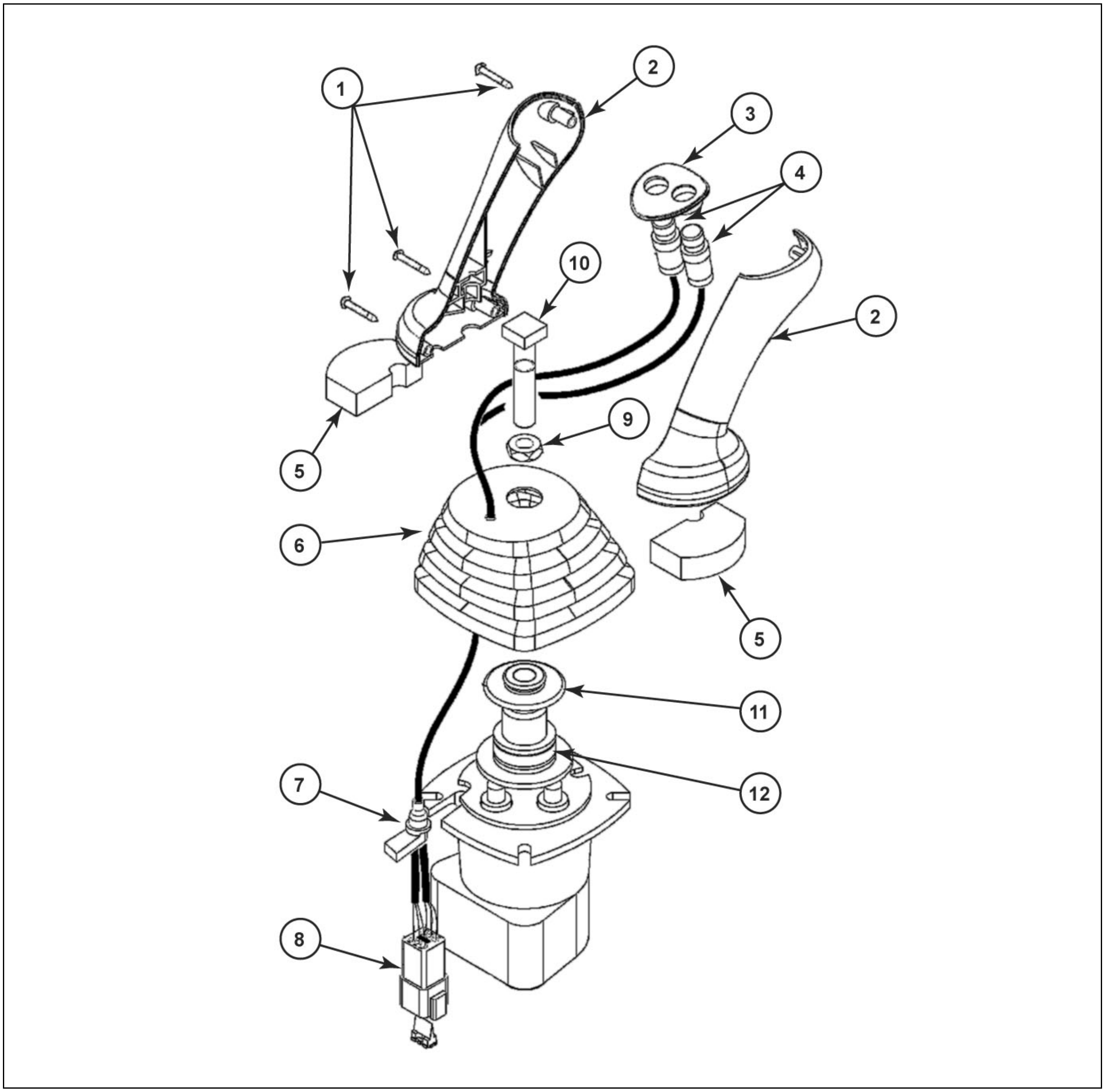
SPECIAL TORQUE SETTINGS

Control block retaining screw .... 30 Nm
Control block universal joint seal .... 50 Nm
Control block nut .... 40 Nm
Lower body screw .... 50 Nm

TOOLS REQUIRED

Torque wrench 40 to 200 Nm
Loctite 271

EXPLODED VIEW OF THE LEVER



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1. Screw
2. Lever
3. Cap
4. Switches
5. Spacers
6. Bellows
7. Cable retaining hardware
8. Cable connection
9. Nut
10. Screw
11. Universal joint cam
12. Control block
13. Left lever horn red and green wires
14. Right lever dipper extension and retraction red wires = +, yellow = signal, black = earth

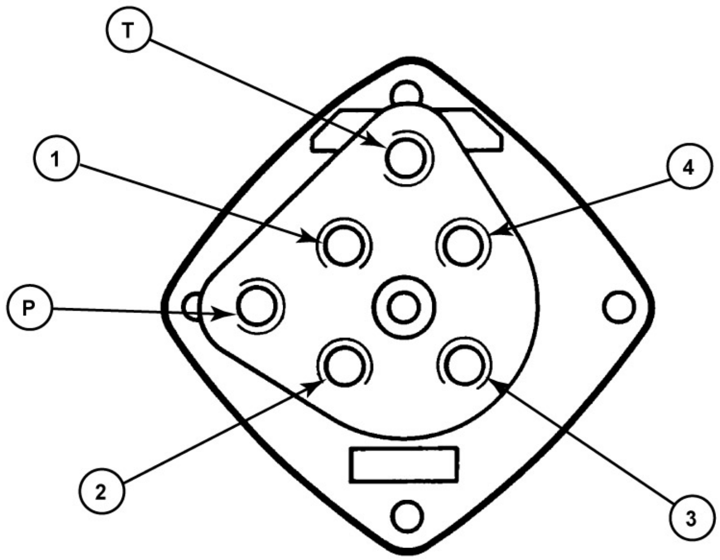
DISASSEMBLY OF THE LEVER

1. Mark the position of the lever parts (see the exploded view on page 2).
2. Remove the screws (1).
3. Separate the half-handles (2), remove the cap (3).
4. Extract the switches (4), remove the spacers (5).
5. Remove the bellows (6) and the cable retaining hardware (7) with the connector (8).
6. Unscrew the nut (9), remove the screw (10).
7. Remove the plate (11).

REASSEMBLY OF THE LEVER

1. To reassemble the lever, proceed in the reverse order to that of removal.
2. Follow the marks made during disassembly, and tighten the nut (9) to a torque of 36 to 44 Nm.

CONNECTING THE HOSES



CRIL03K045F01

P SUPPLY
T RESERVOIR RETURN

RH control block (dipper/bucket)

1. Retracting the dipper
2. Opening the bucket
3. Extending the dipper
4. Closing the bucket

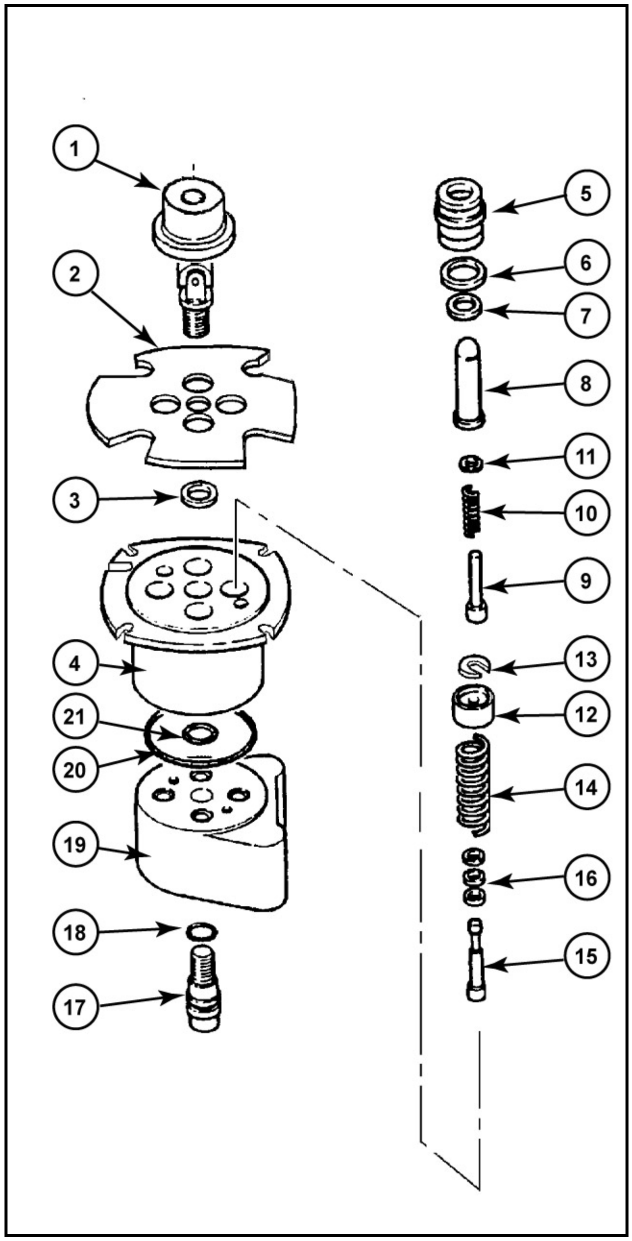
LH control block (boom/swing)

1. Boom raising
2. Boom RH swing
3. Boom lowering
4. Boom LH swing

OVERHAUL OF THE CONTROL BLOCK

DISASSEMBLY

1. Mark the direction of installation of all disassembled parts.
2. Remove the U/J cam (1) using a male 8 mm Allen key.
3. Remove the thrust plate (2).
4. Remove the adjustment shim (3) from the upper body (4).
5. Extract the push-rod guide (5) and discard the seals (6) and (7).
6. Drift the push-rod (8) out.
7. Remove the thrust bearing (9), the spring (10) and the shims (11).
8. Extract the spool assembly.
9. Drive the cup (12) and remove the lock washer (13).
10. Remove the spring (14) and the spool (15).
11. Remove and note the thickness of the shims (16).
12. Proceed in the same manner for the other push-rods.
13. Secure the upper body (4) in a vice.
14. Loosen and remove the screw (17) using a male 10 mm Allen key and discard the seal (18).
15. Separate the upper (4) and lower (19) bodies and discard the seals (20) and (21).



REASSEMBLY

1. To reassemble, proceed in the reverse order to that of removal.
2. In the case of reassembly without changing the U/J cam (1), put the same value of shims (3) as those in place.
3. After changing the U/J cam (1) adjust the pressure of the cam on the push-rods.
4. Install a 2 mm shim (3), check that the recessing of the push-rods is less than 0.2 mm, modify the shimming to more or less if required.
5. Install new seals (6), (7), (18), (20) and (21).
6. Lubricate the moving parts.
7. Apply brake thread fluid on the threads of the U/J cam (1) and the screw (17).
8. Tighten the U/J cam (1) to 50 Nm and the screw (17) to 50 Nm.

NOTES

SECTION 39 – VEHICLE CHASSIS

Chapter 1 – Chassis Components

CONTENTS

SPECIFICATIONS

Specifications are listed for the individual components at the beginning of each section of the Repair Manual for your guidance.

TORQUES

Torque figures for individual components are listed at the beginning of each section of the Repair Manual.

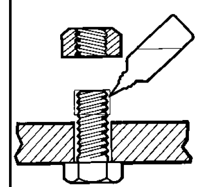
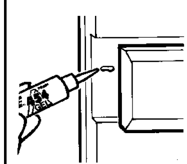
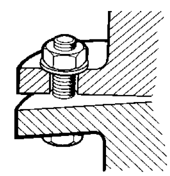
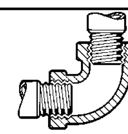
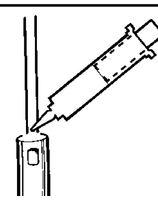
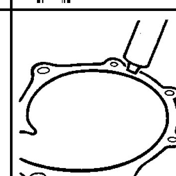
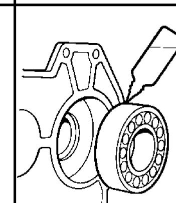
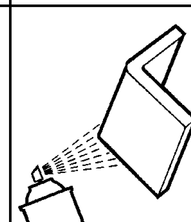
This section specifies the torques of the attachment of components to the vehicle and interlinking parts hoses and tubes. Below are general torque figures for hydraulic hoses, tubes and ORS Connections that you may find on your machine.

Thread Size:	$^{9}/_{16}$ in – 18	13.5 – 16.5 Nm	(10 – 12 lbf ft)
	$^{11}/_{16}$ in – 16	23 – 28 Nm	(17 – 20 lbf ft)
	$^{13}/_{16}$ in – 16	45 – 53 Nm	(32 – 39 lbf ft)
	1 in – 14	62 – 77 Nm	(46 – 57 lbf ft)
	$1^{3}/_{16}$ in – 12	86 – 107 Nm	(63 – 79 lbf ft)
	$1^{7}/_{16}$ in– 12	125 – 142 Nm	(93 – 105 lbf ft)
	$1^{11}/_{16}$ in– 12	169 – 190 Nm	(125 – 140 lbf ft)
	2 in– 12	203 – 246 Nm	(150 – 182 lbf ft)

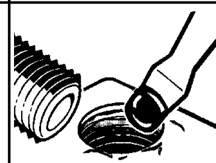
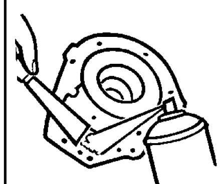
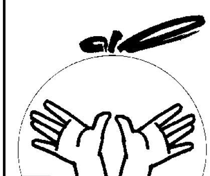
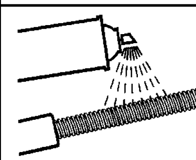
SPECIAL TOOLS

Special Tools are listed in the Repair Manual introduction and at the beginning of each section of the Repair Manual for your guidance.

SEALANTS

Description	Part No. NH	Typical Applications	
THREAD LOCK & SEAL 24ml	82995773	• General locking and sealing of metallic threads–medium strength • Oil tolerant • Resists vibration, seals against corrosion and leakage • Can be dismantled with standard tools	
SUPER GLUE GEL 20gm	82995778	• General purpose instant non drip gel adhesive Ideal for repair of cab trim, mats, external trim etc. • Bonds most materials including wood, rubber, metals, most plastics • Not absorbed by porous materials	
FLEXIBLE GASKET SEALANT 50ml 300ml	82995770 82995771	• Replaces pre cut gasket materials • Use on hydraulic lift cover joint, transmission to axle joint and all rigid machined faces • Anaerobic sealant cures on assembly • Will not cure and block oil ways etc.	
THREAD SEAL 50ml	82995768	• General purpose metallic thread and pipe sealant • Use on fuel system, hydraulics, air lines etc. • Replaces pastes, hemp, pipe tape etc.	
CLEAR ADHESIVE AND SEALANT 50ml 310ml	82995775 82995776	• Clear, flexible adhesive and sealant • Suitable for glass, metal, wood etc., seals and bonds gaps to 6mm • Use to seal glazing and windscreens, vehicle lamps, electrical boxes, sump joints etc.	
GASKET DRESSING 60ml	82995774	• Non hardening sealant–enhances sealing of all types of pre cut gaskets • Holds gasket in place–assists assembly • Dries slowly, sets to pliable film for easy dismantling	
STUD & BEARING LOCK 24ml	82995772	• General high strength metallic locking and sealing of all threaded fasteners and studs • Retains cylindrical parts, e.g. bushes, bearings, gears to shafts etc. • Resists severe vibration loosening. Seals against corrosion	
SOLVENT CLEANER & DEGREASER 400ml	82995779	• All purpose cleaner & degreaser • Specially designed for parts to be lubricated, bonded or sealed leaving no film or residue • Removes grease, oil and dirt from electrical parts, tools etc. FLAMMABLE. Do not smoke, use only in well ventilated areas	

MISCELLANEOUS

Description	Part No. NH	Typical Applications	
STRIPPED THREAD REPAIR KIT	82995777	• Use for fast repair of most stripped or damaged threaded metallic parts (see pack) • Complete kit, no additional special tools required Withstands temperature to 150°C	
GASKET REMOVER 300ml	82995782	• Spray on fast action foaming gasket remover • Removes old heat hardened gasket residue without damaging metal surfaces • Removes all Loctite gaskets and gasket residue. • Removes carbon deposits from cylinder heads etc.	
CITRUS HAND CLEANER 400ml 3 litre	82995780 82995781	• Natural hand cleaner made from citrus oil • Removes ground in dirt, grease, grime, paint, glue oil and tar • Contains premium skin conditioners • Use with or without water	
PENETRATING OIL 330ml	82995769	• General purpose penetrating lubricant • Frees corroded fasteners, mechanisms etc. • Lubricates cables, locks, linkages etc. • Cleans, displaces moisture, prevents corrosion	

DESCRIPTION AND OPERATION

This section can be used as a quick reference for general disassembly of the machine and its components.

Where disassembly of a specific component is required refer to the relevant Repair Manual Section.

REPAIR MANUAL BY SECTION

Section 10 : Engine
Section 17 : Torque Convertor
Section 21 : Transmission
Section 25 : Front Axle (2, 4WD and 4WS)
Section 27 : Rear Axle (2, 4WD and 4WS)
Section 33 : Brake Systems
Section 35 : Hydraulic System
Section 39 : Vehicule Chassis
Section 41 : Steering Systems
Section 50 : Cab Heat And Air Conditioning
Section 55 : Electrical System
Section 82 : Loader
Section 84 : Backhoe
Section 90 : Cab

VEHICLE CHASSIS TYPE

The chassis of the Backhoe Loader is manufactured as a one piece unit on which the major assemblies are attached or supported from. Two chassis type's are available:

SIDESHIFT – Figure 1.

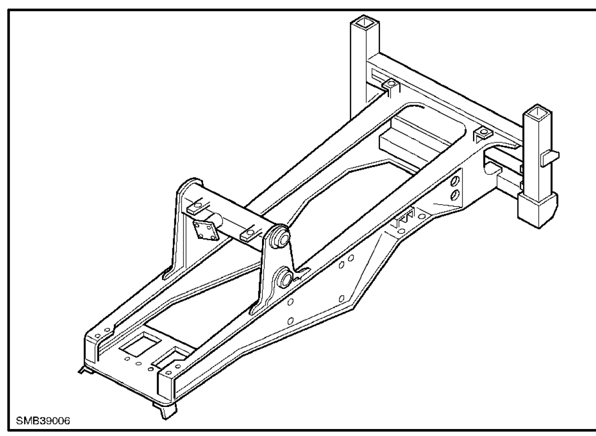
The backhoe on sideshift models is attached to a frame that is attached to the vehicle and can traverse the rear of the machine. For disassembly purposes the backhoe and its support frame can be removed from the machine.

CENTRE PIVOT – Figure 2.

On centre pivot models the backhoe is connected directly to the chassis and can be removed from the machine at that point.

In the following pages are the torque figures for the various assemblies that will may removed to affect repairs

IMPORTANT: *Always ensure prior to carrying out repairs on the machine that the vehicle parking brake is on and the wheels are chocked.*



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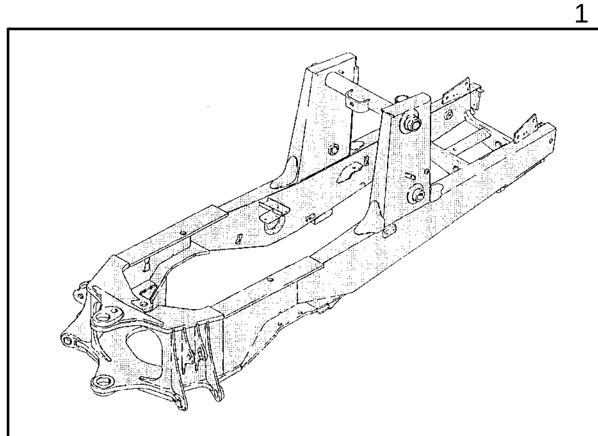

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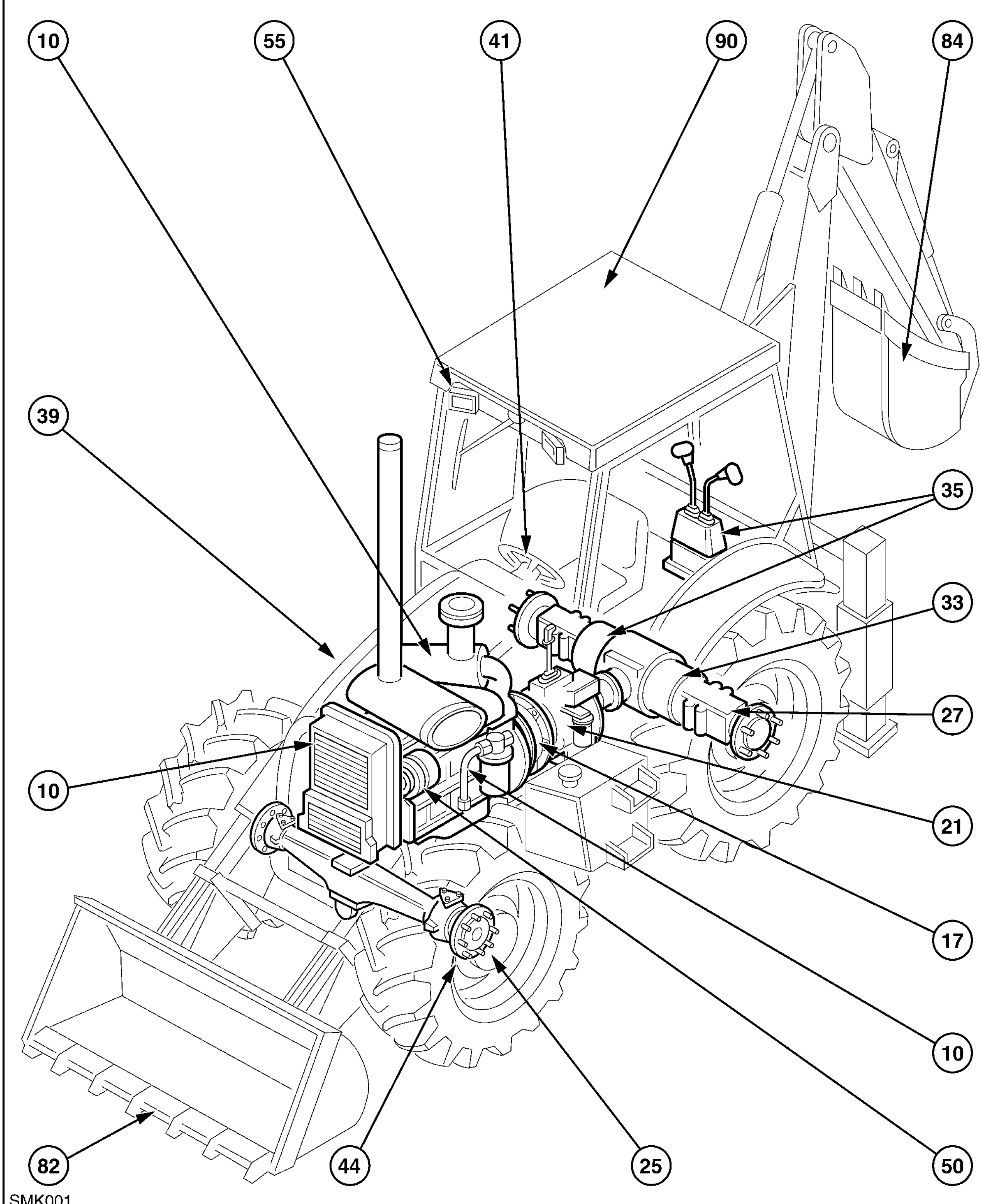

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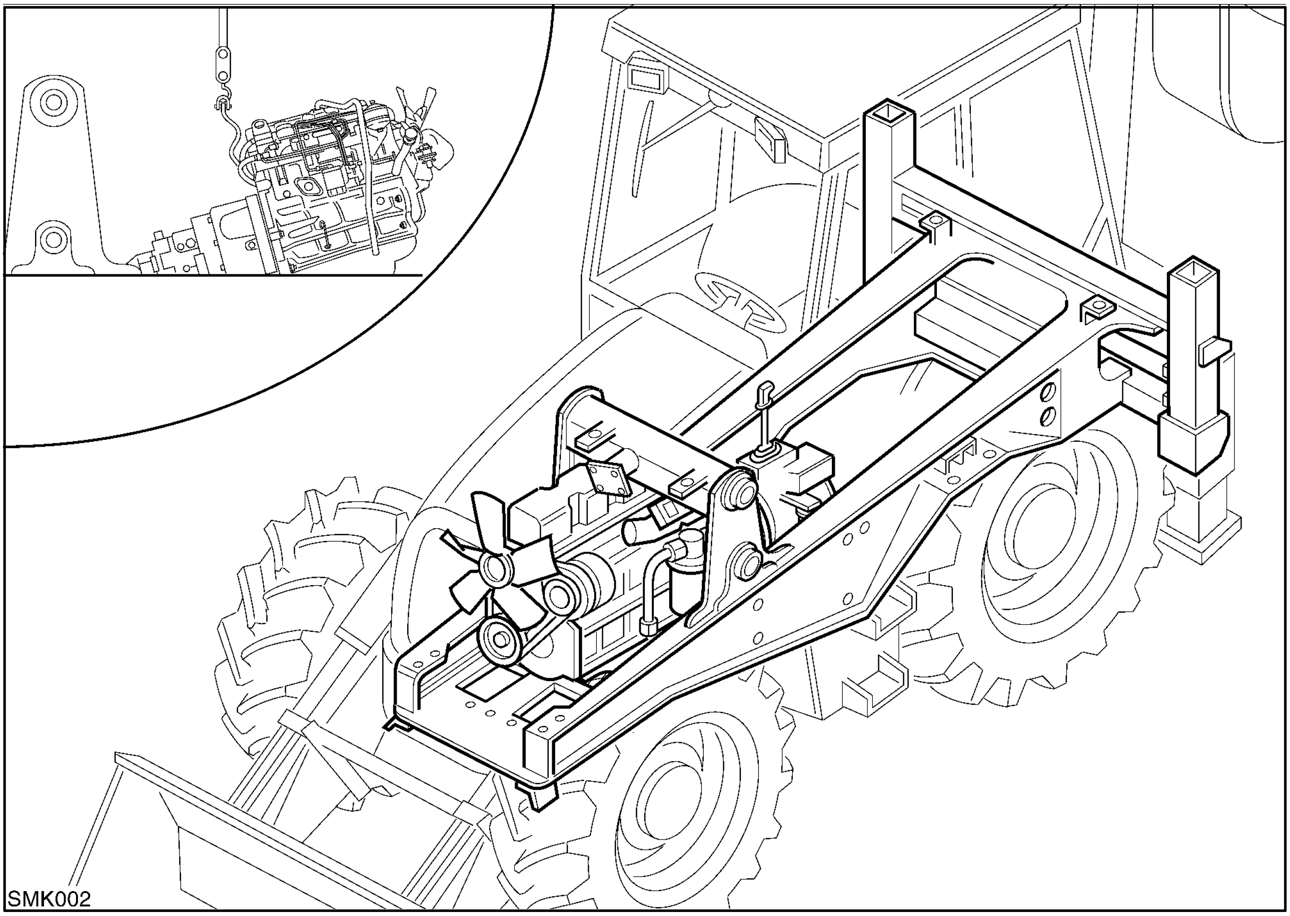
Section 10 : Engine / Section 17 : Torque Convertor / Section 21 : Transmission



Major Components within the chassis 4

ENGINE section 10 – Supported by 2 rubber bushes and held in position by 2 support brackets. The brackets, which are welded to the frame one either side of the engine are positioned just ahead of the loader posts.

WARNING: *The engine and transmission bolted together act as a one piece unit. If separated in the machine they are not self supporting and will collapse causing injury or damage to the machine.*

TORQUE CONVERTOR section 17 – Fitted between the engine and transmission can only be removed when the engine/transmission assembly are separated.

TRANSMISSION section 21 – Attached to the rear of the engine and supported in rubber bushes in fixed brackets and held within the frame just at the rear of the loader post.

To make repairs that require disassembly of the transmission or engine it will be necessary to remove the engine/transmission as a complete unit from the chassis.

To remove the engine/transmission from the machine it will be necessary to remove or disconnect the following:

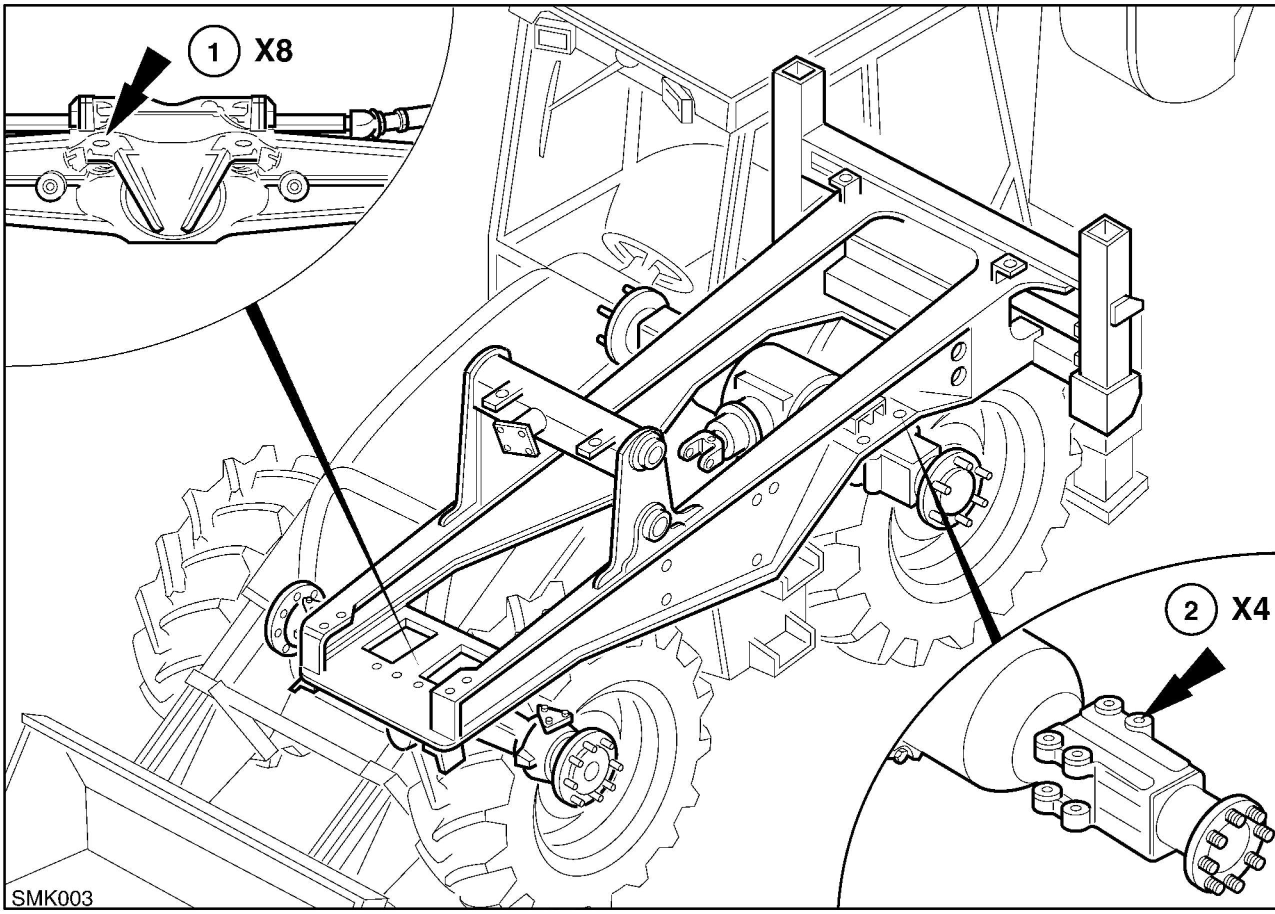
REMOVE:
Air Cleaner bowl
Engine side and top panels
Radiator's and related hoses (Or pivot forward where possible)
Front support cowling (if required)

DISCONNECT:
Fuel pump throttle cable and electric shut off
Engine harness
Fuel tank connection and leak off return pipes
Hydraulic Pump and related pipework (plug all ports as required)
Transmission Lever
Transmission harness connectors
Engine supports (with engine supported by hoist)
Transmission supports

Section 10 : Engine / Section 17 : Torque Convertor / Section 21 : Transmission

COMPONENTS	TORQUES
ENGINE	
Engine / transmission retaining bolts and nuts	95 Nm (70 lbf ft)
Engine coolant expansion tank retaining bolts	25 Nm (18 lbf ft)
Engine / transmission mounting bolts	95 Nm (70 lbf ft)
Engine top panel to support bolts	80 Nm (59 lbf ft)
Air cleaner retaining bolts to frame	25 Nm (18 lbf ft)
Air cleaner bowl to pipe clamp connection	5 Nm (3.6 lbf ft)
Coolant radiator bolts to frame	95 Nm (70 lbf ft)
Radiator hose connections (small)	5 Nm (3.6 lbf ft)
Radiator hose connections (large)	5 Nm (3.6 lbf ft)
Radiator retaining bolts to frame	95 Nm (70 lbf ft)
Fuel tank connecting hoses	5 Nm (3.6 lbf ft)
Front support cowling to frame	214 Nm (158 lbf ft)
Front bonnet to frame	170 Nm (125 lbf ft)
Upper and front bonnet to frame	80 Nm (59 lbf ft)
TRANSMISSION	
Transmission gear lever clamp bolt	90 Nm (66 lbf ft)
Hydraulic pump pipe connection (small)	35 Nm (26 lbf ft)
Hydraulic pump pipe connection (large)	120 Nm (86 lbf ft)
Power steering outlet to tank	55 Nm (41 lbf ft)
Hydraulic oil cooler to coolant radiator bolts	25 Nm (18 lbf ft)
Hose transport lock valve to gearbox	15 Nm (11 lbf ft)
Hose transport lock valve to gearbox dipstick pipe	15 Nm (11 lbf ft)
Spicer universal couplings rear and front (when FWD fitted)	38 Nm (28 lbf ft)

Section 25 : Front Axle 2, 4 WD and 4 WS / Section 27 : Rear Axle 2, 4 WD and 4 WS



Major Components attached below the chassis 5

FRONT AXLE 2WD section 25 – Mounted below the front of the chassis and held in position by the swivel pin trunnion supports attached to the underside of the chassis by 8 through bolts.

To remove the front axle it will be necessary to disconnect or remove the following with the vehicle suitably supported:

REMOVE:
Front Wheels

DISCONNECT:
Steering piston hoses
Axle swivel pin attaching bolts

FRONT AXLE 4WD section 25 – Mounted below the front of the chassis and held in position by the swivel pin trunnion supports. The axle is attached to the underside of the chassis by 8 through bolts.

To remove the front axle it will be necessary to disconnect or remove the following with the vehicle suitably supported:

REMOVE:
Front Wheels

DISCONNECT:
Steering piston hoses
Axle swivel pin attaching bolts
Spicer coupling

REAR AXLE section 27 – Attached to the frame at the rear of the machine by 4 through bolts.

To remove the Rear axle it will be necessary to disconnect or remove the following with the vehicle suitably supported:

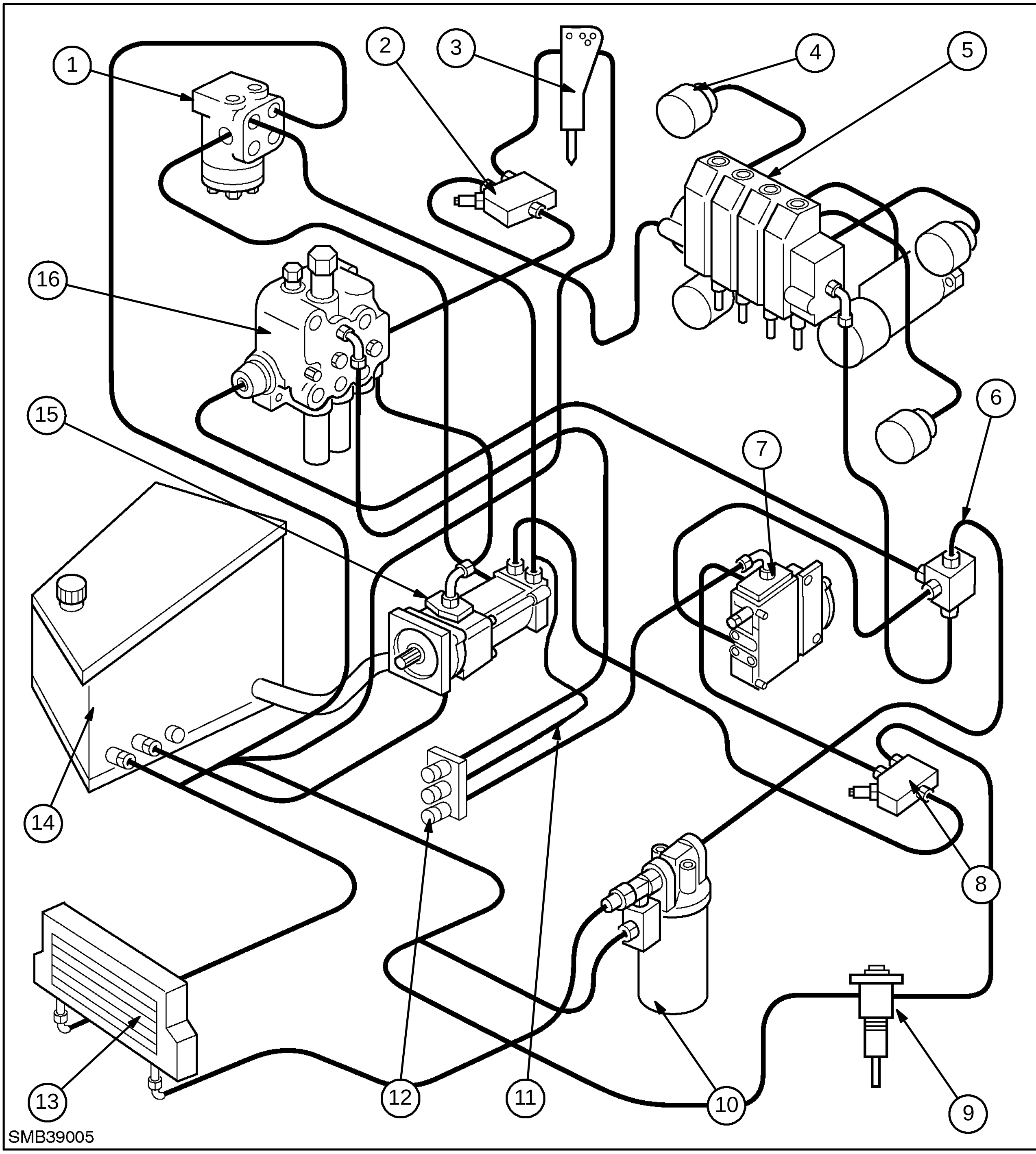
REMOVE:
Rear Wheels

DISCONNECT:
Brake piston hoses (cap all exposed ports)
Spicer coupling
Differential Lock pedal
Axle attaching bolts

Section 25 : Front Axle 2, 4 WD and 4 WS / Section 27 : Rear Axle 2, 4 WD and 4 WS

COMPONENTS	TORQUES
1. FRONT AXLE	
Font axle retaining bolts to frame	607 Nm (447 lbf ft)
Front Wheel Nuts	700 Nm (516 lbf ft)
Front axle power steering hoses	2.5 Nm (1.8 lbf ft)
Spicer coupling to transmission	38 Nm (28 lbf ft)
2. REAR AXLE	
Rear axle to frame retaining bolts	950 Nm (700 lbf ft)
Rear Wheel Nuts	700 Nm (516 lbf ft)
Front axle power steering hoses	2.5 Nm (1.8 lbf ft)
Spicer coupling to transmission	38 Nm (28 lbf ft)

Section 35 : Hydraulic Systems



Hydraulic Components attached within the chassis 6

Contained within the chassis are the hydraulic valve slices, steering motor connections all of which are interconnected by pipes and tubing to the pump and reservoir for the operation of:

IMPORTANT: *Before disconnecting any hoses relieve all pressure in the hydraulic system and have ready suitable clean containers to drain the oil into. Ensure all ports and hoses are plugged or capped to prevent dirt ingress during overhaul.*

Loader, Backhoe and related components, Stabilisers, Backhoe Hammer, Hand Hammer and Steering Motor

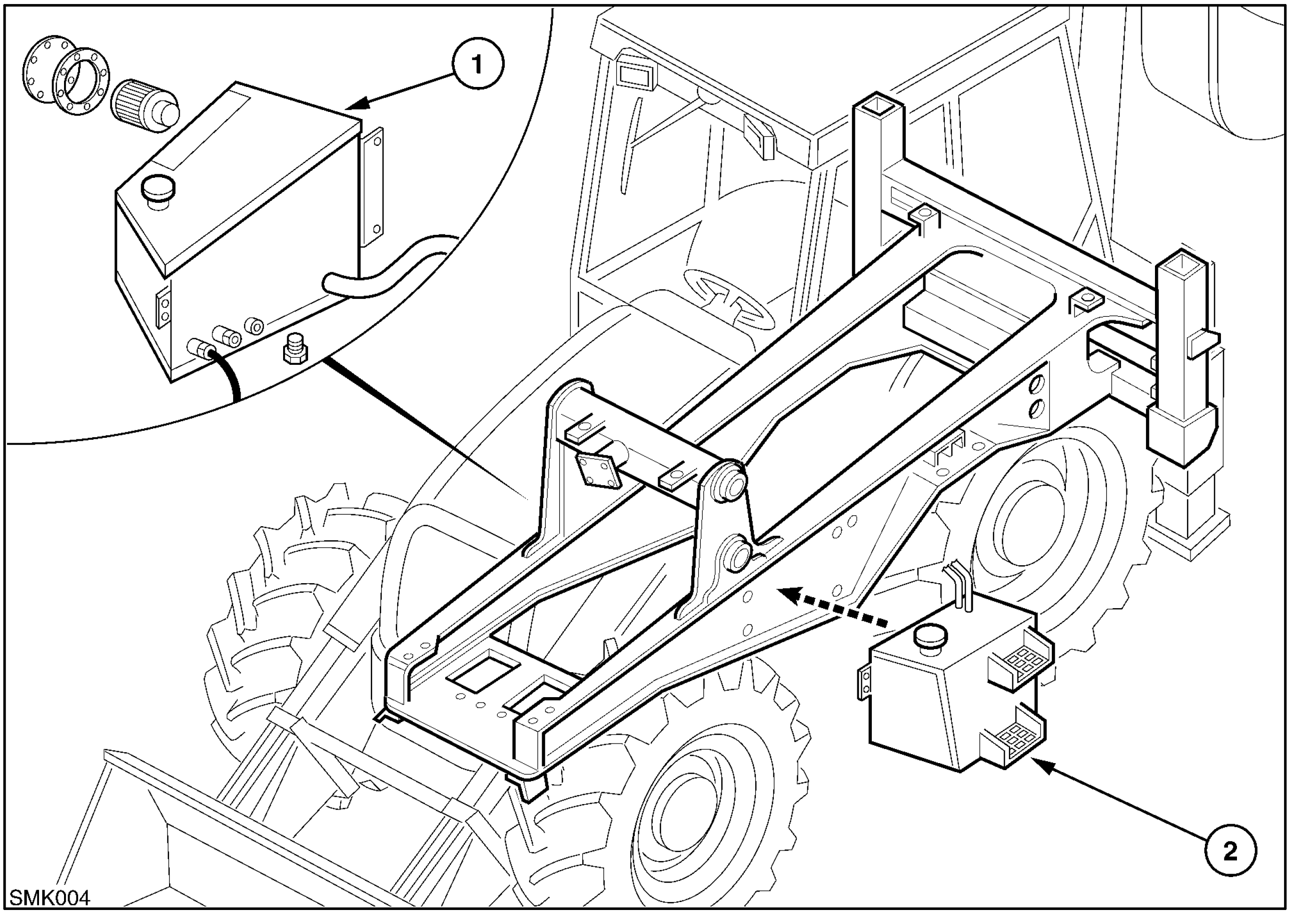
In general the hydraulic components can easily be removed from the machine. However to gain access for the removal of several items at the same time it may be beneficial to consider removal of the cab.

Section 35 : Hydraulic Systems

COMPONENTS	TORQUES
1. Power steering hoses to support frame	55 Nm (41 lbf ft)
1. Power steering outlet to tank	55 Nm (41 lbf ft)
2. Backhoe hammer valve connections (large) 85803431	190 Nm (140 lbf ft)
2. Backhoe hammer valve connections (medium) 85803428/30	160 Nm (118 lbf ft)
2. Backhoe hammer valve connections (small) 85803429	35 Nm (25 lbf ft)
4. Backhoe Clamp Valve Retaining Bolts	10 Nm (7 lbf ft)
5. Hose backhoe control valve to hydraulic oil tank	25 Nm (18 lbf ft)
5. Hoses loader valve to pump	120 Nm (88 lbf ft)
5. Hoses backhoe control valve to swing cylinders	54 Nm (40 lbf ft)
5. Hoses backhoe control valve to hydraulic reservoir	25 Nm (18 lbf ft)
5. Backhoe control valve to frame bolts	90 Nm (67 lbf ft)
6. Hoses loader control valve to return line distributor block	160 Nm (118 lbf ft)
6. Return Line Distributor Block Retaining Bolts	60 Nm (44 lbf ft)
6. Hoses hydraulic oil filter to return line distributor block	190 Nm (140 lbf ft)
6. Hoses loader control valve to return line distributor block	160 Nm (118 lbf ft)
6. Hoses backhoe control valve to return line distributor block	160 Nm (118 lbf ft)
6. Hoses stabiliser control valve to return line distributor block	120 Nm (88 lbf ft)
7. Hoses loader control valve to stabilisers control valve	120 Nm (88 lbf ft)
8. Hose connections to hand hammer valve (large)	85 Nm (63 lbf ft)
8. Hose connections to hand hammer valve (small)	36 Nm (26 lbf ft)
10. Hoses oil filter to oil reservoir	190 Nm (140 lbf ft)
11. Hose transport lock valve to gearbox dipstick pipe	15 Nm (11 lbf ft)
12. Hoses to pressure ports	35 Nm (35 lbf ft)
12.Pressure ports plate retaining bolts	25 Nm (18 lbf ft)
13. Hoses hydraulic heat exchanger to oil tank	160 Nm (118 lbf ft)
14. Oil reservoir hose connections	500 Nm (369 lbf ft)
15. Loader control pipes clamp to frame	25 Nm (18 lbf ft)
15. Hoses loader control valve to backhoe control valve	160 Nm (118 lbf ft)
15. Hydraulic pump to transmission attaching nuts	90 Nm (67 lbf ft)
15. Hoses loader valve to pump	120 Nm (88 lbf ft)
15. Hoses loader valve to pipes	85 Nm (63 lbf ft)
16. Hoses stabilisers valve to pump	85 Nm (63 lbf ft)
– Pipes lockout valves to stabiliser cylinder (where fitted)	55 Nm (41 lbf ft)

- Hoses lockout valve (where fitted) . . . . 55 Nm (41 lbf ft)
- Hoses backhoe control valve to swing cylinder retaining clamps . . . . 50 Nm (37 lbf ft)
- Hoses backhoe control valve to swing post 5/8” . . . . 120 Nm (88 lbf ft)
- Hoses backhoe control valve to swing post 1/2” . . . . 85 Nm (63 lbf ft)

Section 39 : Vehicule Chassis



Components attached to chassis exterior 7

RESERVOIR TANKS – Attached to the chassis below the cab are the tanks for the Hydraulic system mounted to the right hand side of the machine and the fuel tank mounted to the left hand side of the machine.

Both tanks when drained of there contents can be removed from the machine by removal of the attaching pipe work and supporting bolts.

IMPORTANT: *Ensure all ports and pipes are plugged or blanked off to prevent dirt ingress.*

8

Section 39 : Vehicule Chassis

COMPONENTS TORQUES

OIL RESERVOIR (1)

Holding bolts . . . . 85 Nm (63 lbf ft)

Step attaching bolts . . . . 49 Nm (36 lbf ft)

Filter retaining plate to tank . . . . 12 Nm (8.8 lbf ft)

Drain plug . . . . 250 Nm (184 lbf ft)

Hose backhoe control valve to hydraulic oil reservoir . . . . 25 Nm (18 lbf ft)

Hoses oil filter to oil reservoir . . . . 190 Nm (140 lbf ft)

Hoses heat exchanger to oil reservoir . . . . 160 Nm (118 lbf ft)

Filler tube plate retaining bolts . . . . 12 Nm (8.8 lbf ft)

Power steering outlet to reservoir . . . . 55 Nm (40 lbf ft)

FUEL TANK (2)

Holding bolts . . . . 85 Nm (63 lbf ft)

Step attaching bolts . . . . 49 Nm (36 lbf ft)

Fuel sender to tank . . . . 1.7 Nm (15 lbf in)

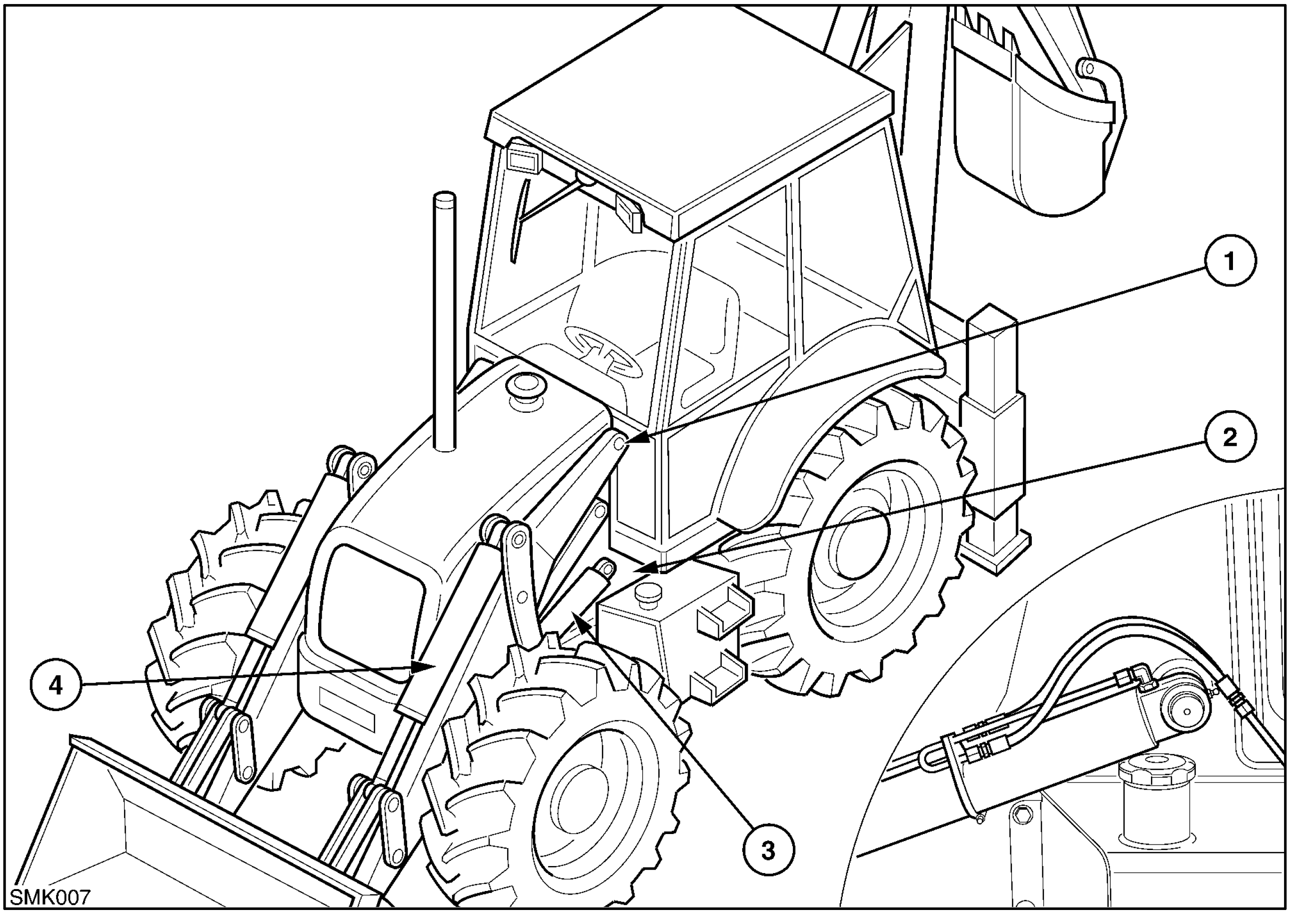
Fuel drain plug . . . . 250 Nm (184 lbf ft)

Hose connections to tank . . . . 500 Nm (369 lbf ft)

BALLAST

Chin weight . . . . 500 Nm (369 lbf ft)

Section 82 : Loader



Loader 9

LOADER section 82 – Attached in position by pins and retained by bolts the loader frame can be removed as an assembly from the machine.

Removal of the loader is achieved by disconnection or removal of the following with the loader fully supported:

IMPORTANT: *Before disconnecting any hoses or cylinders relieve all pressure in the hydraulic system and have ready suitable clean containers to drain the oil into. Ensure all ports and hoses are plugged or capped to prevent dirt ingress during overhaul.*

DISCONNECT:

Leveling Arm
Pivot Pins
Loader pivot cross shaft upper
Lift cylinder hoses
Bucket cylinder hoses
loader pivot support shafts lower

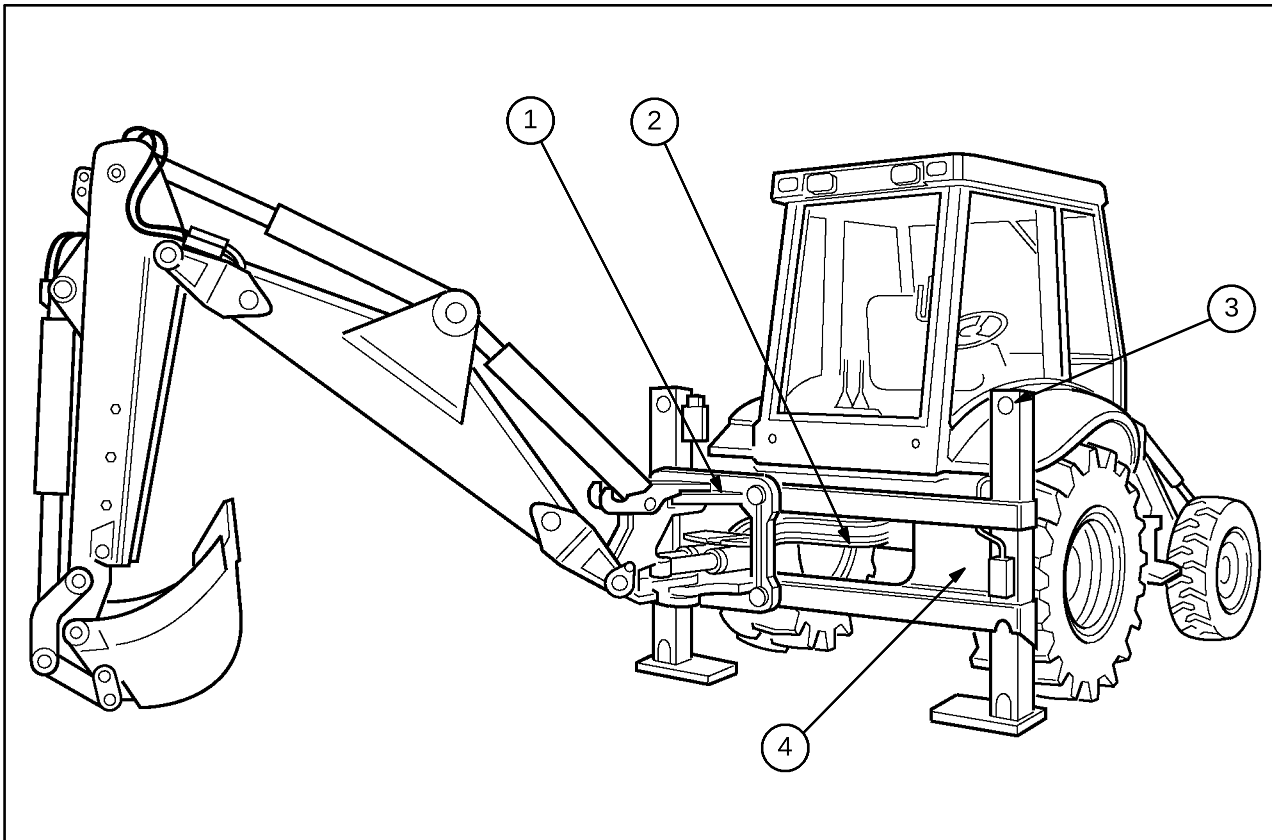
REMOVE:

Bucket

Section 82 : Loader

COMPONENTS	TORQUES
LOADER HOSES AND CONNECTIONS	
1. Loader control pipe bracket to frame	25 Nm (18 lbf ft)
2. Loader lifting cylinders elbows	55 Nm (41 lbf ft)
3. Loader bucket cylinder elbows	55 Nm (41 lbf ft)
4. Bucket cylinder hoses	55 Nm (41 lbf ft)
Hoses loader valve to pipes	85 Nm (63 lbf ft)
Loader Hoses	55 Nm (41 lbf ft)

Section 84 : Backhoe



Backhoe 10

BACKHOE section 84 – Disassembly of the backhoe is similar for both sideshift and centre pivot models upto the swing post.

IMPORTANT: *Before disconnecting any hoses or cylinders relieve all pressure in the hydraulic system and have ready suitable clean containers to drain the oil into. Ensure all ports and hoses are plugged or capped to prevent dirt ingress during overhaul.*

To remove the backhoe it will be necessary to disconnect or remove the following with the backhoe fully supported:

DISCONNECT;

Hoses (de–pressurise the system first)

REMOVE:

Sideshift only – Backhoe support frame to chassis

Sideshift Backhoe

The backhoe on sideshift models is attached to a frame that is attached to the vehicle and can traverse the rear of the machine. For disassembly purposes the backhoe and its support frame can be removed from the machine.

Centre Pivot Backhoe

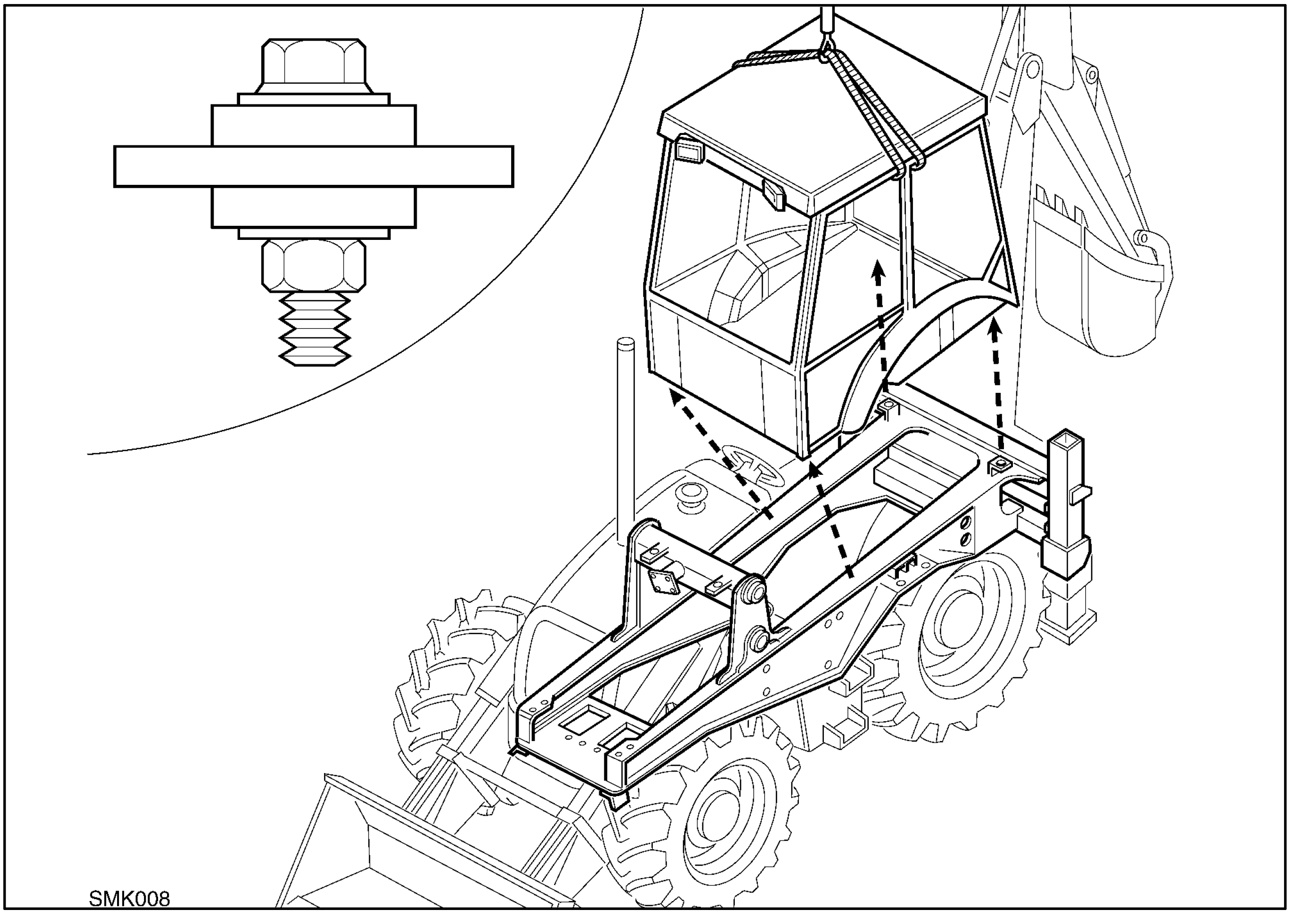
On centre pivot models the backhoe is connected directly to the chassis and can be removed from the machine at that point.

In the following pages are the torque figures for the various assemblies that will may removed to affect repairs

Section 84 : Backhoe

COMPONENTS	TORQUES
BACKHOE	
1. Backhoe sideshift to frame retaining bolts	800 Nm (590 lbf ft)
2. Backhoe to frame hose retaining clamps	52 Nm (38 lbf ft)
Backhoe Clamp Valve Retaining Bolts	10 Nm (7 lbf ft)
Pipes lockout valves to stabiliser cylinder (where fitted)	55 Nm (41 lbf ft)
Transport lock cylinder retaining bolts	25 Nm (18 lbf ft)
BACKHOE HOSES	
Hose transport lock valve to transmission	15 Nm (11 lbf ft)
Hose transport lock valve to transmission dipstick pipe	15 Nm (11 lbf ft)
Hoses backhoe control valve to boom (large)	120 Nm (88 lbf ft)
Hoses backhoe control valve to boom (small)	85 Nm (63 lbf ft)
Hoses backhoe control valve to swing cylinders retaining clamps	50 Nm (37 lbf ft)
Hoses backhoe control valve to swing post 5/8in	120 Nm (86 lbf ft)
Hoses backhoe control valve to swing post 1/2in	85 Nm (63 lbf ft)
Hoses backhoe control valve to swing cylinders	54 Nm (40 lbf ft)
STABILISERS	
3. Stabilisers Upper Pins Retaining Bolt	80 Nm (59 lbf ft)
Stabiliser elbows	81 Nm (60 lbf ft)
Hoses lockout valves (where fitted)	55 Nm (41 lbf ft)
MISCELLANEOUS	
4. Rear Shield to frame bolts	52 Nm (38 lbf ft)

Section 90 : Cab



Major Components attached above the chassis 11

CAB section 90 – the cab frame being a one piece unit is mounted on top of the chassis and retained by 4 fixing bolts between the cab mounts to the chassis.

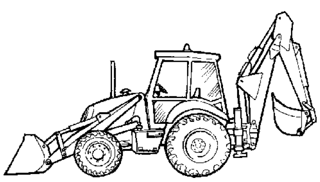
Removal of the cab requires disconnection or removal of the following with the cab fully supported by a hoist:

Cab skirts
Throttle cable to Fuel Pump
Differential lock pedal
Hydraulic Brake Pipes
Loader Lever linkage
Transmission Gear Lever
Main harness connections
Cab attaching bolts

IMPORTANT: *When lifting the cab ensure the hydraulic brake reservoirs are not caught and damaged on the loader support frame.*

Section 90 : Cab

COMPONENTS	TORQUES
CAB	
Cab support	450 Nm (332 lbf ft)
Front cab retaining bolts	214 Nm (158 lbf ft)
Rear cab retaining bolts	180 Nm (133 lbf ft)
SHEET METAL	
Bonnet Front casting to frame	214 Nm (158 lbf ft)
Upper and front bonnet retaining bolts	80 Nm (59 lbf ft)
Front bonnet to frame	170 Nm (125 lbf ft)



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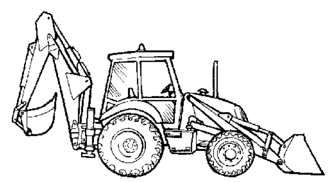


SECTION 41 - STEERING SYSTEMS

Chapter 1 - Steering for 2 and 4 Wheel Drive Only

CONTENT

SPECIFICATIONS

Pump

Oil .... Multi G API GL4, ISO 32/46

Output at 2200 revs/min @ Standby Pressure .... 62.7 litres/min (16.6 US.gals/min)

Steering Motor

Type .... Hydrostatic Load Sensing

Displacement .... 120 cc / rev

Steering Wheel Turns Lock to Lock

Four-Wheel Drive Axle 4.0

Two Wheel Drive 3.8

Steering Pressure Relief Valve .... 136.5 – 143.5 bar (999.25 – 1100.75 psi)

Standby Pressure .... 7 bar (101.5 psi)

TIGHTENING TORQUES

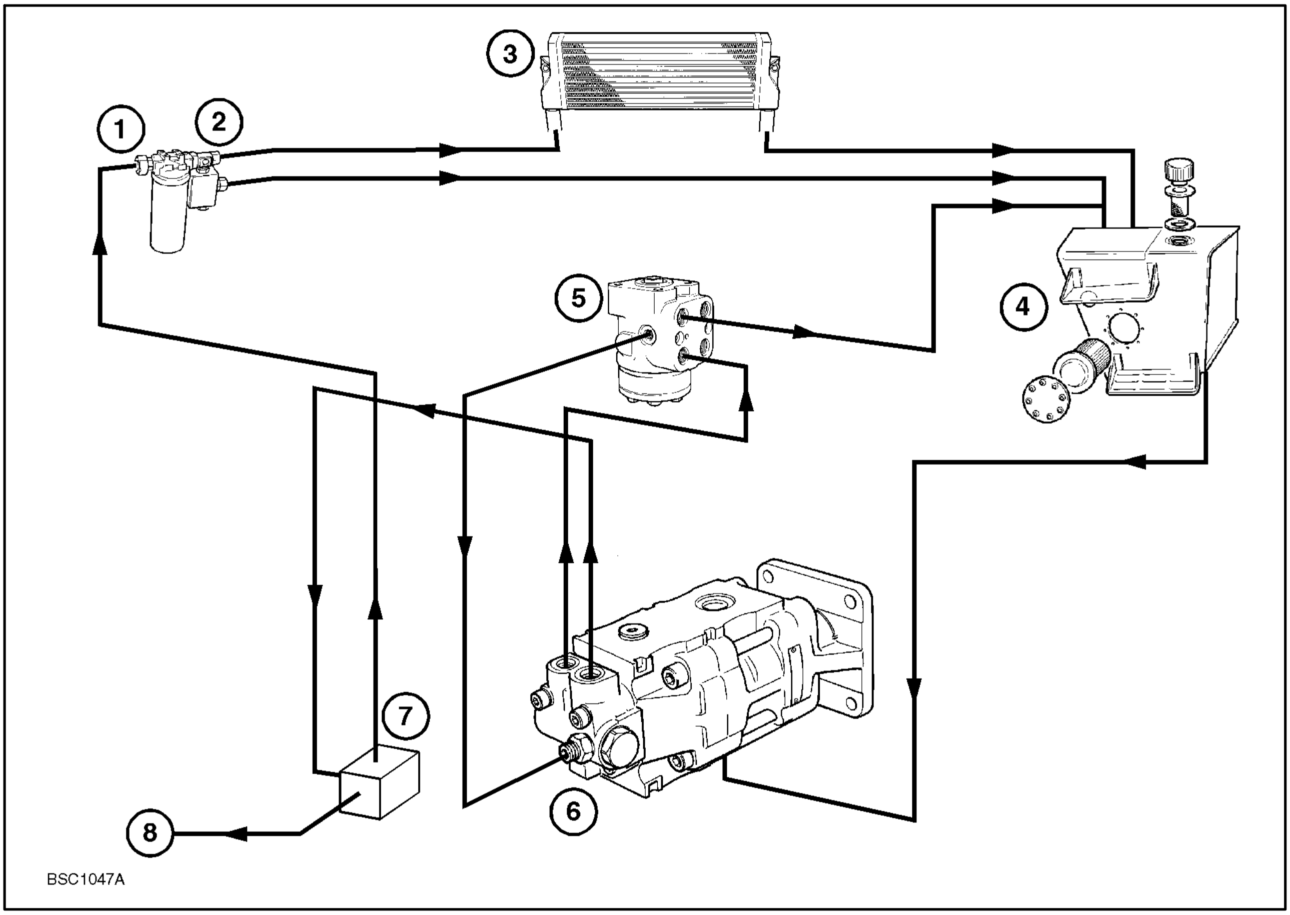
	ft. lbs.	N·m	kgf.m
Steering Wheel Nut	41.0	55.0	5.6
Steering Motor to Steering Column Bracket	17.0	23.0	2.3
Steering Motor End Cover	22.0	30.0	3.0
Steering Motor Pipe Connections	35.0	45.0	4.5
Steering Motor Pipe Adaptors	40.0	55.0	4.0
Steering Cylinder Ball-joint Clamps	32.0	43.0	4.4
Steering Cylinder Ball-joint Nuts	130.0	176.0	18.0
Steering Cylinder Extension Tube to Cylinder	200.0	271.0	27.5
Steering Pump Body Through Bolts	26.0	35.3	3.6
Steering Pump Drive Gear Nut	31.0	42.0	4.3
Steering Pump to Front Cover Bolt	23.0	31.2	3.2
Steering Pump Reservoir Bolt	12.0	16.3	1.7
Steering Pump Relief Valve	31.0	42.0	4.2
Check Valve Bolt	22.0	30.0	4.0

SPECIAL TOOLS

DESCRIPTION

Seal Installer	Danfoss No. SJ.
Pressure Test Quick Release Coupler	Part No 291924

DESCRIPTION AND OPERATION



1

Steering System Layout

1. Hydraulic System Filter
2. Oil Cooler By-Pass Valve
3. Hydraulic Oil Cooler
4. Hydraulic System Reservoir
5. Steering Motor
6. Flow Divider
7. Hand Hammer Control Valve
8. Stabilizer and Extendible Dipper Control Valves

The hydrostatic steering system features;

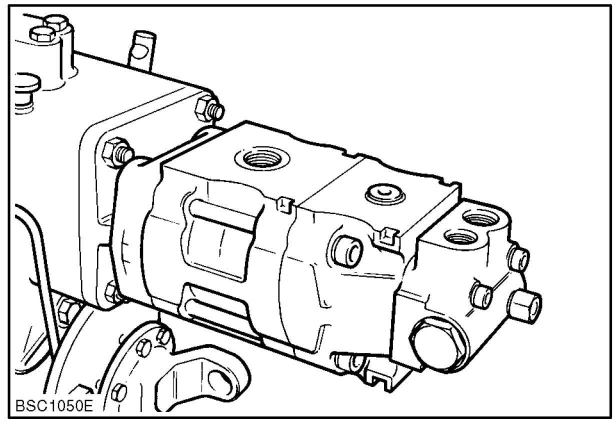
- Double acting, balanced type steering cylinder on both 2 and 4WD axles.
- Common hydraulic reservoir with the main hydraulic system.
- Steering pump located on the rear of the transmission which has a priority valve giving up to 62.7 L/min (16.6 US.gals) at 2200 rev/min.
- Oil cooler and filter is an integral part of the hydraulic system.
- A closed centre steering motor is used.

The backhoe loader is fitted with two hydraulic pumps mounted on the rear of the transmission. Both pumps are driven by a shaft running directly off the flywheel. Oil is drawn through the common inlet port into both pumping elements. The front pump flow is directed to the loader and backhoe control valves and side shift clamping system.

Rear pump flow passes through the flow divider valve which maintains priority oil flow to the steering system with remaining flow directed for stabilisers, loader and backhoe elements.

The flow divider, located on the rear of the pump, comprises a load sensing valve and steering system pressure relief valve.

The valve ensures a priority oil flow to the steering system while the steering is operated, with the remaining flow directed to the stabiliser, loader and backhoe circuits.



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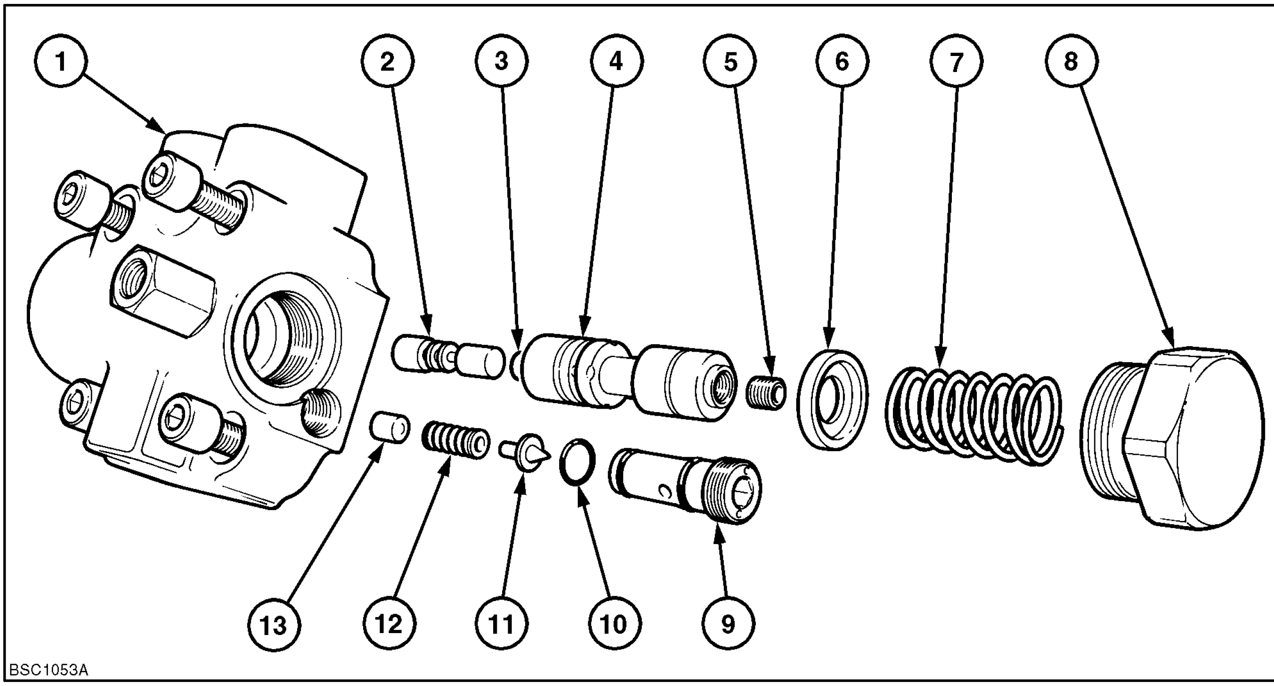
Flow Divider



3

Steering Flow Divider

1. Housing
2. Valve
3. O Ring
4. Spool
5. Adjuster
6. Spring Seat
7. Spring
8. Cap
9. Adjuster
10. O Ring
11. Relief Valve
12. Spring
13. Seat

The flow divider located on the rear of the pump comprises of a load sensed priority valve and steering system pressure relief valve.

The load sense valve ensures that a priority oil flow to the steering system is maintained while steering the vehicle, with remaining flow directed to the stabiliser, loader and backhoe circuits.

NOTE: *Flow from the rear pump on entering the loader and backhoe circuits combines with the flow from the front pump to provide increased flow.*

Operation

Flow from the rear pump enters the flow divider at inlet port (1).

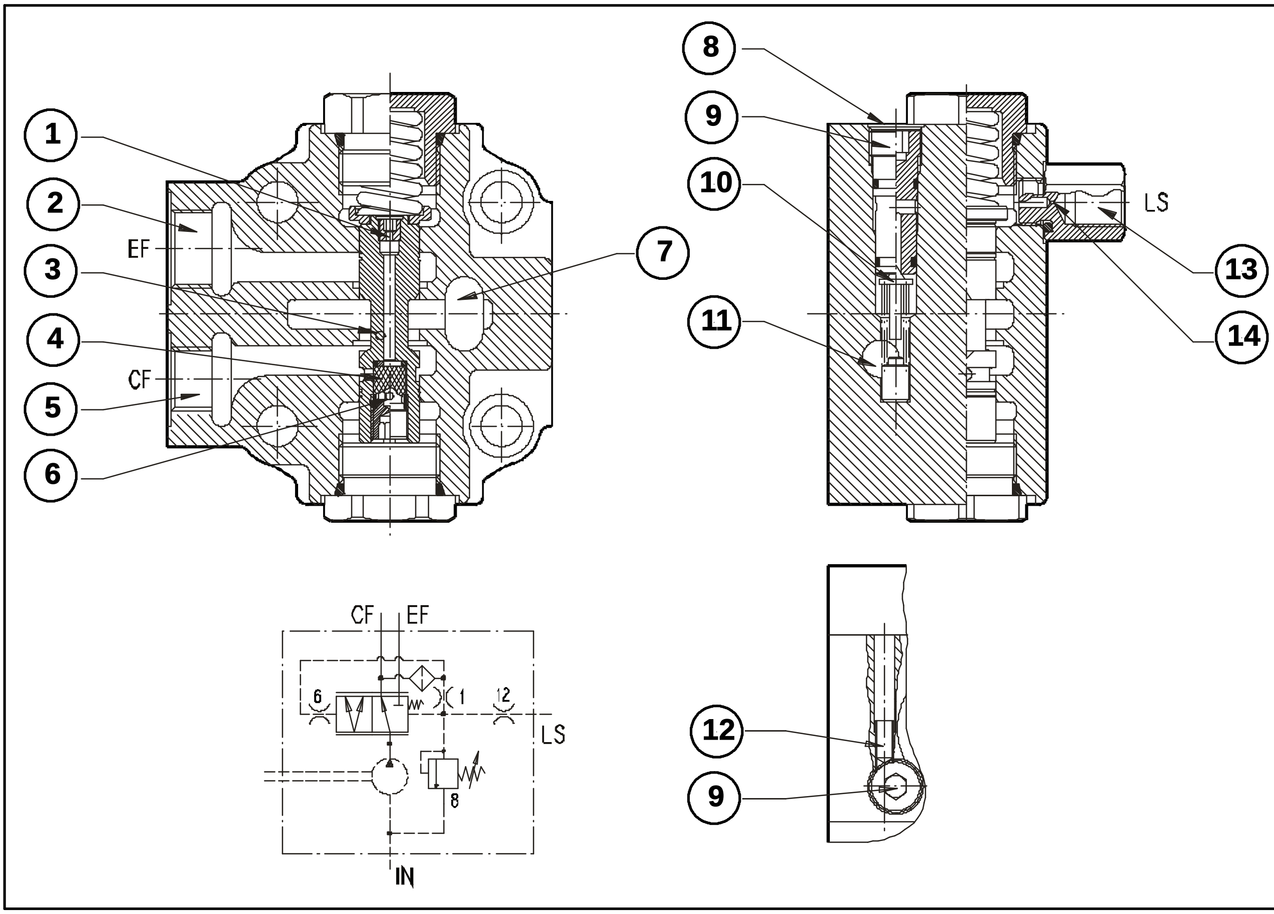
The spring force on the end of the spool holds the spool to the left enabling flow to pass into steering port (3).

Pump flow also passes into centre of spool enabling pump pressure to be sensed through the orifice on the left hand end of the spool. A smaller orifice in the right hand end of the spool also senses pump pressure but acts as a damper to prevent erratic movement of the spool.

When the steering system is in neutral the spring holds the spool to the right until pump pressure reaches a minimum of 7 bar. The pump pressure sensed through orifice (12) can now overcome spring pressure and move the spool to the right restricting flow to the steering motor.

Flow from the rear pump is now directed to the stabiliser and loader/backhoe circuits through port (2) whilst maintaining the 7 bar standby pressure to the steering circuit.

LOAD SENSING VALVE



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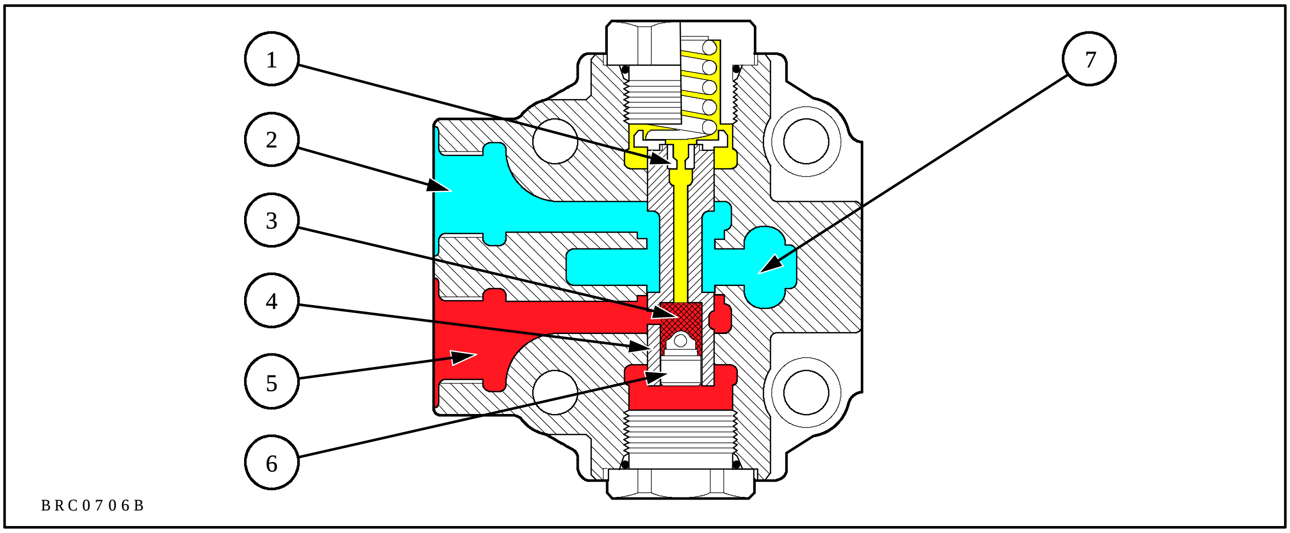
Load Sensing Valve (with pump not running)

1. Orifice
2. To steering priority flow (EF)
3. Filter
4. Spool
5. Backhoe Circuits (CF)
6. Orifice
7. Inlet Port from Rear Pump (IN)
8. Steering Relief Valve
9. Relief Valve Adjuster
10. Poppet
11. Return to Inlet Pump Port
12. Lock Plug
13. Load Sensing Signal (LS)
14. Orifice

When the steering is in neutral the LS port is connected to the unload (through the steering) and the steering inlet port (CF) is open.

LOAD SENSING VALVE



5

Load Sensing Valve with Pump Running – Steering in Neutral

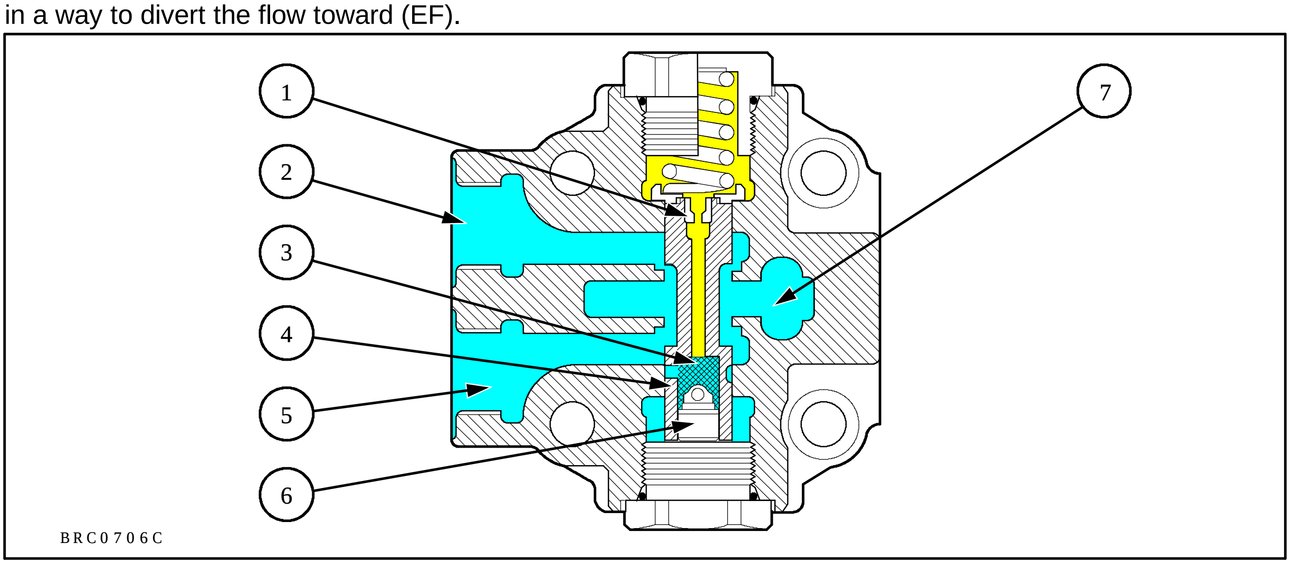
Pressure Oil

Return to Reservoir Oil

Trapped Oil

1. **1.** Orifice
2. **2.** To steering priority flow
3. **3.** Filter
4. **4.** Spool
5. **5.** Backhoe circuits (CF)
6. **6.** Oifice
7. **7.** Inlet Port (from rear port)

The pressure on (CF) increases until the pressure value (standby pressure) is sufficient to move the spool valve in a way to divert the flow toward (EF).



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Load Sensing Valve with Pump Running – Steering working

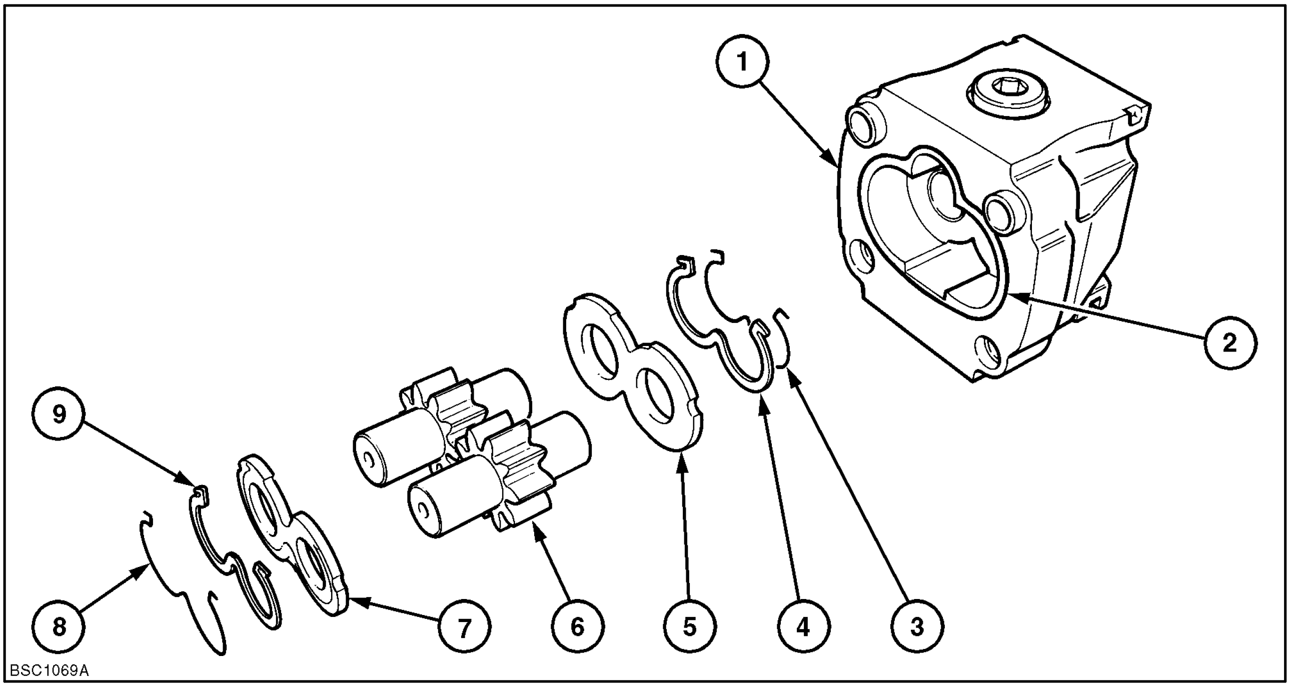
1. **1.** Orifice
2. **2.** To steering priority flow
3. **3.** Filter
4. **4.** Spool
5. **5.** Backhoe circuits (CF)
6. **6.** Oifice
7. **7.** Inlet Port (from rear port)

During steering two actions are performed:

1. The fluid moves to the steering through (CF)
2. The (LS) signal is in communication to the steering

FAULT FINDING - STEERING

PROBLEM	POSSIBLE CAUSES	CORRECTION
No steering or excessive effort required to steer	1. Incorrect oil level in reservoir.	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of air
	3. Pump relief valve faulty	3. Check system pressure
	4. Worn pump	4. Inspect and repair
	5. Leaking power cylinder	5. Inspect and repair
	6. Damaged valve spool	6. Inspect and replace
	7. Broken or damaged steering column	7. Inspect and replace
	8. Damaged or worn metering element	8. Inspect and replace
Steering wanders	1. Excessive play in steering linkage ball joints	1. Inspect and replace
	2. Leaking power cylinder	2. Inspect and repair
	3. Control valve spool sticking or worn	3. Inspect and replace
	4. Damaged or worn metering element	4. Inspect and replace
Front wheels surge when steering	1. Leaking power cylinder	1. Inspect and repair
	2. Control valve spool sticking	2. Inspect and repair
	3. Damaged or worn metering element	3. Inspect and replace
Noisy pump	1. Incorrect oil level in reservoir	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of oil
	3. Water in oil	3. Drain and replace the oil
	4. Worn Pump	4. Replace Pump



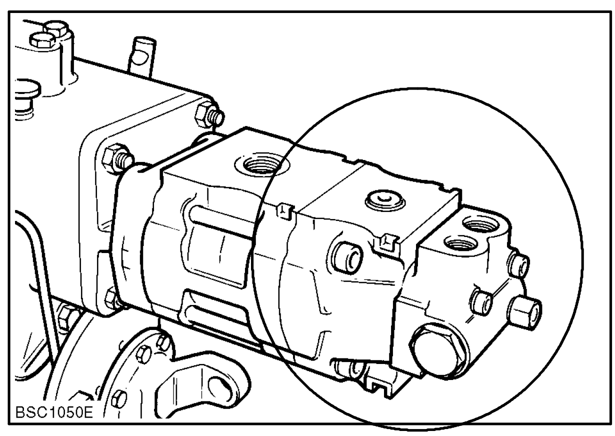
7

Rear Pump Assembly

1. Pump Body
2. 'O' Ring Seal
3. Back-up Seal
4. Pressure Seal (Rubber)
5. Bearing Block
6. Pump Gears
7. Bearing Block
8. Back-up Seal
9. Pressure Seal (Rubber)

OVERHAUL

Steering pump overhaul (rear pump), refer to the hydraulic pump section.



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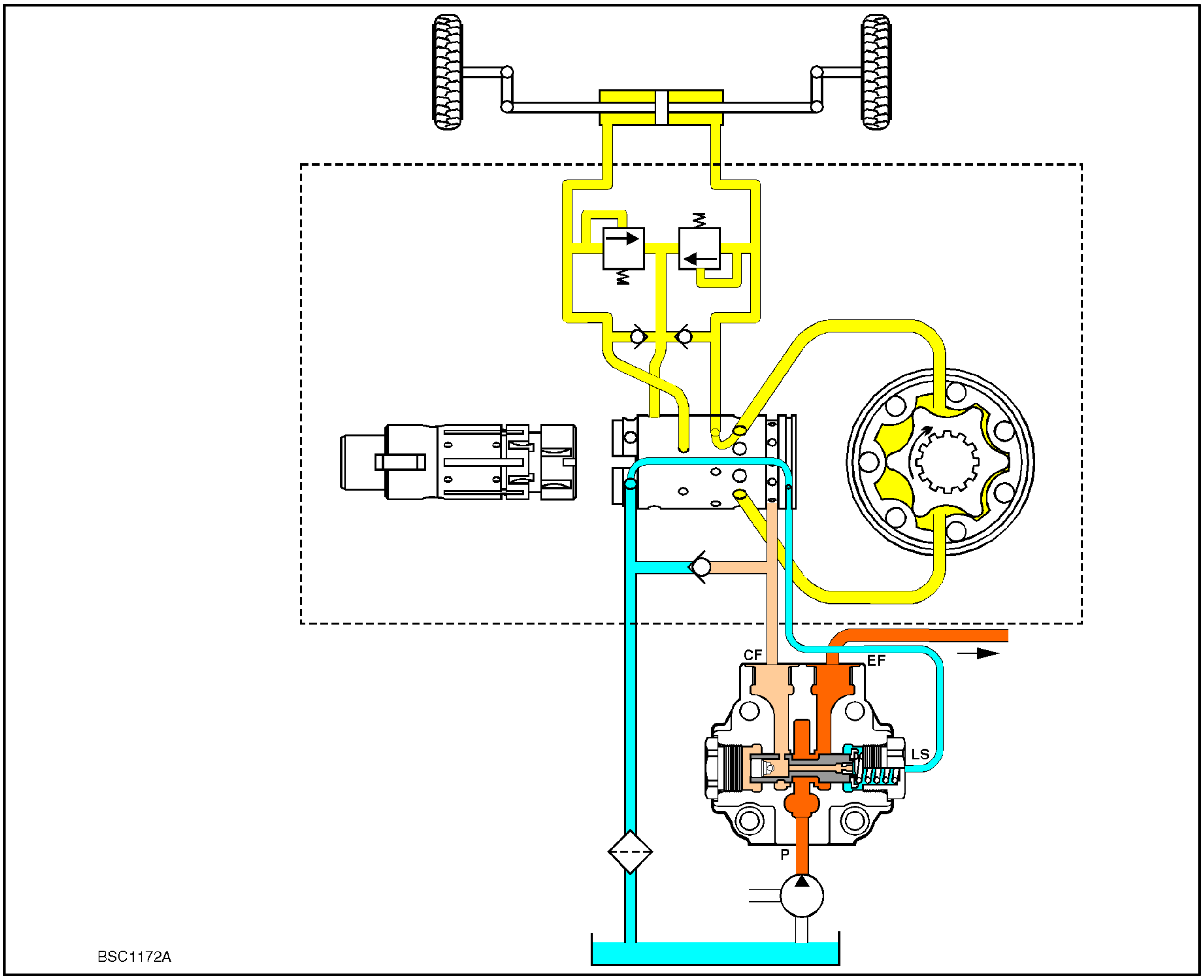


9

Steering Motor – Neutral

Pump Pressure

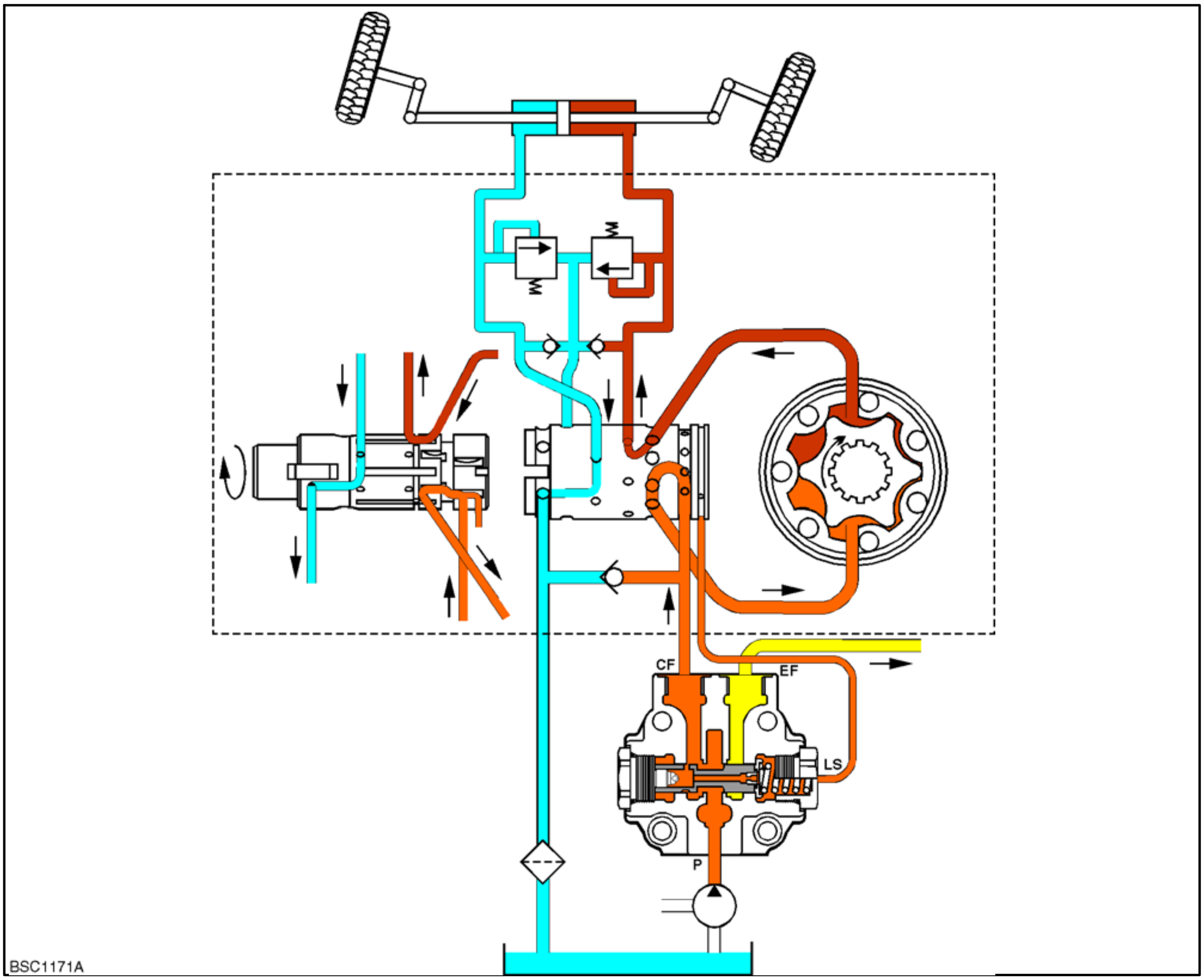
Standby Pressure

Trapped Oil

Return to Reservoir

When the steering wheel is held still, the leaf springs return and hold the spool and sleeve in the neutral position.

This ensures no more oil is supplied to the steering cylinder. The sleeve also traps the oil in the steering cylinder and allows oil in the sensing lines to return to tank therefore allowing the priority flow divider to move to the left.



10

Steering Motor - Turning Right

Pump Pressure	Trapped Oil
Metered Pressure	Return to Reservoir

When the steering wheel is turned, the movement of the control valve spool in its sleeve forms a series of passages. During right turn, oil flows through the sleeve along a groove in the valve spool and into a passage in the steering motor housing which leads to the metering unit. A gallery is also lined up to allow pressure oil to flow down the sensing line to the priority flow divider.

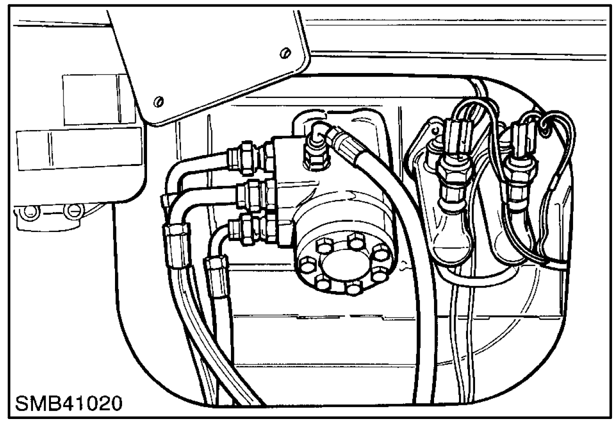
As the metering unit is turned by the drive shaft, it directs a measured quantity of oil along another set of passages in the spool and sleeve then from these to the steering cylinder.

Return oil from the other side of the cylinder is directed through the valve spool and sleeve to a return passage in the housing.

The secondary relief valves regulated to 240 bar protect the hydraulic system between the cylinder and steering motor.

System Overhaul

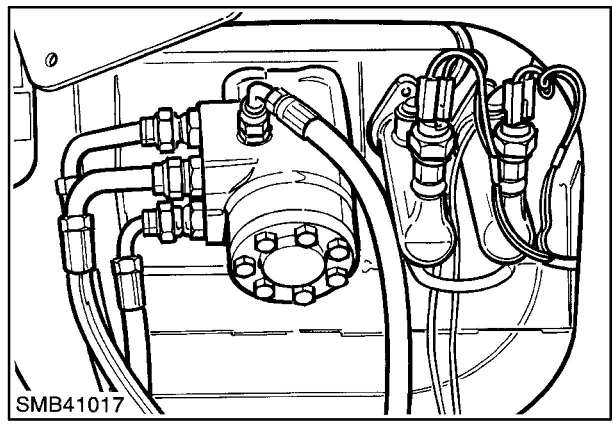
To gain access to the steering motor the bonnet and air cleaner should be removed.



11

Removing Steering Motor

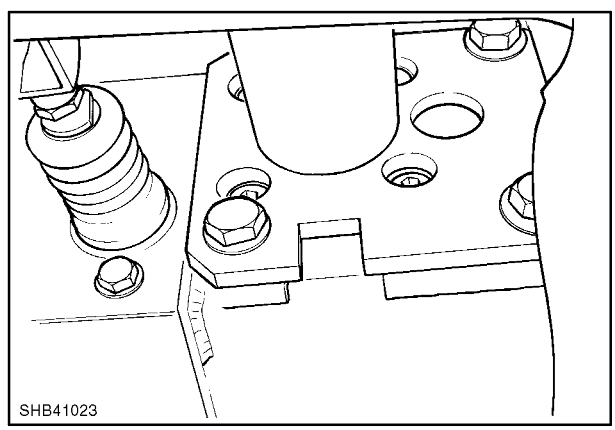
Disconnect the four connectors and collect the 'O' ring seals, noting the connector positions.



12

Remove the four Allen screws from within the cab.

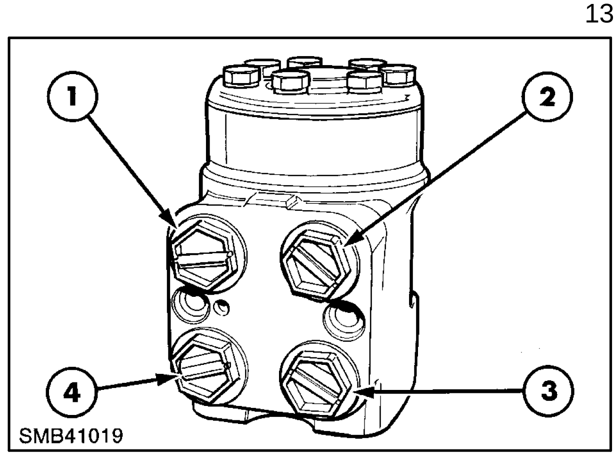
The motor can be removed from the front of the cab through the engine compartment.



13

Steering motor ports.

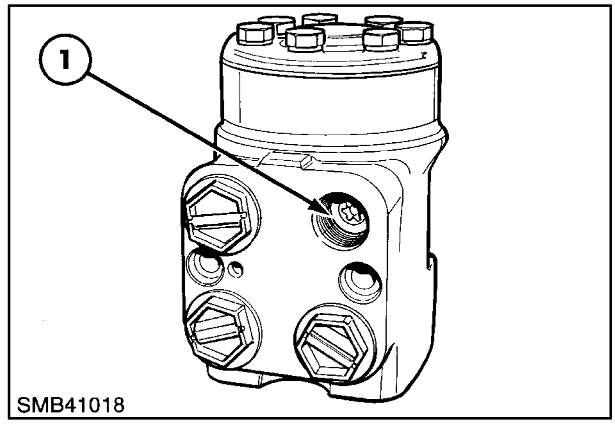
1. Left hand of cylinder
2. Pump in
3. Pump return
4. Right hand of cylinder



14

Supply line non return valve.

1. Non return valve

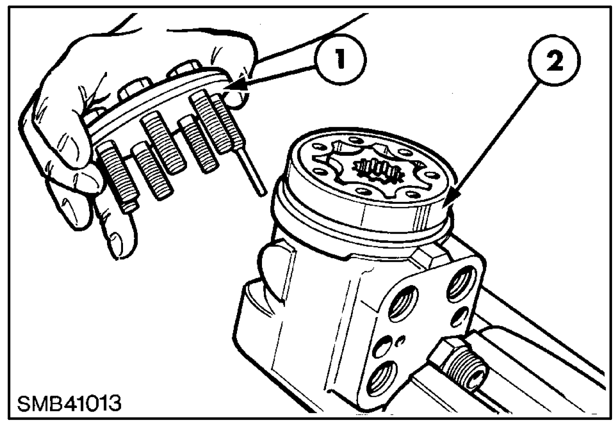


15

End plate removal

NOTE: *The position of the pin bolt must remain the same upon re-assembly of the end cap.*

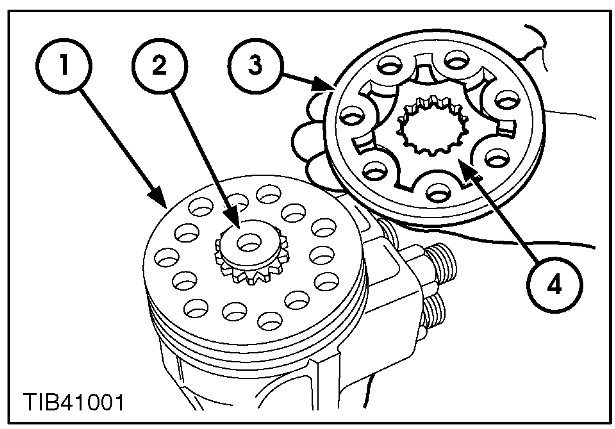
1. End plate
2. Pump body



16

Metering unit removal

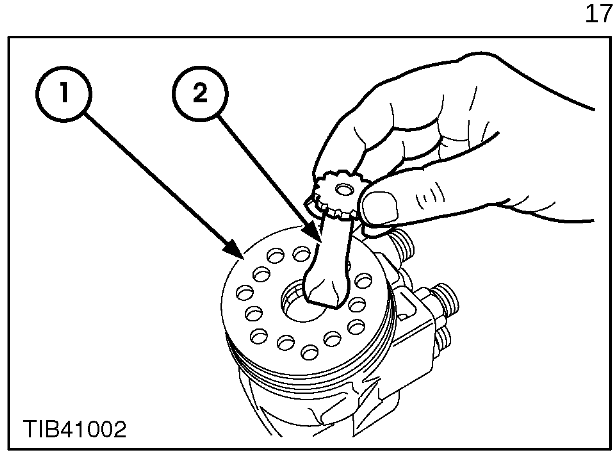
1. Steering motor
2. Driving link
3. Stator
4. Rotor



17

Drive link removal

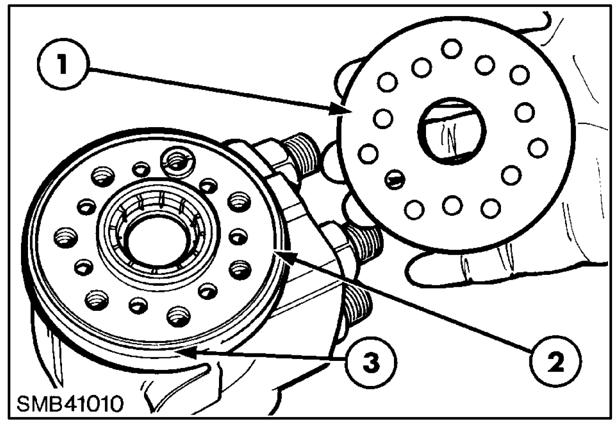
1. Steering motor body
2. Drive link



18

Valve plate removal

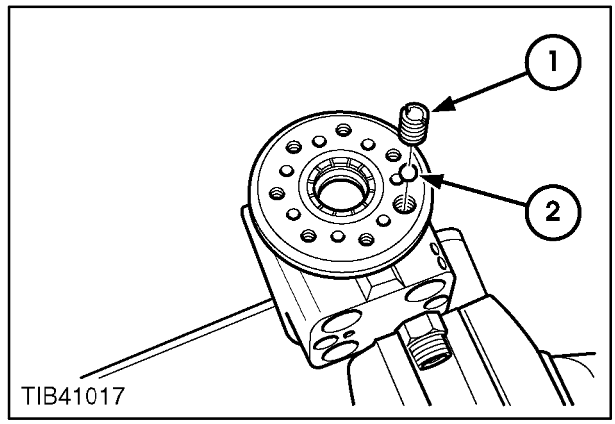
1. Body
2. Valve Plate



19

Check valve removal

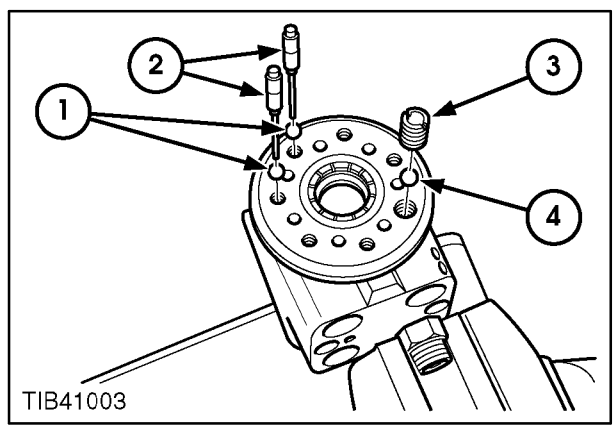
1. Retainer cap
2. Check valve



20

Suction and check valves

1. Suction valve balls
2. Suction valve rods
3. Retainer cap
4. Check valve

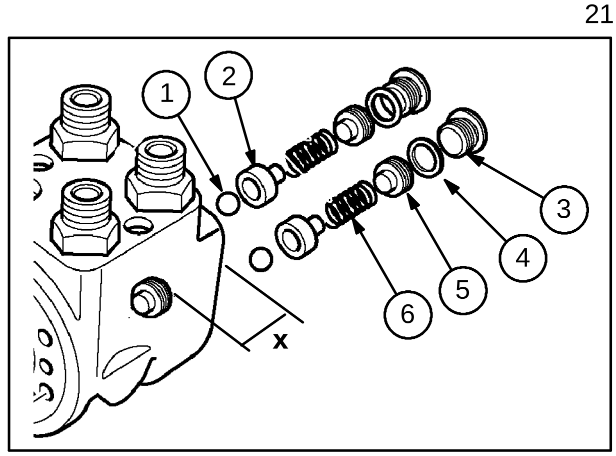


21

Cylinder Relief Valves

IMPORTANT: *Before removal of the cylinder relief for cleaning valves if necessary remove the end plug and seal. Measure at, (x) using a depth gauge, the distance from the outer body to the head of the adjuster (5) and record the results. Upon re-assembly reset the adjuster to the exact depth previously recorded.*

1. Ball
2. Seat
3. End Plug
4. Seal
5. Adjuster
6. Spring

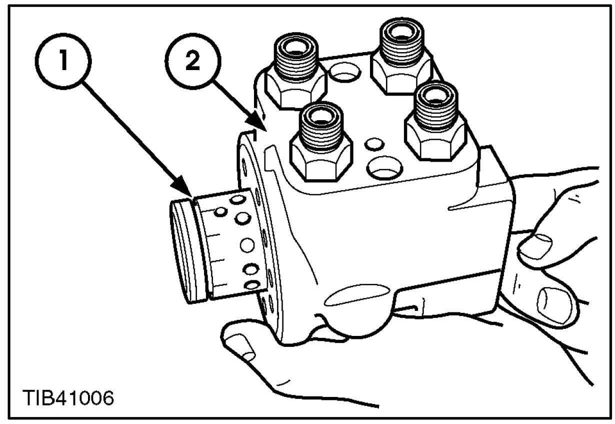


22

Control valve removal

1. Control valve
2. Housing

NOTE: *When removing the control valve spool and sleeve, ensure drive pin is in a horizontal position so that it cannot fall into an integral gallery and make removal difficult.*

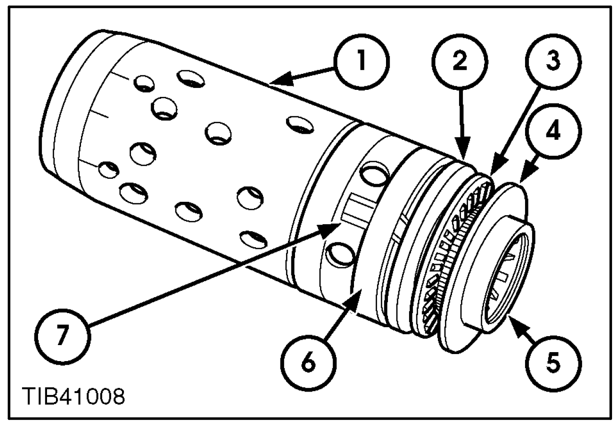


23

Control valve

1. Control valve sleeve
2. Washer
3. Thrust bearing
4. Washer
5. Spool
6. Centring springs retainer
7. Centring springs

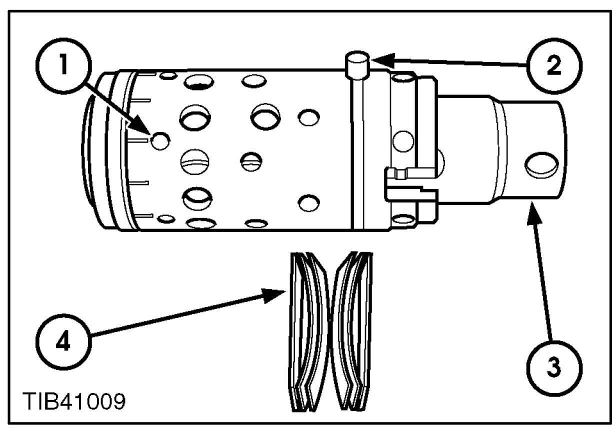
NOTE: *The thick washer must be reinstated with internal diameter chamfer toward the valve sleeve.*



24

Drive pin and centring springs

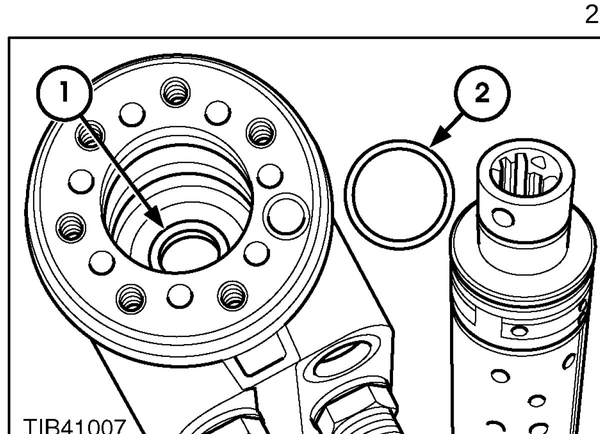
1. Control valve
2. Drive pin
3. Spool
4. Centring springs



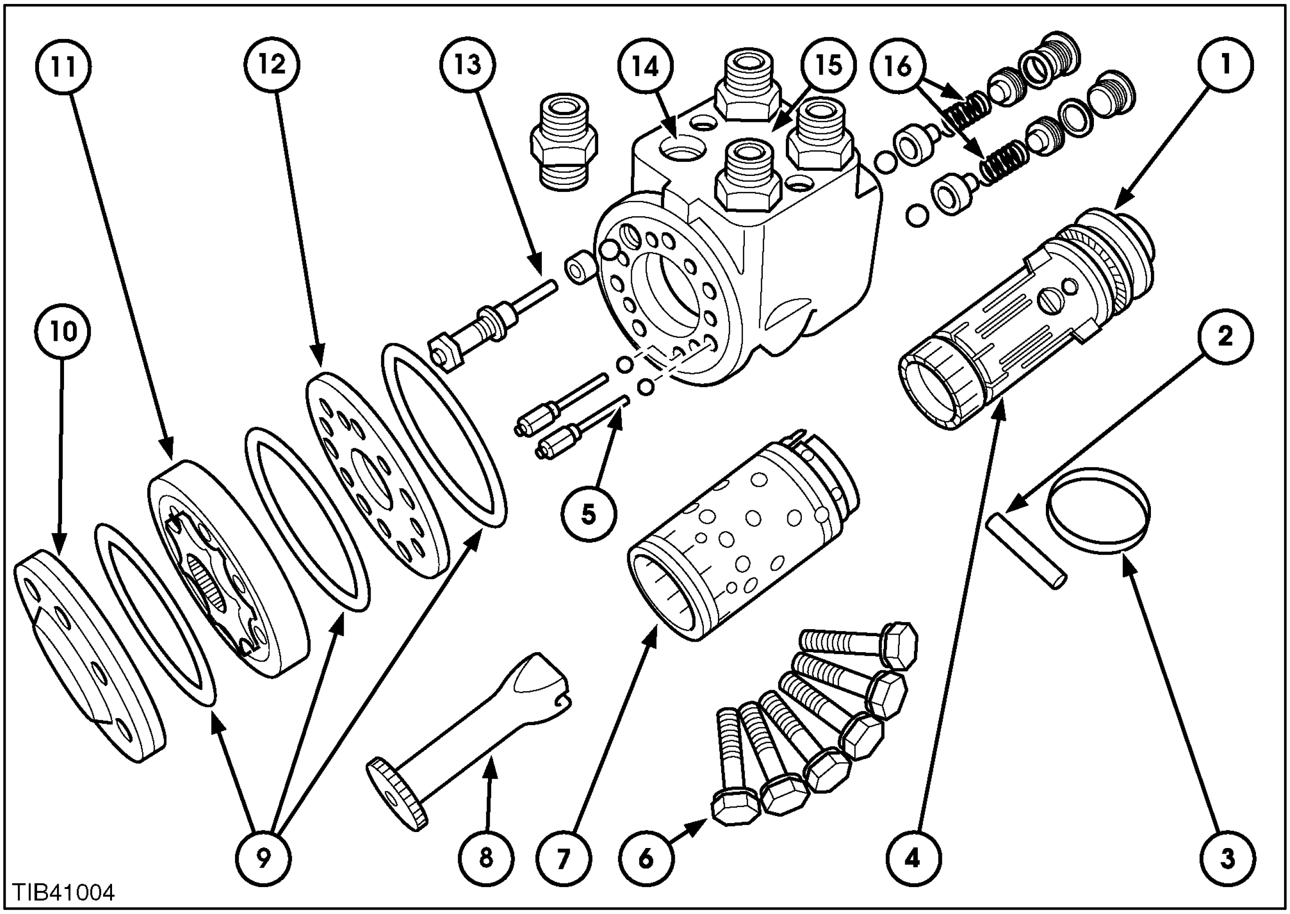
25

Oil seal location

1. Seal seat
2. Seal



26



27

Hydrostatic Steering Motor

1. Valve Thrust Washers and Bearings
2. Drive Pin
3. Spring Retaining Ring
4. Valve Spool
5. Suction Valves
6. Retaining Bolts
7. Valve Sleeve
8. Drive Link
9. 'O' Ring
10. End Plate
11. Metering Unit
12. Distributor Port
13. Check Valve Bolt
14. Non Return Valve
15. Motor Body
16. Cylinder Relief Valve

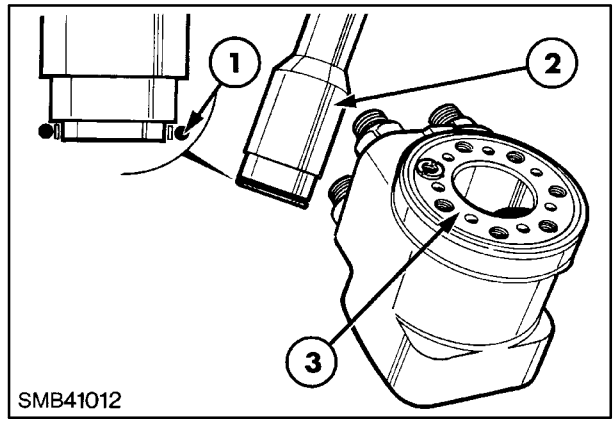
Component Inspection

Check for signs of wear in the following areas:

- Rotor and stator of metering unit move freely
- Check the drive pin is not cracked or bent
- Check the rollers in thrust bearing are free to rotate
- Ensure thrust washers are not warped or cracked
- Ensure check valve ball is free to move
- Check control valve, spool and sleeve for wear or scoring
- Replace all seals and 'O' rings

Oil seal installation

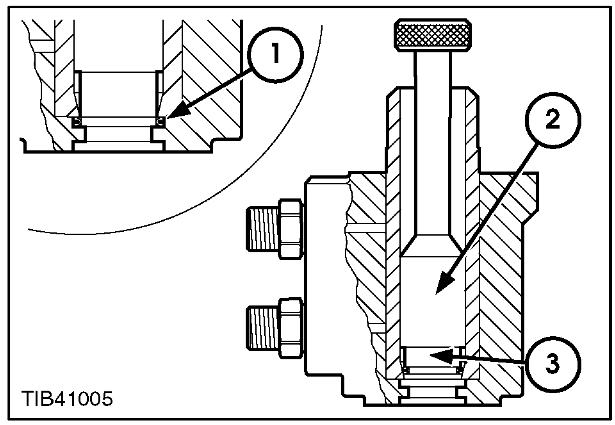
- Lightly coat sleeve with clean hydraulic oil and place in steering motor body
- Place oil seal on seal guide and coat with oil
- Insert seal guide and seal, push downward with a twisting action
- When seal is seated remove tool



28

Oil seal installation

1. Oil seal
2. Outer tool sleeve
3. Inner Tool shaft

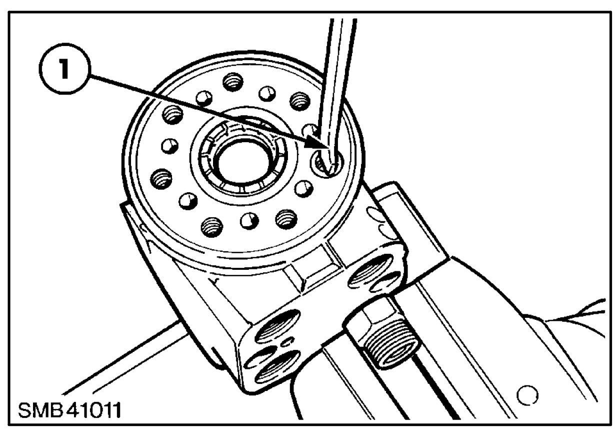


29

Re-assembly

NOTE: *Great care should be taken during re-assembly. Coat all components in hydraulic oil.*

- Ensure drive pin is horizontal before installation.
- Ensure thick thrust washer internal diameter chamfer is towards the valve sleeve.
- Do not over torque end plate.
- This motor does not have to be timed due to a master spline.
- Finally, check motor turns freely.

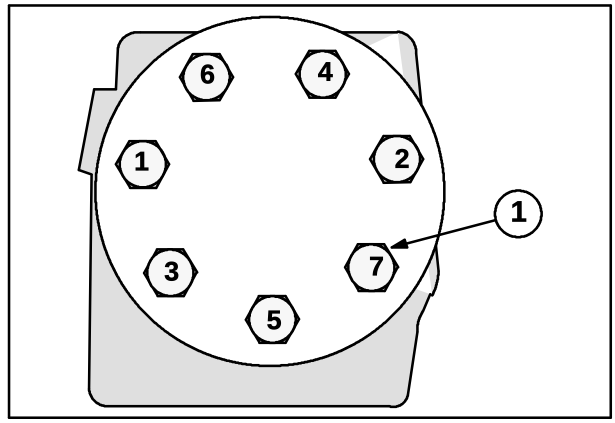


30

Replace The End cover

Refit the bolts and torque up in sequence to an initial setting of 10.8 Nm (8 lbf ft)

Torque up the bolts in sequence to a second setting of 30.0 Nm (21 lbf ft)



31

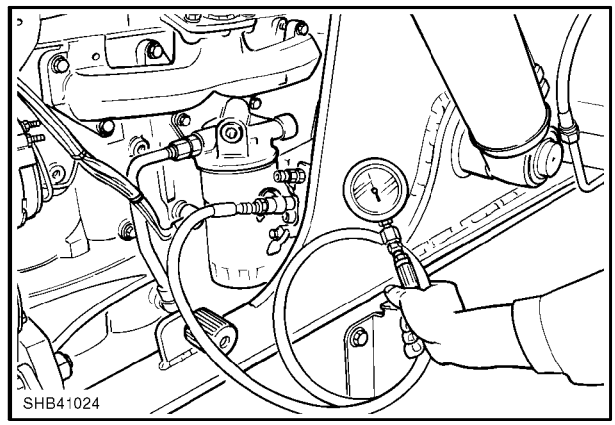
Pressure Testing

Connect a suitable pressure gauge capable of reading up to 200 bar (2900 psi) to the centre connector inside the left hand loader support.

- Start engine. A standby pressure of 6–7 bar (87–101 psi) should be observed.
- Turn steering to the left or right to the stop. A maximum pressure of 140 bar (2030 psi) should be seen.

NOTE: *Engine speed should be set to 1000 rev/min.*

For settings and adjustment procedure refer to the pressure testing section.



32

SECTION 41 – STEERING SYSTEMS

Chapter 2 – Steering for 4 Wheel Steer Only

CONTENT

SPECIFICATIONS

Pump

Oil . . . . Ambra Multi G

Output at 2200 rpm . . . . 72 ltr/min (19 US. gals/min)

Steering Motor

Type . . . . Hydrostatic Load Sensing

Displacement . . . . 120 cm^3/rev

Steering Pressure Relief Valve . . . . 180 bar +/– 3.5 bar (2610 +/– 50 psi)

Standby Pressure . . . . 7bar (101.5 psi)

Shock Valve Setting . . . . 240 bar (3480 psi)

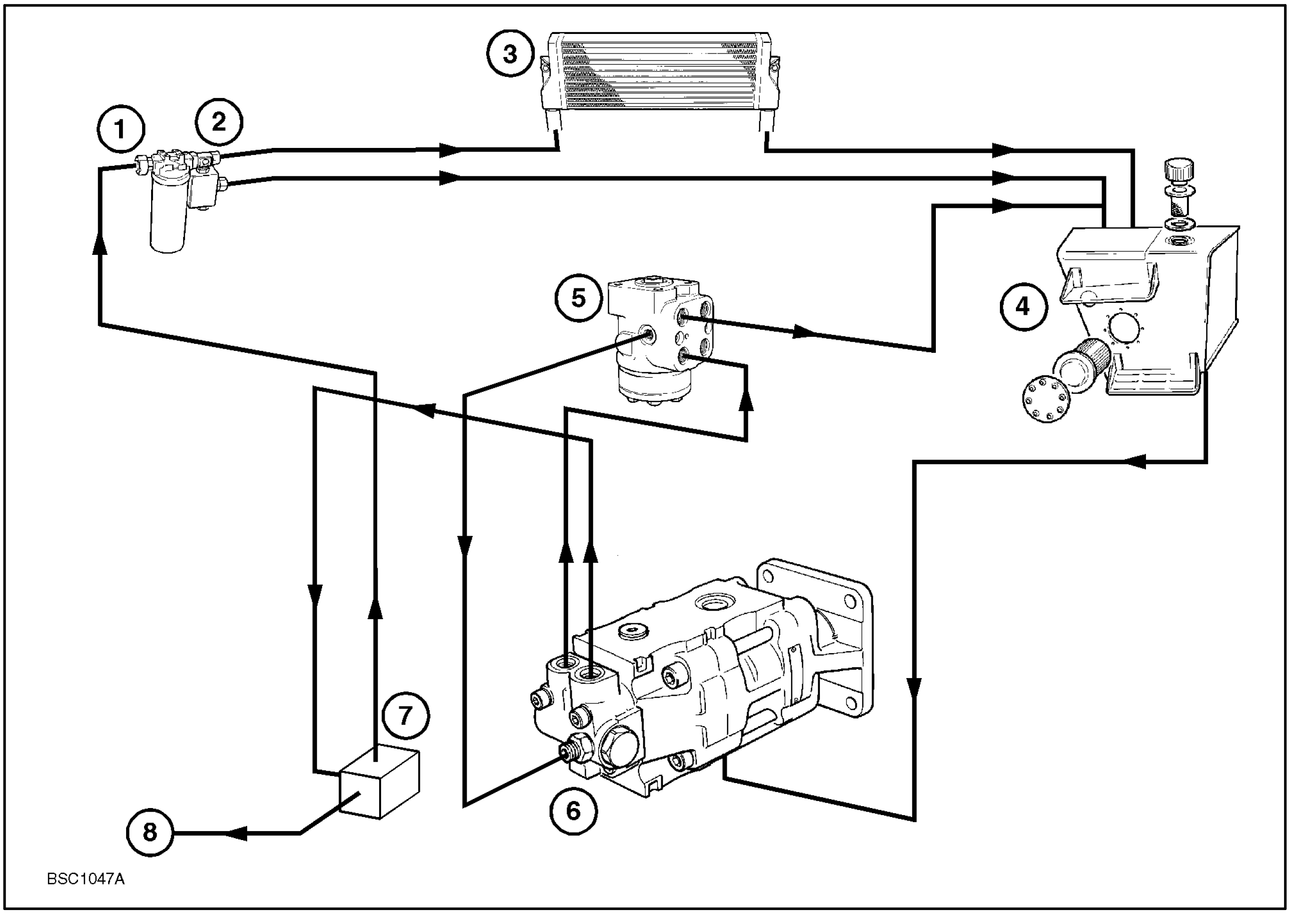
TIGHTENING TORQUES

	ft.lbs	Nm	kgf.m
Steering Wheel Nut	41.0	55.0	5.6
Steering Motor to Steering Column Bracket	17.0	23.0	2.3
Steering Motor End Cover	22.0	30.0	3.0
Steering Motor Pipe Connections	35.0	45.0	4.5
Steering Motor Pipe Adaptors	40.0	55.0	4.0
Steering Cylinder Ball–joint Clamps	32.0	43.0	4.4
Steering Cylinder Ball–joint Nuts	130.0	176.0	18.0
Steering Cylinder Extension Tube to Cylinder	200.0	271.0	27.5
Steering Pump Body Through Bolts	26.0	35.3	3.6
Steering Pump Drive Gear Nut	31.0	42.0	4.3
Steering Pump to Front Cover Bolt	23.0	31.2	3.2
Steering Pump Reservoir Bolt	12.0	16.3	1.7
Steering Pump Relief Valve	31.0	42.0	4.2
Check Valve Bolt	22.0	30.0	4.0

SPECIAL TOOLS

Pressure Test Quick Release Coupler 291924

DESCRIPTION AND OPERATION



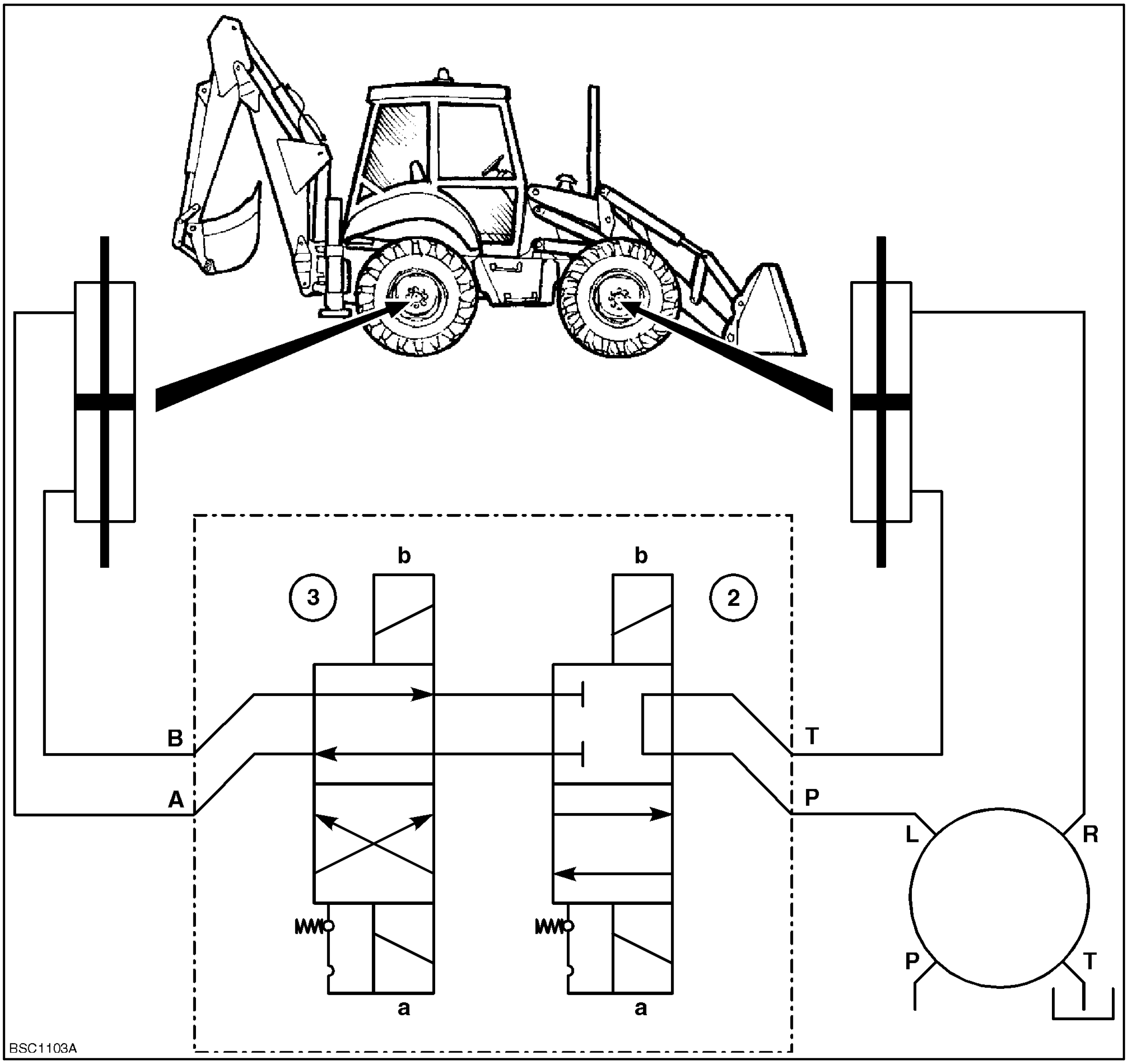
1

Steering System

1. Hydraulic System Reservoir
2. Steering Pump
3. Steering Motor
4. Hydraulic System Filter
5. Flow Divider
6. Hydraulic Oil Cooler

The hydrostatic steering features

- Double acting balanced steering cylinders on both the front and rear axles.
- Common hydraulic reservoir with the main hydraulic reservoir.
- Steering pump located on the rear of the transmission.
- Oil is cooled and filtered during every cycle.
- Oil flow from the steering motor to axles is electronically controlled using a 4 wheel steer valve which diverts oil in various directions depending on the choice selected by the operator.



2

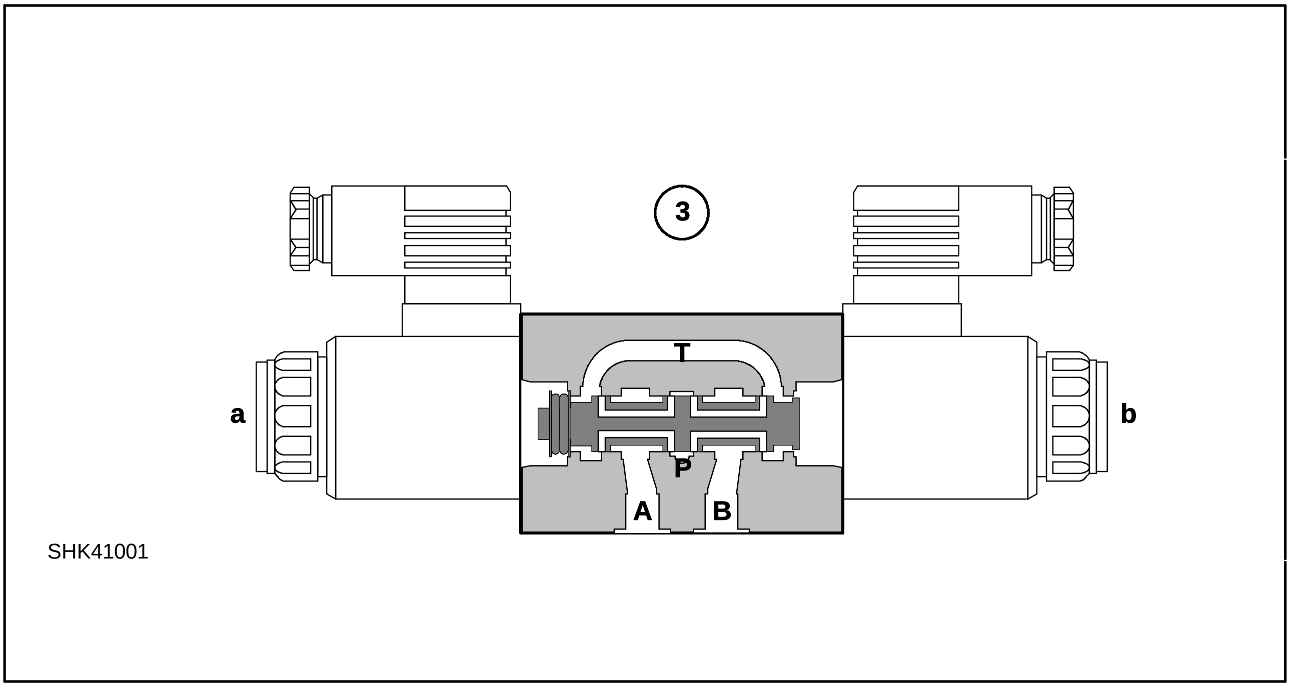
Steering Valve Schematic

In the position shown both spools have been moved by solenoids (2b) and (3b), the detents on the (a) side of the solenoid hold the spool in this position until another solenoid is pulsed

		3a	3b	2a	2b
2WS		O	O	O	O
4WS		X	O	O	O
4WS TO 2WS		O	X	O	O
CRAB		X	O	X	O
CRAB TO 2WS		O	X	O	X

3

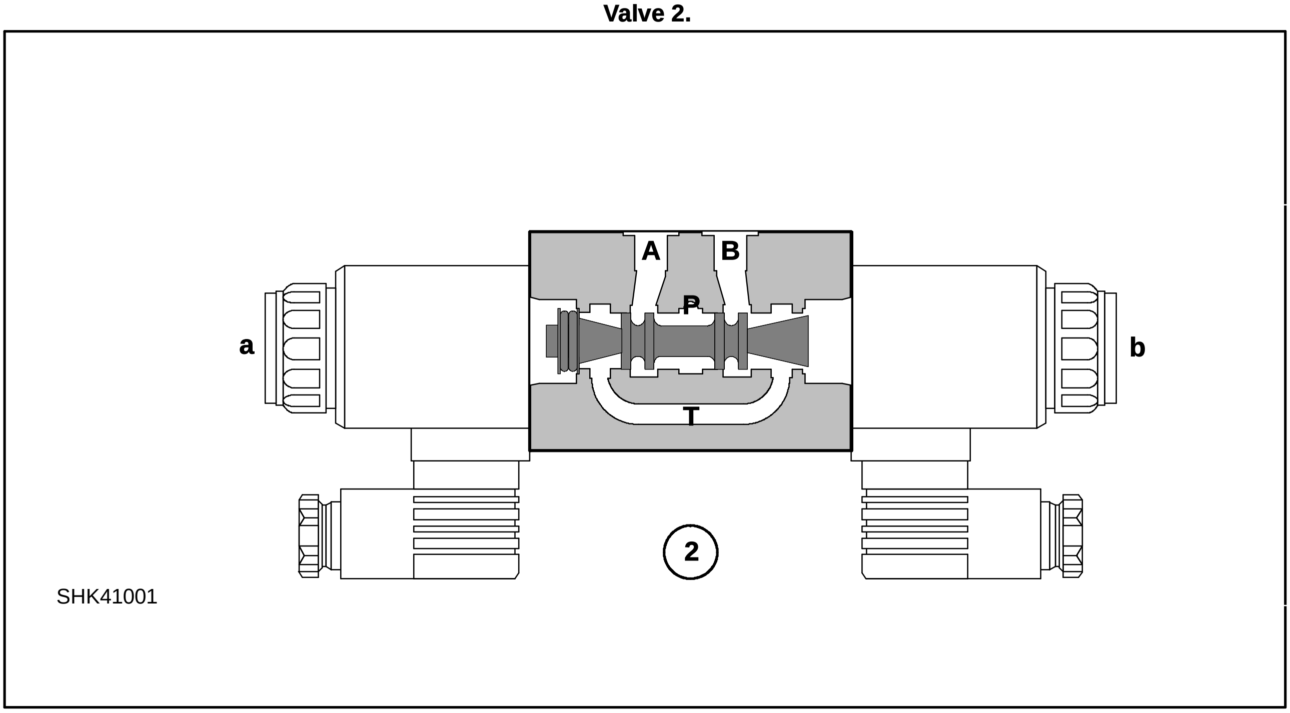
Valve 3



4

The spool in valve 3 above was last moved by solenoid 3b, as can be seen oil flowing in from P flows through the internal gallerys of the spool and exits at port T. Oil cannot exit at A or B, cutting off flow to the rear steering cylinder, the spool is only in this position in the standard front wheel steer mode.

Valve 2.



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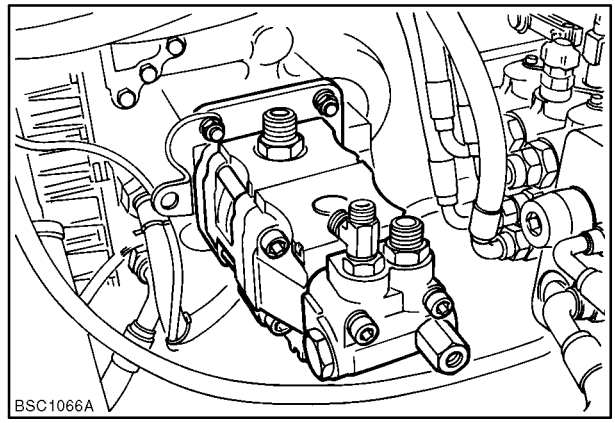
The spool in valve 2 above was last moved by solenoid 2b. Oil enters at port P and exits at port A. Oil enters from valve 3 at port B and exits at port T which enters the front steering cylinder.

The backhoe loader is fitted with two hydraulic pumps mounted on the rear of the transmission. Both pumps are driven by a shaft running directly off the flywheel. Oil is drawn through the common inlet port into both pumping elements. The front pump flow is directed to the loader and backhoe control valves and side shift clamping system.

Rear pump flow passes through the flow divider valve which maintains priority oil flow to the steering system with remaining flow directed for stabilisers, loader and backhoe elements.

The flow divider, located on the rear of the pump, comprises a load sensing valve and steering system pressure relief valve.

The valve ensures a priority oil flow to the steering system while the steering is operated, with the remaining flow directed to the stabiliser, loader and backhoe circuits.



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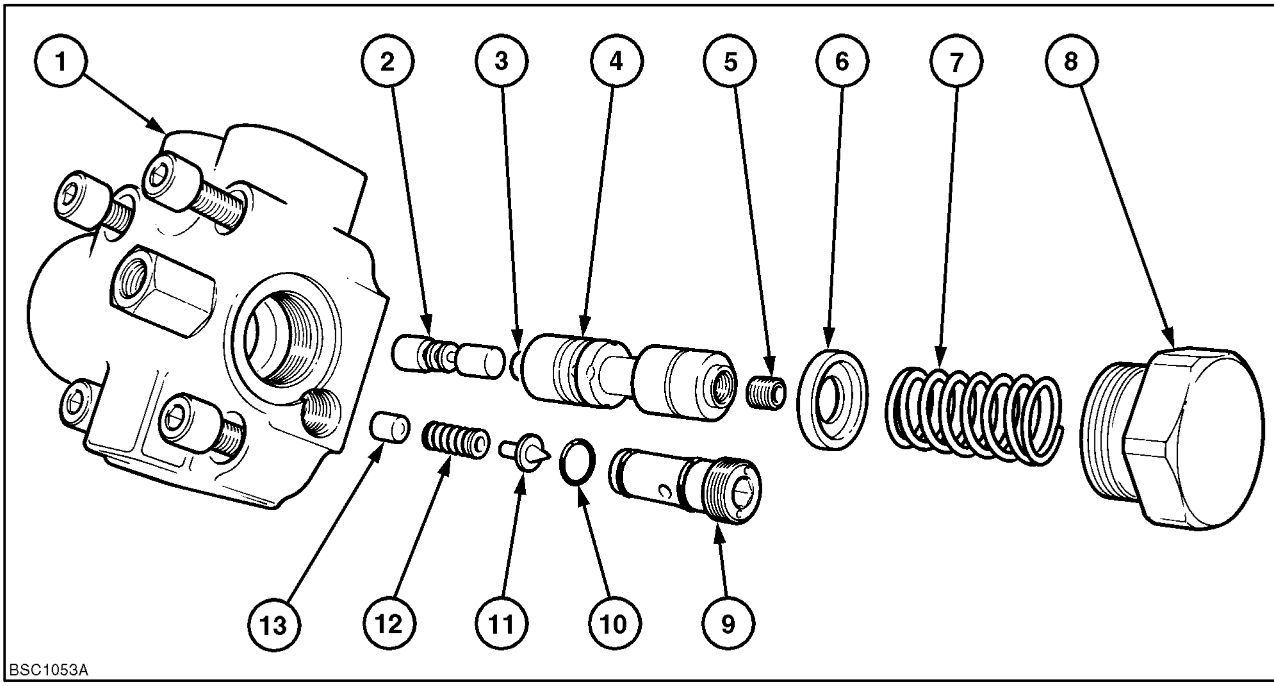
Flow Divider



7

Steering Flow Divider

1. Housing
2. Valve
3. O Ring
4. Spool
5. Adjuster
6. Spring Seat
7. Spring
8. Cap
9. Adjuster
10. O Ring
11. Relief Valve
12. Spring
13. Seat

The flow divider located on the rear of the pump comprises of a load sensed priority valve and steering system pressure relief valve.

The load sense valve ensures that a priority oil flow to the steering system is maintained while steering the vehicle, with remaining flow directed to the stabiliser, loader and backhoe circuits.

NOTE: *Flow from the rear pump on entering the loader and backhoe circuits combines with the flow from the front pump to provide increased flow.*

Operation

Flow from the rear pump enters the flow divider at inlet port (1).

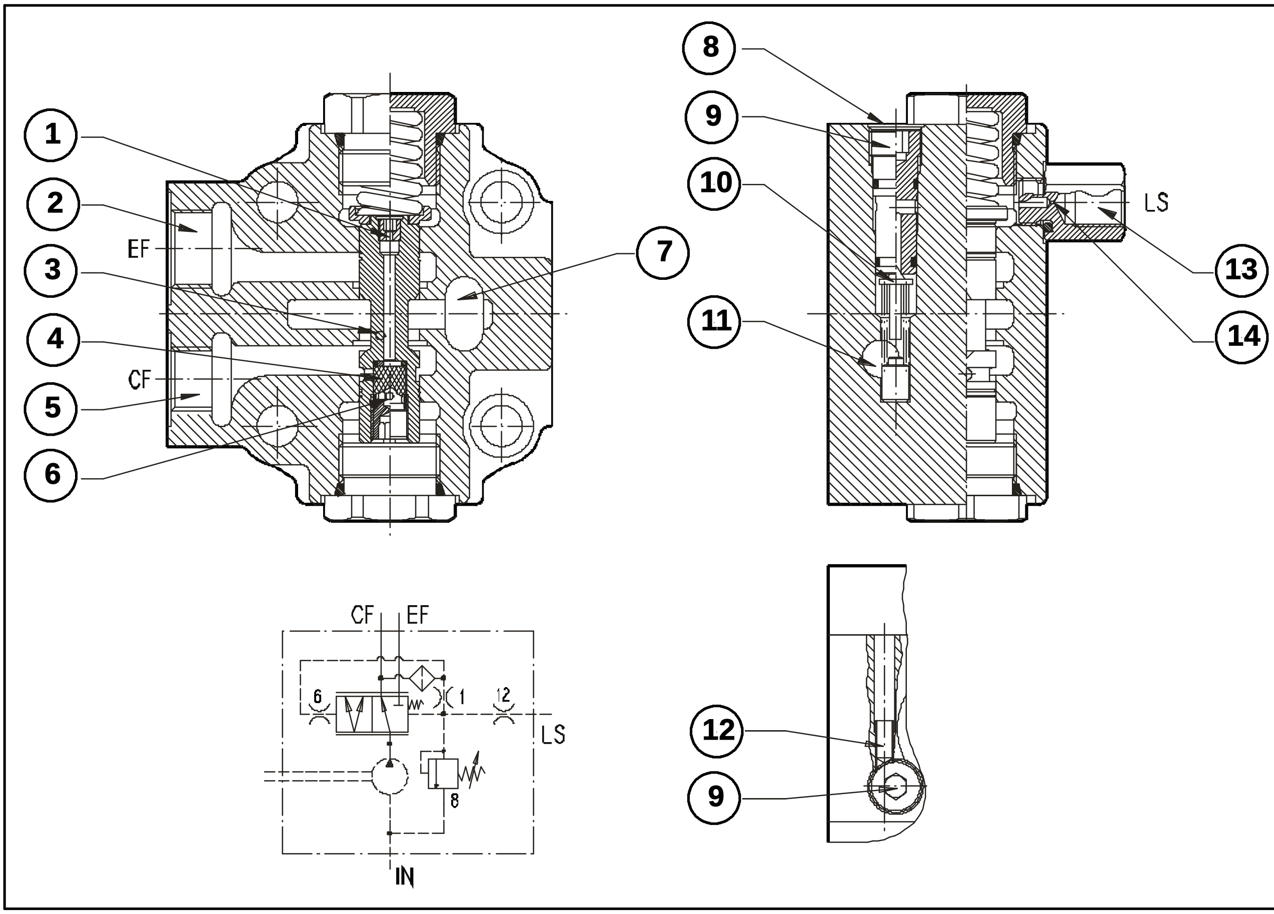
The spring force on the end of the spool holds the spool to the left enabling flow to pass into steering port (3).

Pump flow also passes into centre of spool enabling pump pressure to be sensed through the orifice on the left hand end of the spool. A smaller orifice in the right hand end of the spool also senses pump pressure but acts as a damper to prevent erratic movement of the spool.

When the steering system is in neutral the spring holds the spool to the right until pump pressure reaches a minimum of 7 bar. The pump pressure sensed through orifice (12) can now overcome spring pressure and move the spool to the right restricting flow to the steering motor.

Flow from the rear pump is now directed to the stabiliser and loader/backhoe circuits through port (2) whilst maintaining the 7 bar standby pressure to the steering circuit.

LOAD SENSING VALVE



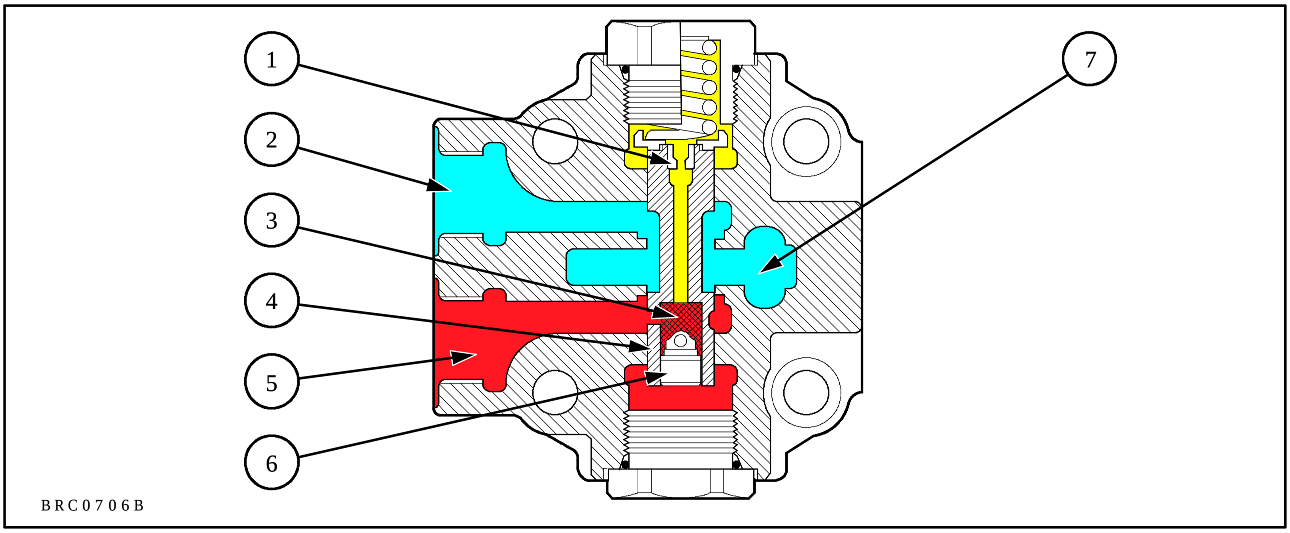
8

Load Sensing Valve (with pump not running)

1. Orifice
2. To steering priority flow (EF)
3. Filter
4. Spool
5. Backhoe Circuits (CF)
6. Orifice
7. Inlet Port from Rear Pump (IN)
8. Steering Relief Valve
9. Relief Valve Adjuster
10. Poppet
11. Return to Inlet Pump Port
12. Lock Plug
13. Load Sensing Signal (LS)
14. Orifice

When the steering is in neutral the LS port is connected to the unload (through the steering) and the steering inlet port (CF) is open.

LOAD SENSING VALVE



9

Load Sensing Valve with Pump Running - Steering in Neutral

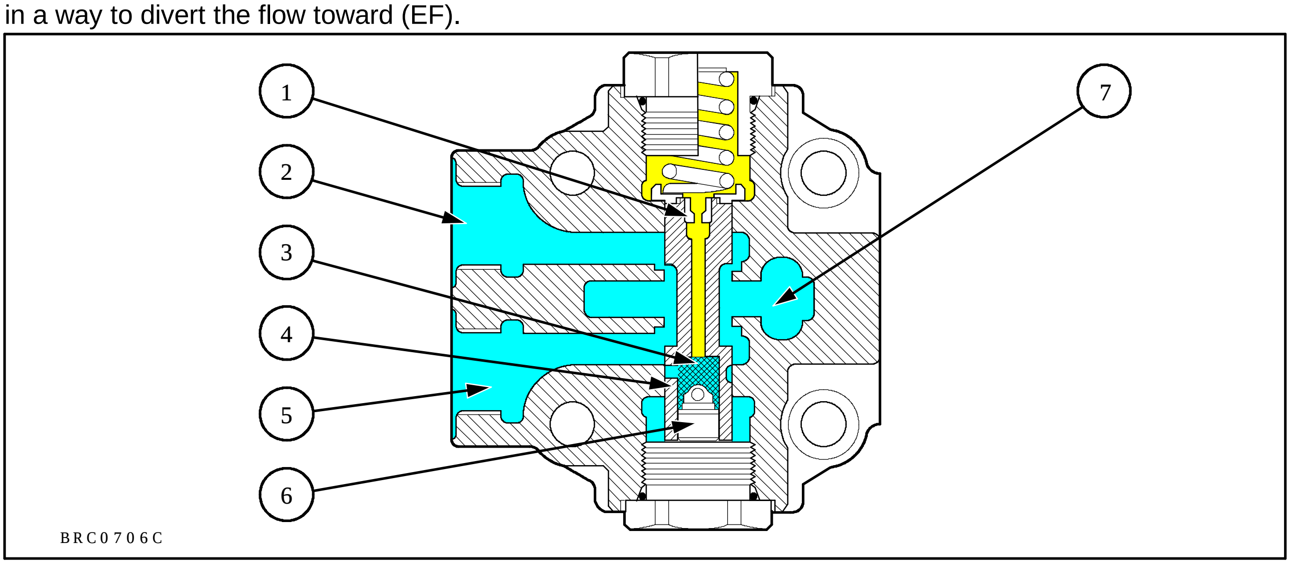
Pressure Oil

Return to Reservoir Oil

Trapped Oil

1. Orifice
2. To steering priority flow
3. Filter
4. Spool
5. Backhoe circuits (CF)
6. Oifice
7. Inlet Port (from rear port)

The pressure on (CF) increases until the pressure value (standby pressure) is sufficient to move the spool valve in a way to divert the flow toward (EF).



10

Load Sensing Valve with Pump Running - Steering working

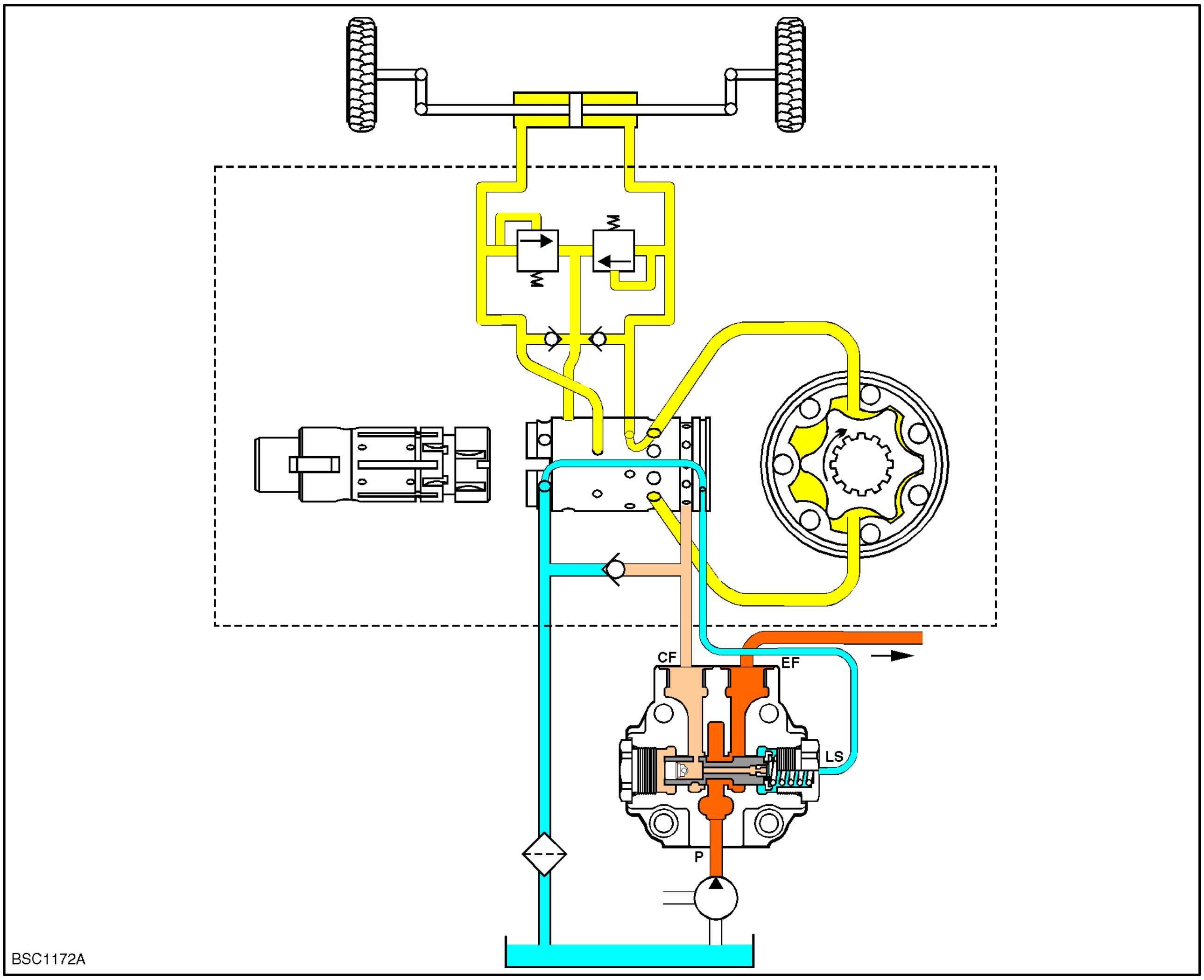
1. Orifice
2. To steering priority flow
3. Filter
4. Spool
5. Backhoe circuits (CF)
6. Oifice
7. Inlet Port (from rear port)

During steering two actions are performed:

1. The fluid moves to the steering through (CF)
2. The (LS) signal is in communication to the steering

FAULT FIINDING – STEERING

PROBLEM	POSSIBLE CAUSES	CORRECTION
No steering or excessive effort required to steer	1. Incorrect oil level in reservoir.	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of air
	3. Pump relief valve faulty	3. Check system pressure
	4. Worn pump	4. Inspect and repair
	5. Leaking power cylinder	5. Inspect and repair
	6. Damaged valve spool	6. Inspect and replace
	7. Broken or damaged steering column	7. Inspect and replace
	8. Damaged or worn metering element	8. Inspect and replace
Steering wanders	1. Excessive play in steering linkage ball joints	1. Inspect and replace
	2. Leaking power cylinder	2. Inspect and repair
	3. Control valve spool sticking or worn	3. Inspect and replace
	4. Damaged or worn metering element	4. Inspect and replace
Front wheels surge when steering	1. Leaking power cylinder	1. Inspect and repair
	2. Control valve spool sticking	2. Inspect and repair
	3. Damaged or worn metering element	3. Inspect and replace
Noisy pump	1. Incorrect oil level in reservoir	1. Fill with the correct grade and quantity of oil
	2. Air in system	2. Check for loose connections or damaged tubing. Purge system of oil
	3. Water in oil	3. Drain and replace the oil
	4. Worn Pump	4. Replace Pump



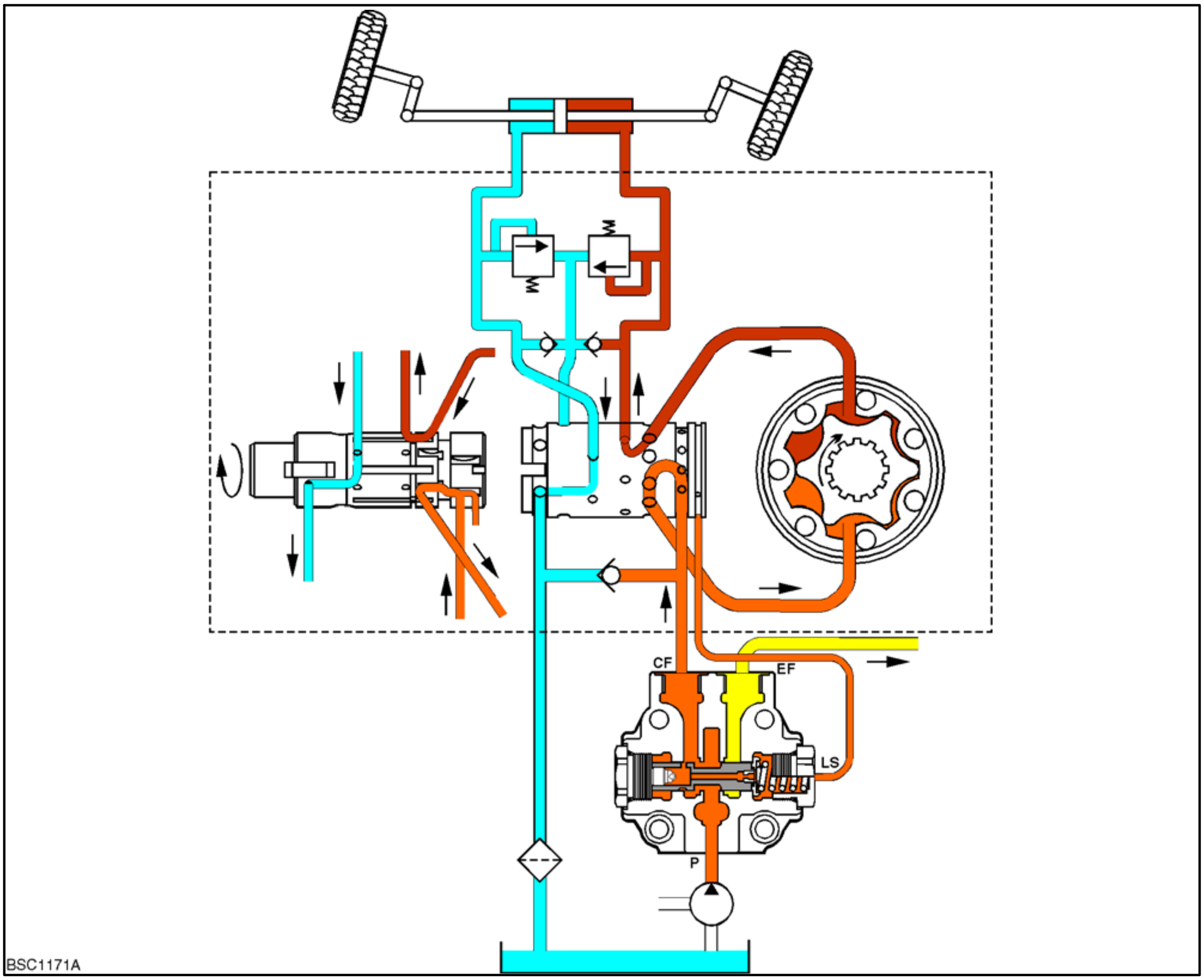
11

Steering Motor - Neutral

Pump Pressure	Trapped Oil
Standby Pressure	Return to Reservoir

When the steering wheel is held still, the leaf springs return and hold the spool and sleeve in the neutral position.

This ensures no more oil is supplied to the steering cylinder. The sleeve also traps the oil in the steering cylinder and allows oil in the sensing lines to return to tank therefore allowing the priority flow divider to move to the left.



12

Steering Motor - Turning Right

Pump Pressure

Metered Oil

Trapped Oil

Return to Reservoir

When the steering wheel is turned, the movement of the control valve spool in its sleeve forms a series of passages. During right turn, oil flows through the sleeve along a groove in the valve spool and into a passage in the steering motor housing which leads to the metering unit. A gallery is also lined up to allow pressure oil to flow down the sensing line to the priority flow divider.

As the metering unit is turned by the drive shaft, it directs a measured quantity of oil along another set of passages in the spool and sleeve then from these to the steering cylinder.

Return oil from the other side of the cylinder is directed through the valve spool and sleeve to a return passage in the housing.

The secondary relief valves regulated to 240 bar protect the hydraulic system between the cylinder and steering motor.

The three modes of steering are as follows:

- Front wheel only steering 
- Front and rear wheel steer 
- Front and rear wheel crab 

The solenoids energised are shown in the table opposite. These are also the pins which need to be pressed when changing steering mode manually in an emergency.

X = Energised
O = Not Energised

		3a	3b	2a	2b
2WS		O	O	O	O
4WS		X	O	O	O
4WS TO 2WS		O	X	O	O
CRAB		X	O	X	O
CRAB TO 2WS		O	X	O	X

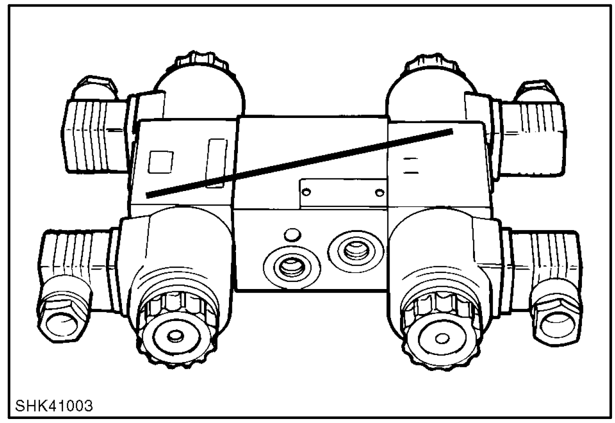
13

Steering Control Valve

The steering control valve is located just above the rear axle attached to the main chassis.

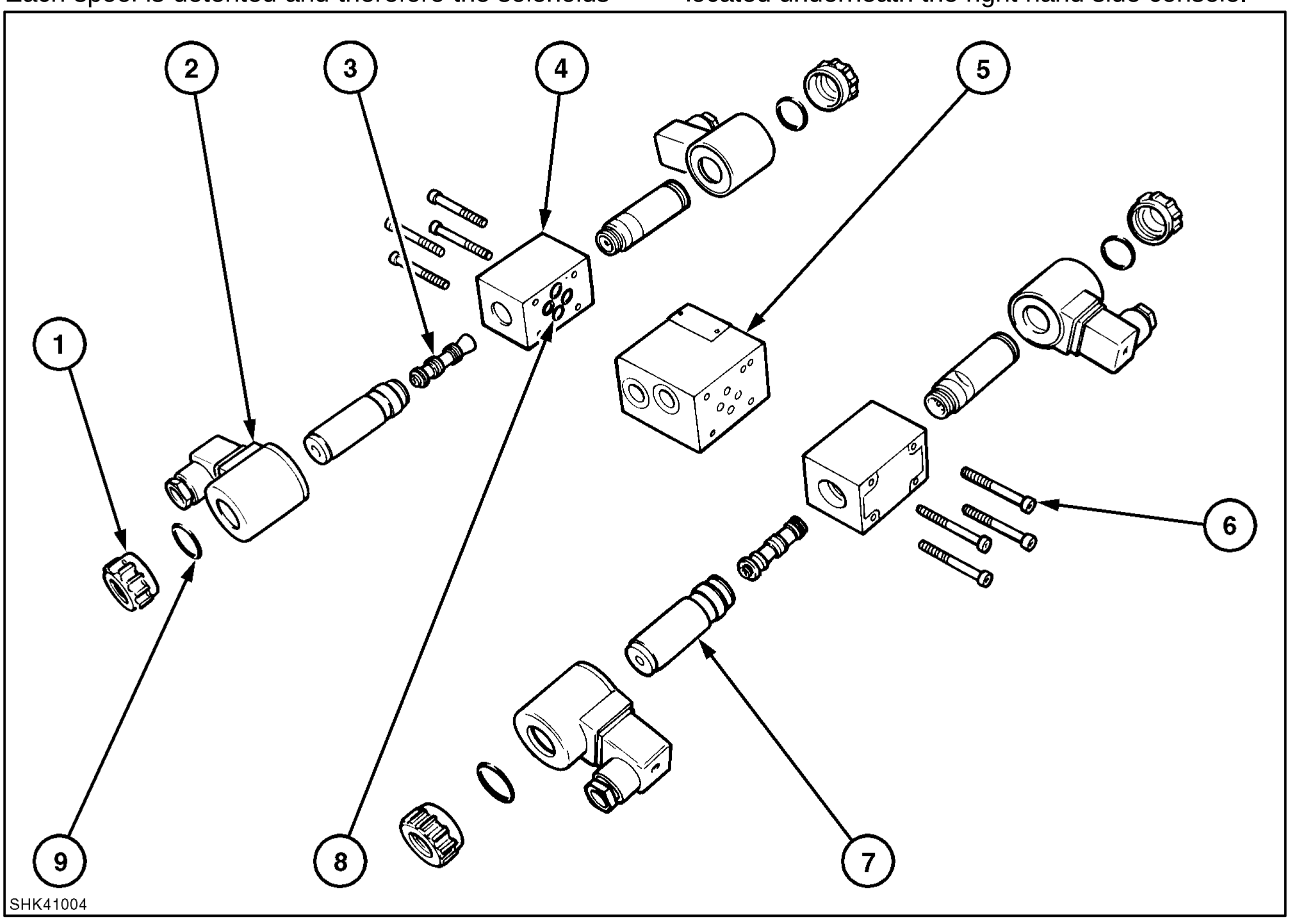
Remove the four pipes and then the 2 chassis fixing bolts, then withdraw the valve for overhaul.

Draw a diagonal line accross the complete valve block this will assist in the corect reassembly later.



14

The valve consists of a central manifold block which all input and output pipes are attached to. On each side of this block is a solenoid valve. The solenoid valves have two positions, both of these positions are working positions and there is no neutral point. Each spool is detented and therefore the solenoids are only energised momentarily to move the spool. On the end of each solenoid is an emergency hand operating pin which moves the control spool without energising the solenoid. The switching of the steering valve is normally controlled by a microprocessor located underneath the right hand side console.



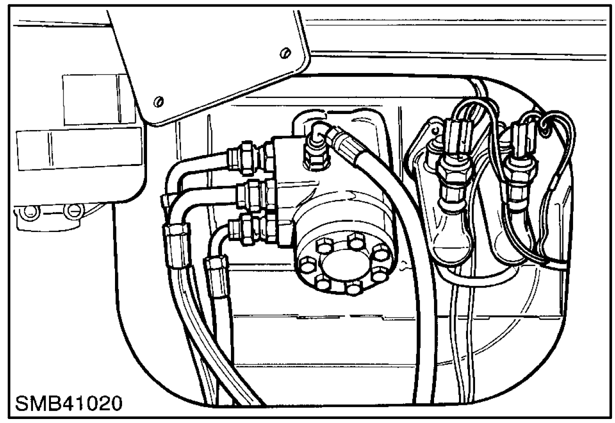
15

Steering Control Valve

1. Solenoid fixing screw
2. Solenoid
3. Control spool
4. Spool block
5. Central manifold block
6. Fixing screws
7. Plunger
8. O rings
9. O ring

Steering Motor Overhaul

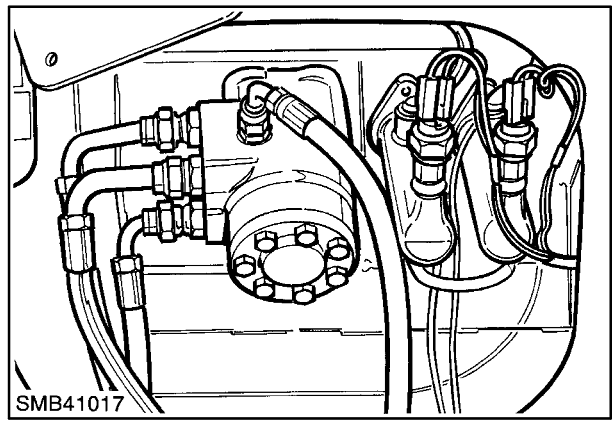
To gain access to the steering motor the bonnet and air cleaner should be removed.



16

Removing Steering Motor

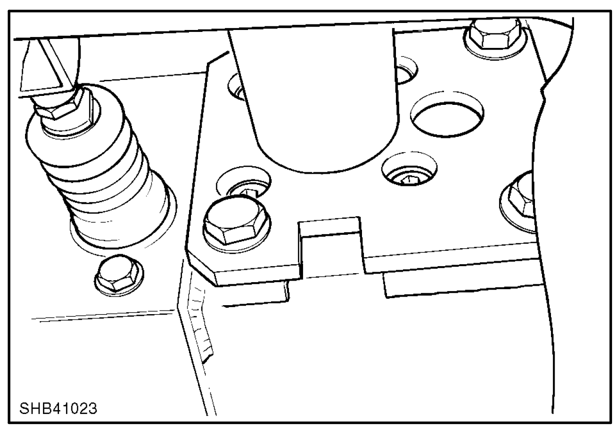
Disconnect the four connectors and collect the O ring seals, noting the connector positions.



17

Remove the four Allen screws from within the cab.

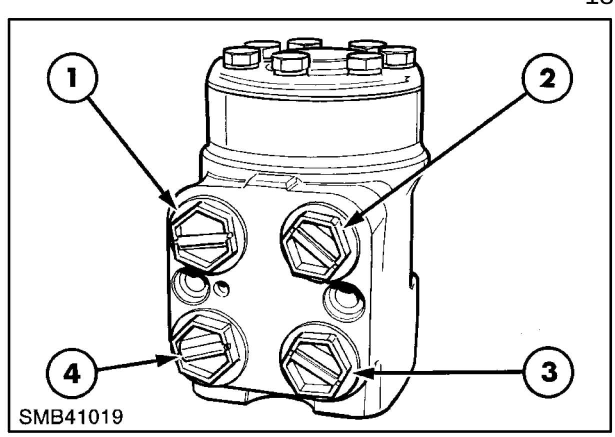
The motor can be removed from the front of the cab through the engine compartment.



18

Steering Motor Ports

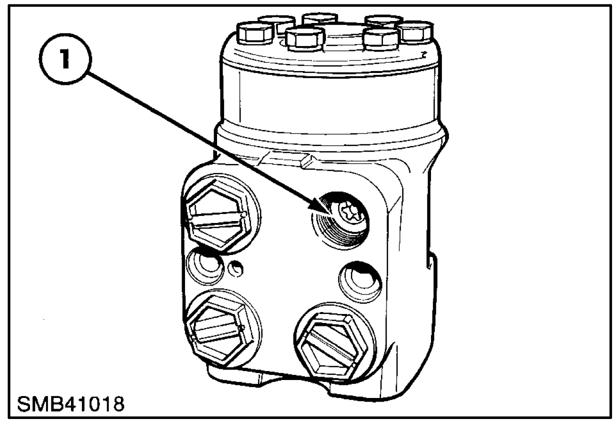
1. Left hand of cylinder
2. Pump in
3. Pump return
4. Right hand of cylinder



19

Supply line non return valve.

1. Non return valve

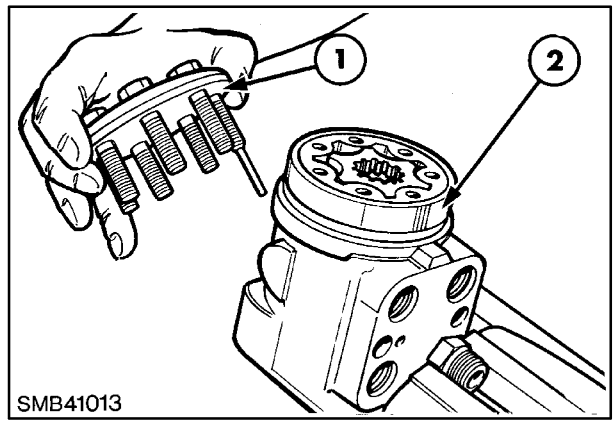


20

End plate removal

NOTE: *The position of the pin bolt must remain the same upon re-assembly of the end cap.*

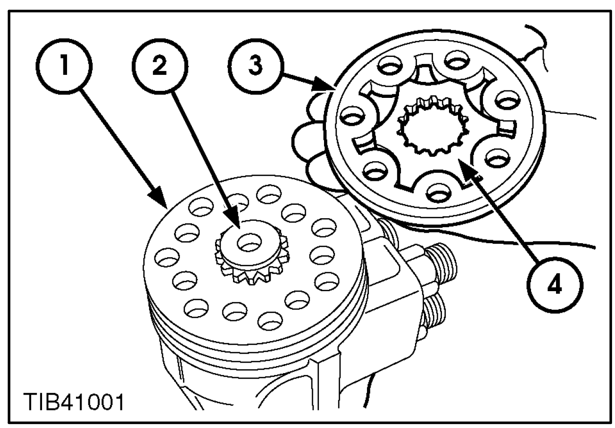
1. End plate
2. Pump body



21

Metering unit removal

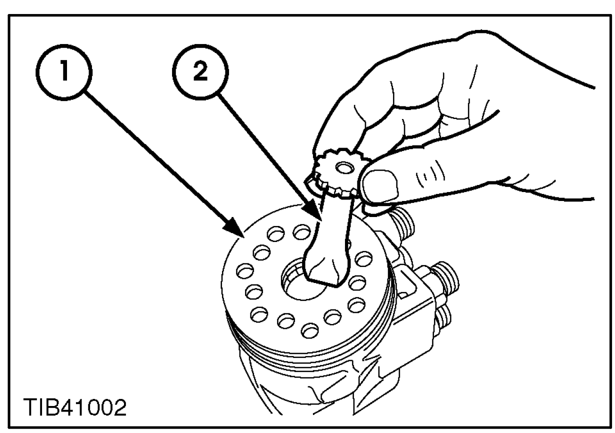
1. Steering motor
2. Driving link
3. Stator
4. Rotor



22

Drive link removal

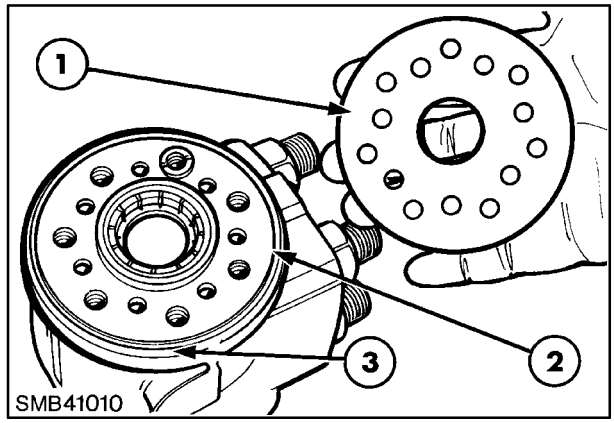
1. Steering motor body
2. Drive link



23

Valve plate removal

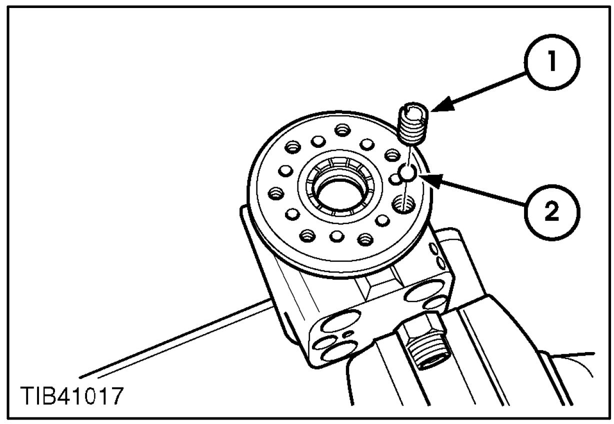
1. Body
2. Valve plate



24

Check valve removal

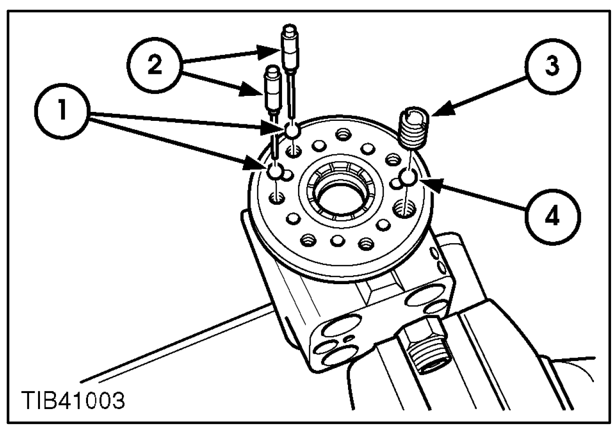
1. Retainer cap
2. Check valve



25

Suction and check valves

1. Suction valve balls
2. Suction valve rods
3. Retainer cap
4. Check valve

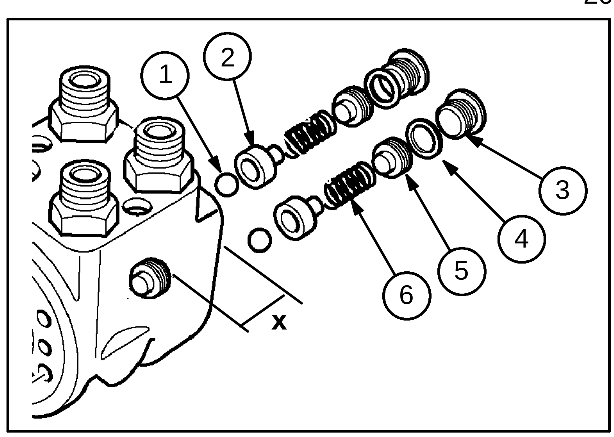


26

Cylinder relief valves

IMPORTANT: *Before removal of the cylinder relief for cleaning valves if necessary remove the end plug and seal. Measure at, (x) using a depth gauge, the distance from the outer body to the head of the adjuster (5) and record the results. Upon re-assembly reset the adjuster to the exact depth previously recorded.*

1. Ball
2. Seat
3. End Plug
4. Seal
5. Adjuster
6. Spring

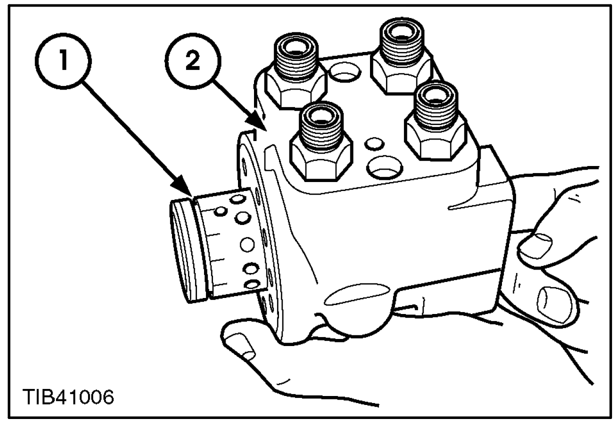


27

Control valve removal

1. Control valve
2. Housing

NOTE: *When removing the control valve spool and sleeve, ensure drive pin is in a horizontal position so that it cannot fall into an integral gallery and make removal difficult.*

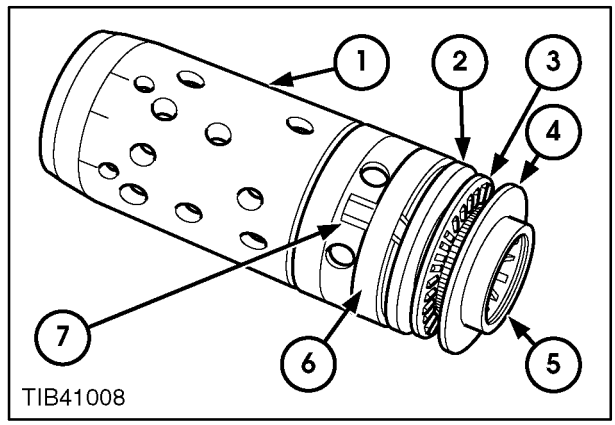


28

Control valve

1. Control valve sleeve
2. Washer
3. Thrust bearing
4. Washer
5. Spool
6. Centring springs retainer
7. Centring springs

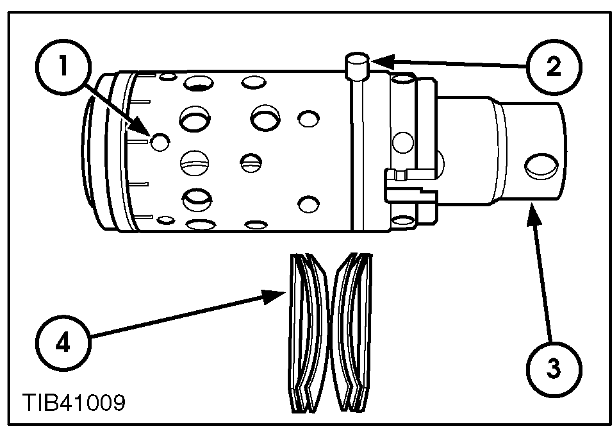
NOTE: *The thick washer must be reinstated with internal diameter chamfer toward the valve sleeve.*



29

Drive pin and centring springs

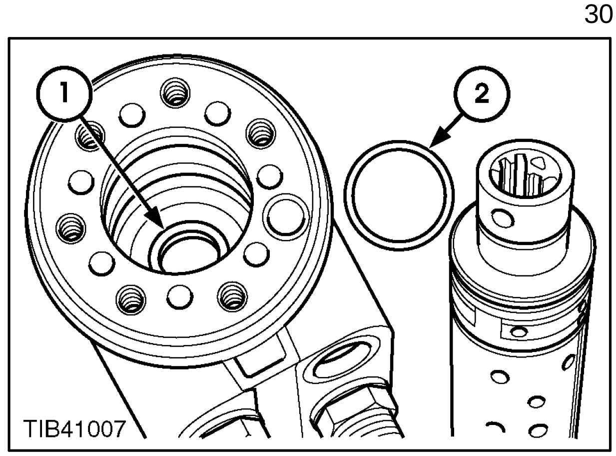
1. Control valve
2. Drive pin
3. Spool
4. Centring springs



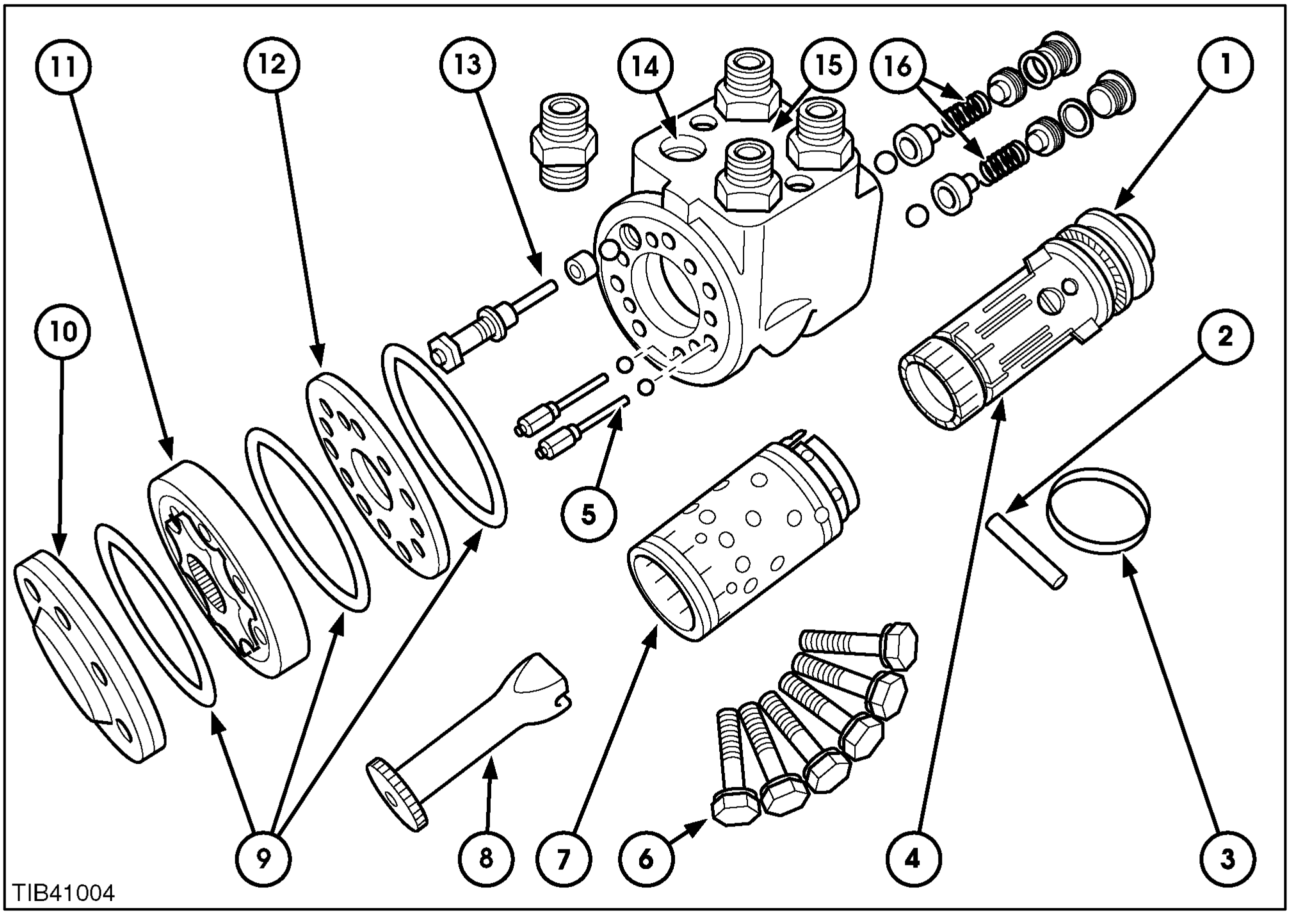
30

Oil seal location

1. Seal seat
2. Seal



31



32

Hydrostatic Steering Motor

1. Valve Thrust Washers and Bearings
2. Drive Pin
3. Spring Retaining Ring
4. Valve Spool
5. Suction Valves
6. Retaining Bolts
7. Valve Sleeve
8. Drive Link
9. 'O' Ring
10. End Plate
11. Metering Unit
12. Distributor Port
13. Check Valve Bolt
14. Non Return Valve
15. Motor Body
16. Cylinder Relief Valve

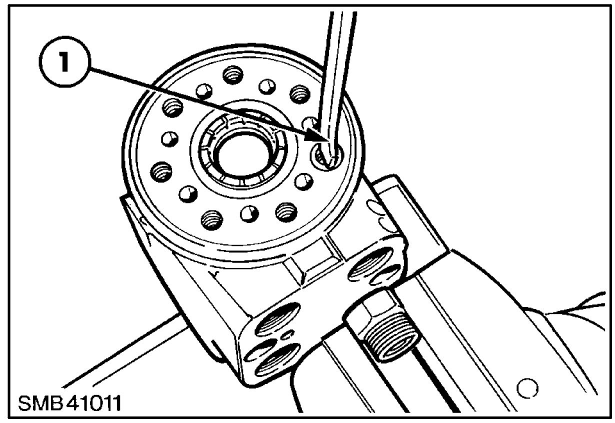
Component Inspection

- Check for signs of wear in the following areas:
- Rotor and stator of metering unit move freely
- Check the drive pin is not cracked or bent
- Check the rollers in thrust bearing are free to rotate
- Ensure thrust washers are not warped or cracked
- Ensure check valve ball is free to move
- Check control valve, spool and sleeve for wear or scoring
- Replace all seals and 'O' rings

Re-assembly

NOTE: *Great care should be taken during re-assembly. Coat all components in hydraulic oil.*

- Ensure drive pin is horizontal before installation.
- Ensure thick thrust washer internal diameter chamfer is towards the valve sleeve.
- Do not over torque end plate.
- This motor does not have to be timed due to a master spline.
- Finally, check motor turns freely.

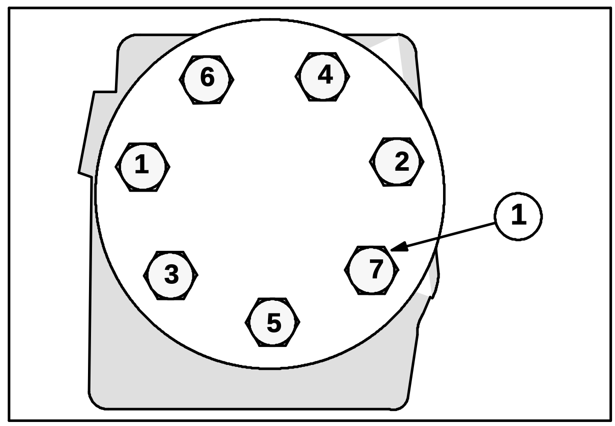


33

Replace the end cover

Refit the bolts and torque up in sequence to an initial setting of 10.8 Nm (8 lbf ft)

Torque up the bolts in sequence to a second setting of 30.0 Nm (21 lbf ft)



34

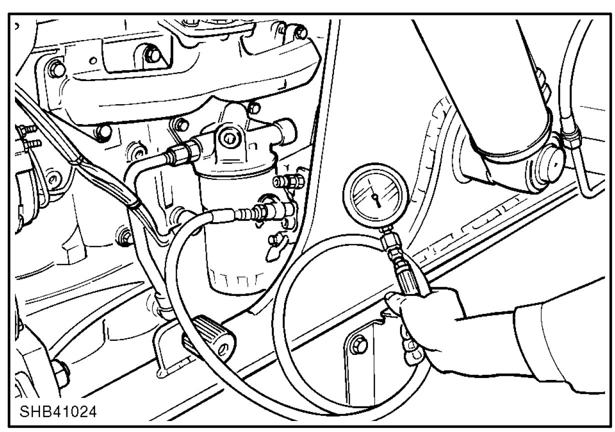
Pressure Testing

Connect a suitable pressure gauge capable of reading up to 200 bar (2900 psi) to the connector inside the left hand loader support.

- Start engine. A standby pressure of 6–7 bar (87–101 psi) should be observed.
- Turn steering to the left or right to the stop. A maximum pressure of 180 bar (2030 psi) should be seen.

NOTE: *Engine speed should be set to 1000 rev/min.*

For settings and adjustment procedure refer to the pressure testing section.



35

NOTES

SECTION 50 – CAB HEATING AND AIR CONDITIONNING

Chapter 1 – Cab Heating

CONTENT

SPECIFICATIONS

Engine Radiator Coolant:	
Antifreeze – Ambra Agriflu	12 Litres (3.1 US. gals)
Water	12 Litres (3.1 US. gals)
System Type	Pressurized Full Flow By–pass with Expansion Chamber
Fan Belt Deflection:	
Naturally Aspirated	13 – 19mm (0.50 in. – 0.75 in)
Turbocharged	10 – 16mm (0.38 – 0.62 in)
Thermostat:	
Start to Open at	82°C (180°F)
Fully Open at	95°C (203°F)
Radiator Cap	0.90 bar (13 psi)

TORQUE VALUES

Coolant/Hot water hose connections	5 Nm (3.6 lbf ft)
Air hose ducting connections	5 Nm (3.6 lbf ft)
Heater housing to floor mounting bolts	6.2 Nm (4.6 lbf ft)

SEALANTS

Code Number	Name
82995768	Sealer–Anaerobic Low strength
82995776	Sealer–Silicone
82995774	Sealer–Polyester Urethane
82995773	Sealer–Anaerobic

DESCRIPTION AND OPERATION

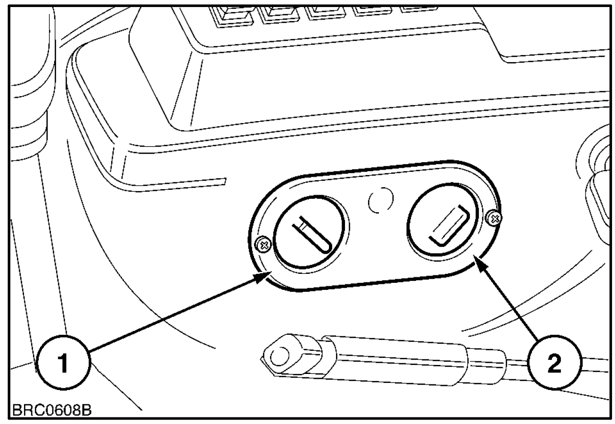
Cab Heating

The cab is heated by a radiator mounted below the cab seat, which is supplied hot water from the engine coolant system. A blower motor mounted behind the cab radiator is used to transfer the heat into the cab.

Heater Blower Control, Figure 1

The three speed blower is controlled by switch (1) mounted in the instrument console to the right of the cab seat. Turn the switch clockwise to the first position for slow speed. Further rotation of the switch in a clockwise direction selects medium and fast speeds.

The blower draws outside air from beneath the cab floor and through a filter medium into the cab.



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Heater Temperature Control, Figure 1

The temperature of the air from the radiator is adjusted by rotation of the control knob (2) which opens or closes the radiator valve increasing or decreasing the water flow as required. Turn the control clockwise to increase the temperature of air from the heater and counter clockwise to reduce the temperature.

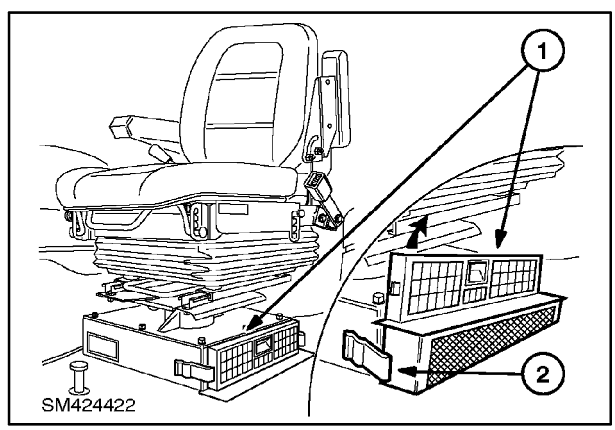
WARNING

The cab air filters are designed to remove dust from the air but may not exclude chemical vapour. When working in an enclosed area ensure there is adequate ventilation as exhaust fumes can suffocate you.

Cab Air Filter

Before servicing the air filter situated under the drivers seat, switch off the blower and close all windows and one door. Forcibly close the other door. The resulting back pressure will dislodge loose dirt from the underside of the filters.

To remove the filter (1) release the retaining straps (2) and remove the filter element. Ensure the element, and sealing faces are not damaged on removal.



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IMPORTANT: *In humid conditions, such as occur on most early mornings, do not switch on the blower prior to servicing the filters. Damp particles drawn into the filter may solidify and prove difficult to remove without washing.*

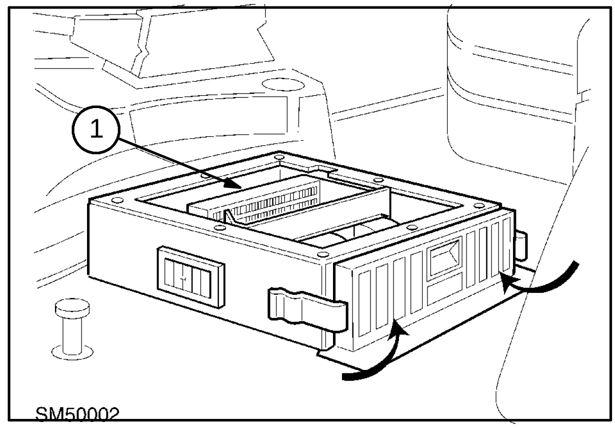
The filter elements are made of specially treated paper with a sealing strip bonded to the outer face.

Clean all of the elements by blowing with compressed air from the clean side through to the dirty side. The compressed air should not exceed 2 bar (30 psi) and the air line nozzle should be at least 300 mm (12 in) from the element.

Heater Radiator

The heater radiator (1) is fitted in a housing under the cab seat for central displacement of warm or cold air flow.

IMPORTANT: *Too ensure a good flow of air through the heater radiator the filter should be cleaned more frequently when operating in extremely dusty conditions.*



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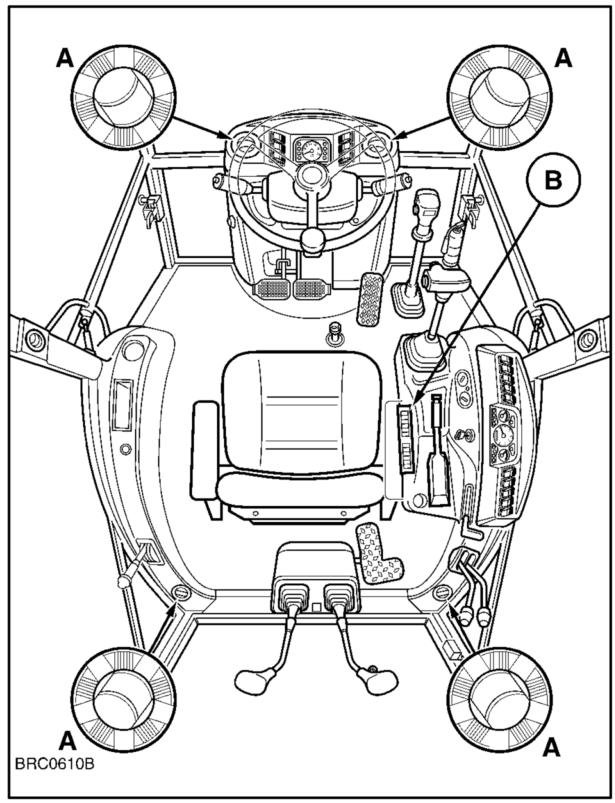
Air Flow Vents

Air flow vents are connected to the heater housing and receive air from the blower motor, to direct warm or cold air onto the windscreen and side windows or to the cab interior as required.

Each vent may be swivelled and adjusted to control the flow of air.

To open a vent, press one side of the disc and turn it, as required, to direct the air flow.



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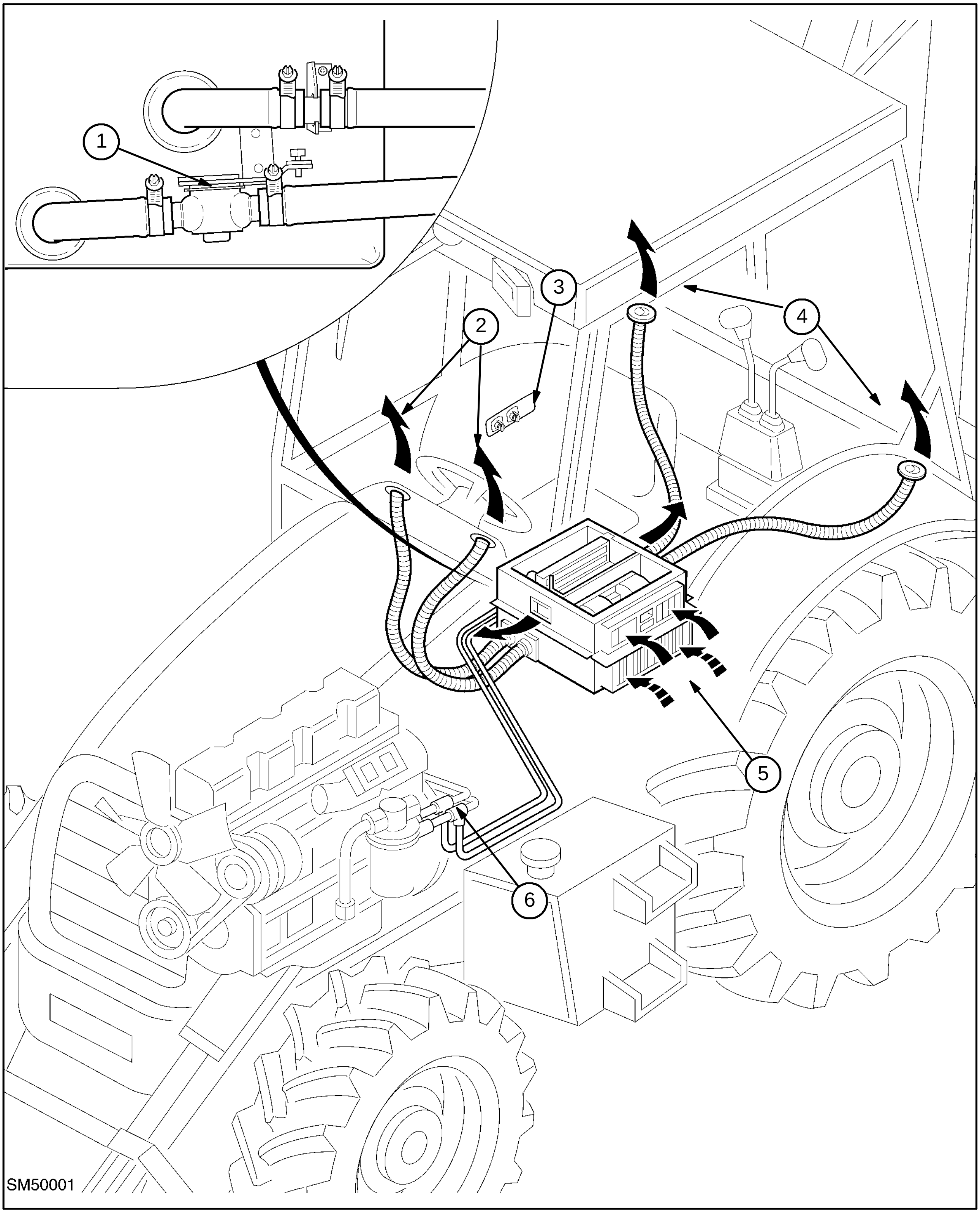

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Schematic – Heater system

1. Heater Valve mounted to the right of the heater housing below the cab floor
2. Air ducting to the front windscreen
3. Heater control panel
4. Air ducting to the rear windscreen
5. Air intake to the heater housing from below the cab floor
6. Heater pipes to and from heater taken from the engine oil cooler pipes

FAULT FINDING – GENERAL

Items that may cause a concern are suggested in the fault finding chart but as a general rule apply the following steps:

Ensure water flow to the heater radiator is steady and all air has been removed from the system.

Hoses are unrestricted and not leaking.

Check the electrical connections are good and the blower motor is operational.

The operating cable to the heater valve and valve is operational.

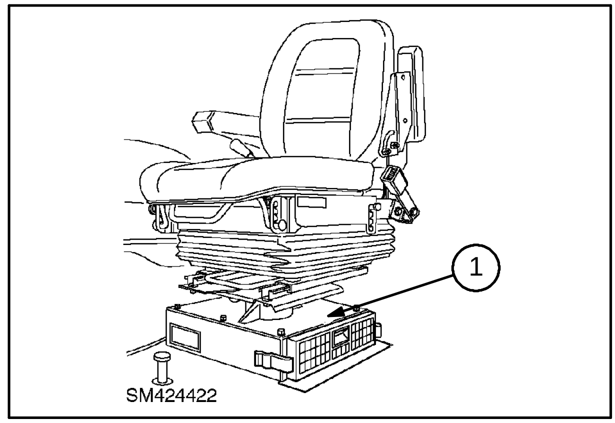
FAULT FINDING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Dust enters the cab	Improper seal around filter element	Check seal condition
	Blocked filter	Clean or replace filter
	Defective filter	Replace filter
	Excessive air leak (s) around doors and windows	Repair and Seal air leak (s)
Blower motor air flow low	Blocked filter or recirculation filter	Clean or replace filter(s)
	Heater radiator core blocked	Clean radiator core thoroughly
Blower motor not working	Fuse blown	Replace fuse
Cab does not heat up	Engine not reaching operating temperature. Thermostat stuck open	Replace thermostat
	Heater hose from engine to cab radiator, kinked or blocked	Ensure water flow to heater radiator is adequate and not restricted
Cab does not cool	Heater control turned on	Turn temperature control knob fully counterclockwise for maximum cooling
	Heater control valve stuck in open position	Free up valve or change as required
Temperature not stable	Low engine coolant	Top up coolant recovery tank

OVERHAUL

IMPORTANT: *When overhauling the heating system remember that with the engine running or shortly after it is turned off that the system will be at engine temperature and therefore the water will be hot and under pressure.*

To effect repairs to the heater core or blower motor, it will be necessary to remove the attaching bolts from the seat and remove seat from the heater housing.



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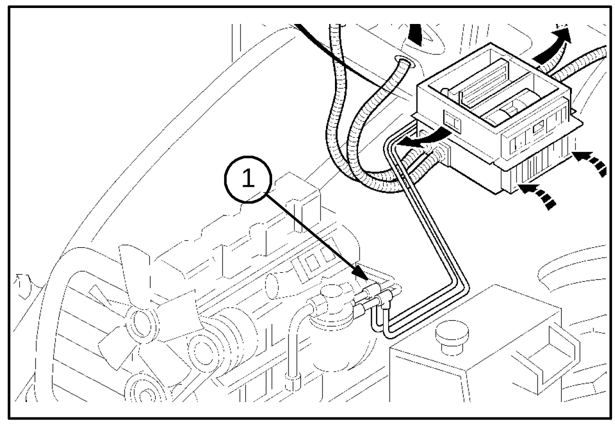
Draining the System

Too drain the cooling system down disconnect either hose at the ‘T’ junction found at the rear of the engine oil filter mounted to the right hand side of the engine.



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Heater Radiator

With the system drained remove the heater radiator hose connections, attaching bolts and remove from the vehicle.

Inspect the Heater Radiator:

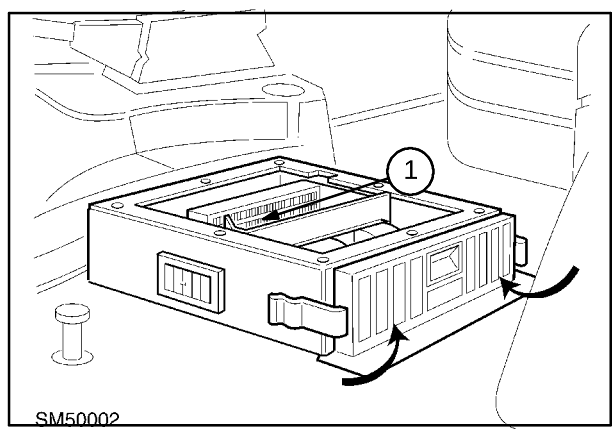
Check water flow through the heater pipe which should be free running, if not clear any blockage.

Fins should be free of all debris and not damaged clean and or repair.

Clean the heater radiator using compressed air not exceeding 7 bar (100 psi) taking care not to damage the radiator fins.

Ensure tbe radiator is not leaking under pressure, repair or replace as required.

Clean the chamber with a damp, cloth and re-assemble the housing filter element with the seal facing the inside of the cover.



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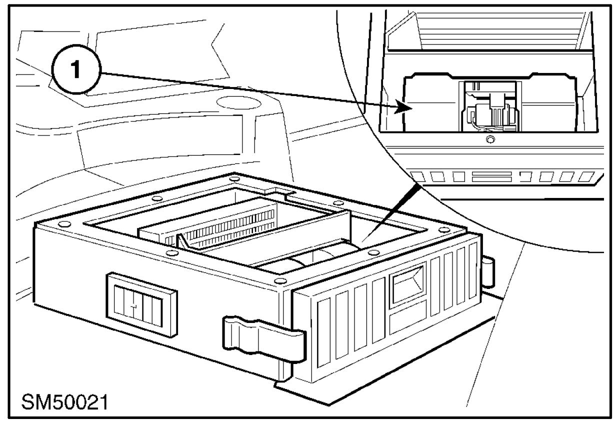
Blower Motor

The blower motor can be removed by removal of the attaching hardware and disconnection of the wiring connector.

Check the blower is working, if not check fuse and continuity of blower motor. If defective replace the blower unit as an assembly.



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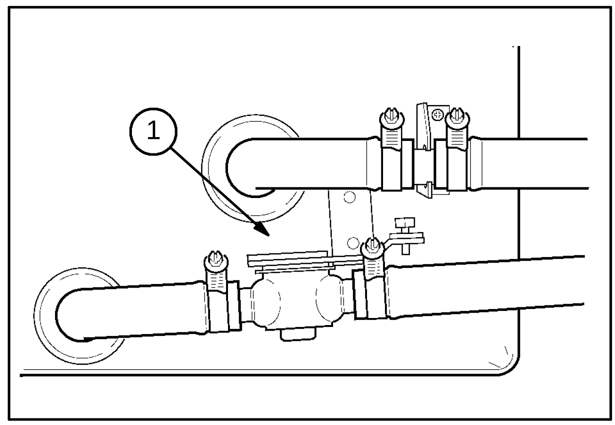
Heater Control Valve

To service the control valve disconnect the hoses and the control cable and remove. Check the operation of the valve and if tight or worn replace.



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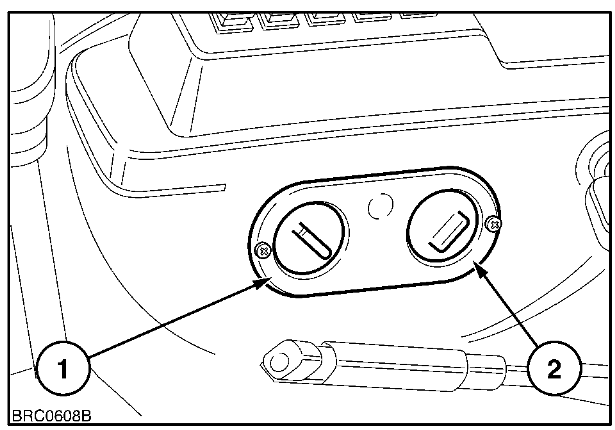
Heater Control Panel

The blower motor is operated by a 3 position switch which through a variable potentiometer increases or decreases voltage to the blower motor.

The heater valve is operated by a control cable which will push or pull the valve into an open or closed position.



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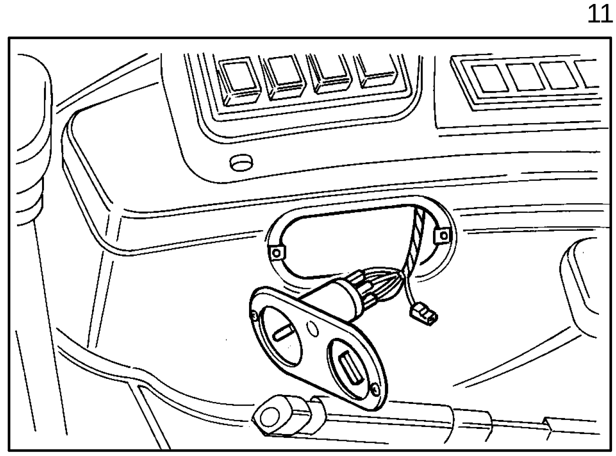
Both of the above are mounted to the right of the drivers seat and can be accessed by removal of the control panel for repair or replacement.



12

NOTES

SECTION 50 – CAB HEATIND AND AIR CONDITIONING

Chapter 2 – Cab Air Conditioning

CONTENT

SPECIFICATIONS

Refrigerant Specification — R134a

Refrigerant Charge — 1.3 kg (2.86 lbs)

Compressor Oil Specifications — SP20 (PAG Type = Viscosity Index 231)

Refrigerant Oil Capacity
System (approximately) — 135 cc (4.7 Fluid Ounces, Imperial)

Cooling capacity @ 22° C – 49° C (75° F – 120°F) ambient. 4.5 kW, 29,000 BTU/hr Typical
(Actual capacity dependent on system control operator settings)

Low Pressure Cut Out Switch (Mounted behind the front radiator grille behind the battery and attached to the receiver drier)

On	2.1 $^{+}/_{-}$ 0.3 bar (30.4 psi)
Off	2.0 $^{+}/_{-}$ 0.2 bar (29.0 psi)

Temperature Cycling Control Switch (Mounted under the seat pod in the right hand side)

Switch Setting	On	Off
Minimum Cooling	14 $^{+}/_{-}$ 2 ° C	10° C
Maximum Cooling	4 $^{+}/_{-}$ 1° C	1 $^{+}/_{-}$ 1° C

COMPRESSOR

Manufacturer and Type	Sanden SD7H15
Compressor Clutch and Pulley Air Gap	0.4–0.8 mm (0.016–0.031in)
Drive Belt Tension (measured at the widest gap)	10 mm (0.4in) deflection with 1kg (2.2lb) force applied midway between the pulleys

TORQUES – COMPRESSOR

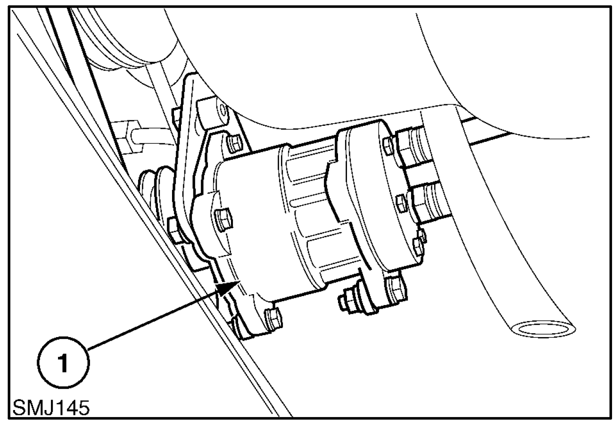
Cylinder Head Bolts	M6	10.8–16.6 Nm (7.8–12.2 lbf.ft)
	M8	29.4–39.2 Nm (21.7–28.9 lbf ft)
Clutch Front Plate Retaining Bolt	M5 x6	7–11 Nm (5.1–7.9 lbf.ft)
Armature Retaining Nut	M8	14.8–20.6 Nm (10.8–15.2 lbf ft)
Compressor Mounting Bolts		43 Nm (32 lbf.ft)

ADJUSTMENT – COMPRESSOR

Air Conditioning Compressor Assembly (where fitted)

A correctly tensioned belt can be deflected 13–19mm (0.50–0.75 in) when hand pressure is applied midway between the alternator and crankshaft pulley

Once adjusted re–torque the tension arm bolt to 33.9Nm (25 lbf ft).



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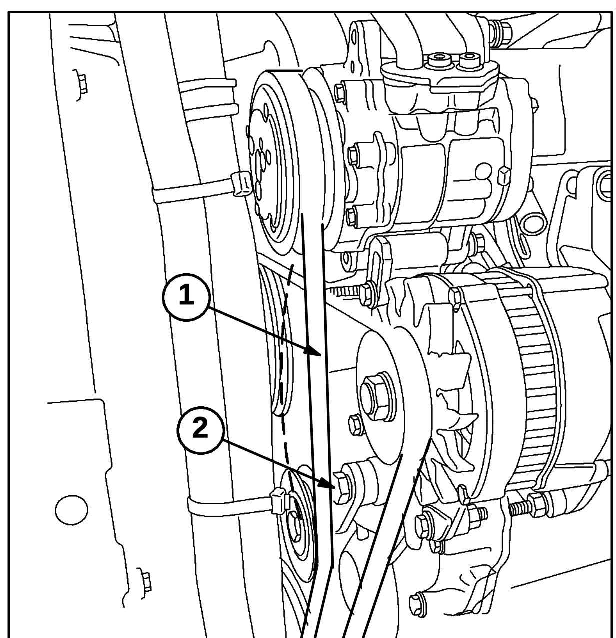
Air Conditioning Compressor Assembly (where fitted)

The compressor drive belt (1) can be tensioned by rotation of the idler arm (2). Slacken the idler arm bolt and adjust the arm to a belt deflection of 16mm (3/8in).

Once adjusted re–torque the tension arm bolt to 33.9Nm (25 lbf ft).



14

SPECIAL TOOLS

Only Certified Refrigerant Recovery, Recycling and Recharge Equipment suitable for the type of refrigerant gas R134a should be used on these vehicles when servicing the air conditioning system.

This special equipment is available through recognised suppliers of air conditioning equipment. Refer to the Tool supplier for details on the latest equipment available for servicing the air conditioning system.

General Tools

Vacuum/charge Portable system	Tool No NH 294030
Recovery/recharge Portable System	Tool No NH 294048
Evaporator and Condenser Cleaner	Tool No NH 293831
Expansion Valve Tape	Tool No NH 293826
Electronic Gas Leak Detector	Tool No NH294036
Manifold Gauge Set (Where required)	OTC/V.L Churchill Ltd Part No NH00172

Compressor Tools

Sanden Compressor SD7H15	Tool No 297423

SAFETY PRECAUTIONS

WARNING

Before overhauling an air conditioning system read and observe the following Safety Precautions If a repair or replacement becomes necessary, ensure that only certified Air Conditioning technicians are employed, using approved equipment to effect repairs. Do not attempt to disassemble the air conditioning system, It is possible to be severely frostbitten or injured by escaping refrigerant.

***IMPORTANT:** Do **not** allow refrigerant to escape into the atmosphere.*

Refrigerant must be handled with care in order to AVOID HAZARDS.

Undue direct contact with liquid refrigerant can produce freezing of skin and eyes.

Keep the refrigerant container and air conditioning system away from flame or heat sources, the resulting pressure increase can cause the container or system to explode.

If in direct contact with open flames or heated metal surfaces, the refrigerant will decompose and produce products that are toxic and acidic.

Make sure to comply with the following indications and simple precautions to avoid any risk of injury:

- Never discharge refrigerant into the atmosphere. When servicing air conditioning units a certified refrigerant recovery unit operated by a certified technician must be used.
- When discharging the refrigerant in the system make sure you are operating in well–ventilated premises with good air circulation and far away from open flames.
- When charging and discharging the system always wear goggles and take suitable precautions to protect the face in general and the eyes in particular, from accidental spillage of the refrigerant fluid.
- The oil and refrigerant mixture inside the air conditioning system is pressurized.
  Consequently, never loosen fittings or tamper with lines unless the system has been properly discharged.
- Before loosening any connection, cover the fitting in question with a cloth and wear gloves and goggles in order to prevent refrigerant from reaching the skin or eyes.
- In the event of an accident, proceed as follows:–

  If the refrigerant has reached the eyes, wash them immediately with copious amounts of sterilised water or mains pressure tap water and transfer to hospital for immediate medical help.

  If the refrigerant has touched the skin, wash with cold water and transfer to hospital for immediate medical help.

Description and Operation

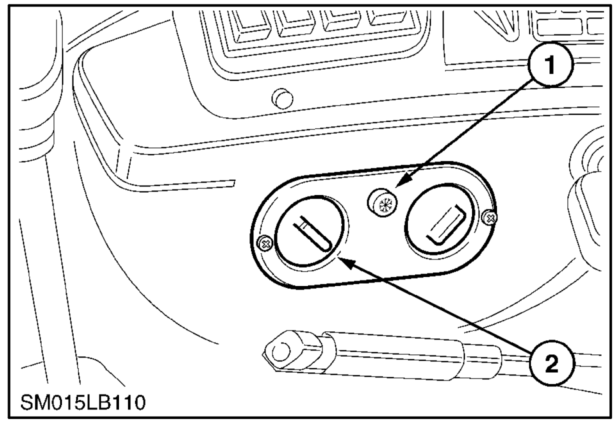
NOTE: *The Air Conditioning compressor will only run when the cab blower motor is operating.*

To operate push the button (1), which will engage the air conditioning compressor

A three speed blower is used for the air circulation and operates by turning the switch (2) Figure 1, mounted to the right of the operator seat.

1st Position – Low Speed
2nd Position – Medium Speed
3rd Position – Fast Speed

The air–conditioner filter is located on the left hand side of the seat pod.



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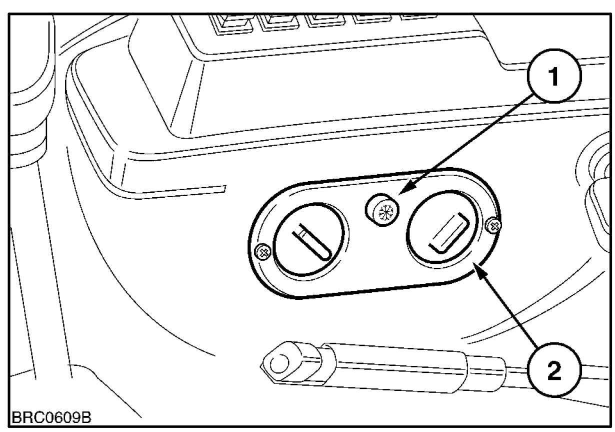
WARNING

The air filter is designed to remove dust from the air but may not exclude chemical vapour. Refer to chemical manufacturers directions regarding protection from dangerous chemicals.

If the machine has been parked in the sun, quicken the cooling by operating the air–conditioning for 2–3 minutes at its coldest setting. Set maximum blower speed with a window left partially open to force most of the warm air from the cab.

With the air cooled sufficiently, close the window and adjust the controls to the desired temperature. To ensure proper operation of the system be sure the cab filter is regularly serviced. Refer to filter maintenance.

It is the normal function of the air–conditioner to extract water from the air. As such it is possible pools of water will collect beneath the drain hose outlets under the cab when the machine is stationary.



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REFRIGERANT R–134a

WARNING

R–134a can be dangerous if improperly handled. Therefore it is important the following warning and directions are adhered to.

R–134a has a boiling point of 10°F (–12°C).

Never expose any part of the air–conditioner system to flame or excessive heat because of risk of fire or explosion, and the production of phosgene gas.

Never disconnect or disassemble any part of the air–conditioning system as escaping refrigerant can cause frostbite.

WARNING

If refrigerant should contact the skin use the same treatment as for frostbite.

Warm the area with your hand or lukewarm water 90°F (32°C), cover the area loosely with a bandage to protect affected area against infection and consult a doctor immediately.

If refrigerant should contact the eyes wash immediately in cold clean water for at least 5 minutes and consult a doctor immediately.

Air Flow Vents

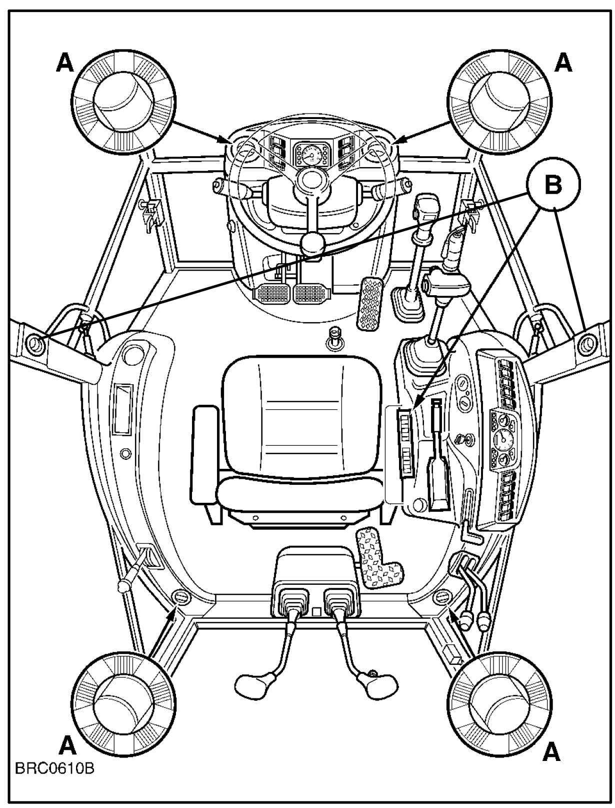
Air flow vents are conveniently positioned in the cab and may be independently adjusted, as required, to direct warm or cold air onto the windscreen and side windows or to the cab interior as required.

Each vent may be swivelled and adjusted to control the flow of air.

To open a vent, press one side of the disc and turn it, as required, to direct the air flow.

A = Standard Layout

B = When Air Conditioning is fitted



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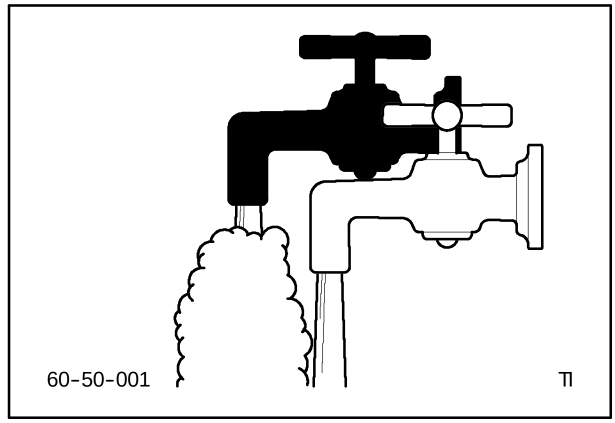
PRINCIPALS OF AIR CONDITIONING

The function of the air conditioning system is to improve the operator's comfort by cooling the air temperature inside the cab and reducing the humidity level.

In order to achieve this heat transfer the following principals of heat generation and transfer are applied within the air conditioning system.

1. When two bodies of different temperature come together heat is transferred from one to another. On air conditioning systems an evaporator is used to hold the low temperature refrigerant which absorbs the heat from the air within the cab.
2. When a gas is pressurised the temperature of the gas will rise. In air conditioning systems the increase in pressure is achieved using a compressor.



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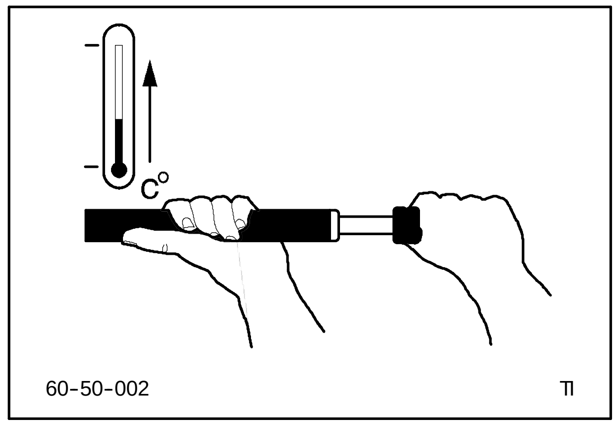

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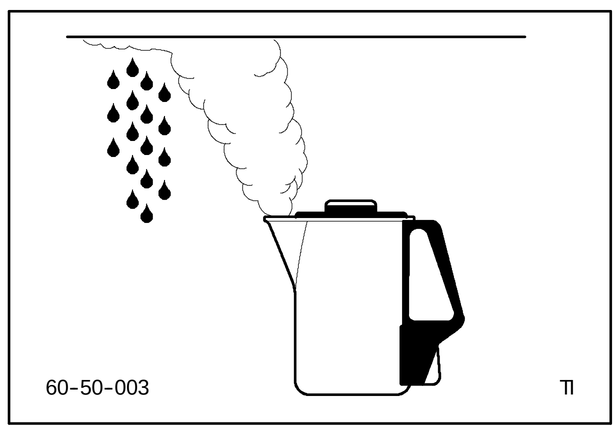
3. When a gas is cooled it will condense into a liquid. In the air conditioning system a condenser is used to cool the gas and the resulting liquid is stored in a receiver dryer.



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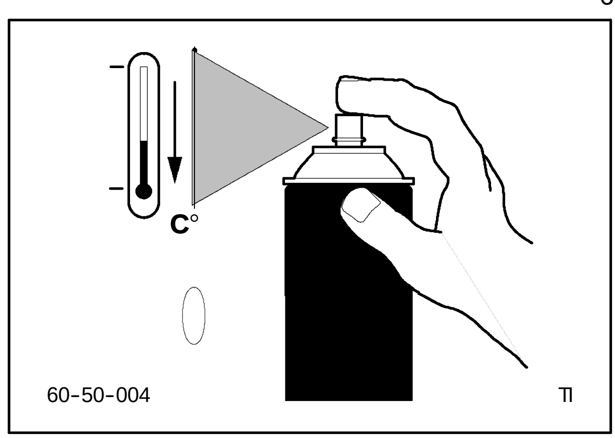
4. When a liquid is atomized through an orifice, the temperature of the resultant vapour will drop. The low temperature of the atomized liquid will then absorb heat from its surroundings. On air conditioning systems the refrigerant is atomized using an expansion valve.



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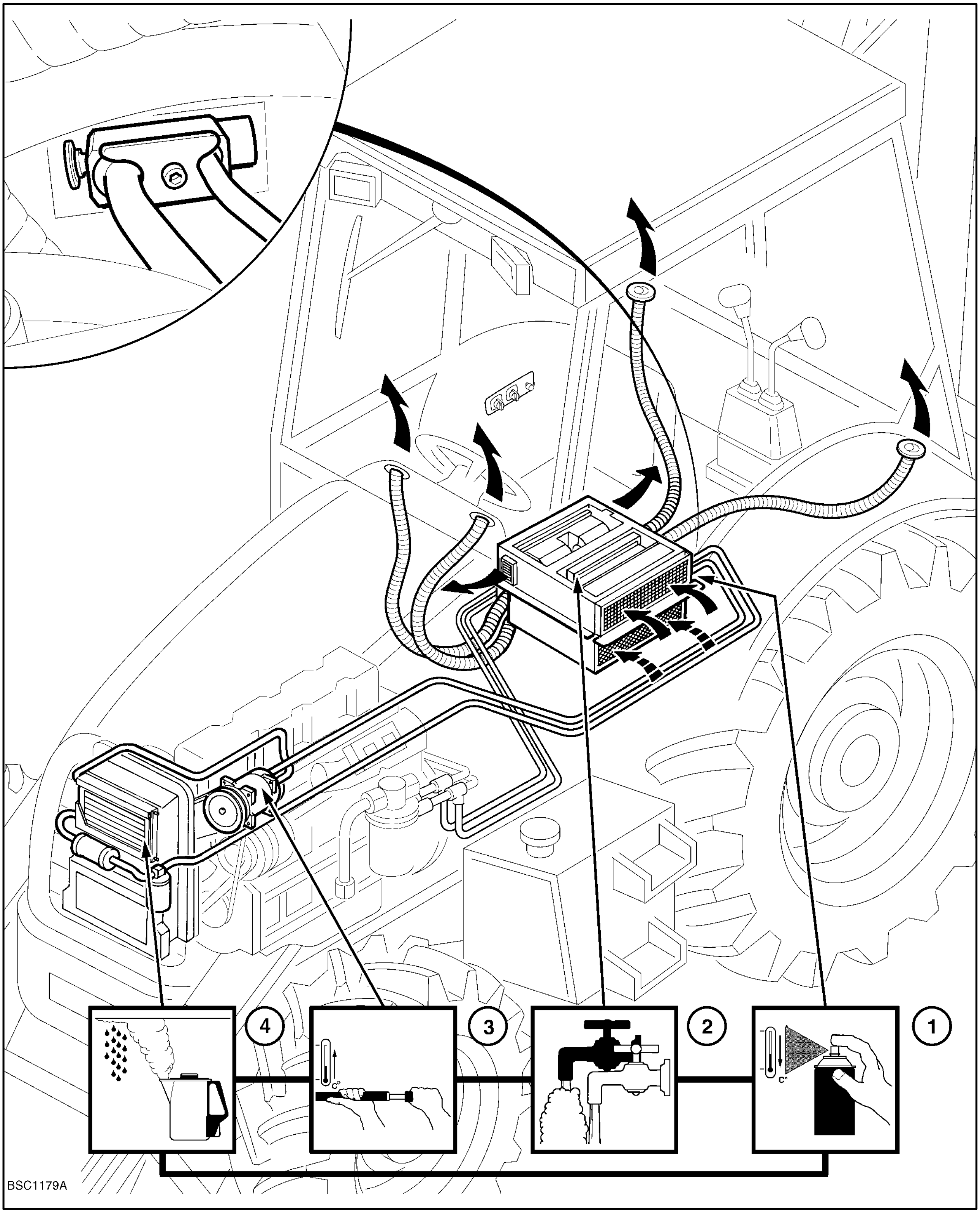

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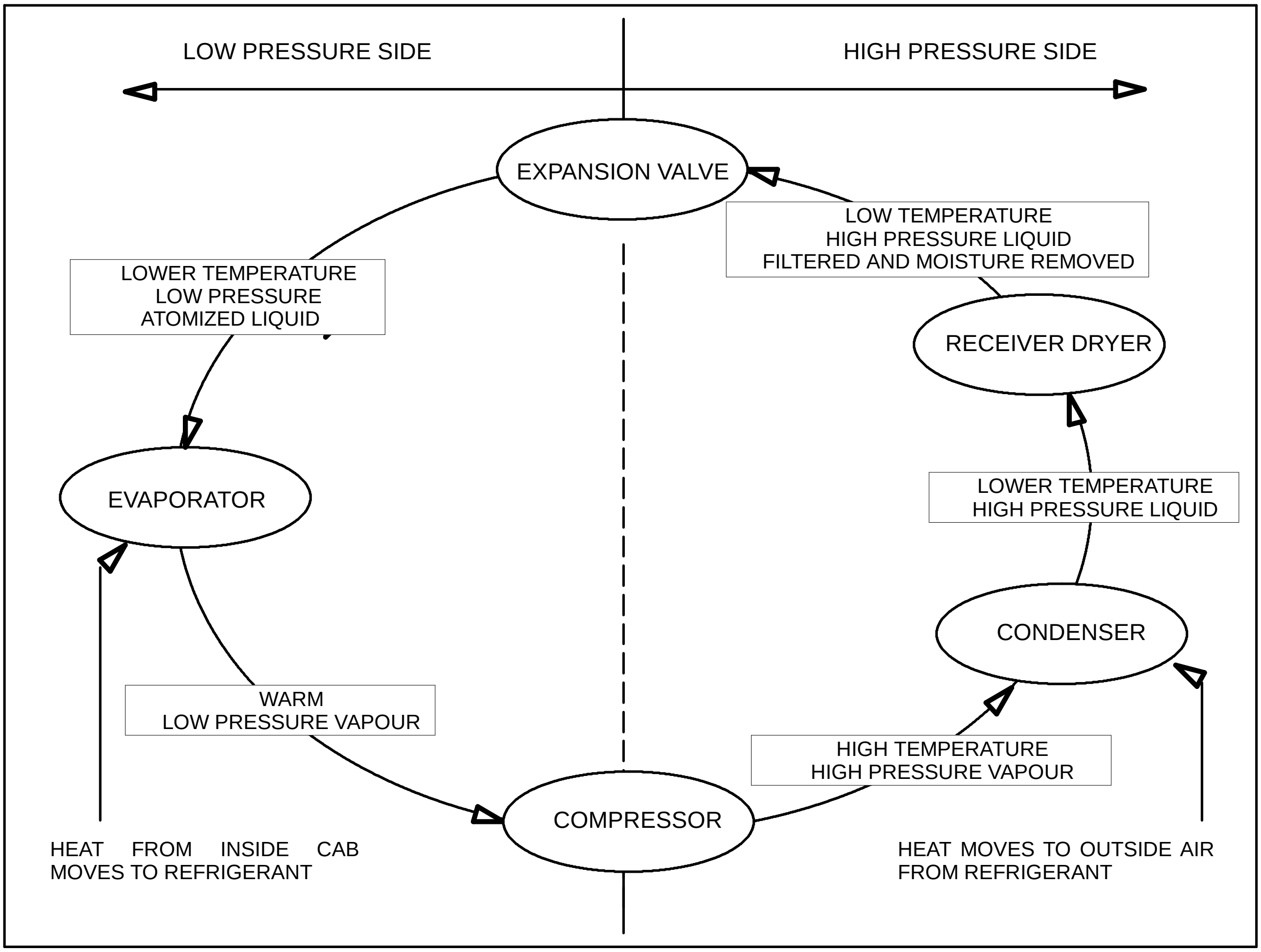
Air Conditioning Principle of Operation

1. Expansion Valve – Atomizes Liquid Refrigerant Before Passing to Evaporator
2. Evaporator– Absorbs Heat From Air In Cab
3. Compressor – Compresses and Raises Temperature Of Refrigerant Gas
4. Condenser and Receiver Dryer – Converts Refrigerant from Gas to a Liquid



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Air Conditioning Flow Diagram

It can now be seen that the principal components of an air conditioning system are:–

- Refrigerant
- Evaporator
- Compressor
- Condenser
- Receiver Dryer
- Expansion Valve

Figure 8, uses the examples above to illustrate the air conditioning cycle.

Figure 9, shows in schematic form the flow of refrigerant through the five major components of an air conditioning system.

Refrigerant is drawn into the compressor as a cool, low pressure vapour which is compressed and then pumped out as a hot, high pressure vapour to the condenser.

As the hot, high pressure vapour passes through the condenser core it gives off heat to the cooler outside air, being drawn past the fins by the engine cooling fan.

By giving off heat to the outside air, the vapour is condensed to a liquid which moves under high pressure to the receiver dryer where it is stored until released to the evaporator by the temperature sensing expansion valve.

As liquid refrigerant passes through the metered orifice in the expansion valve the refrigerant changes from a high pressure liquid to a low pressure atomized liquid with a lower temperature.

This low pressure, low temperature, atomized liquid enters the evaporator coils and absorbs heat from the cab warm air blown across the coils and fins by the cab blower motor. The refrigerant now changes from a cold low pressure atomized liquid to a warm low pressure vapour and leaves the evaporator outlet, moving to the suction (low pressure) side of the compressor to repeat the cycle.

As this heat loss is taking place, moisture (humidity) in the cab air will condense on the outside of the evaporator and drain off as water through the drain hoses attached to the evaporator drain pan, thereby reducing the humidity level of the cab.

SYSTEM DESCRIPTION AND OPERATION

Refrigerant

To achieve the absorption and the release of heat which is, in essence, the function of an air conditioning system, requires the use of a suitable “refrigerant” - a liquid that has a relatively low temperature boiling point, plus certain desirable safety and stability features.

The refrigerant used in the air conditioning system is refrigerant R134a.

NOTE: *To help protect the environment legislation has been introduced in most territories banning the release into the atmosphere of refrigerants,including R134a. All service procedures contained in this manual can be carried out without the need to release refrigerant into the atmosphere.*

In order to prevent the incorrect type of refrigerant being charged to the system the service valves fitted to the Backhoe Loader and necessary to connect up refrigerant recovery, evacuation and recycling/recharging equipment will be of two different sizes as recognised and specified by the air conditioning industry.

WARNING

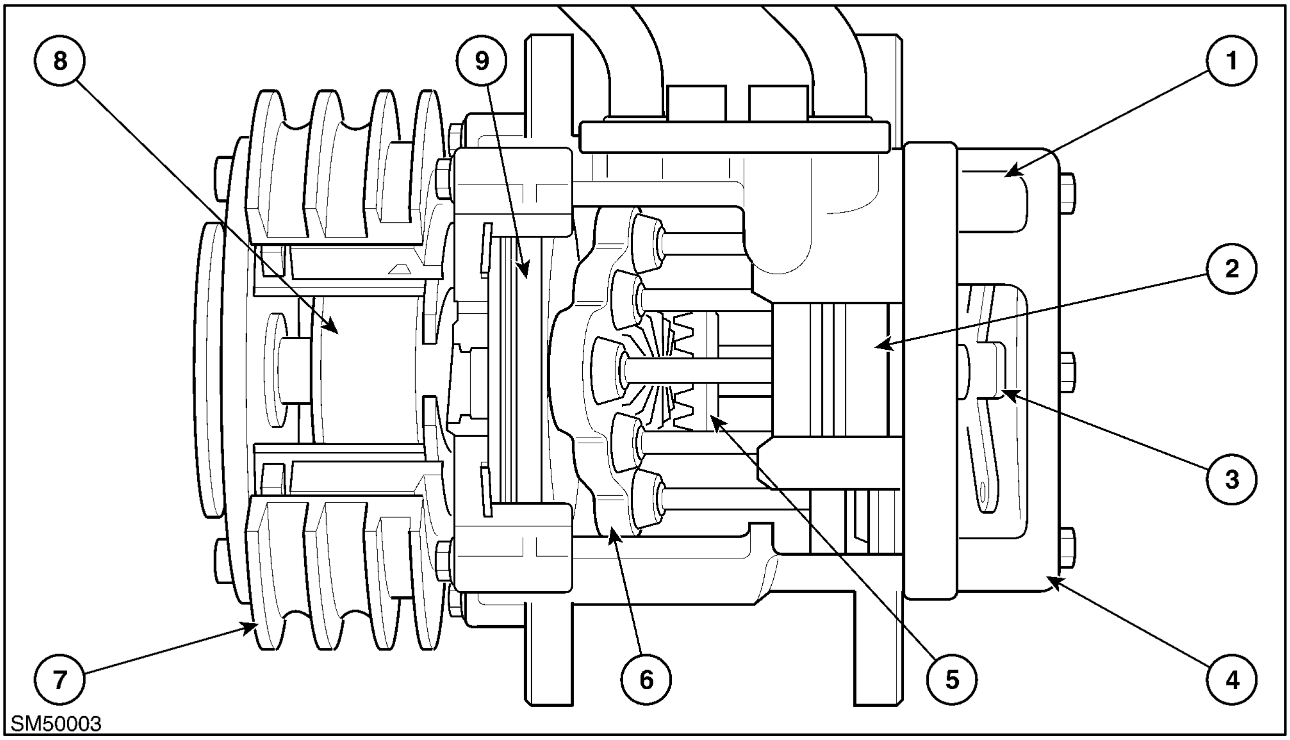
*R134a refrigerant is **not compatible** with R–12 refrigerant. **Do not** attempt to replace R134a refrigerant with R–12 refrigerant or test the system using gauges or equipment previously used with R12 as damage to the system will result.*

R-134a refrigerant is stable at all operating temperatures and able to absorb great quantities of heat.

The boiling point of R-134a is -22° C (-15° F) at atmospheric pressure.

If the pressure is increased, R-134a will readily vaporize to absorb heat at temperatures between -11.7° C (11° F) at 1.9 bar (27.5 psi) and 0°C (32° F) at 2.9 bar (42 psi) in the evaporator.

At higher pressures, R-134a will condense and give off heat at temperatures between 48° C (118° F) at 12.4 bar (180 psi) and 58° C (136° F) at 15.85 bar (230 psi) in the condenser.



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Air Conditioning Refrigerant Compressor

1. Discharge Chamber
2. Pistons
3. Reed Valve Plate Assembly
4. Cylinder Head
5. Static Gear
6. Wobble Plate
7. Pulley/Electro–magnetic Clutch
8. Pulley Bearing
9. Cam Plate

Compressor Pump

The air conditioning compressor pump is mounted on the left hand side of the engine and is belt driven from the crankshaft pulley.

The compressor separates the low and high pressure sides of the system and is basically a pump which has two functions:

(1) To raise the refrigerant temperature by compression to a higher degree of temperature than the ambient (outside air) temperature.

(2) To circulate the required volume of refrigerant through the system.

The refrigerant compressor is a seven cylinder wobble plate unit housed in a die cast aluminium housing.

Drive to the wobble plate is from the pulley, through the electro – magnetic clutch to the main driveshaft. Attached to the driveshaft is a cam rotor which oscillates the wobble plate. The wobble plate is prevented from rotating by a static gear engaging with teeth formed in the face of the plate. The seven pistons are connected to the wobble plate by rods located in ball sockets.

Refrigerant is drawn in on the downward stroke of a piston through the reed valves located either end of the cylinder assembly. Refrigerant enters the cylinder assembly through a gallery in the outer circumference of the cylinder assembly.

The upwards stroke of the piston compresses the refrigerant and expels it through another reed valve into an inner gallery in the cylinder assembly and out into the refrigerant circuit.

The compressor is lubricated with a Polyalklene Glycol (PAG) oil Type SP20. This oil is miscible with the refrigerant and is carried around the refrigerant circuit.

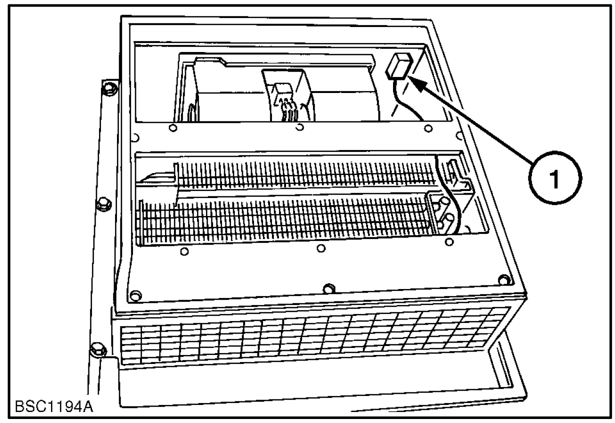
The compressor is activated by an electro-magnetic clutch which functions to engage or disengage the compressor as required in the operation of the air conditioning system.

The clutch is primarily activated by the:–

- Temperature control switch
- Low pressure cut–out switch

Temperature Control Switch

The air conditioner temperature control switch (1) is mounted beneath the cab seat to the right hand side of the blower motor assembly.



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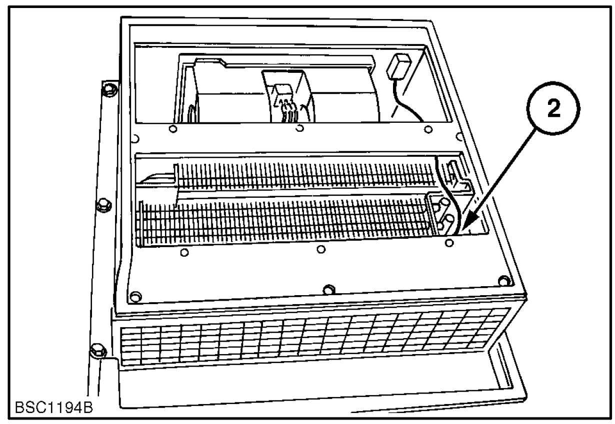
The switch is a device which turns the compressor clutch on and off to maintain a constant average evaporator temperature and senses the evaporator temperature using a thermistor (2) attached to the larger evaporator tube.

The temperature control switch compares the voltage of the thermistor, which is dependent on the temperature of the evaporator, with the voltage across the potentiometer of the 'in cab' temperature control switch.

The switch upon comparing the two voltages determines whether the compressor clutch should be switched 'on' or 'off' in order to maintain the desired in cab temperature control.



12

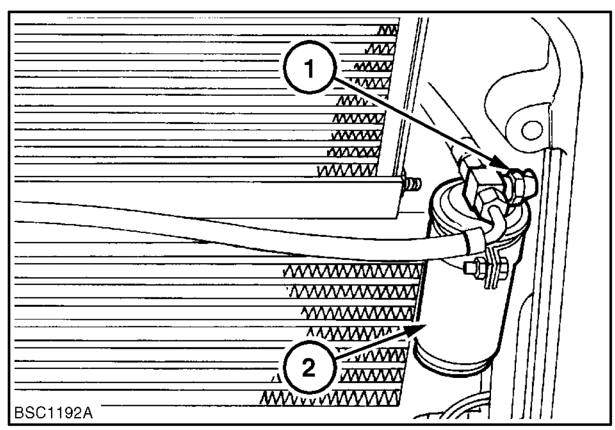
Low Pressure Cut-out Switch

The low pressure switch (1) is mounted in the top of the filter (2) mounted in front the radiator behind the battery.

The purpose of the switch is to shut off the compressor pump in the event of low pressure in the refrigerant system.

Low refrigerant pressure may occur due to a faulty expansion valve, icing up of the expansion valve orifice or refrigerant loss. Low refrigerant pressure may result in damage to the compressor pump.

The low pressure switch is factory set and cannot be adjusted.



13

Condenser

The condenser, (1) located at the front of the machine in front of the engine radiator consists of a number of turns of continuous coil mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

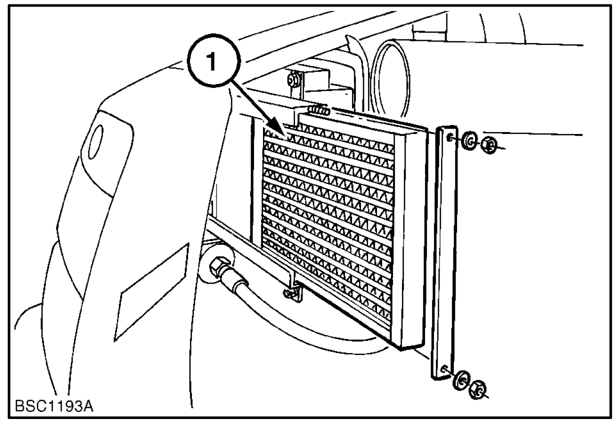
NOTE: *The condenser after removal of the attaching bolts can be slid out for cleaning.*

The condenser receives the hot, high pressure refrigerant vapour from the compressor. The hot vapour passes through the condenser coils and outside air is drawn through the condenser by the engine cooling fan.

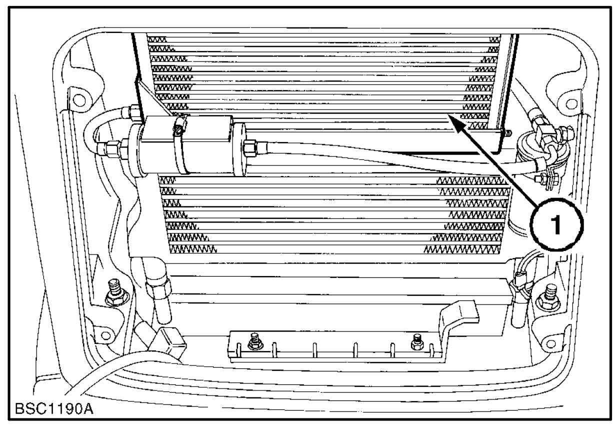
Heat moves from the hot refrigerant vapour into the cooler outside air flowing across the condenser coils and fins.

When the refrigerant vapour reaches the pressure and temperature that will induce a change of state, a large quantity of heat is transferred to the outside air and the refrigerant changes to a high pressure warm liquid.

The warm liquid refrigerant continues onto the receiver/drier where it is filtered and desiccated, to remove any moisture, before passing through an outlet line to the thermostatic expansion valve.



14



15

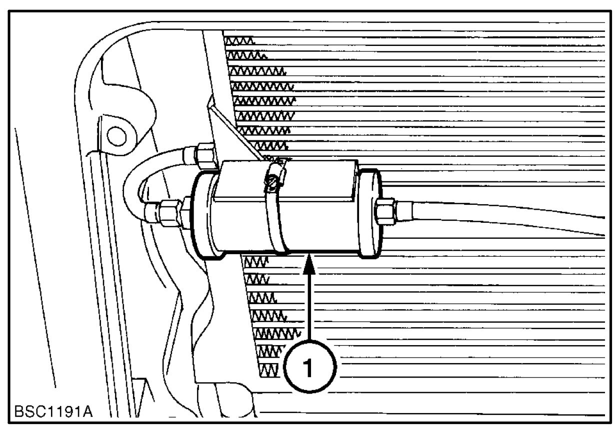
Receiver Dryer

The receiver/dryer (1) situated behind the battery stores the liquid refrigerant to be sure a steady flow to the thermostatic expansion valve is maintained under widely different operating conditions.

The drier section contains a desiccant (Molecular sieve) to absorb any moisture within the system and a filter prevents the entry of foreign particles.

NOTE: *Any moisture in the air conditioning system is extremely harmful. Moisture not absorbed by the dehydrator will circulate with the refrigerant and droplets may collect and freeze in the thermostatic expansion valve orifice. This action will block the refrigerant flow and stop the cooling action. Moisture will also react with refrigerant R-134a and the lubricant to form a corrosive acid.*

The desiccant can only absorb a limited amount of moisture before reaching saturation point. Because of this, after any system component replacement or repairs requiring entry into the system, the receiver/dryer should be replaced.

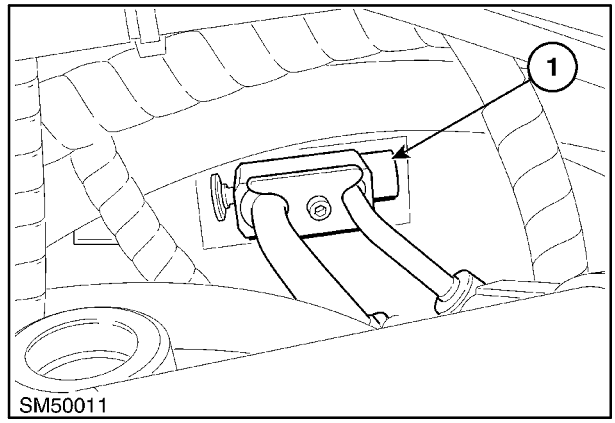


16

Expansion Valve

The expansion valve is located underneath the evaporator in the pressure line leading from the receiver/ dryer and performs the following functions:

1. METERING ACTION -
   A metered orifice changes the liquid refrigerant from a high pressure low temperature liquid to a low pressure, lower temperature atomized liquid.
2. MODULATING ACTION -
   A thermostatically controlled valve within the expansion valve body controls the volume of liquid refrigerant passing through the orifice and makes sure the refrigerant is fully vaporized within the evaporator. Liquid refrigerant would damage the compressor reed valves or freeze the pistons.
3. CONTROLLING ACTION -
   The valve responds to changes in the cooling requirements. When increased cooling is required, the valve opens to increase the refrigerant flow and when less cooling is required the valve closes and decreases the refrigerant flow.



17

Expansion Valve - Operation

All of the needed temperature sensing and pressure sensing functions are consolidated into this basic unit and no external tubes are required for these purposes.

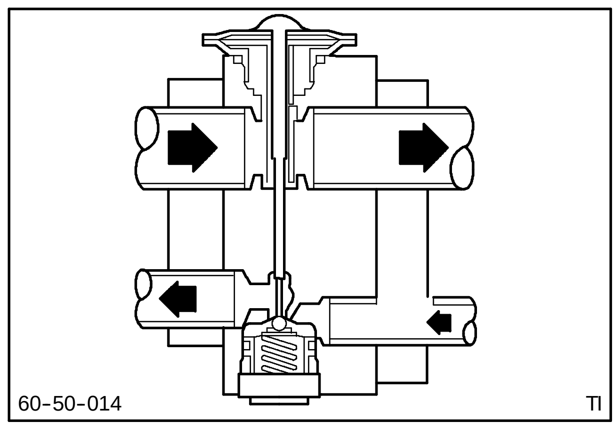
The refrigerant from the condenser and receiver dryer enters the thermostatic expansion valve as a high pressure warm liquid. Upon passing through the ball and spring controlled metering orifice, the pressure and temperature of the refrigerant is reduced and the refrigerant leaves the thermostatic expansion valve as a low pressure, lower temperature atomized liquid.

The atomized liquid now passes through the evaporator where it absorbs heat before returning via the expansion valve to the compressor as a warm low pressure vapour.

There are two refrigerant passages in the valve. One passage is in the refrigerant line from the condenser to the evaporator and contains the ball and spring type orifice valve. The other passage is in the refrigerant line from the evaporator to the compressor and contains the valve's temperature sensing element.

Liquid refrigerant flow from the condenser and receiver dryer is controlled by a push-rod forcing the orifice valve ball off its seat and the spring exerting pressure on the ball to keep it on its seat.

During stabilized (vehicle shutdown) conditions, the pressure on the bottom of the expansion valve diaphragm rises above the pressure on the top of the diaphragm allowing the valve spring to close the orifice.



18

When the system is started, the pressure on the bottom of the diaphragm drops rapidly, allowing the orifice to open and meter atomized liquid refrigerant to the evaporator where it begins to vaporize.

Suction from the compressor draws the vaporized refrigerant out of the evaporator and back through a gallery in the top of the valve which passes the temperature sensor.

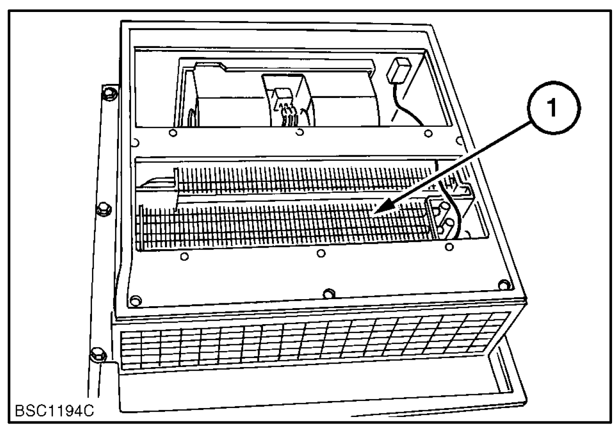
The temperature sensor reacts to variations in refrigerant gas pressure returning from the evaporator. When heat from the passenger compartment is absorbed by the refrigerant the pressure of the gas increases causing a differential pressure above and below the temperature sensor diaphragm. The diaphragm reacts to this pressure differential and a push rod forces the ball in the expansion valve orifice further off its seat. This reaction allows an increase in the atomized refrigerant to flow through the valve, to the evaporator, so that more heat can be absorbed by the air conditioning system.

Similarly when the temperature of the gas returning from the evaporator decreases the pressure of the gas decreases. This causes the diaphragm to react accordingly and allow the ball in the orifice to move closer towards its seat thus reducing the flow of refrigerant through the valve to the evaporator.

Evaporator

The evaporator is located beneath the cab seat and consists of a number of turns of continuous coils mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

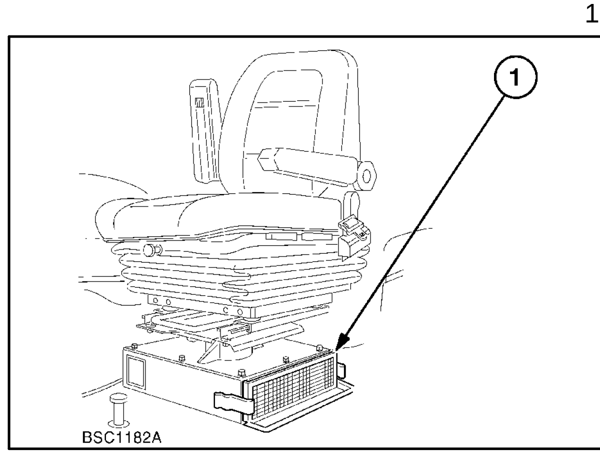
Low temperature refrigerant in the evaporator absorbs heat from the hotter air in the operator's compartment, thereby cooling the air.



19

Air Recirculation

An intake grille is located on the left side of the seat base. A portion of the air flow will recirculate through the evaporator.

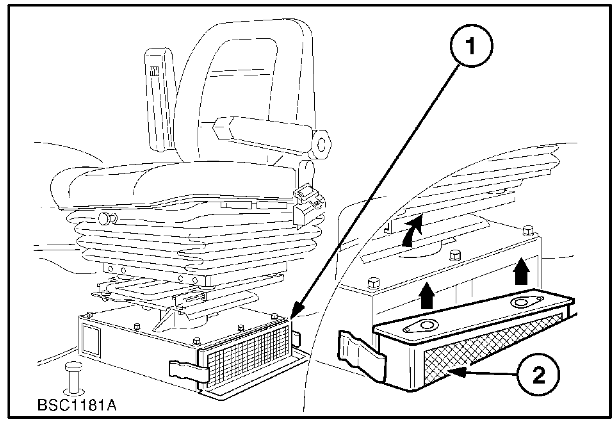


20

Filter General

The blower fan, draws warm air from outside the cab through the intake filter (2) below the cab floor and already cooled dehumidified air through the recirculation grille (1). The air passes over the evaporator then into the cab through the six louvered vents.

Two vents are located on the front instrument panel to direct air onto the windshield. Two are located at the base of the rear posts to direct air onto the rear window. Two additional vents are located at the front and rear of the seat base to direct air at the operators feet.

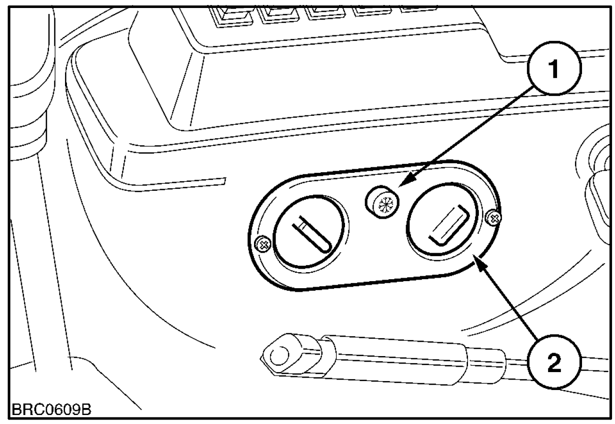


21

Blower Fan

The blower motor is controlled by a three-speed switch (2) the switch uses a variable resistor to change the fan speed.

High blower speed provides the greatest volume of circulated air, however, a slower speed will allow the air to contact the cooling fins and coils of the evaporator for a longer period resulting in the warm air giving up more heat to the cooler refrigerant. Therefore, the coldest air temperature is obtained when the blower fan is operated at the lowest speed.



22

FAULT FINDING AND TESTING THE AIR CONDITIONING SYSTEM

Overhaul of the air conditioning system should only be undertaken by a certified specialist refrigeration engineer using a comprehensive air conditioning test kit, including a gas leak detector, suitable for R134a refrigerant gas.

WARNING

Before dismantling an air conditioning system for repair the gas within the system must be discharged and recovered using a certified recovery unit designed for the type of refrigerant gas used in the system.

NEVER release refrigerant gas into the atmosphere.

ALWAYS wear safety goggles and gloves when servicing any part of the air conditioning system.

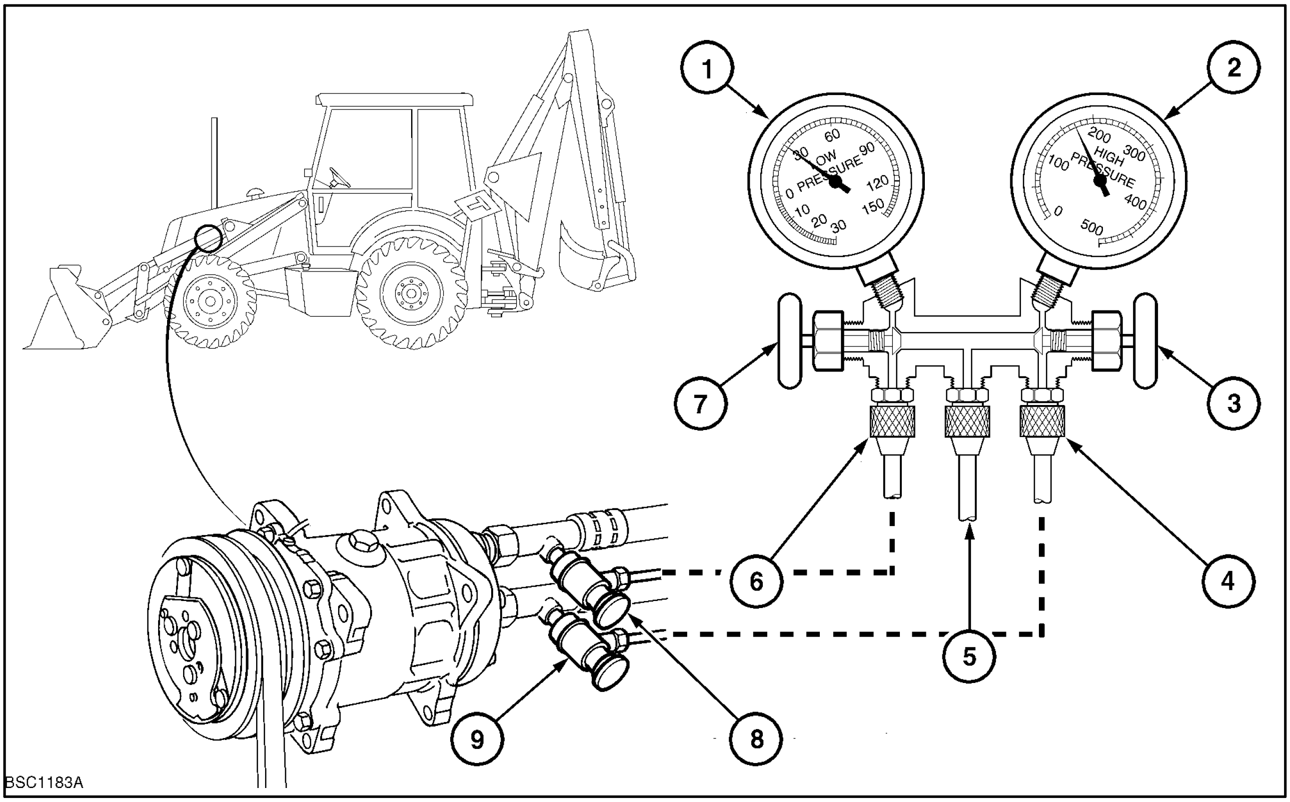
To prevent the entry of any foreign material, observe the following points:

- Ensure all tools, gauges, hoses and replacement parts are kept clean and dry and are suitable for the type of refrigerant gas used in the system.
- Clean all hoses and fittings before disconnecting. Cap or plug all openings when disconnected.
- When adding lubricating oil to the system always uncap and re-cap the oil container immediately before and after use. Always ensure the oil remains free of moisture.

Preliminary Fault Finding

Always conduct the preliminary fault finding checks before performance testing the system.

1. Run the engine at 1000-1200 rev/min for 10 minutes with the air conditioner set at maximum cooling and the blower on high speed.
2. Check that the heater temperature control is switched OFF.
3. Check that the blower fan is operating at all speeds.
4. Check that the compressor clutch engages when the temperature control switch is turned from “OFF” to “ON” position. A clicking sound indicates the clutch is engaging. If the clutch fails to operate it may indicate an electrical problem in the high low pressure cut out switches or malfunction of the electric drive clutch on the compressor.
5. Check the engine cooling fan is drawing cool air through the condenser
6. Check the compressor drive belt tension.
7. Check the condenser core and grid is clean and free of obstruction.
8. Check the cab air filter is clean and free of obstruction.
9. Check the evaporator fins are not plugged or excessively dirty.



23

Attaching Manifold Gauge Set to the Tractor

1. Low Side Gauge
2. High Side Gauge
3. Shut-off Valve
4. Test Hose to High Side Service Connector
5. Centre Hose (Not Used)
6. Test Hose to Low Side Service Connector
7. Shut-off Valve
8. Low Pressure (Suction) Side Service Valve
9. High Pressure (Discharge) Side Service Valve

Performance Testing The Air Conditioning System

The manifold gauge set is the most important tool used in testing and servicing the air conditioning system.

NOTE: *For Dealers who posses the latest design level of refrigerant recovery, recycling and recharging station, these gauges are an integral part of the machine.*

The following instructions for performance testing the air conditioning system is based on the use of the gauge set shown. The principal of operation is however similar when testing the system using a recovery and recharging station with integral gauges.

When using this type of equipment **always** consult the manufacturers operating instructions.

Operating Precautions

IMPORTANT: *Always ensure the shut-off valves are* ***closed*** *(turn clockwise until seated) during all test operations.*

In the closed position, refrigerant circulates around the valve stems to the gauges. Therefore, when the manifold gauge set is connected into a system, pressure is registered on both gauges.

- **NEVER** open the HIGH SIDE shut off valve when the system is operating.
- **ALWAYS** open the LOW SIDE shutoff valve when adding refrigerant.

Attaching The Gauge Set To The Tractor

WARNING

To avoid personal injury, stop the tractor engine during connection of the manifold gauge set.

1. Check that the gauge set shut off valves are closed (turned fully clockwise).
2. Connect the high side gauge hose (normally red) to the high pressure (discharge) side service valve and the low side gauge hose (normally blue) to the low pressure (suction) side service valve on the tractor. Ensure the hose connections are fully tightened.

IMPORTANT: *Prior to connection of the manifold gauge set, identify the suction (low pressure) and discharge (high pressure) service gauge ports. The high pressure service valve is always in the line from the compressor to the condenser.*

The high and low pressure service valves on the tractor are spring loaded valve and will be automatically opened when the test hose is connected.

NOTE: *The test hose must incorporate a valve depressor to actuate this type of valve.*

The service valves have a protective cap. This cap must be removed for test gauge connections and replaced when service operations are completed.

Test Procedure

After the manifold gauge set has been connected and before pressure tests can be made, the system must be stabilized as follows:

1. Apply the parking brake, check the gear shift levers are in neutral and close the cab windows and doors.
2. Re–check that both the high and low side shut off valves on the manifold gauge set are fully **closed.**
3. Run the engine at 1000-1200 rev/min.
4. Turn the heater temperature control 'off'
5. Operate the system at maximum cooling, with the blower fan at high speed for 10 minutes to stabilize all components.
6. Check the manifold low pressure gauge reading is within the specified range of approximately 0.28-2.48 bar (4-36 psi).
7. Check the manifold high pressure gauge reading and compare the reading to the pressure indicated on the pressure temperature chart below.
8. Measure and compare the temperature of conditioned air entering the cab through the louvered air vents with the ambient air at the air intake filters on the outside of the cab.

   If the system is operating correctly the conditioned air entering the cab should be 6–9° C (10–15° F) cooler than the ambient temperature of the outside air.
9. If it is confirmed that the system is not operating correctly refer to the fault diagnostic charts and performance test gauge reading examples on the following pages for possible corrective action.

WARNING

A significant amount of refrigerant vapour may have condensed to a liquid at the service fitting at the high side of the compressor. Use a cloth or other protective material when disconnecting the manifold hose from this fitting to prevent personal injury to hands and face.

APPROXIMATE HIGH PRESSURE GAUGE READINGS

Ambient Air Temperature		High Pressure Gauge Reading		
Degrees F	**Degrees C**	**bar**	**kgf/cm^2**	**lb/in2**
80	27	10.0/11.6	10.3/11.8	147/168
85	29	11.2/12.7	11.4/12.9	162/184
90	32	12.3/13.8	12.5/14.0	179/200
95	35	13.3/15.2	13.6/15.5	194/221
100	38	14.5/16.7	14.8/17.0	210/242
105	41	16.0/18.3	16.3/18.6	231/265
110	43	17.3/20.0	17.7/20.3	252/289

PERFORMANCE TEST DIAGNOSIS

Gauge Readings:- **Low Pressure - Low**
High Pressure - Low

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air not cold	Low refrigerant charge.	Perform leak tests and repair Evacuate system Charge system, re–test system
Evaporator air warm	Extremely low refrigerant charge.	Perform leak tests and repair Evacuate system Charge system, re–test system
Evaporator air cool but not sufficiently cold . Low pressure switch cutting out Expansion valve to evaporator tube shows considerable condensation or frost. Too cold to touch	Expansion valve not permitting sufficient flow. Stuck valve	Check expansion valve as follows: Set a for maximum cooling Low pressure gauge should drop slowly If expansion valve is defective: Discharge system Replace expansion valve Evacuate system Charge system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - High
High Pressure - High

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air warm Liquid line hot (condenser outlet to expansion valve tube) High pressure switch cutting out	Improper operation of condenser Overcharged with refrigerant Air in system	Inspect for dirty condenser restricting air flow and cooling Check operation of condenser cooling fans. Repair or replace as needed. Check for overcharge as follows: Stop the engine. Recover and recycle the charge using correct recovery equipment. Recharge the the system with the correct quantity of refrigerant, replacing any lost lubricant. Recheck performance of air conditioning system.
Evaporator air not cold	Expansion valve allowing too much refrigerant to flow through the evaporator	Check expansion valve as follows: Set for maximum cooling. Low pressure gauge should drop slowly If expansion valve is defective: Discharge System Replace Expansion Valve Evacuate System Charge System Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - Low
High Pressure - High

PROBLEM	POSSIBLE CAUSES	CORRECTION
Insufficient cooling	Restriction in liquid line	Discharge the system Replace the receiver/drier. Inspect all lines and tubing from compressor outlet to expansion valve. Replace if needed. Evacuate the system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - High
High Pressure - Low

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air not cold	Internal leak in compressor. (reed valves, gasket, worn or scored piston rings or cylinder)	Discharge the system Replace the compressor Evacuate the system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - Normal
High Pressure - Normal

PROBLEM	POSSIBLE CAUSES	CORRECTION
Insufficient cooling Low pressure reading does not fluctuate with changes in temperature control switch (pressure should drop until compressor cycles) Evaporator air not cold.	System low on charge. Air or moisture present in system	Perform leak test Discharge system Repair leaks Replace receiver/drier Check oil level Evacuate system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - High
High Pressure - Normal

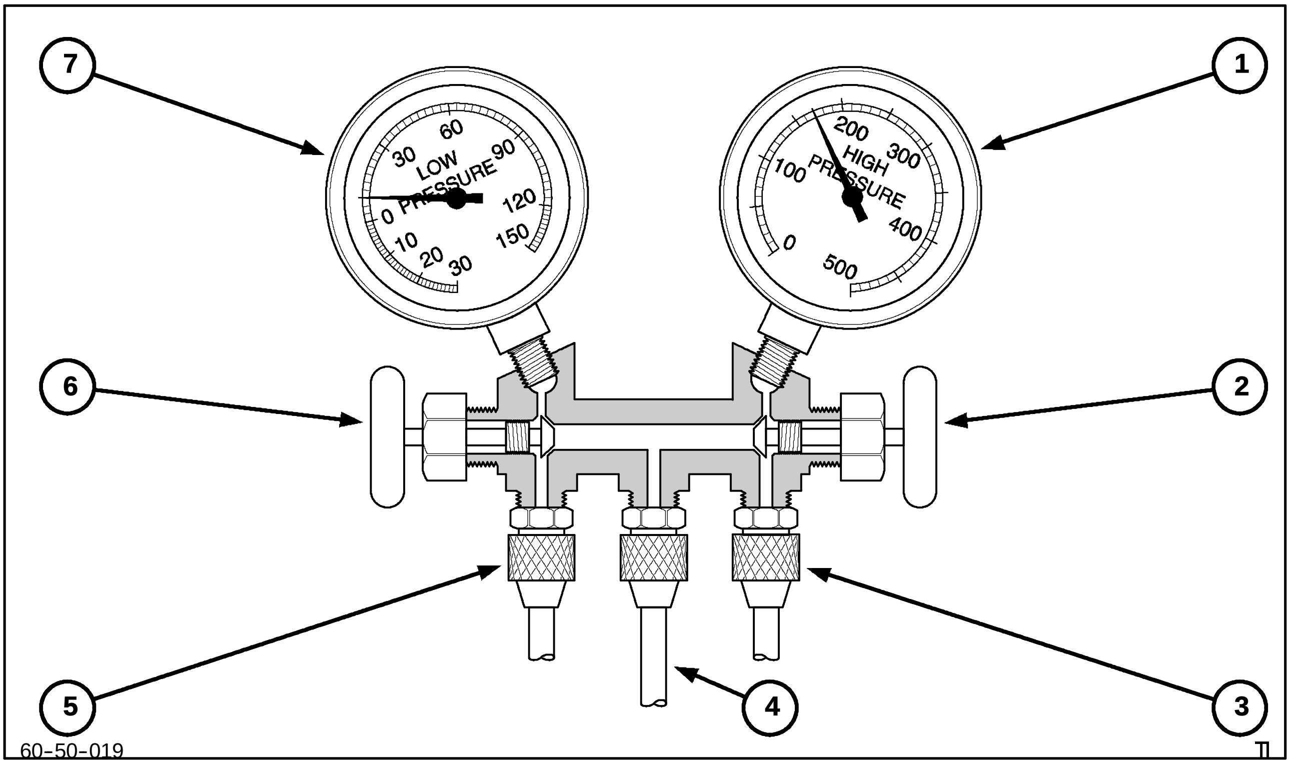
PROBLEM	POSSIBLE CAUSES	CORRECTION
Compressor cycles “on” and “off” too frequently	Defective temperature control (thermostatic) switch	Stop engine and shut off A/C Replace temperature control switch Re–test system and check compressor cycling

EXAMPLES OF MANIFOLD GAUGE READINGS AND INTERPRETATIONS

The following examples show typical low and high pressure gauge readings obtained when performance testing the air conditioning system with an ambient temperature of 35° C (95° F).

The recommended corrective action is based on a similar fault as identified in the performance test diagnosis charts.

PERFORMANCE TEST EXAMPLE 1



24

Performance Test Example 1

1. **1.** High Side Low
2. **2.** High Side Hand Valve Closed
3. **3.** High Side Hose Connected to High Side Service Connector
4. **4.** Not Used
5. **5.** Low Side Hose Connected to Low Side Service Connector
6. **6.** Low Side Hand Valve Closed
7. **7.** Low Side Low

PROBLEM:

Little or no cooling.

CAUSE:

Refrigerant slightly low.

CONDITIONS*

Low side pressure too low.
Gauge should read 1–2 bar (15-30 psi).

High side pressure too low.
Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air not cold.

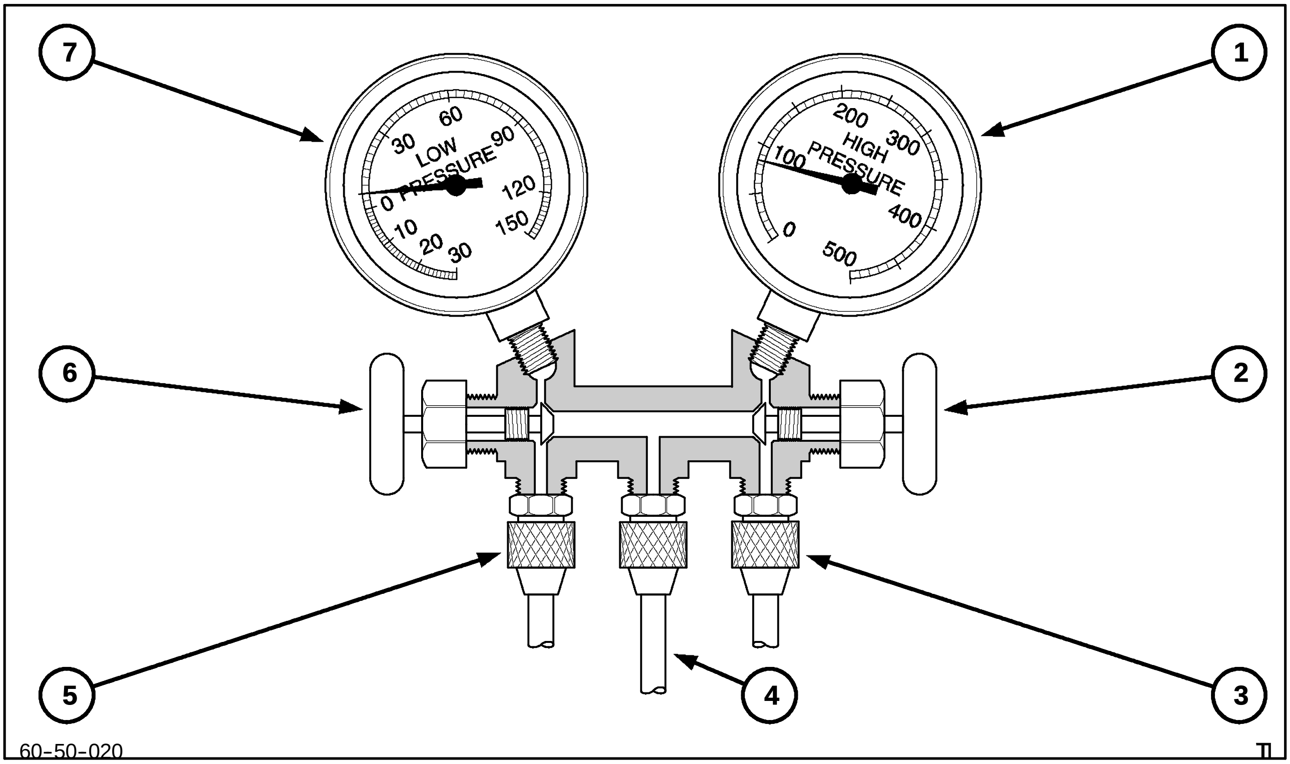
CORRECTIVE PROCEDURES

1. Leak test the system.
2. Repair leaks. (Discharge and recover the refrigerant from the system; replace lines or components).
3. Check compressor oil to ensure no loss.
4. Evacuate the system.
5. Charge the system.
6. Performance test the system.

DIAGNOSIS: *System refrigerant is low. May be caused by a small leak.*

***NOTE:* * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 2



25

Performance Test Example 2

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Normal

PROBLEM:

Insufficient cooling.

CAUSE:

Refrigerant excessively low.

CONDITIONS*

Low side pressure very low.
Gauge should read 1–2 bar (15-30 psi)

High side pressure too low.
Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air warm.

Low pressure switch cutting out

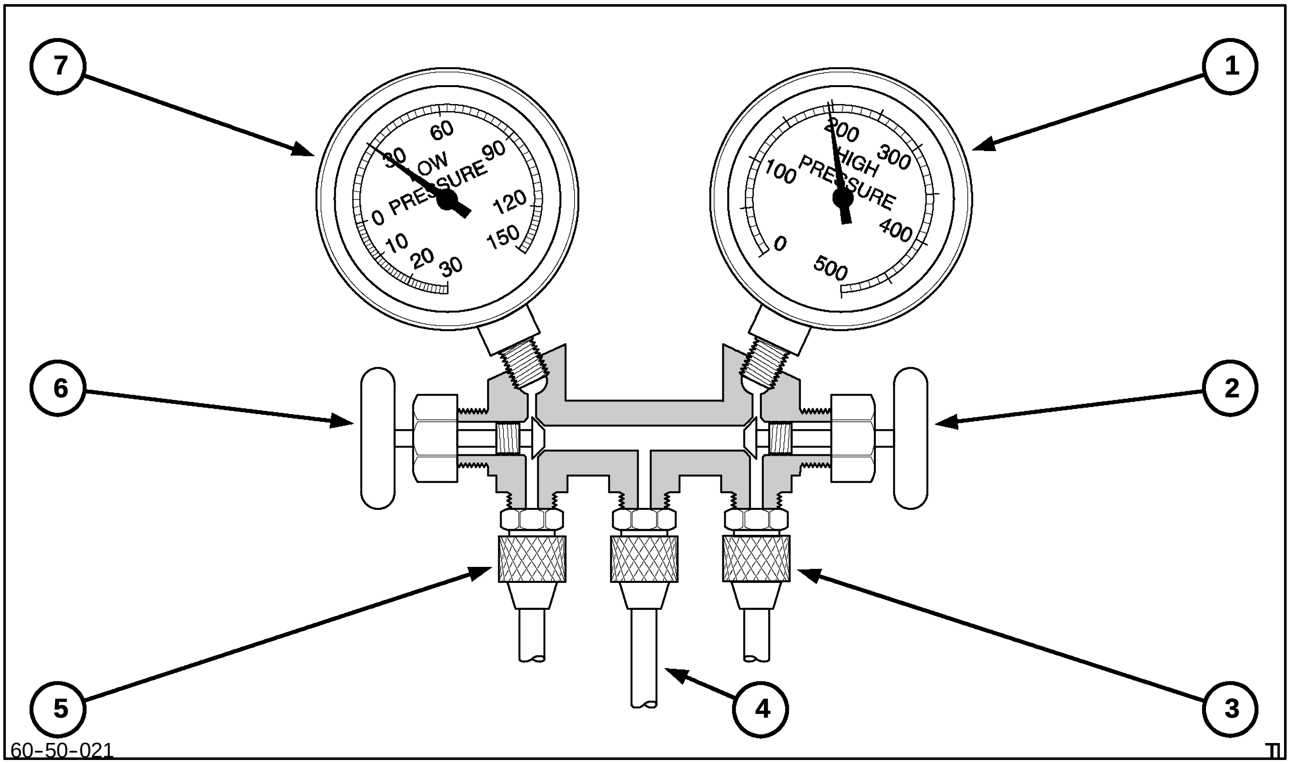
CORRECTIVE PROCEDURES

1. Leak test the system.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Check compressor oil to ensure no loss.
5. Evacuate the system.
6. Charge the system.
7. Performance test the system.

DIAGNOSIS: *System refrigerant is extremely low. A serious leak is indicated.*

***NOTE:* * *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 3



26

Performance Test Example 3

1. **1.** High Side Normal
2. **2.** High Side Hand Valve Closed
3. **3.** High Side Hose Connected to High Side Service Connector
4. **4.** Not Used
5. **5.** Low Side Hose Connected to Low Side Service Connector
6. **6.** Low Side Hand Valve Closed
7. **7.** Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Air in system.

CONDITIONS*

Low side pressure reading does not change when compressor cycles “on” and “off”.

High side pressure slightly high or slightly low. Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air not cold.

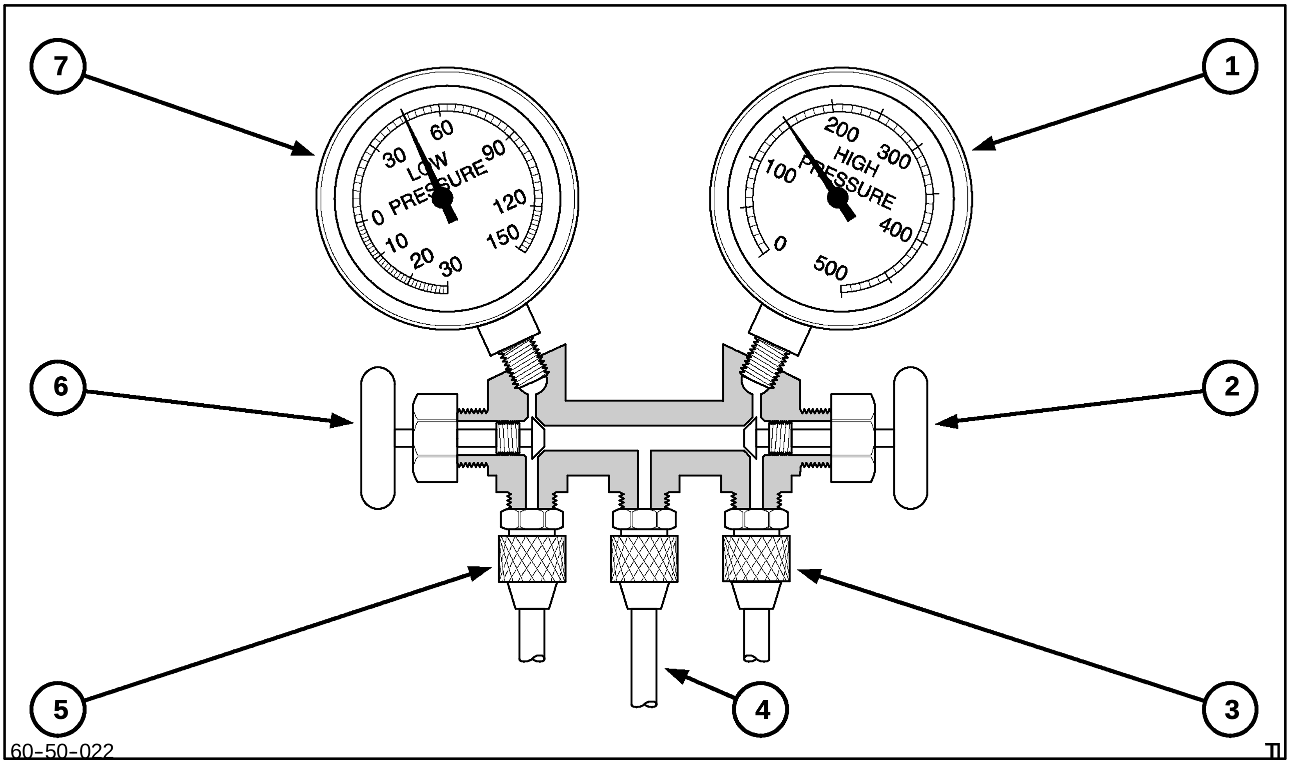
CORRECTIVE PROCEDURES

1. Leak test the system. Give special attention to the compressor seal area.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Replace the receiver/dryer.
5. Check compressor oil to ensure no loss.
6. Evacuate the system.
7. Charge the system.
8. Performance test the system.

DIAGNOSIS: *Air or moisture in system. System not fully charged.*

NOTE: * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 4



27

Performance Test Example 4

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side High

PROBLEM:

Insufficient cooling.

CAUSE:

Compressor malfunction.

CONDITIONS*

Low side pressure too high. Gauge should read 1–2 bar (15-30 psi).

High side pressure too low. Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air not cold.

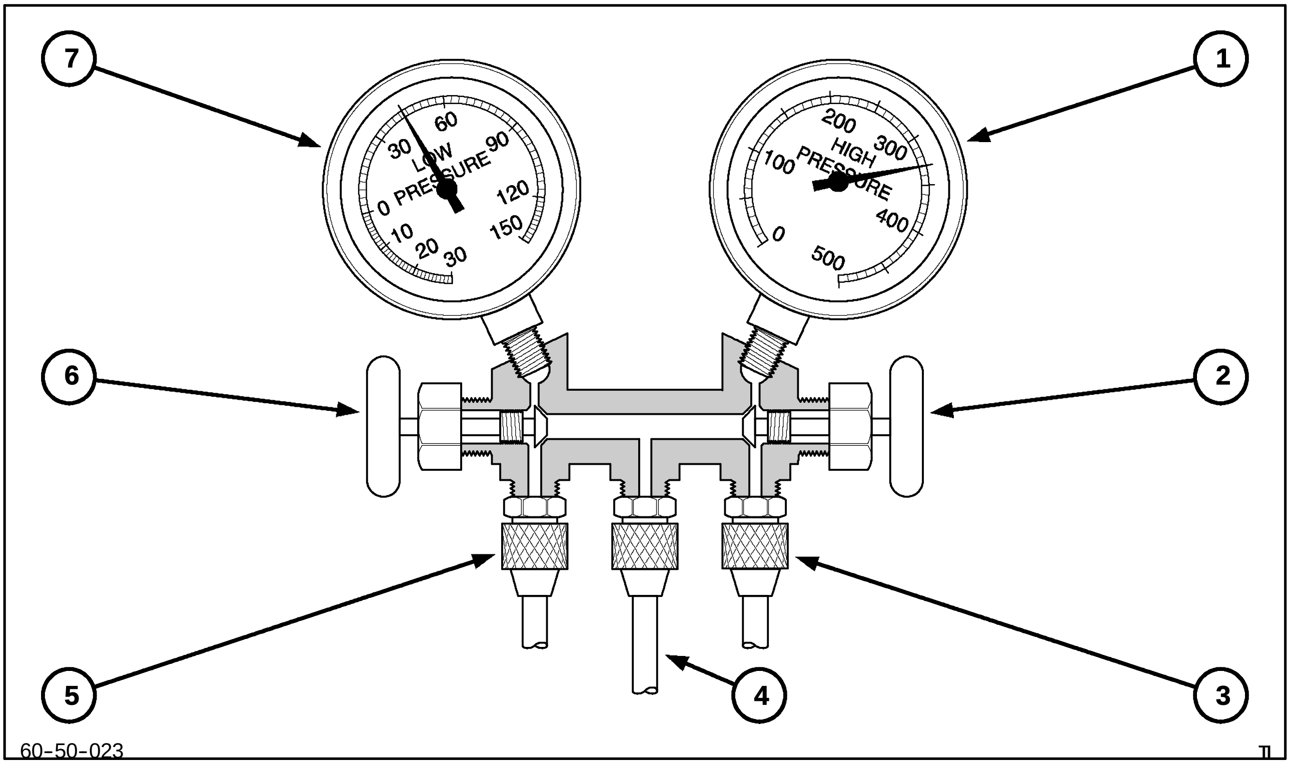
CORRECTIVE PROCEDURES

1. Replace the compressor.

DIAGNOSIS: *Internal leak in compressor caused by worn or scored pistons, rings, or cylinders.*

NOTE: * Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

PERFORMANCE TEST EXAMPLE 5



28

Performance Test Example 5

1. **1.** High Side High
2. **2.** High Side Hand Valve Closed
3. **3.** High Side Hose Connected to High Side Service Connector
4. **4.** Not Used
5. **5.** Low Side Hose Connected to Low Side Service Connector
6. **6.** Low Side Hand Valve Closed
7. **7.** Low Side High

PROBLEM:

Insufficient or no cooling. Engine overheats in some cases.

CAUSE:

Condenser not functioning properly.

CONDITIONS*

Low side pressure too high. Gauge should read 1–2 bar (15-30 psi).

High side pressure too high. Gauge should read 13.3–14.8 bar (194–215 psi).

Liquid line hot.

Evaporator air warm.

High pressure switch cutting out.

CORRECTIVE PROCEDURES

1. Check belt. Loose or worn drive belts could cause excessive pressures in the compressor head.
2. Look for clogged passages between the condenser fins and coil, or other obstructions that could reduce condenser airflow.
3. If engine is overheating replace engine thermostat and radiator pressure cap.

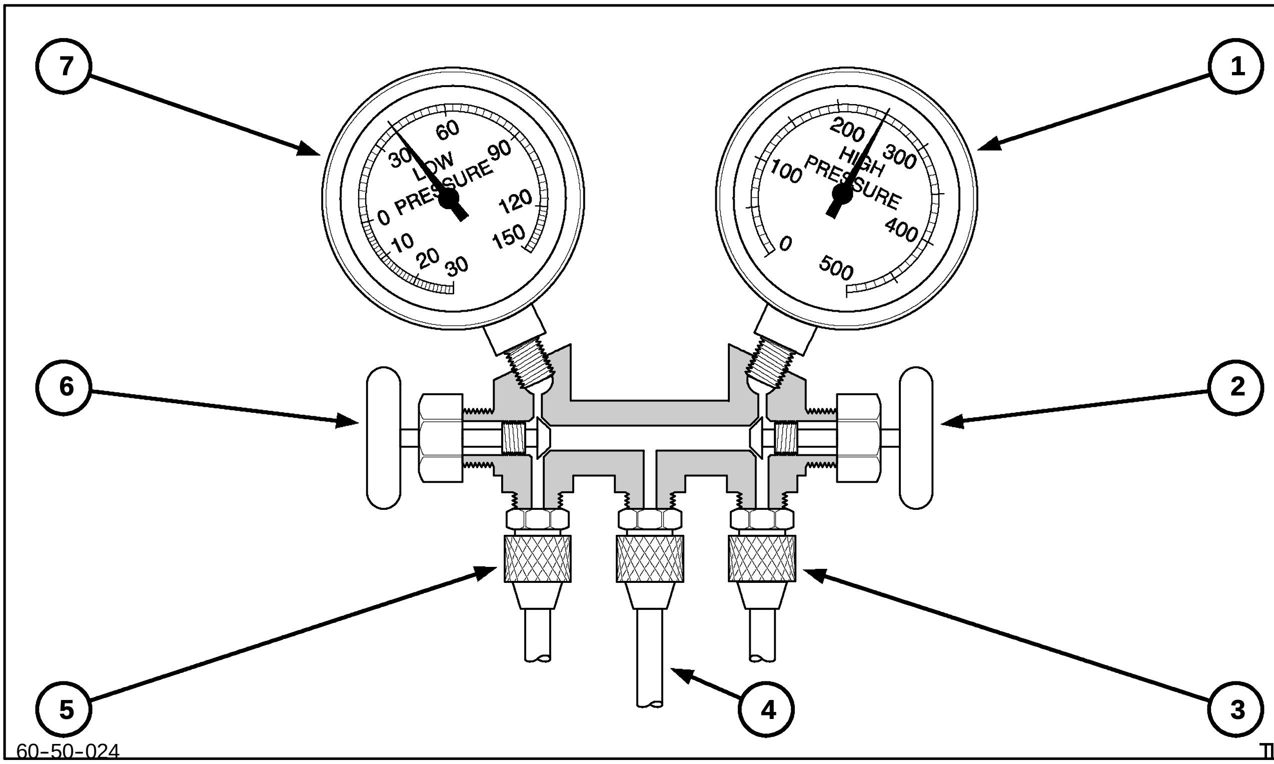
At this point, operate the system and check its performance. If still unsatisfactory, proceed as follows:–

4. Discharge and recover the refrigerant from the system.
5. Remove the condenser and clean and flush it to ensure a free flow of refrigerant. Or, if the condenser appears to be unduly dirty or plugged, replace it.
6. Replace the receiver/dryer.
7. Evacuate the system, and recharge it with the correct quantity of refrigerant.
8. Performance test the system.

DIAGNOSIS: *Lack of cooling caused by pressure that is too high on the high side, resulting from improper operation of condenser. (Refrigerant charge may be normal or excessive).*

NOTE:* * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

PERFORMANCE TEST EXAMPLE 6



29

Performance Test Example 6

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Normal

PROBLEM:

Insufficient or no cooling.

CAUSE:

Large amount of air in system.

CONDITIONS*

Low side pressure too high. Gauge should read 1–2 bar (15-30 psi).

High side pressure too high. Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air not cool.

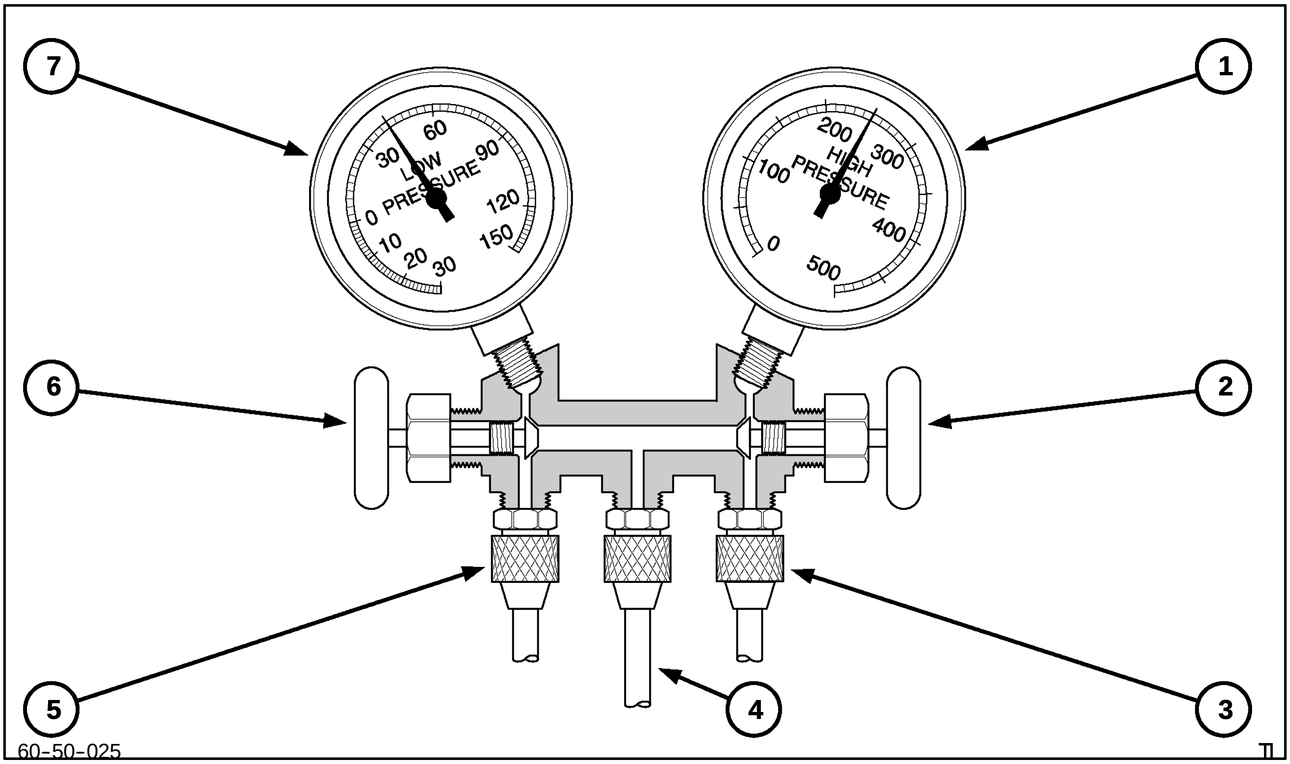
CORRECTIVE PROCEDURES

1. Discharge and recover the refrigerant from the system.
2. Replace the receiver/dryer.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.

DIAGNOSIS: *Air in system. This, and the moisture in the air, is contaminating the refrigerant, causing the system to operate improperly.*

NOTE: * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 7



30

Performance Test Example 7

1. **1.** High Side High
2. **2.** High Side Hand Valve Closed
3. **3.** High Side Hose Connected to High Side Service Connector
4. **4.** Not Used
5. **5.** Low Side Hose Connected to Low Side Service Connector
6. **6.** Low Side Hand Valve Closed
7. **7.** Low Side Hide

PROBLEM:

Insufficient or no cooling.

CAUSE:

Improper operation of thermostatic expansion valve (stuck open)

CONDITIONS*

Low side pressure too high. gauge should read 1–2 bar (15-30 psi).

High side pressure too high. Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air warm.

Evaporator and suction hose (to compressor) surfaces show considerable moisture.

CORRECTIVE PROCEDURES

1. Check for sticking expansion valve as follows:–

   Operate the system at maximum cooling.

   Check the low side gauge. The pressure should drop slowly.

2. If the test indicates that the expansion valve is defective, proceed as follows:

   Discharge and recover the refrigerant from the system.

   Replace the expansion valve.

   Evacuate the system.

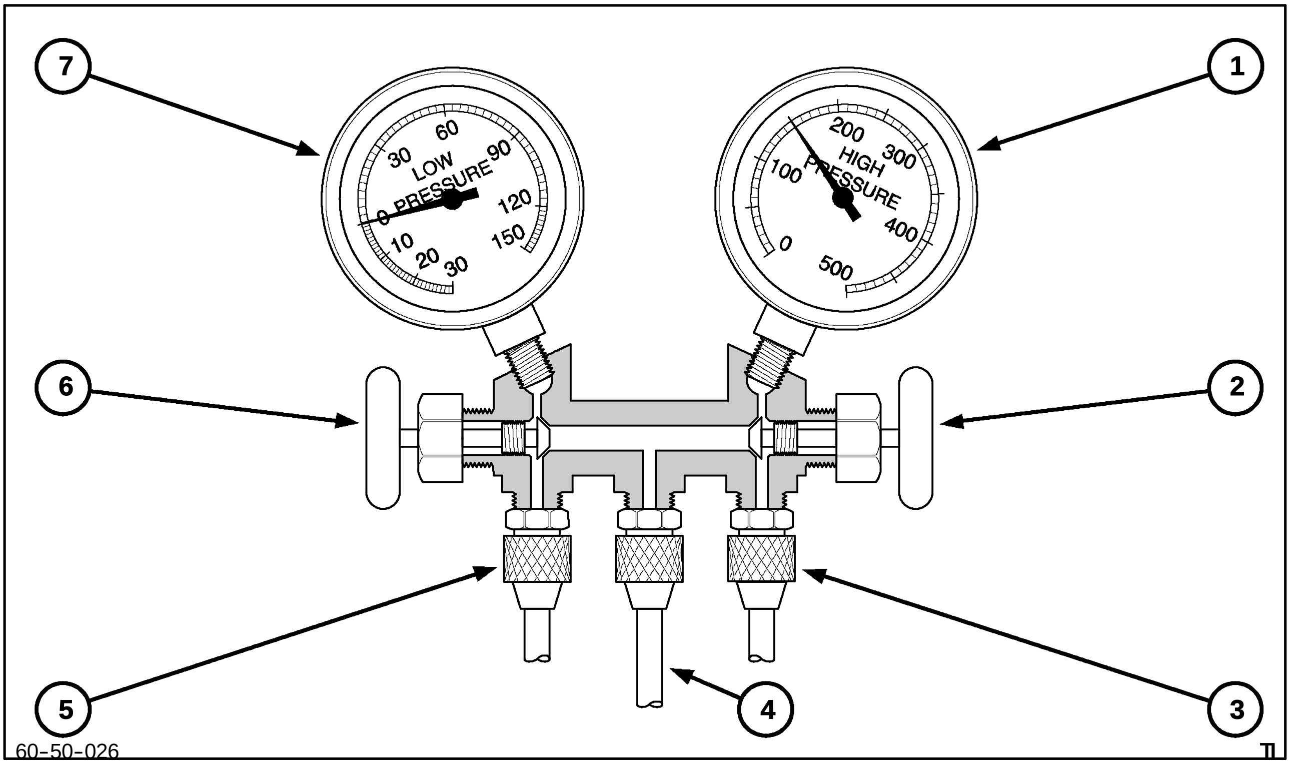
   Charge the system.

   Performance test the system.

DIAGNOSIS: *Thermostatic expansion valve is allowing too much refrigerant to flow through the evaporator coils. Valve may be stuck open.*

***NOTE:* * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 8



31

Performance Test Example 8

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Improper operation of thermostatic expansion valve (stuck closed).

CONDITIONS*

Low side pressure too low (zero or vacuum). Gauge should read 1–2 bar (15-30 psi).

High side pressure low. Gauge should read 13.3–14.8 bar (194–215 psi).

Evaporator air cool, but not sufficiently cold.

Evaporator inlet pipe surface shows considerable moisture or frost.

Low pressure switch cutting out.

CORRECTIVE PROCEDURES

1. Place finger on expansion valve to evaporator tube. If too cold to touch, proceed as follows:

   Operate the system at maximum cooling.

   Check the low side gauge. The pressure should drop slowly.

2. If the procedure outlined in Step 1 shows that the expansion valve is defective, proceed as follows:

   Discharge system

   Replace expansion valve

   Evacuate the system.

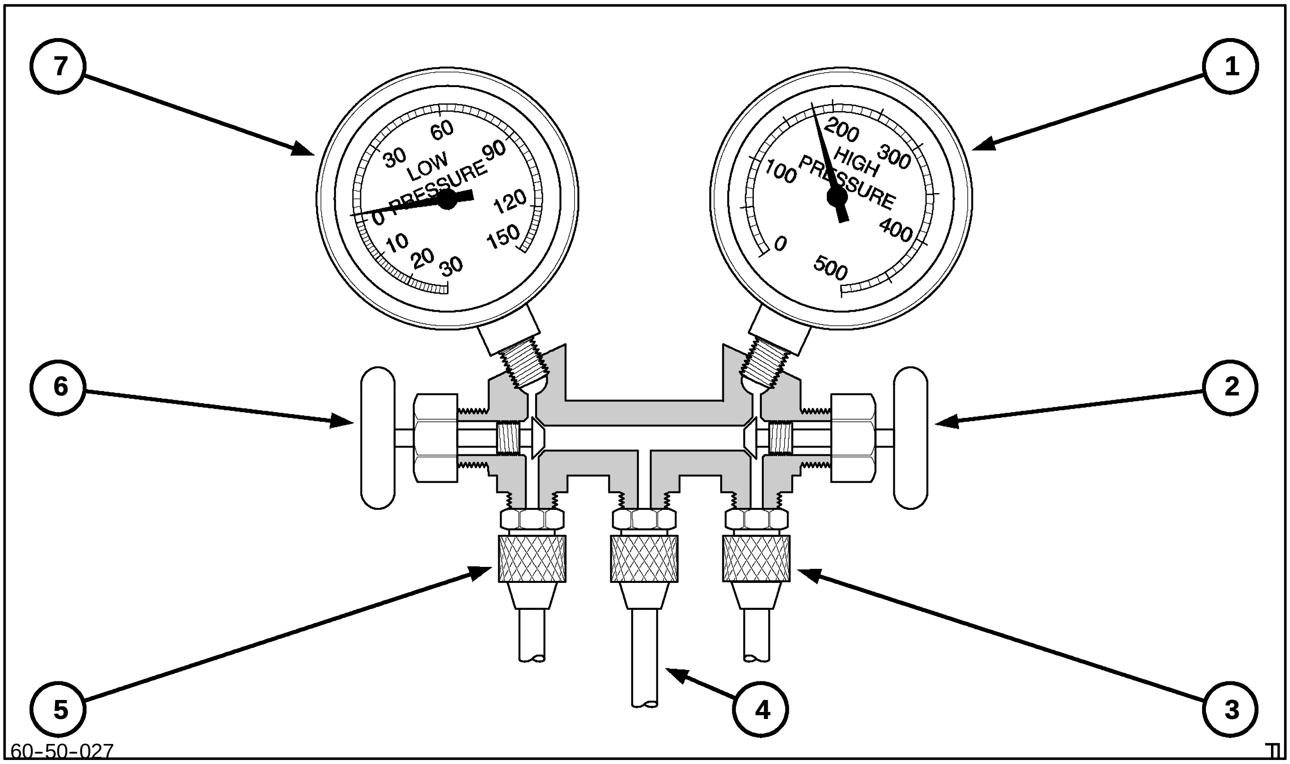
   Charge the system.

   Performance test the system.

DIAGNOSIS: *Expansion valve is not permitting a sufficient flow of refrigerant. May be caused by valve stuck in restricted or closed position.*

NOTE: * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 9



32

Performance Test Example 9

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Restriction in high side of system.

CONDITIONS*

Low side pressure too low. Gauge should read 1–2 bar (15-30 psi).

High side pressure too low. Gauge should read 13.3–14.8 bar (194–215 psi).

NOTE: *A normal or high reading of the high side pressure gauge under these conditions indicates the system is overcharged or the condenser or receiver/dryer is too small.*

Evaporator only slightly cool.

Liquid line and receiver/dryer are cool to touch and show frost or considerable moisture.

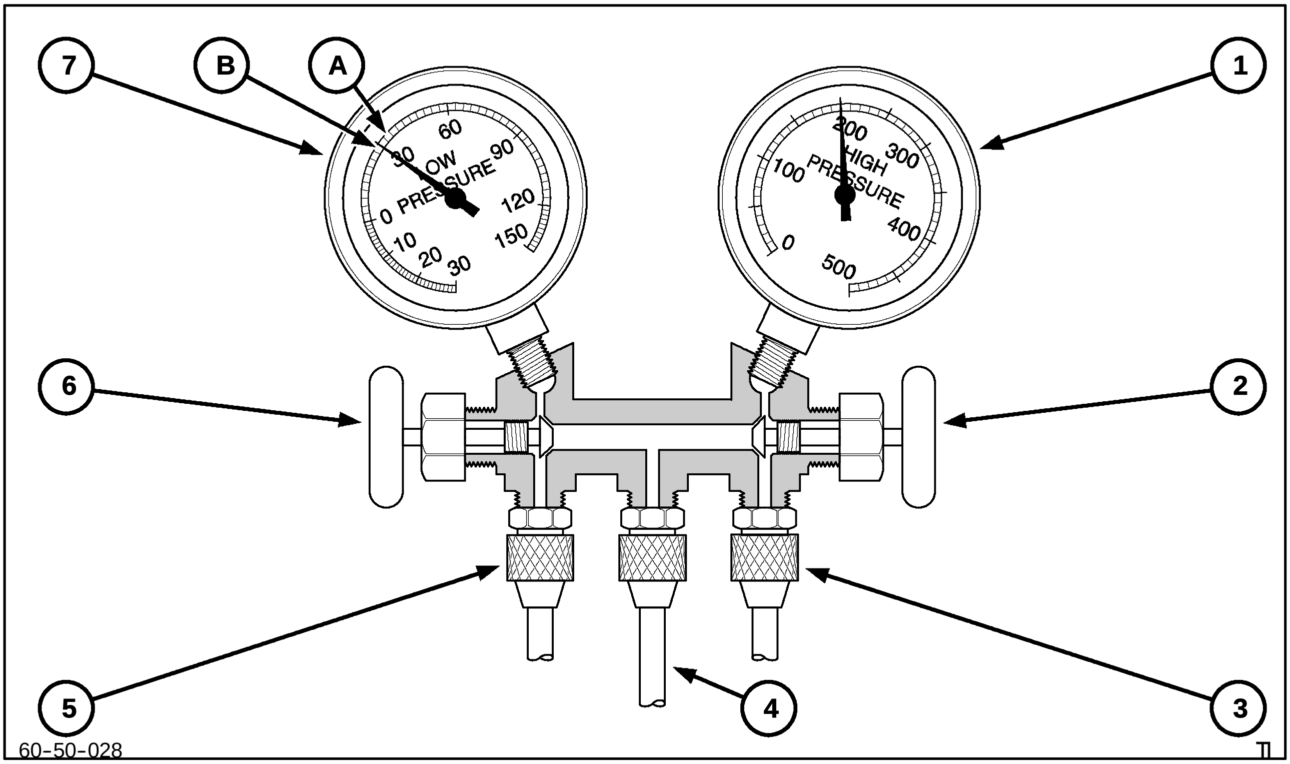
CORRECTIVE PROCEDURES

1. Discharge and recover the refrigerant from the system.
2. Replace the liquid lines, receiver/dryer, or other obstructed components.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.
6.

DIAGNOSIS: *Restriction in the liquid line and/or receiver/dryer resulting in a "starved" evaporator (compressor moving refrigerant from the evaporator faster than it can enter).*

NOTE: * *Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

PERFORMANCE TEST EXAMPLE 10



33

Performance Test Example 10

1. **1.** High Side Normal
2. **2.** High Side Hand Valve Closed
3. **3.** High Side Hose Connected to High Side Service Connector
4. **4.** Not Used
5. **5.** Low Side Hose Connected to Low Side Service Connector
6. **6.** Low Side Hand Valve Closed
7. **7.** Low Side Gauge
Compressor Cycles on at 2.3 bar (34 psi)
Compressor Cycles off at 1.9 bar (28 psi)

PROBLEM:

Compressor cycles (cuts in and out) too rapidly.

CAUSE:

Thermostatic switch defective.

CONDITIONS*

Low side pressure readings too high during both "on" and "off" compressor cycles and between cycles. Readings should be:

0.8–1.0 bar (12-15 psi) - cycle "off"

2.5–2.7 bar (36-39 psi) - cycle "on"

1.7–1.9 bar (24-27 psi) - between cycles

High side pressure normal. Gauge should read 13.3–14.8 bar (194–215 psi).

CORRECTIVE PROCEDURES

1. Stop the engine and shut off A/C system.
2. Replace thermostatic switch with switch of same type.
3. Make sure the switch's temperature sensor is installed in the same position and depth (in evaporator core) as previous.
4. Performance test the system.

DIAGNOSIS: *Defective thermostatic switch.*

NOTE: * *Test procedure based upon ambient temperature of 35°C (95° F). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

LEAK TESTING, DISCHARGING AND CHARGING THE AIR CONDITIONING SYSTEM

Leak Testing

To perform a leak test if refrigerant leakage is suspected, use a leak detector following the manufacturer's instructions.

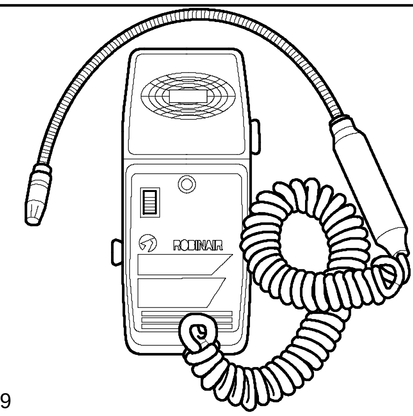
leak detectors use light or sound dependant upon the type used to alert the operator of a leak. If the leak detector's sensitivity is adjustable, be sure you calibrate the detector according to the manufacturer's instructions before use.

When using a leak detector, keep in mind that a very slight amount of leakage in the compressor pulley area is normal and does not necessarily indicate a repair is required.

When a leak is located, follow these steps.

- Discharge the system using a certified refrigerant recovery system.
- Repair the leak.
- Evacuate the system.
- Partially charge system with 400 grammes (14 ozs) of refrigerant.
- Check system for leaks.
- Fully charge the system.

Always check the system for leaks as a final test after evacuating and before recharging. Refer to Evacuating the system.



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34

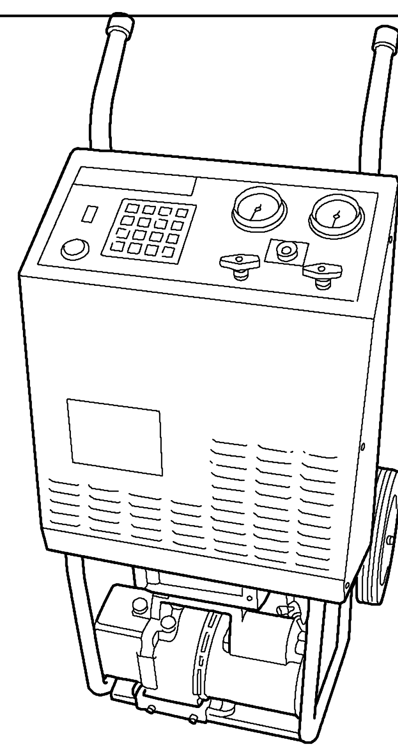
Discharging The System

Legislation has been introduced banning the release of refrigerant into the atmosphere.

Whenever overhauling the air conditioning system or performing other tasks which require the air conditioning system to be dismantled it is necessary to discharge the refrigerant gas before commencing repair.

Before you can dismantle an air conditioning system for repairs, you must discharge and recover the refrigerant using a **certified** recovery unit in accordance with the manufacturers instructions.

Shown is a combined refrigerant recovery, evacuation and recycling/charging station. This equipment removes R-134a refrigerant from the air conditioning system, recycles and recharges all in one hook up. The unit is designed to be used with the manifold gauge set built into the control panel.



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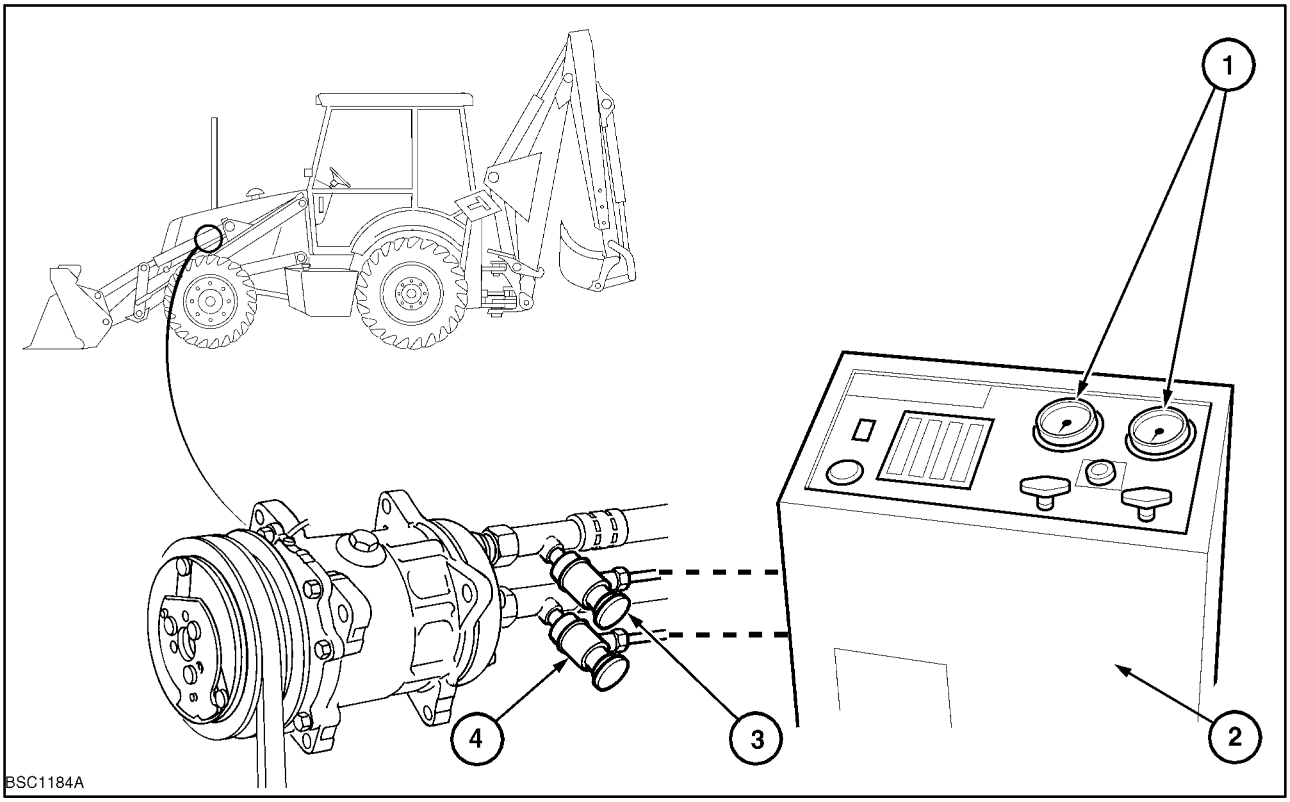
35



36

Connecting Recovery Evacuation and Recycling/Charging Station to the Tractor

1. Built In Manifold Gauge Set
2. Recovery/Recharging Unit
3. Low Side (Suction) Service Valve (Blue Hose)
4. High Side (Discharge) Service Valve (Red Hose)

Other recovery systems are available where the manifold gauges are not an integral part of the machine. When this type of equipment is used a separate manifold gauge set must be used.

The following is a summary of the steps for discharging the system using a recovery/recycling unit

WARNING

***Never** discharge refrigerant gas into the atmosphere. Always wear safety goggles and gloves when working with refrigerant. Only use authorised refrigerant tanks.*

***IMPORTANT:** Always follow the manufactures instructions when operating recovery equipment.*

1. Run the vehicle's air conditioning system for a few minutes.
2. Set up the recovery unit following manufacturer's instructions. Ensure that the units red (high side) hose is connected to the high side (discharge) fitting and the blue (low side) hose to the low side (suction) fitting.

***NOTE:** If a unit requiring the manifold gauge set is being used, the low and high sides of the manifold set are connected to the low and high sides of the tractor air conditioning system. The hose from the recovery unit is then connected to the manifold centre port. .*

3. To recover refrigerant, open both high and low side valves on the control panel or the valves on the manifold gauge set if being used.
4. Open the valves labelled "gas" and "liquid" on the recovery unit refrigerant tank.
5. Plug in the unit's power cord
6. Operate the recovery system in accordance with the manufacturers instructions.

The compressor will shut off automatically when the recovery is complete.

FLUSHING THE SYSTEM

Air conditioning systems may occasionally become contaminated with solid particles. This contamination may be the result of allowing dirt to enter the system while it was open, from aluminium corrosion or sludge, or from disintegrated compressor reed plates. Contamination of this nature can result in plugged evaporators, condensers and expansion valves.

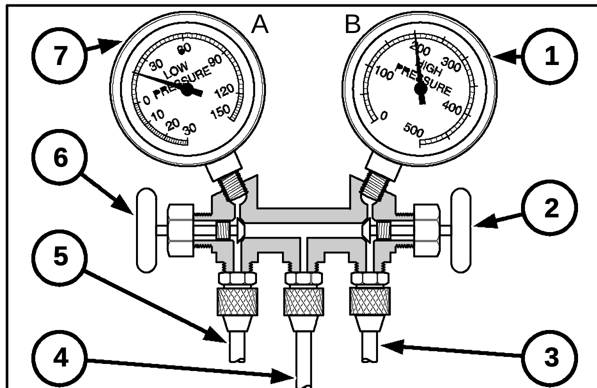
Flush System with dry nitrogen

Each individual component must be flushed after disconnecting every hose fitting.

The compressor and expansion valve can not be flushed, therefore, the compressor should be disassembled and cleaned or replaced and the expansion valve should be replaced. When flushing the system always replace the receiver/drier.

NOTE: *Never use any solvent for flushing an air conditioning system other than a special flush solvent made specifically for air conditioning systems. Always follow the manufacturer's recommendations and directions for using the flushing equipment and solvent.*

Re–assemble and evacuate the system to remove air and moisture as described in "Evacuating the System".



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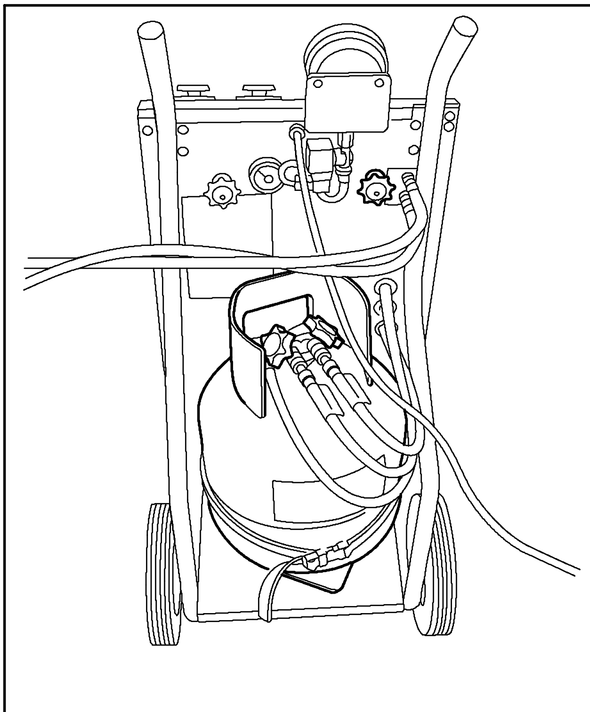
37

Manifold Gauge Set

1. High Side Gauge
2. High Side Shut–off Valve
3. High Side Hose
4. Centre Service Hose
5. Low Side Hose
6. Low Side Shut–off Valve
7. Low Side Gauge



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38

EVACUATING THE SYSTEM

IMPORTANT: *A system in which the refrigerant has been recovered to facilitate repairs, must be evacuated before new refrigerant is installed.*

Air and moisture are removed by evacuating the system using a vacuum pump.

The automatic recycling, recharge and evacuation stations or evacuating and charging stations available throughout the air conditioning industry incorporate a vacuum pump within the assembly. If this type of equipment is not available a separate vacuum pump and manifold gauge set must be used.

As the system is evacuated the boiling point of any moisture within the system is similarly lowered. As the vacuum increases the boiling reduces to below that of the ambient temperate and the moisture is subsequently boiled away.

The relationship of system vacuum to the boiling temperature at which the water vapour is removed from the system is as follows:

System Vacuum		Temperature	
In Mercury	Cm. of Mercury	° F	° C
28.0	71.0	100	38
28.9	73.4	80	27
29.4	74.6	60	16
29.7	75.4	40	5
29.8	75.7	20	-7
29.9	75.9	0	-18

NOTE: *For every 1000 feet (305 m) above sea level, the vacuum gauge reading must be corrected by adding 1″ (2.54 cm) of mercury to compensate for the change in atmospheric pressure.*

IMPORTANT: *Be sure the system is completely discharged as refrigerant will damage the vacuum pump.*

1. If the manifold gauge set is being used connect the low and high sides of the manifold to the low and high sides of the vehicle air conditioning system as described for discharging the system.

   Connect the manifold centre hose to the vacuum pump suction port as per the manufacturers instructions.

   Fully open both the low and high side gauge shutoff valves.

2. If a combined recovery/evacuation unit is to be used attach the unit to the air conditioning system in accordance with the manufacturers instructions. Be sure to read all installation and operating instructions carefully before starting the unit.
3. After starting the evacuation cycle, note the low side gauge to be sure the system pulls down into a vacuum.
4. Time the evacuation for a minimum of 30 minutes from the point when lowest vacuum is attained.
5. Thirty minutes later when the low side gauge attains the lowest steady vacuum, stop the evacuation process.

NOTE: *The vacuum pump achieves ultimate vacuum with the vented exhaust valve closed. Do not evacuate too quickly as oil may be drawn from the system.*

6. Check the system by closing the gauge shut–off valves, turning the vacuum pump off and noting the low side gauge reading. A loss of more than 2″ (5 cm) of vacuum in 5 minutes indicates either a leak or moisture in the system.
7. If the gauge needle remains stationary and the vacuum is maintained for 3-5 minutes, close both the high and low side manifold hand valves, turn off and disconnect the center hose from the pump. The system is now ready for charging.
8. If a leak is detected, charge the system with approximately 14 ozs (400 g) of refrigerant, see charging the system and locate the leak using a leak detector.
9. Once the leak is located discharge and recover the refrigerant in the system, repair the leak, then repeat the evacuation procedure.

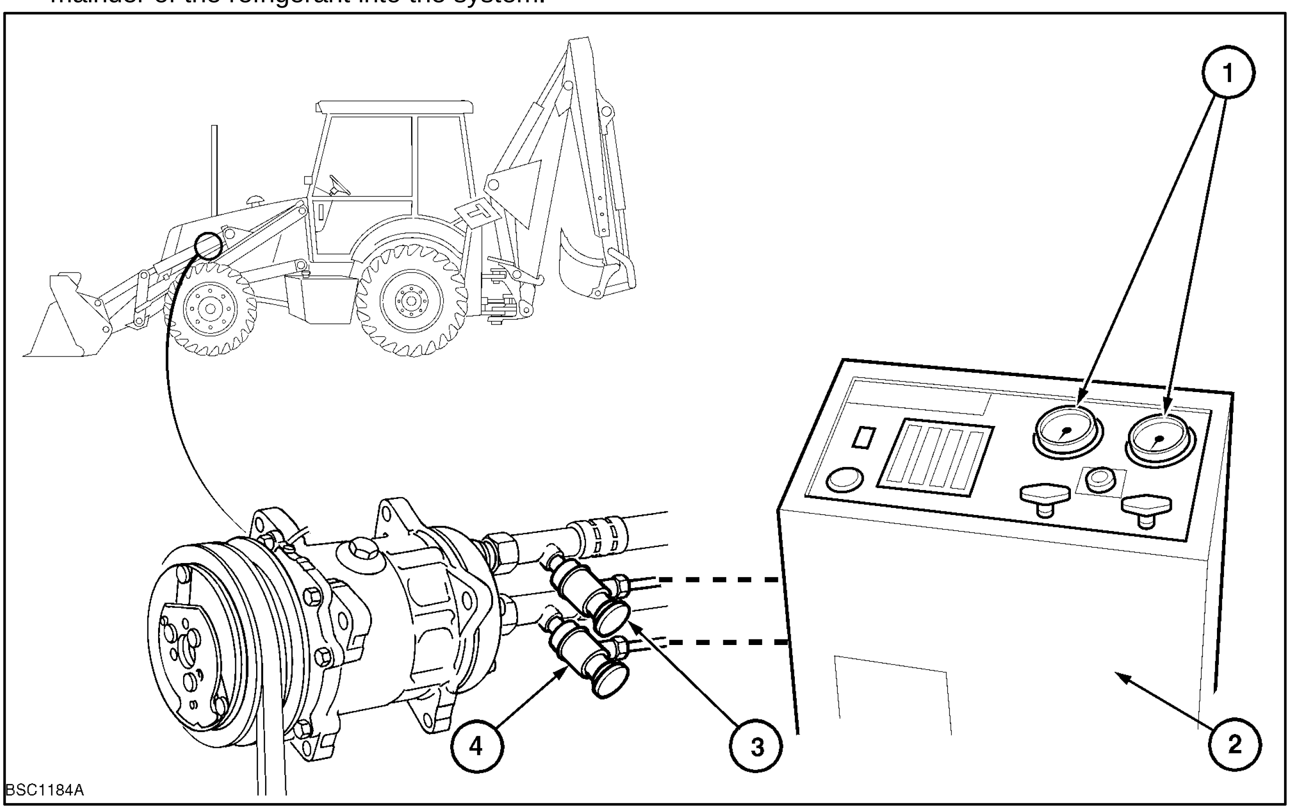
CHARGING THE SYSTEM

IMPORTANT: *Be sure there are no leaks in the system and the system has been fully evacuated. Observe all safety recommendations when handling refrigerant R-134a, see “Precautions when Handling Refrigerant R-134a” in this Section.*

1. Ensure the charging unit is correctly connected to the tractor air conditioning system in accordance with the manufacturers instructions.
2. If a charging unit, in conjunction with the manifold gauge set is used, open the high and low side hand valves on the manifold.
3. Charge the system with 0.75 kg (1.65 lbs) of refrigerant as per the manufacturers instructions.
4. If the charging rate becomes very slow **close the high side valve carefully,** start the tractor and set engine speed to idle. Turn ‘ON’ the air conditioning so that the compressor can pull the remainder of the refrigerant into the system.
5. If the refrigerant charge will not completely transfer to the air conditioning system, recover and recharge the system.
6. Close the high and low side valves on the units control panel, or manifold gauge set if being used and test the air conditioning as detailed in Performance Testing The Air Conditioning System on Page 15.

NOTE: *After charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system:*

- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least one minute before increasing engine speed.



39

Connecting Recovery Evacuation and Recycling/Charging Station to the Tractor

1. Built In Manifold Gauge Set
2. Recovery/Recharging Unit
3. Low Side (Suction) Service Valve (Blue Hose)
4. High Side (Discharge) Service Valve (Red Hose)

COMPONENT OVERHAUL (EXCLUDING COMPRESSOR)

GENERAL

WARNING

Before disconnecting components in the air conditioning system the refrigerant gas must be discharged and recovered using a certified recovery system. Refer to Discharging the system on Page 31. ***Do Not*** *discharge the gas into the atmosphere.*

If an air conditioning component is to be replaced during a system overhaul it is necessary to drain any refrigerant oil that has collected in the component being replaced into a clean calibrated container.

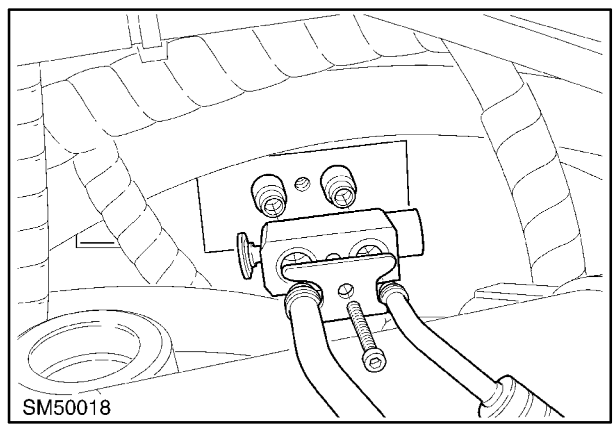
A volume of clean refrigerant oil equivalent to that removed from the replaced component must then be added to the new item before being installed onto the tractor.

Upon completion of the repair evacuate, recharge, leak test and performance test the system to ensure correct operation.

EXPANSION VALVE

The expansion valve is not a serviceable item and must be replaced if defective.

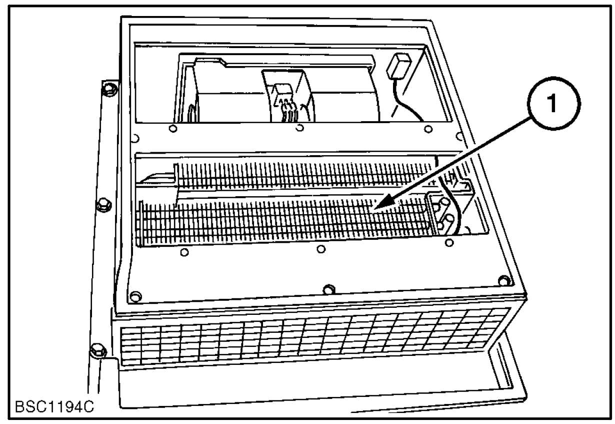
1. Fully discharge the air conditioning system.
2. Remove the seat to gain access to the valve.
3. To gain access to the expansion valve partially lift the evaporator core from its position in the cab floor.
4. Remove the Allen screw securing the inlet and outlet connections to the valve and pull valve from tubing.
5. Replace the ‘O’ ring seals and lubricate with refrigerant oil prior to installing the valve using disassembly procedure in reverse.
6. Evacuate, leak test and recharge the system.



40

EVAPORATOR

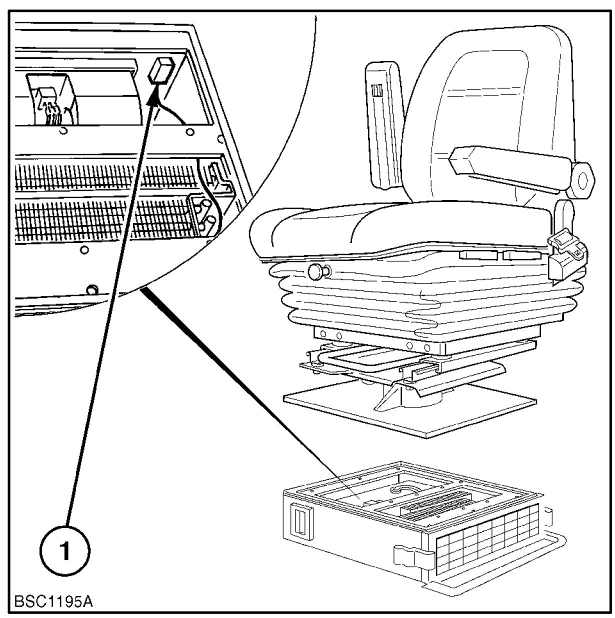
1. Discharge and reclaim refrigerant gas using certified recovery systems.
2. Remove the seat and cover plate to reveal evaporator assembly.
3. Remove temperature cycling control thermocouple.
4. Disconnect tubing to expansion valve.
5. Remove evaporator.
6. Check the evaporator assembly fins for damage. Straighten fins if necessary.
7. Clean the evaporator core of all foreign material to be sure it is free of obstructions.
8. Check the evaporator assembly for indications of refrigerant leakage. If damage or leaks are evident, replace the evaporator core.
9. If a new evaporator is to be installed drain the refrigerant oil in the evaporator into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the replacement evaporator core.
10. Install evaporator using disassembly procedure in reverse.
11. Evacuate, leak test and recharge the system.



41

AIR CONDITIONER TEMPERATURE CYCLING CONTROL SWITCH

1. Remove the seat mounting plate.
2. The temperature cycling switch is mounted to the side of the blower motor assembly.
3. Carefully pull and disconnect the switch wiring at the connector.
4. Remove temperature control switch and replace as required.



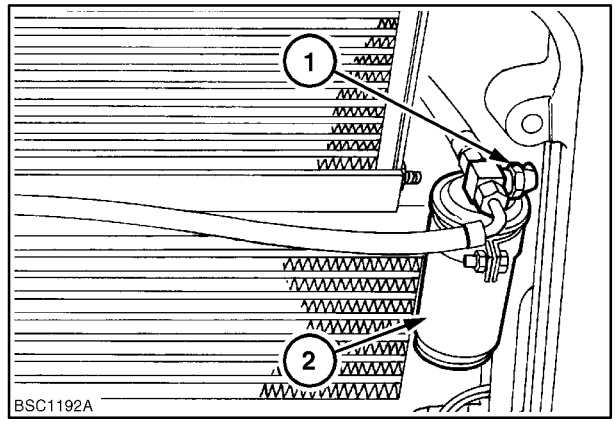
42

LOW PRESSURE CUT–OUT SWITCH

1. With the engine ‘Off’ check continuity across the switch contacts. If the switch shows ‘Open Circuit’ replace as detailed below.

IMPORTANT: *The pressure switch can not be replaced without discharging the system.*

2. Remove switch by unscrewing from self sealing schrader valve.
3. Replace with new switch and connect to harness.



43

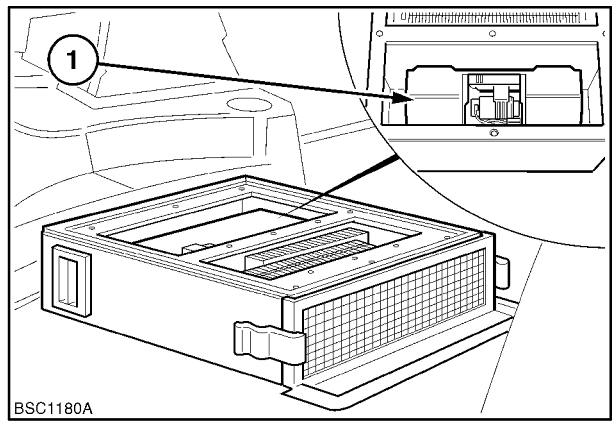
BLOWER MOTOR ASSEMBLY

The blower motor can if required be removed without discharging the system as follows:–

1. Remove the cab seat mounting plate.

NOTE: *Take care not to damage hoses during this operation. If the cab heater hoses restrict movement of the housing drain the heater assembly and disconnect the hoses.*

2. Disconnect the motor wiring connector block.
3. Remove the remaining motor securing screws and withdraw motor.
4. Re–assembly follows the disassembly procedure in reverse.



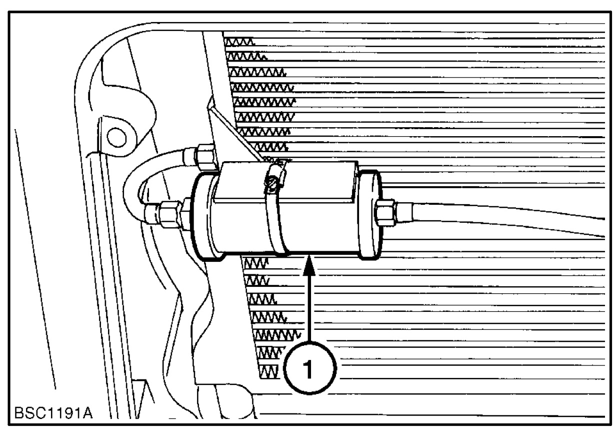
44

RECEIVER DRYER

The receiver/dryer cannot be overhauled and must be replaced as an assembly. The receiver/dryer assembly should be replaced if it is suspected that moisture is in the system.

The receiver dryer must also be replaced if the system has been discharged and the air conditioning joints disconnected.

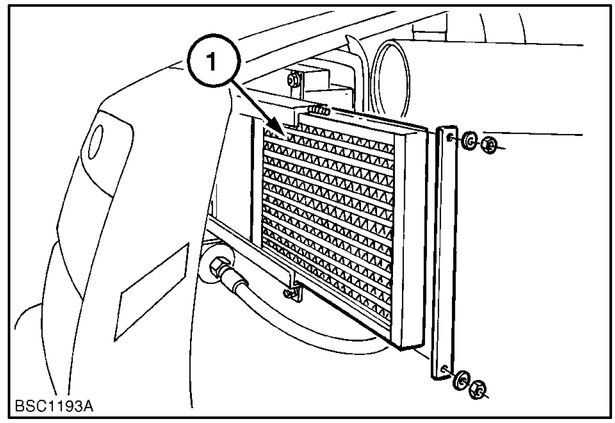
1. Discharge and reclaim refrigerant gas using certified recovery systems.
2. Disconnect the hoses and switch and remove the dryer from the tractor.
3. Drain the refrigerant oil from the receiver dryer into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new item.
4. Cap and plug all fittings to prevent any dirt entering the system.
5. Install a new receiver dryer.



45

CONDENSER

1. Disconnect the connections to the condenser.
2. Remove condenser from machine.
3. Inspect the condenser assembly fins for damage and be sure they are not plugged.
4. Check the condenser for signs of leakage. If the condenser is damaged or leaking, install a new condenser assembly.
5. If the condenser is to be replaced, drain the refrigerant oil from the condenser into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new condenser.
6. Soak new tubing connector 'O' rings in clean refrigerant lubrication oil and install onto tubing
7. Evacuate, leak test and recharge the system.

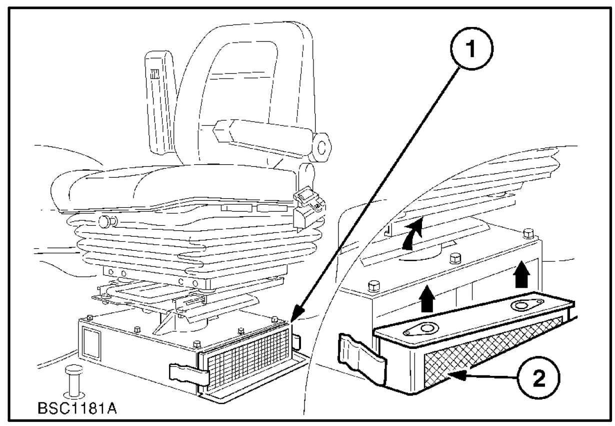


46

CAB AIR FILTER

1. Before servicing the filters, switch off the blower and close all windows and one door. Slam the final door closed and the resulting back pressure will dislodge most of the loose dirt from the underside of the filters.
2. Remove filter element(s) and clean by blowing with compressed air not exceeding 2 bar (30 lbf/in^2).

   Blow the dust from the upper surface through the element to the underside. Hold the nozzle at least 12 in (300 mm) from the element to prevent damage to the paper pleats.
3. Clean both filter chambers with a damp, lint free cloth.
4. Replace the filter elements with the rubber seal uppermost and re–install the covers.



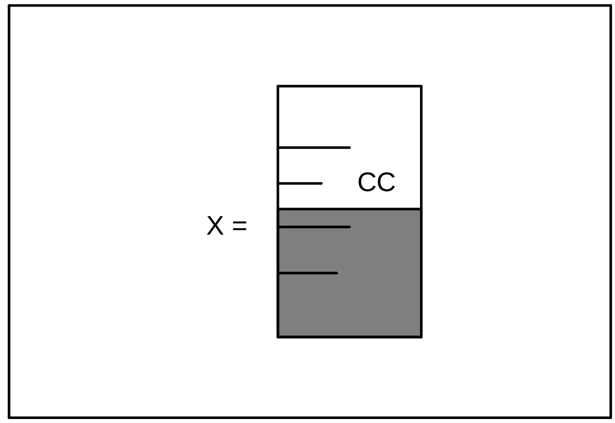
47

COMPRESSOR – OVERHAUL

Compressor Removal

1. Discharge and reclaim refrigerant gas using certified recovery systems. Record the amount of oil discharged into the collector as (**X**).
2. Disconnect tubing to compressor.
3. Disconnect wiring to compressor clutch.
4. Disconnect drive belt, remove the four mounting bolts and remove compressor from tractor.
5. Drain the refrigerant oil from the old compressor into a clean calibrated container. Measure and record the quantity of oil as (**Y**). This information is required during installation of the new or overhauled unit.

NOTE: *It is necessary to rotate the compressor drive shaft several times to completely expel all the oil.*



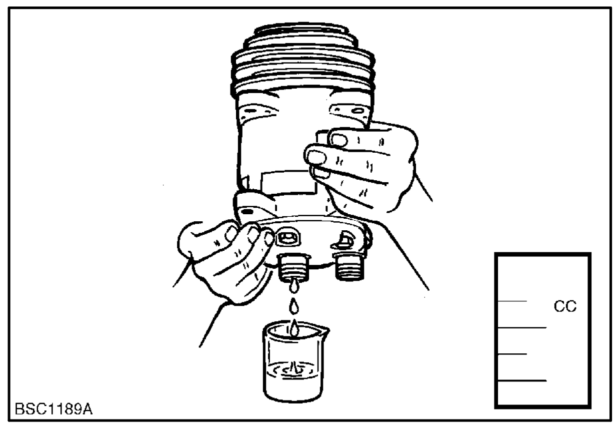
48

Compressor Installation

6. Installation is the reversal of the removal but the following points should be noted:–

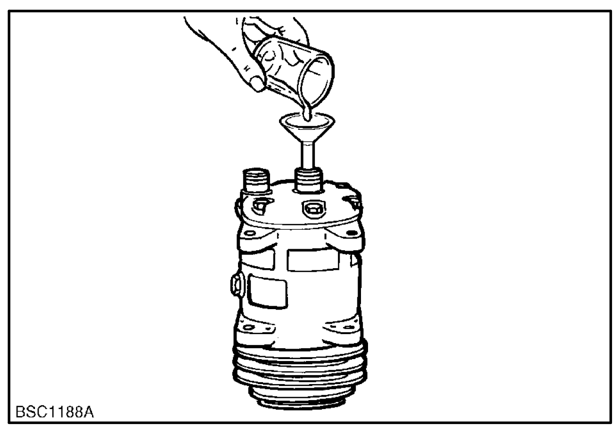
- Torque the mounting bolts to 40–51Nm (29–38lbf.ft).

NOTE: *It is recommended that a new receiver / drier assembly is installed after any system component replacement or any repair that requires entry into the system.*



49

- Drain the oil from the new compressor to be fitted into a clean container, or if the old compressor is to be refitted, obtain a new can of refrigerant oil.
- Calculate the amount of oil to be installed as, **(x)+(y)** and refill the compressor.
- Reconnect the hoses to the compressor and tighten all bolts and hoses.



50

After charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system:

- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least five minutes before increasing engine speed.

Oil Retained in System Components

After replacement of individual system components it will be necessary to add some oil to the system to make up the amount lost in the removed component.

The table below shows some typical volumes for the components. It is, however, still recommended that the oil level measurement, described previously is carried out after a new component has been installed to establish correct oil quantity.

Component	Typical oil amount	
	fl.oz.	cc
Compressor	2	57
Evaporator	1.15	33
Condenser	0.5	14
Receiver / drier	0.25	7
Hoses	0.14	4

Preliminary Inspection

1. Rotate the compressor shaft. Use a suitable socket on the hub centre bolt or by hand using the rubber dampers.

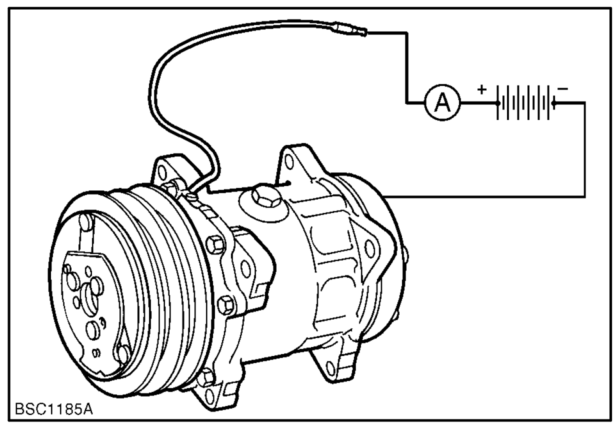
   If severe roughness is felt while rotating the hub, the compressor should be disassembled.

2. Using a 12 volt battery check current drawn by the field coil which should be between 3.6– 4.2 Amps.

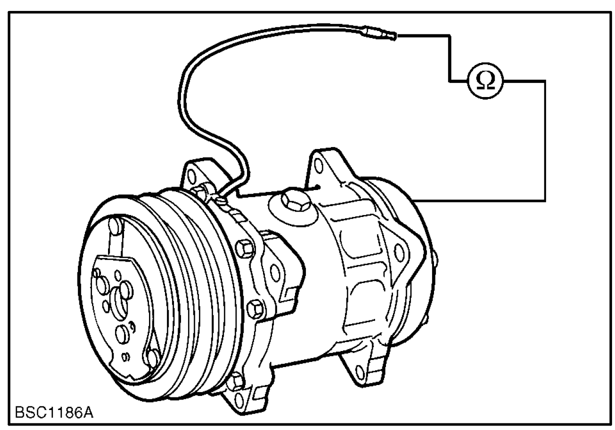
   Very high current readings indicate a short circuit in the field coil and no current reading indicate an open circuit. Replace coil with either fault. Resistance of the coil using an ohmmeter should be approximately 3.0Ω at 20°C.

   A poor earth (ground) connection of the field coil will result in a low voltage.

3. Ensure clutch is disengaged and rotate pulley by hand. If roughness in the bearing is felt, it will be necessary to replace the pulley and bearing as an assembly.



51

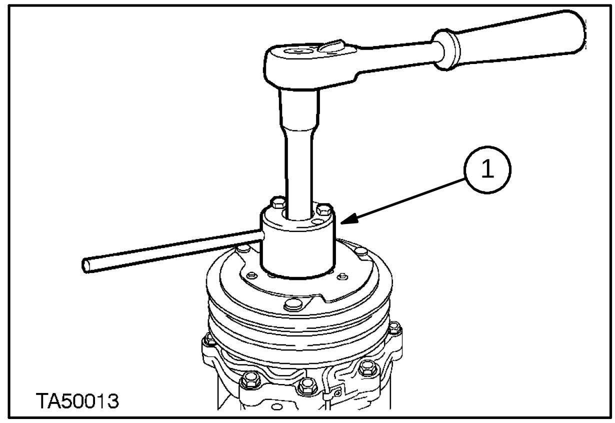


52

Clutch Disassembly – Removal

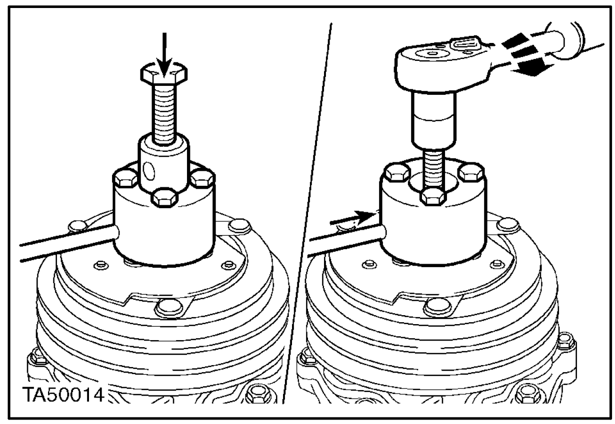
All clutch servicing should be done with the compressor removed from the vehicle:

1. Support the compressor. If using a vice, do not hold on to the housing.
2. Attach tool (1) number **297423** to the cover on the front of the clutch plate and placing a socket and ratchet through the tool remove the the cover attaching nut.



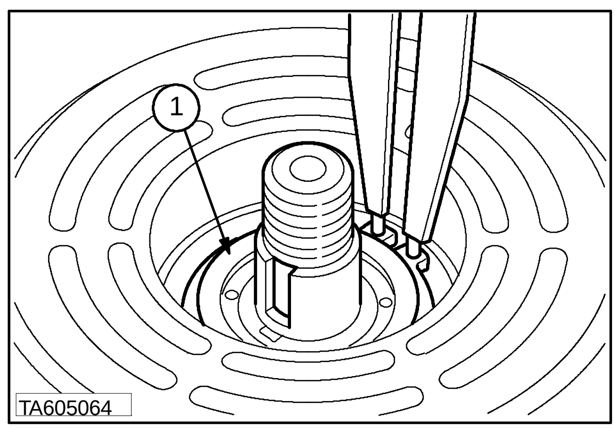
53

3. Using the front plate tool, insert tool number JD166/3 into 297423 and place a tommy bar through both hold the clutch plate stationary.
4. Place the bolt into the tool JD166/3 and by tightening the bolt onto the end of the shaft the front plate will be extracted from the shaft.



54

5. Remove the pulley bearing external snap ring (1) and lift the pulley assembly from the compressor.



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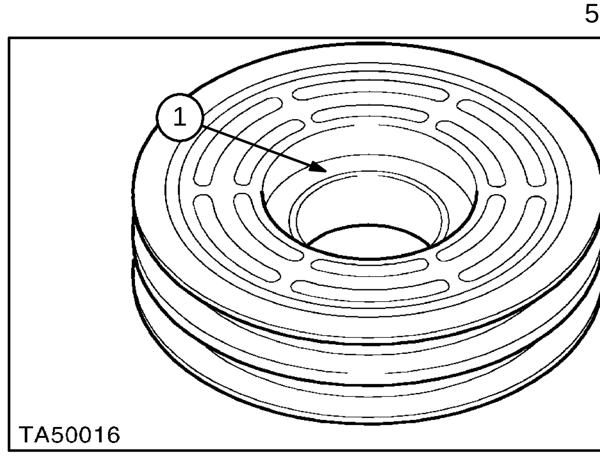
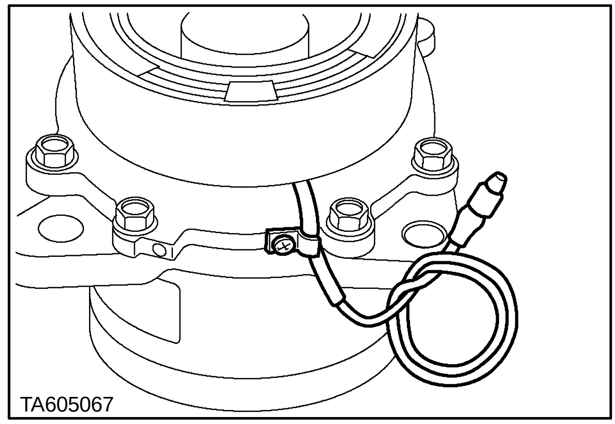
6. Inspect the pulley bearing assembly for wear and replace the assembly as necessary.



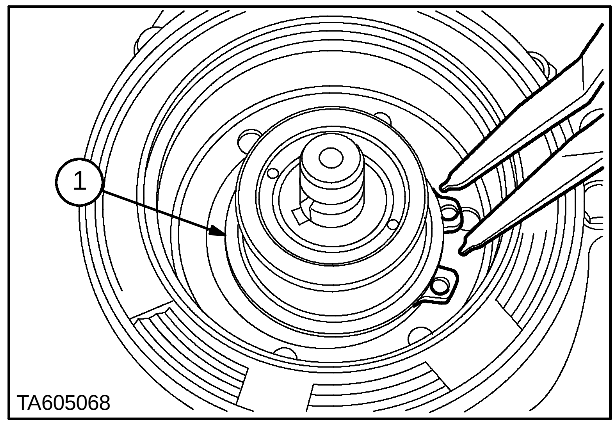
56

7. Remove the field coil wire retaining clip.



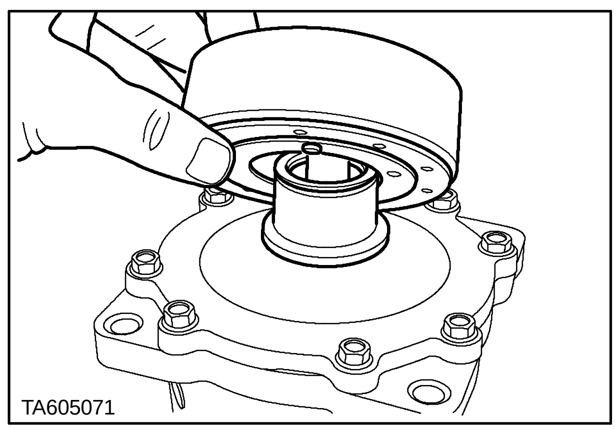
57

8. Remove the field coil retaining snap ring.



58

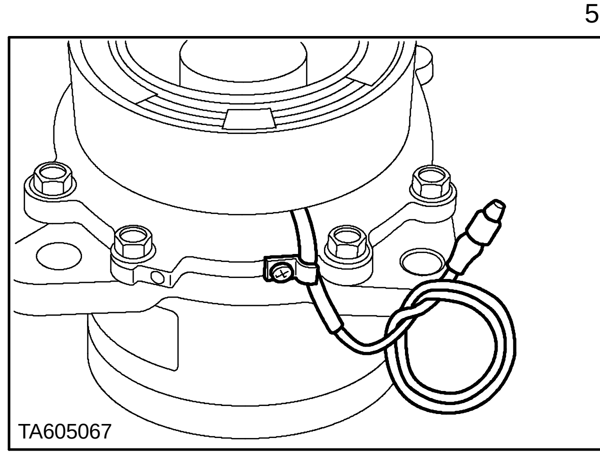
9. Lift the coil from the housing and replace as required.



59

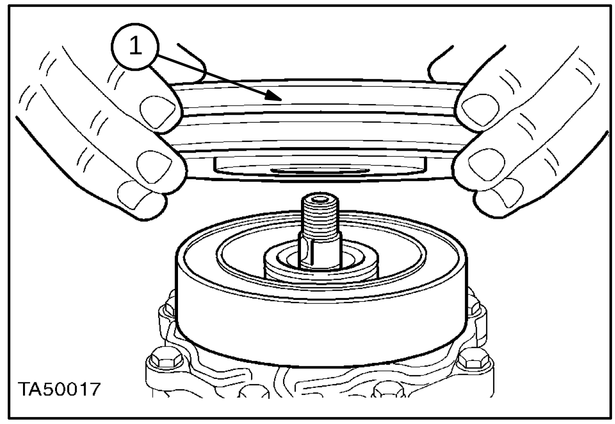
Clutch Reassembly

1. Install the field coil, ensuring that the wire is located back at cable clip on the outside of the body and snap ring is placed in the groove.



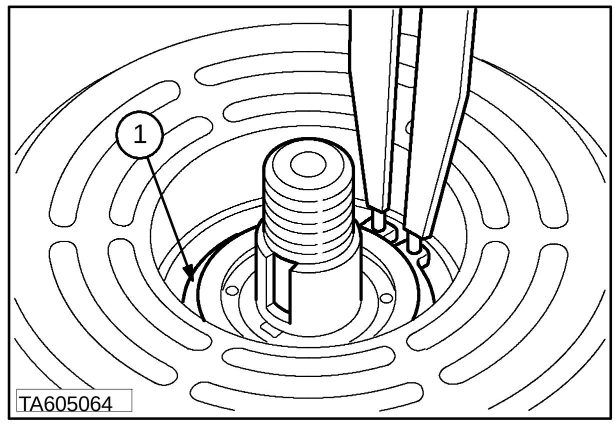
60

2. Position the pulley on the housing hub and carefully slide the pulley down the shaft.



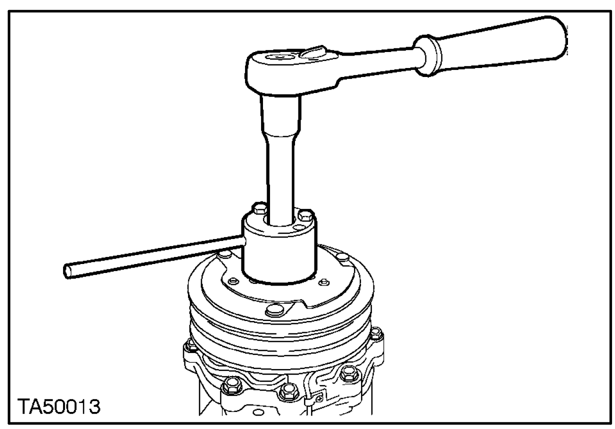
61

3. Install the bearing snap ring.



62

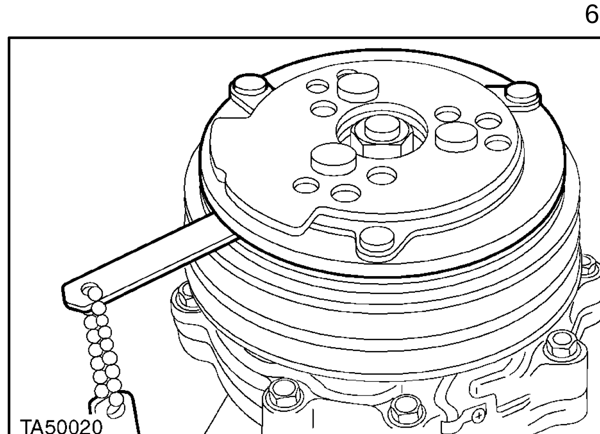
4. Replace the front plate and retaining nut and tighten to a torque of 18Nm (13lbf.ft).



63

5. Check the clearance between the clutch front plate and pulley. This should be consistent around the circumference and be between 0.4–0.8mm (0.016–0.031in.)

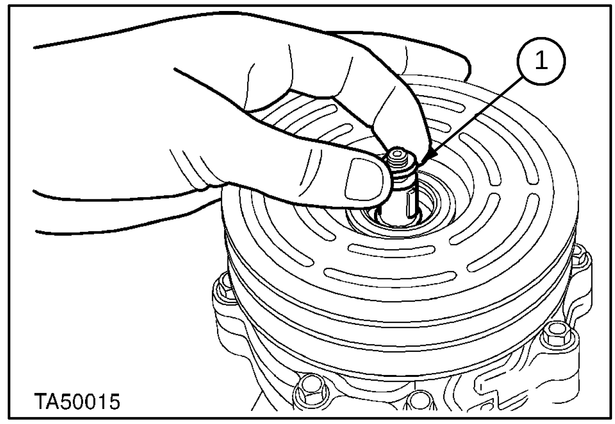
NOTE: *If the air gap is not consistent, lightly pry up on the counter weighted front plate at the low spots or lightly tap down at the high spots.*



64

6. If the clearance is not within specification the shims under the front plate should be added to or subtracted from, until the correct clearance is obtained.

NOTE: *New shims are available in sizes 1.00, 0.50 and 0.13 mm, (0.040, 0.020 and 0.005 in.).*



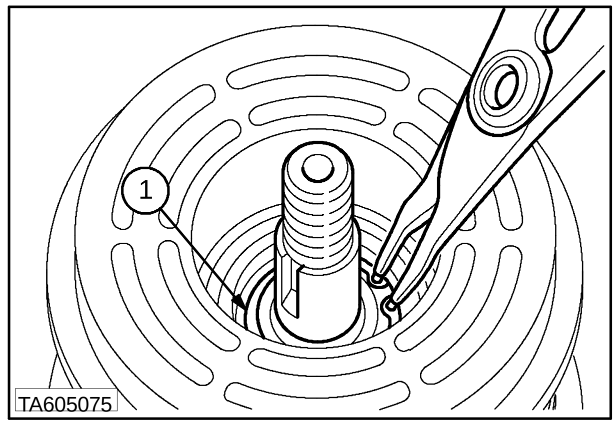
65

Shaft Seal Replacement

The refrigerant must be discharged from the system and the compressor removed from the vehicle prior to replacing the shaft seal.

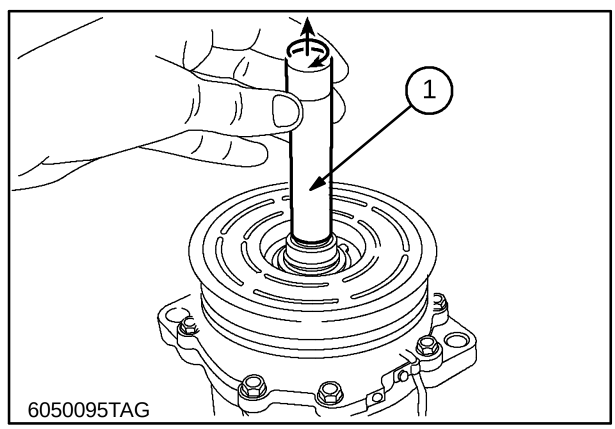
Removal

1. Remove the clutch front plate, as detailed in the steps of clutch disassembly.
2. Remove the woodruff key, shims and felt lubrication ring to expose the snap ring.
3. Remove the shaft seal retaining snap ring.



66

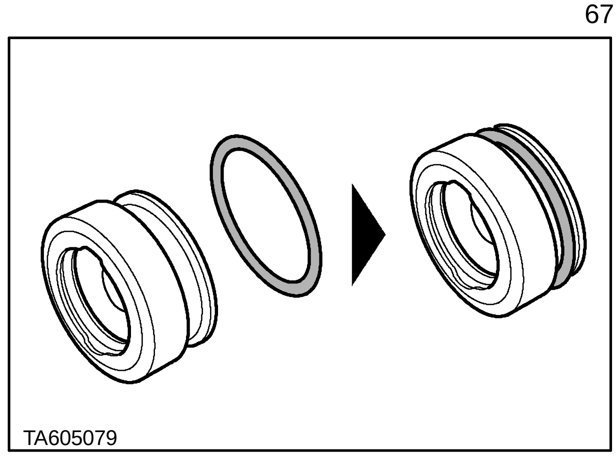
4. Insert the seal remover/installer tool **297423**. Twist the tool to engage the slots in the seal. Pull up to remove and discard the seal.



67

Installation

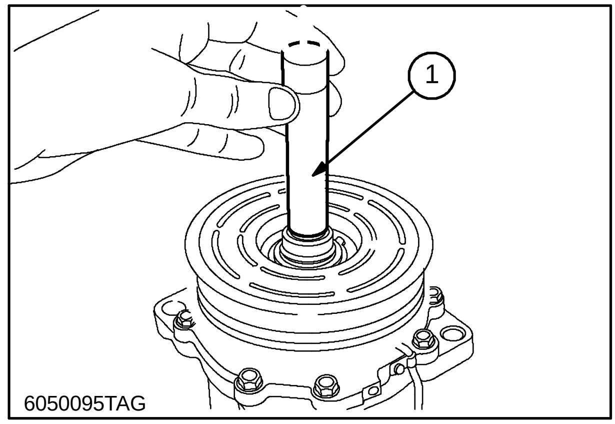
1. Thoroughly clean the seal cavity in the hub. Use ‘lint free’ cloth only.
2. Ensure the new shaft seal ‘O’ ring is installed onto the seal assembly. Dip the new seal assembly in clean refrigerant oil and attach to the seal remover/installer tool.



68

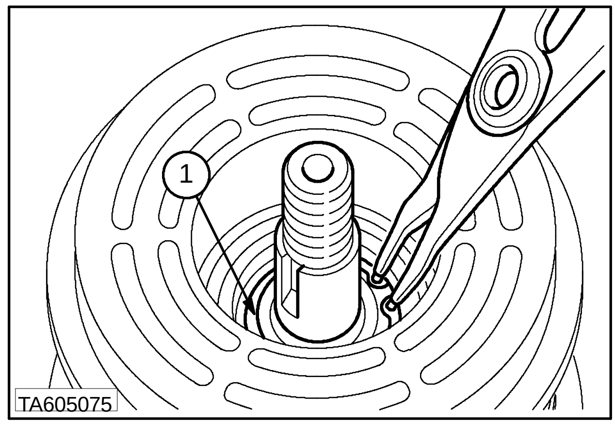
3. Insert the new seal fully into the hub.

NOTE: *If remover/installer tool is not available, position the seal squarely in the hub and tap gently until fully seated.*



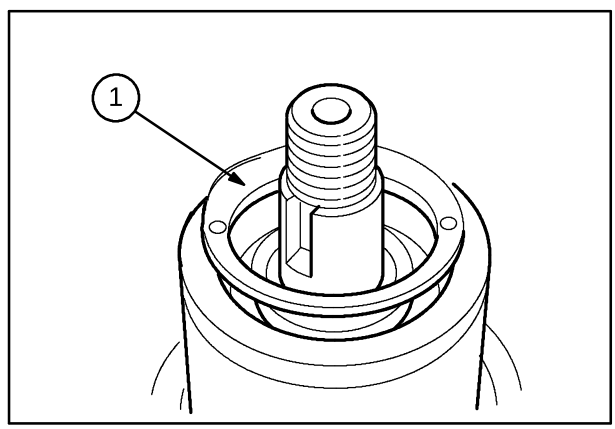
69

4. Install the seal snap ring. If the snap ring has a bevelled edge this should face outwards.



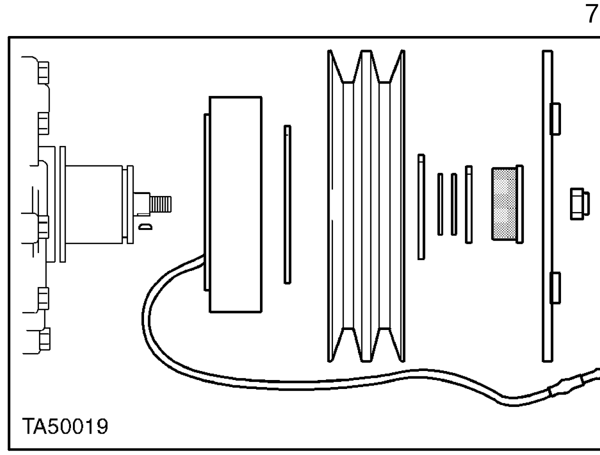
70

5. Install a new felt seal and push into position.



71

6. Position the shims over the shaft and refit the woodruff key.
7. Reinstall the clutch front plate as described in clutch reassembly.

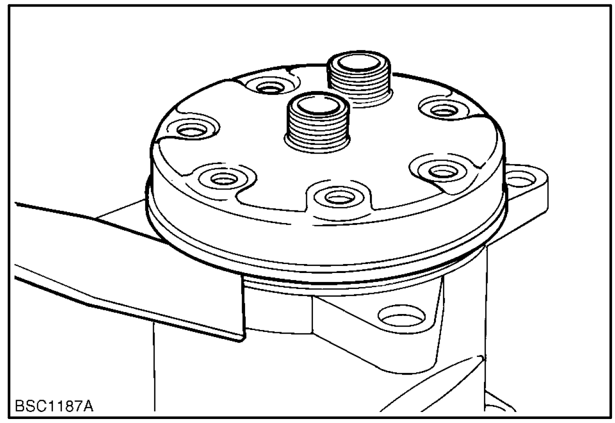


72

CYLINDER HEAD SERVICING

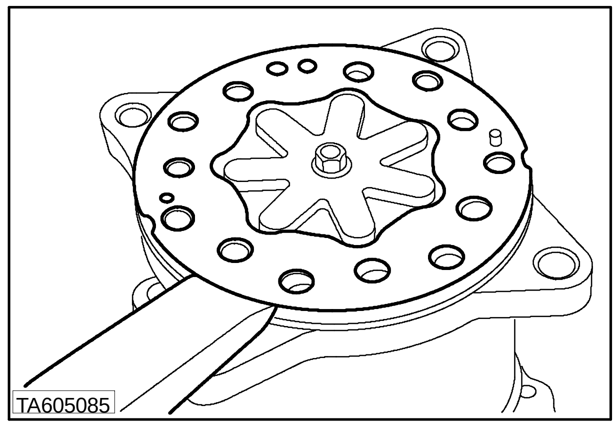
Disassembly

1. Drain the refrigerant oil from the compressor into a clean calibrated container. Measure and record the quantity of oil obtained. This information is required during installation of the new or overhauled unit.
2. Remove the six cylinder head bolts and using a hide mallet, gently tap the cylinder head free. The use of a gasket scraper may also be required to free the cylinder head from the compressor body.



73

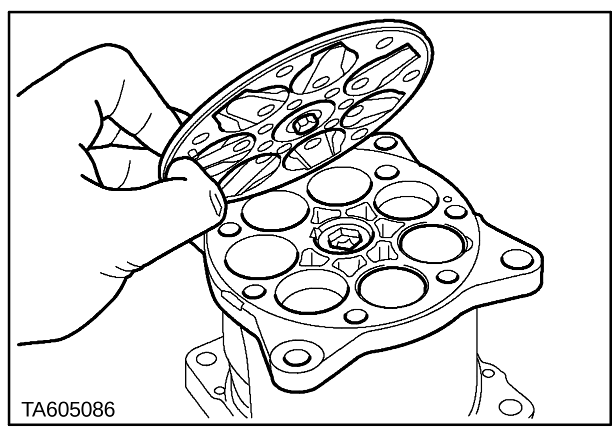
3. If the valve plate and/or cylinder head are to be reused, carefully remove the gasket using a suitable scraper.
4. Gently pry the valve plate free from the cylinder block and remove the gasket.
5. Inspect the valve plate for damage.



74

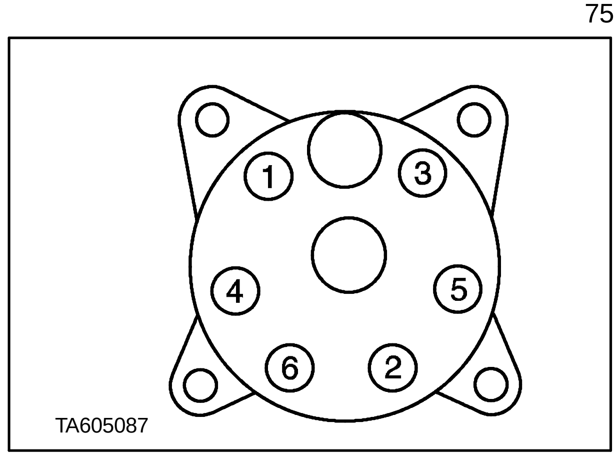
Reassembly

1. Coat the top of the valve plate with clean refrigerant oil and reassemble the cylinder head using the reverse of the disassembly procedure.
2. When installing the gaskets and valve plate ensure they are correctly positioned over the locating pins in the cylinder block.



75

3. Install the cylinder head bolts and tighten using the sequence shown. Torque initially to 20Nm (14lbf.ft) then finally to 32Nm (24 lbf.ft).
4. When the overhaul is complete add to the compressor a volume of oil equivalent to that drained prior to disassembly, or as the reclaim measured fill.



76

NOTES

SECTION 55 - ELECTRICAL SYSTEM

Chapter 1 - System General

CONTENT

ELECTRICAL EQUIPMENT SPECIFICATIONS

Headlight Bulb	55/60W H4 Halogen
Stop/Tail Light Bulb	5/21W Bayonet Cap
Interior Light Bulb	10W Festoon and 10W Bayonet Cap
Flasher Light Bulb	21W Bayonet Cap
Work Light Bulbs	55W H3 Halogen
Instrument/Warning Light Bulbs	1.2W Capless
Rocker Switch Bulbs	1.2W Capless

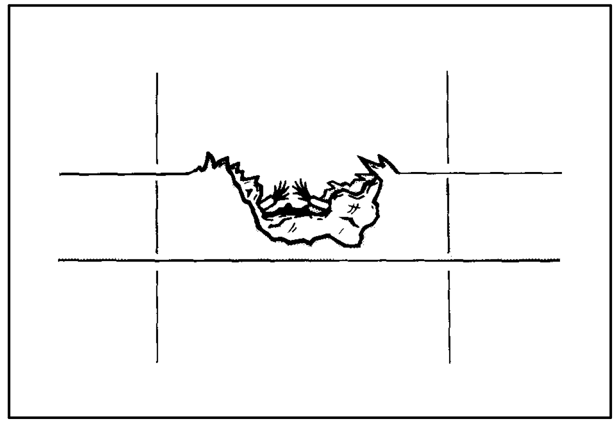
Temporary Wiring Harness Repair

The following method to repair wiring is a temporary expedient only. Wiring should be replaced as soon as possible. Replacement of temporary repaired cables with new is particularly important if the tractor is to be used for spraying as chemicals can enter the repaired area, travel up the cable and damage electrical components. Do not attempt to repair the wire on any system sensors as these are sealed and should only be replaced with a new component.

NOTE: *When conducting a cable repair it is important that only RESIN CORED SOLDER is used. Use of other types of solder may result in further cable damage.*

To carry out a temporary repair, proceed as follows:–

1. Locate damaged portion of cable then cut away outer protective cover on both sides of the damaged area, Figure 1.
2. Peel back the cable from both ends of the damaged area and carefully cut away the inner cable cover at the damaged area and strip about 13 mm ($^1/_2$ inch) of insulation from the wires. Do not cut away any wire strands.
3. Using a suitable solvent, clean about 2 inches (50 mm) from each cover end. Clean the grey cable cover and the individual leads.



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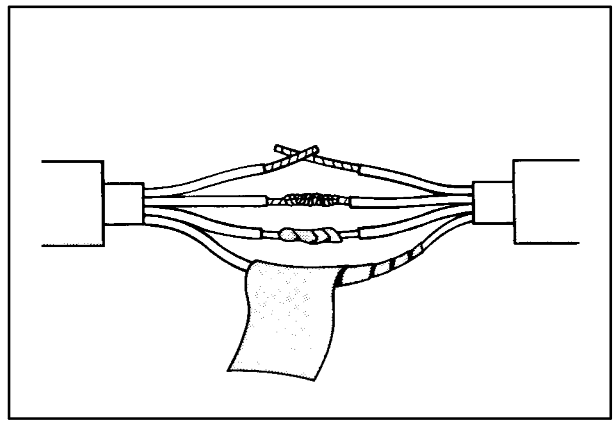

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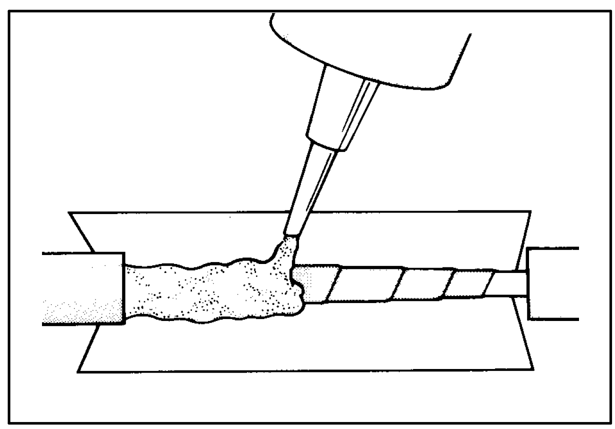
4. Twist two bare leads together for each damaged lead, being careful to match wire colours, then solder the leads using resin cored solder. Tape each repaired lead with vinyl insulation tape, Figure 2.
5. Wind a layer of vinyl insulation tape up to the grey cable cover at each end of the repair section. Make a paper trough, Figure 3, then apply silicon rubber compound (non hardening sealant) over the repaired section up to the cover ends. Sufficient sealant must be used to fill the ends of the cut away area.



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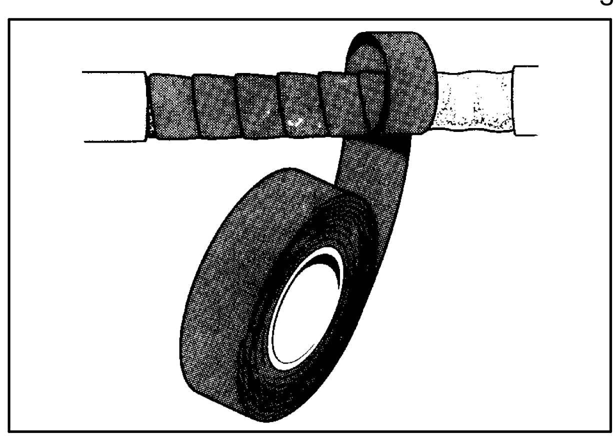
6. Allow the compound to cure then cover the area with insulating tape taking the tape well over each end of the repair. An overlap of at least 2 inches (50 mm) of tape at each end is necessary, Figure 4.
7. Check to ensure the repair is satisfactory and secure the repaired cable so that repeat damage is avoided.

NOTE: *This is a temporary repair only. Ensure the damaged cable is replaced as soon as possible to prevent ingress of water or chemicals.*



4

ELECTRICAL SYSTEM – GENERAL FAULT FINDING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Electrical system is inoperative	Loose or corroded battery connections	Clean and tighten connections
	Sulphated batteries	Check battery open circuit voltage for 12.6 volts minimum. Check electrolyte level and specific gravity.
	Battery Isolator switch turned ‘off’	Re–instate isolator switch
	Main machine fuse link blown	Establish reason of failure and replace fuse link
Starter speed low and engine cranks slowly	Loose or corroded connections	Clean and tighten loose connections
	Low battery output	Check battery open circuit voltage for 12.6 volts minimum. Check electrolyte level and specific gravity.
	Incorrect viscosity engine oil	Use correct viscosity oil for temperature conditions
Starter inoperative	Transmission shift lever in gear	Place shift lever in neutral
	Loose or corroded connections	Clean and tighten loose connections
	Dead batteries	Charge or replace batteries.
Charge indicator lamp stays on with engine running	Low engine idle speed	Increase idle speed
	Loose belt	Check belt tension
	Malfunctioning battery	Check battery open circuit voltage for 12.6 volts minimum. Check electrolyte level and specific gravity.
	Malfunctioning alternator	Check alternator
Batteries will not charge	Loose or corroded terminal connections	Clean and tighten connections
	sulphated batteries	Check battery open circuit voltage for 12.6 volts minimum. Check electrolyte level and specific gravity.
	Loose or worn belt	Check automatic belt tensioner. Replace belt if required.
Charge indicator flashing indicating excessive charging voltage	Malfunctioning alternator	Check alternator

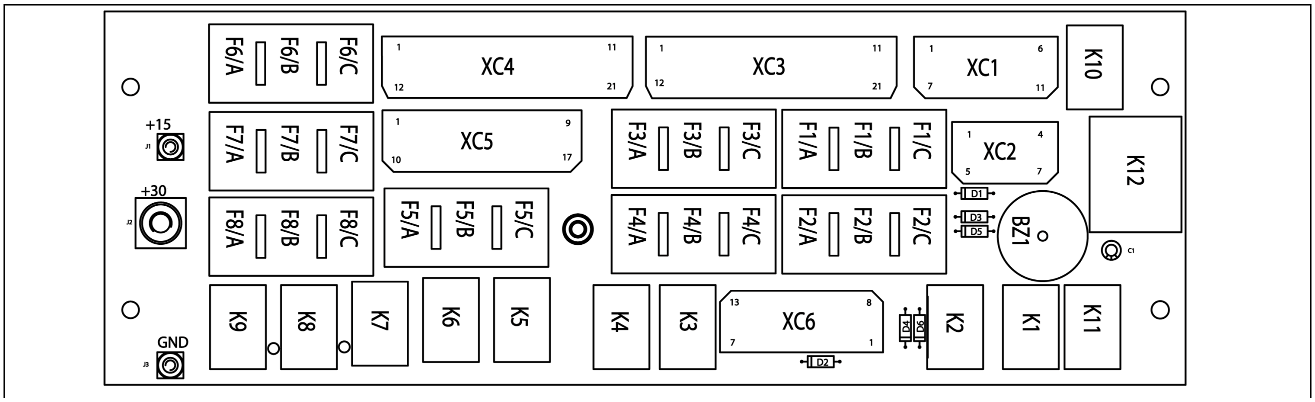
NOTES

SECTION 55 - ELECTRICAL SYSTEM

Chapter 2.1 - Schematic diagrams of Powershuttle (European and North American model)

CONTENTS

FUSES AND RELAYS



Fuse No.	Rating	Colour	Circuit	Schematic No.
F1/A	15 A	Blue	Rear windshield wiper and washer (S14)	**7**
F1/B	7.5 A	Brown	Fuel shut off, antitheft supply	**1**
F1/C	10 A	Red	Stop light switch (S33)	**5**
F2/A	15 A	Blue	Power supply for the instruments, switch lamps, brake oil level sender, seat, buzzer	**4**
F2/B	15 A	Blue	Blower motor	**8**
F2/C	20 A	Yellow	Preheating	**1**
F3/A	3 A	Violet	Rear right & front left side lights, instruments & air conditioning illumination	**4**
F3/B	3 A	Violet	Front right & rear left side lights, number plate light	**4**
F3/C	10 A	Red	Switches S1, S4, S5, S6 & S11	**7**
F4/A	5 A	Orange	Forward and reverse gears, reversing buzzer, gear switch	**2**
F4/B	10 A	Red	Rear chisel switch, clamshell level detector and valve, clutch shut off switches	**2**
F4/C	10 A	Red	Rear working light switch (S12) & rear travel lock switch (S7) (European model)	**6**
F5/A	15 A	Blue	Front working lights - internal	**6**
F5/B	10 A	Red	Dipped headlights (European model)	**4**
F5/C	15 A	Blue	Main beam (European model)	**4**
F6/A	7.5 A	Brown	Rotary beacon	**7**
F6/B	7.5 A	Brown	Flasher (+15) (NA model)	**4**
F6/C	7.5 A	Brown	Hammer, 4WD	**2**
F7/A	10 A	Red	Hazard lights, horn (+30)	**4**
F7/B	10 A	Red	Auxiliary 12 V socket, radio, cab interior light	**8**
F7/C	6 A	Black	Front windshield wiper (special bi-metal, re-setting fuse)	**7**
F8/A	15 A	Blue	Rear working lights - external	**6**
F8/B	15 A	Blue	Front working lights - external	**6**
F8/C	15 A	Blue	Rear working lights - internal	**6**

RELAYS

No.	Circuit	Schematic No.	No.	Circuit	Schematic No.
K1	Forward-Reverse gear	**2**	**K7**	Rear working lights - internal	**6**
K2	Gear alarm, hand brake	**2**	**K8**	Front working lights - external	**6**
K3	Starting	**1**	**K9**	Rear working lights - external	**6**
K4	Clamshell level solenoid valve	**2**	**K10**	Reverse gear	**2**
K5	Dipped & main beam lights	**4**	**K11**	Forward gear	**2**
K6	Front working lights - internal	**6**	**K12**	Hazard lights, flasher	**4**

BUZZER

BZ1	Audible warning buzzer

CONNECTORS

XC	Main harness connections into fuse board

COMPONENTS

A1 LVC electronic control box
A2 Cold start electronic control box (optional)
BS1 Right speaker (optional)
BS2 Left speaker (optional)
BZ1 Alarm buzzer
D1 Diode
D2 Diode
EV0 Fuel shut off solenoid valve
EV1 Double supply solenoid valve (optional)
EV2 Hammer solenoid valve (optional)
EV3 Rear chisel solenoid valve (optional)
EV4 Rear travel solenoid valve (European model)
EV5 Excavator rear lock solenoid valve (optional)
EV6 Clamshell level solenoid valve
EV8 4WD solenoid valve (optional)
EV9 Reverse gears solenoid valve
EV10 Forward gears solenoid valve
EV11 Ride control solenoid valve (optional)
EV12 Tool solenoid valve (optional)
EV20 Backhoe pilot pressure solenoid valve
EV21 Solenoid valve for switchover between boom/dipper control
EV22 Solenoid valve for switchover between boom/dipper control
EV23 LH stabilizer raising solenoid valve
EV24 LH stabilizer lowering solenoid valve
EV25 RH stabilizer raising solenoid valve
EV26 RH stabilizer lowering solenoid valve
EV27 Telescopic dipper retraction solenoid valve
EV28 Telescopic dipper extension solenoid valve
EV29 Hydraulic auxiliary solenoid valve (optional)
EV30 Hydraulic auxiliary solenoid valve (optional)
FG1 General fuse 80 A
FG2 A/C fuse 10 A
FC10 Cold start heater fuse 300 A (optional)
G1 Battery
G2 Generator
H1 Excavator rear lock warning light (optional)
H2 Front left light (European model)
H3 Front right light (European model)
H4 Rear left light (European model)
H5 Number plate lamp (European model)
H6 Rear right light (European model)
H7 Front left flashing indicator (NA model)
H8 Rear left light (NA model)
H9 Front right light (NA model)
H11 Front left external working light
H10 Rear right flashing indicator (NA model)
H12 Front right external working light
H13 Rear left external working light
H14 Rear right external working light
H15 Rotary beacon
H16 Rotary beacon
H17 Auxiliary 12 V socket illumination
H18 Cab interior light
H19 Front left internal working light (optional)
H20 Front right internal working light (optional)
H21 Rear left internal working light (optional)
H22 Rear right internal working light (optional)
HA1 Reverse speed buzzer
HA2 Horn
K01 Starter relay
K02 Air-conditioning relay
K13 Antitheft unit
K20 Safety relay
K21 Cold start heater relay (optional)
KC Fuse & relay board
KF Indicator flasher unit (NA model)
M1 Starter motor
M4 Rear windshield wiper motor
M5 Front windshield wiper motor
M6 Rear windshield washer motor
M7 Front windshield washer motor
M8 Blower motor
M9 Optional blower motor
M10 A/C compressor
R2 Engine water temperature sender
R3 Fuel level sender
R10 Cold start heater
S1 Cold start switch (optional)
S2 4WD switch (optional)
S3 Hammer switch (optional)
S4 Double delivery switch (optional)
S5 Ride control switch (optional)
S6 Tools switch (optional)
S7 Rear travel lock switch (European model)
S8 Excavator rear lock switch (optional)
S9 Light switch
S10 Hazard lights switch
S11 Front working lights switch
S12 Rear working lights switch
S14 Rear windshield wiper & washer switch
S15 Rotary beacon switch
S17 Starting switch
S18 Handbrake switch
S20 Engine oil low pressure switch
S21 Clogged air filter switch
S24 Transmission oil pressure switch
S25 Transmission oil high temperature switch
S26 Clutch shut off switch
S27 Clutch shut off switch
S28 Clamshell sender
S29 Horn switch
S30 Rear chisel pedal switch (optional)
S31 Brake oil level sender
S32 Stop light switch
S33 Stop light switch
S34 Left cab interior light switch
S35 Right cab interior light switch
S40 Gear change switch

S41 Front windshield wiper & washer - indicators switch (NA model)
S41 Front windshield wiper & washer - lights switch (European model)
S42 Gear indicator sender (optional)
S43 Radio (optional)
S44 Seat (optional)
S45 Conditioner and blower motor switch
S46 12V auxiliary socket
S47 Main switch
S48 Thermostat
S49 A/C pressure switch
S50 Seat safety switch
S60 Backhoe pilot switch
S61 Boom/dipper control switch
S62 Safety switch
S63 Telescopic dipper extension switch
S64 Horn switch (LH control lever)
S65 LH stabilizer switch
S66 RH stabilizer switch
S67 LH stabilizer pressure switch
S68 RH stabilizer pressure switch
S69 Telescopic dipper retraction switch
S70 Hydraulic auxiliary switch (optional)
S71 Hydraulic auxiliary switch (optional)
ST1 Side panel with optional diagnostics
ST2 Front panel

CONNECTORS

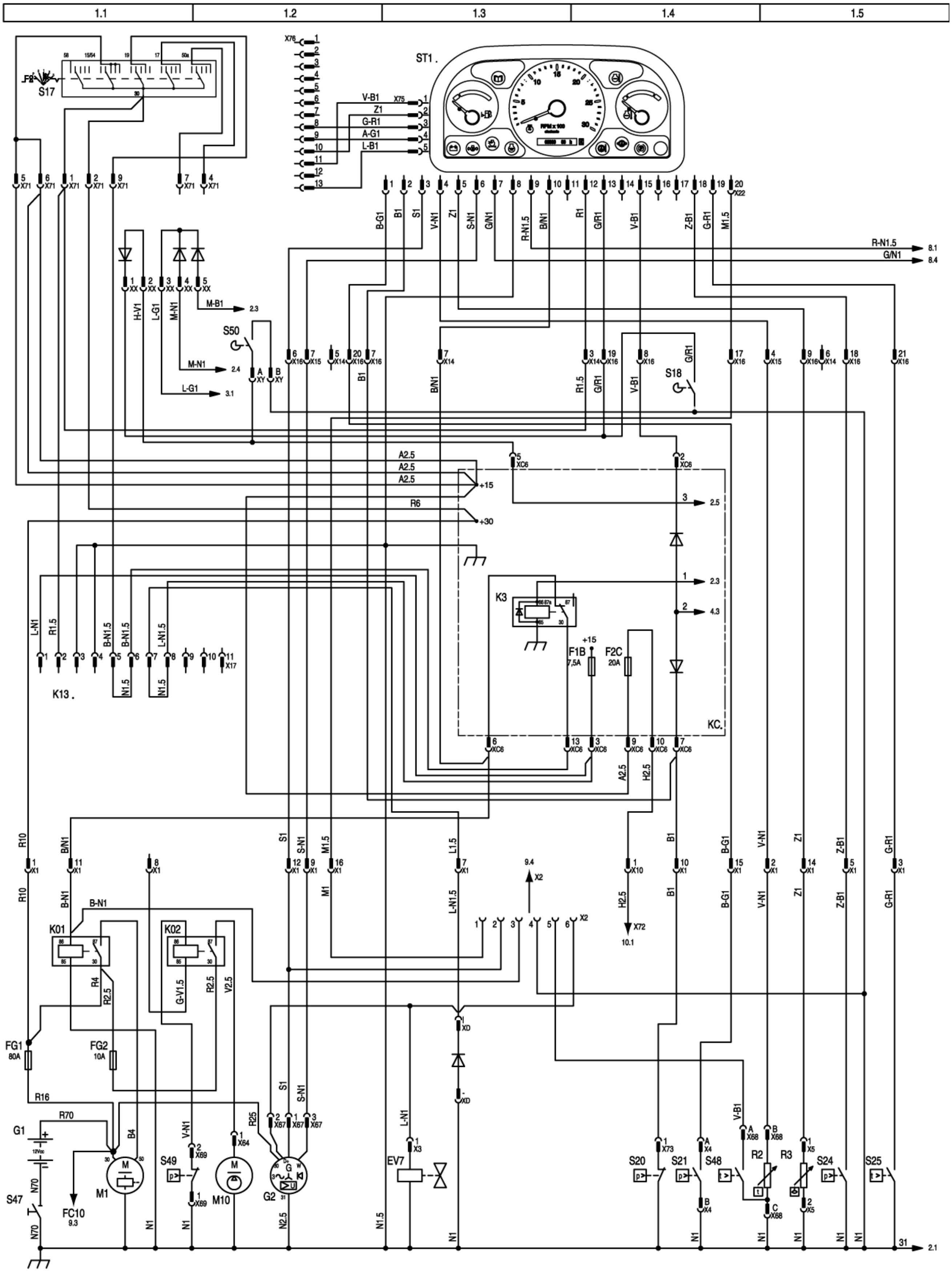
X1 General cable - Engine cable - 18 way connector
X2 Cold start - 12 way connector
X3 Fuel shut off - 1 way connector
X4 Air filter - 2 way connector
X5 Fuel level sender - 2 way connector
X6 Forward gear - 2 way connector
X7 Reverse gear - 2 way connector
X8 Differential locking - 2 way connector
X9 General cable - front dashboard - 9 way connector
X10 Solenoid valves cable - general cable - 29 way connector
X11 1 way connector
X12 General cable - cabin cable - 5 way connector
X13 Heater - 4 way connector
X14 General cable - side dashboard - 9 way connector
X15 General cable - side dashboard - 7 way connector
X16 General cable - side dashboard - 21 way connector
X17 Antitheft - 11 way connector
X18 General cable - rear lamps cable - 12 way connector (European model)
X19 Reverse buzzer - 2 way connector
X20 Conditioner switch illumination - 2 way connector
X21 Seat - 4 way connector
X22 Side panel - 20 way connector
X23 Clutch shut off switch - 2 way connector
X24 Rear travel lock solenoid valve - 2 way connector
X25 Excavator rear lock solenoid valve - 2 way connector
X26 Clamshell sender - 3 way connector
X27 Horn switch - 2 way connector
X28 Clutch shut off connector - 2 way connector
X29 Clamshell level - 2 way connector
X30 Double delivery solenoid valve - 2 way connector
X31 Tools rapid connection solenoid valve - 2 way connector
X32 Rear chisel solenoid valve - 2 way connector
X33 Gear indicator sender - 2 way connector
X34 Ride control solenoid valve - 2 way connector
X35 Hammer solenoid valve - 2 way connector
X36 Rear chisel switch - 2 way connector
X37 Rear right light - 4 way connector
X38 Rear right working light - 4 way connector
X39 Rear windshield wiper - 4 way connector
X40 Rear right working light (opt) - 4 way connector
X41 Optional blower motor - 2 way connector
X42 Front right indicator - 4 way connector
X43 Rotary beacon - 4 way connector
X44 Front right working light - 4 way connector
X45 Front right working light (opt) - 4 way connector
X46 Rear left working light (opt) - 4 way connector
X47 Rear left working light - 4 way connector
X48 Rear left light - 4 way connector
X49 Front windshield wiper - 6 way connector
X50 Front left working light (opt) - 4 way connector
X51 Front left working light - 4 way connector
X52 Front left indicator - 4 way connector
X53 Radio (brown color) - 8 way connector
X54 Radio (black color) - 8 way connector
X55 Auxiliary 12 V socket - 2 way connector
X56 Front windshield washer - 2 way connector
X57 Rear windshield washer - 2 way connector
X58 Flasher unit - 13 way connector (NA model)
X58 Shunts- 13 way connector (European model)
X59 Right light - 5 way connector
X60 Horn / left light - 7 way connector
X61 Wiper and lights switch - 12 way connector
X62 Gear change - 6 way connector
X63 Number plate light - 2 way connector (European model)
X64 Air conditioning compressor - 1 way connector
X65 Cold start switch - 1 way connector
X67 Generator - 3 way connector
X68 Engine water temperature sender - 3 way connector
X69 A/C pressure switch - 2 way connector
X70 Front panel - 12 way connector
X71 Key switch - 10 way connector
X72 Pilot control line - 1 way connector
X73 Engine oil pressure switch - 1 way connector
X75 Diagnostics - 5 way connector
X76 Diagnostics - 13 way connector
X77 Blower motor third gear - 1 way connector
X79 Horn jumper connection - 2 way connector
X80 Rotary beacon - 2 way connector
X81 Rotary beacon - 2 way connector
X82 Controller - 10 way connector
X83 Relay - 2 way connector
XA Horn - 2 way connector
XC1 On board - 11 way connector
XC2 On board - 7 way connector
XC3 On board - 21 way connector
XC4 On board - 21 way connector
XC5 On board - 17 way connector

XC6 On board - 13 way connector
XD Fuel shut off diode - 2 way connector
XD1 Diode D1 - 2 way connector
XD2 Diode D2 - 2 way connector
XP1 Solenoid valve EV21 - 2 way connector
XP2 Solenoid valve EV22 - 2 way connector
XP4 LH control lever switch - 2 way connector
XP11 LH stab. pressure switch - 2 way connector
X12 RH stab. pressure switch - 2 way connector
XP13 RH armrest switches - 5 way connector
XP14 RH control lever switch - 6 way connector
XP17 Backhoe pilot solenoid valve - 2 way connector
XP20 LVC electronic control box - 23 way connector
XP23 Safety switch - 2 way connector
XP24 LH control lever switches - 6 way connector
XL LH stabilizer control lever - 3 way connector
XR RH stabilizer control lever - 3 way connector
XX Diodes - 5 way connector
XY Seat safety switch - 2 way connector
YP3 Solenoid valve EV24 - 2 way connector
YP4 Solenoid valve EV23 - 2 way connector
YP5 Solenoid valve EV26 - 2 way connector
YP6 Solenoid valve EV25 - 2 way connector
YP7 Solenoid valve EV28 - 2 way connector
YP8 Solenoid valve EV27 - 2 way connector
YP9 Solenoid valve EV30 - 2 way connector
YP10 Solenoid valve EV29 - 2 way connector

WIRE COLOURS:

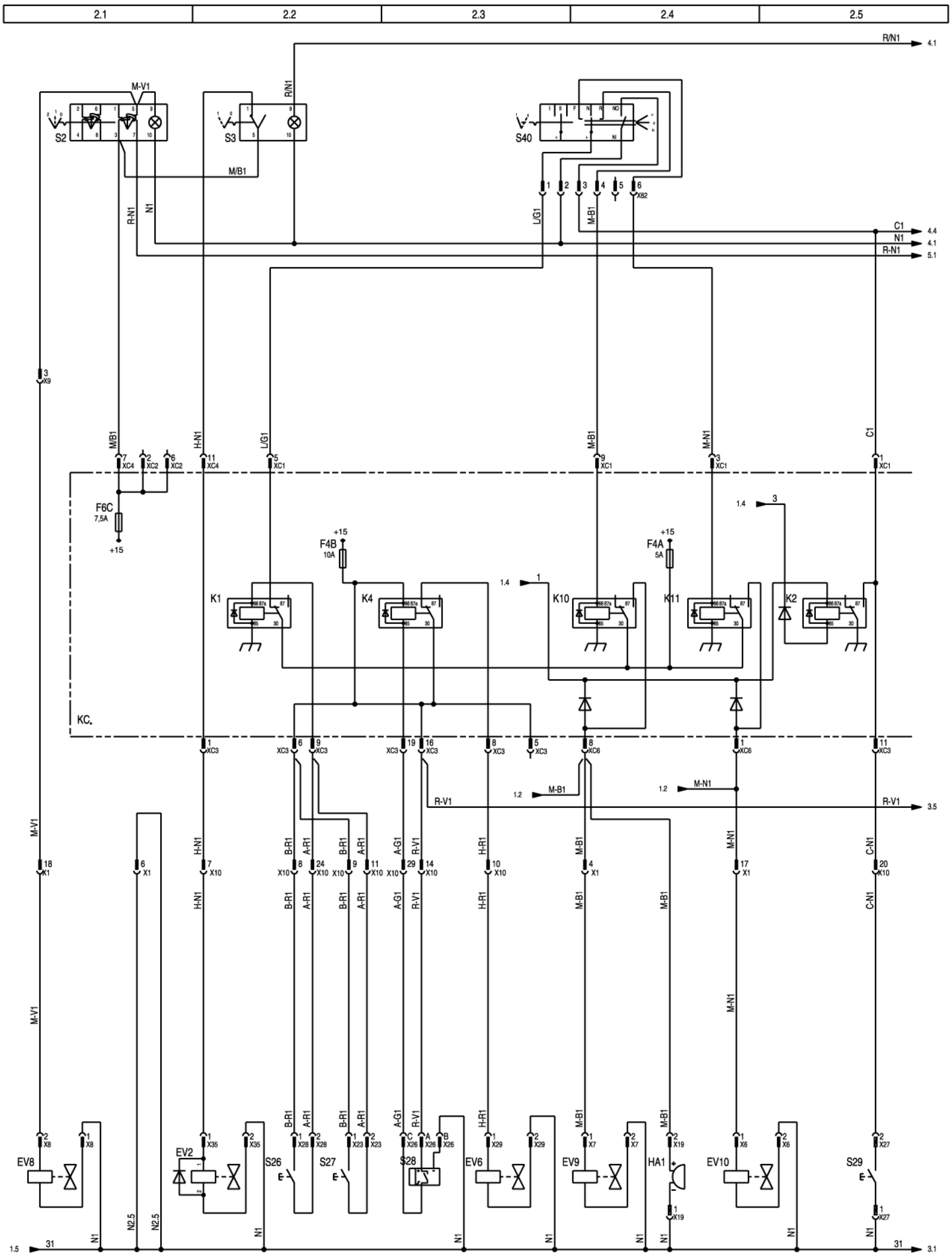
A = LIGHT BLUE .... M = BROWN
B = WHITE........................ N = BLACK
C = ORANGE.................... R = RED
G = YELLOW.................... S = PINK
H = GREY......................... V = GREEN
L = BLUE .... Z = VIOLET
Example of mixed colours
G/V = Yellow/Green (transverse colours)
G-V = Yellow-Green (longitudinal colours)

SYSTEM FROM KEY START (SCHEMATIC No. 1)



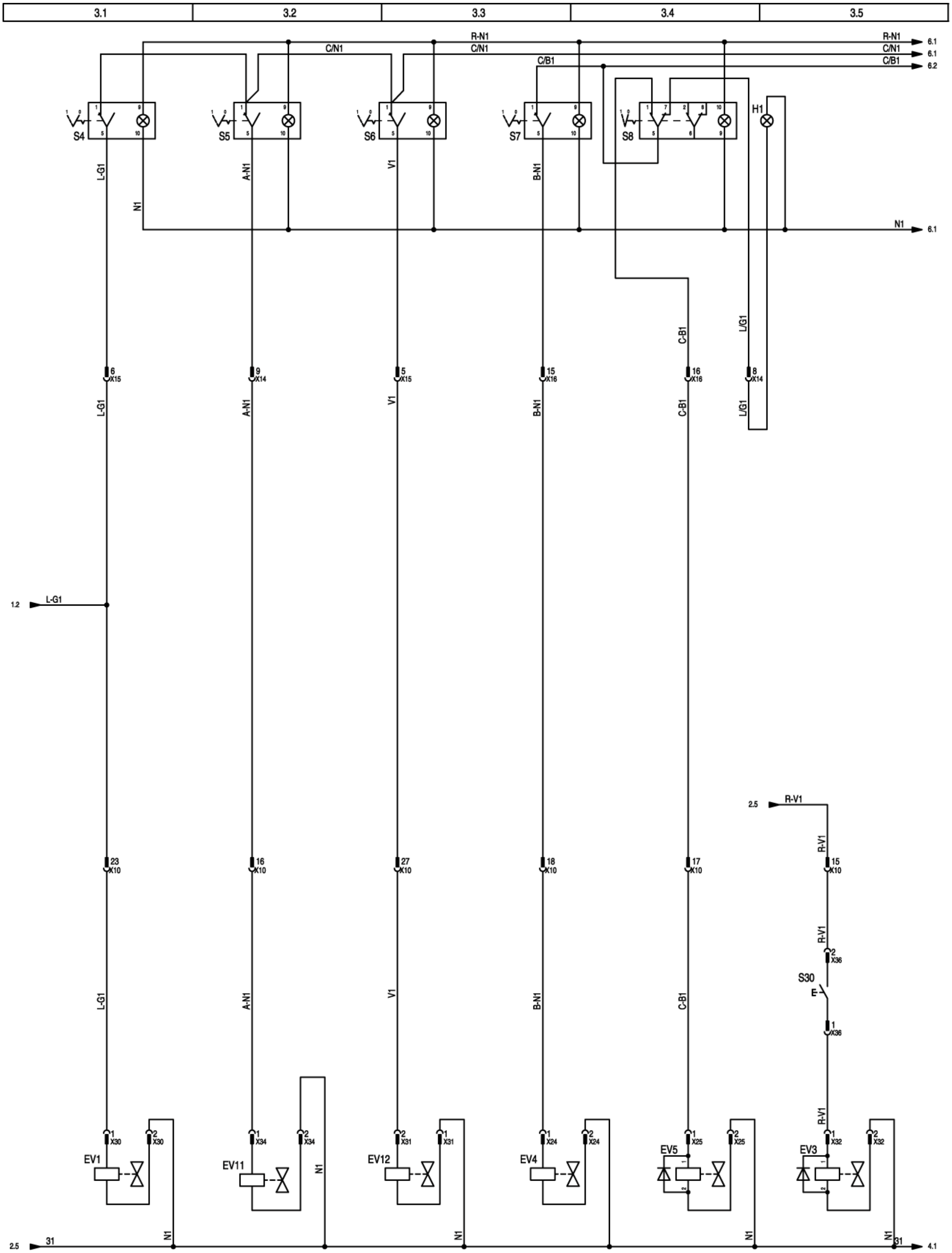
CRIL03K030H00

SOLENOID VALVES (SCHEMATIC No. 2)



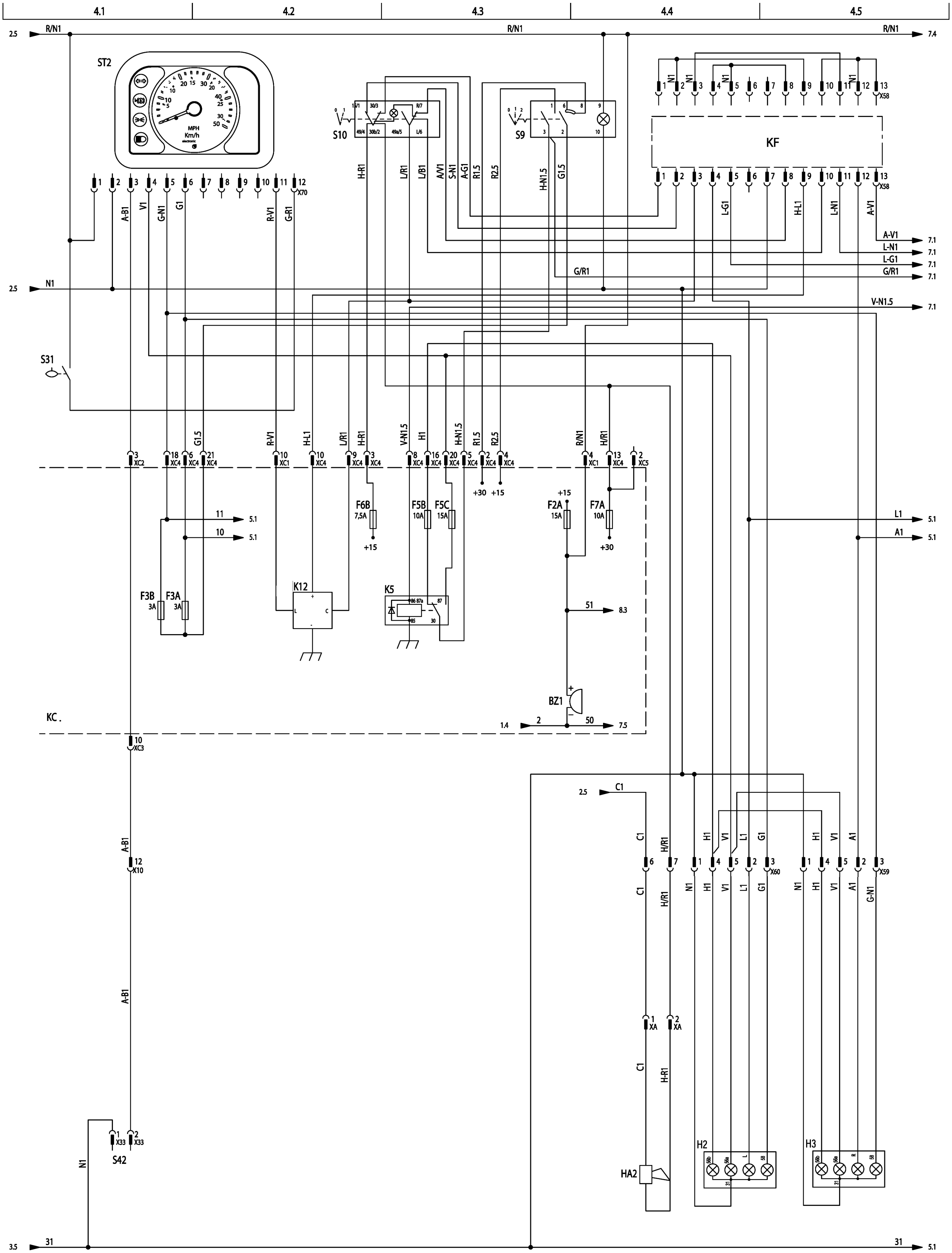
CRIL03K031H

SOLENOID VALVES (SCHEMATIC No. 3)

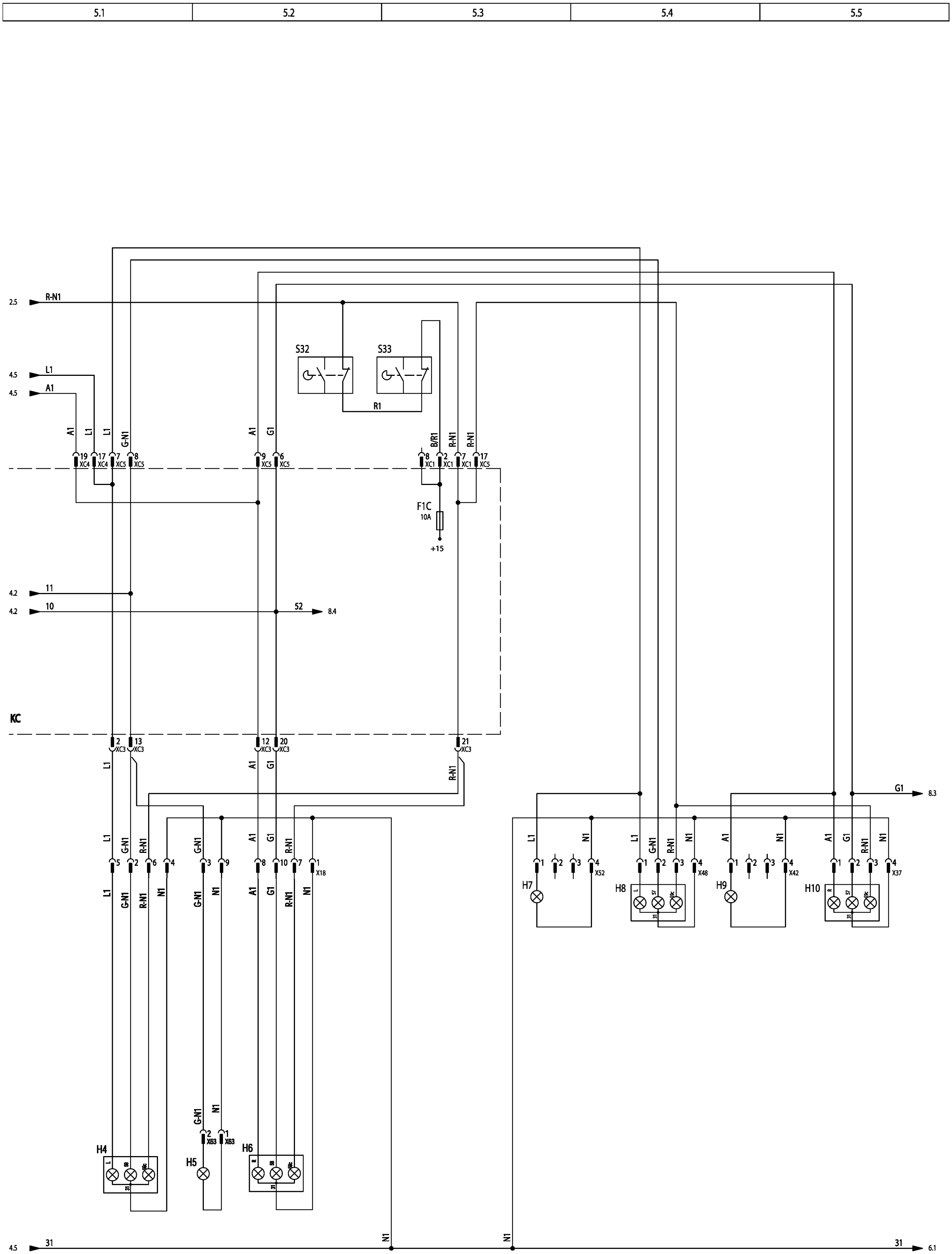


CRILO03K192H00

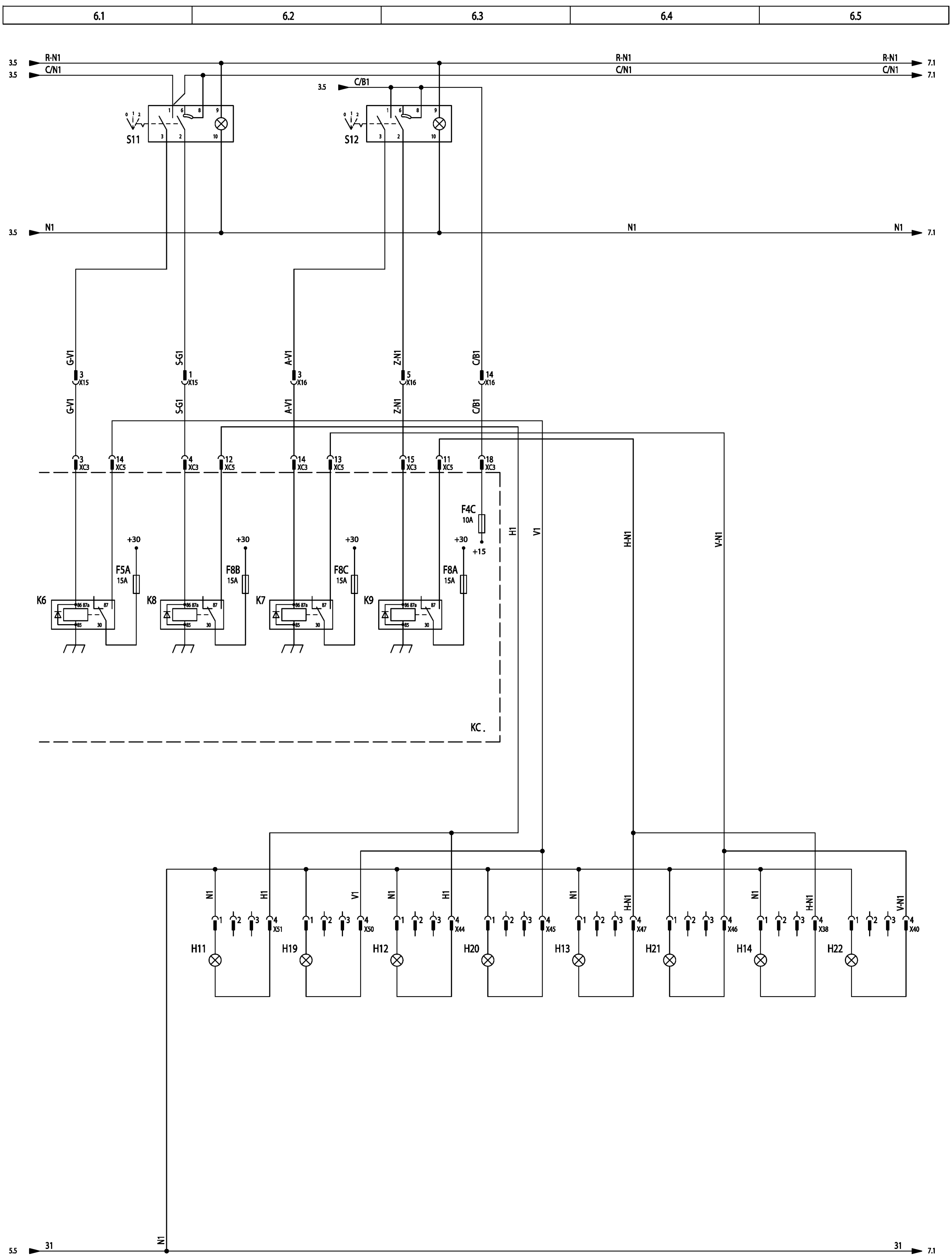
LIGHTS (SCHEMATIC No. 4)



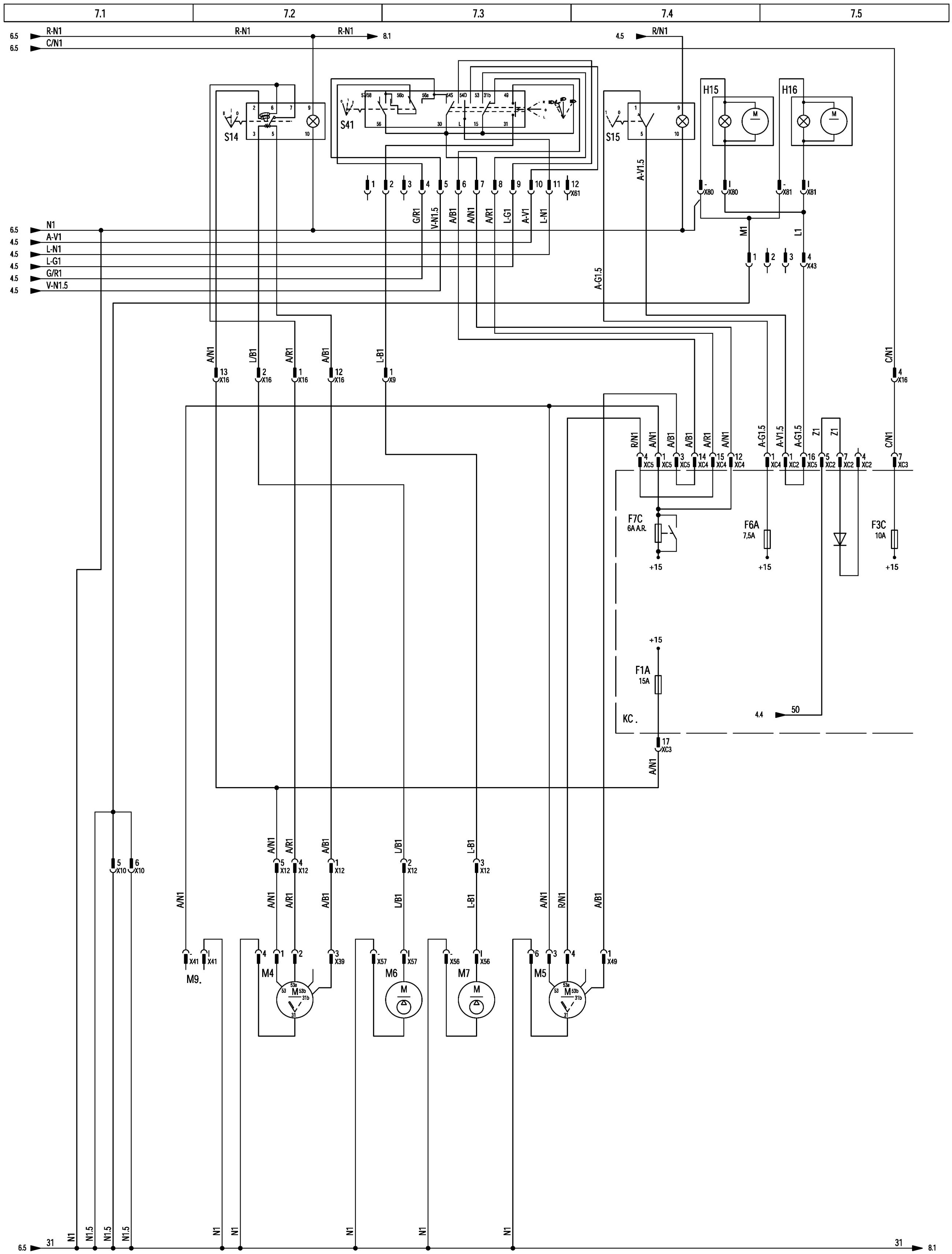
LIGHTS - REAR LIGHTS (SCHEMATIC No. 5)



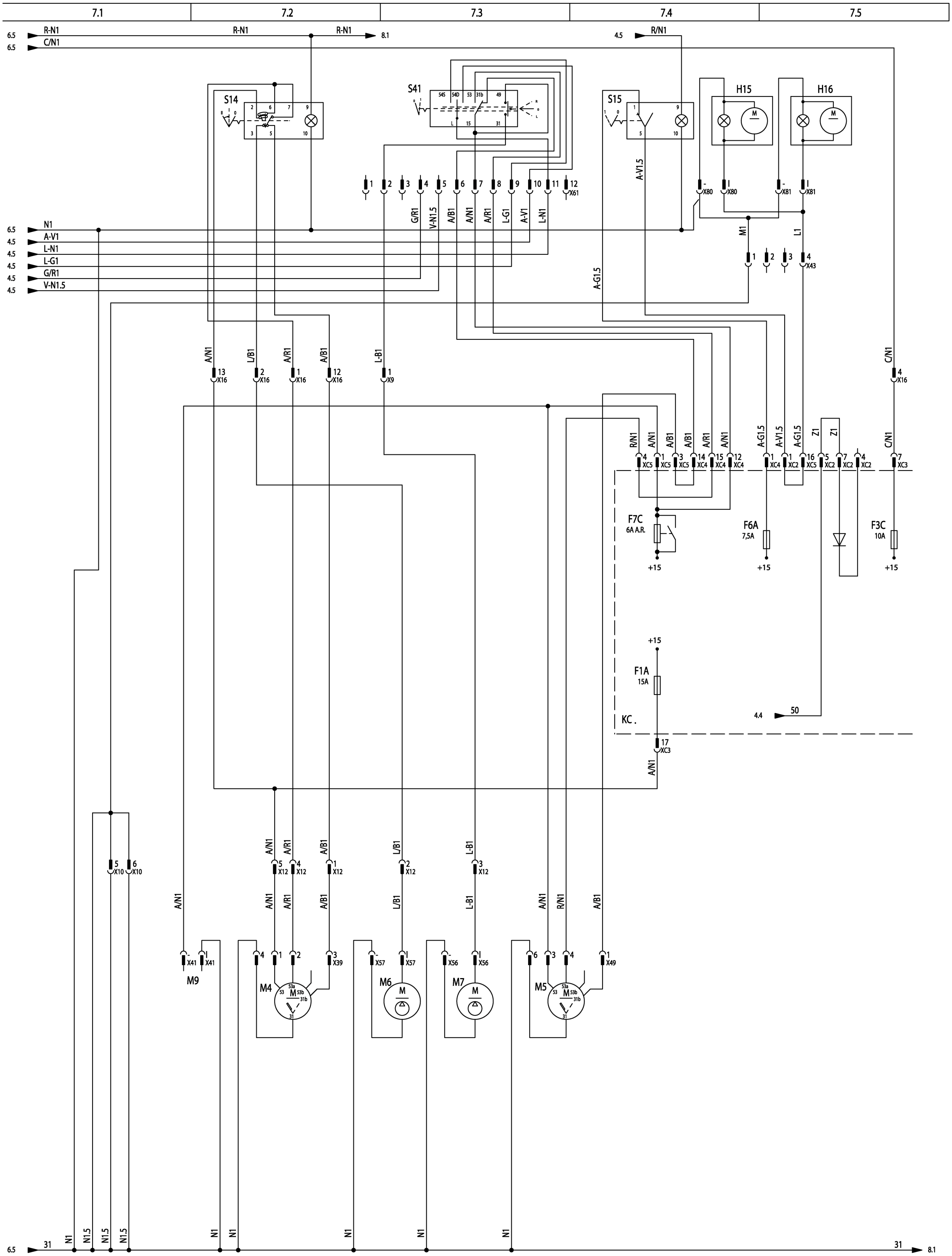
WORKING LIGHTS (SCHEMATIC No. 6)



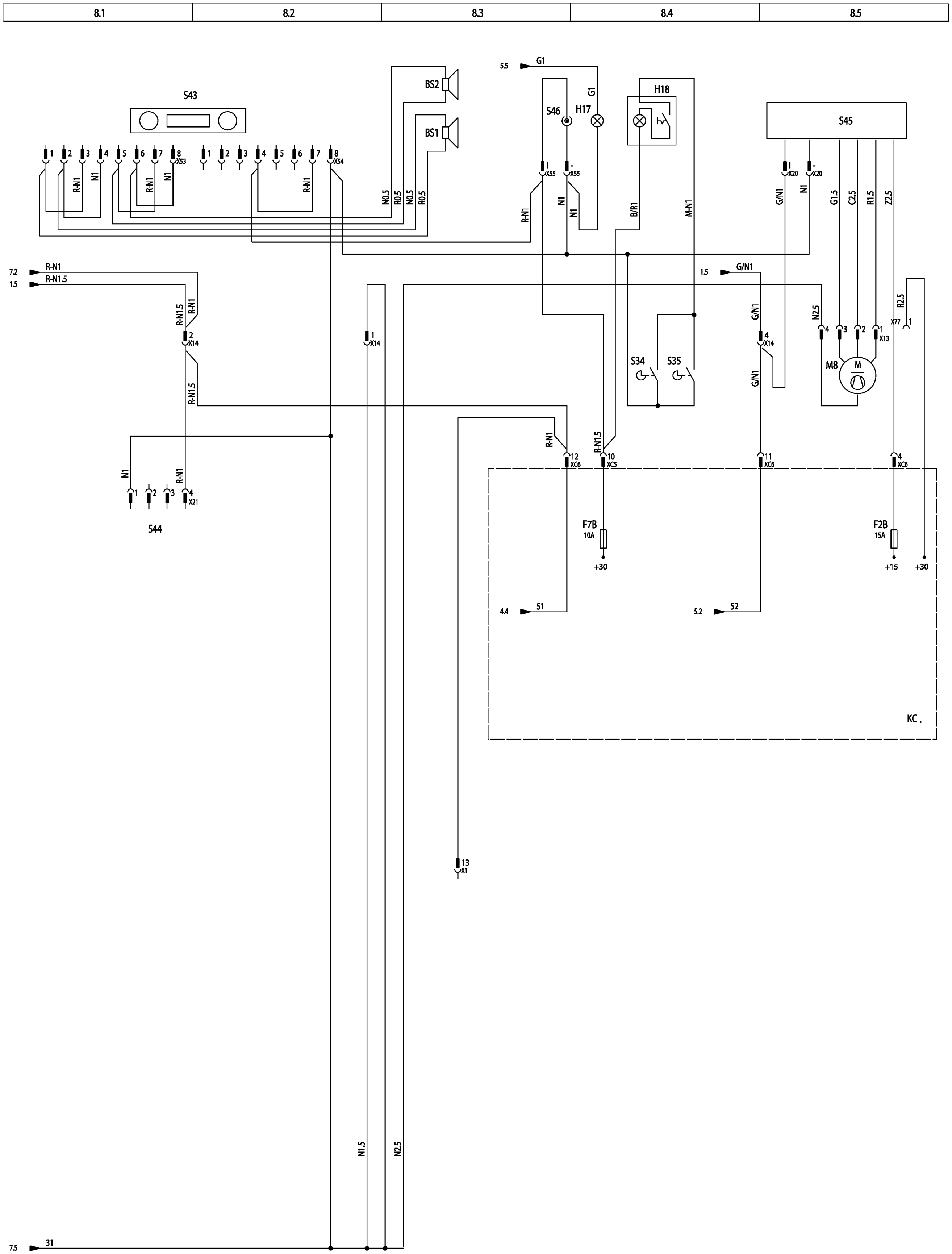
WINDSHIELD WIPER & WASHER (SCHEMATIC No. 7) EUROPEAN MODEL



WINDSHIELD WIPER & WASHER (SCHEMATIC No. 7) NA MODEL

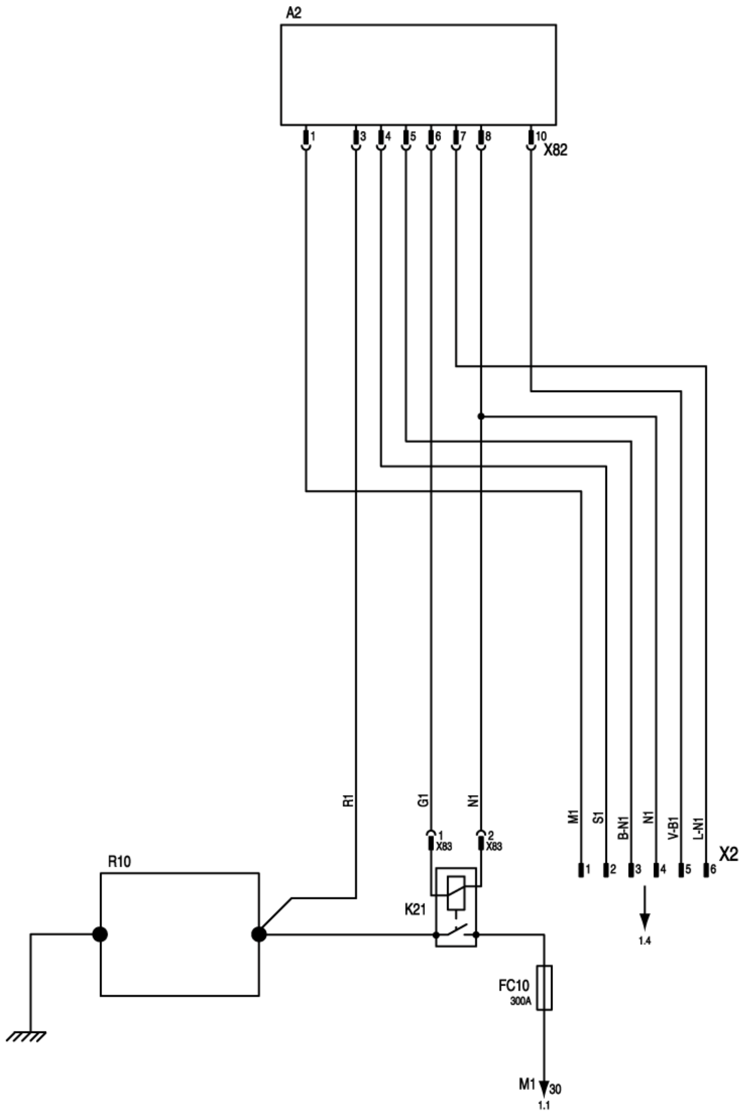


HEATER (SCHEMATIC No. 8)



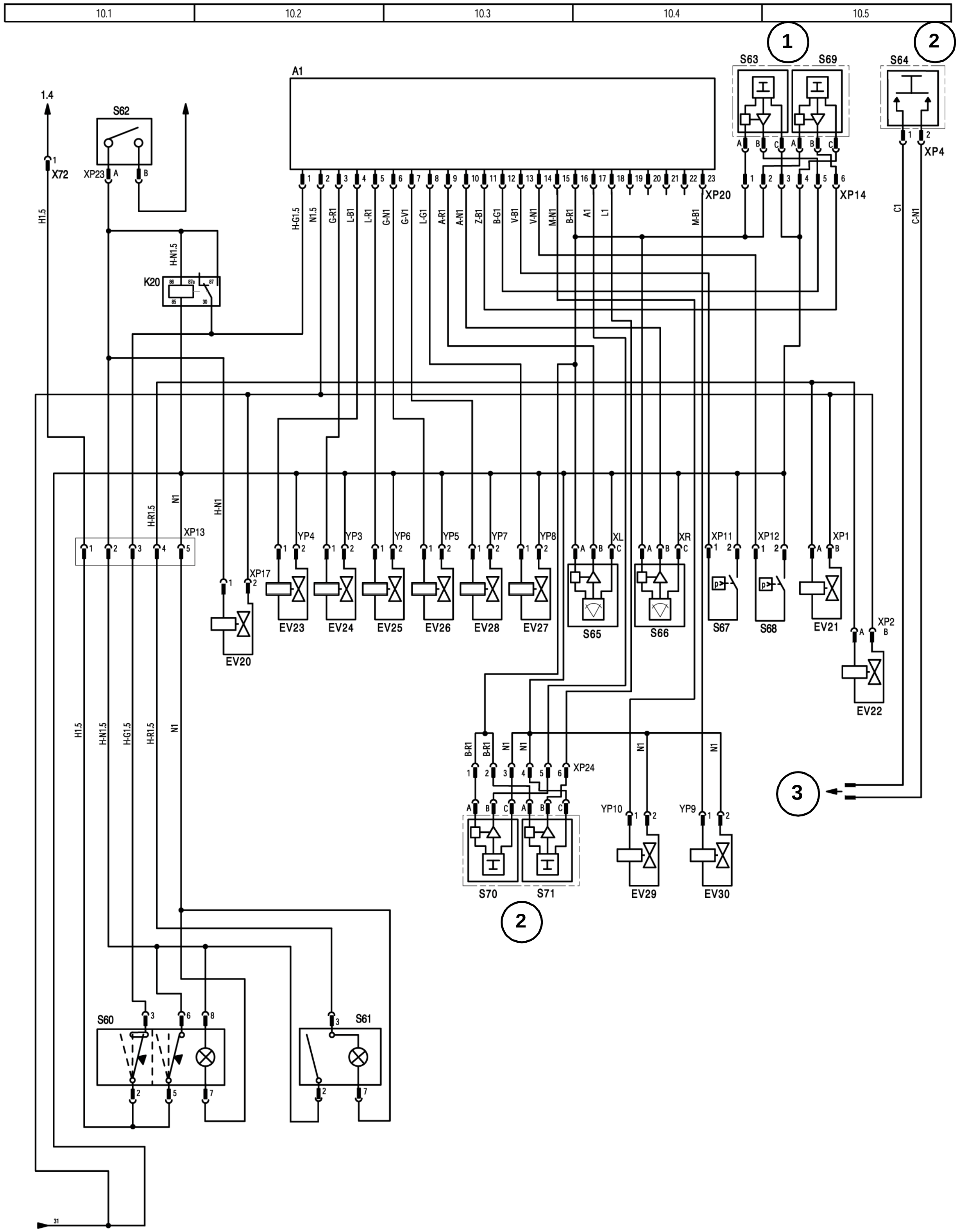
COLD START (SCHEMATIC No. 9)

9.1	9.2	9.3	9.4	9.5



CRIL03K187H00

LVC PILOT CONTROL (SCHEMATIC No. 10)



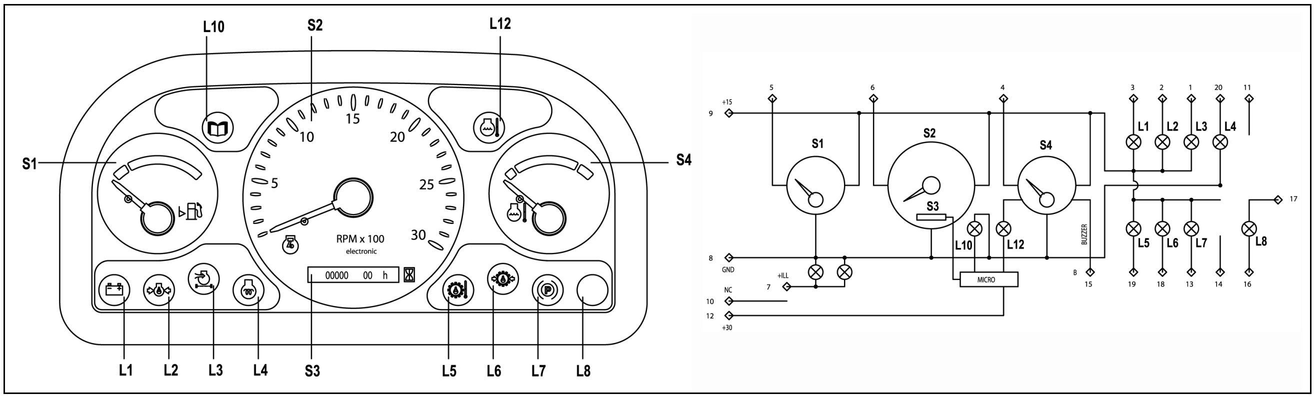
CRIL05A002H01

1 RH control lever

2 LH control lever

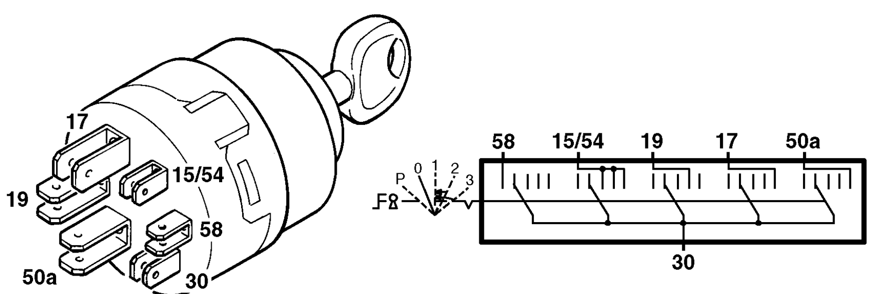
3 To horn control HA1, schematic 2

SIDE INSTRUMENT PANEL



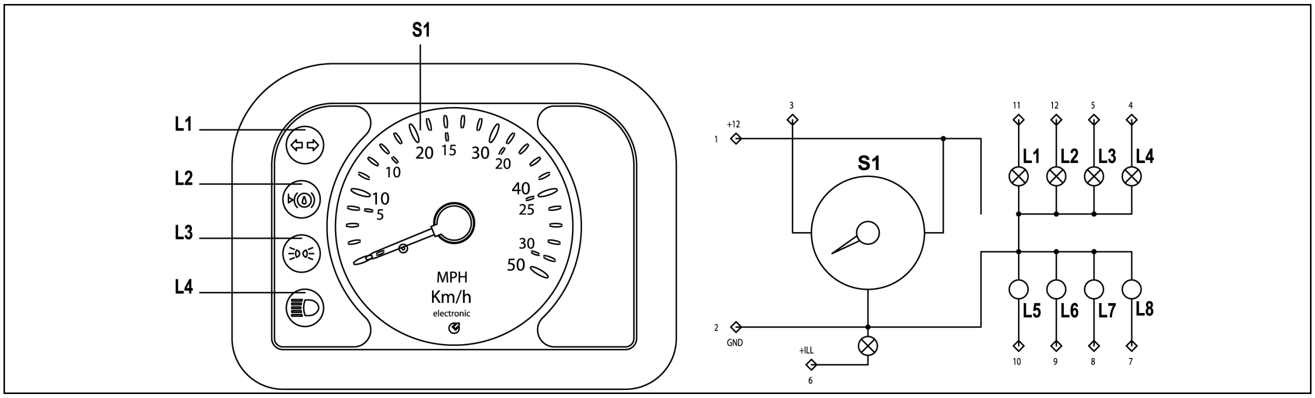
Pos.	Pin	Function	Signal	Pos.	Pin	Function	Signal
L3	1	Air cleaner lamp	-		11	NC	
L2	2	Engine oil pressure lamp	-	+30	12	Permanent supply voltage (+batt)	
L1	3	Generator lamp	-	L7	13	Handbrake lamp	
S4	4	Water temperature gauge	ohm		14	NC	
S1	5	Fuel level gauge	ohm	B	15	External buzzer driving	
S2	6	Tachometer	Hz	L8	16	Neutral red lamp	+/-
+ILL	7	Instrument lighting	+ Lighting	L8	17	Neutral red lamp	+/-
GND	8	Negative		L6	18	Transm. oil pressure lamp	-
+15	9	Positive		L5	19	Transm. oil temperature lamp	-
	10	NC		L4	20	Engine preheating lamp	+
L10		Maintenance lamp	Int.	L12		High water temperature lamp	INT.

KEY SWITCH



30 - 58	No connection
30 - 15/54	OFF
30 - 19	Accessories
30 - 17	Preheat & engine run
30 - 50a	Engine start

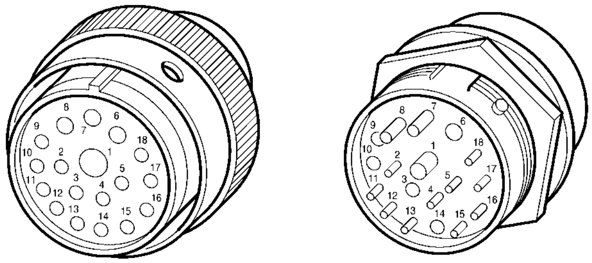
FRONT INSTRUMENT PANEL



Pos.	Pin	Function	Signal
+12	1	Positive (+12 V)	
GND	2	Negative	
S1	3	Speedometer	Hz
L4	4	Dipped beam indicator lamp	+
L3	5	Position lights indicator lamp	+
+ILL	6	Instrument lighting	+ Lighting
L8	7	NC	
L7	8	NC	
L6	9	NC	
L5	10	NC	
L1	11	Direction indicator lamp	+
L2	12	Brake fluid level lamp	+

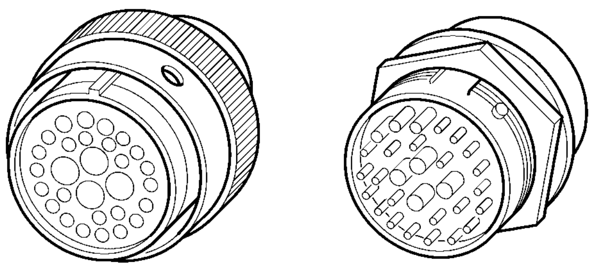
CONNECTOR

X1



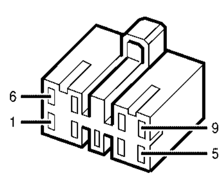
1	R 10	7	L 1.5	13	R-N 1
2	V-N 1	8	-	14	Z 1
3	G-R 1	9	S-N 1	15	B-G 1
4	M-B 1	10	B 1	16	M 1.5
5	Z-B 1	11	B/N 1	17	M-N 1
6	N 2.5	12	S 1	18	M-V 1

X10



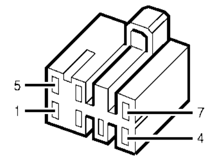
1	H 2.5	11	A-R 1	21	-
2	-	12	A-R 1	22	-
3	-	13	-	23	L-G 1
4	-	14	R-V 1	24	A-R 1
5	N 1.5	15	R-V 1	25	-
6	N 1.5	16	A-N 1	26	-
7	H-N 1	17	C-B 1	27	V 1
8	B-R 1	18	B-N 1	28	-
9	B-R 1	19	-	29	A-G 1
10	H-R 1	20	C-N 1		

X14



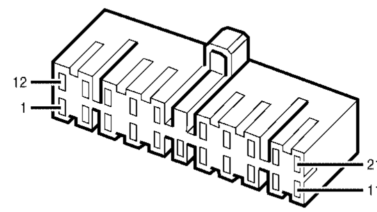
1	N 1.5	4	G/N 1	7	B/N 1
2	R-N 1.5		G/N 1	8	L/G 1
	R-N 1	5	M 1.5	9	A-N 1
3	R 1.5	6	B 1.5		

X15



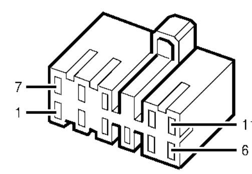
1	S-G 1	4	V-N 1	7	S-N 1
2	-	5	V 1		
3	G-V 1	6	L-G 1		

X16



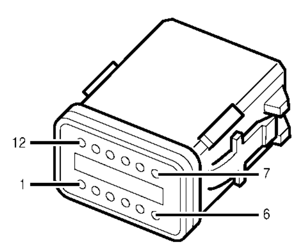
1	A/R 1	9	Z 1	16	C-B 1
2	L/B 1	10	-	17	M/N 1
3	A-V 1	11	-	18	Z-B 1
4	C/N 1	12	A/B 1	19	G/R 1
5	Z-N 1	13	A/N 1	20	B-G 1
6	S 1		A/N 1	21	G-R 1
7	B 1	14	C/B 1		
8	V-B 1	15	B-N 1		

X17



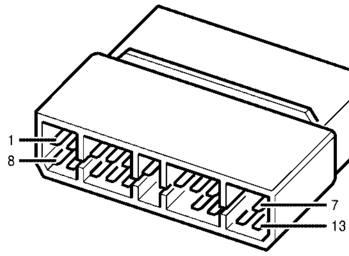
1	L-N 1	5	B-N 1.5	9	-
2	R 1.5	6	B-N 1.5	10	-
3	N 1.5	7	L 1.5	11	-
4	N 1.5	8	L-N 1.5		

X18



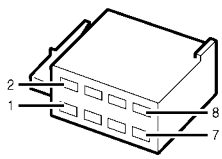
1	N 1	5	L 1	9	N 1
2	G-N 1	6	R-N 1	10	G 1
3	G-N 1	7	R-N 1	11	-
4	N 1	8	A 1	12	-

X22



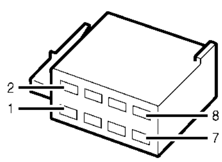
1	B-G 1	8	N 1.5	15	V-B 1
2	B 1	9	R-N 1.5	16	-
3	S 1	10	B/N 1	17	-
4	G/R 1	11	-	18	Z-B 1
5	Z 1	12	R 1	19	G-R 1
6	S-N 1	13	G/R 1	20	M/N 1
7	G/N 1	14	-		

X53



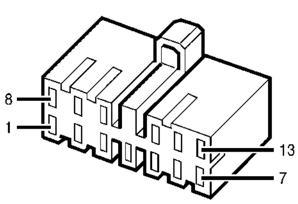
1	R-P 0.5	3	R-N 1	6	N 1
	R-N 1	4	N 1	7	R-N 1
2	N-P 0.5	5	R-P 0.5	8	N-P 0.5
	N1		R-N 1		N1

X54



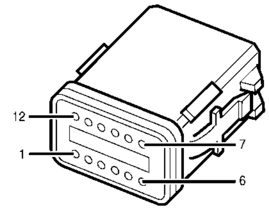
1	-	4	R-N 1	8	N 1
2	-	5	-		N 1
3	-	6	-		
4	R-N 1	7	R-N 1		

X58



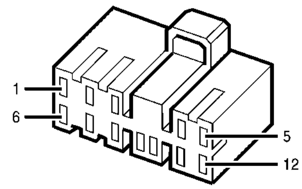
1	A-G 1	6	-	10	L/B 1
2	S-N 1	7	N 1	11	L-N 1
3	L/R 1		N 1	12	A1
4	L 1	8	A/V 1	13	A-V 1
5	L-G 1	9	H-L 1		

X61



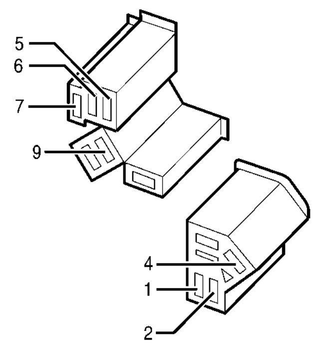
1	-	5	V-N 1.5	9	L-G 1
2	L-B 1	6	A/B 1	10	A-V 1
3	-	7	A/N 1	11	L-N 1
4	G/R 1	8	A/R 1	12	-

X70



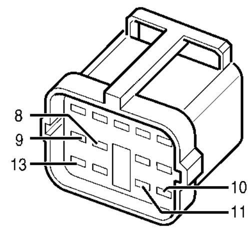
1	R/N 1	5	G-N1	9	-
2	N 1	6	G 1	10	-
3	A-B 1	7	-	11	R-V 1
4	V 1	8	-	12	G-R 1

X71



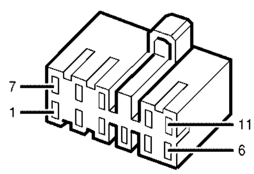
1	R 1.5	4	M-N 1.5	8	-
	R 1.5	5	A 2.5	9	M-N 1.5
2	R 6	6	A 2.5		M/N 1
3	-		A 2.5	10	-
4	M-N 1.5	7	B-N 1.5		

X76



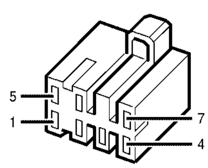
1	-	6	-	11	V-B 1
2	-	7	-	12	-
3	-	8	G-R 1	13	L-B 1
4	-	9	A-G 1		
5	-	10	Z 1		

XC1



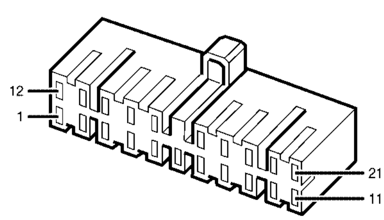
1	C 1	4	R/N 1	8	-
2	B/R 1	5	L-G 1	9	M-B 1
3	M-N 1	6	-	10	R-V 1
4	R/N 1	7	R-N 1	11	-

XC2



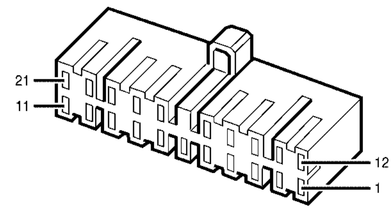
1	A-V 1.5	4	-	7	Z 1
2	-	5	Z 1		
3	A-B 1	6	-		

XC3



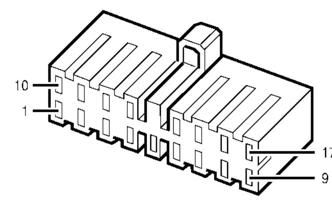
1	H-N 1	9	A-R 1	16	R-V 1
2	L 1		A-R 1		R-V 1
3	G-V 1	10	A-B 1	17	A/N 1
4	S-G 1	11	C-N 1	18	C/B 1
5	H 2.5	12	A 1	19	A-G 1
6	B-R 1	13	G-N 1	20	G 1
	B-R 1		G-N 1	21	R-N 1
7	C/N 1	14	A-V 1		R-N 1
8	H-R 1	15	Z-N 1		

XC4



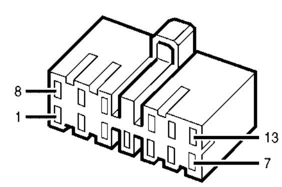
1	A-G 1.5	9	L/R 1	16	H 1
2	R 1.5	10	H-L 1		H 1
3	H-R 1	11	H-N 1	17	L 1
4	R 2.5	12	A/N 1	18	G-N 1
5	H-N 1.5	13	H/R 1	19	A 1
6	G 1		H/R 1	20	V 1
7	M/B 1	14	A/B 1		V 1
8	V-N 1.5	15	A/R 1	21	G 1.5

XC5



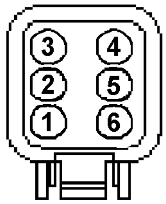
1	A/N 1	8	G-N 1	13	V-N 1
	A/N 1	9	A1	14	V 1
2	-		A1		V 1
3	A/B 1	10	R-N 1.5	15	-
4	R/N 1		B/R 1	16	A-G 1.5
5	-	11	H-N 1	17	R-N 1
6	G 1		H-N 1		R-N 1
	G 1	12	H 1		
7	L 1		H 1		
	L 1	13	V-N 1		

XC6



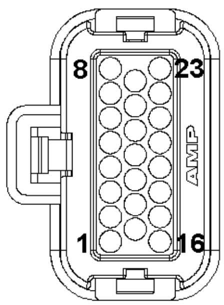
1	M-N 1	6	B/N 1	9	M-N 1.5
2	V-B 1		B/N 1	10	B 1.5
3	L-N 1	7	B 1	11	G/N 1
	L-N 1		B 1	12	R-N 1.5
4	Z 2.5	8	M-B 1		R-N 1
5	G/R 1		M-B 1	13	B-N 1.5

XP14



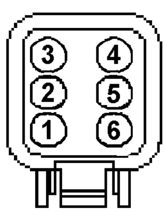
1	B-R 1	3	N 1	5	B-G 1
2		4		6	Z-B 1

XP20



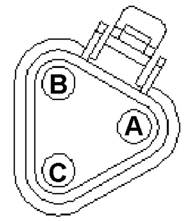
1	H-G 1.5	9	A-R 1	17	A 1
2	N 1.5	10	A-N 1	18	L 1
3	G-R 1	11	Z-B 1	19	-
4	L-B 1	12	B-G 1	20	-
5	L-R 1	13	V-B 1	21	-
6	G-N 1	14	V-N 1	22	-
7	G-V 1	15	M-N 1	23	M-B 1
8	L-G 1	16	B-R 1		

XP24



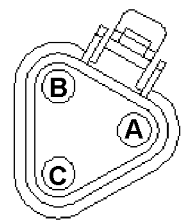
1	B-R 1	3	N 1	5	A 1
2		4		6	L 1

XR



A	B-R 1	C	N 1
B	A-N 1		

XL



A	B-R 1	C	N 1
B	A-R 1		

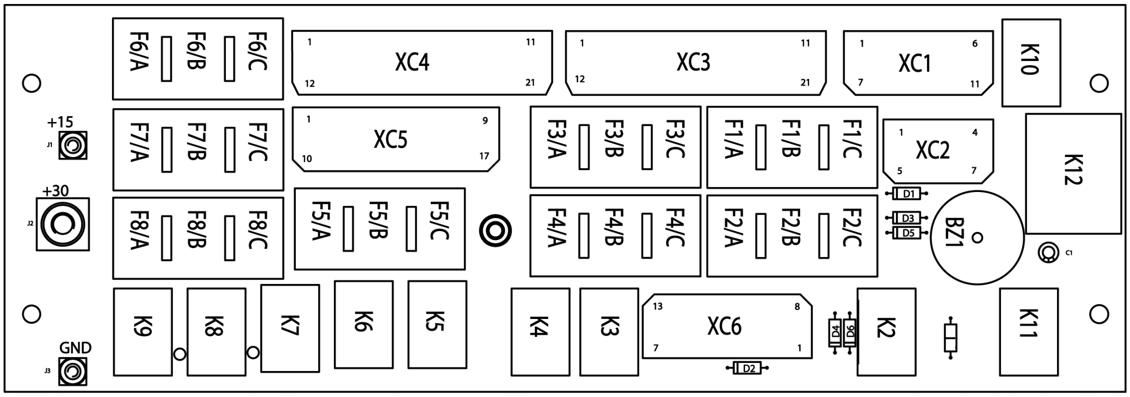
NOTES

SECTION 55 - ELECTRICAL SYSTEM

Chapter 2.2 - Schematic diagrams of Powershift (European and North American model)

CONTENTS

FUSES AND RELAYS



Fuse No.	Rating	Colour	Circuit	Schematic No.
F1/A	15 A	Blue	Rear windshield wiper and washer (S14)	**7**
F1/B	7.5 A	Brown	Fuel shut off, antitheft supply	**1**
F1/C	10 A	Red	Brake light switch (S33)	**5**
F2/A	15 A	Blue	Power supply for the instruments, switch lamps, brake oil level sender, seat, buzzer	**4**
F2/B	15 A	Blue	Blower motor	**8**
F2/C	20 A	Yellow	Preheating	**1**
F3/A	3 A	Violet	Rear right & front left side lights, instruments & air conditioning illumination	**4**
F3/B	3 A	Violet	Front right & rear left side lights, number plate light	**4**
F3/C	10 A	Red	Switches S1, S4, S5, S6 & S11	**7**
F4/A	7.5 A	Brown	EGS power supply, clutch shut off switch, 4WD switch (S2)	**2**
F4/B	10 A	Red	Rear chisel switch, clamshell level valve and sensor	**2**
F4/C	10 A	Red	Rear working light switch (S12) & rear travel lock switch (S7) (European model)	**6**
F5/A	15 A	Blue	Front working lights - internal	**6**
F5/B	10 A	Red	Traffic lights (European model)	**4**
F5/C	15 A	Blue	Main beam (European model)	**4**
F6/A	7.5 A	Brown	Rotary beacon	**7**
F6/B	7.5 A	Brown	Flasher (+15) (NA model)	**4**
F6/C	7.5 A	Brown	Hammer, differential locking	**2**
F7/A	10 A	Red	Hazard lights, horn (+30)	**4**
F7/B	10 A	Red	Auxiliary 12 V socket, radio, cab interior light	**8**
F7/C	6A	Black	Front windshield wiper (special bi-metallic re-setting fuse)	**7**
F8/A	15 A	Blue	Rear working lights - external	**6**
F8/B	15 A	Blue	Front working lights - external	**6**
F8/C	15 A	Blue	Rear working lights - internal	**6**

RELAYS

No.	Circuit	Schematic No.	No.	Circuit	Schematic No.
K2	Speed alarm, hand brake	**2**	**K8**	Front working lights - external	**6**
K3	Starting	**1**	**K9**	Rear working lights - external	**6**
K4	Clamshell level solenoid valve	**2**	**K10**	Differential locking	**2**
K5	Dipped & main beam lights	**4**	**K12**	Hazard lights, flasher unit	**4**
K6	Front working lights - internal	**6**			
K7	Rear working lights - internal	**6**			

BUZZER

BZ1	Audible warning buzzer

CONNECTORS

XC	Main harness connections into fuse board

COMPONENTS

A1 LVC electronic control box
A2 Cold start electronic control box (optional)
BS1 Right speaker (optional)
BS2 Left speaker (optional)
BZ1 Alarm buzzer
D1 Diode
D2 Diode
EV0 Fuel shut off solenoid valve
EV1 Double delivery solenoid valve (optional)
EV2 Hammer solenoid valve (optional)
EV3 Rear chisel solenoid valve (optional)
EV4 Rear travel solenoid valve (optional)
EV5 Excavator rear lock solenoid valve (optional)
EV6 Clamshell level solenoid valve
EV7 Differential locking solenoid valve
EV11 Ride control solenoid valve (optional)
EV12 Tool solenoid valve (optional)
EV20 Backhoe pilot pressure solenoid valve
EV21 Solenoid valve for switchover between boom/dipper control
EV22 Solenoid valve for switchover between boom/dipper control
EV23 LH stabilizer raising solenoid valve
EV24 LH stabilizer lowering solenoid valve
EV25 RH stabilizer raising solenoid valve
EV26 RH stabilizer lowering solenoid valve
EV27 Telescopic dipper retraction solenoid valve
EV28 Telescopic dipper extension solenoid valve
EV29 Hydraulic auxiliary solenoid valve (optional)
EV30 Hydraulic auxiliary solenoid valve (optional)
FG1 General fuse 80 A
FG2 A/C fuse 10 A
FC10 Cold start heater fuse 300 A (optional)
G1 Battery
G2 Generator
H1 Excavator rear lock warning light (optional)
H2 Front left light (European model)
H3 Front right light (European model)
H4 Rear left light (European model)
H5 Number plate lamp (European model)
H6 Rear right light (European model)
H7 Front left flashing indicator (NA model)
H8 Rear left light (NA model)
H9 Front right light (NA model)
H10 Rear right indicator (NA model)
H11 Front left external working light
H12 Front right external working light
H13 Rear left external working light
H14 Rear right external working light
H15 Rotary beacon
H16 Rotary beacon
H17 Auxiliary 12 V socket illumination
H18 Cab interior light
H19 Front left internal working light (optional)
H20 Front right internal working light (optional)
H21 Rear left internal working light (optional)
H22 Rear right internal working light (optional)
HA1 Reverse gear buzzer
HA2 Horn
K01 Starter relay
K02 Air-conditioning relay
K13 Antitheft unit
K14 Clutch detachment relay
K20 Safety relay
K21 Cold start heater relay (optional)
KC Fuse & relay board
KF Indicator flasher unit (NA model)
M1 Starter motor
M4 Rear windshield wiper motor
M5 Front windshield wiper motor
M6 Rear windshield washer motor
M7 Front windshield washer motor
M8 Blower motor
M9 Blower motor (optional)
M10 A/C compressor
R2 Engine water temperature sender
R3 Fuel level sender
R10 Cold start heater
S1 Cold start switch (optional)
S2 4WD switch
S3 Hand hammer switch (optional)
S4 Double delivery switch (optional)
S5 Ride control switch (optional)
S6 Tools switch (optional)
S7 Rear travel lock switch
S8 Excavator rear lock switch (optional)
S9 Light switch
S10 Hazard lights switch
S11 Front working lights switch
S12 Rear working lights switch
S14 Rear windshield wiper & washer switch
S15 Rotary beacon switch
S17 Starting switch
S18 Handbrake switch
S20 Engine oil low pressure switch
S21 Clogged air filter switch
S24 Transmission oil pressure switch
S25 Transmission oil high temperature switch
S26 Clutch shut off switch
S27 Horn switch
S28 Clamshell sender
S29 Horn switch
S30 Rear chisel pedal switch (optional)
S31 Brake oil level sender
S32 Stop light switch
S33 Stop light switch
S34 Left cab interior light switch
S35 Right cab interior light switch
S41 Front windshield wiper & washer - indicators switch (NA model)

S41	Front windshield wiper & washer - lights switch (european model)
S42	Main switch
S43	Radio (optional)
S44	Seat (optional)
S45	Conditioner and blower motor switch
S46	Auxiliary 12 V socket
S47	Differential locking switch
S48	EGS manual - auto switch
S49	A/C pressure switch
S51	EGS switch
S60	Backhoe pilot switch
S61	Boom/dipper control switch
S62	Safety switch
S63	Telescopic dipper extension switch
S64	Horn switch (LH control lever)
S65	LH stabilizer switch
S66	RH stabilizer switch
S67	LH stabilizer pressure switch
S68	RH stabilizer pressure switch
S69	telescopic dipper retraction switch
S70	Hydraulic auxiliary switch (optional)
S71	Hydraulic auxiliary switch (optional)
ST1	Side panel with optional diagnostics
ST2	Front panel

CONNECTORS

X1 General cable - engine cable - 18 way connector
X2 Cold start - 12 way connector
X3 Fuel pump - 3 way connector
X4 Air filter - 2 way connector
X5 Fuel level sender - 2 way connector
X8 Differential locking - 2 way connector
X9 General cable - front dashboard - 9 way connector
X10 Solenoid valves cable - general cable - 29 way connector
X11 1 way connector
X12 General cable - cabin cable - 5 way connector
X13 Heater - 4 way connector
X14 General cable - side dashboard - 9 way connector
X15 General cable - side dashboard - 7 way connector
X16 General cable - side dashboard - 21 way connector
X17 Antitheft - 11 way connector
X18 General cable - rear lamps cable - 12 way connector
X19 Reverse buzzer - 2 way connector
X20 Conditioner switch illumination - 2 way connector
X21 Seat - 4 way connector
X22 Side panel - 20 way connector
X23 Clutch shut off button - 2 way connector
X24 Rear travel lock solenoid valve - 2 way connector
X25 Excavator rear lock solenoid valve - 2 way connector
X26 Clamshell sender - 3 way connector
X27 Horn button - 2 way connector
X28 Clutch shut off & horn switch - 2 way connector
X29 Clamshell level - 2 way connector
X30 Double delivery solenoid valve - 2 way connector
X31 Tools rapid connection solenoid valve - 2 way connector
X32 Rear chisel solenoid valve - 2 way connector
X34a Ride control solenoid valve - 2 way connector
X34b Ride control solenoid valve - 2 way connector
X35 Hand hammer solenoid valve - 2 way connector
X36 Rear chisel switch - 2 way connector
X37 Rear right light - 4 way connector
X38 Rear right working light - 4 way connector
X39 Rear windshield wiper - 4 way connector
X40 Rear right working light (opt) - 4 way connector
X41 Optional blower motor - 2 way connector
X42 Front right indicator - 4 way connector
X43 Rotary beacon - 4 way connector
X44 Front right working light - 4 way connector
X45 Front right working light (opt) - 4 way connector
X46 Rear left working light (opt) - 4 way connector
X47 Rear left working light - 4 way connector
X48 Rear left light - 4 way connector
X49 Front windshield wiper - 6 way connector
X50 Front left working light (opt) - 4 way connector
X51 Front left working light - 4 way connector
X52 Front left indicator - 4 way connector
X53 Radio (brown colour) - 8 way connector
X54 Radio (black colour) - 8 way connector
X55 Auxiliary 12 V socket - 2 way connector
X56 Front windshield washer - 2 way connector
X57 Rear windshield washer - 2 way connector
X58 Flasher unit - 13 way connector (NA model)
X58 Shunts - 13 way connector (European model)
X59 Right light - 5 way connector
X60 Horn / left light - 7 way connector
X61 Wiper and lights switch - 12 way connector
X63 Number plate lights - 2 way connector (European model)
X64 optional conditioner - 1 way connector
X65 Cold start switch - 1 way connector
X67 Generator - 3 way connector
X68 Engine water temperature sender - 3 way connector
X69 A/C pressure switch - 2 way connector
X70 Front panel - 12 way connector
X71 Key switch - 10 way connector
X72 Pilot control line - 1 way connector
X73 Engine oil pressure switch - 1 way connector
X75 Diagnostics - 5 way connector
X76 Diagnostics - 13 way connector
X77 Blower motor third speed - 1 way connector
X78 Left control lever - 2 way connector
X79 Horn jumper connection - 2 way connector
X80 Rotary beacon - 2 way connector
X81 Rotary beacon - 2 way connector
X82 EGS system - 9 way connector
X83 EGS switch - 19 way connector
X84 Gear box extension - 13 way connector
X85 Gear box - 12 way connector
X89 Front left lights - 6 way connector (European model)
X90 Manifold power - 2 way connector
X91 Tower cable - 4 way connector
X92 Plug 4 LH Down - 2 way connector
X93 Plug 3 LH Up - 2 way connector

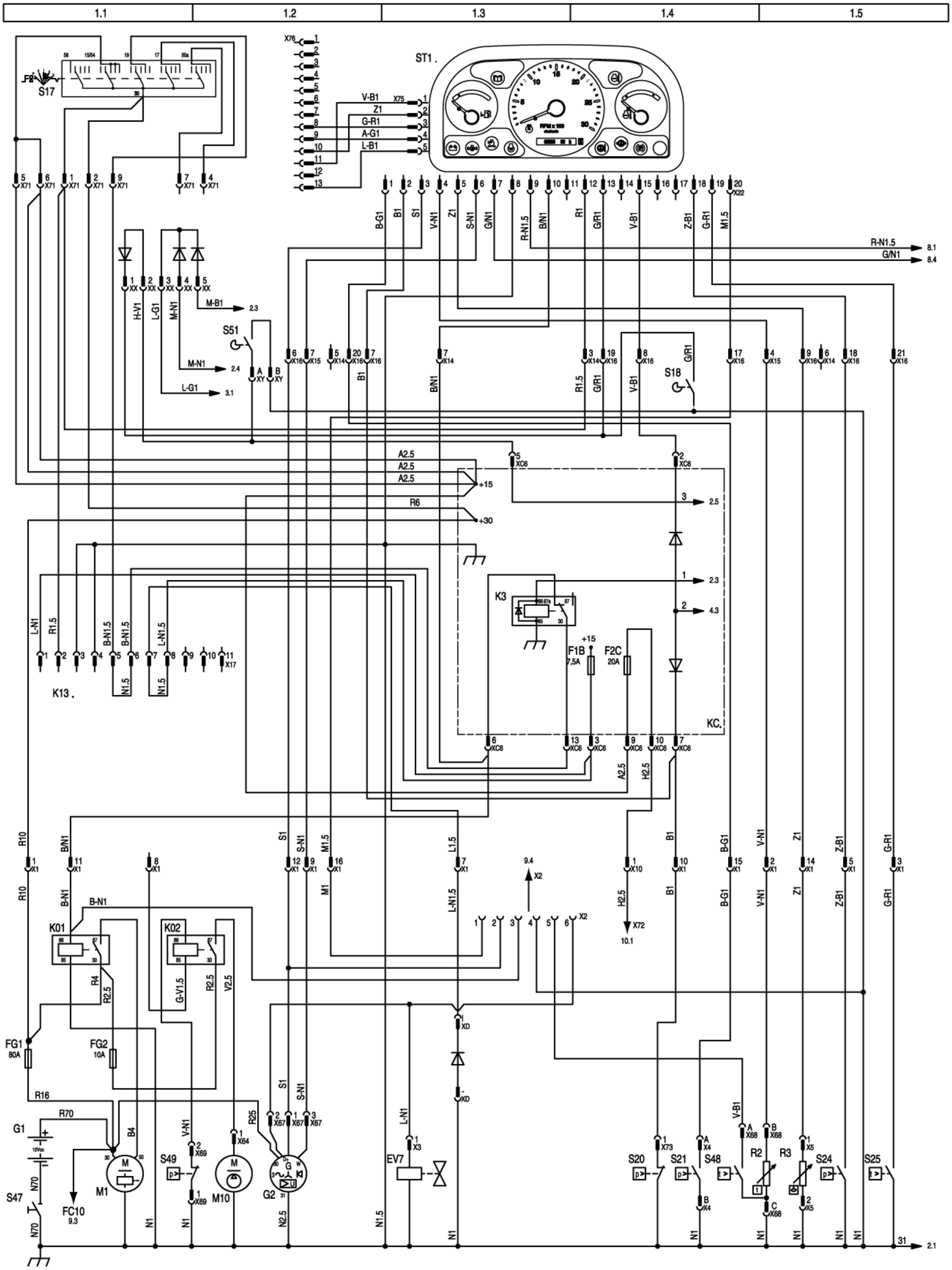
X94 Plug 6 RH Down - 2 way connector
X95 Plug 5 RH Up - 2 way connector
X96 Plug 7 Retract - 2 way connector
X97 Plug 8 Extend - 2 way connector
X98 LH stabilizer lever - 3 way connector
X99 RH stabilizer lever - 3 way connector
X100 Right lever - 6 way connector
X101 Left lights - 6 way connector (European model)
X102 Controller - 10 way connector
X103 Relay - 2 way connector

XA Horn cable - 2 way connector
XC1 On board - 11 way connector
XC2 On board - 7 way connector
XC3 On board - 21 way connector
XC4 On board - 21 way connector
XC5 On board - 17 way connector
XC6 On board - 13 way connector
XD Fuel shut off diode - 2 way connector
XD1 Diode D1 - 2 way connector
XD2 Diode D2 - 2 way connector
XP1 Solenoid valve EV21 - 2 way connector
XP2 Solenoid valve EV22 - 2 way connector
XP4 LH control lever switch - 2 way connector
XP11 LH stab. pressure switch - 2 way connector
X12 RH stab. pressure switch - 2 way connector
XP13 RH armrest switches - 5 way connector
XP14 RH control lever switch - 6 way connector
XP17 Backhoe pilot solenoid valve - 2 way connector
XP20 LVC electronic control box - 23 way connector
XP23 Safety switch - 2 way connector
XP24 LH control lever switches - 6 way connector
XL LH stabilizer control lever - 3 way connector
XR RH stabilizer control lever - 3 way connector
XS1 RH stab. pressure switch - 2 way connector
XS2 LH stab. pressure switch - 2 way connector
XX Diodes - 5 way connector
XY Seat safety switch - 2 way connector
YP3 Solenoid valve EV24 - 2 way connector
YP4 Solenoid valve EV23 - 2 way connector
YP5 Solenoid valve EV26 - 2 way connector
YP6 Solenoid valve EV25 - 2 way connector
YP7 Solenoid valve EV28 - 2 way connector
YP8 Solenoid valve EV27 - 2 way connector
YP9 Solenoid valve EV30 - 2 way connector
YP10 Solenoid valve EV29 - 2 way connector

WIRE COLOURS:

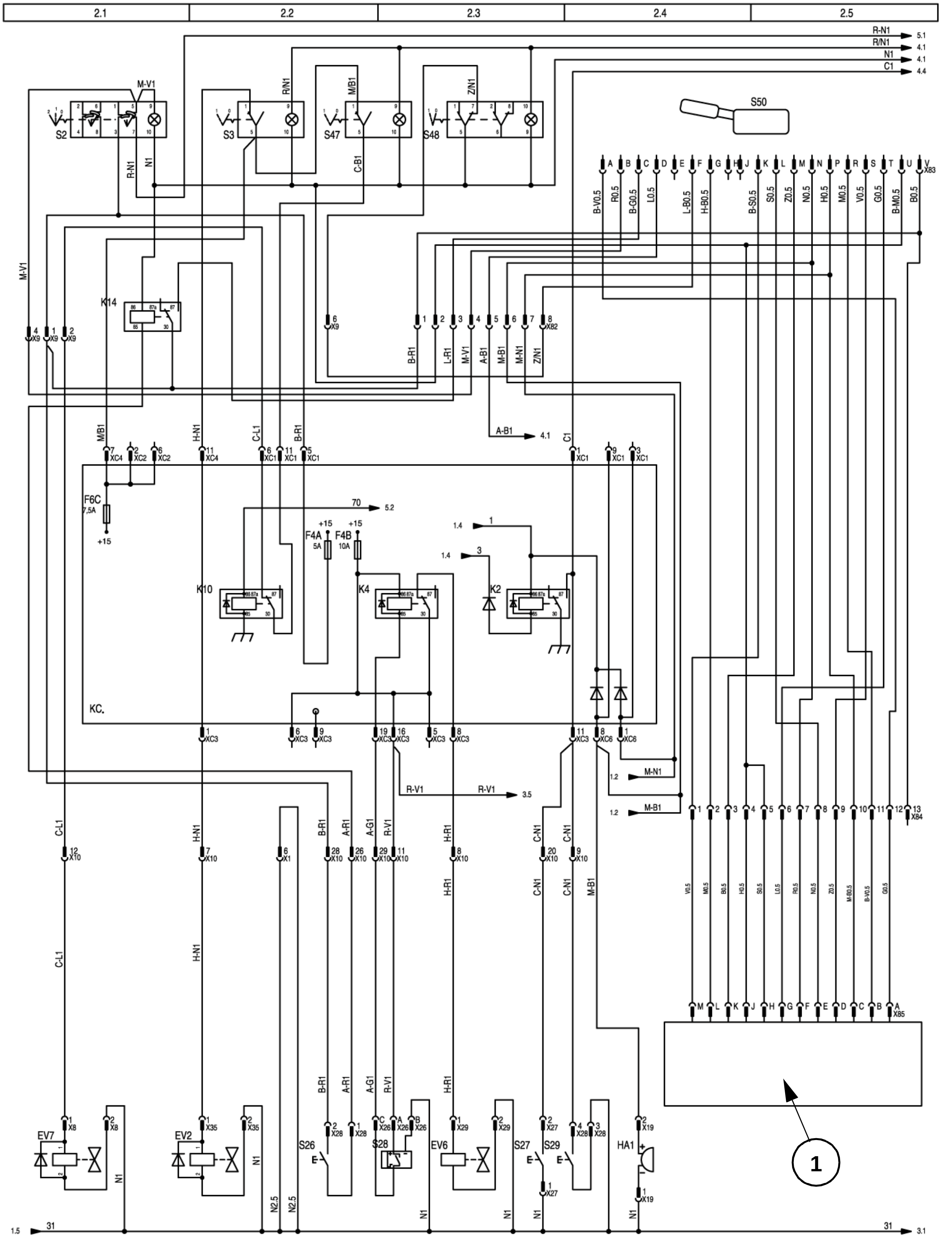
A = LIGHT BLUE .... M = BROWN
B = WHITE........................ N = BLACK
C = ORANGE.................... R = RED
G = YELLOW .... S = PINK
H = GREY .... V = GREEN
L = BLUE .... Z = VIOLET
Example of mixed colours
G/V = Yellow/Green (transverse colours)
G-V = Yellow-Green (longitudinal colours)

SYSTEM FROM KEY START (SCHEMATIC No. 1)



CRIL03L011H00

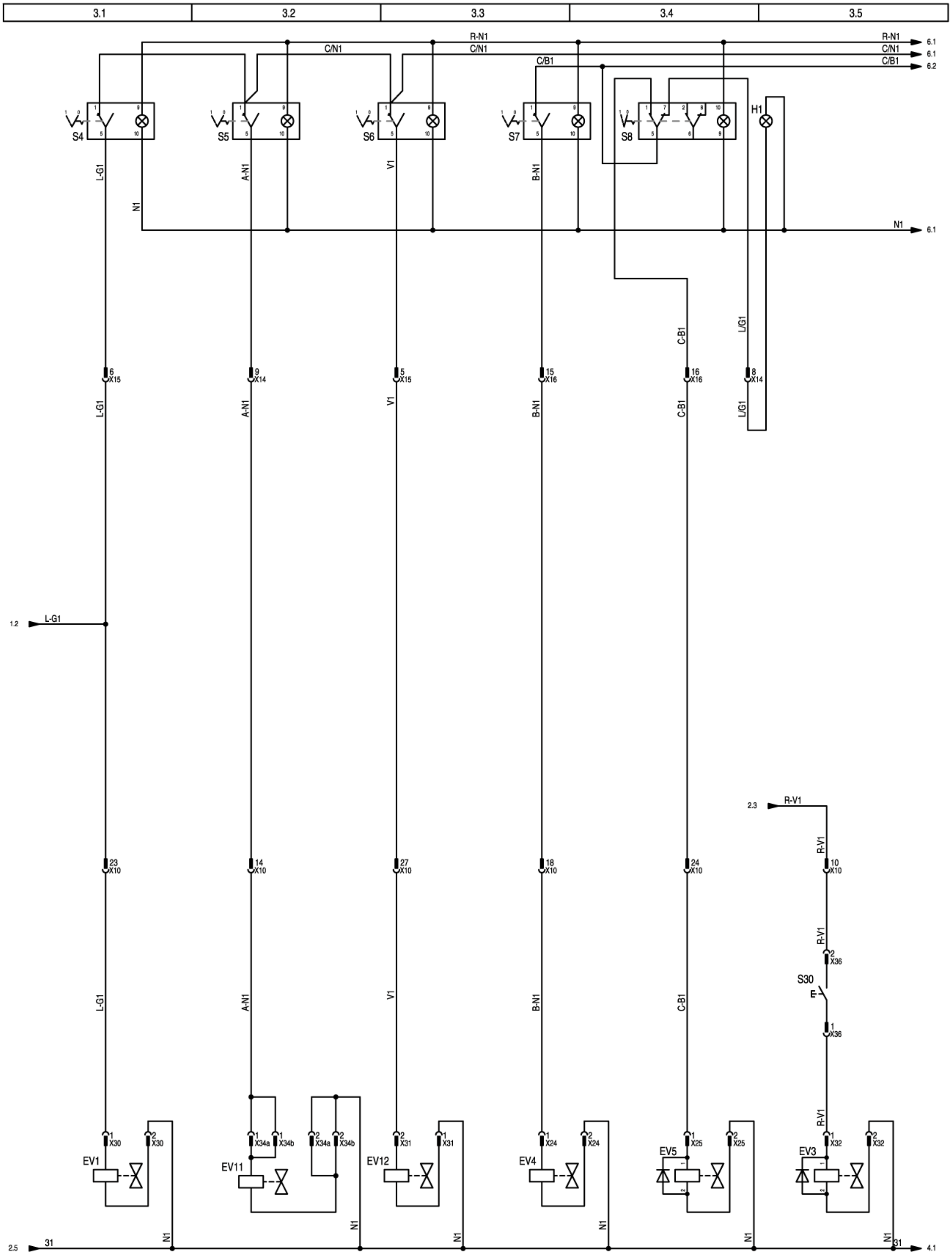
SOLENOID VALVES AND GEAR BOX (SCHEMATIC No. 2)



CRIL03L00600

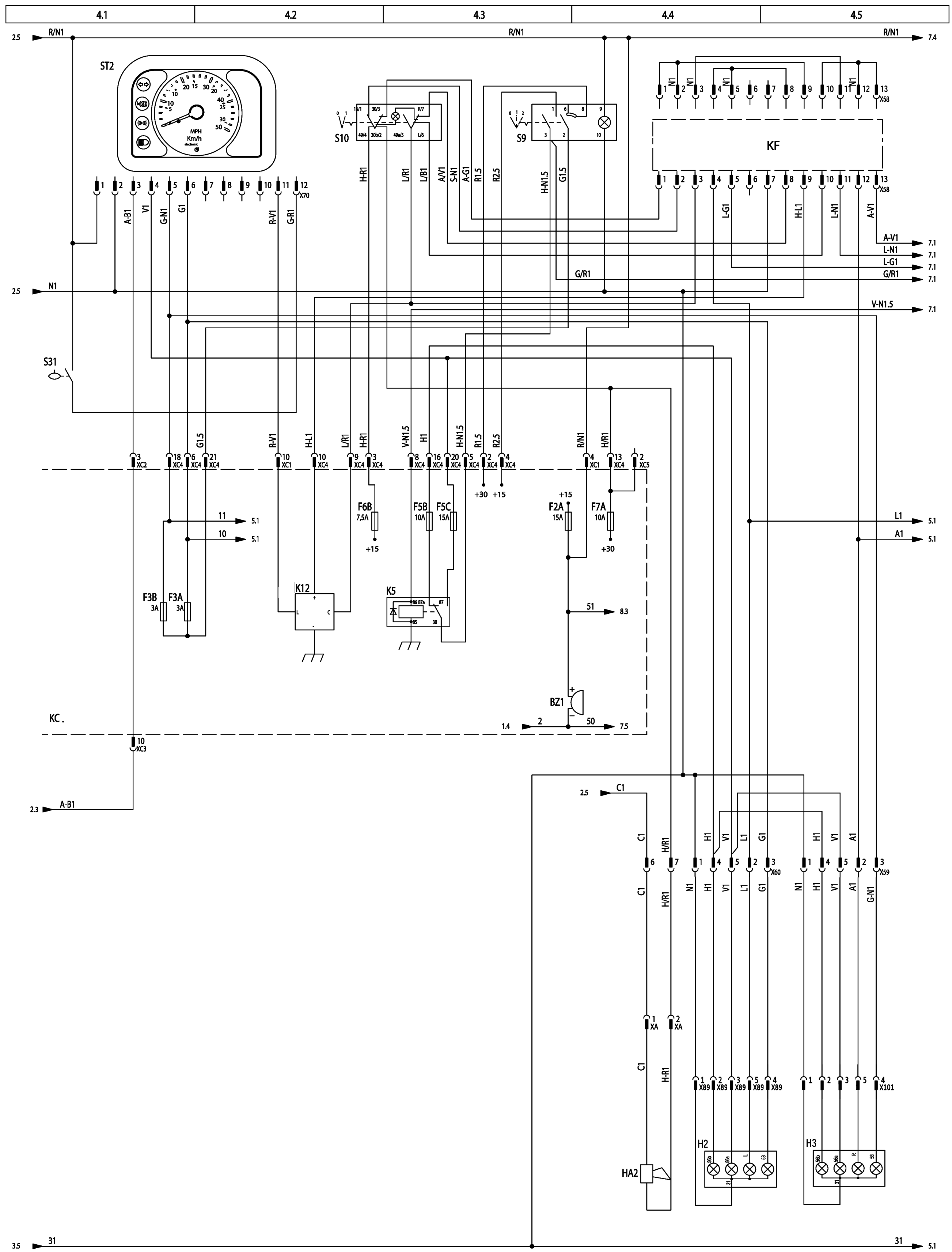
1 Gear box

SOLENOID VALVES (SCHEMATIC No. 3)

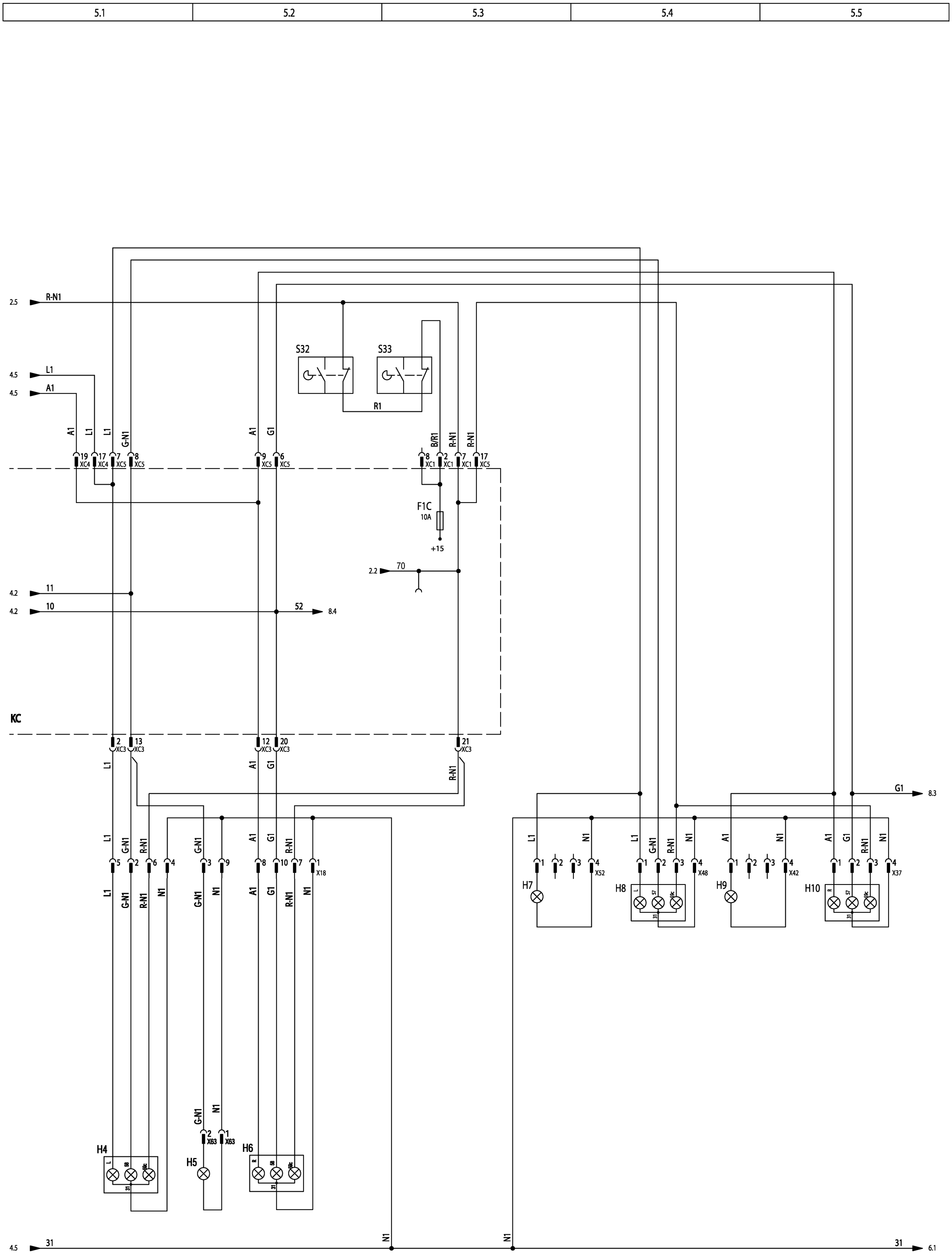


CRIL03L010H00

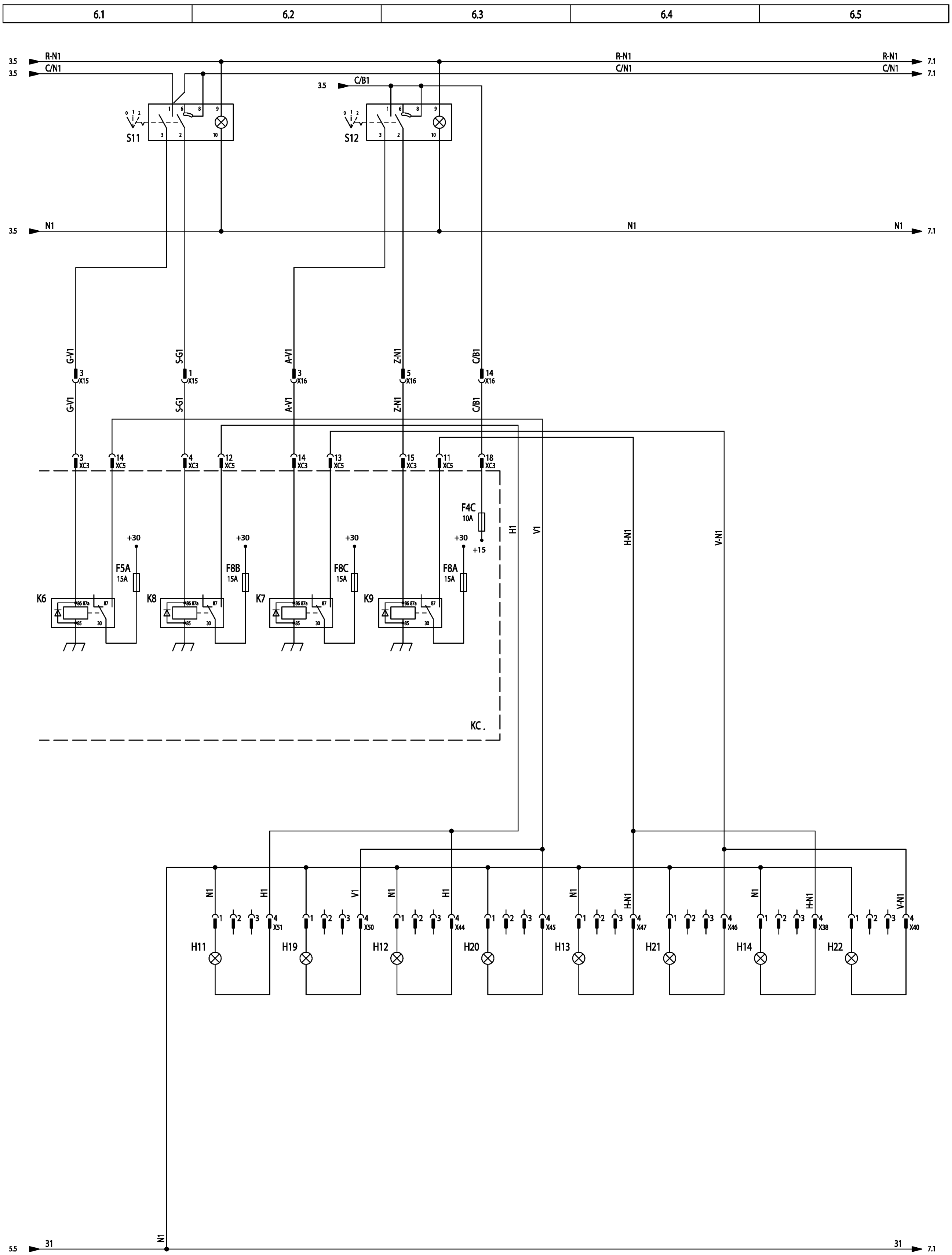
LIGHTS (SCHEMATIC No. 4)



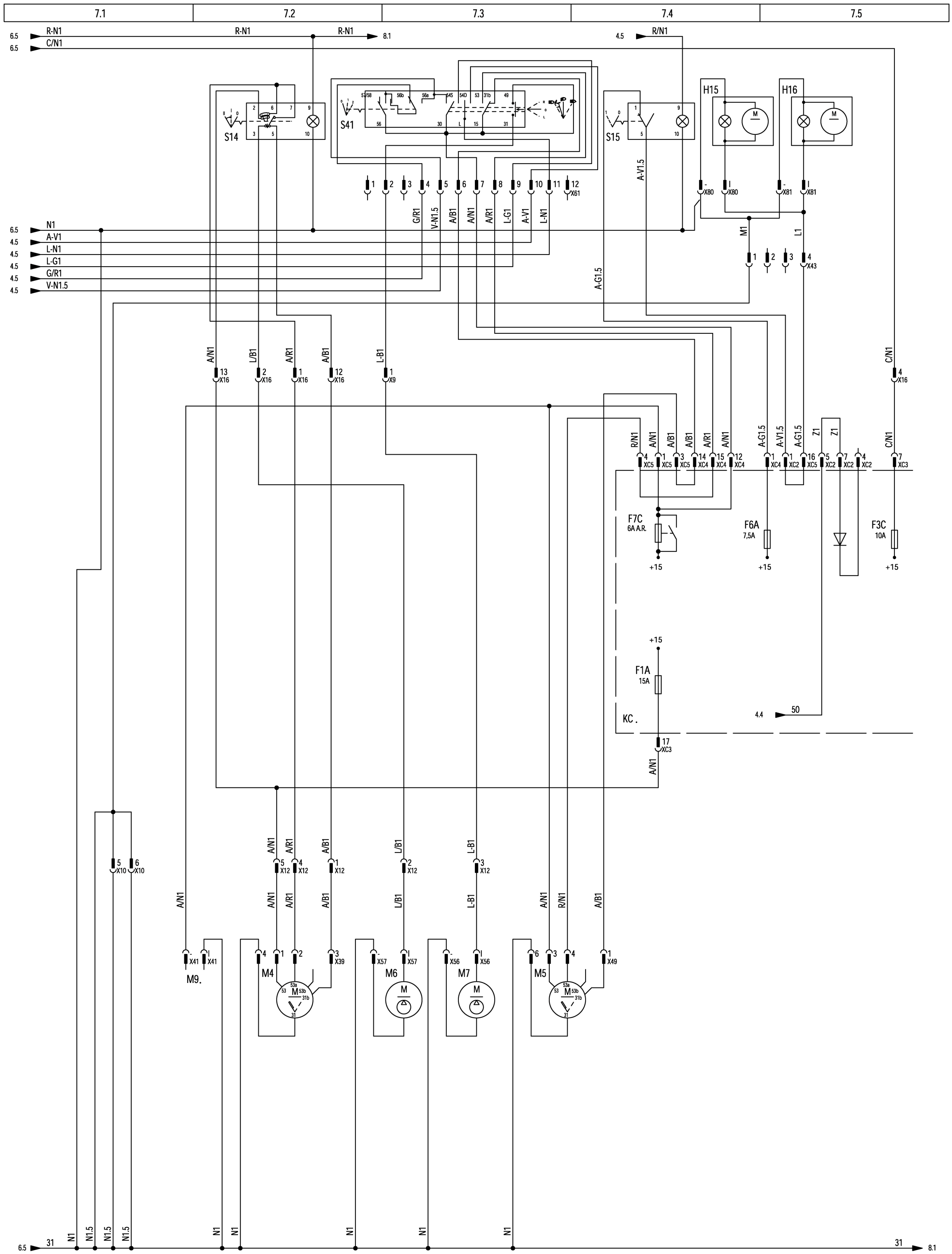
LIGHTS - REAR LIGHTS (SCHEMATIC No. 5)



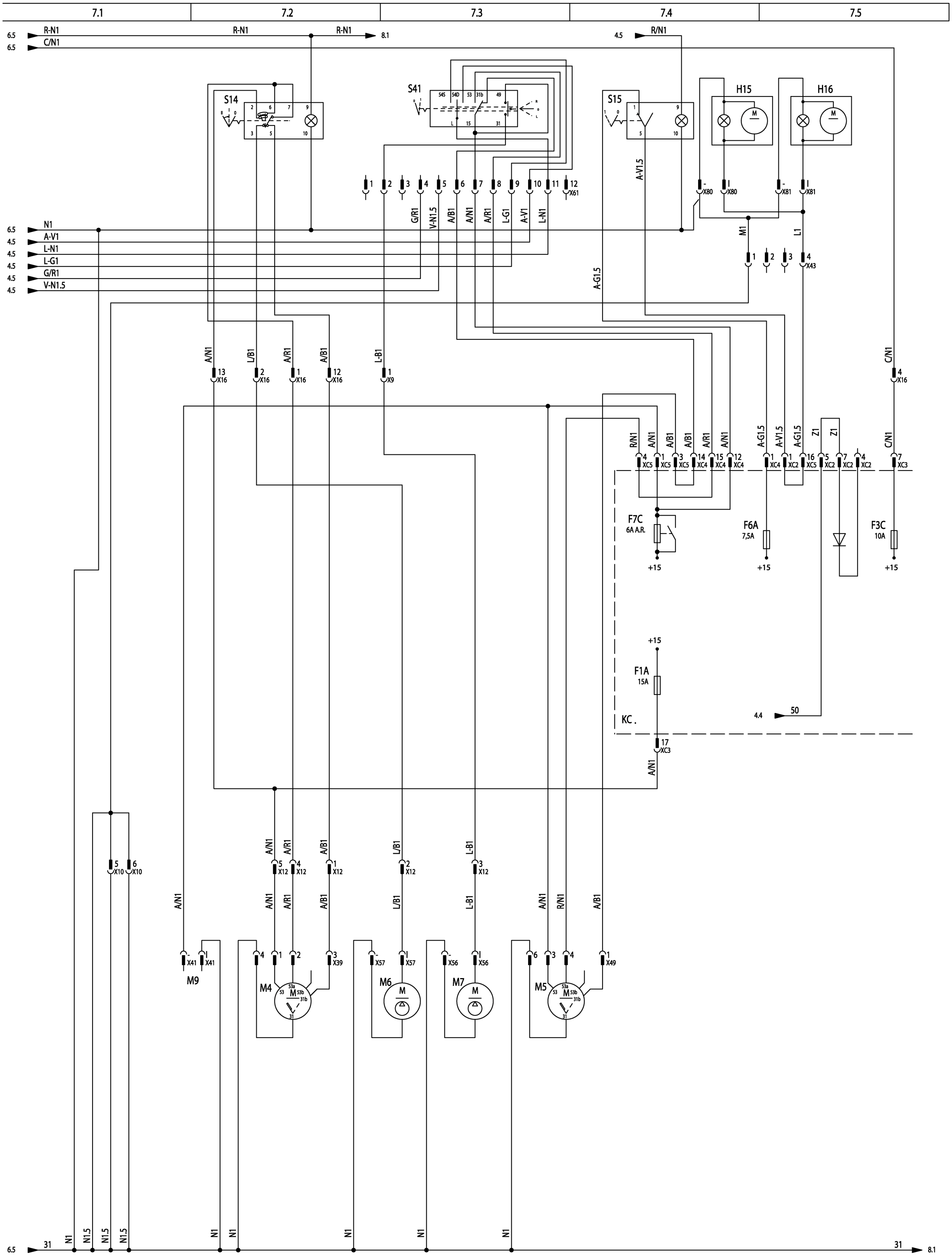
WORKING LIGHTS (SCHEMATIC No. 6)



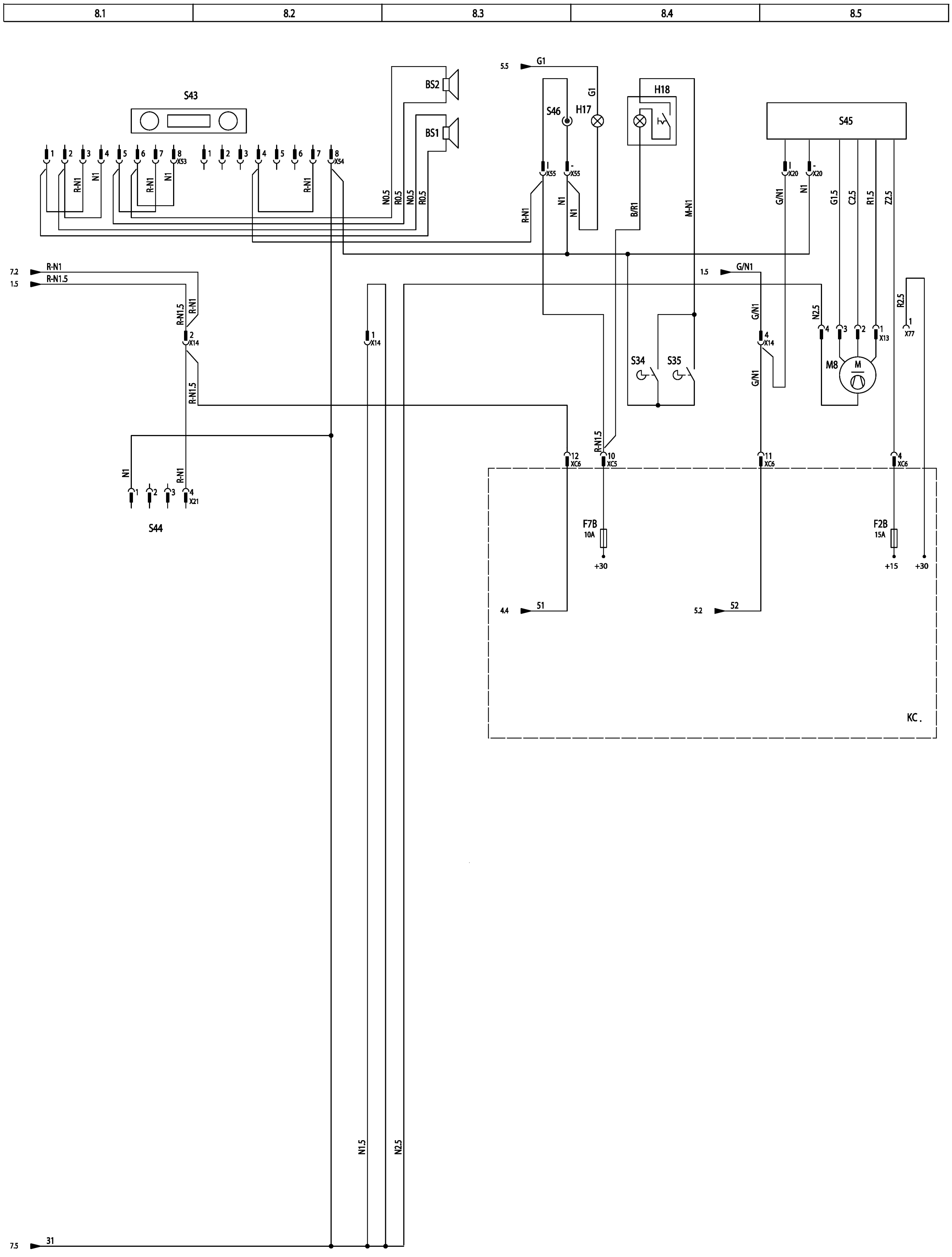
WINDSHIELD WIPER & WASHER (SCHEMATIC No. 7) EUROPEAN MODEL



WINDSHIELD WIPER & WASHER (SCHEMATIC No. 7) NA MODEL

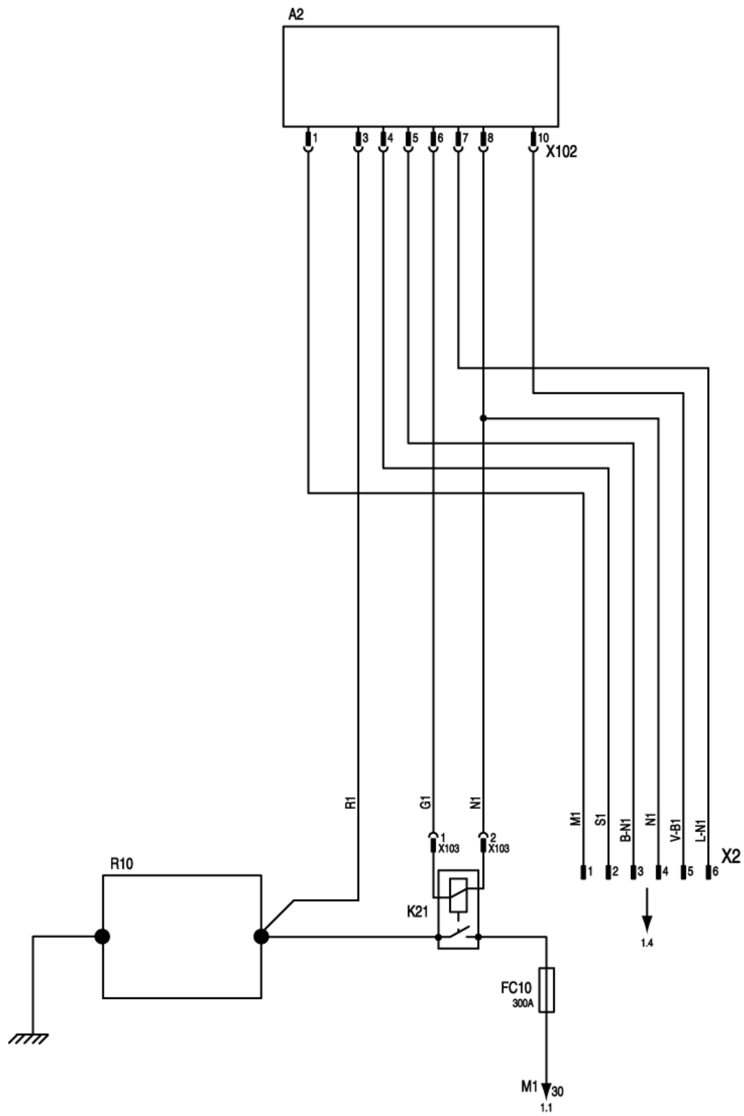


HEATER (SCHEMATIC No. 8)



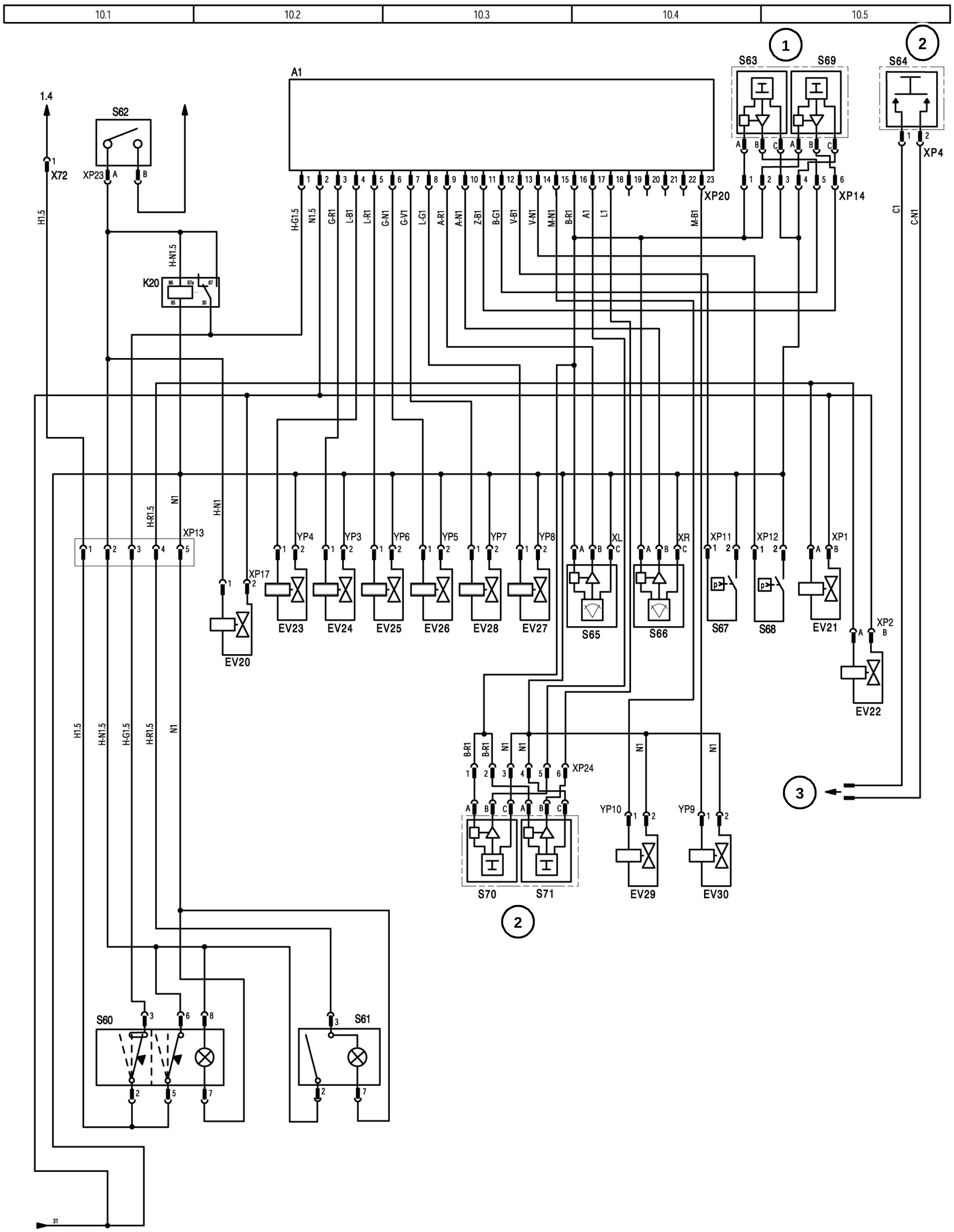
COLD START (SCHEMATIC No. 9)

9.1	9.2	9.3	9.4	9.5



CRIL03L012H00

LVC PILOT CONTROL (SCHEMATIC No. 10)



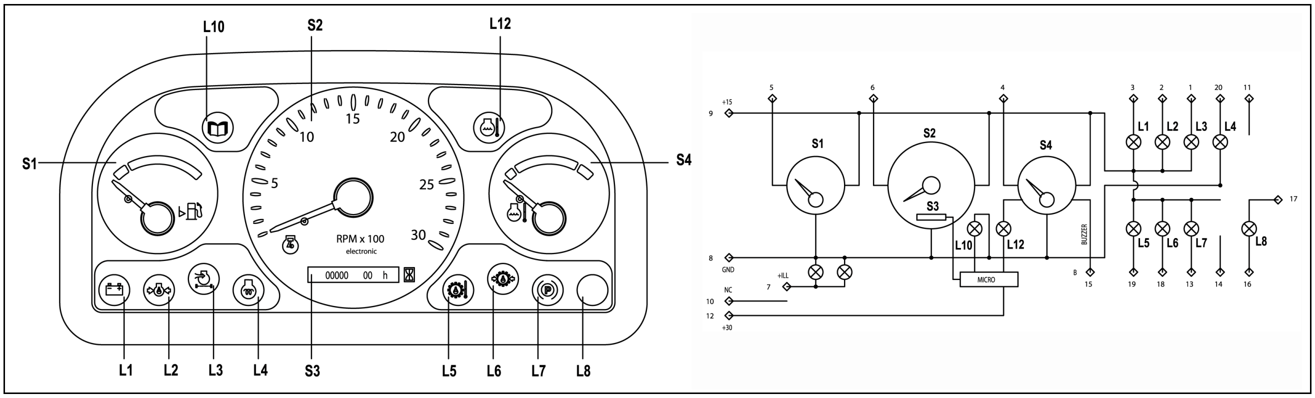
CRIL05A002H01

1 RH control lever

2 LH control lever

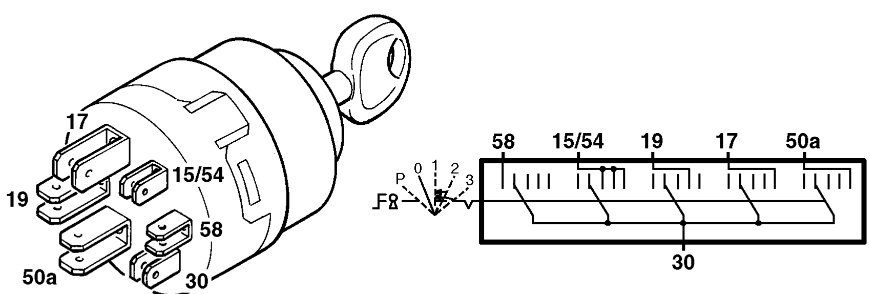
3 To horn control HA1, schematic 2

SIDE INSTRUMENT PANEL



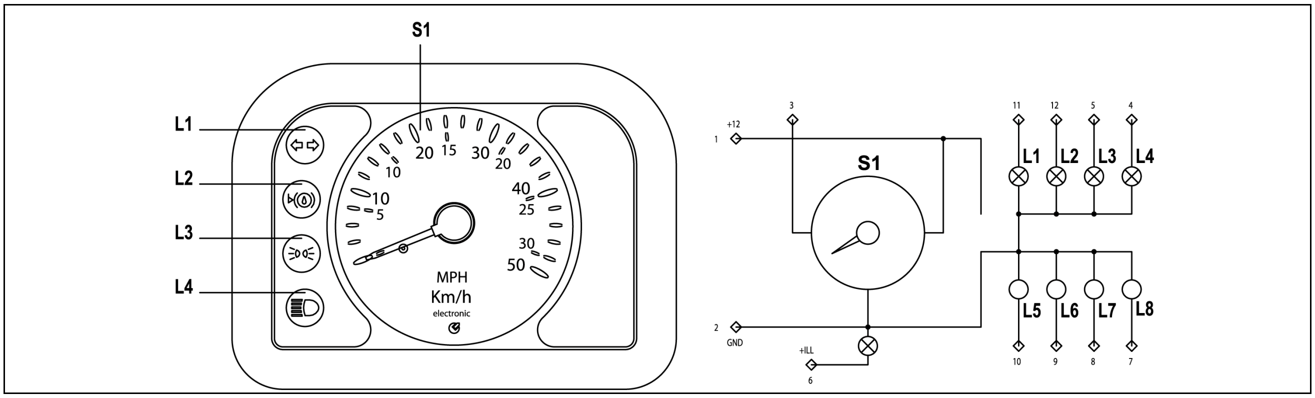
Pos.	Pin	Function	Signal	Pos.	Pin	Function	Signal
L3	1	Air cleaner indicator lamp	-		11	NC	
L2	2	Engine oil pressure lamp	-	+30	12	Permanent supply voltage (+batt)	
L1	3	Alternator indicator lamp	-	L7	13	Handbrake lamp	
S4	4	Water temperature gauge	ohm		14	NC	
S1	5	Fuel level gauge	ohm	B	15	Piloting external buzzer	
S2	6	Tachometer	Hz	L8	16	Neutral red indicator lamp	+/-
+ILL	7	Instrument lighting	+ Lighting	L8	17	Neutral red indicator lamp	+/-
GND	8	Negative		L6	18	Transm. oil pressure lamp	-
+15	9	Positive (+key)		L5	19	Transm. oil temperature lamp	-
	10	NC		L4	20	Engine preheating lamp	+
L10		Maintenance indicator lamp	Int.	L12		High water temperature lamp	INT.

KEY SWITCH



30 - 58	No connection
30 - 15/54	OFF
30 - 19	Accessories
30 - 17	Preheat & engine running
30 - 50a	Engine start

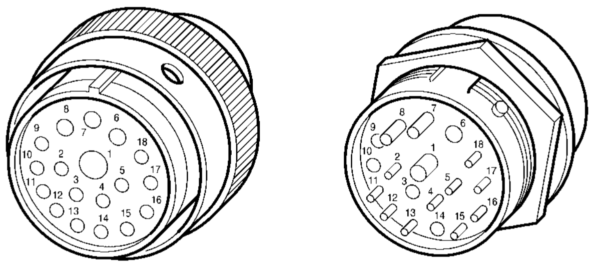
FRONT INSTRUMENT PANEL



Pos.	Pin	Function	Signal
+12	**1**	Positive (+12 V)	
GND	**2**	Negative	
S1	**3**	Speedometer	**Hz**
L4	**4**	Dipped beam indicator lamp	**+**
L3	**5**	Position lights indicator lamp	**+**
+ILL	**6**	Instrument lighting	**+ Lighting**
L8	**7**	NC	
L7	**8**	NC	
L6	**9**	NC	
L5	**10**	NC	
L1	**11**	Direction indicator lamp	**+**
L2	**12**	Brake fluid level lamp	**+**

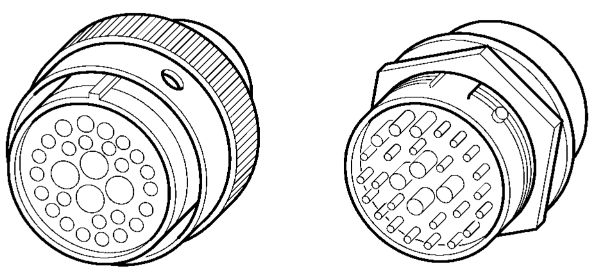
CONNECTOR

X1



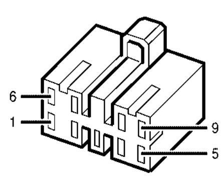
1	R 10	7	L 1.5	13	R-N 1
2	V-N 1	8	-	14	Z 1
3	G-R 1	9	S-N 1	15	B-G 1
4	M-B 1	10	B 1	16	M 1.5
5	Z-B 1	11	B/N 1	17	M-N 1
6	N 2.5	12	S 1	18	M-V 1

X10



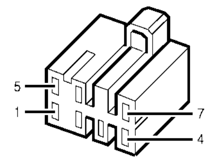
1	H 2.5	11	A-R 1	21	-
2	-	12	A-R 1	22	-
3	-	13	-	23	L-G 1
4	-	14	R-V 1	24	A-R 1
5	N 1.5	15	R-V 1	25	-
6	N 1.5	16	A-N 1	26	-
7	H-N 1	17	C-B 1	27	V 1
8	B-R 1	18	B-N 1	28	-
9	B-R 1	19	-	29	A-G 1
10	H-R 1	20	C-N 1		

X14



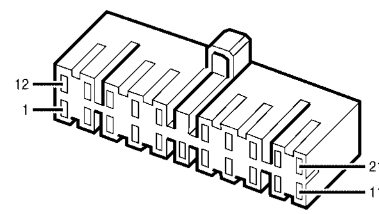
1	N 1.5	4	G/N 1	7	B/N 1
2	R-N 1.5		G/N 1	8	L/G 1
	R-N 1	5	M 1.5	9	A-N 1
3	R 1.5	6	B 1.5		

X15



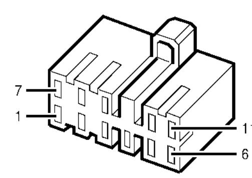
1	S-G 1	4	V-N 1	7	S-N 1
2	-	5	V 1		
3	G-V 1	6	L-G 1		

X16



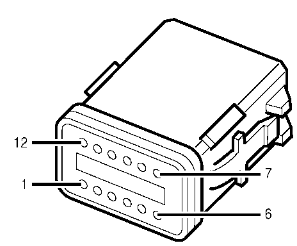
1	A/R 1	9	Z 1	16	C-B 1
2	L/B 1	10	-	17	M/N 1
3	A-V 1	11	-	18	Z-B 1
4	C/N 1	12	A/B 1	19	G/R 1
5	Z-N 1	13	A/N 1	20	B-G 1
6	S 1		A/N 1	21	G-R 1
7	B 1	14	C/B 1		
8	V-B 1	15	B-N 1		

X17



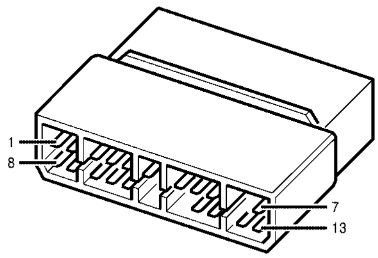
1	L-N 1	5	B-N 1.5	9	-
2	R 1.5	6	B-N 1.5	10	-
3	N 1.5	7	L 1.5	11	-
4	N 1.5	8	L-N 1.5		

X18



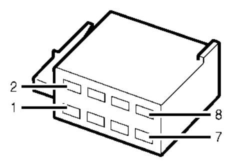
1	N 1	5	L 1	9	N 1
2	G-N 1	6	R-N 1	10	G 1
3	G-N 1	7	R-N 1	11	-
4	N 1	8	A 1	12	-

X22



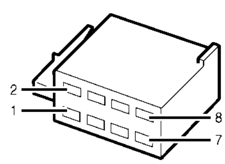
1	B-G 1	8	N 1.5	15	V-B 1
2	B 1	9	R-N 1.5	16	-
3	S 1	10	B/N 1	17	-
4	G/R 1	11	-	18	Z-B 1
5	Z 1	12	R 1	19	G-R 1
6	S-N 1	13	G/R 1	20	M/N 1
7	G/N 1	14	-		

X53



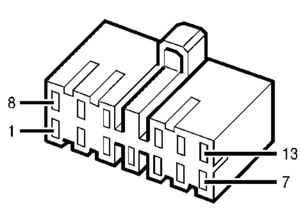
1	R-P 0.5	3	R-N 1	6	N 1
	R-N 1	4	N 1	7	R-N 1
2	N-P 0.5	5	R-P 0.5	8	N-P 0.5
	N1		R-N 1		N1

X54



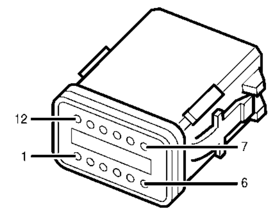
1	-	4	R-N 1	8	N 1
2	-	5	-		N 1
3	-	6	-		
4	R-N 1	7	R-N 1		

X58



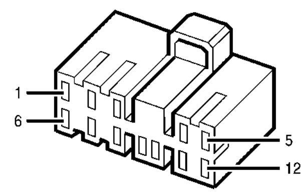
1	A-G 1	6	-	10	L/B 1
2	S-N 1	7	N 1	11	L-N 1
3	L/R 1		N 1	12	A1
4	L 1	8	A/V 1	13	A-V 1
5	L-G 1	9	H-L 1		

X61



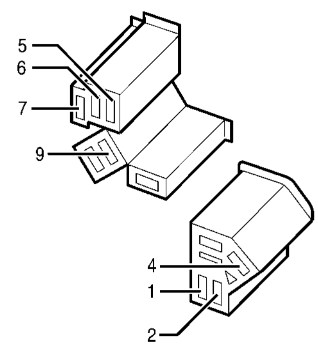
1	-	5	V-N 1.5	9	L-G 1
2	L-B 1	6	A/B 1	10	A-V 1
3	-	7	A/N 1	11	L-N 1
4	G/R 1	8	A/R 1	12	-

X70



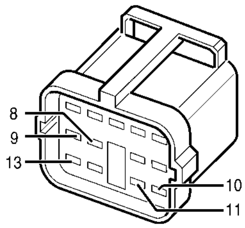
1	R/N 1	5	G-N1	9	-
2	N 1	6	G 1	10	-
3	A-B 1	7	-	11	R-V 1
4	V 1	8	-	12	G-R 1

X71



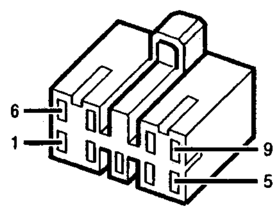
1	R 1.5	4	M-N 1.5	8	-
	R 1.5	5	A 2.5	9	M-N 1.5
2	R 6	6	A 2.5		M/N 1
3	-		A 2.5	10	-
4	M-N 1.5	7	B-N 1.5		

X76



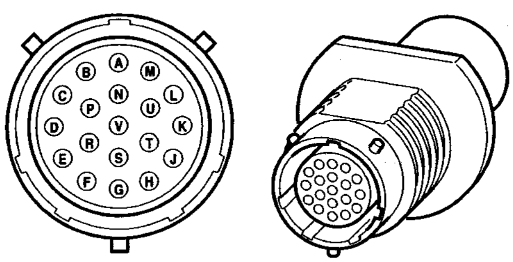
1	-	6	-	11	V-B 1
2	-	7	-	12	-
3	-	8	G-R 1	13	L-B 1
4	-	9	A-G 1		
5	-	10	Z 1		

X82



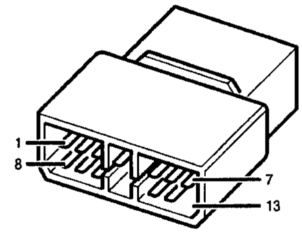
1	B-R 1	4	M-V 1	7	M-N 1
2	N 1	5	A-B 1	8	Z/N 1
3	A-R 1	6	M-B 1	9	-

X83



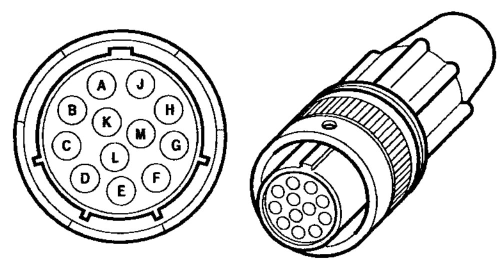
A	B-V 0.5	H	-	R	M 0.5
B	R 0.5	J	-	S	V 0.5
C	B-G 0.5	K	B-S 0.5	T	G 0.5
D	L 0.5	L	S 0.5	U	B-M 0.5
E	-	M	Z 0.5	V	B 0.5
F	L-B 0.5	N	N 0.5		
G	H-B 0.5	P	H 0.5		

X84



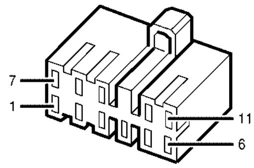
1	V 0.5	6	L 0.5	11	B-V 0.5
2	M 0.5	7	R 0.5	12	G 0.5
3	B 0.5	8	N 0.5	13	-
4	H 0.5	9	Z 0.5		
5	S 0.5	10	M-B 0.5		

X85



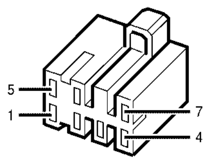
A	G 0.5	E	N 0.5	J	H 0.5
B	B-V 0.5	F	R 0.5	K	B 0.5
C	M-B 0.5	G	L 0.5	L	M 0.5
D	Z 0.5	H	S 0.5	M	V 0.5

XC1



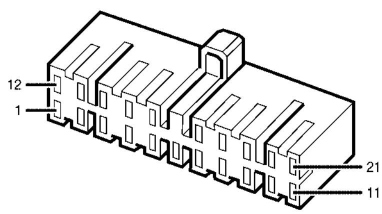
1	C 1	4	R/N 1	8	-
2	B/R 1	5	L-G 1	9	M-B 1
3	M-N 1	6	-	10	R-V 1
4	R/N 1	7	R-N 1	11	-

XC2



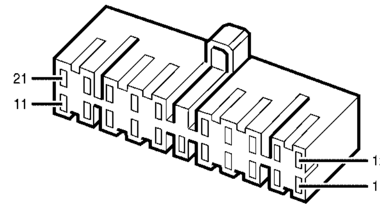
1	A-V 1.5	4	-	7	Z 1
2	-	5	Z 1		
3	A-B 1	6	-		

XC3



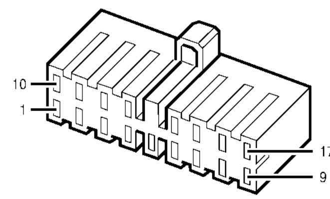
1	H-N 1	9	A-R 1	16	R-V 1
2	L 1		A-R 1		R-V 1
3	G-V 1	10	A-B 1	17	A/N 1
4	S-G 1	11	C-N 1	18	C/B 1
5	H 2.5	12	A 1	19	A-G 1
6	B-R 1	13	G-N 1	20	G 1
	B-R 1		G-N 1	21	R-N 1
7	C/N 1	14	A-V 1		R-N 1
8	H-R 1	15	Z-N 1		

XC4



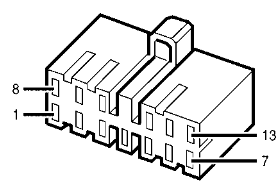
1	A-G 1.5	9	L/R 1	16	H 1
2	R 1.5	10	H-L 1		H 1
3	H-R 1	11	H-N 1	17	L 1
4	R 2.5	12	A/N 1	18	G-N 1
5	H-N 1.5	13	H/R 1	19	A 1
6	G 1		H/R 1	20	V 1
7	M/B 1	14	A/B 1		V 1
8	V-N 1.5	15	A/R 1	21	G 1.5

XC5



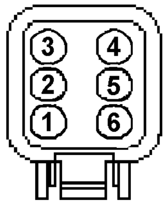
1	A/N 1	8	G-N 1	13	V-N 1
	A/N 1	9	A1	14	V 1
2	-		A1		V 1
3	A/B 1	10	R-N 1.5	15	-
4	R/N 1		B/R 1	16	A-G 1.5
5	-	11	H-N 1	17	R-N 1
6	G 1		H-N 1		R-N 1
	G 1	12	H 1		
7	L 1		H 1		
	L 1	13	V-N 1		

XC6



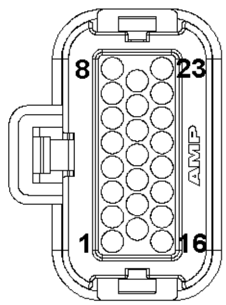
1	M-N 1	6	B/N 1	9	M-N 1.5
2	V-B 1		B/N 1	10	B 1.5
3	L-N 1	7	B 1	11	G/N 1
	L-N 1		B 1	12	R-N 1.5
4	Z 2.5	8	M-B 1		R-N 1
5	G/R 1		M-B 1	13	B-N 1.5

XP14



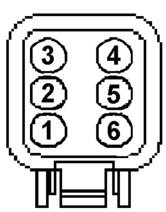
1	B-R 1	3	N 1	5	B-G 1
2		4		6	Z-B 1

XP20



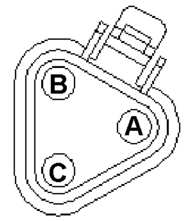
1	H-G 1.5	9	A-R 1	17	A 1
2	N 1.5	10	A-N 1	18	L 1
3	G-R 1	11	Z-B 1	19	-
4	L-B 1	12	B-G 1	20	-
5	L-R 1	13	V-B 1	21	-
6	G-N 1	14	V-N 1	22	-
7	G-V 1	15	M-N 1	23	M-B 1
8	L-G 1	16	B-R 1		

XP24



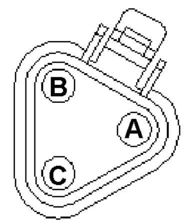
1	B-R 1	3	N 1	5	A 1
2		4		6	L 1

XR



A	B-R 1	C	N 1
B	A-N 1		

XL



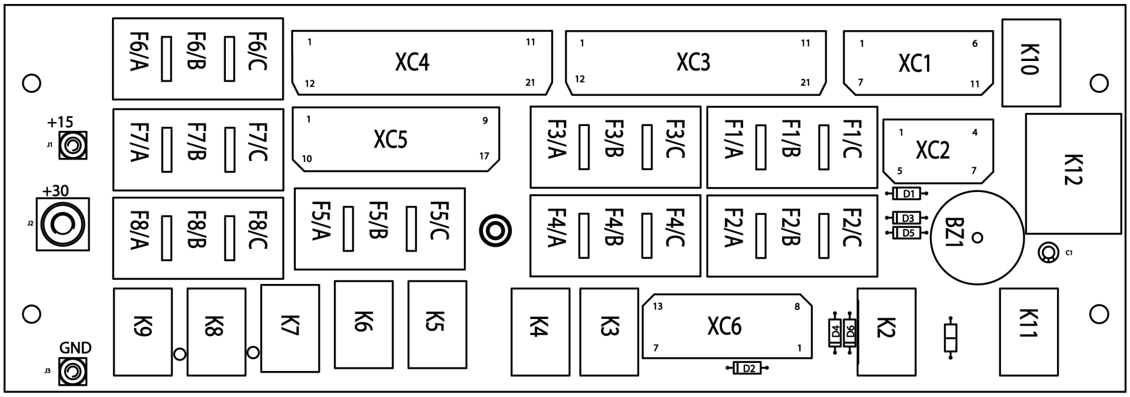
A	B-R 1	C	N 1
B	A-R 1		

SECTION 55 - ELECTRICAL SYSTEM

Chapter 2.3 - Schematic diagrams of Powershift 4 wheel-drive (European and North American model)

CONTENTS

FUSES AND RELAYS



Fuse No.	Rating	Colour	Circuit	Schematic No.
F1/A	15 A	Blue	Rear windshield wiper and washer (S14)	**7**
F1/B	7.5 A	Brown	Fuel shut off, antitheft supply	**1**
F1/C	10 A	Red	Steering unit, steering switch (S51)	**5**
F2/A	15 A	Blue	Instrument power supply, switches lamps, brake oil level sensor, seat, buzzer, stop light switch (S33)	**4**
F2/B	15 A	Blue	Blower motor	**8**
F2/C	20 A	Yellow	Preheating	**1**
F3/A	3 A	Violet	Rear right & front left side lights, instruments & air conditioning illumination	**4**
F3/B	3 A	Violet	Front right & rear left side lights, number plate light	**4**
F3/C	10 A	Red	Switches S1, S4, S5, S6 & S11	**7**
F4/A	7.5 A	Brown	EGS power supply, clutch shut off switch, 4WD switch (S2)	**2**
F4/B	10 A	Red	Rear chisel switch, clamshell level valve and sensor	**2**
F4/C	10 A	Red	Rear working light switch (S12) & rear translation lock switch (S7) (European model)	**6**
F5/A	15 A	Blue	Front working lights - internal	**6**
F5/B	10 A	Red	Traffic lights (European model)	**4**
F5/C	15 A	Blue	Main beam (European model)	**4**
F6/A	7.5 A	Brown	Beacon lamp	**7**
F6/B	7.5 A	Brown	Flasher (+15) (NA model)	**4**
F6/C	7.5 A	Brown	Hammer	**2**
F7/A	10 A	Red	Hazard lights, horn (+30)	**4**
F7/B	10 A	Red	Auxiliary 12 V socket, radio, cab interior light	**8**
F7/C	6 A	Black	Front windshield wiper (special bi-metal, re-setting fuse)	**7**
F8/A	15 A	Blue	Rear working lights - external	**6**
F8/B	15 A	Blue	Front working lights - external	**6**
F8/C	15 A	Blue	Rear working lights - internal	**6**

RELAYS

No.	Circuit	Schematic No.	No.	Circuit	Schematic No.
K2	Speed alarm, hand brake	**2**	**K8**	Front working lights - external	**6**
K3	Starting	**1**	**K9**	Rear working lights - external	**6**
K4	Clamshell level solenoid valve	**2**	**K10**	optional	**2**
K5	Traffic & main beam lights	**4**	**K12**	Hazard lights, flasher	**4**
K6	Front working lights - internal	**6**			
K7	Rear working lights - internal	**6**			

BUZZER

BZ1	Audible warning buzzer

CONNECTORS

XC	Main harness connections into fuse board

COMPONENTS

A1 LVC electronic control box
A2 Cold start electronic control box (optional)
BS1 Right speaker (optional)
BS2 Left speaker (optional)
BZ1 Alarm buzzer
D1 Diode
D2 Diode
EV0 Fuel shut off solenoid valve
EV1 Double delivery solenoid valve (optional)
EV2 Hammer solenoid valve (optional)
EV3 Rear chisel solenoid valve (optional)
EV4 Rear travel solenoid valve (optional)
EV5 Excavator rear lock solenoid valve (optional)
EV6 Clamshell level solenoid valve
EV11Ride control solenoid valve (optional)
EV12 Tool solenoid valve (optional)
EV20 Backhoe pilot pressure solenoid valve
EV21 Solenoid valve for switchover between boom/ dipper control
EV22 Solenoid valve for switchover between boom/ dipper control
EV23 LH stabilizer raising solenoid valve
EV24 LH stabilizer lowering solenoid valve
EV25 RH stabilizer raising solenoid valve
EV26 RH stabilizer lowering solenoid valve
EV27 Telescopic dipper retraction solenoid valve
EV28 Telescopic dipper extension solenoid valve
EV29 Hydraulic auxiliary solenoid valve (optional)
EV30 Hydraulic auxiliary solenoid valve (optional)
EVA2 Crab steering solenoid valve
EVA3 4 wheel steering enabling solenoid valve
EVB2 4 wheel steer selection solenoid valve
EVB3 Normal steering (front wheels only) enabling solenoid valve
FC10 Cold start heater fuse 300 A (optional)
FG1 General fuse 80 A
FG2 A/C fuse 10 A
G1 Battery
G2 Generator
H1 Excavator rear lock warning light (optional)
H2 Front left light (European model)
H3 Front right light (European model)
H4 Rear left light (European model)
H5 Number plate lamp (European model)
H6 Rear right light (European model)
H7 Front left flashing indicator (NA model)
H8 Rear left light (NA model)
H9 Front right light (NA model)
H10 Rear right indicator (NA model)
H11 Front left external working light
H12 Front right external working light
H13 Rear left external working light
H14 Rear right external working light
H15 Beacon lamp
H16 Beacon lamp
H17 Auxiliary 12 V socket illumination
H18 Cab interior light
H19 Front left internal working light (optional)
H20 Front right internal working light (optional)
H21 Rear left internal working light (optional)
H22 Rear right internal working light (optional)
HA1 Reverse speed buzzer
HA2 Horn
K01 Starter relay
K02 C/A relay
K13 Antitheft unit
K14 Clutch detachment relay
K20 Safety relay
K21 Cold start heater relay (optional)
KC Fuse & relay board
KF Indicator flasher unit (NA model)
KS Steering unit
M1 Starter motor
M4 Rear windshield wiper motor
M5 Front windshield wiper motor
M6 Rear windshield washer motor
M7 Front windshield washer motor
M8 Blower motor
M9 Blower motor (optional)
M10 A/C compressor
R2 Engine water temperature sender
R3 Fuel level sender
R10 Cold start heater
S1 Cold start switch (optional)
S2 4WD switch
S3 Hand hammer switch (optional)
S4 Double delivery switch (optional)
S5 Ride control switch (optional)
S6 Tools switch (optional)
S7 Rear translation lock switch
S8 Excavator rear lock switch (optional)
S9 Light switch
S10 Hazard lights switch
S11 Front working lights switch
S12 Rear working lights switch
S14 Rear windshield wiper & washer switch
S15 Beacon lamp switch
S17 Starting switch
S18 Handbrake switch
S20 Engine oil low pressure switch
S21 Air filter blocked switch
S24 Transmission oil pressure switch
S25 Transmission oil high temperature switch
S26 Clutch shut off switch
S27 Horn switch
S28 Clamshell sender
S29 Horn switch
S30 Rear chisel pedal switch (optional)
S31 Brake oil level sender
S32 Stop light switch
S33 Stop light switch
S34 Left cab interior light switch
S35 Right cab interior light switch
S36 A/C pressure switch

S40	Front axle sensor
S41	Front windshield wiper & washer - indicators switch (NA model)
S41	Front windshield wiper & washer - lights switch (European model)
S42	Rear axle sensor
S43	Radio (optional)
S44	Seat (optional)
S45	Conditioner and blower motor switch
S46	Auxiliary 12 V socket
S47	Steering switch
S48	EGS manual - auto switch
S49	Main switch
S50	EGS switch
S51	Seat safety switch
S60	Backhoe pilot switch
S61	Boom/dipper control switch
S62	Safety switch
S63	Telescopic dipper extension switch
S64	Horn switch (LH control lever)
S65	LH stabilizer switch
S66	RH stabilizer switch
S67	LH stabilizer pressure switch
S68	RH stabilizer pressure switch
S69	telescopic dipper retraction switch
S70	Hydraulic auxiliary switch (optional)
S71	Hydraulic auxiliary switch (optional)
ST1	Side panel with optional diagnostics
ST2	Front panel

CONNECTORS

X1 General cable - Engine cable - 18 way connector
X2 Cold start - 12 way connector
X3 Fuel pump - 3 way connector
X4 Air filter - 2 way connector
X5 Fuel level sender - 2 way connector
X9 General cable - front dashboard - 9 way connector
X10 Solenoid valves cable - general cable - 29 way connector
X11 1 way connector
X12 General cable - cabin cable - 5 way connector
X13 Heater - 4 way connector
X14 General cable - side dashboard - 9 way connector
X15 General cable - side dashboard - 7 way connector
X16 General cable - side dashboard - 21 way connector
X17 Antitheft - 11 way connector
X18 General cable - rear lamps cable - 12 way connector
X19 Reverse buzer - 2 way connector
X20 Conditioner switch illumination - 2 way connector
X21 Seat - 4 way connector
X22 Side panel - 20 way connector
X23 Clutch shut off button - 2 way connector
X24 Rear translation lock solenoid valve - 2 way connector
X25 Excavator rear lock solenoid valve - 2 way connector
X26 Clamshell sender - 3 way connector
X27 Horn switch - 2 way connector
X28 Clutch shut off & horn switch - 4 way connector
X29 Clamshell level - 2 way connector
X30 Double delivery solenoid valve - 2 way connector
X31 Tools rapid connection solenoid valve - 2 way connector
X32 Rear chisel solenoid valve - 2 way connector
X33 Bridge - 2 way connector
X34a Ride control solenoid valve - 2 way connector
X35 Hand hammer solenoid valve - 2 way connector
X36 Rear chisel switch - 2 way connector
X37 Rear right light - 4 way connector
X38 Rear right working light - 4 way connector
X39 Rear windshield wiper - 4 way connector
X40 Rear right working light (opt) - 4 way connector
X41 Optional Blower motor - 2 way connector
X42 Front right indicator - 4 way connector
X43 Beacon lamp - 4 way connector
X44 Front right working light - 4 way connector
X45 Front right working light (opt) - 4 way connector
X46 Rear left working light (opt) - 4 way connector
X47 Rear left working light - 4 way connector
X48 Rear left light - 4 way connector
X49 Front windshield wiper - 6 way connector
X50 Front left working light (opt) - 4 way connector
X51 Front left working light - 4 way connector
X52 Front left indicator - 4 way connector
X53 Radio (brown color) - 8 way connector
X54 Radio (black color) - 8 way connector
X55 Auxiliary 12 V socket - 2 way connector
X56 Front windshield washer - 2 way connector
X57 Rear windshield washer - 2 way connector
X58 Flasher unit - 13 way connector (NA model)
X58 Shunts - 13 way connector (European model)
X59 Right light - 5 way connector
X60 Horn / left light - 7 way connector
X61 Wiper and lights switch - 12 way connector
X63 Number plate light 2 way connector (European model)
X64 Optional conditioner - 1 way connector
X65 Cold start switch - 1 way connector
X67 Generator - 3 way connector
X68 Engine water temperature sender - 3 way connector
X69 A/C pressure switch - 2 way connector
X70 Front panel - 12 way connector
X71 Key switch - 10 way connector
X72 Pilot control line - 1 way connector
X73 Engine oil pressure switch - 1 way connector
X75 Diagnostics - 5 way connector
X76 Diagnostics - 13 way connector
X77 Blower motor third speed - 1 way connector
X78 Left control lever - 2 way connector
X79 Horn jumper connection - 2 way connector
X80 Beacon lamp - 2 way connector
X81 Beacon lamp - 2 way connector
X82 EGS system - 9 way connector
X83 EGS switch - 19 way connector
X84 Gear box extension - 13 way connector
X85 Gear box - 12 way connector
X89 Front left lights - 6 way connector (European model)
X91 Circular steering solenoid valve - 2 way connector
X92 Crab steering solenoid valve - 2 way connector
X93 4WS enable solenoid valve - 2 way connector
X93 2WS enable solenoid valve - 2 way connector
X95 Steering unit - 12 way connector
X96 Steering unit - 8 way connector

X97 Front axle sensor - 3 way connector
X98 Rear axle sensor - 3 way connector
X100 Right lever - 6 way connector
X101 Front right lights - 6 way connector (European model)
X102 Controller - 10 way connector
X103 Relay - 2 way connector
X104 LVC unit - 23 way connector
X105 LH stab. pressure switch - 2 way connector
X106 RH stab. pressure switch - 2 way connector
X109 Manifold power - 2 way connector
X110 Tower cable - 4 way connector
X111 Plug 4 LH down - 2 way connector
X112 Plug 3 LH up - 2 way connector
X113 Plug 6 RH down - 2 way connector
X114 Plug 5 RH up - 2 way connector
X115 Plug 7 Retract - 2 way connector
X116 Plug 8 Extend - 2 way connector
X117 LH stabilizer lever - 3 way connector
X118 RH stabilizer lever - 3 way connector
X119 Right lever - 6 way connector

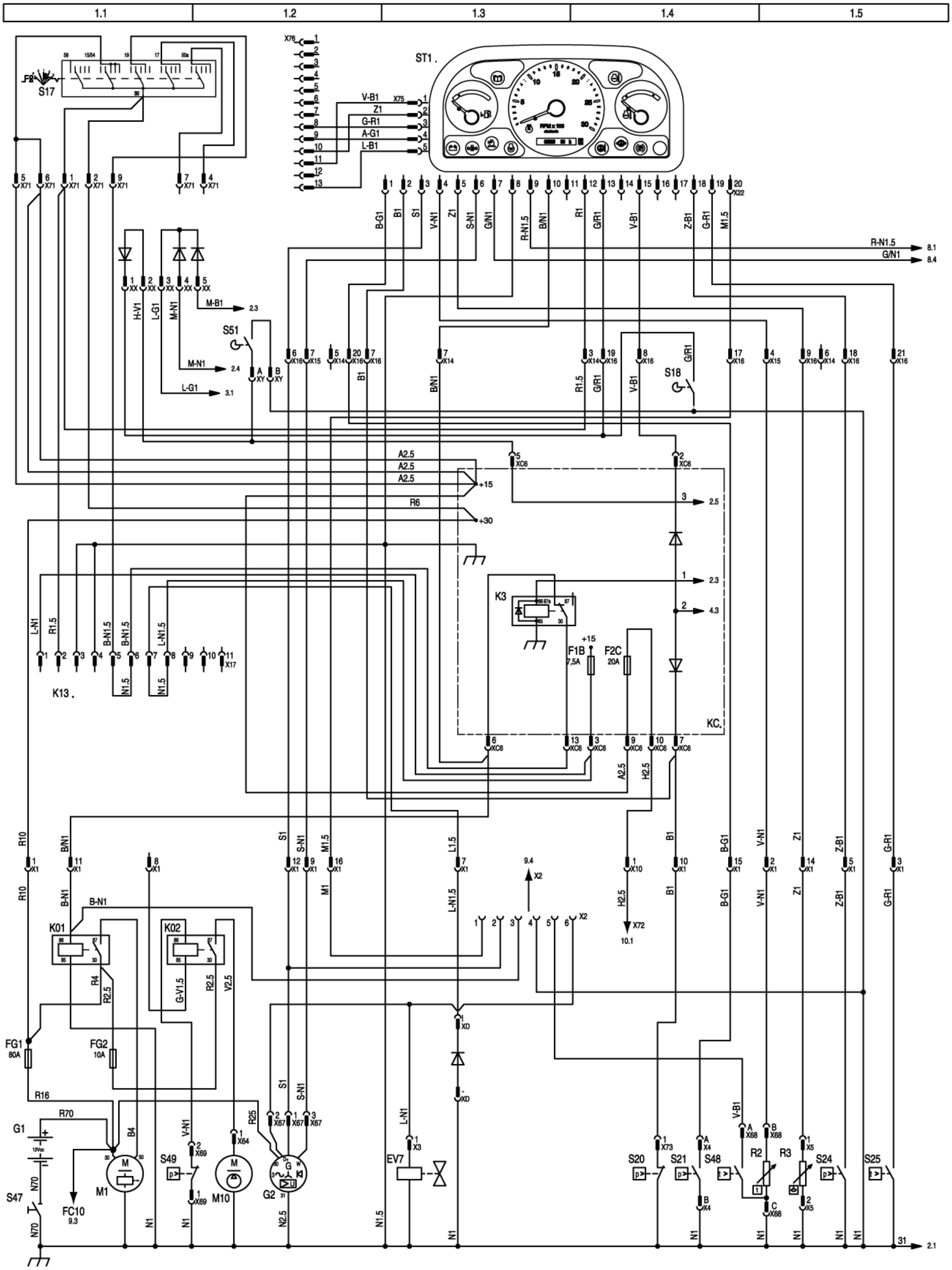
XA Horn cable - 2 way connector
XC1 On board - 11 way connector
XC2 On board - 7 way connector
XC3 On board - 21 way connector
XC4 On board - 21 way connector
XC5 On board - 17 way connector
XC6 On board - 13 way connector
XD Fuel shut off diode - 2 way connector
XD1 Diode D1 - 2 way connector
XD2 Diode D2 - 2 way connector
XP1 Solenoid valve EV21 - 2 way connector

WIRE COLOURS:

A = LIGHT BLUE .... M = BROWN
B = WHITE........................ N = BLACK
C = ORANGE.................... R = RED
G = YELLOW.................... S = PINK
H = GREY .... V = GREEN
L = BLUE .... Z = VIOLET
Example of mixed colours
G/V = Yellow/Green (transverse colours)
G-V = Yellow-Green (longitudinal colours)

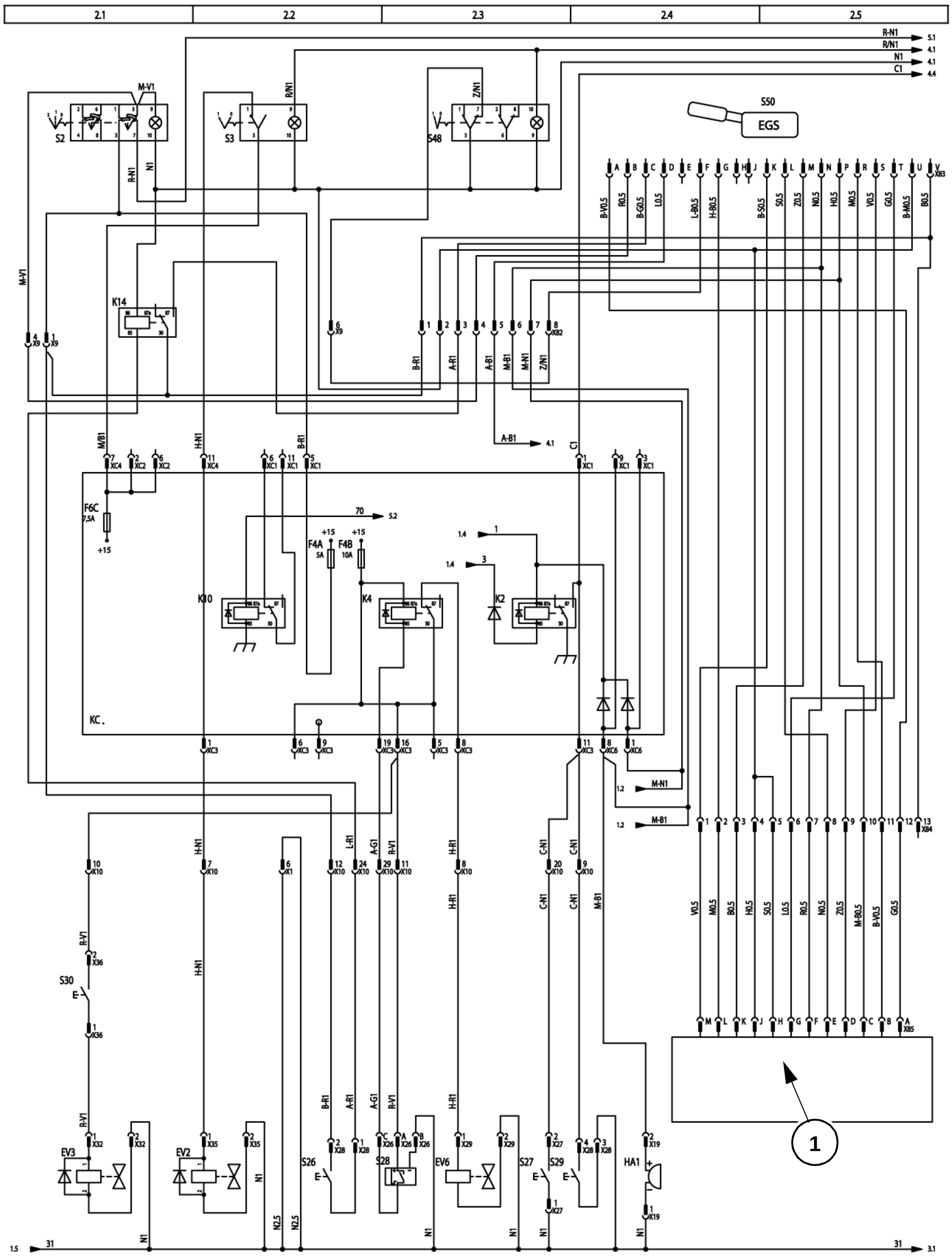
XP2 Solenoid valve EV22 - 2 way connector
XP4 LH control lever switch - 2 way connector
XP11 LH stab. pressure switch - 2 way connector
X12 RH stab. pressure switch - 2 way connector
XP13 RH armrest switches - 5 way connector
XP14 RH control lever switch - 6 way connector
XP17 Backhoe pilot solenoid valve - 2 way connector
XP20 LVC electronic control box - 23 way connector
XP23 Safety switch - 2 way connector
XP24 LH control lever switch - 6 way connector
XL LH stabilizer control lever - 3 way connector
XR RH stabilizer control lever - 3 way connector
XS1 RH stab. pressure switch - 2 way connector
XS2 LH stab. pressure switch - 2 way connector
XX Diodes - 5 way connector
XY Seat safety switch - 2 way connector
YP3 Solenoid valve EV24 - 2 way connector
YP4 Solenoid valve EV23 - 2 way connector
YP5 Solenoid valve EV26 - 2 way connector
YP6 Solenoid valve EV25 - 2 way connector
YP7 Solenoid valve EV28 - 2 way connector
YP8 Solenoid valve EV27 - 2 way connector
YP9 Solenoid valve EV30 - 2 way connector
YP10 Solenoid valve EV29 - 2 way connector

SYSTEM FROM KEY START (SCHEMATIC No. 1)



CRIL03L011H00

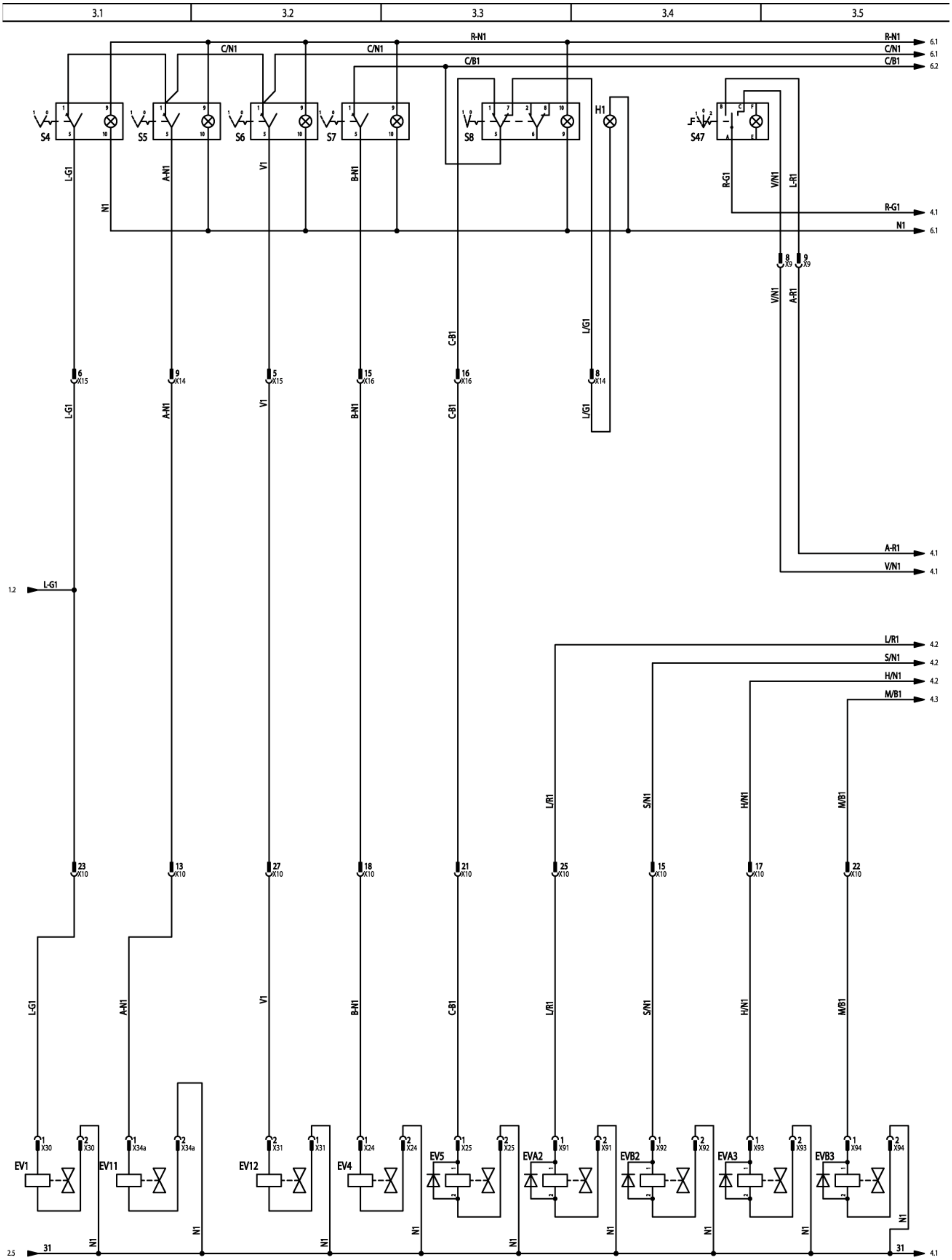
SOLENOID VALVES AND GEARBOX (SCHEMATIC No. 2)



CRIL03L013H00

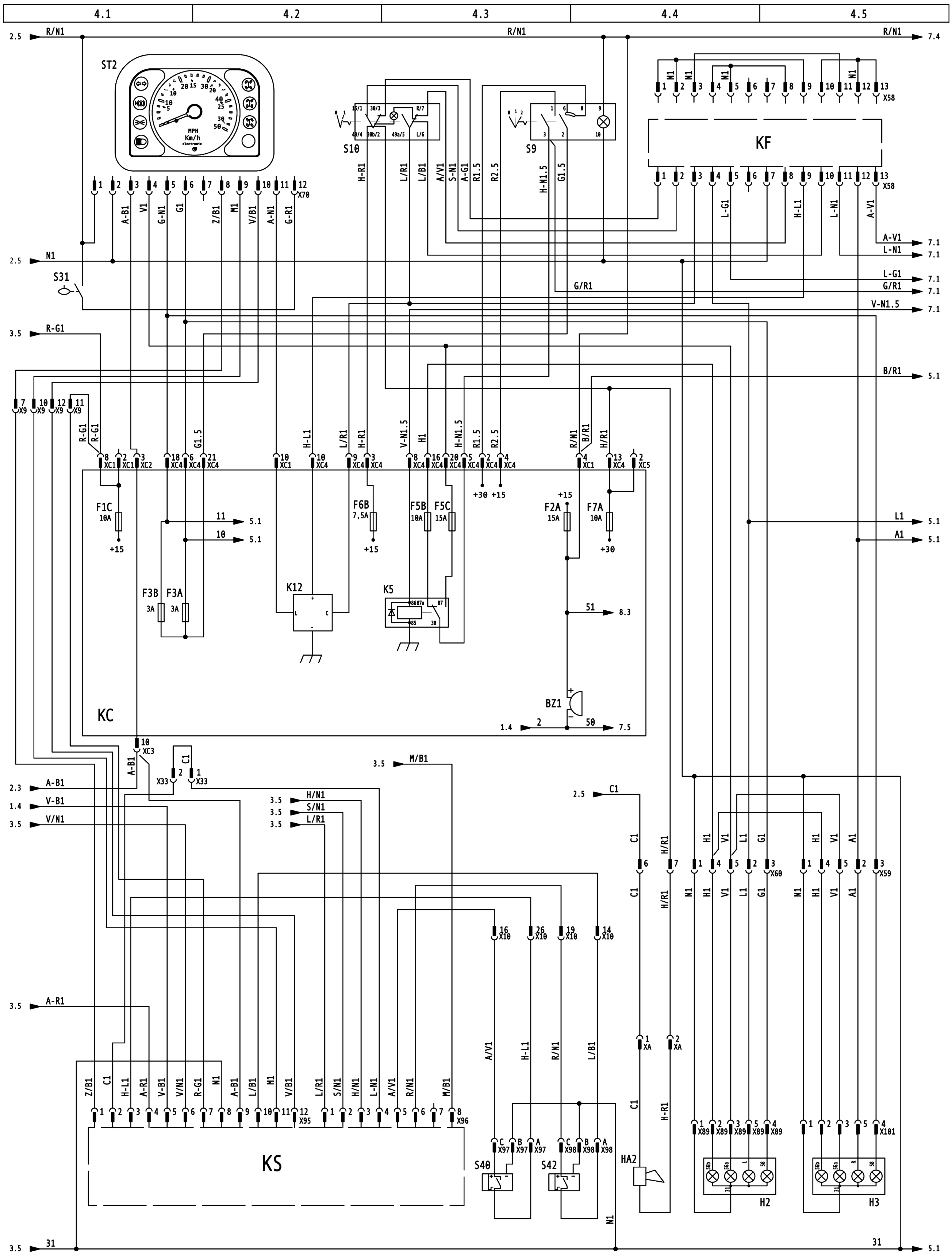
1 Gear box

SOLENOID VALVES (SCHEMATIC No. 3)

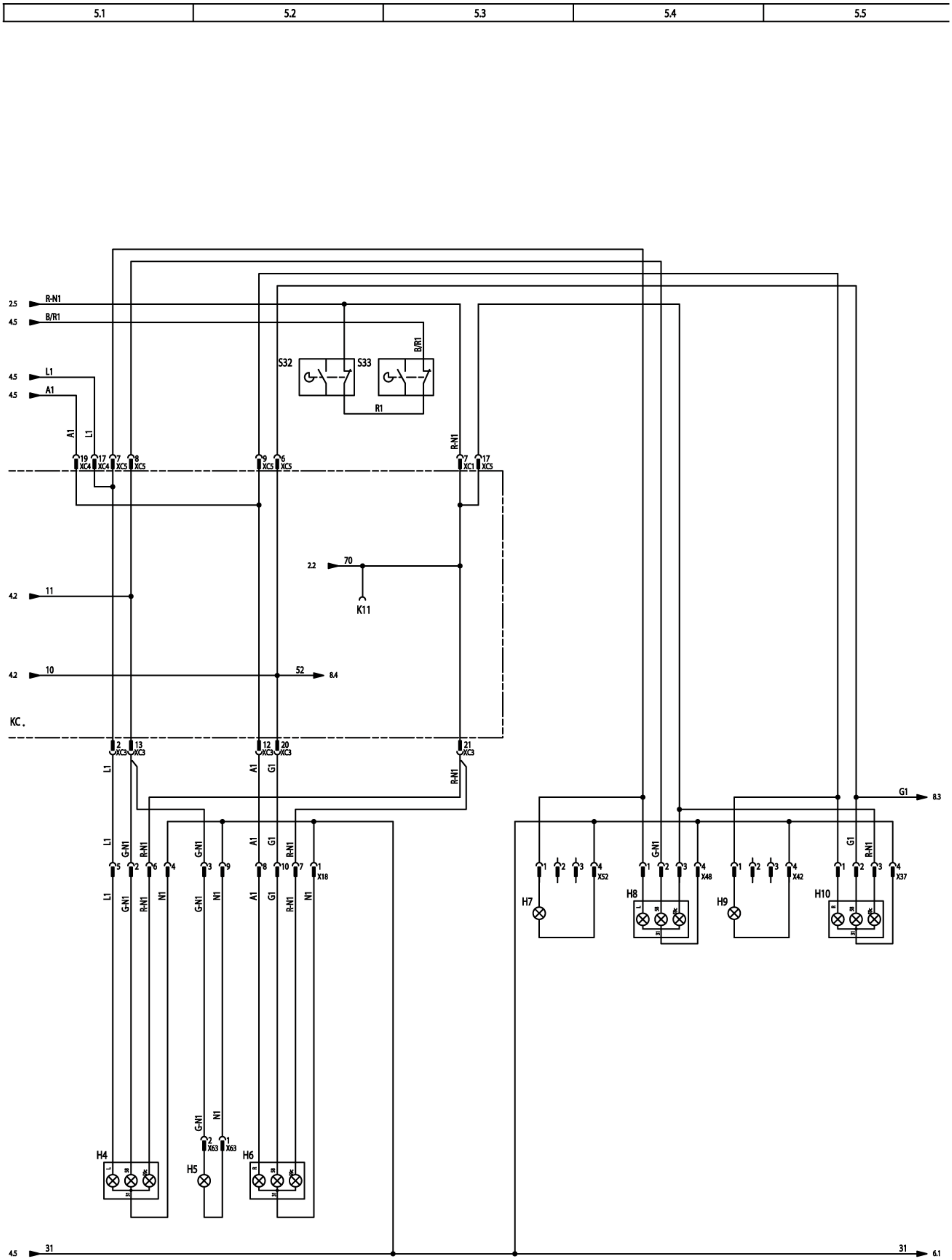


CRIL03L014H00

LIGHTING AND STEERING UNIT (SCHEMATIC No. 4)

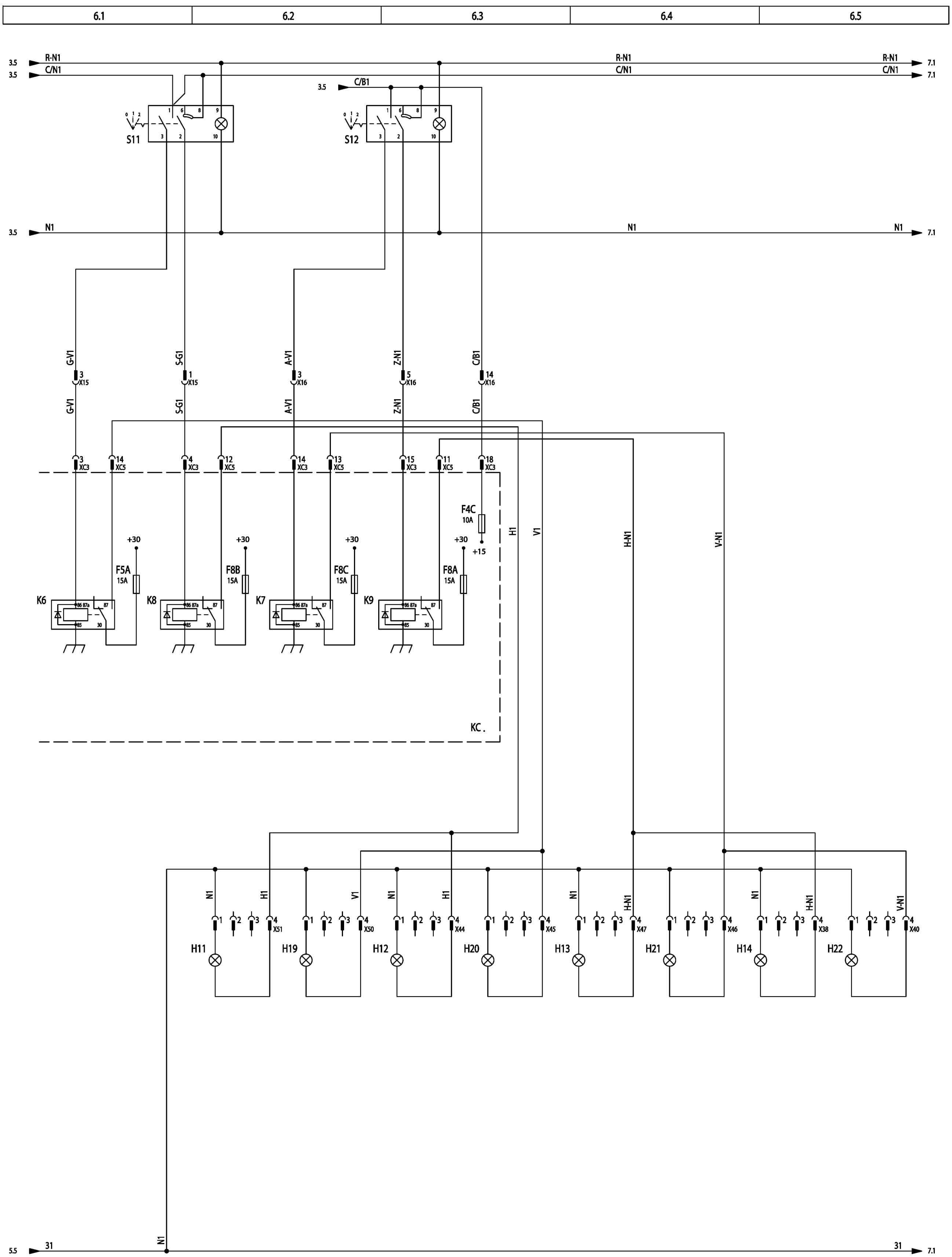


LIGHTS - REAR LIGHTS (SCHEMATIC No. 5)

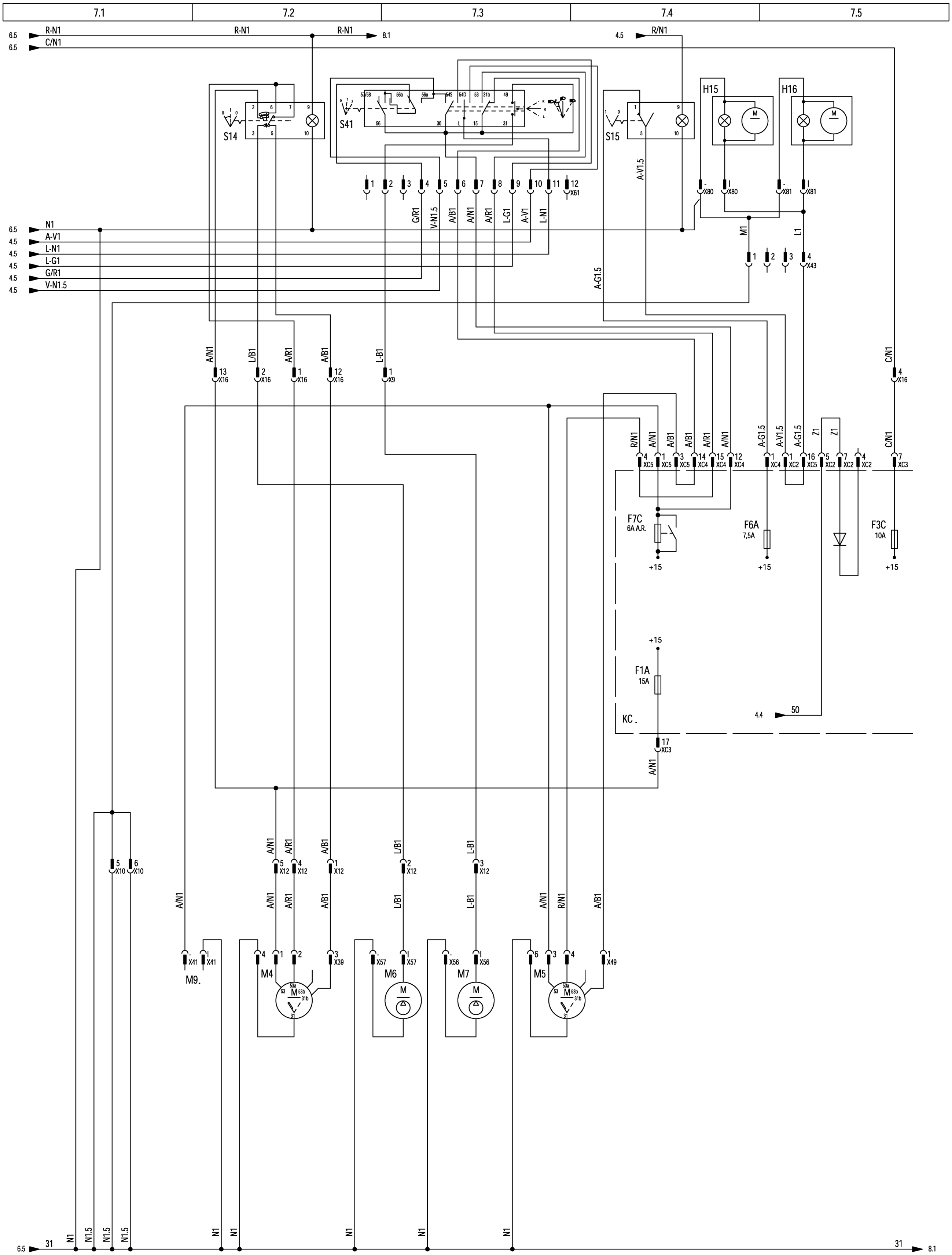


CRIL03L015H00

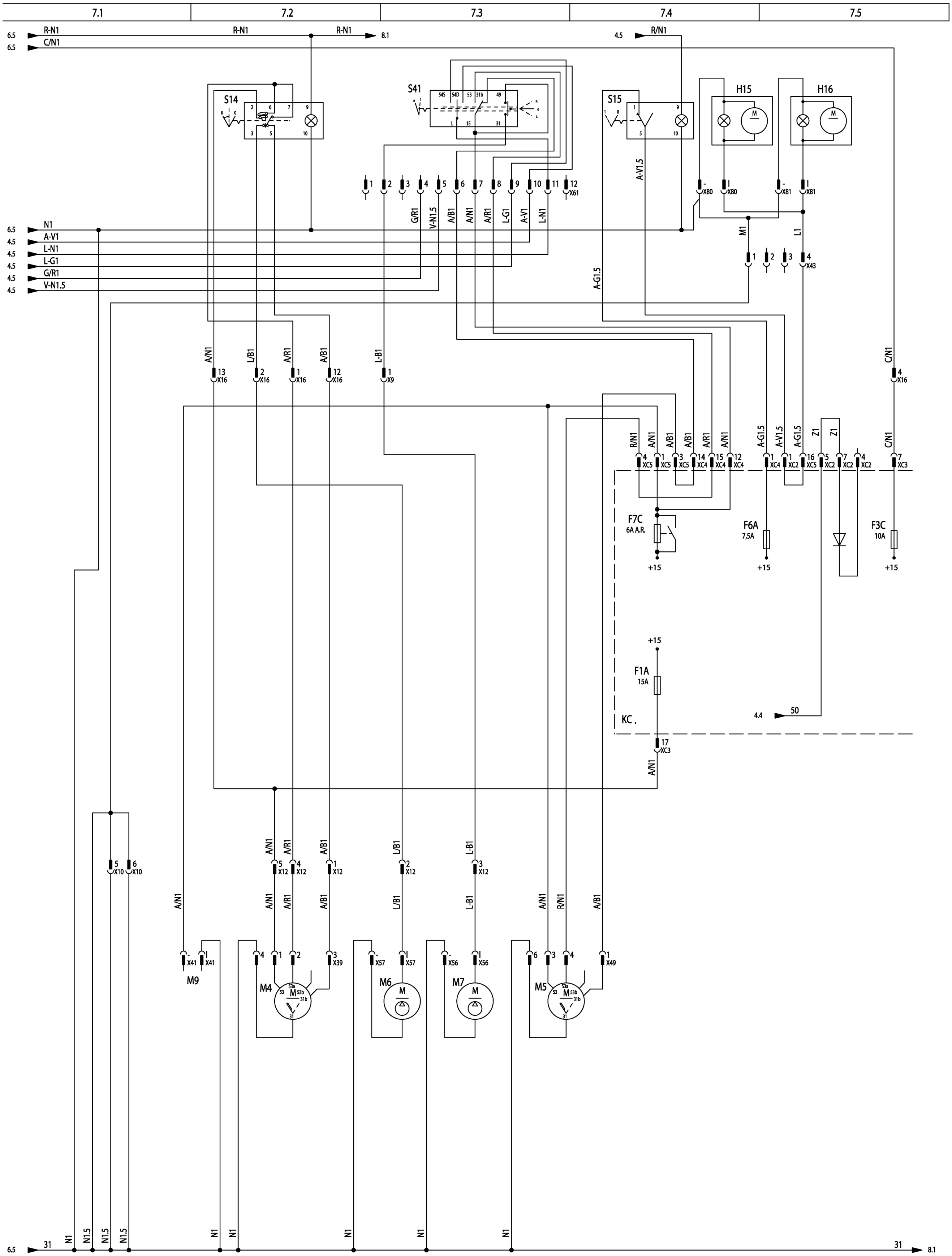
WORKING LIGHTS (SCHEMATIC No. 6)



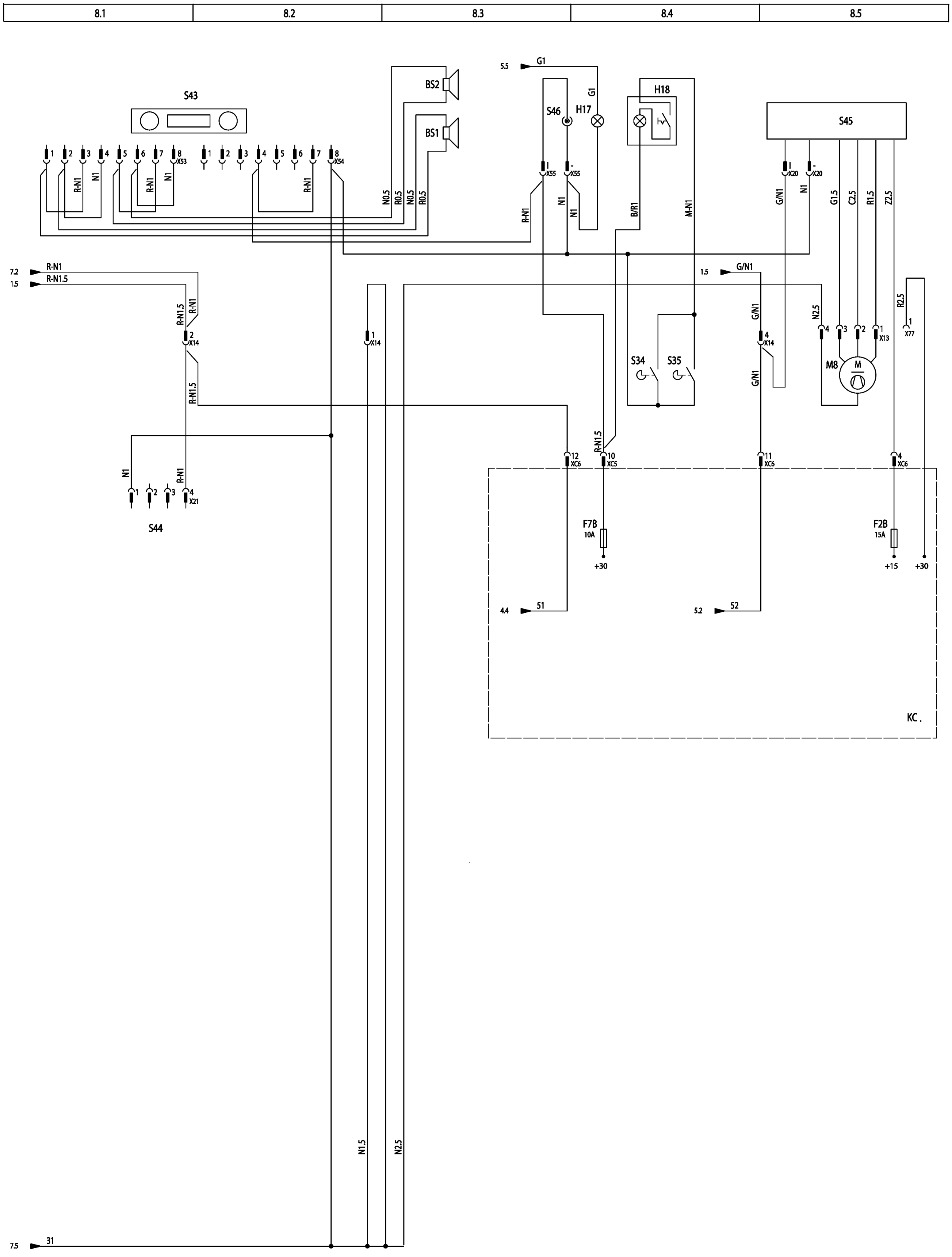
WINDSHIELD WIPER & WASHER (SCHEMATIC No. 7) EUROPEAN MODEL



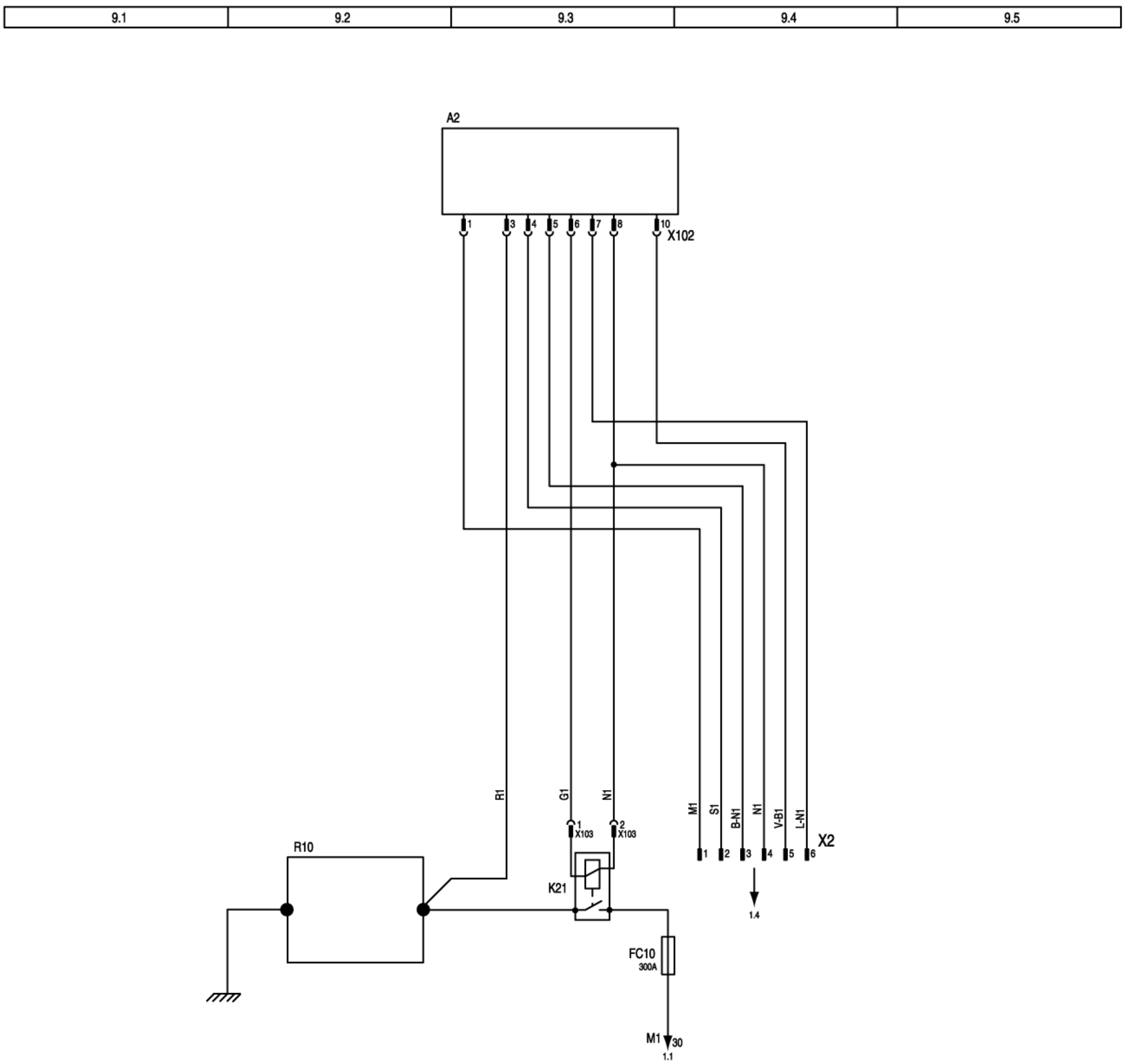
WINDSHIELD WIPER & WASHER (SCHEMATIC No. 7) NA MODEL



HEATER (SCHEMATIC No. 8)

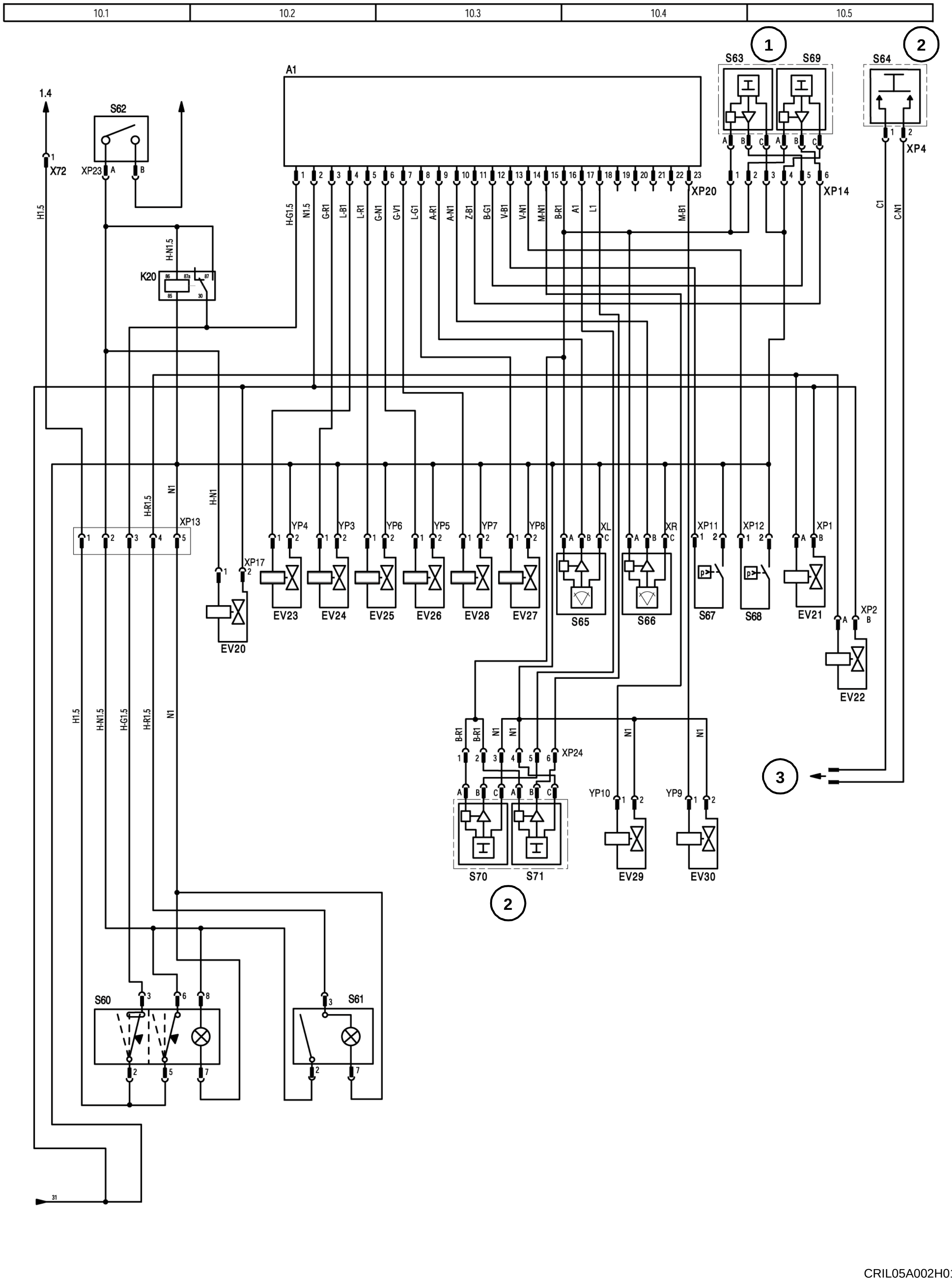


COLD START (SCHEMATIC No. 9)



CRIL03L012H00

LVC PILOT CONTROL (SCHEMATIC No. 10)

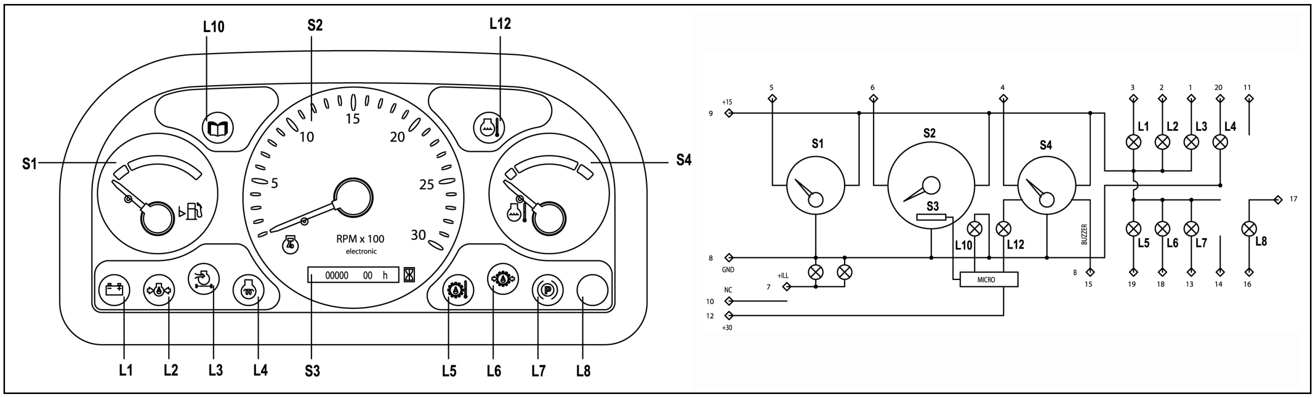


1 RH control lever

2 LH control lever

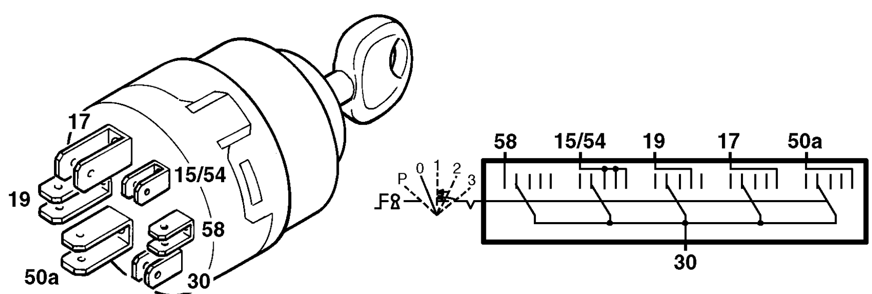
3 To horn control HA1, schematic 2

SIDE INSTRUMENT PANEL



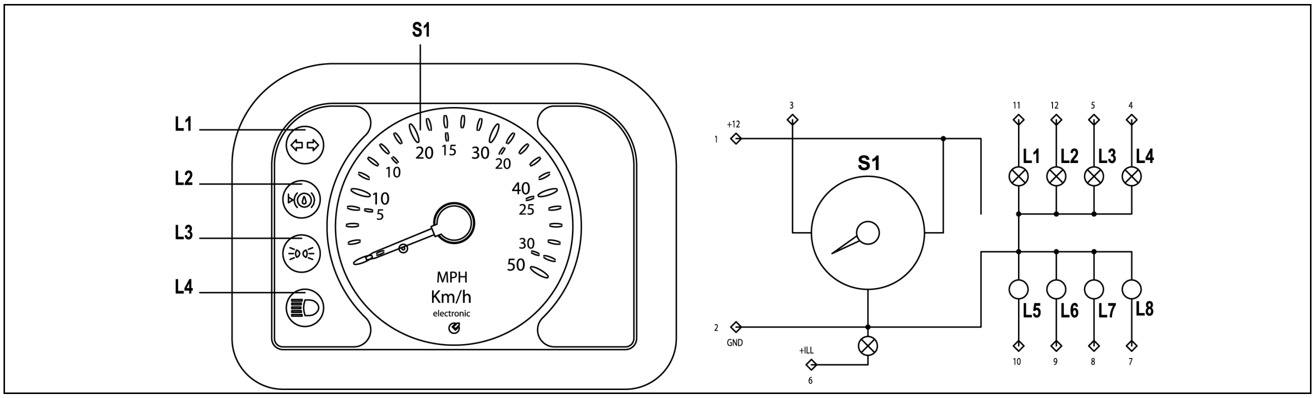
Pos.	Pin	Function	Signal	Pos.	Pin	Function	Signal
L3	1	Air cleaner lamp	-		11	NC	
L2	2	Engine oil pressure lamp	-	+30	12	Permanent supply voltage (+batt)	
L1	3	Generator lamp	-	L7	13	Handbrake lamp	
S4	4	Water temperature gauge	ohm		14	NC	
S1	5	Fuel level gauge	ohm	B	15	External buzzer driving	
S2	6	Tachometer	Hz	L8	16	Neutral red lamp	+/-
+ILL	7	Instrument lighting	+ Lighting	L8	17	Neutral red lamp	+/-
GND	8	Negative		L6	18	Transm. oil pressure lamp	-
+15	9	Positive (+key)		L5	19	Transm. oil temperature lamp	-
	10	NC		L4	20	Engine preheating lamp	+
L10		Service lamp	Int.	L12		High water temperature lamp	INT.

KEY SWITCH



30 - 58	No connection
30 - 15/54	OFF
30 - 19	Accessories
30 - 17	Preheat & engine run
30 - 50a	Engine start

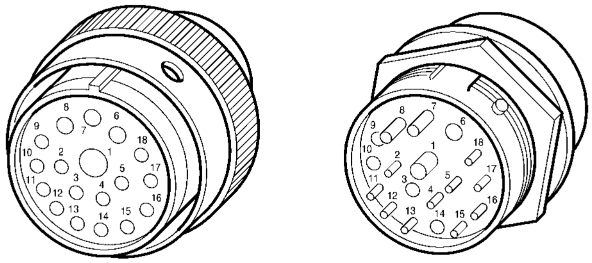
FRONT INSTRUMENT PANEL



Pos.	Pin	Function	Signal
+12	1	Positive (+12 V)	
GND	2	Negative	
S1	3	Speedometer	Hz
L4	4	Driving beam lamp	+
L3	5	Position lights indicator lamp	+
+ILL	6	Instrument lighting	+ Lighting
L8	7	Neutral green indicator lamp	-
L7	8	Crab steering lamp	-
L6	9	Front steering lamp	-
L5	10	Circular steering lamp	-
L1	11	Direction lamp	+
L2	12	Brake fluid level lamp	+

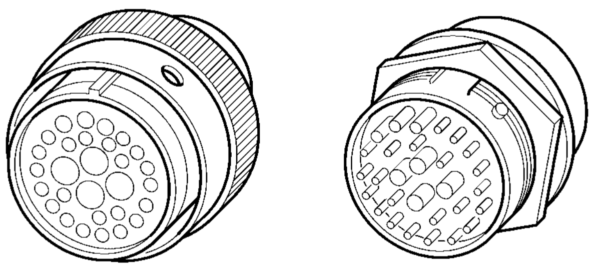
CONNECTOR

X1



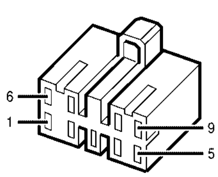
1	R 10	7	L 1.5	13	R-N 1
2	V-N 1	8	-	14	Z 1
3	G-R 1	9	S-N 1	15	B-G 1
4	M-B 1	10	B 1	16	M 1.5
5	Z-B 1	11	B/N 1	17	M-N 1
6	N 2.5	12	S 1	18	M-V 1

X10



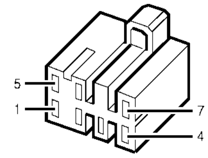
1	H 2.5	11	A-R 1	21	-
2	-	12	A-R 1	22	-
3	-	13	-	23	L-G 1
4	-	14	R-V 1	24	A-R 1
5	N 1.5	15	R-V 1	25	-
6	N 1.5	16	A-N 1	26	-
7	H-N 1	17	C-B 1	27	V 1
8	B-R 1	18	B-N 1	28	-
9	B-R 1	19	-	29	A-G 1
10	H-R 1	20	C-N 1		

X14



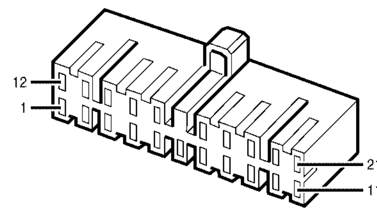
1	N 1.5	4	G/N 1	7	B/N 1
2	R-N 1.5		G/N 1	8	L/G 1
	R-N 1	5	M 1.5	9	A-N 1
3	R 1.5	6	B 1.5		

X15



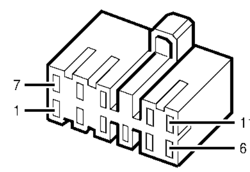
1	S-G 1	4	V-N 1	7	S-N 1
2	-	5	V 1		
3	G-V 1	6	L-G 1		

X16



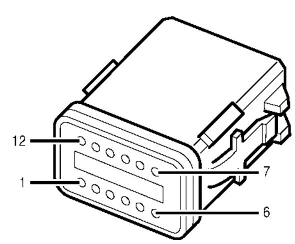
1	A/R 1	9	Z 1	16	C-B 1
2	L/B 1	10	-	17	M/N 1
3	A-V 1	11	-	18	Z-B 1
4	C/N 1	12	A/B 1	19	G/R 1
5	Z-N 1	13	A/N 1	20	B-G 1
6	S 1		A/N 1	21	G-R 1
7	B 1	14	C/B 1		
8	V-B 1	15	B-N 1		

X17



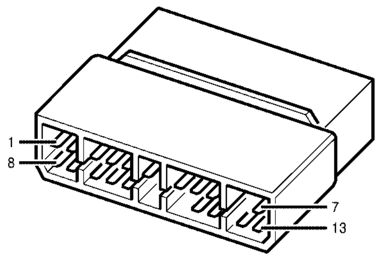
1	L-N 1	5	B-N 1.5	9	-
2	R 1.5	6	B-N 1.5	10	-
3	N 1.5	7	L 1.5	11	-
4	N 1.5	8	L-N 1.5		

X18



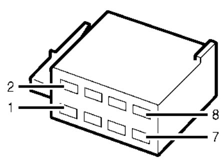
1	N 1	5	L 1	9	N 1
2	G-N 1	6	R-N 1	10	G 1
3	G-N 1	7	R-N 1	11	-
4	N 1	8	A 1	12	-

X22



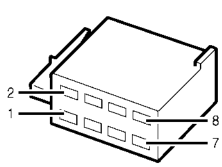
1	B-G 1	8	N 1.5	15	V-B 1
2	B 1	9	R-N 1.5	16	-
3	S 1	10	B/N 1	17	-
4	G/R 1	11	-	18	Z-B 1
5	Z 1	12	R 1	19	G-R 1
6	S-N 1	13	G/R 1	20	M/N 1
7	G/N 1	14	-		

X53



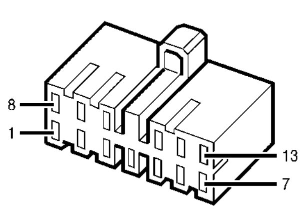
1	R-P 0.5	3	R-N 1	6	N 1
	R-N 1	4	N 1	7	R-N 1
2	N-P 0.5	5	R-P 0.5	8	N-P 0.5
	N1		R-N 1		N1

X54



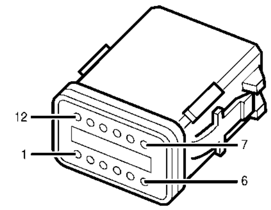
1	-	4	R-N 1	8	N 1
2	-	5	-		N 1
3	-	6	-		
4	R-N 1	7	R-N 1		

X58



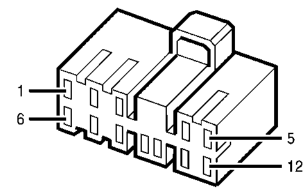
1	A-G 1	6	-	10	L/B 1
2	S-N 1	7	N 1	11	L-N 1
3	L/R 1		N 1	12	A1
4	L 1	8	A/V 1	13	A-V 1
5	L-G 1	9	H-L 1		

X61



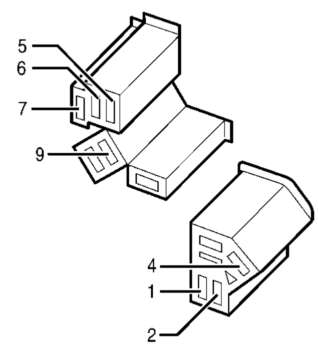
1	-	5	V-N 1.5	9	L-G 1
2	L-B 1	6	A/B 1	10	A-V 1
3	-	7	A/N 1	11	L-N 1
4	G/R 1	8	A/R 1	12	-

X70



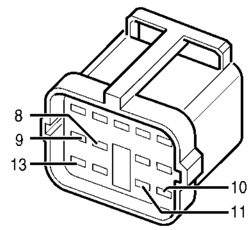
1	R/N 1	5	G-N1	9	M1
2	N 1	6	G 1	10	V/B1
3	A-B 1	7	-	11	A-N1
4	V 1	8	Z-B1	12	G-R 1

X71



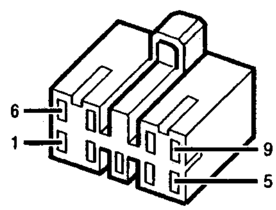
1	R 1.5	4	M-N 1.5	8	-
	R 1.5	5	A 2.5	9	M-N 1.5
2	R 6	6	A 2.5		M/N 1
3	-		A 2.5	10	-
4	M-N 1.5	7	B-N 1.5		

X76



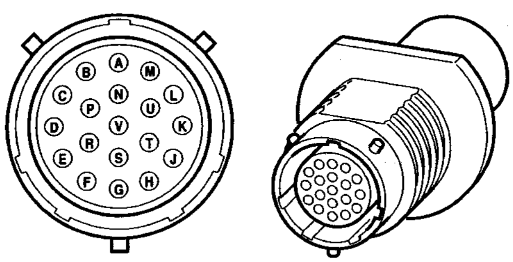
1	-	6	-	11	V-B 1
2	-	7	-	12	-
3	-	8	G-R 1	13	L-B 1
4	-	9	A-G 1		
5	-	10	Z 1		

X82



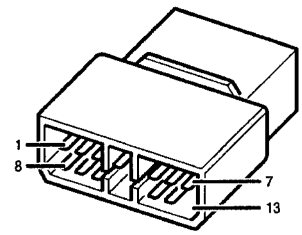
1	B-R 1	4	M-V 1	7	M-N 1
2	N 1	5	A-B 1	8	Z/N 1
3	A-R 1	6	M-B 1	9	-

X83



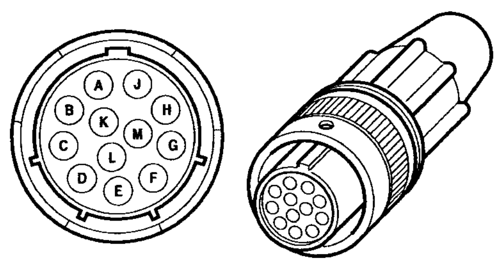
A	B-V 0.5	H	-	R	M 0.5
B	R 0.5	J	-	S	V 0.5
C	B-G 0.5	K	B-S 0.5	T	G 0.5
D	L 0.5	L	S 1	U	B-M 0.5
E	-	M	Z 0.5	V	B 0.5
F	L-B 0.5	N	N 0.5		
G	H-B 0.5	P	H 0.5		

X84



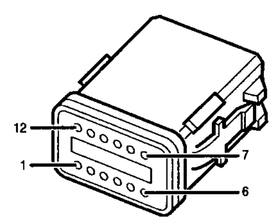
1	V 0.5	6	L 0.5	11	B-V 0.5
2	M 0.5	7	R 0.5	12	G 0.5
3	B 0.5	8	N 0.5	13	-
4	H 0.5	9	Z 0.5		
5	S 1	10	M-B 0.5		

X85



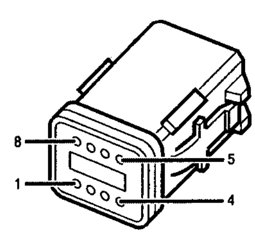
A	G 0.5	E	N 0.5	J	H 0.5
B	B-V 0.5	F	R 0.5	K	B 0.5
C	M-B 0.5	G	L 0.5	L	M 0.5
D	Z 0.5	H	S 1	M	V 0.5

X95



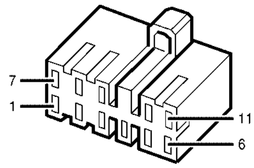
1	Z/B 1	5	V-B 1	9	A-B 1
2	C 1	6	V/N 1	10	L/B 1
3	H-L 1	7	R-G 1	11	M 1
4	A-R 1	8	N 1	12	V/B 1

X96



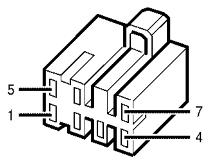
1	L/R 1	4	L-N 1	7	-
2	S/N 1	5	A/V 1	8	M/B 1
3	H/N 1	6	R/N 1		

XC1



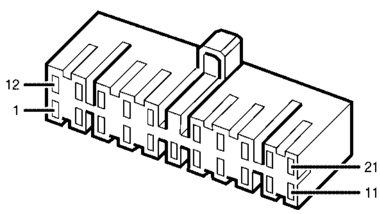
1	C 1	4	R/N 1	8	-
2	B/R 1	5	L-G 1	9	M-B 1
3	M-N 1	6	-	10	R-V 1
4	R/N 1	7	R-N 1	11	-

XC2



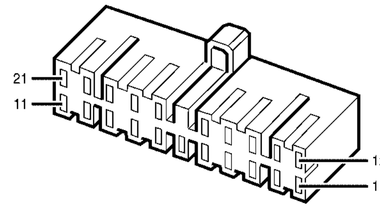
1	A-V 1.5	4	-	7	Z 1
2	-	5	Z 1		
3	A-B 1	6	-		

XC3



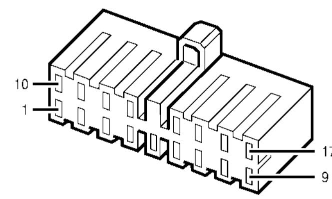
1	H-N 1	9	A-R 1	16	R-V 1
2	L 1		A-R 1		R-V 1
3	G-V 1	10	A-B 1	17	A/N 1
4	S-G 1	11	C-N 1	18	C/B 1
5	H 2.5	12	A 1	19	A-G 1
6	B-R 1	13	G-N 1	20	G 1
	B-R 1		G-N 1	21	R-N 1
7	C/N 1	14	A-V 1		R-N 1
8	H-R 1	15	Z-N 1		

XC4



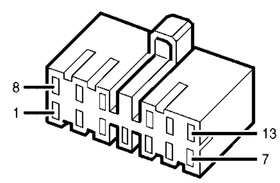
1	A-G 1.5	9	L/R 1	16	H 1
2	R 1.5	10	H-L 1		H 1
3	H-R 1	11	H-N 1	17	L 1
4	R 2.5	12	A/N 1	18	G-N 1
5	H-N 1.5	13	H/R 1	19	A 1
6	G 1		H/R 1	20	V 1
7	M/B 1	14	A/B 1		V 1
8	V-N 1.5	15	A/R 1	21	G 1.5

XC5



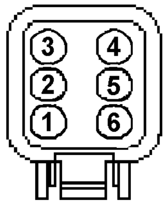
1	A/N 1	8	G-N 1	13	V-N 1
	A/N 1	9	A1	14	V 1
2	-		A1		V 1
3	A/B 1	10	R-N 1.5	15	-
4	R/N 1		B/R 1	16	A-G 1.5
5	-	11	H-N 1	17	R-N 1
6	G 1		H-N 1		R-N 1
	G 1	12	H 1		
7	L 1		H 1		
	L 1	13	V-N 1		

XC6



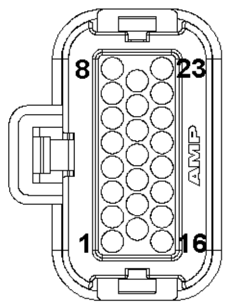
1	M-N 1	6	B/N 1	9	M-N 1.5
2	V-B 1		B/N 1	10	B 1.5
3	L-N 1	7	B 1	11	G/N 1
	L-N 1		B 1	12	R-N 1.5
4	Z 2.5	8	M-B 1		R-N 1
5	G/R 1		M-B 1	13	B-N 1.5

XP14



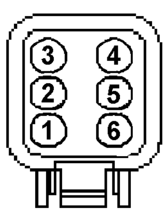
1	B-R 1	3	N 1	5	B-G 1
2		4		6	Z-B 1

XP20



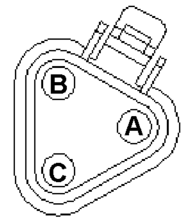
1	H-G 1.5	9	A-R 1	17	A 1
2	N 1.5	10	A-N 1	18	L 1
3	G-R 1	11	Z-B 1	19	-
4	L-B 1	12	B-G 1	20	-
5	L-R 1	13	V-B 1	21	-
6	G-N 1	14	V-N 1	22	-
7	G-V 1	15	M-N 1	23	M-B 1
8	L-G 1	16	B-R 1		

XP24



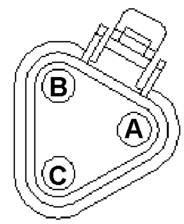
1	B-R 1	3	N 1	5	A 1
2		4		6	L 1

XR



A	B-R 1	C	N 1
B	A-N 1		

XL



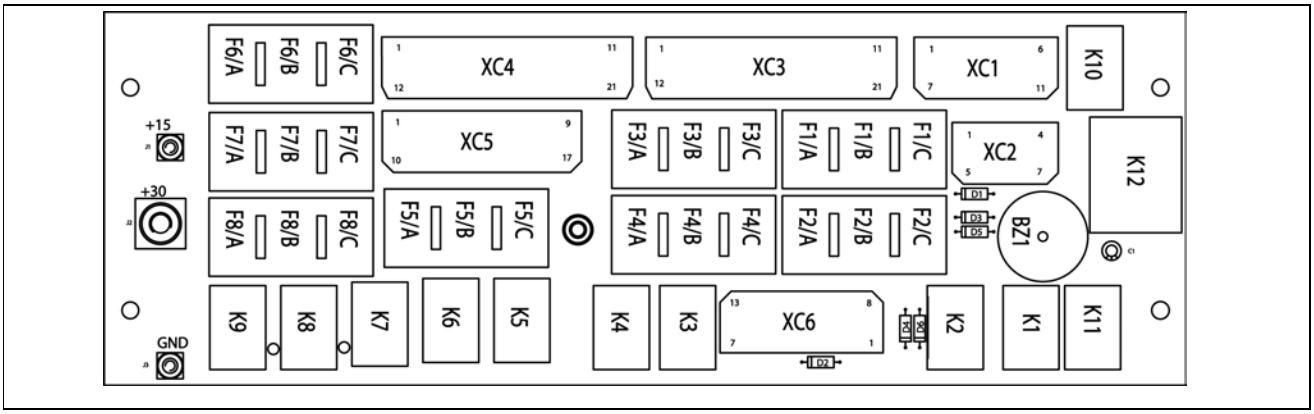
A	B-R 1	C	N 1
B	A-R 1		

SECTION 55 - ELECTRICAL SYSTEM

Chapter 2.4 - ROPS Wiring Diagrams (N/A & Europeen model)

CONTENT

FUSES AND RELAYS



Fuse No.	Rating	Colour	Circuit	Schematic N°
F1/A	15 A	Blue	Pilot control	**7**
F1/B	7.5 A	Brown	Fuel shut off, Antitheft supply	**1**
F1/C	10 A	Red	Stop light switch (S33)	**5**
F2/A	15 A	Blue	Instrument power supply, switches lamps, brake oil level sensor, seat, buzzer	**4**
F2/B	15 A	Blue	Not used	**-**
F2/C	20 A	Yellow	Preheating	**1**
F3/A	3 A	Violet	Rear right & front left side lights, Instruments illumination	**4**
F3/B	3 A	Violet	Front right & rear left side lights, licence plate light	**4**
F3/C	10 A	Red	S1, S4, S5, S6 & S11, switches	**7**
F4/A	5 A	Orange	Forward & reverse speed, reverse buzzer, speed switch	**2**
F4/B	10 A	Red	Rear hammer switch, Grab level valve and sensor, Clutch shut off switch	**2**
F4/C	10 A	Red	Rear working light switch (S12) & rear translation lock switch (S7) (Europeen model)	**6**
F5/A	15 A	Blue	Front working lights - internal	**6**
F5/B	10 A	Red	Traffic lights (Europeen model)	**4**
F5/C	15 A	Blue	Main beam (Europeen model)	**4**
F6/A	7.5 A	Brown	Beacon lamp	**7**
F6/B	7.5 A	Brown	Flasher (+15) (NA model)	**4**
F6/C	7.5 A	Brown	Hand hammer, 4WD	**2**
F7/A	10 A	Red	Warning, Horn (+30)	**4**
F7/B	10 A	Red	Not used	**-**
F7/C	6A	Black	Not used	**-**
F8/A	15 A	Blue	Rear working lights - external	**6**
F8/B	15 A	Blue	Front working lights - external	**6**
F8/C	15 A	Blue	Rear working lights - internal	**6**

RELAYS

N°	Circuit	Schematic N°	N°	Circuit	Schematic N°
K1	Forward-Reverse speed	**2**	**K7**	Rear working lights - internal	**6**
K2	Speed alarm, hand brake	**2**	**K8**	Front working lights - external	**6**
K3	Starting	**1**	**K9**	Rear working lights - external	**6**
K4	Grab level solenoid valve	**2**	**K10**	Reverse speed	**2**
K5	Traffic & main beam lights	**4**	**K11**	Forward speed	**2**
K6	Front working lights - internal	**6**	**K12**	Warning, flasher	**4**

BUZZER

BZ1	Audible warning buzzer

CONNECTORS

XC	Main harness connections into fuse board

COMPONENTS

BZ1 Alarm buzzer
EV0 Fuel shut off solenoid valve
EV1 Double delivery solenoid valve (Optional)
EV2 Hand hammer solenoid valve (Optional)
EV3 Rear hammer solenoid valve (Optional)
EV4 Rear translation solenoid valve (Europeen model)
EV5 Excavator rear lock solenoid valve (Optional)
EV6 Grab level solenoid valve
EV8 4WD solenoid valve (Optional)
EV9 Reverse speed solenoid valve
EV10 Forward speed solenoid valve
EV11 Ride control solenoid valve (Optional)
EV12 Tools solenoid valve (Optional)
FG1 General fuse 80 A
FG2 A/C fuse 10 A
G1 Battery
G2 Generator
H1 Excavator rear lock warning light (Optional)
H2 Front left light (Europeen model)
H3 Front right light (Europeen model)
H4 Rear left light (Europeen model)
H5 Number plate lamp (Europeen model)
H6 Rear right light (Europeen model)
H7 Front left indicator (NA model)
H8 Rear left light (NA model)
H9 Front right light (NA model)
H10 Rear right indicator (NA model)
H11 Front left external working light
H12 Front right external working light
H13 Rear left external working light
H14 Rear right external working light
H15 Beacon lamp
H16 Beacon lamp (Europeen model)
H19 Front left internal working light (optional)
H20 Front right internal working light (optional)
H21 Rear left internal working light (optional)
H22 Rear right internal working light (optional)
HA1 Reverse speed buzzer
HA2 Horn
K01 Starter relay
K02 A/C relay
K13 Antitheft unit
KC Fuse & relay board
KF Indicator flasher unit (NA model)
M1 Starter motor
R2 Engine water temperature sender
R3 Fuel level sender
S1 Cold start switch (Optional)
S2 4WD switch (Optional)
S3 Hand hammer switch (Optional)
S4 Double delivery switch (Optional)
S5 Ride control switch (Optional)
S6 Tools switch (Optional)
S7 Rear translation lock switch (Europeen model)
S8 Excavator rear lock switch (Optional)
S9 Light switch
S10 Warning switch
S11 Front working lights switch
S12 Rear working lights switch
S15 Beacon lamp switch
S17 Starting switch
S18 Hand brake switch
S20 Engine oil low pressure switch
S21 Air filter blocked switch
S24 Transmission oil pressure switch
S25 Transmission oil high temperature switch
S26 Clutch shut off switch
S27 Clutch shut off switch
S28 Grab sender
S29 Horn switch
S30 Rear hammer pedal switch (Optional)
S31 Brake oil level sender
S32 Stop light switch
S33 Stop light switch
S40 Gear shift switch
S41 Indicators switch (NA model)
S41 Lights switch (europeen model)
S42 Speedometer sender (Optional)
S44 Seat (Optional)
S47 Main switch
S48 Thermostat
S49 A/C pressure switch
S51 LH Stabilizer pressure switch
S52 RH Stabilizer pressure switch
ST1 Side panel with optional diagnostics
ST2 Front panel

CONNECTORS

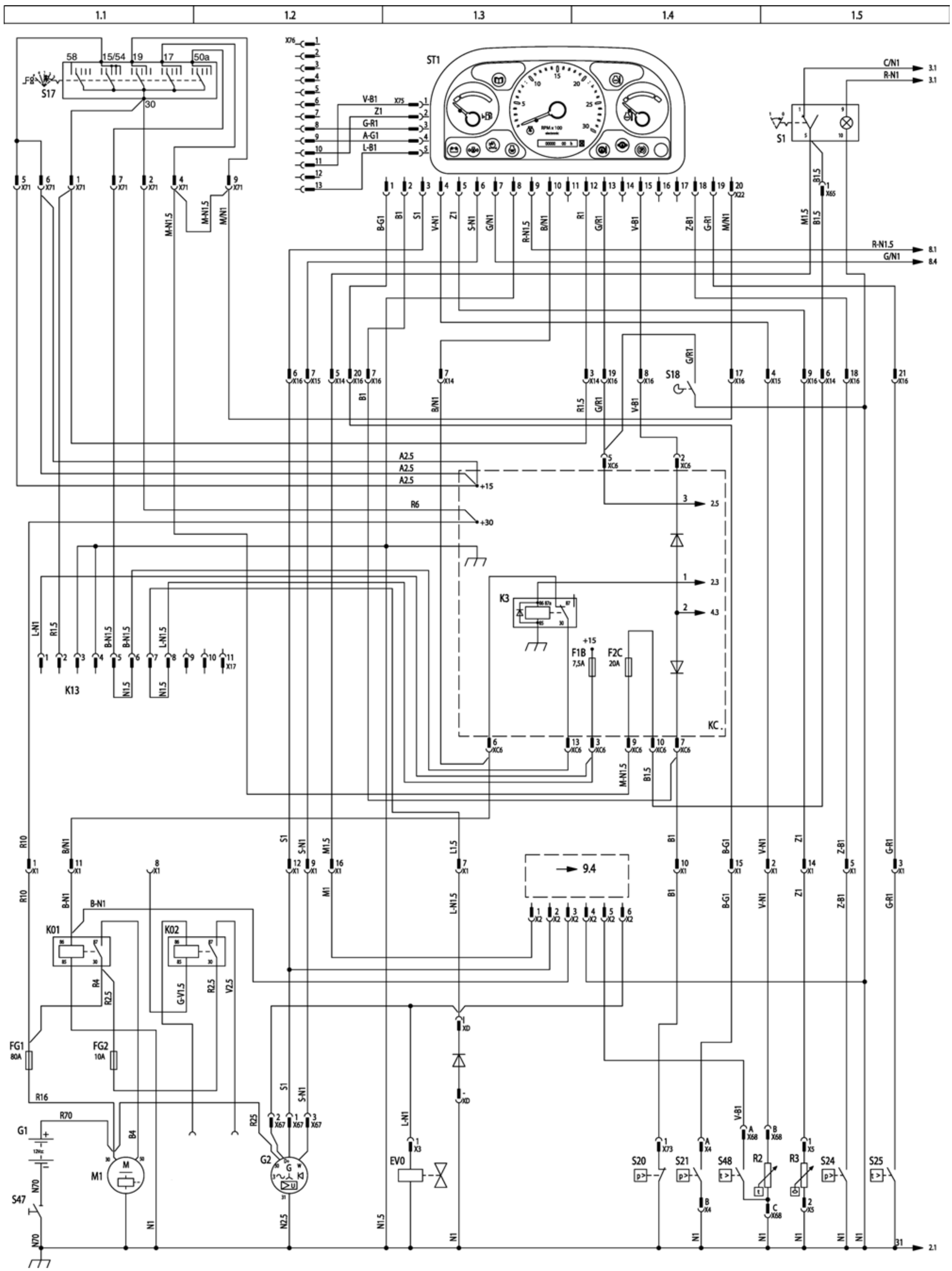
X1 General cable - Engine cable - 18 way connector
X2 Cold Start - 12 way connector
X3 Fuel shut off _ 1 way connector
X4 Air filter - 2 way connector
X5 Fuel level sender - 2 way connector
X6 Forward speed - 2 way connector
X7 Reverse speed - 2 way connector
X8 4WD - 2 way connector
X9 General cable - Front dashboard - 1 way connector
X10 Solenoid valves cable - General cable - 29 way connector
X11 1 way connector
X12 General cable - Cabin cable - 5 way connector
X14 General cable - side dashboard - 9 way connector
X15 General cable - side dashboard - 7 way connector
X16 General cable - side dashboard - 21 way connector
X17 Antithef - 11 way connector
X18 General cable - Rear lamps cable - 12 way connector (Europeen model)
X19 Reverse buzer - 2 way connector
X21 Seat - 4 way connector
X22 Side panel - 20 way connector
X23 Clutch shut off switch - 2 way connector
X24 Rear translation lock solenoid valve - 2 way connector
X25 Excavator rear lock solenoid valve - 2 way connector
X26 Grab sender - 3 way connector
X27 Horn switch - 2 way connector
X28 Clutch shut off switch - 2way connector
X29 Grab level - 2 way connector
X30 Double delivery solenoid valve -2 way connector
X31 Tools rapid connection solenoid valve - 2 way connector
X32 Rear hammer solenoid valve - 2 way connector
X33 Speedometer sender - 2 way connector
X34a Ride control solenoid valve - 2 way connector
X35 Hand hammer solenoid valve - 2 way connector
X36 Rear hammer button - 2 way connector
X37 Rear right light - 2 way connector (NA model)
X38 Rear right working light - 4 way connector
X40 Rear right working light (Opt) - 4 way connector
X42 Front right indicator - 4 way connector (NA model)
X44 Front right working light - 4 way connector
X45 Front right working light (Opt) - 4 way connector
X46 Rear left working light (Opt) - 4 way connector
X47 Rear left working light - 4 way connector
X48 Rear left light - 4 way connector (NA model)
X50 Front left working light (Opt) - 4 way connector
X51 Front left working light - 4 way connector
X52 Front left indicator - 4 way connector (NA model)
X59 Right light - 5 way connector (Europeen model)
X60 Horn / left light - 7 way connector
X61 Lights switch - 12 way connector
X62 Gear shift - 6 way connector
X63 Number plate light 2 way connector (Europeen model)
X64 Optional - 1 way connector
X65 Cold start switch - 1 way connector
X67 Generator - 3 way connector
X68 Engine water temperature sender - 3 way connector
X70 Front panel - 12 way connector
X71 Starting switch - 10 way connector
X72 Pilot control line - 1 way connector
X73 Engine oil pressure switch - 1 way connector
X75 Diagnostics - 5 way connector
X76 Diagnostics - 13 way connector
X77 Blower motor third speed - 1 way connector
X78 Left joystick - 2 way connector
X79 Horn jumper connection - 2 way connector
X80 Beacon lamp - 2 way connector
X81 Beacon lamp - 2 way connector (Europeen model)
X89 Front left lights - 6 way connector (Europeen model)
X100 Right joystick - 6 way connector
X101 Front right lights - 6 way connector (Europeen model)
X102 Controller - 10 way connector
X103 Relay - 2 way connector
X104 LVC unit - 23 way connector
X105 LH stab. pressure switch - 2 way connector
X106 RH stab. pressure switch - 2 way connector
X107 Pattern valve 1 - 2 way connector
X108 Pattern valve 2 - 2 way connector
X109 Mainfold power - 2 way connector
X110 RH tower line - 4 way connector
X111 Plug 4 LH Down - 2 way connector
X112 Plug 3 LH Up - 2 way connector
X113 Plug 6 RH Down - 2 way connector
X114 Plug 5 RH Up - 2 way connector
X115 Plug 7 Retract - 2 way connector
X116 Plug 8 Extend - 2 way connector
X117 LH stab. joystick - 3 way connector
X118 RH stab. joystick - 3 way connector
X119 Left joystick - 6 way connector

XA Horn - 2 way connector
XC1 On board - 11 way connector
XC2 On board - 7 way connector
XC3 On board - 21 way connector
XC4 On board - 21 way connector
XC5 On board - 17 way connector
XC6 On board - 13 way connector
XD Fuel shut off diode - 2 way connector
XP1 Pilot ON/OFF switch - 8 way connector
XP2 Pattern switch - 8 way connector
XS1 RH stab. pressure switch - 2 way connector
XS2 LH stab. pressure switch - 2 way connector

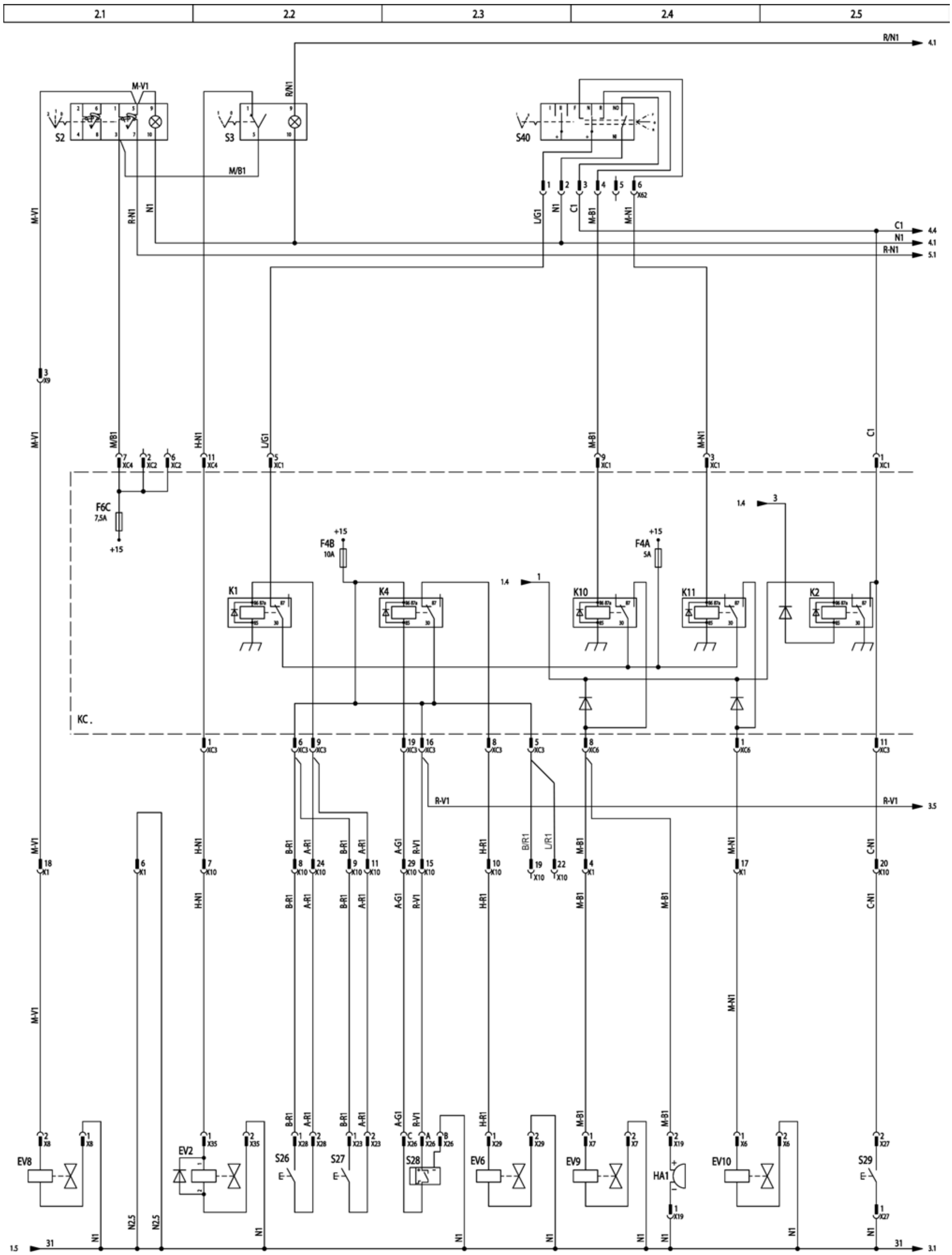
WIRE COLOURS:

A = LIGHT BLUE .... M = BROWN
B = WHITE........................ N = BLACK
C = ORANGE.................... R = RED
G = YELLOW.................... S = PINK
H = GREY .... V = GREEN
L = BLUE .... Z = VIOLET
Example of mixed colours
G/V = Yellow/Green (transverse colours)
G-V = Yellow-Green (longitudinal colours)

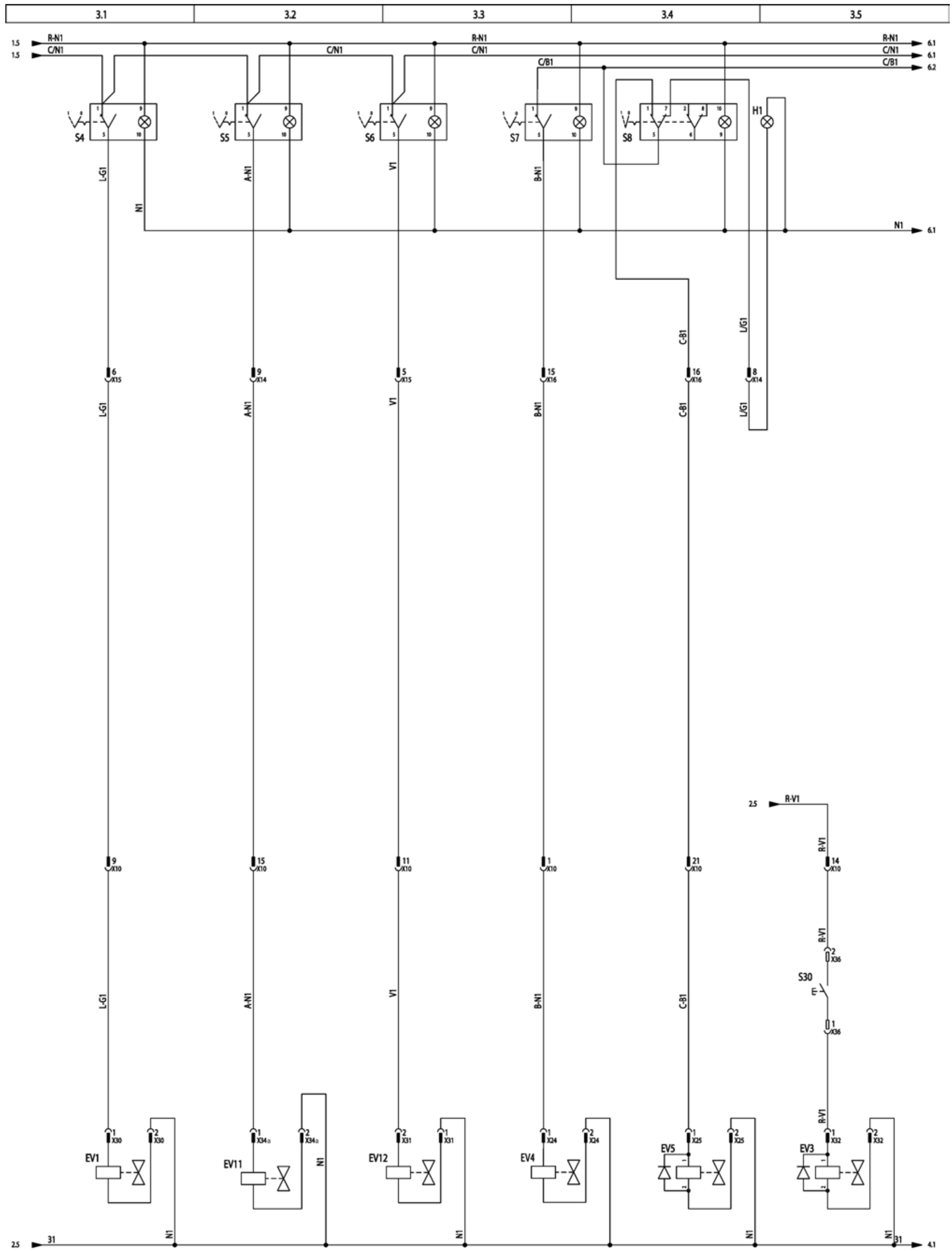
SYSTEM FROM KEY START (SCHEMATIC N°1)



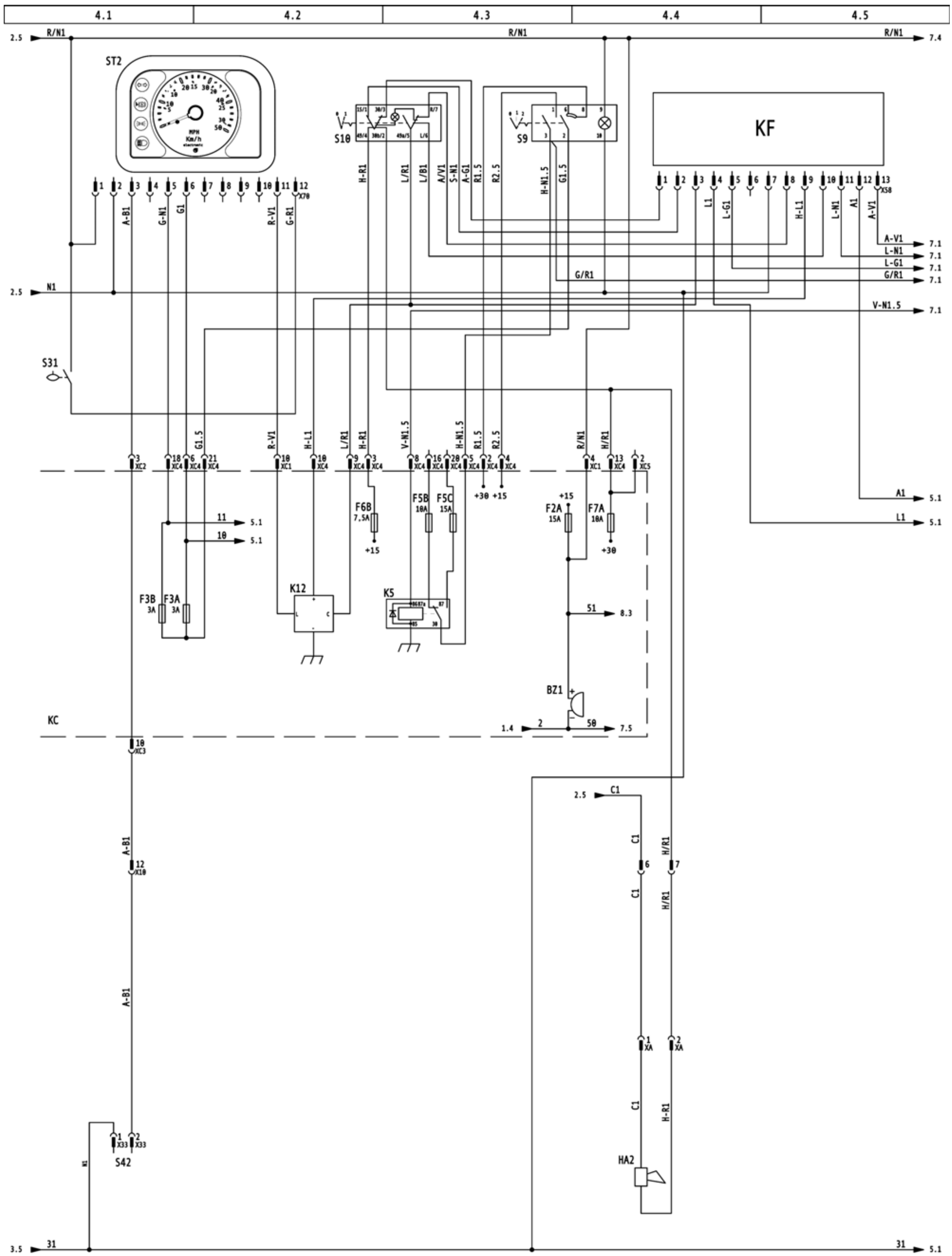
SOLENOID VALVES (SCHEMATIC N° 2)



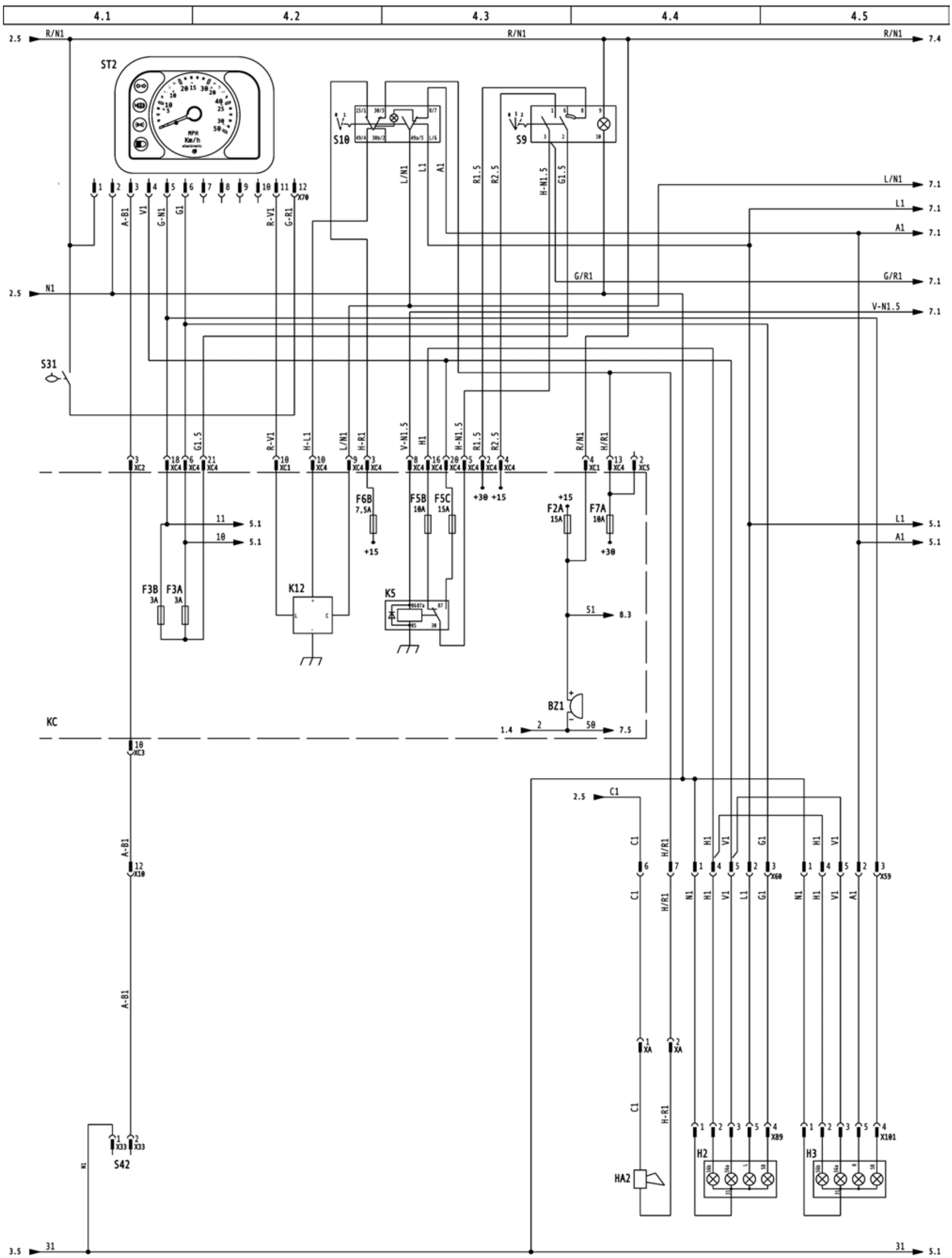
SOLENOID VALVES (SCHEMATIC N° 3)



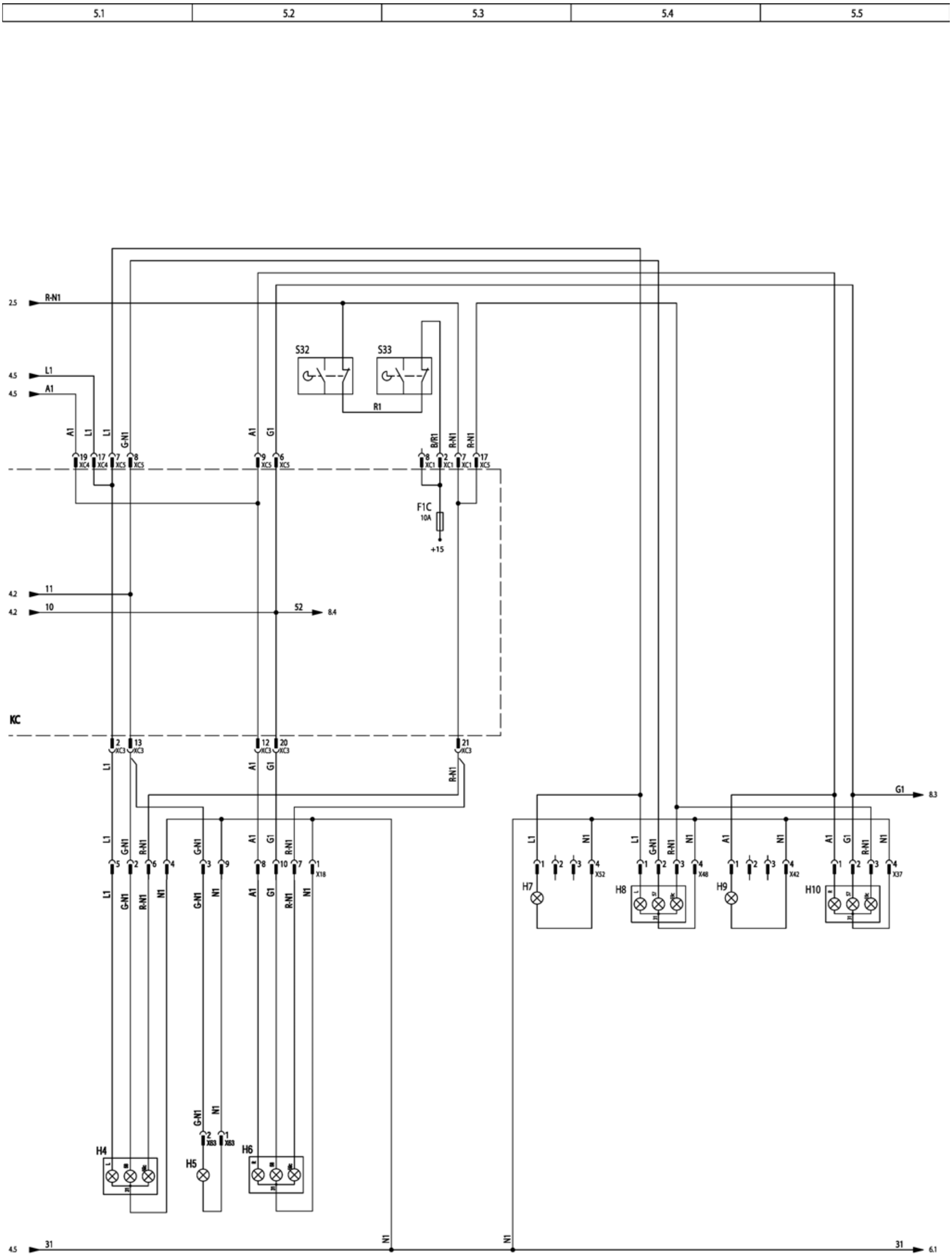
LIGHTS (SCHEMATIC N°4) N/A MODEL



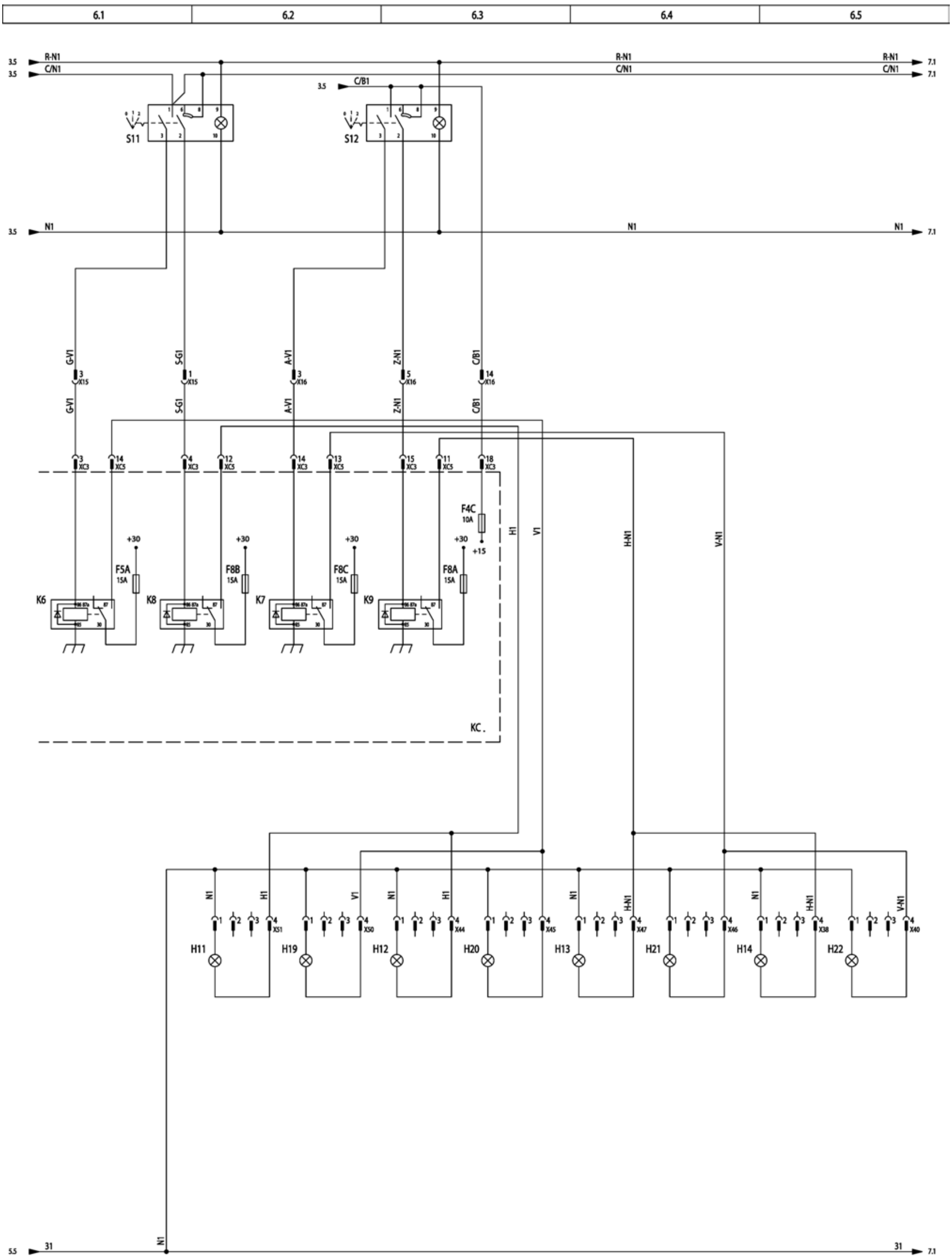
LIGHTS (SCHEMATIC N°4) EUROPEEN MODEL



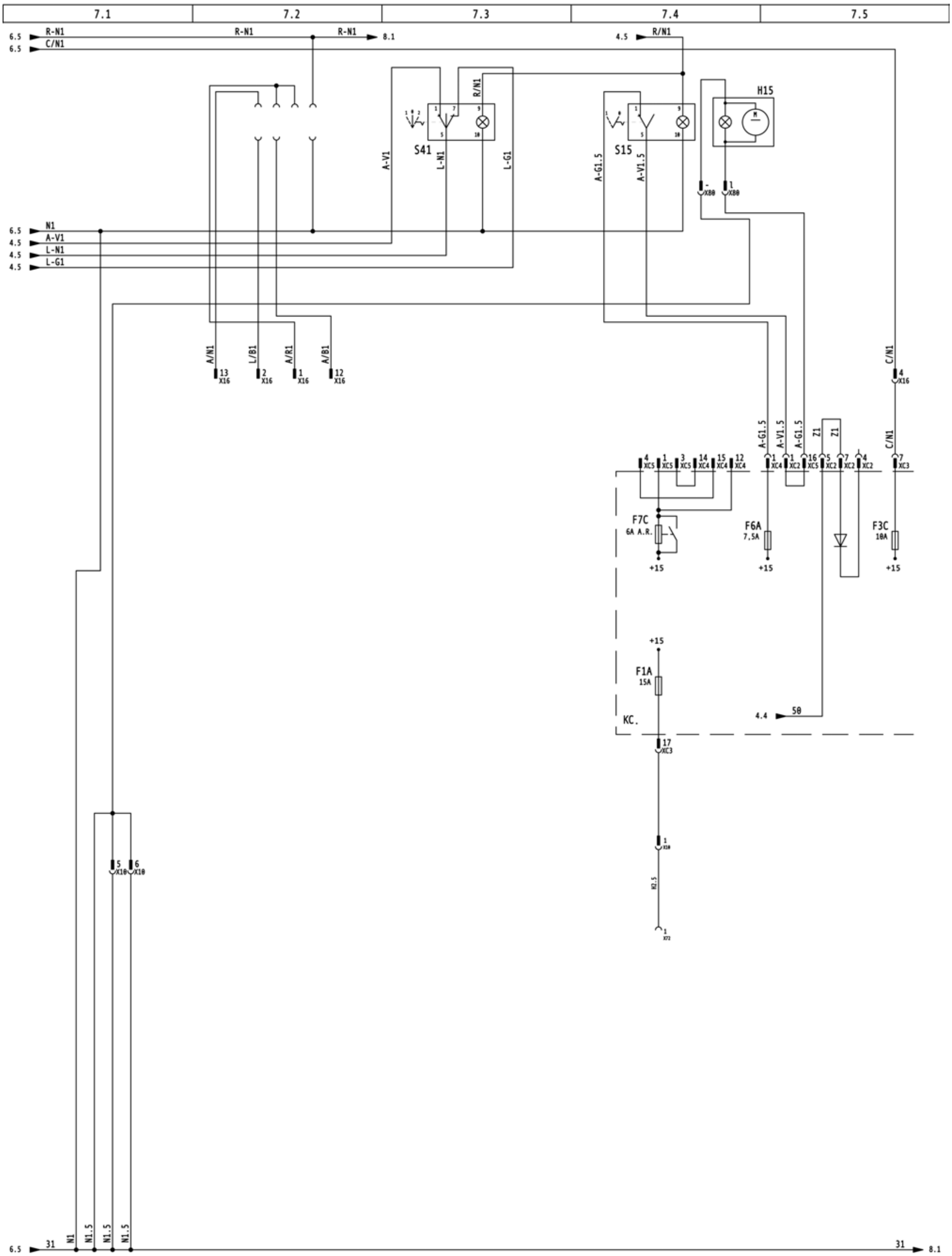
LIGHTS - REAR LIGHTS (SCHEMATIC N°5)



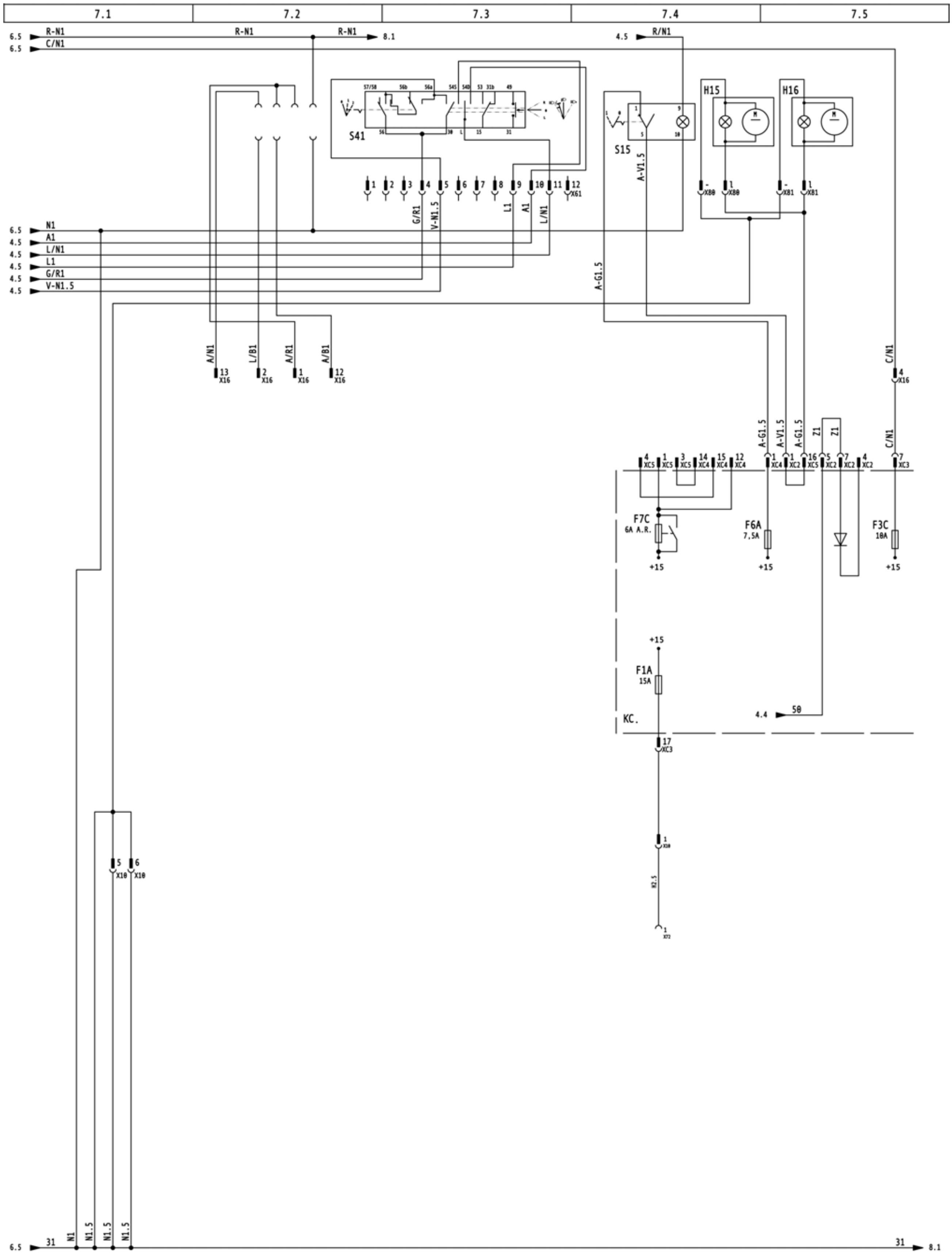
WORKING LIGHTS (SCHEMATIC N°6)



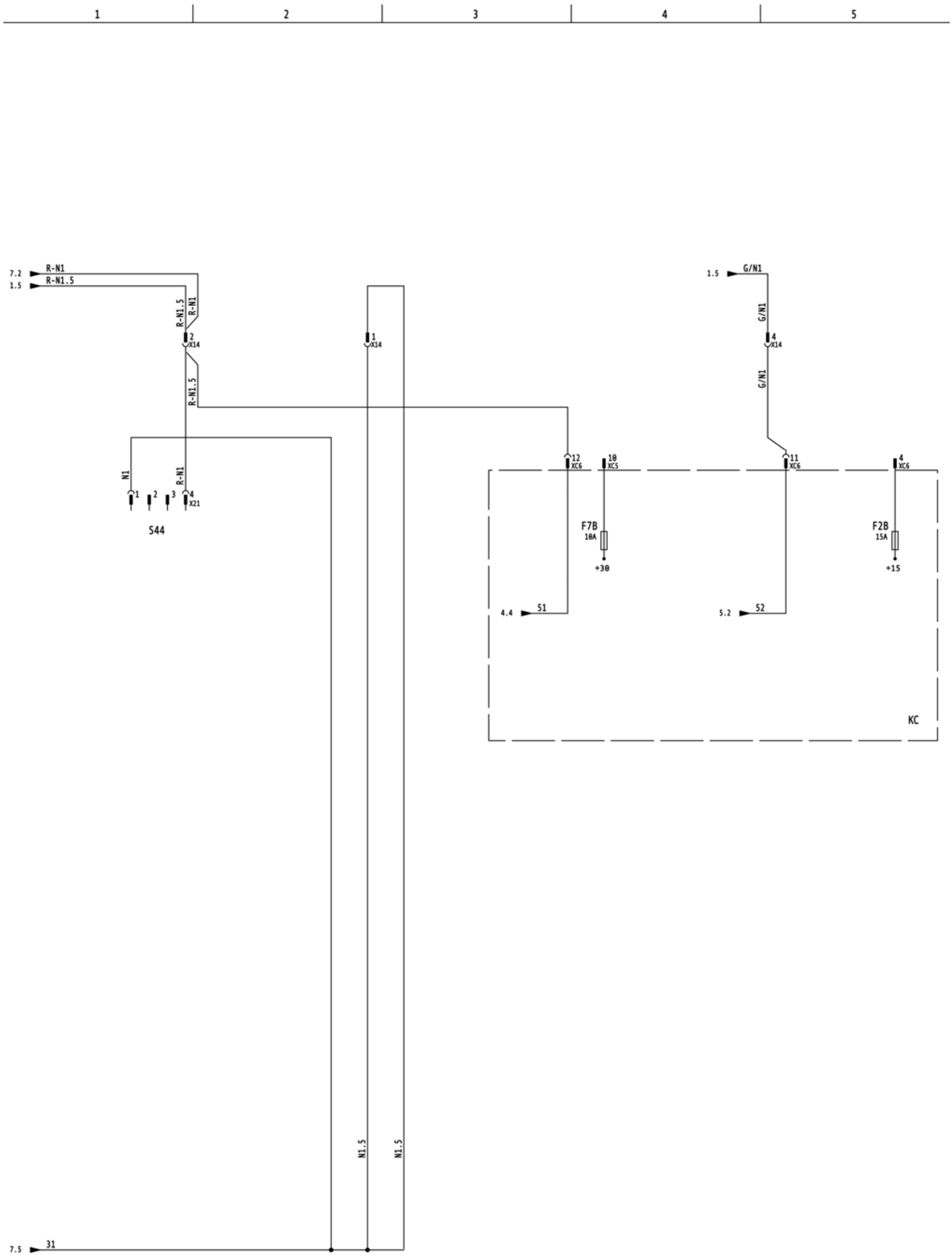
INDICATOR SWITCH & BEACON (SCHEMATIC N°7) N/A MODEL



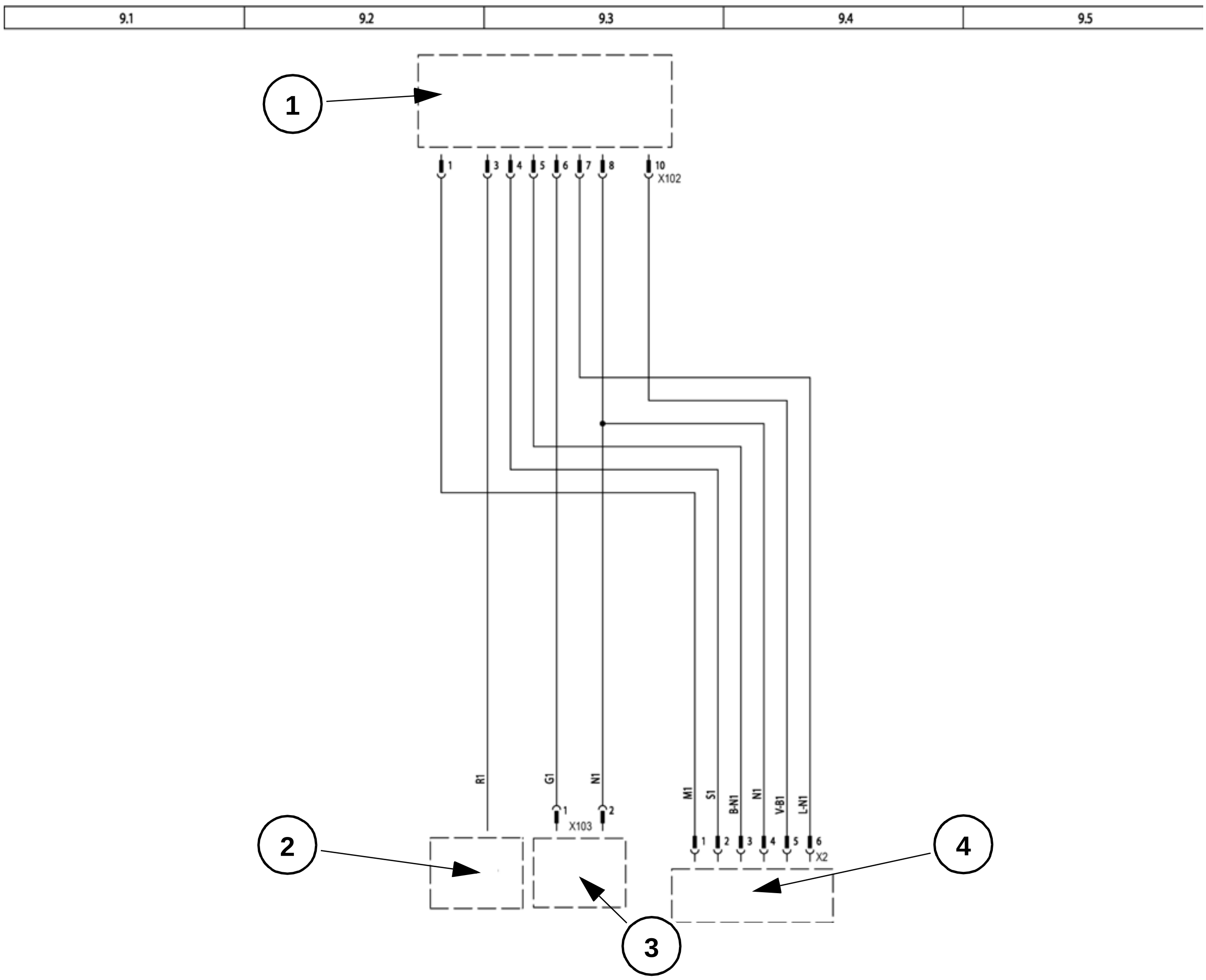
LIGHT SWITCH & BEACON (SCHEMATIC N°7) EUROPEEN MODEL



OPTIONAL SEAT (SCHEMATIC N° 8)

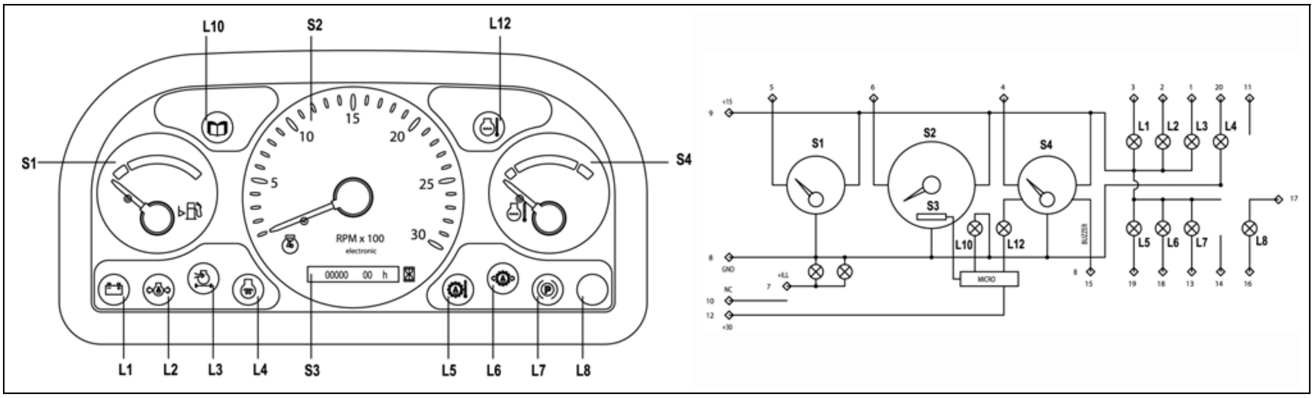


COLD START (SCHEMATIC N° 9)



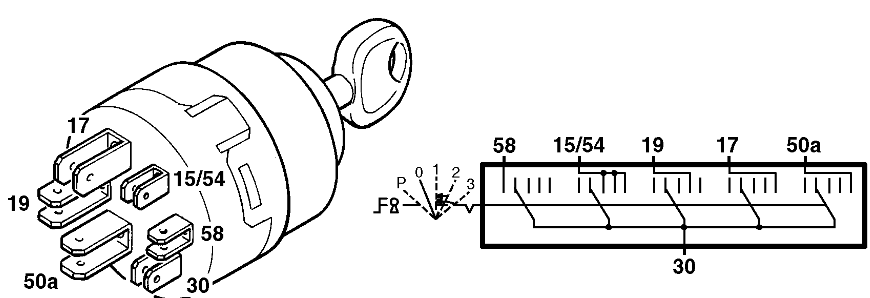
1 Controller
2 Grid Heater
3 Relay
4 To engine line (1.4)

SIDE INSTRUMENT PANEL



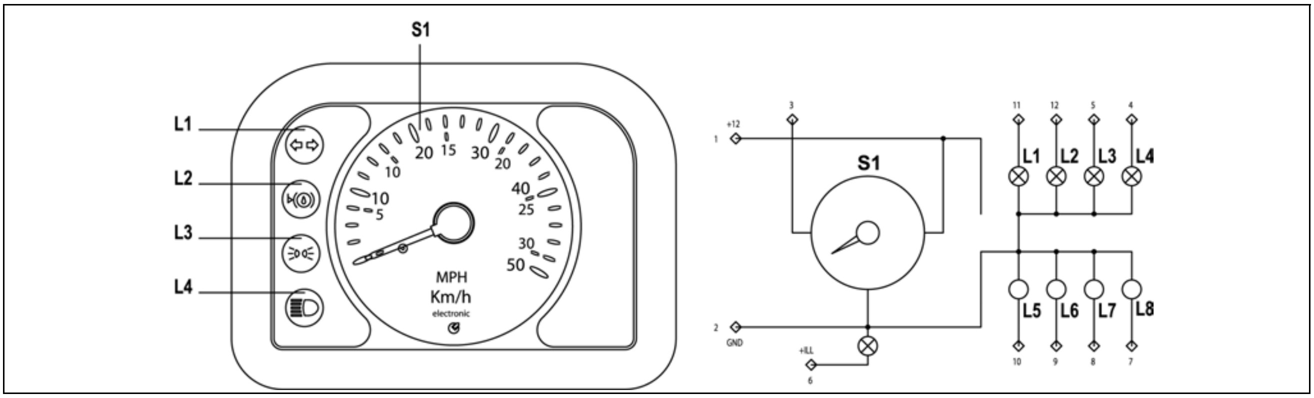
Pos.	Pin	Function	Signal	Pos.	Pin	Function	Signal
L3	1	Air cleaner lamp	-		11	NC	
L2	2	Engine oil pressure lamp	-	+30	12	Permanent supply voltage (+batt)	
L1	3	Generator lamp	-	L7	13	Handbrake lamp	
S4	4	Water temperature gauge	ohm		14	NC	
S1	5	Fuel level gauge	ohm	B	15	External buzzer driving	
S2	6	Tachometer	Hz	L8	16	Neutral red lamp	+/-
+ILL	7	Instrument lighting	+Lights	L8	17	Neutral red lamp	+/-
GND	8	Negative		L6	18	Transm. oil pressure lamp	-
+15	9	Positive		L5	19	Transm. oil temperature lamp	-
	10	NC		L4	20	Engine preheating lamp	+
L10		Service lamp	Int.	L12		Hight water temperature lamp	INT.

KEY START



30 - 58	No connection
30 - 15/54	OFF
30 - 19	Accessories
30 - 17	Preheat & Engine run
30 - 50a	Engine start

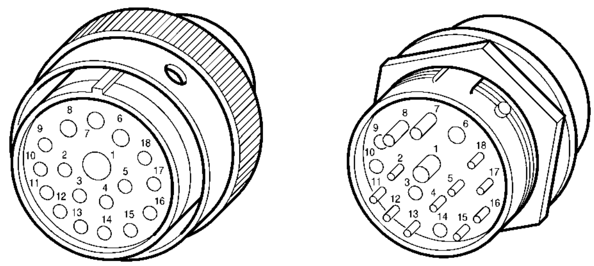
FRONT INSTRUMENT PANEL



Pos.	Pin	Function	Signal
+12	1	Positive (+12V)	
GND	2	Negative	
S1	3	Speedometer	Hz
L4	4	Driving beam lamp	+
L3	5	Position lights lamp	+
+ILL	6	Instrument lighting	+Lights
L8	7	NC	
L7	8	NC	
L6	9	NC	
L5	10	NC	
L1	11	Direction lamp	+
L2	12	Brake level oil lamp	+

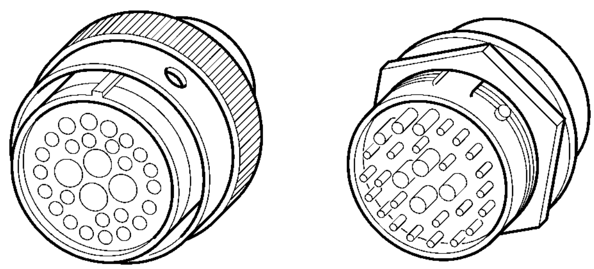
CONNECTOR

X1



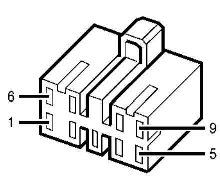
1	R 10	7	L 1.5	13	R-N 1
2	V-N 1	8	-	14	Z 1
3	G-R 1	9	S-N 1	15	B-G 1
4	M-B 1	10	B 1	16	M 1.5
5	Z-B 1	11	B/N 1	17	M-N 1
6	N 2.5	12	S 1	18	M-V 1

X10



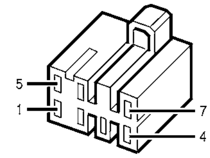
1	H 2.5	11	A-R 1	21	-
2	-	12	A-R 1	22	-
3	-	13	-	23	L-G 1
4	-	14	R-V 1	24	A-R 1
5	N 1.5	15	R-V 1	25	-
6	N 1.5	16	A-N 1	26	-
7	H-N 1	17	C-B 1	27	V 1
8	B-R 1	18	B-N 1	28	-
9	B-R 1	19	-	29	A-G 1
10	H-R 1	20	C-N 1		

X14



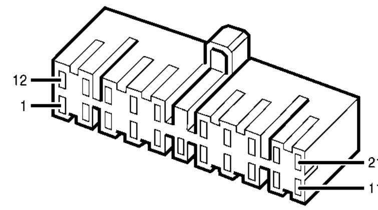
1	N 1.5	4	G/N 1	7	B/N 1
2	R-N 1.5		G/N 1	8	L/G 1
	R-N 1	5	M 1.5	9	A-N 1
3	R 1.5	6	B 1.5		

X15



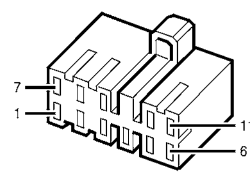
1	S-G 1	4	V-N 1	7	S-N 1
2	-	5	V 1		
3	G-V 1	6	L-G 1		

X16



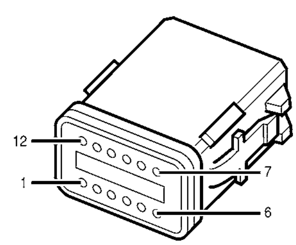
1	A/R 1	9	Z 1	16	C-B 1
2	L/B 1	10	-	17	M/N 1
3	A-V 1	11	-	18	Z-B 1
4	C/N 1	12	A/B 1	19	G/R 1
5	Z-N 1	13	A/N 1	20	B-G 1
6	S 1		A/N 1	21	G-R 1
7	B 1	14	C/B 1		
8	V-B 1	15	B-N 1		

X17



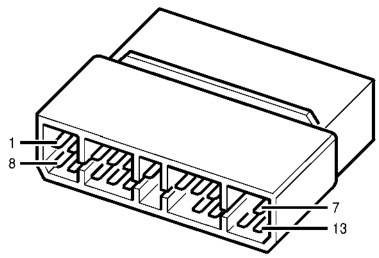
1	L-N 1	5	B-N 1.5	9	-
2	R 1.5	6	B-N 1.5	10	-
3	N 1.5	7	L 1.5	11	-
4	N 1.5	8	L-N 1.5		

X18



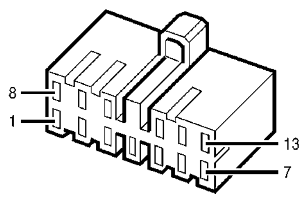
1	N 1	5	L 1	9	N 1
2	G-N 1	6	R-N 1	10	G 1
3	G-N 1	7	R-N 1	11	-
4	N 1	8	A 1	12	-

X22



1	B-G 1	8	N 1.5	15	V-B 1
2	B 1	9	R-N 1.5	16	-
3	S 1	10	B/N 1	17	-
4	G/R 1	11	-	18	Z-B 1
5	Z 1	12	R 1	19	G-R 1
6	S-N 1	13	G/R 1	20	M/N 1
7	G/N 1	14	-		

X58



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<tr><td>3</td><td>L/R 1</td><td>N 1</td><td>12</td><td>A1</td></tr>
<tr><td>4</td><td>L 1</td><td>8</td><td>A/V 1</td><td>13</td><td>A-V 1</td></tr>
<tr><td>5</td><td>L-G 1</td><td>9</td><td>H-L 1</td><td></td><td></td></tr>
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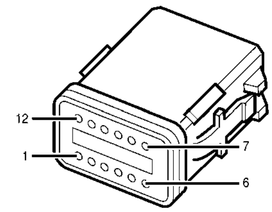
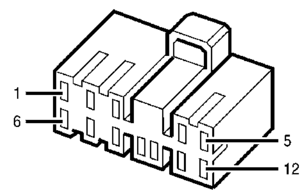
X61



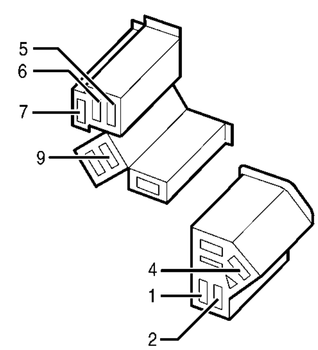
1	-	5	V-N 1.5	9	L-G 1
2	L-B 1	6	A/B 1	10	A-V 1
3	-	7	A/N 1	11	L-N 1
4	G/R 1	8	A/R 1	12	-

X70



1	R/N 1	5	G-N1	9	-
2	N 1	6	G 1	10	-
3	A-B 1	7	-	11	R-V 1
4	V 1	8	-	12	G-R 1

X71



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<tr><td>2</td><td>R 6</td><td rowspan="2">6</td><td>A 2.5</td><td>M/N 1</td></tr>
<tr><td>3</td><td>-</td><td>A 2.5</td><td>10</td><td>-</td></tr>
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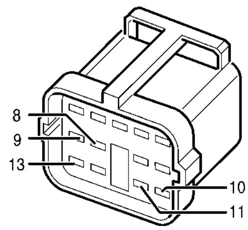
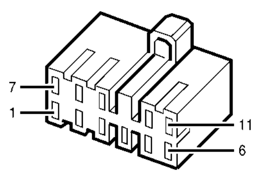
X76



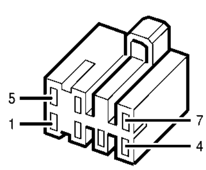
1	-	6	-	11	V-B 1
2	-	7	-	12	-
3	-	8	G-R 1	13	L-B 1
4	-	9	A-G 1		
5	-	10	Z 1		

XC1



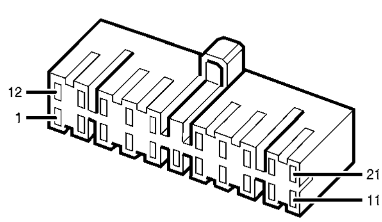
1	C 1	4	R/N 1	8	-
2	B/R 1	5	L-G 1	9	M-B 1
3	M-N 1	6	-	10	R-V 1
4	R/N 1	7	R-N 1	11	-

XC2



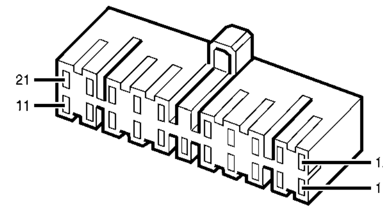
1	A-V 1.5	4	-	7	Z 1
2	-	5	Z 1		
3	A-B 1	6	-		

XC3



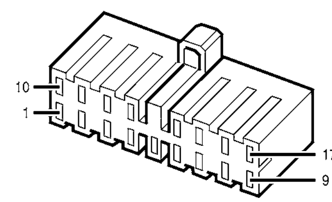
1	H-N 1	9	A-R 1	16	R-V 1
2	L 1		A-R 1		R-V 1
3	G-V 1	10	A-B 1	17	A/N 1
4	S-G 1	11	C-N 1	18	C/B 1
5	H 2.5	12	A 1	19	A-G 1
6	B-R 1	13	G-N 1	20	G 1
	B-R 1		G-N 1	21	R-N 1
7	C/N 1	14	A-V 1		R-N 1
8	H-R 1	15	Z-N 1		

XC4



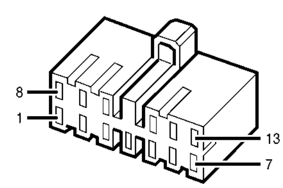
1	A-G 1.5	9	L/R 1	16	H 1
2	R 1.5	10	H-L 1		H 1
3	H-R 1	11	H-N 1	17	L 1
4	R 2.5	12	A/N 1	18	G-N 1
5	H-N 1.5	13	H/R 1	19	A 1
6	G 1		H/R 1	20	V 1
7	M/B 1	14	A/B 1		V 1
8	V-N 1.5	15	A/R 1	21	G 1.5

XC5



1	A/N 1	8	G-N 1	13	V-N 1
	A/N 1	9	A1	14	V 1
2	-		A1		V 1
3	A/B 1	10	R-N 1.5	15	-
4	R/N 1		B/R 1	16	A-G 1.5
5	-	11	H-N 1	17	R-N 1
6	G 1		H-N 1		R-N 1
	G 1	12	H 1		
7	L 1		H 1		
	L 1	13	V-N 1		

XC6



1	M-N 1	6	B/N 1	9	M-N 1.5
2	V-B 1		B/N 1	10	B 1.5
3	L-N 1	7	B 1	11	G/N 1
	L-N 1		B 1	12	R-N 1.5
4	Z 2.5	8	M-B 1		R-N 1
5	G/R 1		M-B 1	13	B-N 1.5

NOTES

SECTION 55 - ELECTRICAL CIRCUITS

Chapter 3 - Starter motor 2,7kW

CONTENTS

SPECIFICATIONS

Manufacturer	Denso
Voltage	12 V
Rated power	2.7 kW
Starting system	Positive
Operating time	30 s
Direction of rotation	Clockwise seen from the pinion side
Weight	8.4 kg
Maximum consumption without load at 11 V and 3000 rpm minimum	200 A maximum
Maximum consumption with a torque of 19.6 Nm at 8 V and 1130 rpm minimum	600 A maximum
Maximum consumption when shimming at 3 V with a torque of 39.2 Nm minimum	1400 A maximum

PRINCIPLE OF OPERATION

The system includes a key switch, reinforced cabling, a motor and a relay and solenoid assembly.

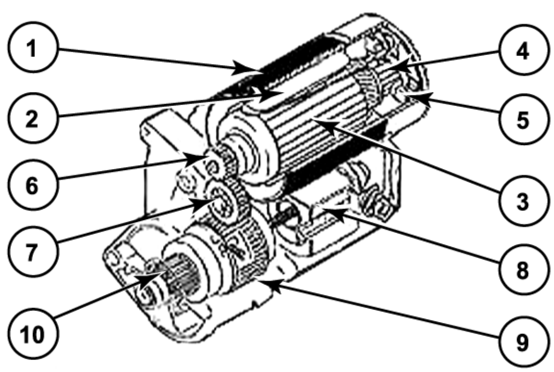
This is a starter motor with built-in solenoid and positive engagement drive system.

When the key switch is operated with the reverse travel lever in the neutral position, the solenoid windings are energised and cause the mobile core to be drawn inside the solenoid.

This movement causes the drive pinion to mesh with the ring gear on the engine flywheel. When the ring gear and the drive pinion are engaged, the mobile core of the solenoid closes a series of contacts enabling the battery to power the field coils directly and provide the entire power to the starter motor.

The starter motor contains only a single set of contacts and a mobile core, which closes the contacts completely, even if the teeth of the drive pinion and the gear are not aligned. In this case, a spring is compressed and forces the complete engagement of the pinion as soon as the starter motor starts rotating.

Once the ignition is turned off, the solenoid and the starter motor are de-energised. The solenoid's recoil spring causes the drive pinion to be uncoupled and the contacts of the solenoid to reopen.



CRIL03K011A01

1 Motor
2 Induction coils
3 Armature
4 Commutator
5 Brush assembly
6 Pinion gear
7 Intermediate pinion
8 Solenoid
9 Clutch
10 Drive pinion

TROUBLESHOOTING

THE MOTOR DOES NOT START IF THE IGNITION KEY IS OPERATED AND THE TRANSMISSION IS IN THE NEUTRAL POSITION

Is the battery properly charged?
NO → Charge or replace the battery
YES ↓

Check the starter motor cabling. Are there bad connections, cut or stripped cables?
YES → Repair or replace the cables
NO ↓

Is the starter motor seized?
YES → Repair or replace the starter motor
NO ↓

Operate the key switch. Is there a voltage of +12 V on the (white) wire at the input of the starter motor solenoid (terminal 30)?
YES → Does the solenoid make a "clicking" sound?
- YES → Windings, brush or starter motor mechanism possibly defective.
- NO → Solenoid possibly defective. Remove the starter motor and inspect

NO ↓

Check the starter motor relay (K01). Can one hear the relay operate after operating the key switch?
NO ↓

Remove the connector from the relay (K01). Is there a voltage of +12 V at terminal 86 (white/black) after the key switch is operated?
YES → Replace the relay
NO ↓

Check the starter motor safety relay (K3). Can one hear the relay operate after operating the reverse travel lever?
NO ↓

Remove the connector from relay K3. Is there a voltage of +12 V at terminal 86 (white/black) after the reverse travel lever is operated?
YES → Replace the relay
NO ↓

Are the cable wires of the reverse travel lever properly connected?
NO → Reconnect the wires to the switch
YES ↓

Does the reverse travel lever switch operate correctly?
NO → Replace the switch
YES ↓

Are the indicators on the instrument panel correctly lighted after operating the key switch?
NO → Check the main power supply between the battery and the starter motor key switch. Pin 2 (red wire) of the ignition key connector.
YES ↓

Are the cable wires of the key switch connected correctly?
YES ↓ Replace the key switch.
NO → Reconnect the wires to the key switch

CHECKING THE STARTER MOTOR CIRCUIT

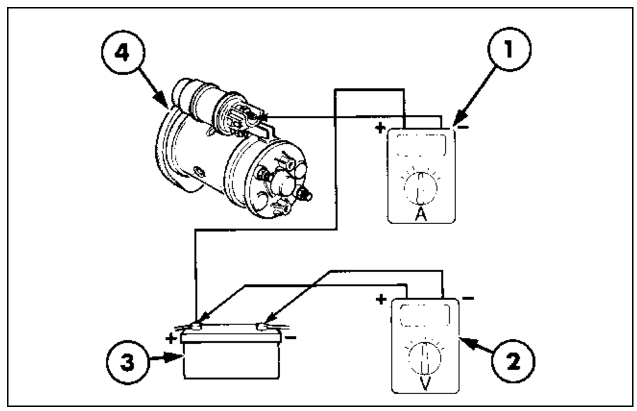
To troubleshoot the starter motor circuit rapidly and easily, it is recommended that a battery-starter motor testing device (quick discharge) be used, which includes a 0-20 V voltmeter and a 0-500 A ammeter to detect problems in the starter motor circuit.
Use a testing device in accordance with the manufacturer's instructions. If a testing device of the type indicated is not available, use a standard 0-20 V voltmeter and a 0-500 A ammeter to check the operation of the starter motor on the vehicle.
Before testing:

- Check that the battery is properly charged.
- Check the state of the starter motor circuit, by making sure that no wire is cut or stripped and that the connections are not loose.
- Check that the motor is not seized.

Current draw of the starter motor circuit:

1. Disconnect the earth cable (negative) from the battery (3).
2. Disconnect the positive cable from the battery on the solenoid of the starter motor. Connect the positive cable of the ammeter (1) to the positive terminal of the battery and the negative cable to the input terminal of the solenoid.
3. Reconnect the earth cable (negative) of the battery to the negative terminal of the battery.
4. Connect the positive cable of the voltmeter (2) to the positive terminal of the battery and the negative cable of the voltmeter to the negative terminal of the battery.
5. Disconnect the injection pump fuel inlet cut-off wire from the solenoid.
6. Start the motor and observe the values indicated by the voltmeter and ammeter. The voltage must remain steady at around 12 V with a current draw of 250 to 300 A.

- If the current draw is within the indicated range, the starter motor (4) is operating correctly. If the voltage reduces during the test, refer to the "Resistance of the starter motor circuit" section below.
- If the current draw is higher than the specified range, check the circuit as indicated below. If tests of the starter motor circuit have proved satisfactory, the starter motor is defective and must be removed in order to identify the source of the problem.
- If the current draw is less than the specified range, the starter motor is defective and must be removed in order to identify the source of the problem.



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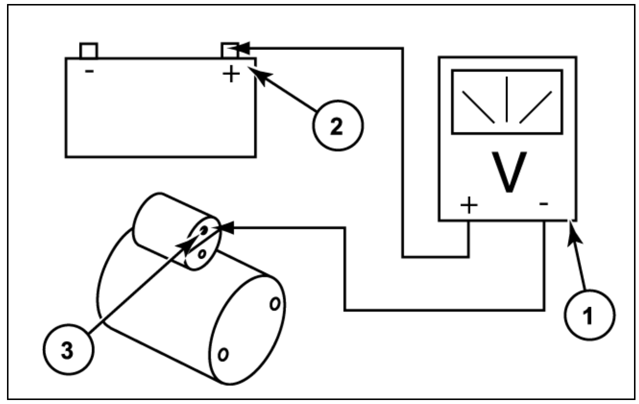
RESISTANCE OF THE STARTER MOTOR CIRCUIT (Voltage drop)

If the current draw is excessive, check the circuit by noting down the voltage drops at various components of the circuit.

IMPORTANT: *Disconnect the injection pump fuel inlet cut-off wire from the solenoid.*

Positive cable of the battery:

1. Connect the positive cable of the voltmeter (1) to the positive terminal of the battery (2).
2. Connect the negative terminal of the voltmeter (1) to the terminal connected to the battery of the starter motor solenoid (3).
3. Start the starter motor and observe the reading on the voltmeter. If the voltage drop is greater than 0.2 V, check and retighten the cable connections. Check the voltage again. If it is still excessive, replace the cable.



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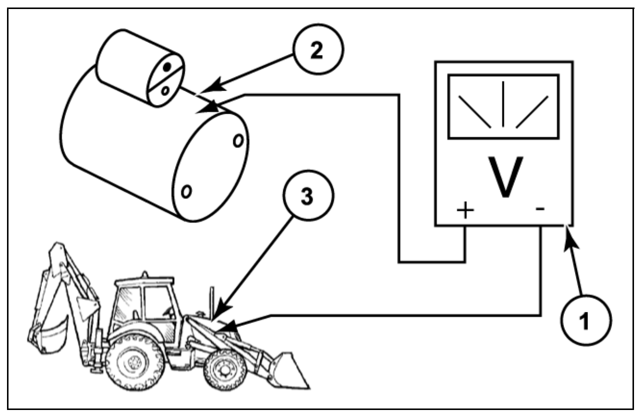
Connections to the starter motor ground:

1. Connect the positive cable of the voltmeter (1) to the body of the starter motor (2).
2. Connect the negative cable of the voltmeter (1) to the motor block (3).
3. Start the starter motor and observe the reading on the voltmeter. If the voltage drop is greater than 0.2 V, check and retighten the cable connections, check the ground connections between the starter motor clamp and the undercarriage.



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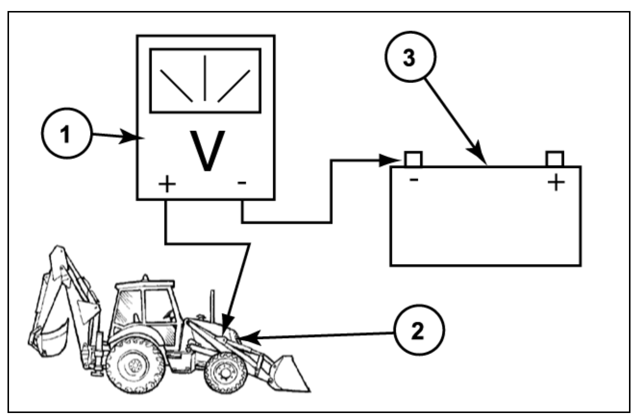
Earth cable of the battery:

1. Connect the positive cable of the voltmeter (1) to the motor block (2).
2. Connect the negative cable of the voltmeter (1) to the negative terminal of the battery (3).
3. Start the starter motor and observe the reading on the voltmeter. If the voltage drop is greater than 0.2 V, check and retighten the earth cable connections. Check the voltage again. If it is still excessive, replace the earth cable.



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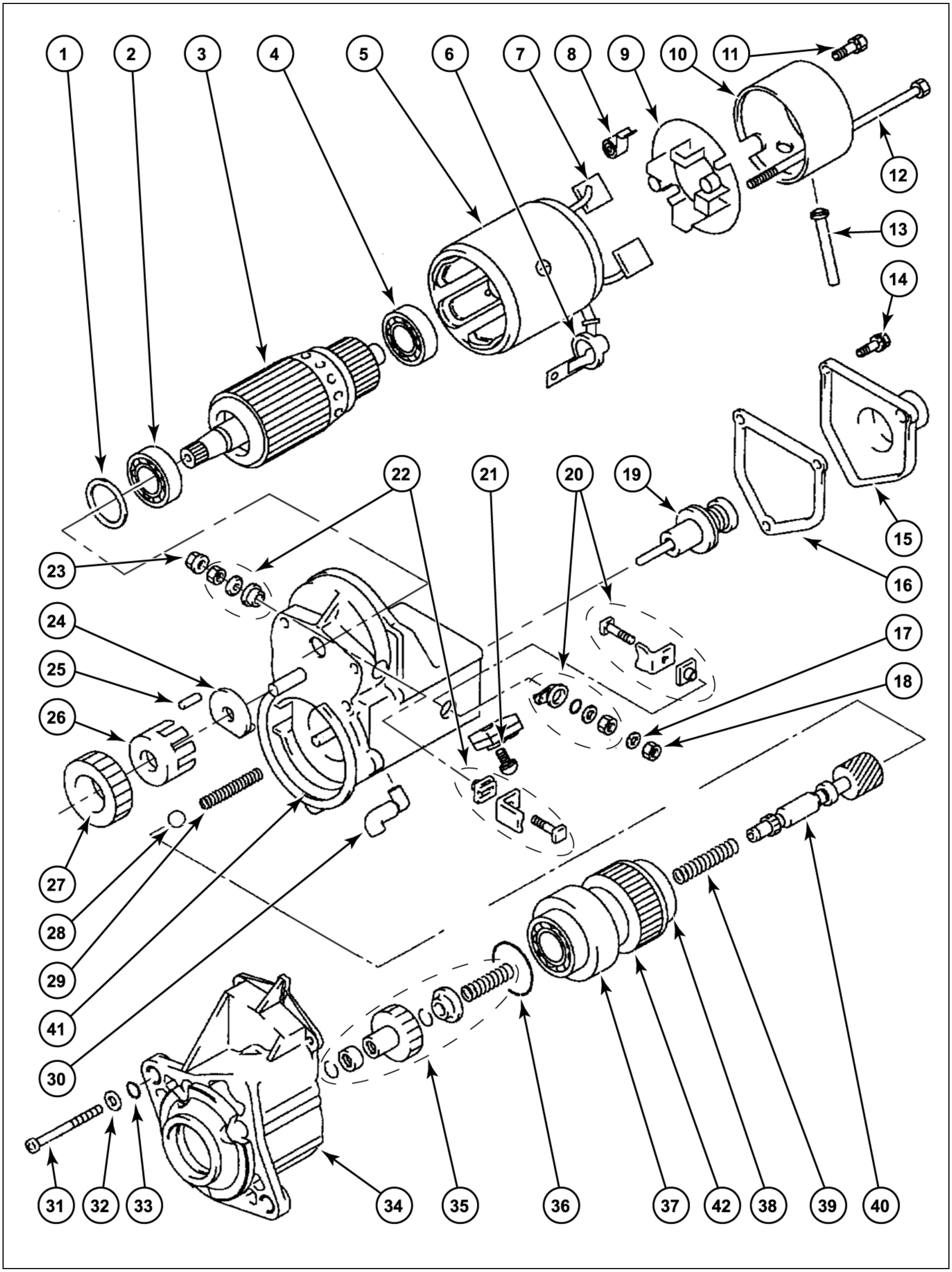
STARTER MOTOR - EXPLODED VIEW



CRIL03J179H01

1 Felt washer
2 Ball bearings
3 Armature
4 Ball bearings
5 Housing and induction coils assembly
6 Protection
7 Brush assembly
8 Brush spring
9 Brush bracket
10 Rear protective cover
11 Screw and washer
12 Screw
13 Ventilation drain of the rear hood
14 Screw and washer
15 Solenoid hood
16 Union
17 Spring washer
18 Nut
19 Push-rod
20 Connection assembly
21 Screw
22 Connection assembly
23 Nut
24 Retaining ring
25 Roller
26 Roller cage
27 Pinion
28 Ball
29 Spring
30 Ventilation drain of the solenoid housing
31 Screw
32 Flat washer
33 O-ring
34 Starter motor box
35 Pinion, rings and spring assembly
36 Union
37 Ball bearings
38 Ball bearings
39 Spring
40 Shaft pinion
41 Solenoid housing
42 Clutch assembly

REMOVING AND INSTALLING THE STARTER MOTOR

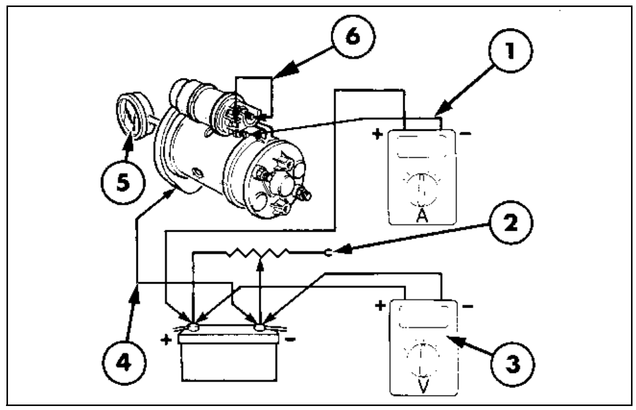
1. Disconnect the earth cable (negative) from the battery.
2. Remove the rear protective cover and disconnect all cables connected to the starter motor.
3. Remove the three retaining bolts of the starter motor and remove the starter motor.
4. To install the starter motor, proceed in the reverse order to that of removal.

TEST BENCH CHECK

Checking the starter motor without load

NOTE: *Before carrying out the test, check that the battery is fully charged then obtain a battery-starter motor testing device (quick discharge) and a carbon cell (variable load resistance).*

1. Lock the starter motor in a vice with soft jaws.
2. Connect the negative cable (4) of the battery to the mounting clip of the starter motor.
3. Connect a short cable (6) between the solenoid battery wire and the terminals of the solenoid switch.
4. Connect the positive cable of the voltmeter (3) to the positive terminal of the battery, the negative cable of the voltmeter to the negative terminal of the battery, the positive cable of the ammeter (1) to the positive terminal of the battery and the negative terminal of the ammeter to the terminal of the battery or the starter motor.
5. Install a tachometer (5) at the end of the armature shaft. Activate the starter motor by adjusting the carbon cell (2) to obtain a voltage of 11 V. When the armature is rotating at 3000 rpm, the maximum current draw must not exceed 200 A.
6. If the starter motor does not fulfil these conditions, check that the field coils are not grounded, that the armature is not rubbing and that its shaft is not deformed.



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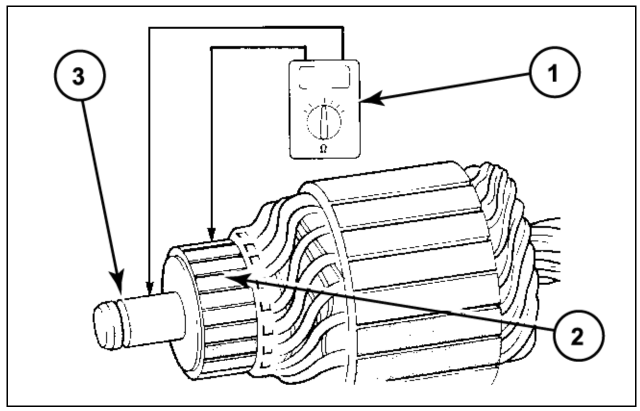
Armature

1. The surface of the commutator must be clean and without traces of burns. If necessary, remove traces of burns using fine sandpaper. Do not use emery cloth. Then, clean the commutator with a cloth soaked in gasoline.
2. After rectifying the commutator, polish it with fine sandpaper, then wipe it with a cloth soaked in gasoline.

NOTE: *Make sure not to graze the metal of the commutator during rectification of insulating notches.*

3. The resistance of the armature insulation may be checked by connecting an ohmmeter (1) between the blades of the commutator (2) and the armature shaft (3). The resistance must be infinite (no continuity).
4. To check that the armature is not short-circuited, a special device for armatures must be used. The other solution is to replace the armature.
5. If the circumference of the armature has come into contact with the starter pole shoes, the bearings of the armature are probably excessively worn out. First check that the starter pole shoes have been tightened and that the armature rotates without any concentric defect. If necessary, replace the armature bearings.



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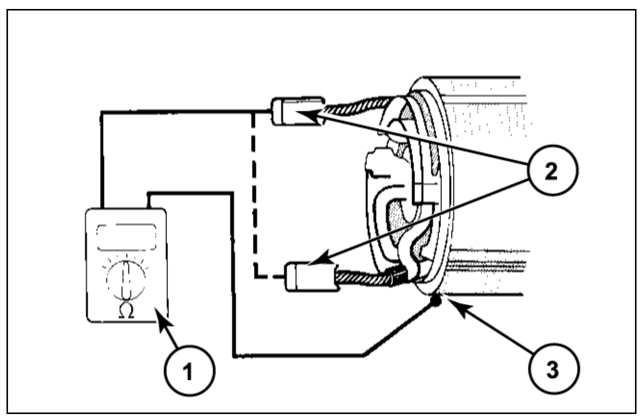
Field coils

1. To check the resistance of the field coil insulation, connect an ohmmeter (1) between the brushes of each induction coil (2) and a clean unpainted area of the body (3). The resistance must be infinite (no continuity).
2. To check the continuity of the field coils, connect an ohmmeter between the brushes of each induction coil and the main supply terminal (the thickest braided wire). The resistance must be equal to 1 MΩ.
3. If the field coils are defective, the entire assembly consisting of the body and the field coils must be replaced.



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Drive pinion

1. The drive pinion must only rotate clockwise. If the pinion is seized or turns in both directions or if its teeth are damaged, change the complete drive assembly.

NOTE: *If the teeth of the drive pinion are damaged, also check the teeth of the engine flywheel ring gear, as described in section 10 "Motor circuit".*

NOTES

SECTION 55 - ELECTRICAL CIRCUITS

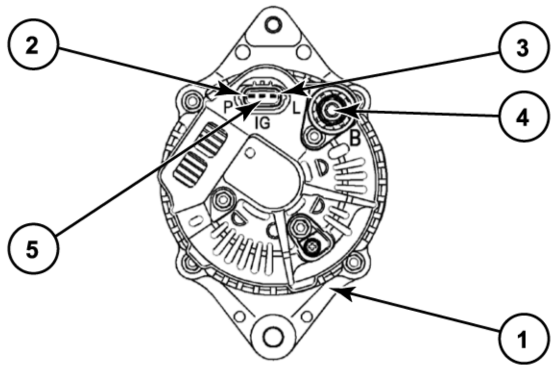
Chapter 4 - Alternator 90A

CONTENTS

SPECIFICATIONS

Manufacturer	Denso
Rated voltage	12 V
Polarity	Negative terminal grounded
Current	90 A
Minimum charging speed	1400 rpm
Maximum speed	9000 rpm
Operating temperature	-30°C to 90°C (-22°F to 194°F)
Direction of rotation	Clockwise seen from the pulley side
Regulated voltage at 5000 rpm with 10 A at 25°C (77°F)	14.2 - 14.8 V
Maximum load that can be applied at terminal L	12V, 3.4 W x 6

DESCRIPTION AND PRINCIPLE OF OPERATION



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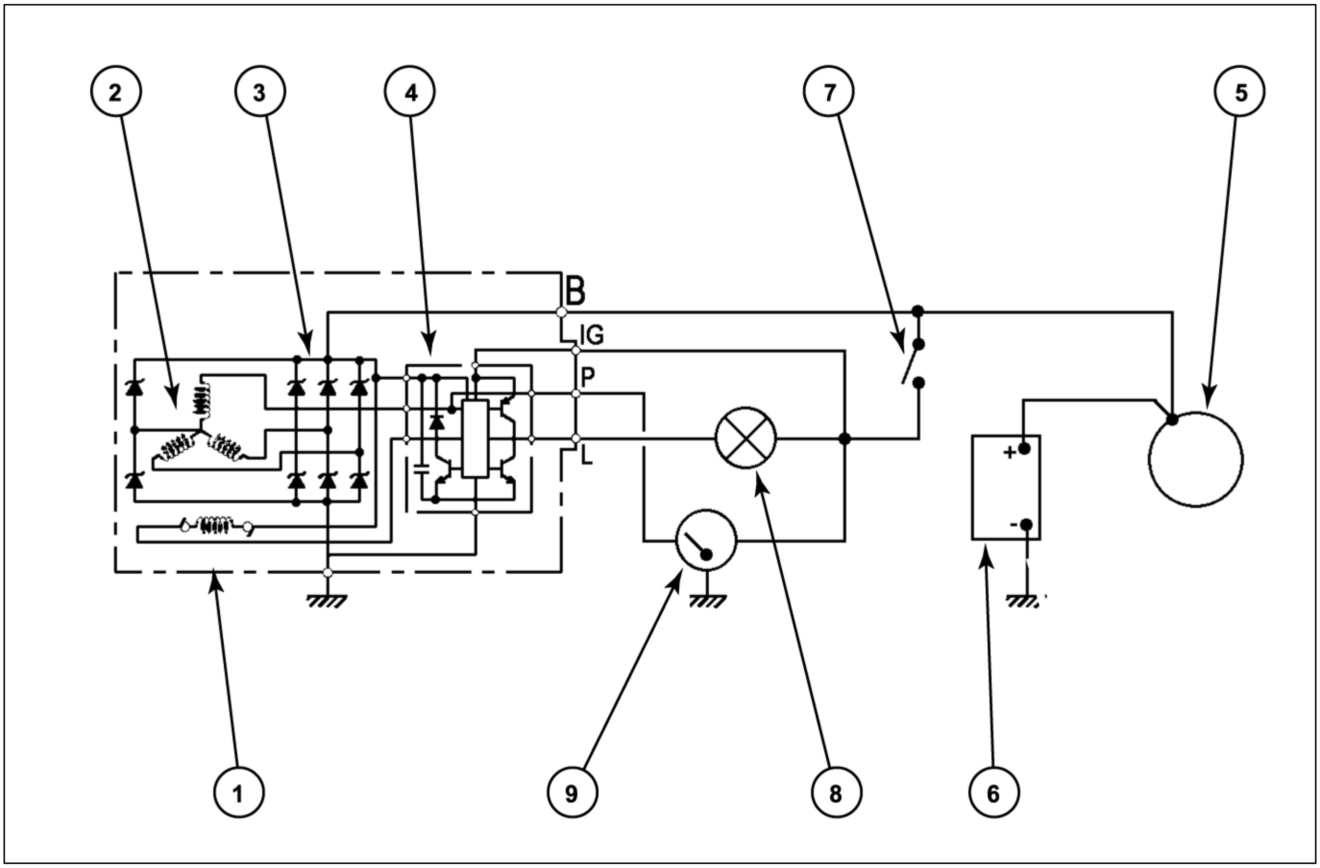
1. **1** Earth connection
2. **2** Terminal **P**: motor tachometer
3. **3** Terminal **L**: charge indicator
4. **4** Terminal **B+**: charge +12V
5. **5** Terminal **IG**: +12V after ignition (10A fuse)

The alternator, installed on the motor, on the front RH side of the vehicle, is driven by the crankshaft pulley with the help of a belt. The alternator contains built-in regulators.

Current draw of the starter motor circuit:

When the ignition key is turned, a current of low intensity is sent by the battery to the field winding of the rotor (terminal IG).
At this stage, the indicator lamp (terminal L) comes on and the rotor is partially magnetised.
When the motor starts and the partially magnetised rotor rotates inside the stator, a three-phase alternating current is generated (terminal B+). A constant portion of this current is transformed into a direct current by three excitation diodes installed in the rectifier.
The direct current is sent as reinforcement through the field winding of the rotor.
Using this method an increase in the magnetic field of the rotor is obtained, as well as a rapid rise in the voltage and current generated at the output.
The luminosity of the indicator lamp decreases when the voltage generated at the output is increasing (terminal L). The indicator lamp goes out when the voltage at terminal "L" is equal to that of the battery.
The voltage continues to increase up to the value predefined by the regulator.
In case the alternator belt is broken, the voltage does not accumulate in the alternator and the load indicator lamp remains lighted to indicate the problem.

CHECKING THE CHARGING CIRCUIT



CRIL03K019F01

1 Alternator
2 Output winding of the rotor
3 Rectifier
4 Regulator
5 Starter motor
6 Battery
7 Key switch
8 Charge indicator
9 Motor tachometer

TROUBLESHOOTING

PRECAUTIONS TO BE TAKEN DURING MAINTENANCE

To prevent damage to components of the alternator charging circuit, the following precautions must be taken during maintenance:

- **NEVER** connect or disconnect a charging circuit connection, including the battery, when the motor is running.
- **NEVER** dead short to earth any component of the charging circuit.
- **ALWAYS** disconnect the earth cable from the battery (negative) to recharge the battery on the vehicle using a battery charger.
- **ALWAYS** respect the polarity when connecting the battery on the vehicle or when connecting an auxiliary starter battery to the motor.

IMPORTANT: *CONNECT THE POSITIVE CABLE TO THE POSITIVE TERMINAL AND THE NEGATIVE CABLE TO THE NEGATIVE TERMINAL*

PRELIMINARY CHECKS

Before undertaking an electrical inspection, check the charging circuit and the electrical circuit carefully.

Check the state of cables and the tightening of connections.

1. **Checking the battery**

Check each cell of the battery with a hydrometer. The battery must be charged at least 70% and be in good condition.

2. **Checking the drive belt**

Check that the belt and the pulley of the alternator are clean, without any trace of oil and grease and that they are in good condition.

CHECKING THE INDICATOR LAMP

Turn the ignition key and check that the charge indicator is well lit.

If it is not fully lighted, check its bulb. If the bulb is OK, check the alternator wire connections as described in the "Preliminary tests" section below.

If the indicator lamp is lighted, start the motor and run it at a speed that is higher than the idling speed. The indicator lamp must go out.

If the indicator lamp does not go out, turn off the motor and disconnect the earth cable L. If the indicator lamp goes out, an alternator component is defective. Follow the instructions given in the "Checking the alternator components" section below.

If the indicator lamp stays lighted, look for a dead short to earth between the terminal "L" cable and the indicator lamp.

PRELIMINARY TESTS

The preliminary tests may be carried out without removing the charging circuit components, these tests help check the following items:

- Connections of the alternator cables
- Charging current and regulated voltage of the alternator
- Voltage drops in the alternator charging circuit
- Maximum flow of the alternator

Required devices:

- Voltmeter (0-30 V, moving coil)
- Millivoltmeter (0-1 V)
- Ammeter (0-110 A, moving coil)
- Variable resistance of 1.5 Ohm, 110 A

NOTE: *Most testing instruments sold in shops group together several measurement functions in a single device. Use these devices in accordance with the manufacturer’s instructions.*

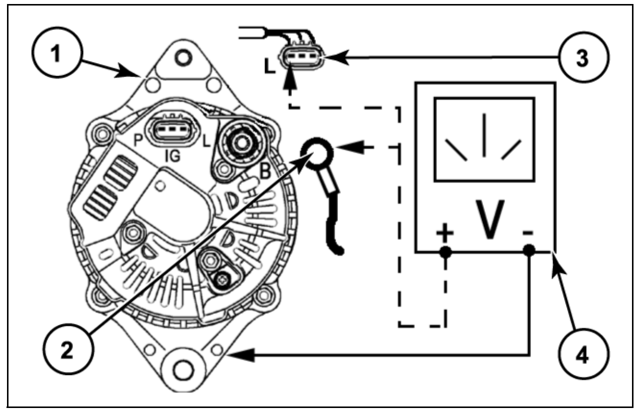
CHECKING THE CONNECTIONS OF THE ALTERNATOR CABLES

1. Disconnect the battery
2. Disconnect the terminals B+ (2) and L (3) from the alternator.
3. Reconnect the battery and turn the ignition key without starting the motor. Connect a voltmeter (4) between each terminal (B+ or L) and the earth (1). The voltmeter must show the battery voltage.

If there is no battery voltage, the external cable has a continuity fault; in this case, check the entire circuit and carry out the necessary repairs.

4. Connect the terminal L indicator lamp wire to the earth. The indicator lamp should come on.
5. Disconnect the battery and reconnect the cables to the alternator.

NOTE: *If the indicator lamp does not come on after having reconnected the alternator, the regulator of the alternator or the rotor circuits is defective. Make sure that terminal L is clean, then check the components of the alternator as indicated in this chapter*



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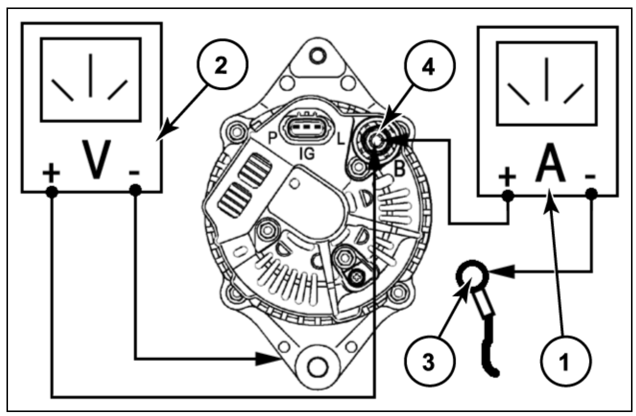
Checking the charging current and the regulated voltage

1. Make sure that all electrical components are powered off and that the ignition is turned off (key on "off").
2. Disconnect the negative terminal from the battery and disconnect terminal B+ (4) from the alternator.
3. Connect an ammeter (1) between the disconnected cable (3) and terminal B+ of the alternator.
4. Connect a voltmeter (2) between terminal B+ of the alternator and the earth.
5. Reconnect the battery. Start the motor and run it at a speed of 2000 rpm. Observe the values shown on the ammeter and the voltmeter



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The voltage shown on the voltmeter should at first be too high and then should stabilise between 14.2-14.8 V when the value on the ammeter drops below 10 A.
If the voltmeter stabilises at a voltage greater than 14.8 V, the regulator of the alternator needs to be replaced (after replacing the alternator, carry out checks 4 and 5).
On the other hand, if the voltmeter stabilises below 14.2 V, a component of the alternator is defective or the resistance in the external connections of the charging circuit is too high.
If the ammeter indicates zero amps, an alternator component is defective. Turn off the motor and carry out the operations described in the "Checking the alternator components" section in this chapter.

Check the voltage drops in the charging circuit

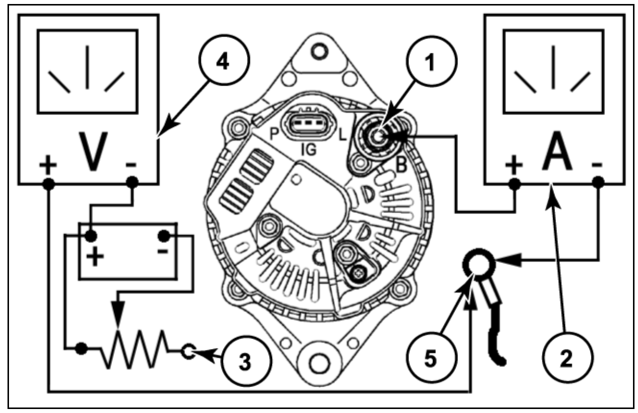
(a) Voltage drops on insulated side

Check that the ignition is turned off (key on "off").

1. Disconnect the negative cable from the battery and disconnect cable B+ (1) from the alternator.
2. Connect a millivoltmeter (4) between the positive terminal of the battery and cable B+ (5) (positive side on cable).
3. Connect an ammeter (2) between terminal B+ of the alternator and cable B+ (negative side on cable).
4. Reconnect the negative cable of the battery and connect a variable resistance (3) between the battery terminals by adjusting the cursor to the minimum current draw (maximum resistance).
5. Start the motor and increase its speed to 2000 rpm.
6. Gradually reduce the resistance until the ammeter shows 90 A.
7. Observe the millivoltmeter, which must not indicate a value that is greater than 400 millivolts.

If the value exceeds 400 millivolts, the resistance of the external circuit is too high.
If the output value of the alternator is not sufficient and the millivoltmeter indicates a value that is less than 400 millivolts, an alternator component is defective. Carry out the operations described in the "Checking the alternator components" section in this chapter.

8. Switch off the motor.



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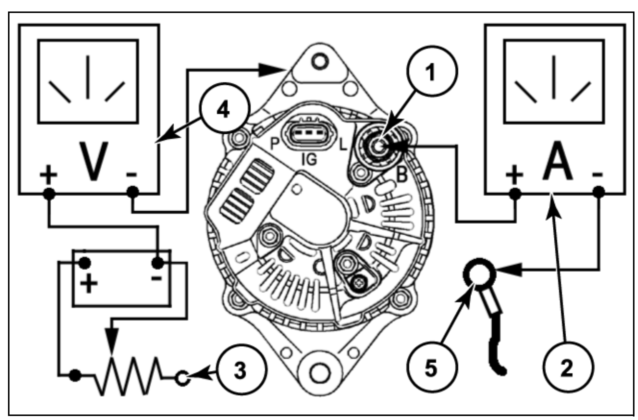
(b) Voltage drop on earth side

1. Check that the ignition is turned off (key on "off").
2. Check the same circuit as the one in the previous test, but by connecting the millivoltmeter (4) between the negative terminal of the battery and the alternator body (negative side on body).

NOTE: *Make sure that the variable resistance (3) is in the minimum current draw position (maximum resistance).*

3. Start the motor and increase its speed to 2000 rpm.
4. Gradually reduce the resistance until the ammeter (2) shows 90 A.
5. Observe the millivoltmeter, which must not indicate a value that is greater than 200 millivolts.

If the value exceeds 200 millivolts, the resistance of the external circuit is too high.



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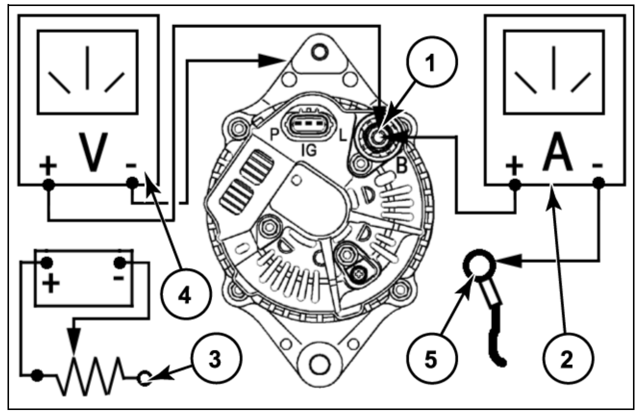
If the output value of the alternator is not sufficient and the millivoltmeter indicates a value that is less than 200 millivolts, an alternator component is defective. Carry out the operations described in the "Checking the alternator components" section in this chapter.

6. Switch off the motor.

Checking the maximum output of the alternator

1. Make sure that the ignition is turned off (key on "off").
2. Disconnect the negative cable from the battery and disconnect cable B+ (5) from the alternator.
3. Connect an ammeter (2) between terminal B+ (1) of the alternator and the disconnected cable B+ (negative side towards the cable).
4. Connect a voltmeter (4) between terminal B+ of the alternator and the earth.
5. Reconnect the battery, start the motor and increase its speed to 2000 rpm.
6. Gradually reduce the resistance (3) until the ammeter shows 90 A.
7. Observe the voltmeter, which must not indicate a value that is less than 14.2 V

If the value drops below 14.2 V, an alternator component is defective. Carry out the operations described in the "Checking the alternator components" section in this chapter.



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CHECKING THE ALTERNATOR COMPONENTS

Checking of components must be done only if the PRELIMINARY TESTS reveal an alternator defect which relates to the following components:

- Regulator
- Continuity of the rotor field winding
- Brushes, springs and slip rings

NOTE: *These checks may be carried out without removing the alternator from the vehicle. The alternator must be removed to check the other components of the alternator. Refer to the "Removal" section in this chapter.*

IMPORTANT: *Before disconnecting the cables from the alternator, make sure that the ignition is turned off (key on "off") and the negative cable of the battery is disconnected.*

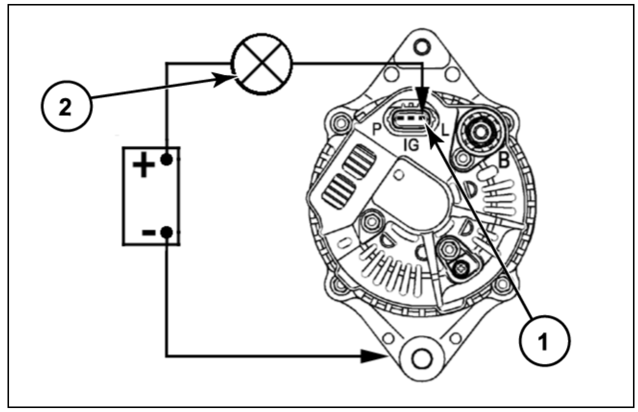
Required devices:

- 12 V battery
- Multimeter
- 2.2 W test lamp

Checking the regulator and the field circuit of the regulator

1. Disconnect all cables from the alternator.
2. Connect a 12 V battery and a 2.2 W test lamp (2) in series between terminal L (1) and the alternator body (negative side on body).
3. The test lamp must come on.

If the lamp does not come on, the rotor circuit is defective. Check the brushes, the slip rings and the continuity of the rotor field windings.
If the inspection reveals that these components are in good condition, the defect may be due to the regulator.



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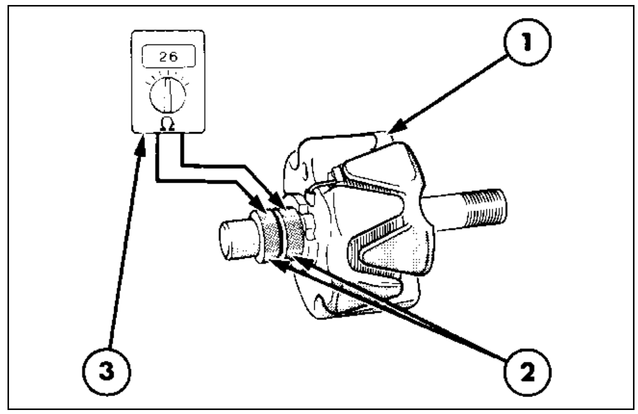
Checking the continuity of the rotor field winding

1. Remove the regulator with the brush holder.
2. Connect an ohmmeter (3) between the slip rings (2). The resistance must be 2.6 ohms at 20°C.

If the resistance is not correct, replace the rotor (1) as described in the "Removal" section below.



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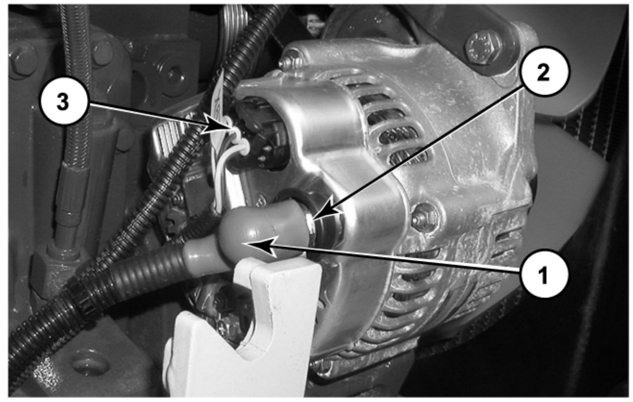
REMOVING AND CHECKING THE ALTERNATOR COMPONENTS

REMOVAL

Electrical disconnections of the alternator

1. Disconnect the negative cable from the battery.
2. Disconnect the battery cable (1) from terminal B+ (2).
3. Disconnect the connector (3).



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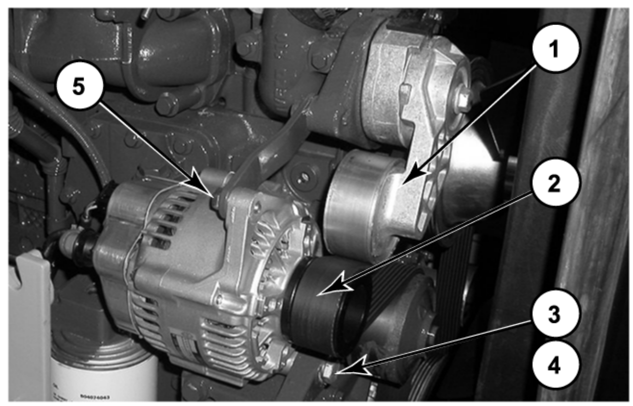
Removing the alternator

1. Free the tension roller (1) using a suitable wrench, then remove the belt (2).
2. Remove the screw (3) and the nut (4).
3. Remove the screw (5).
4. Remove the alternator.



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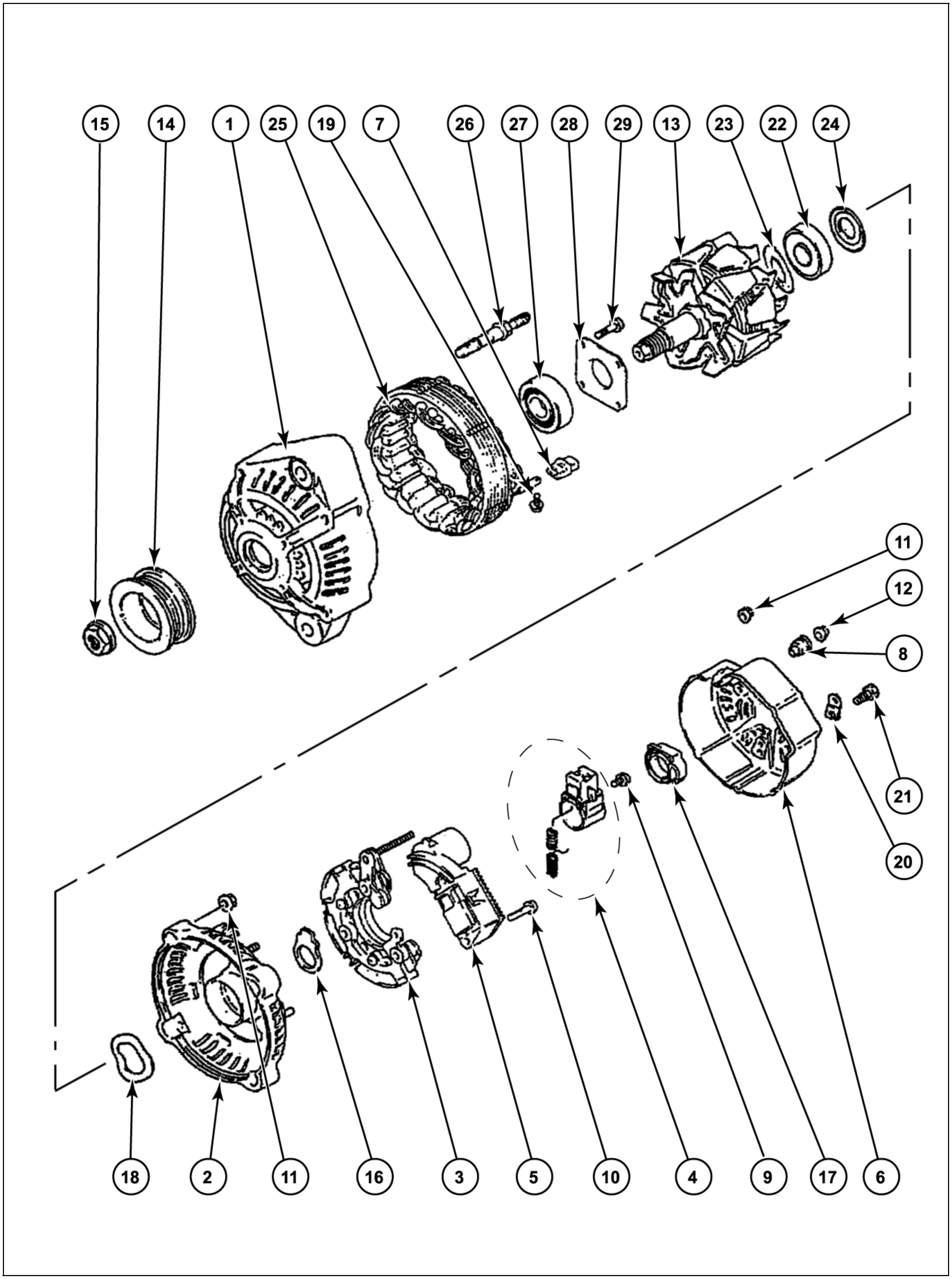
12 V / 90 A ALTERNATOR - EXPLODED VIEW



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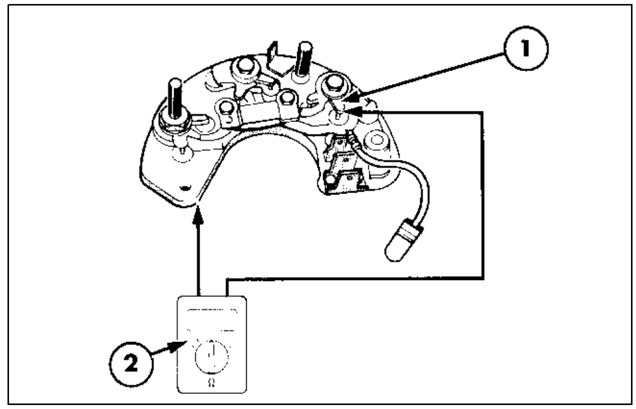
1 Front housing
2 Rear housing
3 Rectifier
4 Brush holder
5 Regulator
6 Rear protective hood
7 Insulation ring
8 Insulation ring
9 Screw
10 Screw and retaining washer of the regulator
11 Nut
12 Nut
13 Rotor
14 Pulley
15 Pulley nut
16 Seal ring
17 Seal ring
18 Washer
19 Screw with washer
20 Electrical terminal
21 Screw
22 Ball bearing
23 Ball bearing flange
24 Ball bearing flange
25 Stator
26 Stud bolt
27 Ball bearings
28 Retaining plate
29 Screw

Rectifier - Checking the positive / negative diodes

Check each of the six diodes separately by proceeding as follows:

1. Connect a multimeter (2) in series with one of the diodes. Place one wire of the multimeter on the connecting pin (1) of the diode and the other wire on the plate where the diode is installed.
2. Note down the value of the resistance indicated by the multimeter. Reverse the wires of the multimeter.
3. The multimeter should indicate infinite resistance (open circuit) only during the first half of the test. If this check reveals that a diode is defective, replace the entire rectifier.



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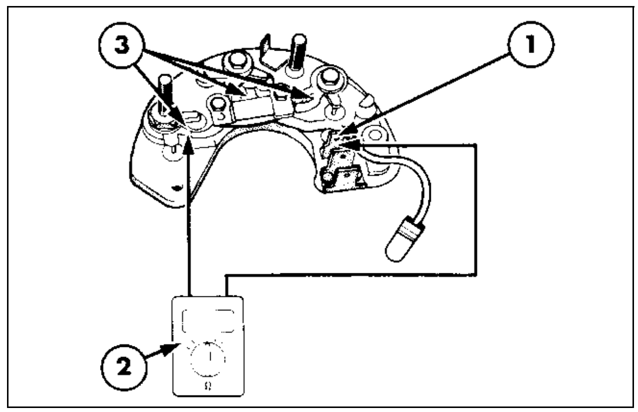
Rectifier - Checking the excitation diodes

Check each excitation diode separately by proceeding as follows:

1. Connect a multimeter (2) in series on the excitation diode module. Place the negative wire on terminal L (1) and the other wire on the connection of each excitation diode (3).
2. Note down the value of the resistance indicated by the multimeter. Reverse the wires of the multimeter.
3. The multimeter should indicate infinite resistance (open circuit) only during the first half of the test. If this check reveals that a diode is defective, replace the entire rectifier.



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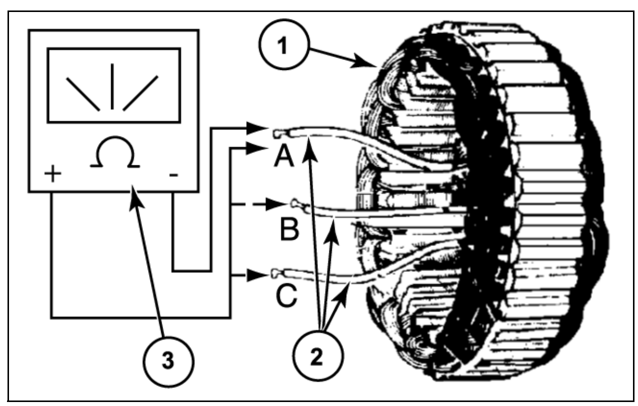
Stator - Checking the continuity of the winding

Check each excitation diode separately by proceeding as follows:

1. Connect the wires of the ohmmeter (3) between wires A, B and C (2). The resistance between each of the wires must be low (0.1 W). If the resistance is greater than this value, it indicates a possible break in the winding, i.e. an open circuit. A lower value (0.0 Ω for example) indicates a short circuit in the winding. If the result of this check is not satisfactory, replace the stator (1) and its casing.



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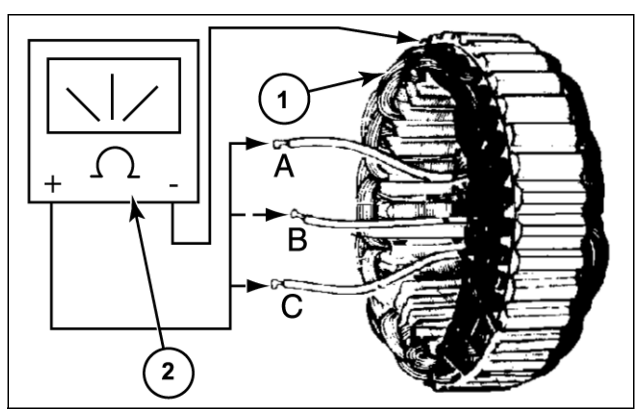
Stator - Checking the insulation

1. Check the insulation of each winding with respect to the alternator casing. There must not be any continuity between the winding and the casing. If the ohmmeter (2) indicates any value other than an open circuit, replace the entire stator (1).



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Checking the rotor

Before checking the rotor components, inspect the slip rings to make sure that they are in good condition.

1. Check that the slip rings are clean and smooth. If necessary, clean them with a cloth soaked in gasoline. If the slip rings are burnt, scrape them with very fine sandpaper (do not use emery cloth) and wipe them

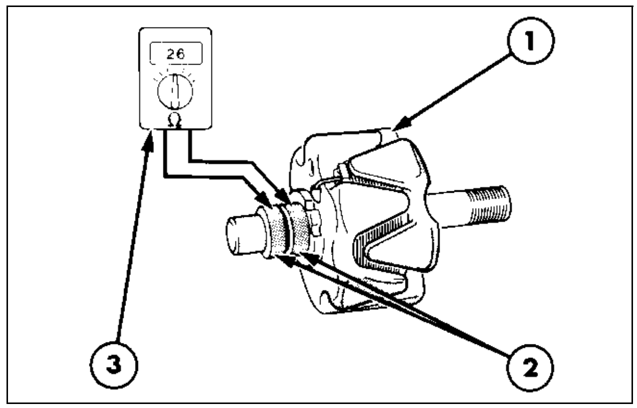
NOTE: *Make sure that the sandpaper is sufficiently fine in order to obtain a perfect finish of the slip ring surfaces and avoid premature wear of the brushes.*

2. If the slip rings are excessively worn, replace the rotor.

Rotor - Checking the continuity of the field winding

1. Connect an ohmmeter (3) between the two slip rings (2). The resistance must be 2.6 ohms at 20°C.

If the resistance is incorrect, replace the rotor (1).



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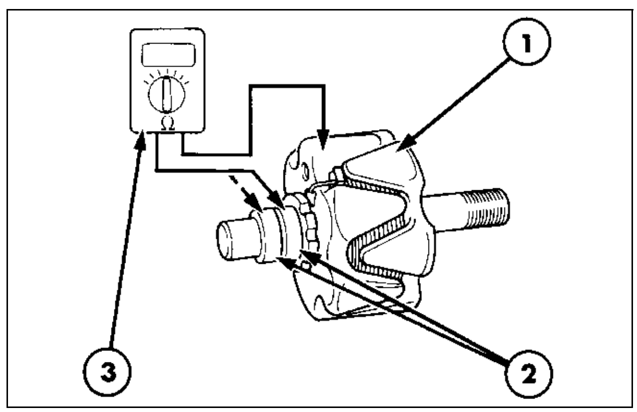
Rotor - Checking the insulation of the field winding

1. Using an ohmmeter (3), measure the resistance between each slip ring (2) and the rotor terminals (1). The resistance should always be infinite. If a resistance is not infinite, replace the rotor.



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NOTES

SECTION 55 - ELECTRICAL SYSTEM

Chapter 5 - BATTERY

CONTENT

SPECIFICATIONS

	Standard
Capacity	95
Cold Cranking Ampere Rating	960
Voltage	12
Cells	6
Ground Terminal	Negative

DESCRIPTION AND OPERATION

All models feature one 12 volt, negative ground, 'maintenance free' lead calcium (Pb–Ca) type battery, of six cell construction.

NOTE: *'Maintenance Free' means that under normal charging conditions the battery does not lose water from the electrolyte. Conditions that may cause water loss include prolonged charging above 14.4volts where gassing occurs as it approaches full charge. This can be caused by a faulty charging system or boost/recovery charging equipment.*

The battery is mounted behind the right hand side panel of the unit.

The battery has four major functions:

- To provide a source of current for starting, lighting and instrumentation.
- To help control the voltage in the electrical system.
- To furnish current when the electrical demands exceed the alternator output.
- To support quiescent loads from radio and micro processor memory.

The battery is constructed in such a manner that each cell contains positive and negative plates placed alternatively next to each other. Each positive plate is separated from a negative plate by a non-conducting porous envelope separator. If any of the positive plates should make contact with negative plates within a cell, the cell will short circuit and suffer irreparable damage. All of the positive plates are welded to a bus-bar, forming a positive terminal and all of the negative plates are welded to a similar bus-bar forming a negative terminal.

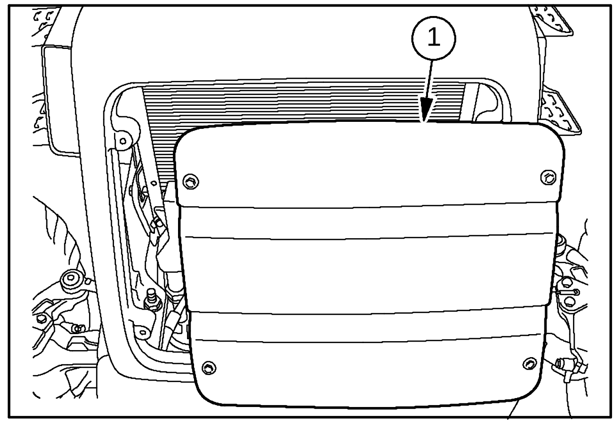
Each positive plate is composed of a lead grid with lead peroxide pasted into the grid openings. The negative plates are composed of a lead grid with spongy lead pasted into the grid openings.

The plates are submerged in a liquid electrolyte solution of diluted sulphuric acid.

REMOVAL AND INSTALLATION

Removal

1. Tilt the side panel up on its support gas struts.
2. Remove the negative lead and then the positive lead from the battery.
3. Remove battery securing bracket.
4. Using the lifting handles, remove the battery.

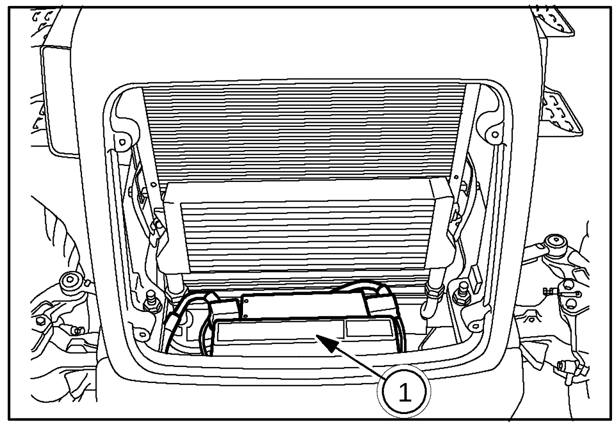


1

Installation

5. Installation of the battery, (1), is the removal procedure in reverse, observing the following points:

- Ensure that the battery is clean and dry and that the vent caps are fully installed. Smear the terminals with petroleum jelly (vaseline or equivalent), do not use conventional lubricating greases as these can promote electrolytic corrosion.
- Ensure the battery tray and clamps are clean and free from stones or small objects which may puncture the battery casing.
- Ensure that the battery terminal polarity is correct and that the terminal connections are sufficiently tight, but not overtightened.
- The radio, if fitted, will lose its stored information and will require re-programming.



2

BATTERY MAINTENANCE AND TESTS

Specific Gravity

The specific gravity of the battery electrolyte indicates the state of charge. Fully charged the specific gravity of the electrolyte is 1.280 minimum at 25°C (77°F).

Alternatively the approximate state of charge can be measured by using an accurate digital volt meter (+/– 0.01V) as follows:–

Less than	10.5V Battery un–serviceable*
Less than	11.8V Battery discharged
Less than	12.3V Battery 1/2 charged
Better than	12.6V Battery fully charged

* See note under tests for possible recovery of a mildly sulphated battery.

Battery voltage to be taken with the battery unloaded and:–

A) After the battery has rested unloaded for at least 4 hours.

B) If the vehicle has recently run or battery has recently been charged, switch on headlamps for 2 minutes.

When a battery discharges, sulphuric acid in the electrolyte combines chemically with the plates and this action lowers the specific gravity of the solution.

A battery hydrometer will determine the specific gravity of the electrolyte in a cell and the amount of unused sulphuric acid in the solution is a measure of the degree of charge of that cell.

The lower the temperature at which a battery is required to operate, the more necessary it is that the battery is maintained in a fully charged condition. For example a battery with a low specific gravity of 1.225 at 27°C (80°F) will operate the starting motor at warm ambient temperatures but may not, due to lower battery efficiency at a low temperature.

Table 1 shows the effect of temperature on the efficiency of a typical battery.

Table 1

Temperature	Efficiency of a Fully Charged Battery
25.0°C (77.0°F)	100%
–4.5°C (23.9°F)	82%
–24.0°C (–11.2°F)	64%
–27.5°C (–17.5°F)	58%
–31.0°C (–23.8°C)	50%
–34.5°C (–30.1°C)	40%
–37.5°C (–35.5°C)	33%

Maximum battery life will be obtained if the correct care and periodic inspection is given. It is important that output capacity should not be exceeded by constant and excessive overloading and that charging requirements are maintained.

Servicing The Battery

WARNING

Batteries contain sulphuric acid and during charging generate a highly explosive mixture of hydrogen and oxygen gases.

- *Never use equipment that generates flames or sparks in order to control electrolyte level*
- *Do not remove the battery cover plugs without protection for eyes and hands.*

When servicing a battery the following steps should be observed:

1. Maintain the electrolyte to the recommended level of 6 mm (0.25 in.) above the plates. If this is not observed the acid will reach a high concentration that will damage the separators and impair the performance of the plates.
2. Use only distilled or de–mineralised water, do not overfill and never use tap water or water from a rain barrel or other source.
3. Always keep the battery at least 75% charged otherwise the plates will become sulphated and loss of efficiency will result with possible damage from freezing at low temperatures.
4. Avoid overcharging the battery as excessive charging will create high internal heat that will cause plate grid deterioration and produce water loss.
5. When fast charging ensure the battery temperature does not exceed 50°C (122°F).
6. Do not add sulphuric acid to a cell unless the electrolyte has been lost through spilling. Before replenishing ensure the solution is at the correct specific gravity. A slow charge is the only method to be employed to fully charge a battery. A high rate charger can be used to quickly boost the battery capacity but this must be followed by a slow charge rate to bring the battery to full capacity.

Dry Charged Batteries

1. Remove the battery cell vent plugs.
2. Fill each cell to the recommended level with electrolyte of 1.260 specific gravity.

Dry charged batteries must be prepared for service as follows:

NOTE: *The electrolyte must be diluted sulphuric acid preferably at a temperature of 21°-32°C (70°-90°F).*

3. After filling, allow the battery to stand for 15 minutes then re-check the electrolyte level and top up if necessary.
4. Charge the battery for 4 hours at a rate of 5-8 amperes and check that all cells are gassing freely.
5. Install the battery cell vent plugs.

Charging The Battery

Before charging a battery:

1. Thoroughly clean the battery casing and cell covers with dilute ammonia or hot water and clean the terminals.
2. Check the level of the electrolyte in each cell and, if below plates, add distilled water to bring above plate level.

Normal (Top-up) Charging

1. With a slow charger use a rate of 3 to 6 amperes for the time necessary to bring the battery to full charge. This may take 36 hours or more if the battery is heavily discharged. A severely sulphated battery might not accept a charge. When the battery is fully charged the cells will gas freely and the specific gravity will remain constant. Remove the charger after three consecutive hydrometer readings taken at hourly intervals indicate that the specific gravity has stopped rising.
2. When using a fast or high rate of charge carefully follow the manufacturers instructions. High rate charging raises the temperature of the electrolyte and unless the charger is equipped with an automatic time or temperature device, the electrolyte temperature could exceed 50°C (122°F) , which may cause violent battery gassing and damage to internal components.
3. Re-check the level of electrolyte in each cell and add distilled water as necessary.

WARNING

When a battery is being charged an explosive gas is produced. Do not smoke or use an exposed flame when checking the electrolyte level and ensure the charger is switched off before connecting or disconnecting to avoid sparks which could ignite the gas.

Recharging Deeply Discharged Batteries

The recommended method to recharge a maintenance free Pb-Ca battery is to use a constant voltage charger. For deeply discharged batteries a 48 hours charging period at 16volts is recommended, with current limitation, (47.5A for 95Ah).

This system is self regulating: high current is delivered at the beginning (when battery voltage is low), lower and lower current is then absorbed when battery reaches full charge (and its voltage is high).

If only constant current chargers are available it is recommended to use the current levels and times shown Table 2 below. The figures are intended for deeply discharged batteries. If the battery is only 50% discharged use one half of the time listed (slow charge programs). For other states of discharge reduce proportionally the time of charge. Whenever possible use the slowest charge program to increase the battery's life.

If when charging the battery, violent gassing or spewing of electrolyte occurs, or the battery case feels hot (50°C or greater), reduce or temporarily halt charging to avoid damaging the battery.

Table 2

	Battery Type
	95Ah
Slow Charge Programs	18hrs at 5A 9hrs at 10A
Fast charge Program (emergencies only)	5hrs at 18A

Tests

Before commencing battery tests check the battery for clogged vents, corrosion, raised vent plugs or a cracked case.

Test equipment required:

- Hydrometer
- Battery starter tester (High rate discharge tester)
- Thermometer
- Battery Charger

Specific Gravity:

This test will determine the state of battery charge.

1. With the float in the vertical position take the reading.
2. Adjust the hydrometer reading for electrolyte temperature variations by subtracting 4 points (0.004 specific gravity) for every 5.5°C (10°F) below the temperature at which the hydrometer is calibrated and by adding 4 points (0.004 specific gravity) for every 5.5°C (10°F) above this temperature.

The following examples are calculated using a hydrometer calibrated at 30°C (86°F).

Example 1:
Temperature below 30°C (86°F)
Electrolyte temperature 19°C (66°F)
Hydrometer reading 1.2
70
Subtract <u>11.0</u> x 0.004 0.008
5.5
Corrected specific gravity = <u>1.262</u>

Example 2:
Temperature above 30°C (86°F)
Electrolyte temperature 40°C (104°F)
Hydrometer reading 1.2
20
Add <u>10.0</u> x 0.004 0.0
07
5.5
Corrected specific gravity = <u>1.227</u>

3. Use the following table to determine the state of charge.

State of Charge	Corrected Specific Gravity @15°C	Corrected Specific Gravity @25°C	Average Battery Voltage
100%	1.295	1.287	12.76
75%	1.253	1.246	12.52
50%	1.217	1.210	12.30
25%	1.177	1.170	12.06
Discharged	1.137	1.130	11.84

NOTE: *Specific gravity should not vary more than 0.025 points between cells.*

4. If the specific gravity is 1.280 or more the battery is fully charged and in good operating condition.5
5. Should the corrected specific gravity be below 1.280, charge the battery and inspect the charging system to determine the cause of the low battery charge.

NOTE: *If distilled water has recently been added the battery should be recharged for a short period otherwise accurate hydrometer readings will not be obtained.*

If the battery has been charged under static conditions, denser electrolyte will accumulate at the bottom of the cells. The battery should be shaken periodically to mix the electrolyte, this will improve the charge rate and provide a more accurate hydrometer reading when tested.

Performance Test:

The performance test is to determine if the battery has adequate capacity to turn the engine. The voltage reading obtained is used to determine the battery condition. Prior to testing, ensure the electrolyte level is correct and the open circuit voltage is 12.5V or more. The battery may be tested on or off the tractor.

6. Set the current control switch of the battery starter tester (high rate discharge tester) to the 'off' position and the voltage selector switch equal to, or slightly higher than, the rated battery voltage. Connect the tester positive leads to the battery positive terminal and the negative leads to the negative battery terminal.
7. Turn the current control knob until the ammeter reading is half the CCA rating of the battery and take the voltage reading.

- If the reading is 9.6 volts or more after 15 seconds, the battery has an acceptable output capacity and will readily accept a normal charge.

If however the reading is below 9.6 volts, the battery is considered unsatisfactory for service and should be test charged as described below.

CAUTION

Do not leave the high discharge load on the battery for periods longer than 15 seconds.

Test Charging:

This test is designed only for batteries that have failed the previous capacity test.

1. Attach the battery starter (high rate discharge tester) positive leads to the battery positive terminal and the negative leads to the battery negative terminal.
2. Connect the battery charger positive lead to the battery positive terminal and the negative lead to the battery negative terminal.
3. Turn the charger timer past a '3 minutes' charge indication and then back to the '3 minutes' mark.
4. Set the charging rate as close as possible to 40 amperes.
5. After 3 minutes at this fast charge take the voltmeter reading.

- If the total voltage is over 15.5 volts the battery is unsatisfactory and is probably sulphated or worn out and should be replaced.

NOTE: *A mildly sulphated battery can be recovered by using a multiple battery type charger, with an open circuit upper voltage limit of 50 volts. Owing to the high resistance of a sulphated battery, it will primarily require a high voltage setting to overcome the resistance of the sulphation. initially there may be no visible acceptance of the charge. After a few minutes of inactivity a small charge will be apparent, followed by a rapid increase in the charge rate. The charge rate must not exceed 14.0 amperes or the electrolyte temperature 50°C. When the ampere rate has stabilised, reset the volts until the charge rate is a steady 5 amperes. Continue at this rate until the electrolyte specific gravity stops rising at approximately 1.275–1.280 at 20°C (68°F), this can take up to 48 hours of charging. Stand the battery for 24 hours and then conduct the capacity test detailed previously.*

- If the total voltage is under 15.5 volts, test the specific gravity of each cell and re–charge the battery to the following scale:

Specific Gravity	Fast charge up to:
1.150 or less	60 minutes
1.151 to 1.175	45 minutes
1.176 to 1.200	30 minutes
1.201 to 1.225	15 minutes (Slow charge only)

NOTE: *When battery problems are experienced the fan belt tension and the complete charging system should be checked.*

Common Causes of Battery Failures

1. Internal open circuit.
2. Internal short circuit.
3. Loss of electrolyte.
4. Separation of active materials from grids.
5. Accumulation of sulphate crystals too large to disperse.

These failures are normally caused by the following:

1. Failure of inter cell components.
2. Excessive crystal growth may puncture the separators and cause short circuits.
3. Excessive over charging (charging system malfunction, boost/recovery techniques with high voltage, operation in very high temperatures.
4. Freezing of electrolyte.

   A fully charged battery does not freeze until –65°C (–85°F). A 50% charged battery freezes between –17°C (1.4°F) and –27°C (–16.6°F). Fully discharged electrolyte freezes at –3°C (–26.6°F) to –11°C (–12.2°F).

   Excessively high boost charging and gassing will also cause separation of active materials from the grids. Separation destroys the chemical function of the battery.
5. Crystal growth occurs whenever batteries are left discharged. High temperatures and extended discharged periods increase this condition. At room temperature after one week the battery is unlikely to recover on the vehicle. Recharge will require a higher constant voltage. After 3 weeks the battery will have suffered permanent degradation and the procedure detailed previously for charging a 'Deeply Discharged' battery should be followed.

When fully charged, batteries have a long shelf life. The lead calcium type battery self discharges at 3% per month. This means that it will take 16 months to drop to 50% charged. On the tractor the quiescent load is about 50mA. To predict rundown on a static vehicle this should be added as approximately 8Ah per week.

It is worth stressing that when cranking, if a battery starts to fade, it is beneficial to stop and allow two minutes for the battery to recover. The recovery time should be increased as the temperature decreases.

SECTION 55 - ELECTRICAL SYSTEM

Chapter 6 - Service Diagnostics, Calibration and Immobiliser

CONTENT

SERVICE INDICATOR (WHERE FITTED)

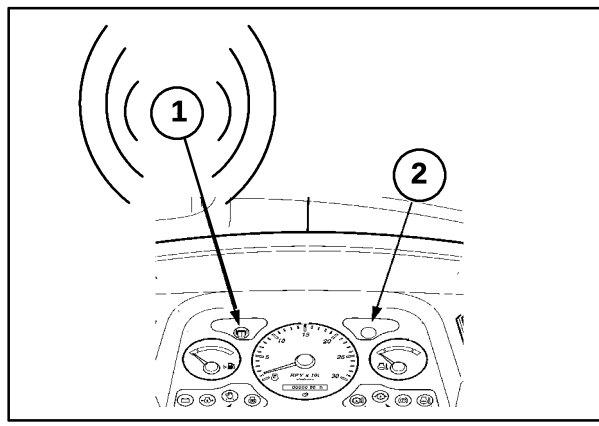
The Service warning light (1) “from new” will illuminate after the first 50 hours of work along with the buzzer.

It will then come on again after 250 hours “from new” and then every 300 working hours along with the buzzer.

Every time it illuminates the buzzer will sound intermittently for 6 secs at a frequency of 1 hertz (hz) and then turn itself off.

The warning will remain on for 10 hours or until turned off by:

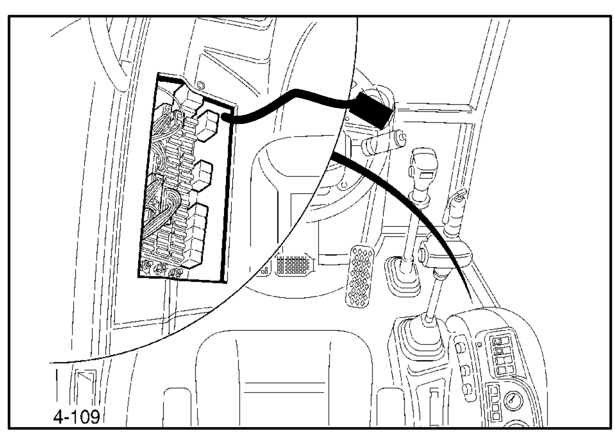
- A special bridged connector tool, or turned off by a Laptop PC using a link connected at the fuse panel location.
- At each successive Key Start the buzzer will sound intermittently for 6 secs if it has not been reset to Zero. This cycle repeats itself every 300 hours



1

Fuse Panel Location

The fuse panel is situated in the side console and can be accessed through a small panel after removal of the attaching cover screws. The lap link or bridging tool is then connected to the diagnostic connector

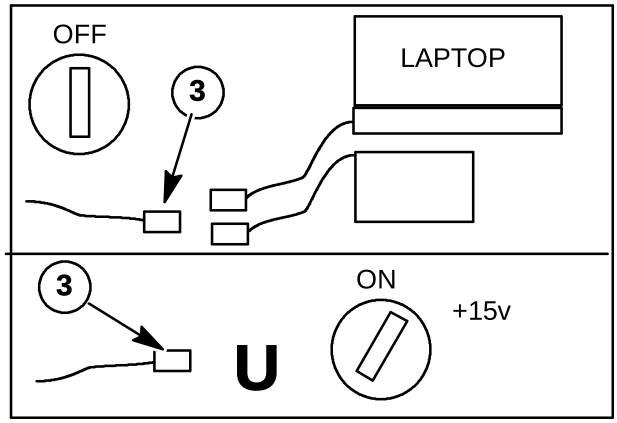


2

NOTE: *When the warning lamps are not turned off ie maintenance not carried out the counting of the next 300 hours always begins again from the time the signalling began.*

The light (2) can only be turned off via a laptop or bridging tool. The reading of the diagnostics programming must be done through the connector on the instrument panel and with the display key in the off position and NOT turned to the on +15 position.

When the connector with U Bolt is used the key must be turned to the ON +15, any lamps and the buzzer are turned off, but the cells recording the times of events cannot be reset to zero



3

ALARMS AND DIAGNOSTIC SIGNALLING

NOTE: *For all machines fitted with diagnostic capability.*

The malfunctioning data for the functions being diagnosed will be memorised on the micro processor and can be displayed by the technician through a serial line accessible through the 5 way 5238 molex connector (3).

The time of the malfunctioning of each individual function will be memorised in four cells in the following way.

The first malfunction will be memorised in the fourth cell and will remain there until the user cancels it by computer.

The next malfunction will be displayed in the first cell and then slip into the second cell when the third malfunction occurs until all 3 cells have been filled.

When the fifth malfunction occurs the data moves down, cancelling the second occurrence and memorising the most recent one in the first cell.

In twos way the very first and last three malfunctions remain in the memory.

Each malfunction is memorised when it appears for the first time at successive Key offs and Key on if the same event occurs it will not be memorised as a new malfunction.

The time will be memorised only if there has been a rework of the service and a later anomaly

NOTE: *The data can only be cancelled while the events are being visualised on the computer. There may be a small variance between times shown on the hour meter and those displayed by the diagnostics programming*

TOTAL HOURS

0.0h

	* Filter	Engine Oil Pressure	Engine Oil Temperature	Trans Oil Pressure	Engine Cool Temperature
Last Record	0h	0h	0h	0h	0h
Penultimate	0h	0h	0h	0h	0h
3rd Record	0h	0h	0h	0h	0h
1st Record	0h	0h	0h	0h	0h

START MENU SAVE CANCEL ERROR Error Out Time Out

MALFUNCTION EXAMPLE

* FILTER

1ST	2ND	3RD	4TH	1ST	2ND	3RD	4TH
10 h	20 h	30 h	40 h				
		10 h					
	10 h	10 h					
10 h	10 h	10 h					

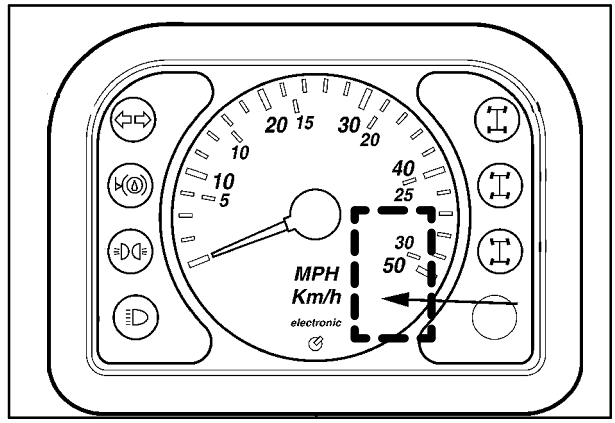
4

FUNCTION	Check	Service	Diagnostics	Note
Air Filter	yes		yes	
Transmission Oil Temperature	yes		yes	
Transmission Oil Pressure	yes		yes	
Engine Coolant Temperature	yes		yes	
Service 1	yes	yes		
Battery	Autocheck			
Engine Oil Pressure	Autocheck		yes	
Engine Cold Start	Autocheck			Only on Iveco
Brake	yes			
Buzzer	yes			

CALIBRATION OF SPEEDOMETER

Dependant upon the model and tyres fitted it may be a requirement to set the calibration of the front console.

This setting is required if fitting a new instrument or a change of tyres takes place, and can be performed by adjusting the settings of the switch block, mounted at the rear of the console.



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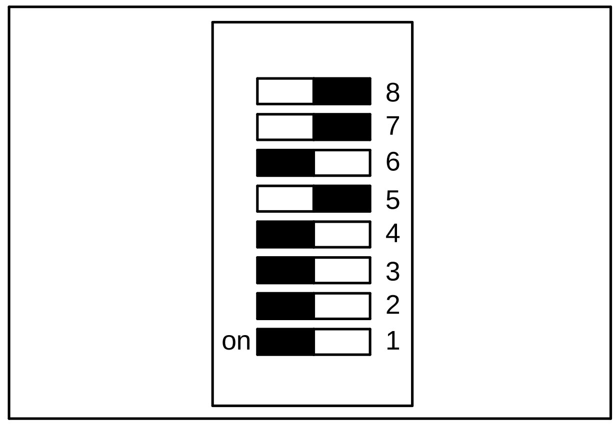
Each switch numbered 1 to 8 mounted in the block should be turned ON = or OFF as shown in the opposite example, to suit the requirement and as shown in the following tables.

Switch Positions:
1 = ON
0 = OFF



6

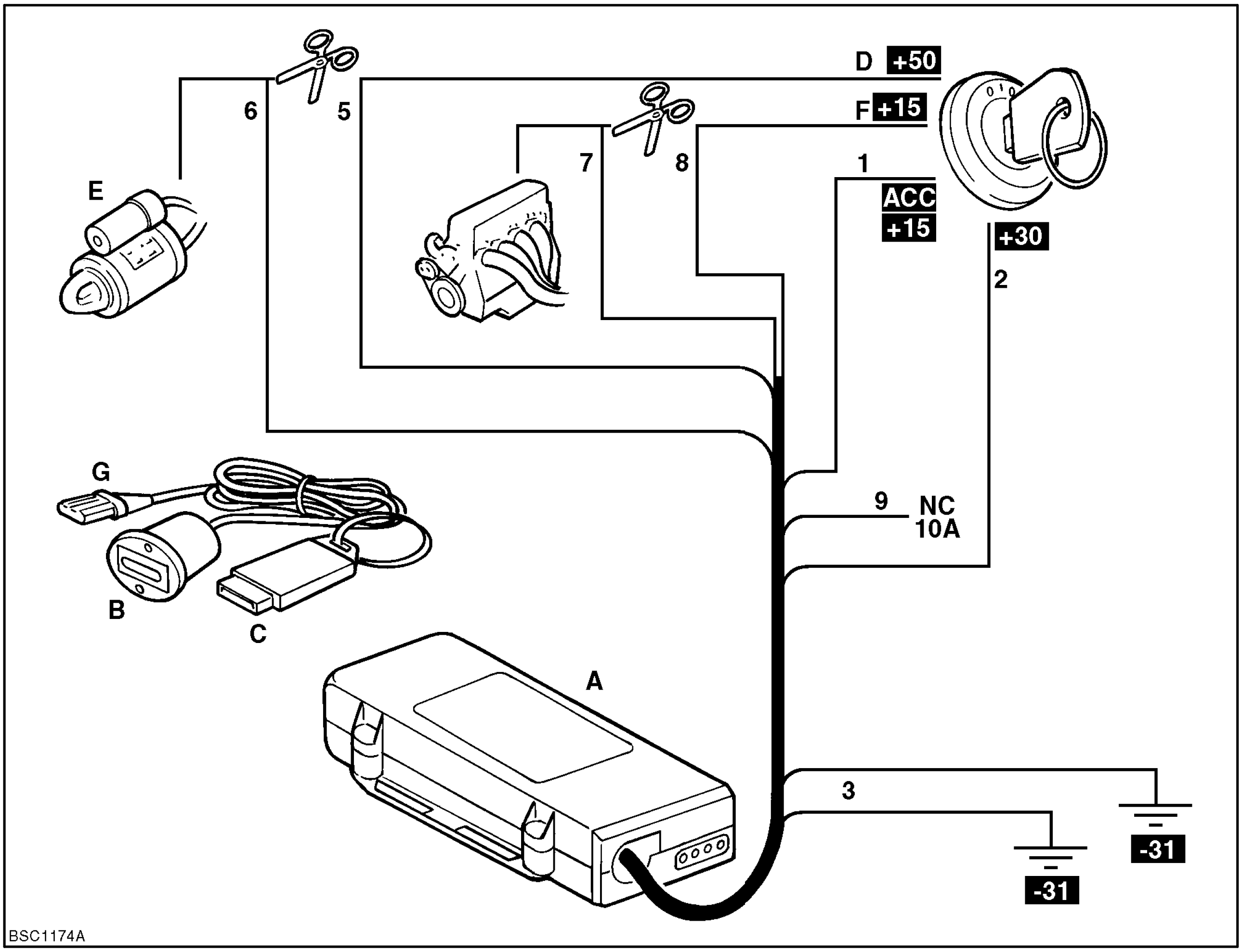
POWER SHUTTLE

AXLE RATIO	TYRE – ROLLING CIRCUMFERENCE	FREQUENCY AT 50 Km/hr	SWITCH POSITIONS 1–2–3–4–5–6–7–8
18.5	4065 – 4335	2055	1–1–1–1–0–1–0–0
18.5	3810 – 3911	2245	1–1–1–0–1–0–1–0
20.8	4065 – 4335	2310	1–1–1–0–1–1–1–0
20.8	3810 – 3911	2522	1–1–0–0–0–0–0–1

POWER SHIFT

EGS FREQUENCY	TYRE – ROLLING CIRCUMFERENCE	FREQUENCY AT 50 Km/hr	SWITCH POSITIONS 1–2–3–4–5–6–7–8
6.53 – 6.13	4065 – 4335	315 Hz	0–0–0–0–0–0–0–0
6.97 – 6.79	3810 – 3911	345 Hz	0–1–0–0–0–1–0–0

IMMOBILISER CIRCUIT



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Immobiliser Connections

C. M38 Immobiliser
D. Electronic key socket with LED
E. 2 piece electronic key
F. +50 to ignition
G. Starter motor
H. Engine control wire
I. Plug connecting electronic key socket to immobiliser

Wire No.	Function	Connection
1	(+15) Key positive	Connected to the +12V full ignition supply
2	(+30) Permanent +12V power supply	Connected to the wire from the battery positive
3	(–31) Negative power supply	Connected to the vehicle negative at two independent points
5 & 6	Immobolisation relay No.2	Connected in line with the wire controlling the starter motor relay/solenoid – min.500mA. max.10A capacity
7, 8, 9	Immobilisation relay No.1	Connect in line with the wire controlling the ignition or fuel circuit – min.500mA. max.10A capacity

NOTES

SECTION 55 - ELECTRICAL SYSTEM

Chapter 7 - Component Testing

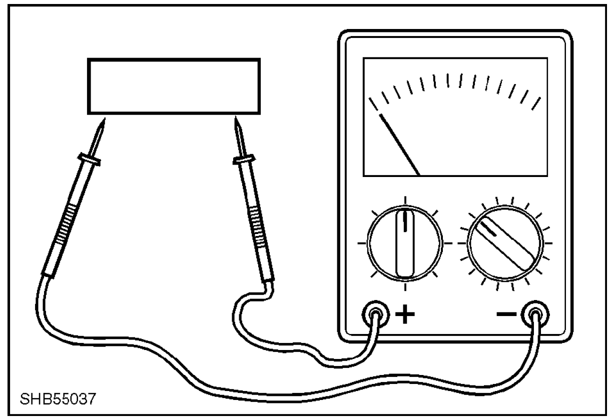
CONTENT

GENERAL INTRODUCTION

No special tools are required to remove or replace electrical components. Refer to the appropriate section of this Service Manual for overhaul procedures to cover the starter motor and alternator.

Fault Finding of electrical systems should be carried out in a logical and methodical fashion. A few minutes spent understanding the system and analyzing the symptoms can save considerable time.

An essential piece of equipment for checking electrical systems is a good quality Multimeter with a high impedance which can measure voltage, current and resistance.



1

NOTE: *Labelling of connectors prior to disassembly will greatly assist when reconnecting any harness.*

Where it is necessary to clean the multiple connectors, a contact spray should be used.

IMPORTANT: *DO NOT use a cleaner that contains trichlorethylene which will dissolve the plastic connectors.*

The wiring harnesses contain wires which are colour coded for identification. Each harness can be removed and replaced, but certain precautions must be observed:

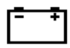
- Disconnect or isolate the battery, negative terminal first, prior to disconnection or removal of any wiring harness.
- Prior to removal, note the harness routing, clamping positions and terminal connections.
- On replacement, be sure that the harness routing is not in contact with sharp edges, the exhaust system or moving parts.
- Check connections for wire colour matching.
- Use a light coating of di-electric grease on the connector pins to prevent corrosion.
- Be sure that all connectors are fully engaged and no conductor is exposed.
- Tape back unused connectors.
- Be sure that ground connections are clean with metal-to-metal contact. Use toothed lock washers for good ground connections.
- Be sure that fuses are of the specified rating.
- Check the circuit current draw before connecting power to the harness.
- Check polarity of the battery before connecting power to the harness.
- When it is necessary to remove or partially disconnect a wiring harness, label each connector before removal from its mating instrument.

COMPONENT TESTING

In general with the key start on there should be 12 Volts found at the component connections.

Where 12V is not present check fuses, relays and wiring for breaks.

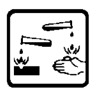
BATTERY

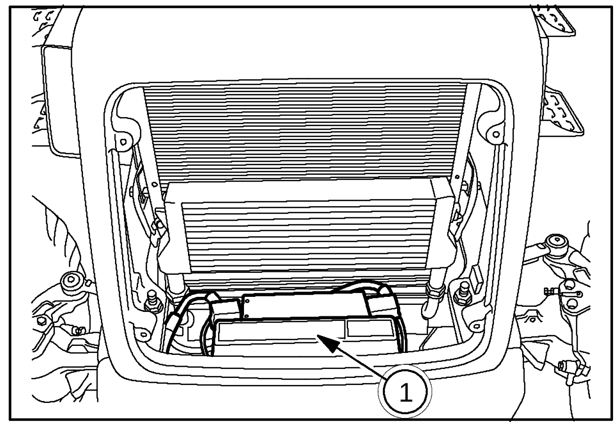


The battery fitted to the machines are LEAD/CADMIUM batteries.

WARNING

Battery gasses can be corrosive and explosive handle with care





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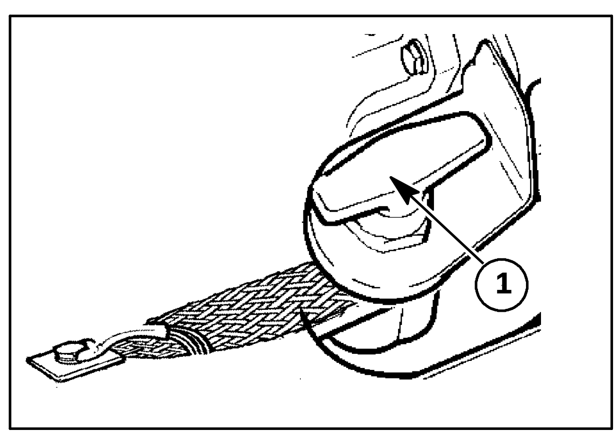
If the battery becomes discharged to such an extent that the voltage is less 7 volts then they should be re charged using the procedure outlined in the following table or replaced if not chargeable / serviceable.

BATTERY CHARGING RATES

BATTERY CHARGING	Battery Type 95Ah
Slow Charge Programs	18hrs at 5A 9hrs at 10A
Fast charge Program (emergencies only)	5hrs at 18A

BATTERY ISOLATOR

The battery isolator is found on the negative side of the battery and can be used to isolate all circuits of the machine (no earth no circuits).



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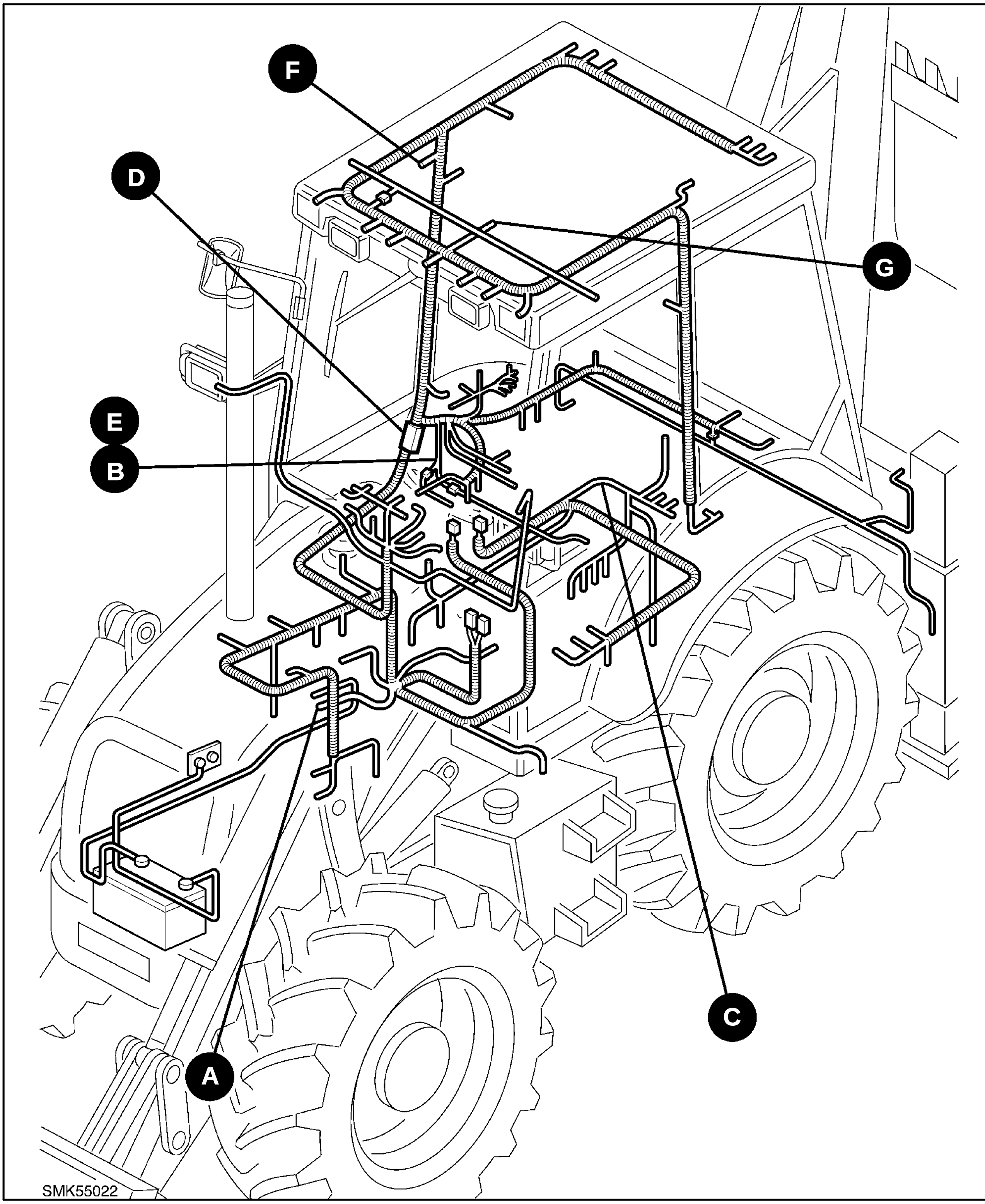
COMPONENT EARTH POINTS



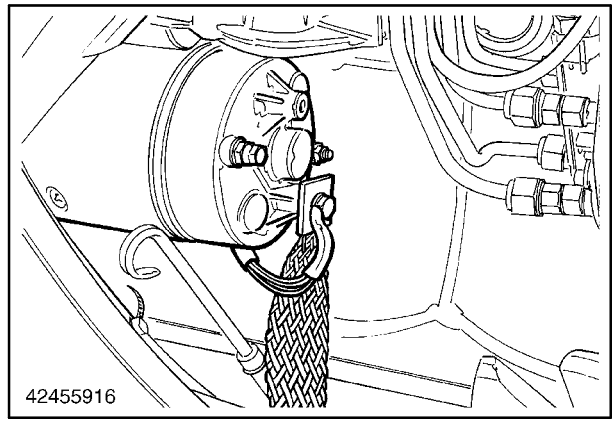
4

A	Starter Solenoid
B	Front Console Harness – Joins earth point B behind right hand console
C	Chassis Harness – Located underneath body to rear of chassis, above rear axle
D	Fuse Board – Located behind right hand console
E	Cab Main – Located behind right hand console
F	Roof Harness – Located in roof above right hand B pillar
G	Roof Harness – Located in cab roof with interior lamp assembly

IMPORTANT: *Always ensure the earth/ground points are clean and functional. A poor earth will cause the electrics to fail*

Earth Point A – Starter Motor (Engine harness)

Earth Point A is also linked to Earth Point B.



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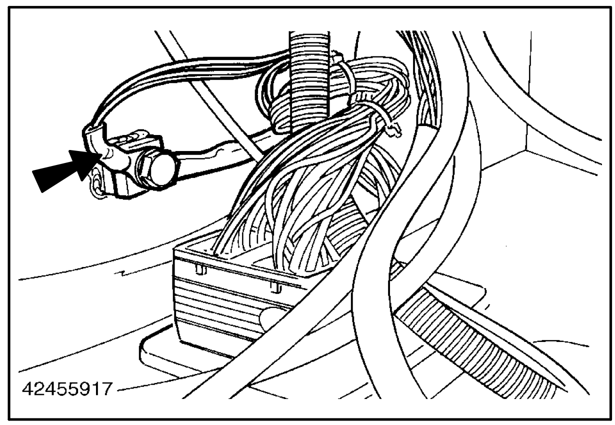
Earth Point B – Right hand Console (front console harness)

This is also linked to earth points A, C, and D.



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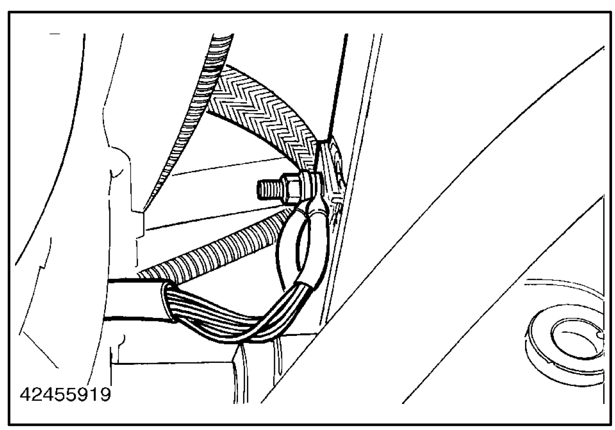
Earth Point C – Rear of Chassis (Chassis harness)

This is also linked to Earth point E.



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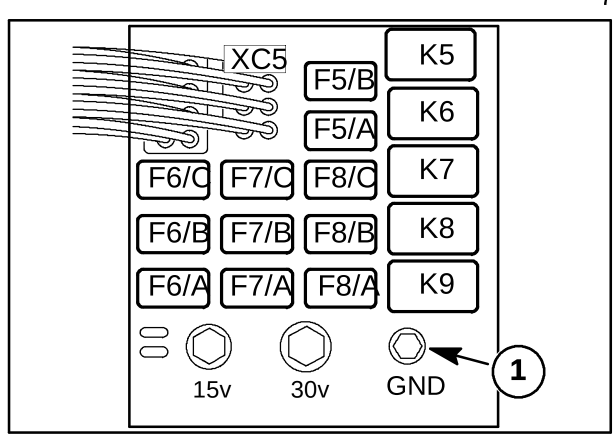
Earth Point D – Fuse board

Air Seat

This is also a back-up earth point for Location E.



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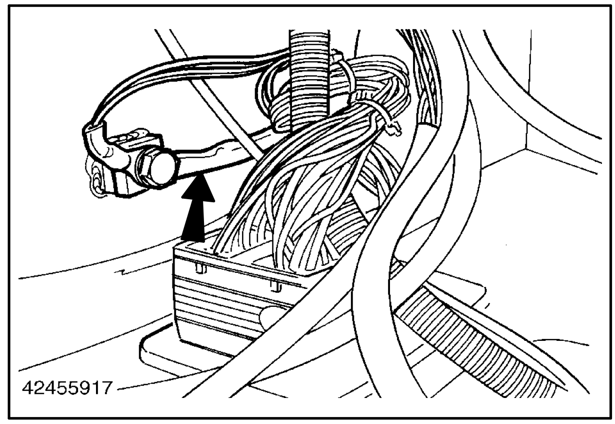
Earth Point E – Right hand console (Cab main harness)

This is also a link to earth point B and C.



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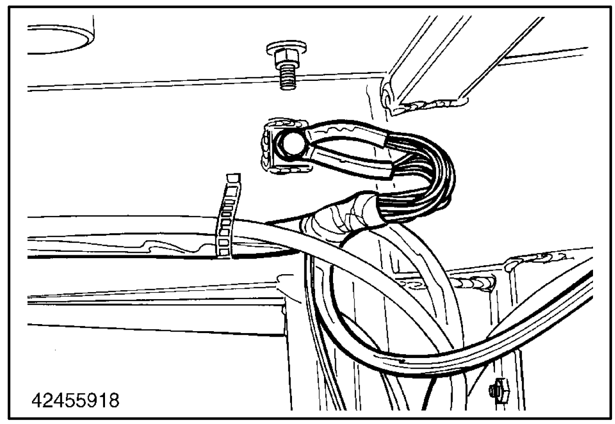
Earth Point F – Top right hand B pillar (roof harness)

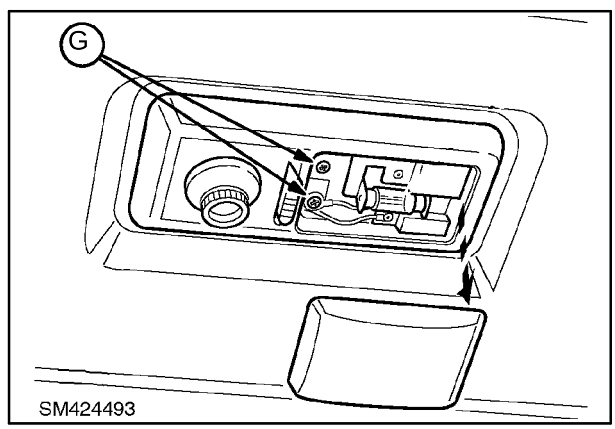
This is also linked to earth point G.



10

Earth Point G – Interior lamp

This is also linked to earth point F.

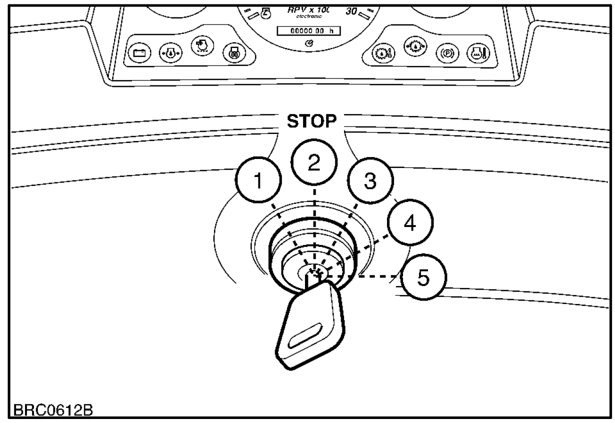


11

KEY-START AND STOP SWITCH – S17

NOTE: *When the key-start/stop switch is turned to the "ON" position the audible alarm will be activated until the engine is started or the key returned to the off position.*

Key Start
1 = Not used
2 = Off
3 = Ignition "ON"
4 = Thermostart (Engine pre-heat)
5 = Engine Start (cranking)



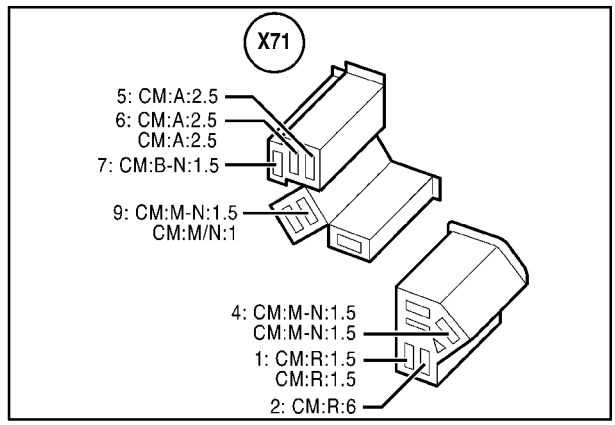
2

SWITCH – X71

Test Procedure

Voltage:

Pin No.	Key Switch Position			
	OFF	Pos. I	Pos. II	Pos.III
9	0v	0v	12v	12v
7	0v	0v	0v	12v
4	0v	0v	12v	12v
5 & 6	0v	12v	12v	12v
2	12v	12v	12v	12v



13

Continuity:

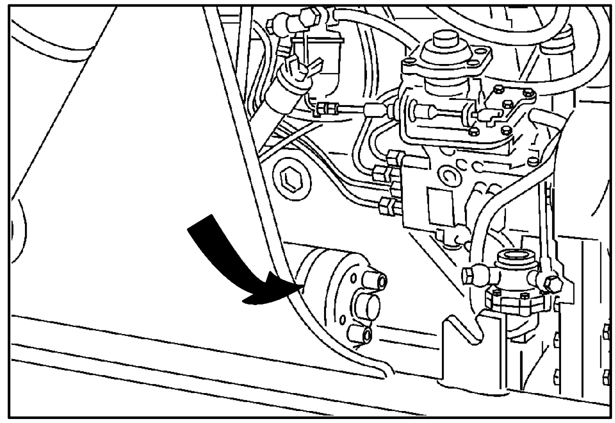
Pin No.	Key Switch Position			
	OFF	Pos. I	Pos. II	Pos.III
9			n	n
7				n
4			n	n
5 & 6		n	n	n
2		n	n	n

STARTER MOTOR – M1

Test Procedure

	Key Switch Position			
	OFF	AUX.	ON	START
	0v	0v	0v	12v

Resistance 0.3 Ohms

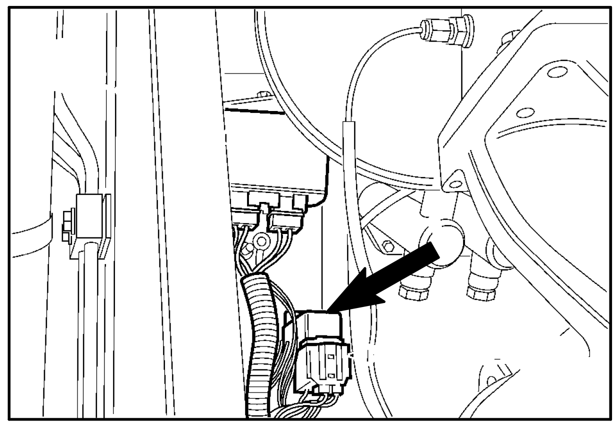


14

STARTER RELAY – KO1

Test Procedure

Pin No.	Key Switch Position			
	OFF	AUX.	ON	START
1	0v	0v	0v	12v
2	0v	0v	0v	0v
3	12v	12v	12v	12v
4	0v	0v	0v	12v



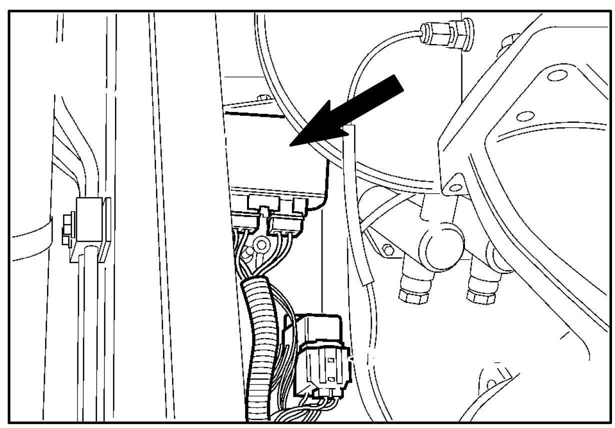
15

FUSES – 80 amp. – FG1

The main fuses have been designed to protect the whole electrical system. Fuses fitted are dependant on models

Test Procedure

Battery voltage should be found both sides of fuse at all times.



16

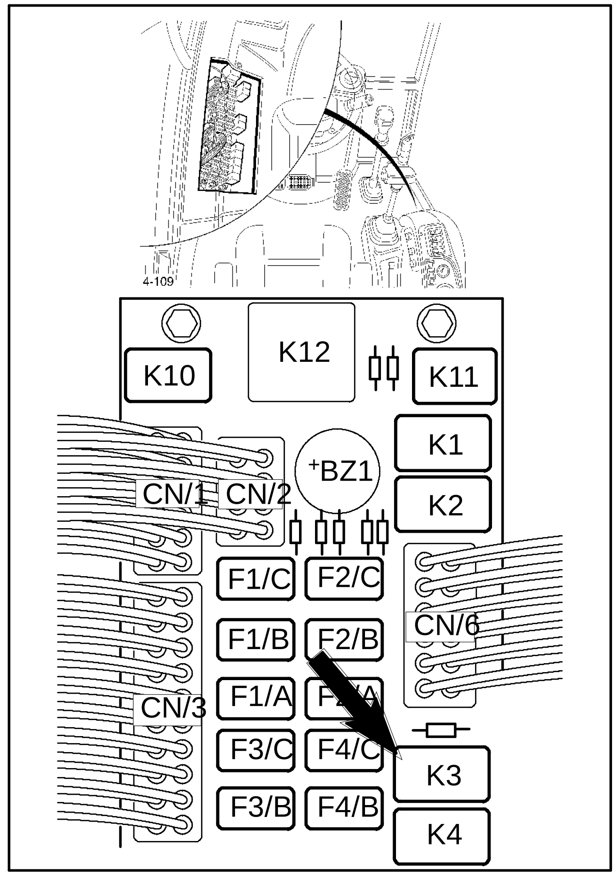
SAFETY START RELAY - K3

Power Shuttle lever in Forward or Reverse (Engine will not start) Park brake ON, Klaxon sounds

Power Shift lever in Forward up-shift or reverse up-shift. (Engine will start) Park Brake ON, Klaxon Sounds.

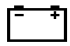
Pin No.	Key Switch Position Voltage Check			
	OFF	Pos. I	Pos. II	Pos.III
9	0v	0v	12v	12v
7	0v	0v	0v	12v
4	0v	0v	12v	12v
5 & 6	0v	12v	12v	12v
2	12v	12v	12v	12v

Pin No.	Key Switch Position Continuity Check			
	OFF	Pos. I	Pos. II	Pos.III
9			n	n
7				n
4			n	n
5 & 6		n	n	n
2		n	n	n



17

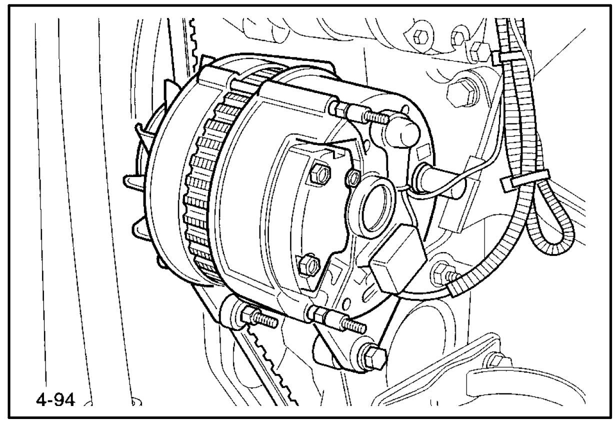
ALTERNATOR – G2



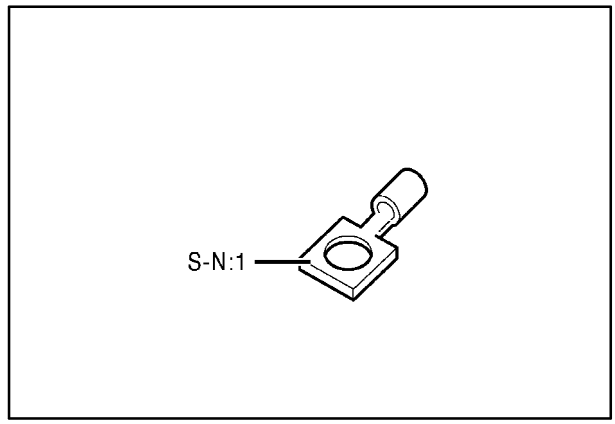
This sends a square wave signal, the frequency of which varies between 142.52 855Hz (480–3060rpm) to the instrument panel.

With the engine running, the warning light should go out. If not, disconnect the wire connected to the terminal D+ (pink wire).

When D+ is not connected and the warning light goes out, there is a fault with the alternator. If it does not go out, then check the bulb and the wiring loom.



18



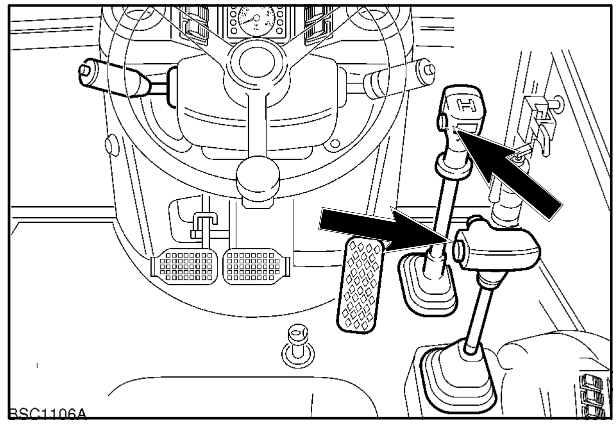
19

TRANSMISSIONS

POWERSHUTLE DISCONNECT – X23 / X28

N

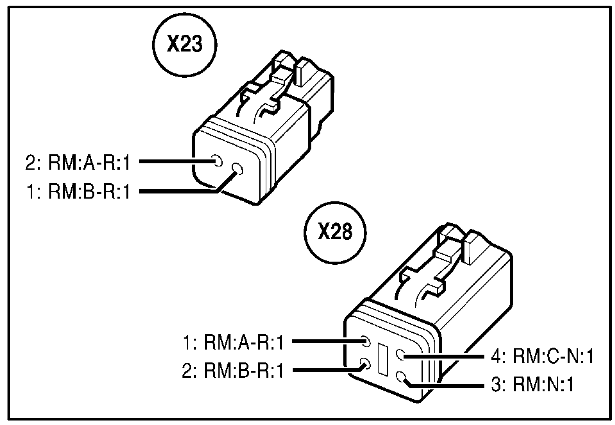
Energises the transmission dump solenoid at 12 volts



20

Test Procedure

Continuity should be found between Pin 1 and Pin 2 when switch is operated.

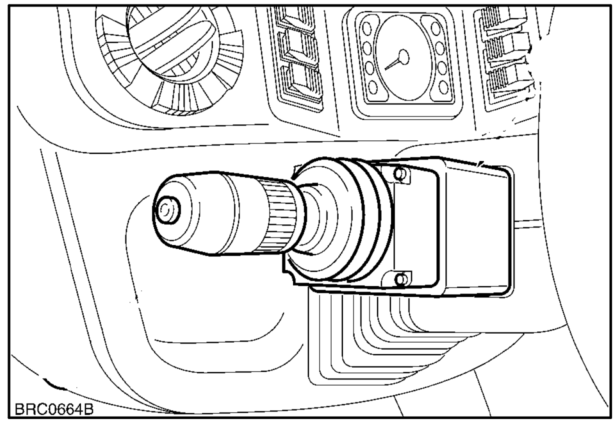


21

POWERSHIFT EGS CONNECTOR

The EGS receives input from the FWD Switch, brakes, switches, transmission disconnect switch, temperature sensor and speed sensor. The EGS also sends signals to the transmission control valve.

For input and output tests to check correct operation of the EGS , refer to Section 21 chapter 1.



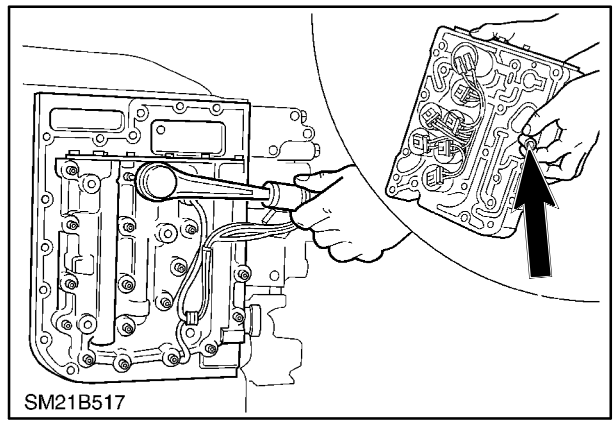
22

Test Procedure.

Test procedure of the speed sensor refer to the next page.

POWERSHIFT CONTROL VALVE

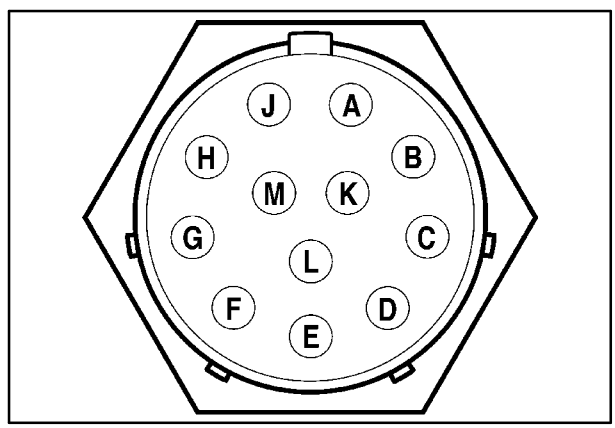
The control valve receives signals switching ON or OFF the solenoids allowing the desired gears to be selected. A variable current solenoid receives a reducing signal from the EGS controlling modulator. The control valve is fitted with a combined temperature and speed sensor which sends signals back to the EGS.



23

Test Procedure

Test between pin indicated in the left hand column and either pin H or M as detailed in the table below.



24

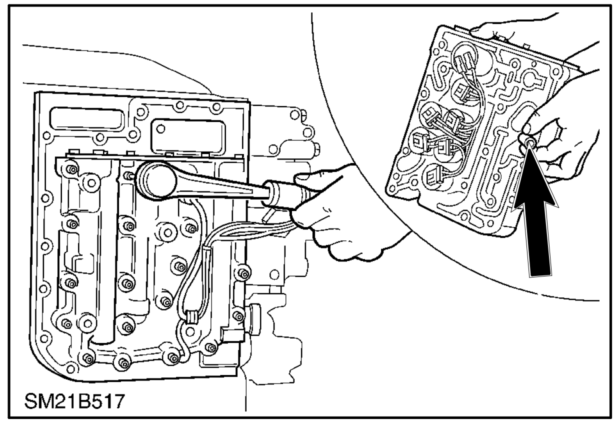
Description

Pin No.	H	M
A	27.5Ω	----
B	27.5Ω	----
C	27.5Ω	----
D	27.5Ω	----
E	27.5Ω	----
F	27.5Ω	----
G	----	14Ω
K	----	31Ω

* A Speed sensor plus output
B Forward Lo/Hi solenoid
C Forward/neutral solenoid
D Range 1/2 solenoid
E FWD solenoid
F Reverse neutral solenoid
G Direction modulation solenoid
K Range modulation solenoid
L Transmission temperature out ground
M Control valve common plus

POWERSHIFT SPEED SENSOR TEST

Disconnect from control valve and fit the 12 pin connector from special tool. Connect the power socket into the 12volt power socket . Install the probes from a Multimeter into the tool. Raise the unit off the ground and observe voltage (V1). Turn the rear wheel which inturn rotates the transmission output shaft, observe the second voltage (V2).

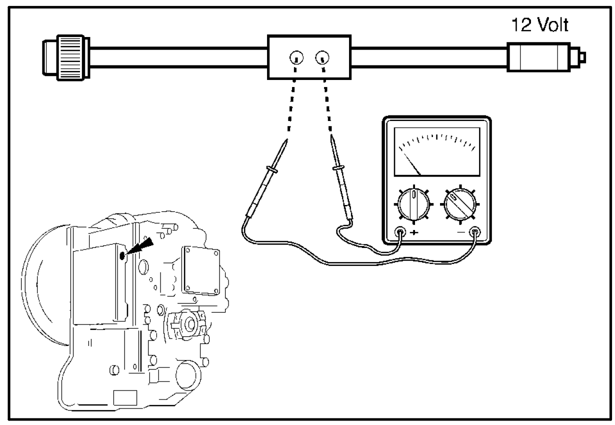


25

Test Procedure

Pin No.	V1	V2
A	0.6-0.8	1.3-1.5

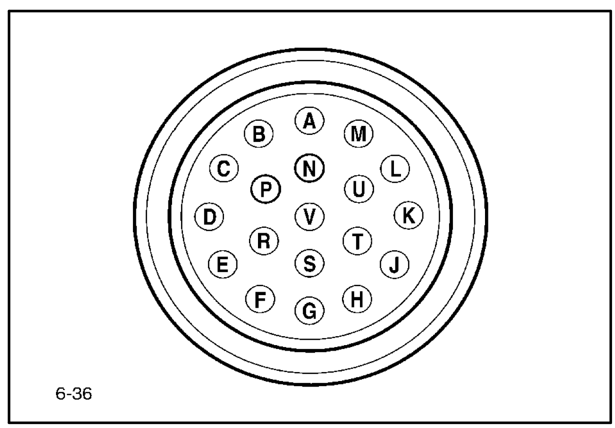
The special tool connects to pin A speed sensor plus out put, and pin J speed sensor / temperature sensor ground.



26

Description

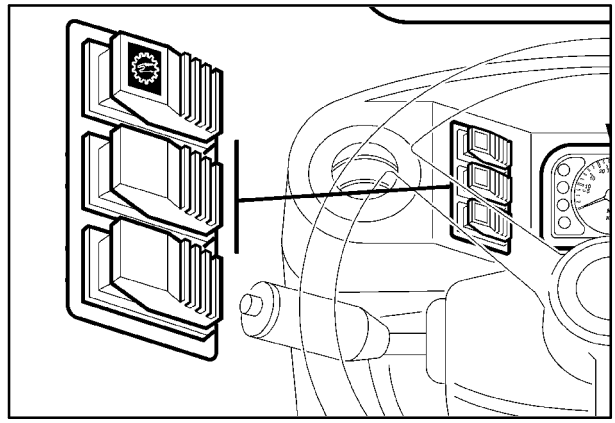
A Speed sensor +
B FWD request
C Disconnect request input
D Speedometer output
E Diagnostic link input
F Analogue Input 1
G Analogue Input 0
H -
J -
K PWM solenoid supply
L Solenoid 3
M PWM 1
N Range solenoid
P Forward solenoid
R Solenoid 2
S Solenoid 1
T VCS
U Ground
V Battery +



27

POWERSHIFT EGS OVERRIDE - S48

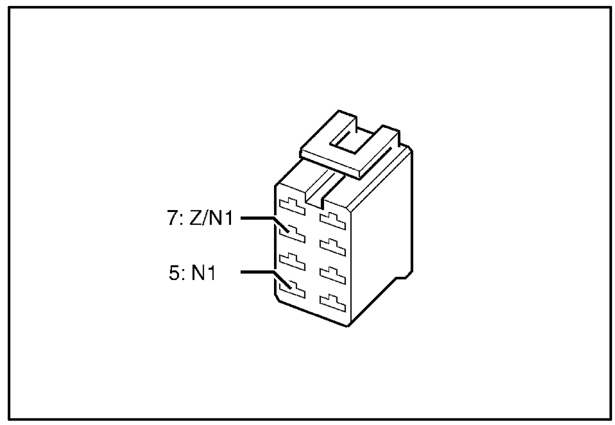
In situations where a "***MANUAL"*** gear change (up or downshift) is required the powershift auto change can be overridden by selection of this console mounted switch.



28

Test Procedure

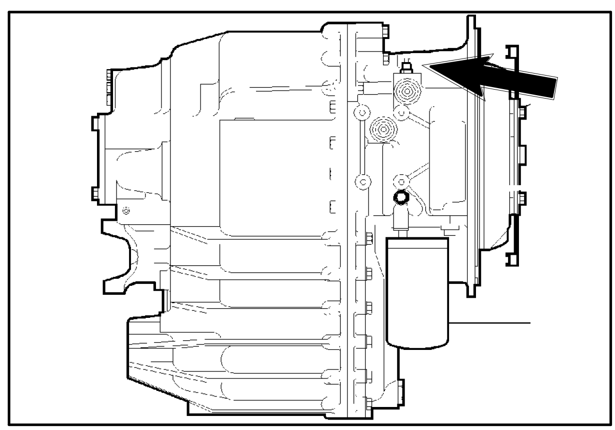
Continuity should be found between Pin 1 and Pin 2 when switch is operated.



29

OIL PRESSURE SWITCH - POWERSHIFT

Energised at 12 volts If the transmission pressure is to low, the warning lamp will flash.



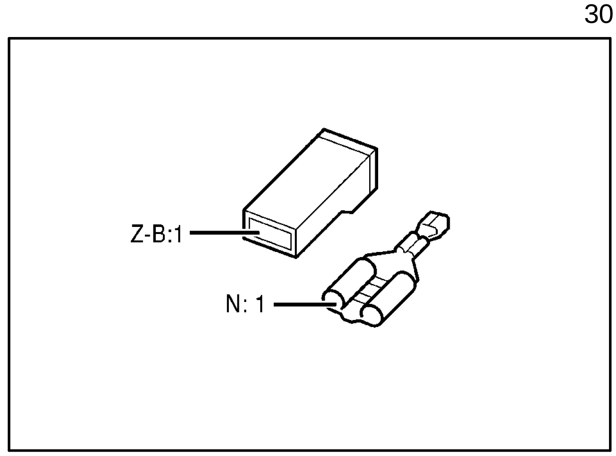
30

Test procedure

The voltage measured between Pin 1 and Pin 2 should be 12V.

With Transmission oil pressure continuity should be found.

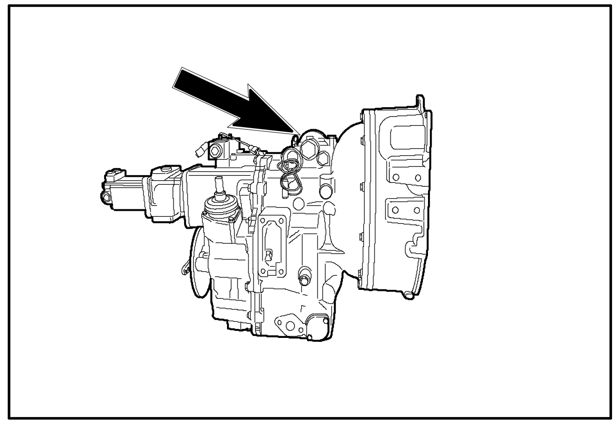
Pin No.	Sender	Resistance
1	12V	at low pressure 0.3 Ω



31

OIL PRESSURE SWITCH - POWERSHUTTLE

If the transmission pressure is to low, the warning lamp to flash.



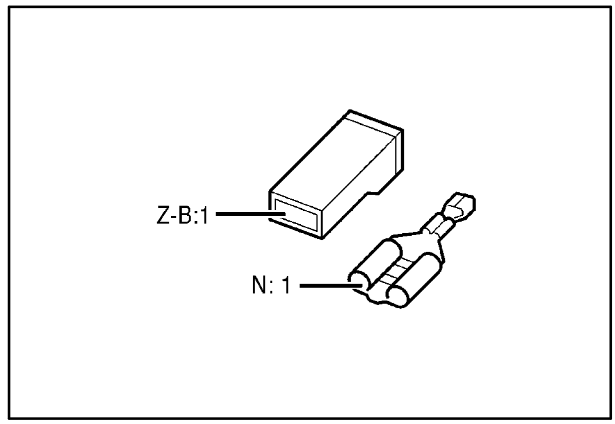
32

Test procedure

The voltage measured between Pin 1 and Pin 2 should be 12V.

With Transmission oil pressure continuity should be found.

Pin No.	Sender	Resistance
1	12V	at low pressure 0.3 Ω

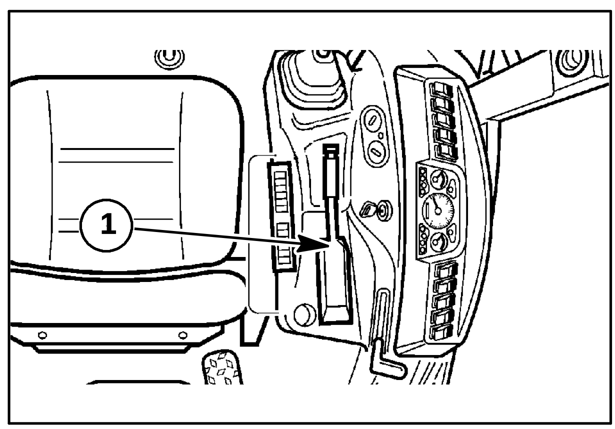


33

PARKING BRAKE SWITCH

When the handbrake has been applied, the switch will be closed and the warning lamp is illuminated.

An alarm / klaxon will sound if the handbrake is on with the transmission shuttle lever applied.

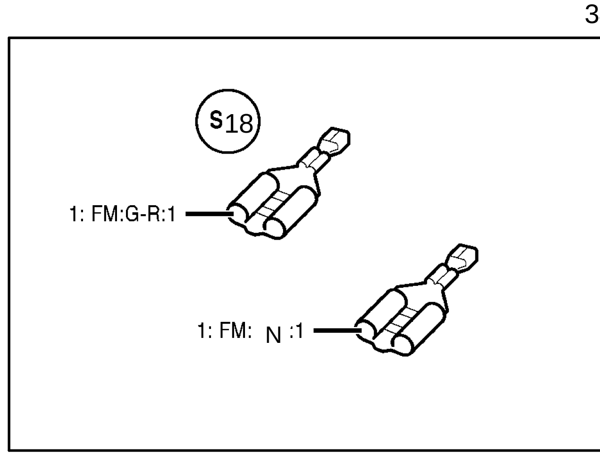


34

Test Procedure

Brake Engaged:
switch closed warning light illuminated

Brake Disengaged:
switch open warning light off



35

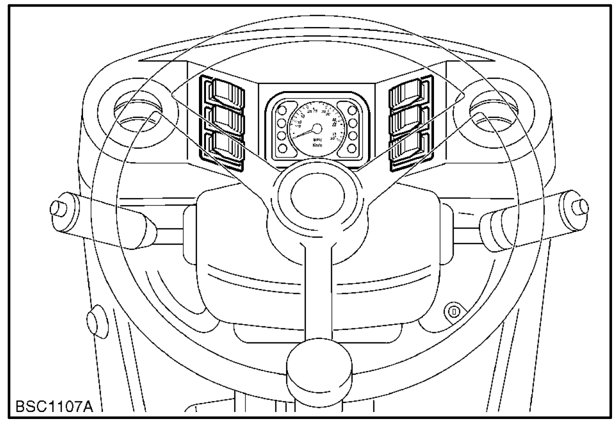
CAB

FRONT INSTRUMENT PANEL – X70 12 PIN

The front instrument panel is sent signals from the brake oil level sender, transmission speed sensor, light switch and indicator switch.

At the rear of the panels are connectors that are attached to the vehicle harness system.

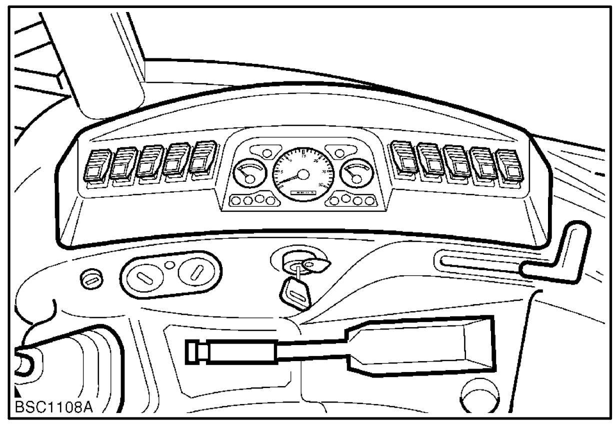
These connectors and functions are listed on the following pages



36

SIDE INSTRUMENT PANEL – X22 20 PIN

Receives signal from sensors to display, hours, engine RPM, oil pressure, fuel level and signals to warning and indicator lights.



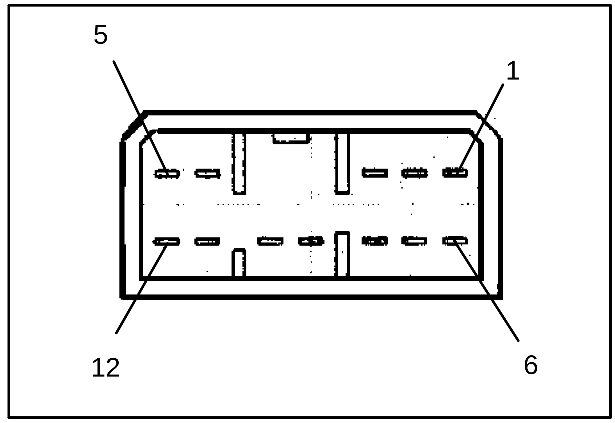
37

**FRONT PANEL CONNECTOR –
CONNECTOR – AMP. 070 12 VIE – X70
POWERSHUTTLE:**

Pin Functions and Test Procedure

Listed below are the pin numbers,warning lights, and gauges.

1. 12 volt Key Start
2. Earth: Check continuity
3. Tachometer:
   Signal from W output of the alternator
4. Dipped Beam:
   Green warning light illuminates at 12v with multi function light switch on.
5. High Beam – Blue warning light illuminates at 12v with multi function switch on.
6. 12 volt and Instrument Backlighting
7. Not used
8. Not Used
9. Not Used
10. Not Used
11. Direction indicators:
    Green warning light illuminates at 12v with light switch on.
12. Brake Oil Level;
    Red warning light when the input is connected to earth with Ignition on 12V



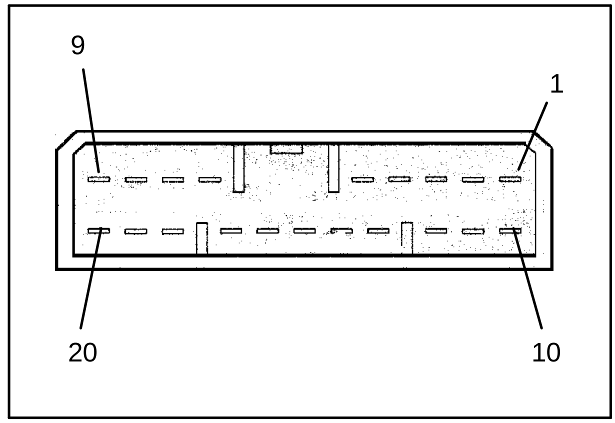
38

**SIDE PANEL CONNECTOR –
CONNECTOR AMP. 070 20 VIE – X22
POWERSHUTTLE:**

Pin Functions and Test Procedure

Listed below are the pin numbers,warning lights, and gauges.

1. Air filter:
   The Red warning light is illuminated if the input is connected to earth with Ignition on 12V
2. Engine Oil Pressure:
   The Red warning light is illuminated if the input is connected to earth with Ignition on 12V
3. Battery:
   Low battery charging the Red warning light comes on when the input is connected to +V DC. Ignition on 0V or Engine running 12V.
4. Engine Coolant Temperature Gauge:
   The Red warning light is illuminated if the input is connected to earth with Ignition on 12V (At 75°C Indicator is on Red the warning Buzzer sounds at 107°C)
5. Fuel Level Gauge:
   When the input is connected to earth with Ignition on 12V
6. Tachometer Gauge:
   Signal from W output of the alternator
7. 12 volt and Backlighting
8. Earth – Check continuity
9. 12 volt key Start
10. Not Used
11. Not used
12. Not Used
13. Park brake – Red warning light Hand brake on 0V, hand brake off 12V
14. 24 volt Option
15. Buzzer
16. Options
17. Options
18. Transmission Low Oil Pressure – Red warning light is illuminated and buzzer sounds if the input is connected to earth. Ignition on 0V, Engine running 12V.
19. Transmission Oil Temperature – Red warning light illuminates if the input is connected to earth. Ignition on 12V.
20. Engine Cold start The yellow warning light comes on when the input is connected to 12V. Ignition on 0V Preheat engaged 12V



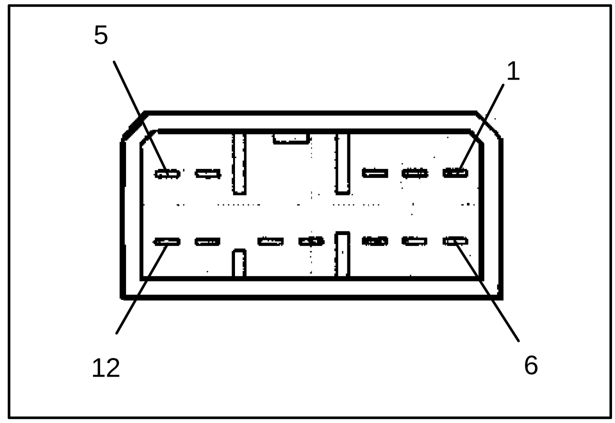
39

**FRONT PANEL CONNECTOR –
CONNECTOR – AMP. 070 12 VIE – X70
POWERSHIFT:**

Pin Functions and Test Procedure

Listed below are the pin numbers,warning lights, and gauges.

1. 12 volt Key Start
2. Earth: Check continuity
3. Tachometer:
   Signal from W output of the alternator
4. Dipped Beam:
   Green warning light illuminates at 12v with multi function light switch on.
5. High Beam – Blue warning light illuminates at 12v with multi function switch on.
6. 12 volt and Instrument Backlighting
7. Not used
8. 4 Wheel Steer – Green warning light Four wheel input. With Ignition ON and 4WS selected 0.5V should be indicated. With 2WS or Crab steer selected 0V should be indicated.
9. Crab Steer – Green warning light
10. 2 Wheel Steer – Green warning light
    Two wheel steer input. With Ignition ON and 2WS selected 1.5V should be indicated. With 4WS or crab steer selected 12V should be indicated.
11. Direction indicators:
    Green warning light illuminates at 12v with light switch on.
12. Brake Oil Level;
    Red warning light when the input is connected to earth with Ignition on 12V



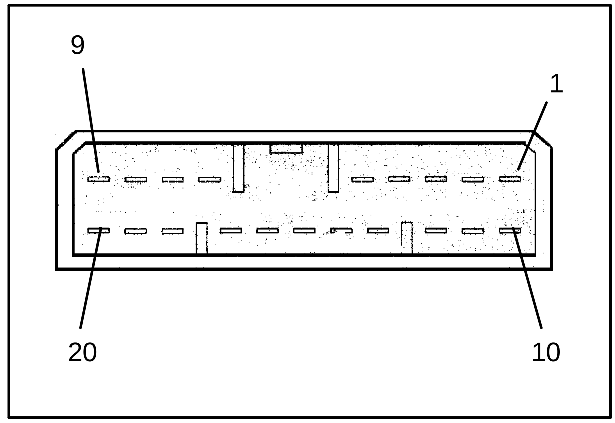
40

SIDE PANEL CONNECTOR – CONNECTOR AMP. 070 20 VIE – X22 POWERSHIFT:

Pin Functions and Test Procedure

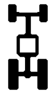
Listed below are the pin numbers,warning lights, and gauges.

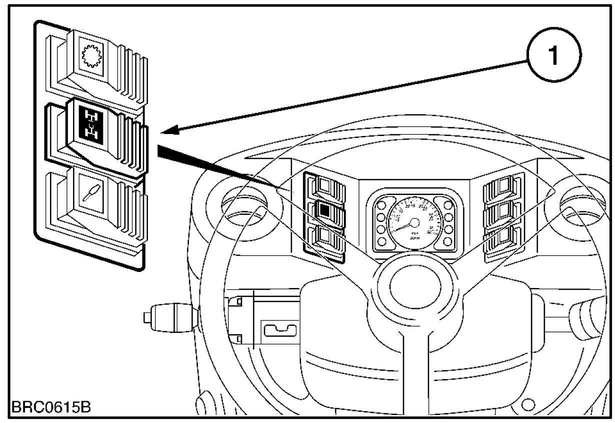
1. Air filter:
   The Red warning light is illuminated if the input is connected to earth with Ignition on 12V
2. Engine Oil Pressure:
   The Red warning light is illuminated if the input is connected to earth with Ignition on 12V
3. Battery:
   Low battery charging the Red warning light comes on when the input is connected to +V DC. Ignition on 0V or Engine running 12V.
4. Engine Coolant Temperature Gauge:
   The Red warning light is illuminated if the input is connected to earth with Ignition on 12V (At 75°C Indicator is on Red the warning Buzzer sounds at 107°C)
5. Fuel Level Gauge:
   When the input is connected to earth with Ignition on 12V
6. Tachometer Gauge:
   Signal from W output of the alternator
7. 12 volt and Backlighting
8. Earth – Check continuity
9. 12 volt key Start
10. Not Used
11. Not used
12. 30 volt battery
13. Park brake – Red warning light Hand brake on 0V, hand brake off 12V
14. 24 volt Option
15. Buzzer
16. Options
17. Options
18. Transmission Low Oil Pressure – Red warning light is illuminated and buzzer sounds if the input is connected to earth. Ignition on 0V, Engine running 12V.
19. Transmission Oil Temperature – Red warning light illuminates if the input is connected to earth. Ignition on 12V.
20. Engine Cold start The yellow warning light comes on when the input is connected to 12V. Ignition on 0V Preheat engaged 12V



41

4WD SWITCH S2



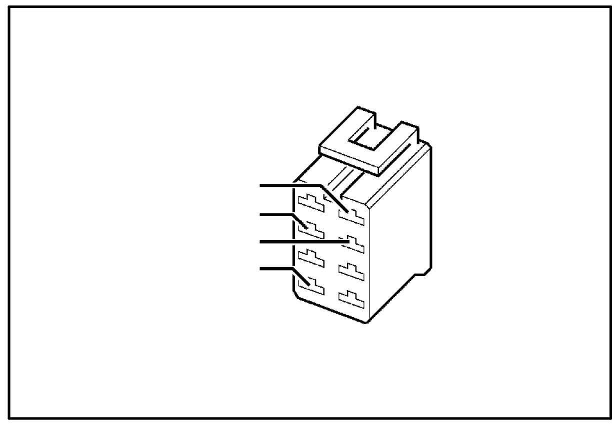


42

Test Procedure

Continuity		
Switch OFF	**Position 1**	**Position 2**
Pin 7 to Pin 5	Pin 5 to Pin 3	Pin 1 to Pin 3
Pin 6 to Pin 8	Pin 4 to Pin 6	Pin 2 to Pin 4

Voltage:
Ignition ON: Pin 3 = 12v
Pin 6 = 9v



43

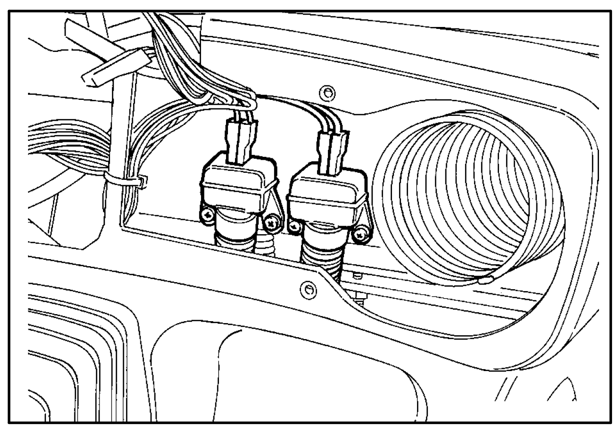
BRAKE PEDAL SWITCHES S32 / S33

Test Procedure

Continuity:

Brakes not applied: no continuity.
Brakes applied: continuity, between the two centre pins of each switch.

Both brake pedals must be applied to allow 12V to relay.

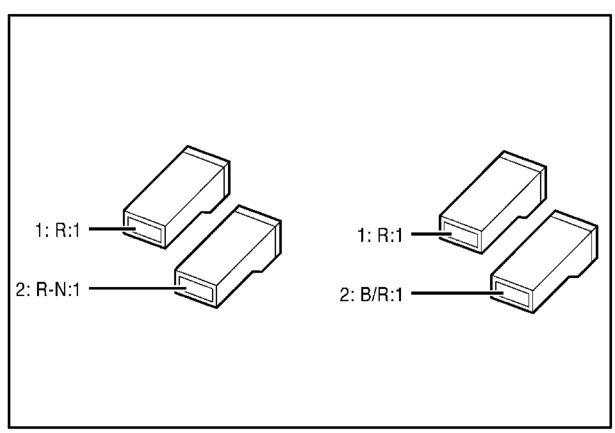


44

Voltage:

Left Switch:
White/Red wire – 12V Continuous with Ignition ON
Red Wire – 12V Pedal depressed,
0V pedal released.

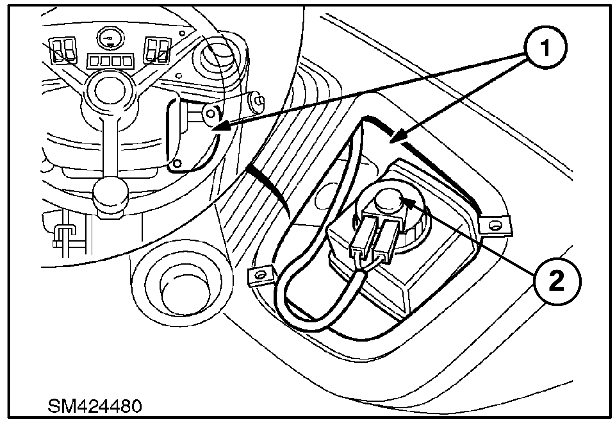
Right Switch:
Red wire – 12V Pedal depressed
0V Pedal released
Red–Black wire – 12V Pedal depressed
0V Pedal released



45

BRAKE OIL LEVEL SWITCH S31

When the switch is activated due to low oil level this sends a signal to the instrument cluster to illuminate the low brake fluid level warning lamp.

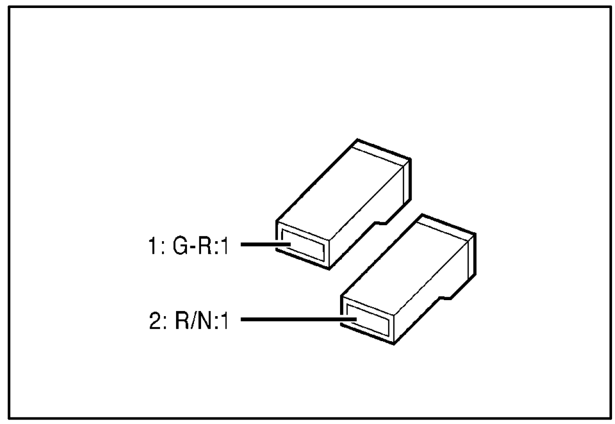


46

Test procedure:

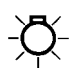
Continuity:
With the fluid level correct there should be no continuity through the switch. Continuity should be seen when the level is low or the test button pushed.

Voltage:
With the Ignition ON there should be 12V at the Red/Black terminal.

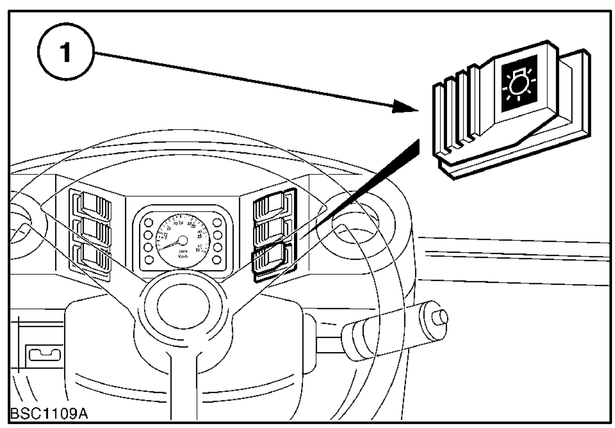


47

MAIN LIGHT SWITCH S9



12 volts should be found at the switch at all times irrespective of keystart position



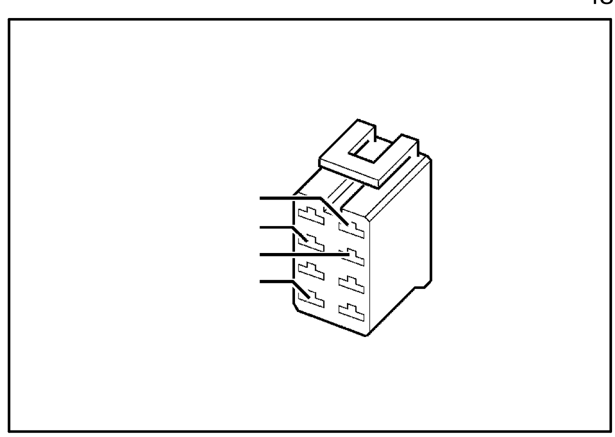
48

Test Procedure

(Switch Off)
Continuity should not be found between any pins

(Switch Side)
Continuity should be found between pins 1 and 3.

(Switch Main)
Continuity should be found between pins 2 and 8.

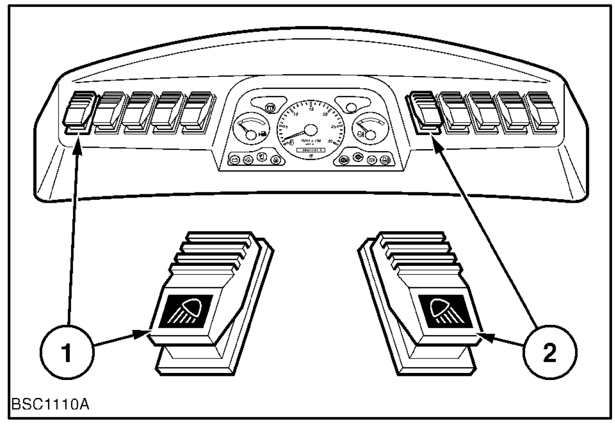


49

FRONT WORK LAMP SWITCH S11 (1)

REAR WORK LAMP SWITCH S12 (2) MAIN LIGHT SWITCH

12 volts should be found at the switch only after main light switch is on and key start activated

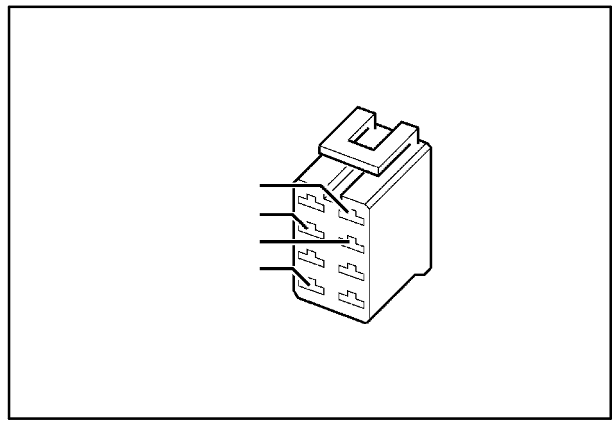


50

Test Procedure

(Switch Off)
Continuity should not be found between any pins

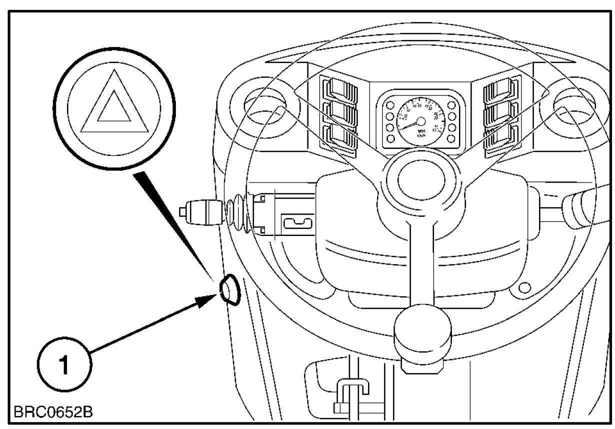
(Switch On)
Continuity should be found between pins 1 and 3 and 2 and 8.



51

HAZARD SWITCH S10

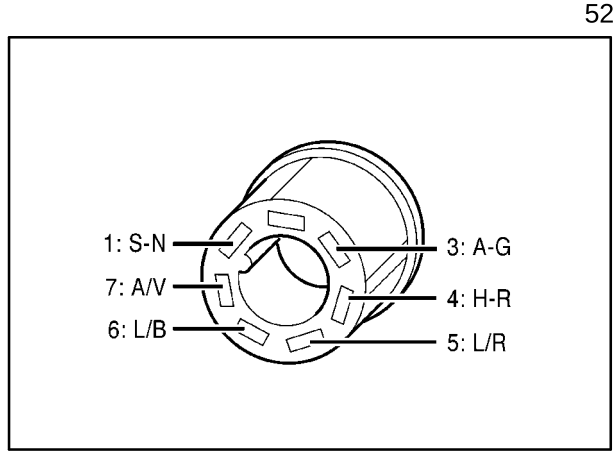
12 volts should be found at this switch at all times regardless of key start position



52

Test Procedure

Pin No.	Switch OFF	Switch ON
1	to Pin 4	----
3	----	to Pins 5/6/7
4	to PIn 1	----
5	----	to Pins 2/3/6/7
6	----	to Pins 2/3/5/7
7	----	to Pins 2/3/5/6

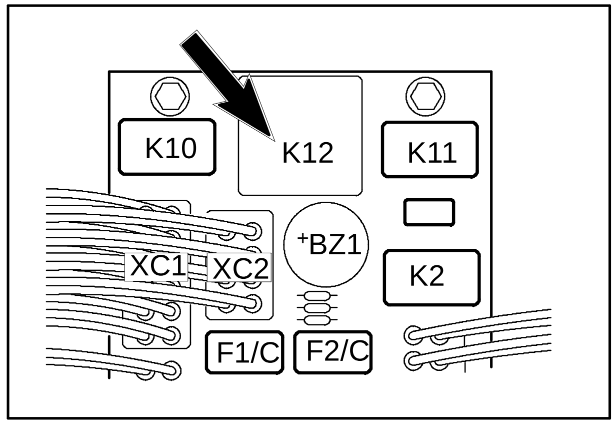


53

FLASHER MODULE K12

⇦⇨

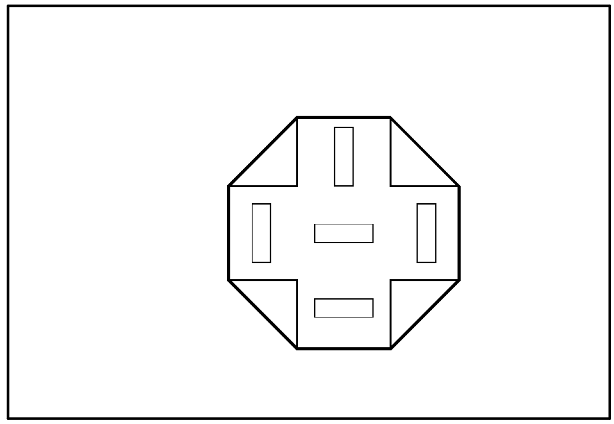
Operational at all times in conjunction with the hazard switch



54

CONTINUITY

Pin No.	Hazard/Indicator	
	Switch OFF	Switch ON
CL	12v	12v
+	----	12v–0v–12v–0v–
31	----	12v–0v–12v–0v–
PR	----	----

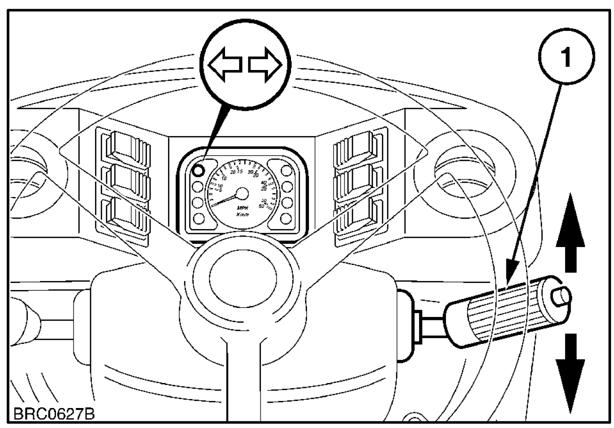


55

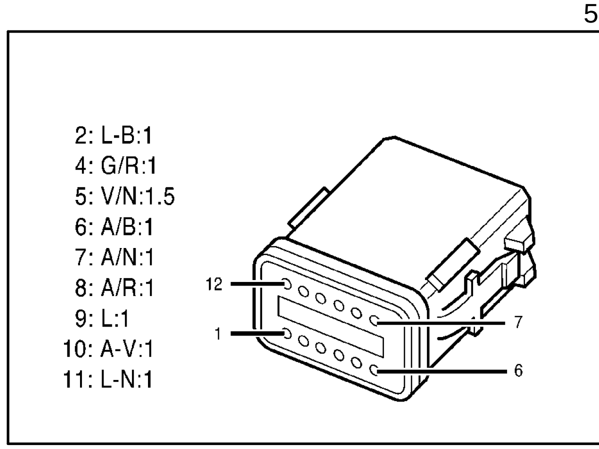
MULTI FUNCTION SWITCH S41

Switch Continuity.

Pin No.	All Switches OFF	wind-screen wash-er	Indicator		Beam		Wiper
			Left	Right	Low	High	On
1							
2		Pin7					
3						Pin4	
4					Pin5	Pin3	
5					Pin4		
6	Pin8						
7		Pin2					Pin8
8	Pin6						Pin7
9			Pin 11				
10				Pin 11			
11			Pin9	Pin 10			
12							



56

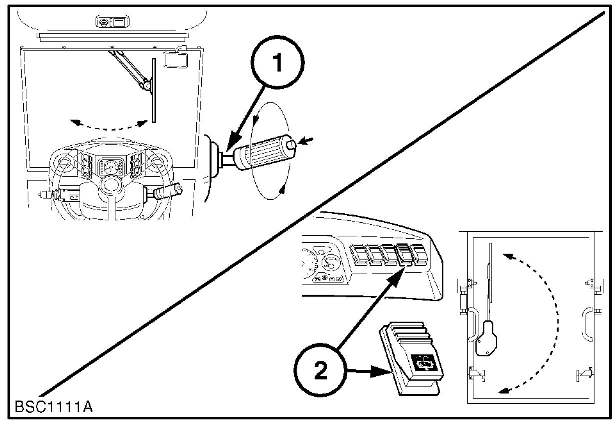


57

FRONT WIPER MOTOR M5 (1)

REAR WIPER MOTOR M4 (2)

Energised at key start at 12 volts

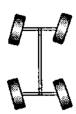


58

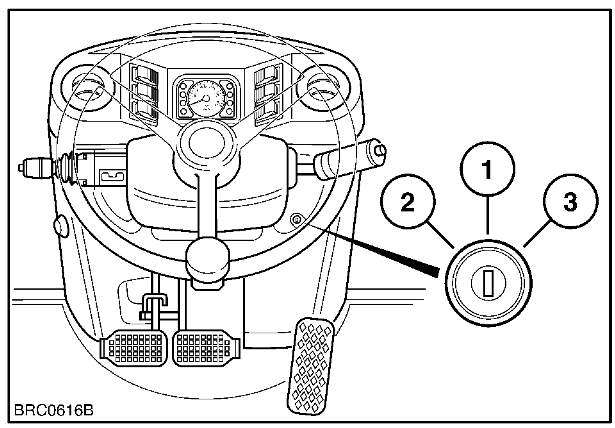
Test Procedure

Pin No.	Continuity	Continuity
1	Pin 3	Pin 5 2Ω.
3	Pin 5 2Ω.	----

4WS – STEERING SELECTOR SWITCH – S47



At key start 12 volts should be found at the switch and is directed to the steering sensors when a switch selection is made.

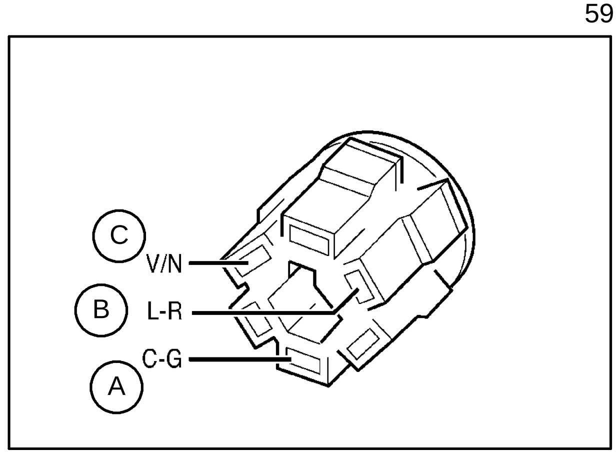


59

Test Procedure

With Ignition ON

Pin	2WS	4WS	CRAB
A	12v	12v	12v
B	–	–	12v
C	–	12v	–

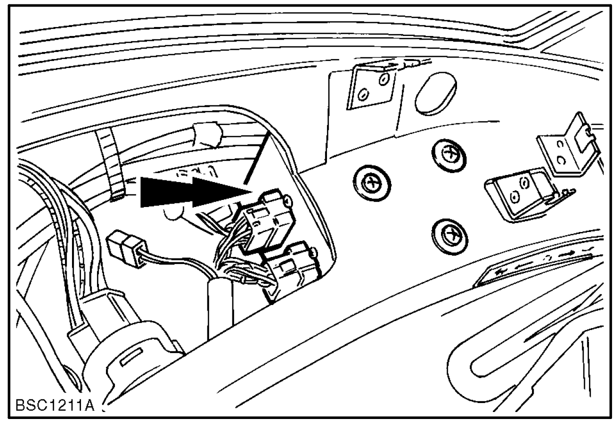


60

STEERING CONTROL UNIT

The Steering Control Unit controls the different steering functions that can be selected from the switch S47.

When changing steering mode, the light for the current mode is extinguished and the light for the new mode starts to flash. When movement of the steering wheel is detected, the light for the new mode remains steady.

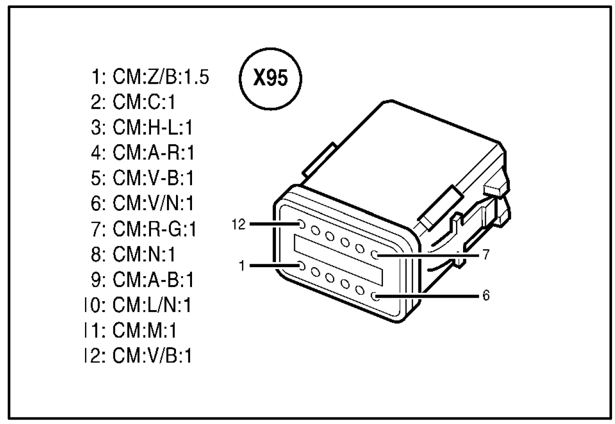


61

Connector Pin Out Description

12 pin connector – X95:

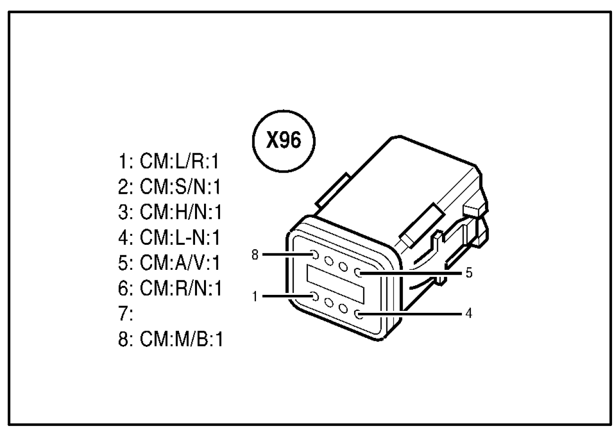
Pin	Function	Signal
1	Crab steering warning light	–
2	Buzzer configuration	–
3	Front alignment sensor input	+12
4	Crab steering control	+12
5	Buzzer output	–
6	Rod iron steering control	+12
7	Control unit supply	+12
8	Ground	–
9	Speed sensor input	–
10	Rear alignment sensor input	+12
11	2WS warning light	–
12	4WS warning light	–



62

8 pin connector – X96:

Pin	Function	Signal
1	EV2A output	+12
2	EV2B output	+12
3	EV3A output	+12
4	Ground	–
5	Front sensor supply output	+12
6	Rear sensor supply output	+12
7	Available optional output	+12
8	EV3B output	+12



63

Solenoid Valve Operation

Crab/4WS > 2WS

When the rear axle sensor detects alignment of its axis, the control unit de–energises the active steering solenoid valves and activates the solenoid valves for 2WS.

2WS > Crab/4WS

When the rear axle sensor detects bridge alignment, all the solenoid valves for 2WS are de–activated and the solenoid valves for the selected mode are energised.

Crab > 4WS and 4WS > Crab

When the rear axle sensor detects alignment the 2WS temporarily activates (energising the corresponding solenoid valves) until, after overcoming the condition of rear bridge alignment, the desired steering type activates when, by reversing the steering swing direction, the rear axle sensor detects alignment.

Solenoid Valve Output

Solenoid	2WS	4WS	CRAB
EVA2			X
EVA3		X	X
EVB2	X	X	
EVB3	X		

Solenoid Valve Failure

The operation condition of any solenoid valve output is tested each time the selected steering requires its supply. Even when only one solenoid valve output is short circuited or open, the control unit provides to cut the supply to all the solenoid valves by means of the self protection (the control unit is locked) and to signal this condition (short– or open– circuit) by means of the three warning lights relative to steering flashing at the same time. Once the solenoid valve causing the failure has been de–energised or the correct operation has been reset.

Buzzer Operation

Buzzer operation depends on setting of pin 2 of the 12 way connector:

- Pin 2 not connected (North America only) If 12 km/h is exceeded in crab mode, the buzzer sounds.
- pin 2 grounded (Outside of N/America). If 12 km/h is exceeded in crab or 4WS mode, the buzzer sounds.

Buzzer operation is intermittent, 250ms on and 250ms off.

The control unit is set at 9 km/h; steering mode change is not possible when this speed is exceeded.

Speed Pulses

Speed pulses are drawn from EGS–CLARK control unit. Output reference values of Clark gearbox are;

- 7 Hz for 1 kmÆ
- 14 Hz for 2 kmÆ
- 35 Hz for 5 kmÆ

values in volts –8 and +8.

The speed calculation has been determined with a tyre having a circumference of 4.165m.

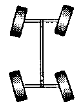
Steering Type Storage

The steering type is stored in a non–volatile memory each time the machine is turned off. This information is therefore stored for an indefinite time even with the supply cut off.

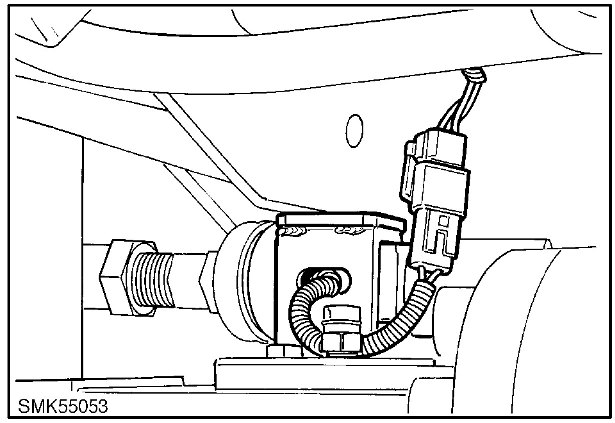
Start–up and Axle Recovery

The control units are supplied with a storage of the last steering selected at two wheels. With this steering type selected, it is always possible to recover the axle alignment; “short–circuit” the sensor or front and rear axles, supply the machine (with the switch in 2 wheel position) and select the type of 4 wheel steering enabling the bridge alignment.

4WS REAR AXLE STEERING SENSOR – S42



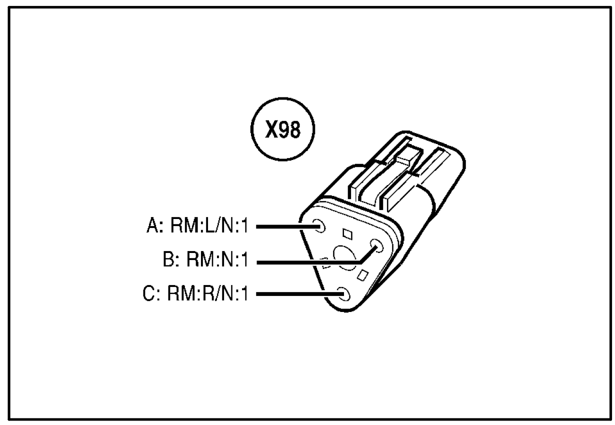
At key start 12 volts should be found at the switch and is directed to the steering sensor when the switch selection is made.



64

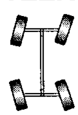
TEST PROCEDURE – X98

Pin	2WS	4WS	CRAB
A	12v	12v	12v
B	–	–	–
C	–	–	–

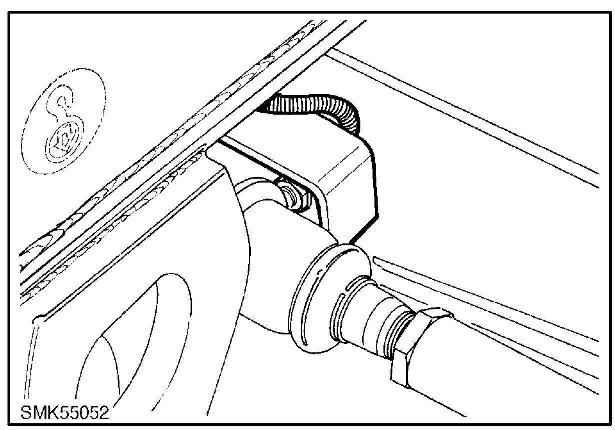


65

4WS FRONT AXLE STEERING SENSOR – S40



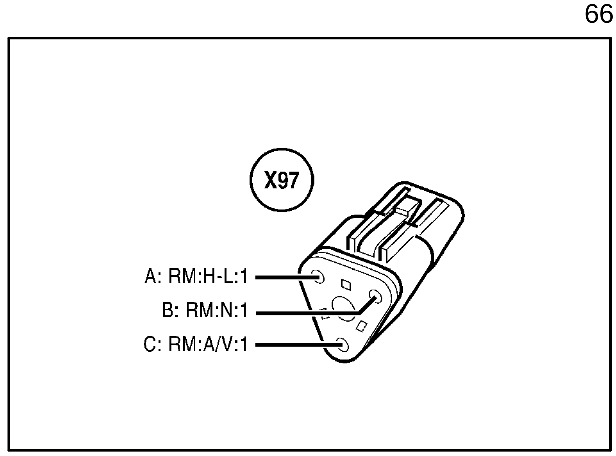
At key start 12 volts should be found at the switch and is directed to the steering sensor when a switch selection is made.



66

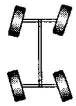
TEST PROCEDURE – X97

Pin	2WS	4WS	CRAB
A	12v	12v	12v
B	–	–	–
C	–	–	–

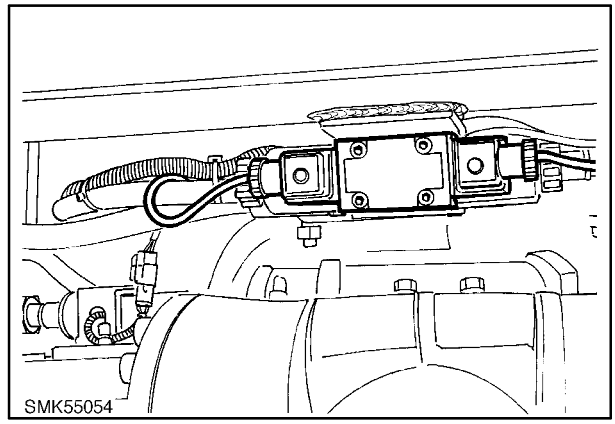


67

STEERING SOLENOIDS



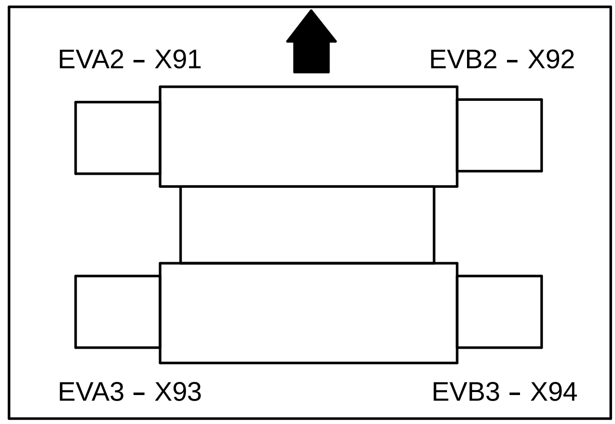
Energised at 12 volts but governed by the steering processor.



68

Solenoid connections, viewed from the top. Arrow denotes front of tractor

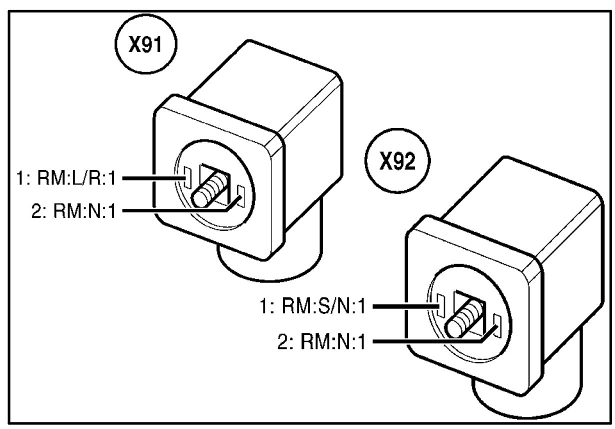
Solenoid	2WS	4WS	CRAB
EVA2	0v	0v	12v
EVA3	0v	12v	12v
EVB2	12v	12v	0v
EVB3	12v	0v	0v



69

TEST PROCEDURE

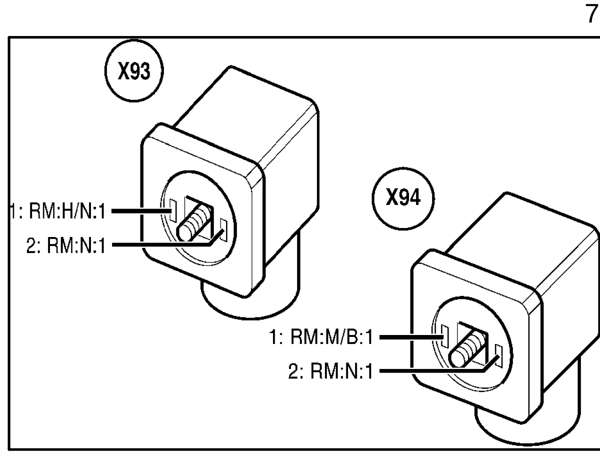
Pin No.	Solenoid	resistance
1	0V	5.0 Ω



70

TEST PROCEDURE

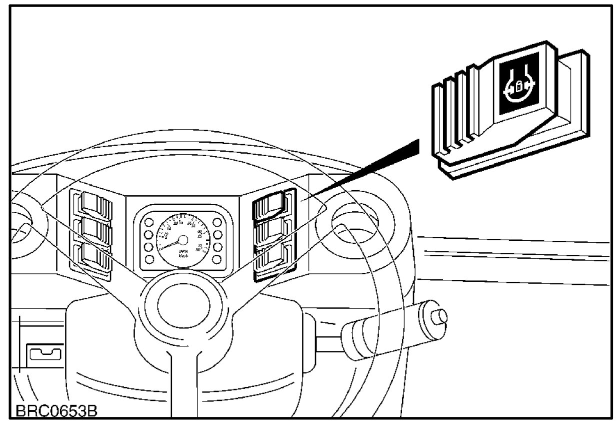
Pin No.	Solenoid	resistance
1	0V	5.0 Ω



71

DIFFERENTIAL LOCK SWITCH - S47

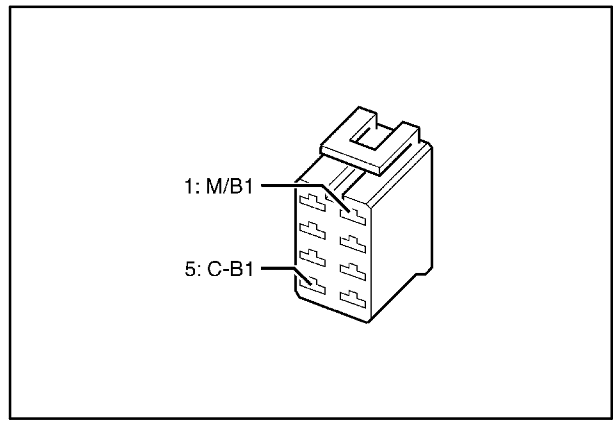
At key start the spring loaded switch has 12 volts and when operated energises the differential solenoid valve



72

Test Procedure

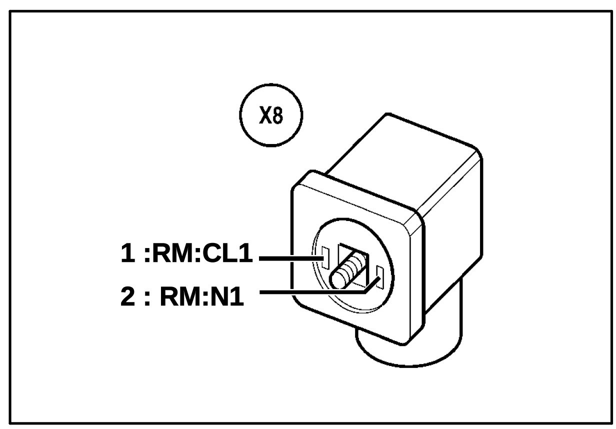
(Switch Off)
Continuity should not be found between any pins
(Switch On)
Continuity should be found between pins 1 and 5



73

TEST PROCEDURE -EV7

Pin No.	Solenoid	resistance
1	0V	5.0 Ω



74

LOADER

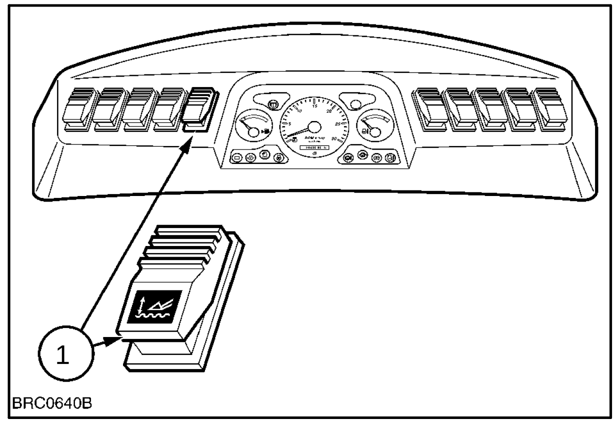
GLIDE RIDE CONTROL – S5

Designed to reduce loader bounce when travelling with an unladen bucket

WARNING

If the machine is raised using the loader bucket do not operate the glide switch ensure it is switched OFF.

If the switch is ON, upon engine start up the vehicle will fall to the ground without any control.

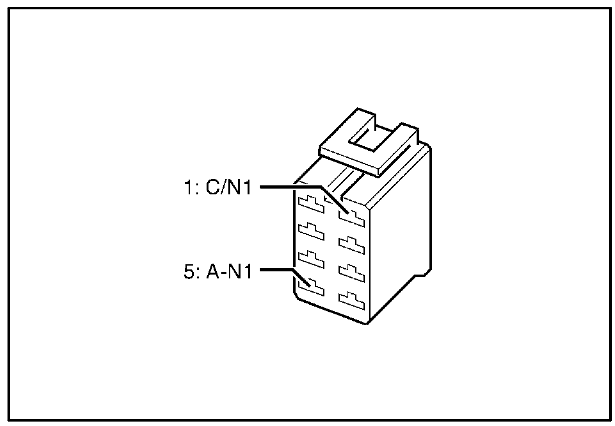


75

Test Procedure

(Switch Off)
Continuity should not be found between any pins

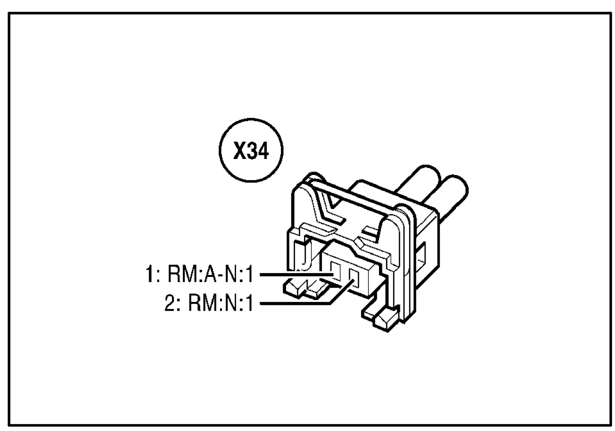
(Switch On)
Continuity should be found between pins 1 and 5



76

TEST PROCEDURE – EV11

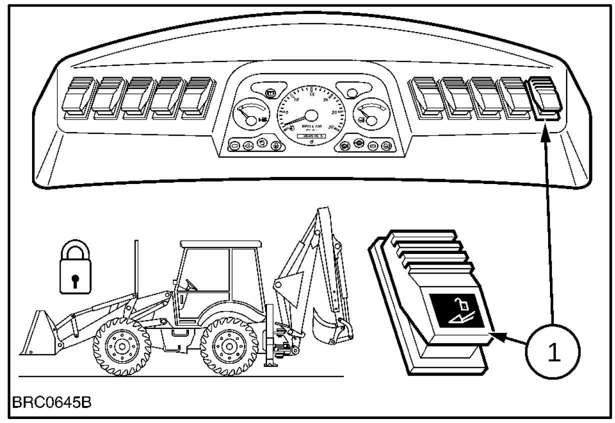
Pin No.	Solenoid	resistance
1	0V	5.0 Ω



77

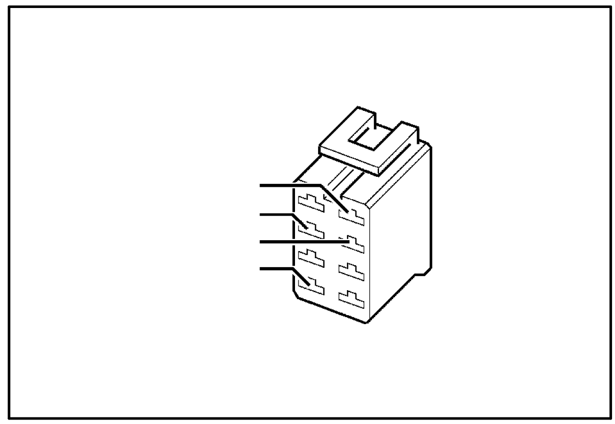
LOADER LOCK VALVE

The loader lock when actuated is designed to prevent movement of the front loader.during road travel.



78

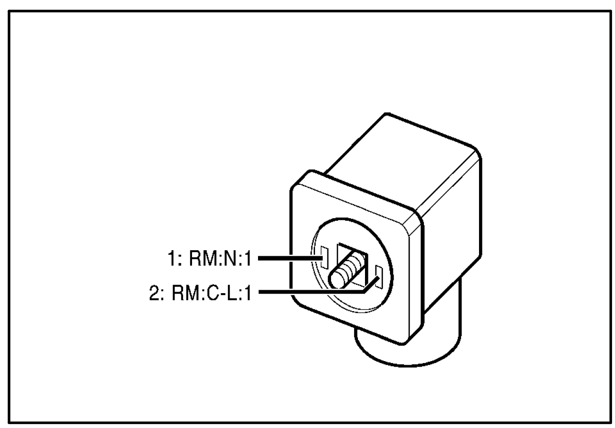
Continuity should be found between Pin 1 and 3.



79

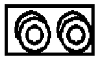
TEST PROCEDURE

Pin No.	Solenoid	resistance
1	0V	5.0 Ω

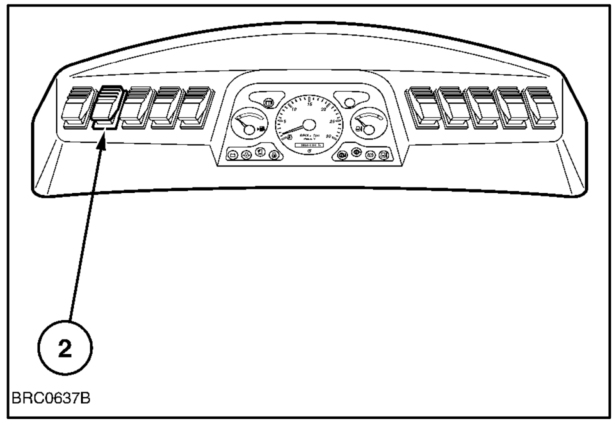


80

DOUBLE DELIVERY CONNECTION - S4



Auxiliary hydraulic line for external tool operation.

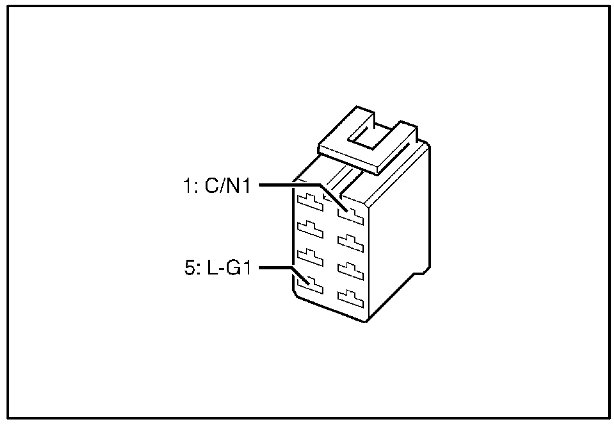


81

Test Procedure

(Switch Off)
Continuity should not be found between any pins

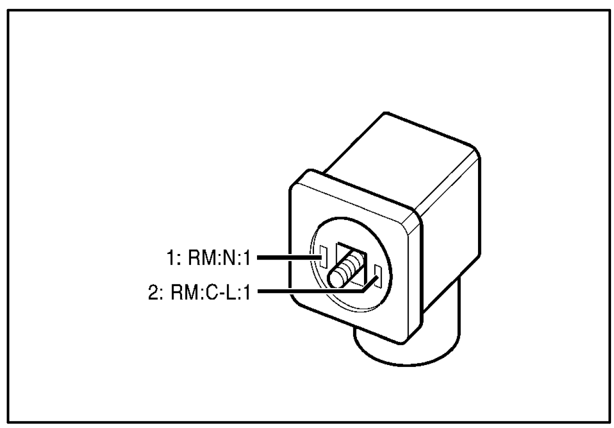
(Switch On)
Continuity should be found between pins 1 and 5



82

TEST PROCEDURE - EV1

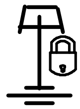
Pin No.	Solenoid	resistance
1	0V	5.0 Ω



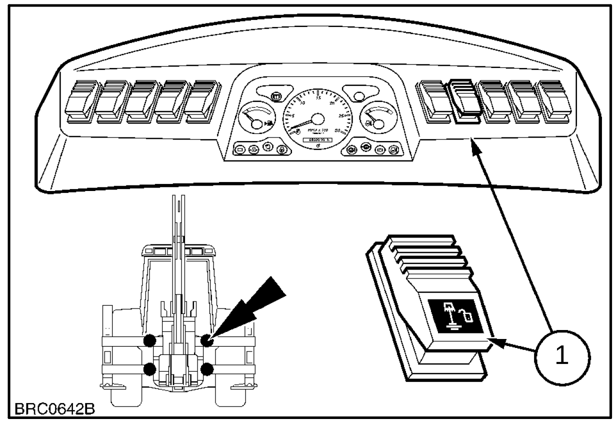
83

BACKHOE

SIDE SHIFT LOCK SWITCH - S7



At key start the switch should have 12 volts to release/engage sideshift clamps.

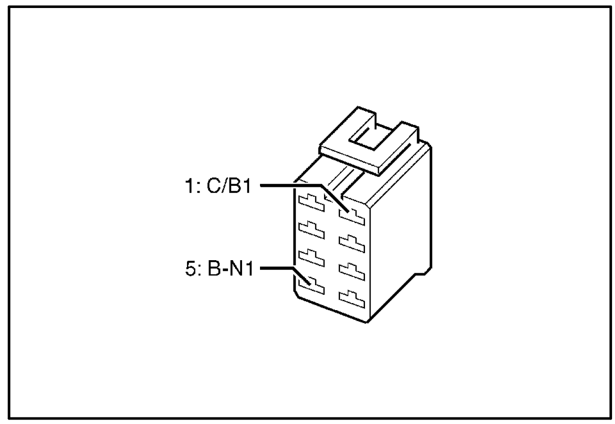


84

Test Procedure

(Switch Off)
Continuity should not be found between any pins

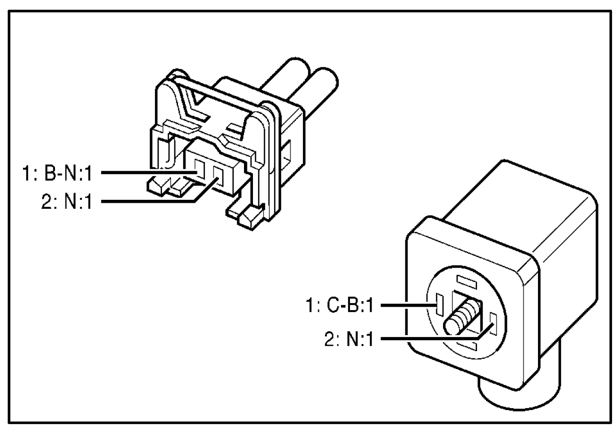
(Switch On)
Continuity should be found between pins 1 and 5



85

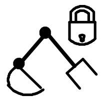
SIDE SHIFT LOCK SOLENOID LINK TEST PROCEDURE - EV4

Pin No.	Solenoid	resistance
1	12V	9.7 Ω

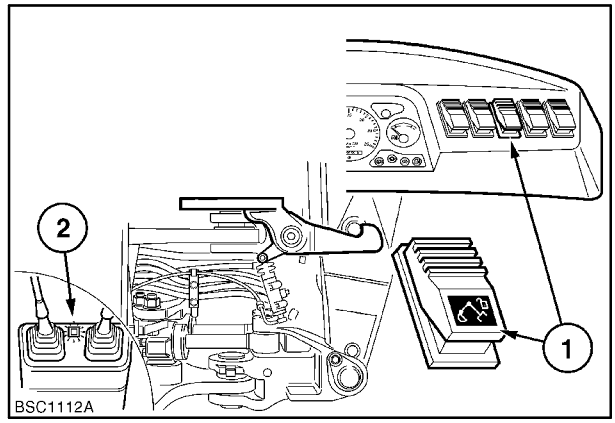


86

BOOM LOCK SWITCH (1) – S8



At key start switch should have 12 volts for operation of the boom lock

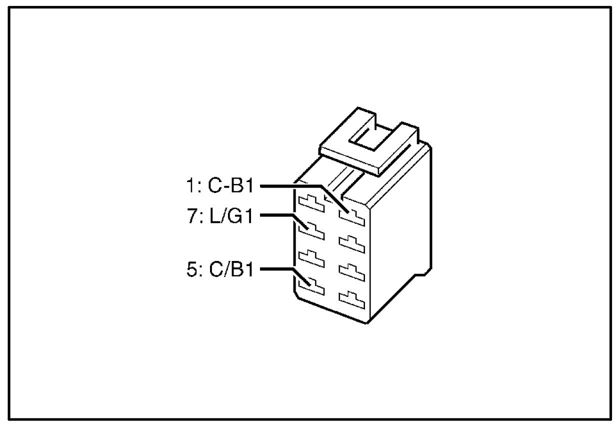


87

Test Procedure

(Switch Off) – X25
Continuity should be found between pins 1 and 5.

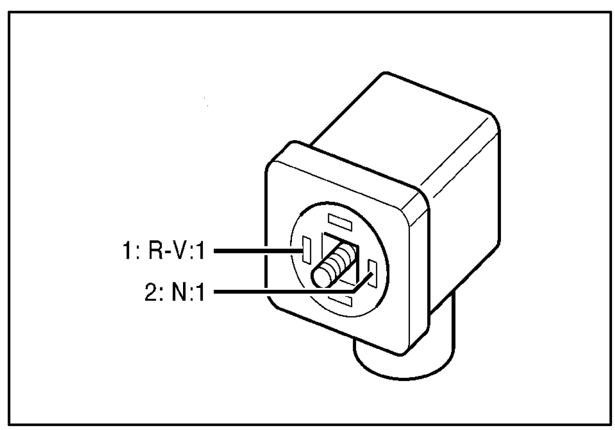
(Switch On)
Continuity should be found between pins 5 and 7.



88

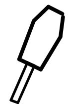
BOOM LOCK SOLENOID – EV5

Pin No.	Solenoid	resistance
1	12V	7.5 Ω

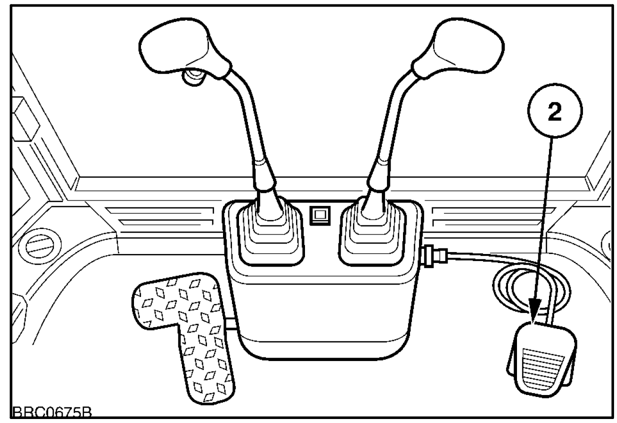


89

BACKHOE HAMMER SWITCH – S30

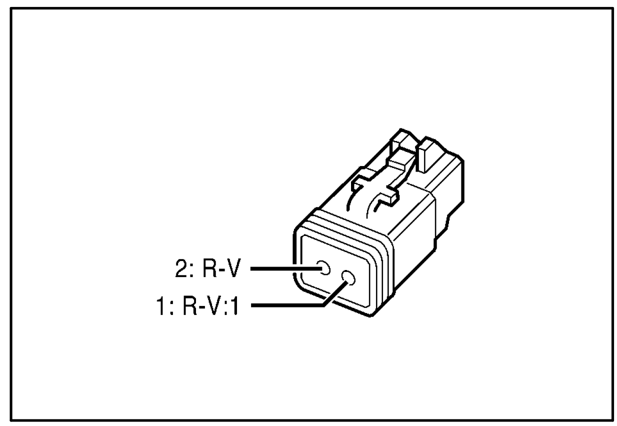


At key start the foot switch should have 12 volts for operation of an attachment.



90

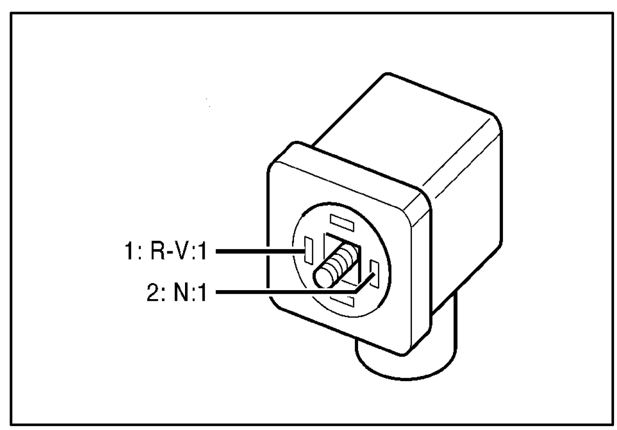
When switch is operated 12V should be found at Pin 2.



91

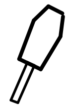
BACKHOE HAMMER SOLENOID – EV3

Pin No.	Solenoid	resistance
1	12V	7.5 Ω

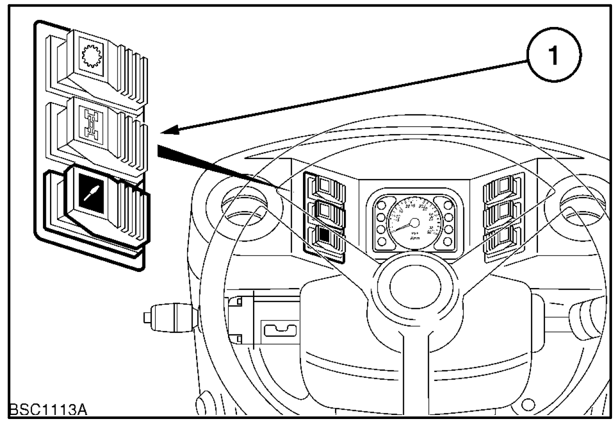


92

HAND HAMMER SWITCH – S3

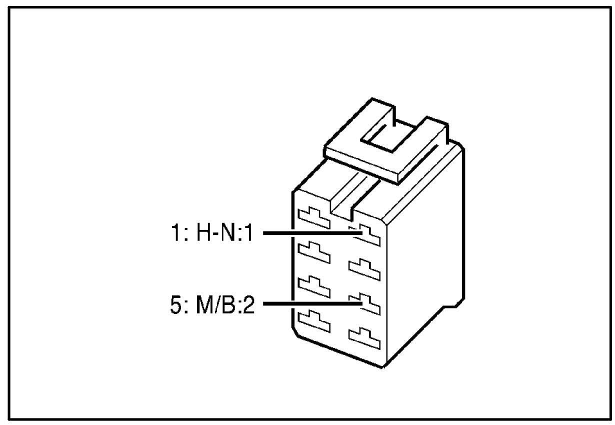


At key start 12 volts should be found at the switch for operation of a hammer.



93

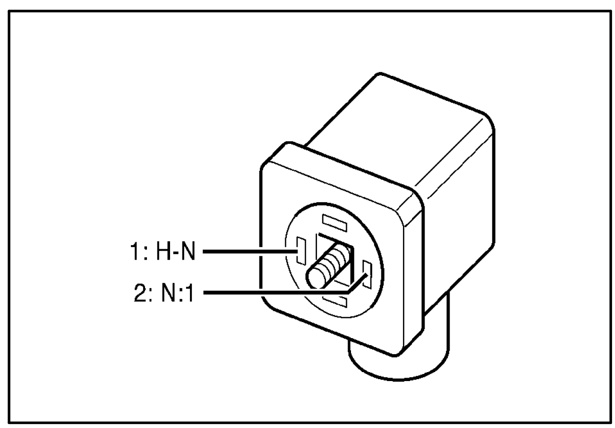
When the switch is operated 12V should be found at Pin 1



94

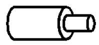
HAND HAMMER SOLENOID VALVE – EV2

Pin No.	Solenoid	resistance
1	12V	7.5 Ω

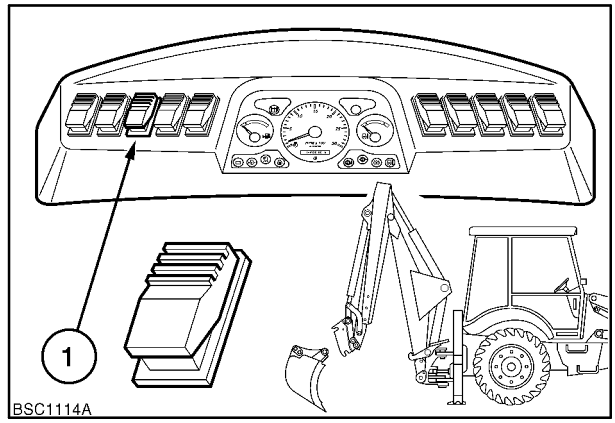


95

QUICK HITCH - BUCKET/TOOLS - S6

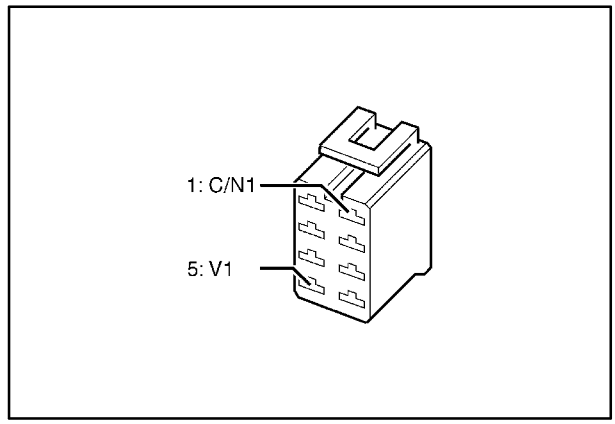


An accessory for attachment of buckets and tools activated at 12 volts.



96

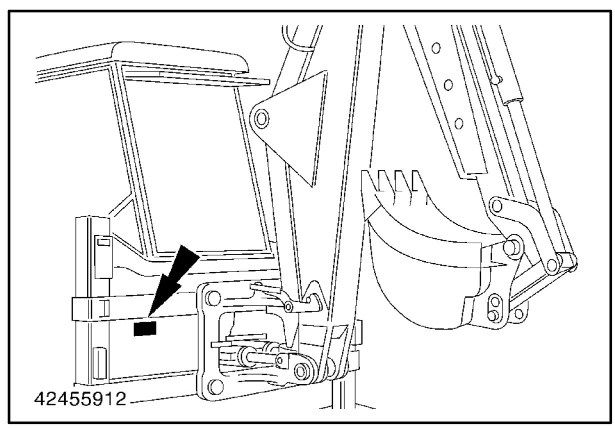
When switch is operated 12V should be found at Pin 5.



97

QUICK HITCH SOLENOID - EV12

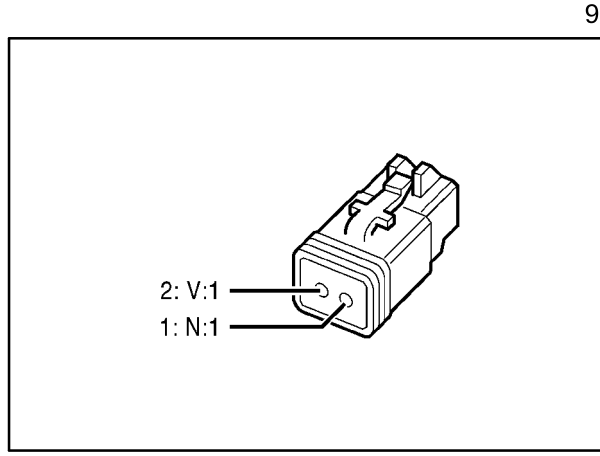
Positioned on the backhoe frame.



98

When switch is operated 12V should be found at Pin 1

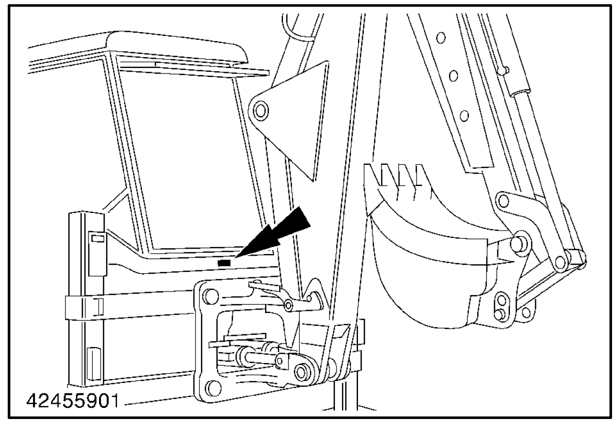
Solenoid resistance should be 9.7 Ω



99

REVERSING BUZZER HA1

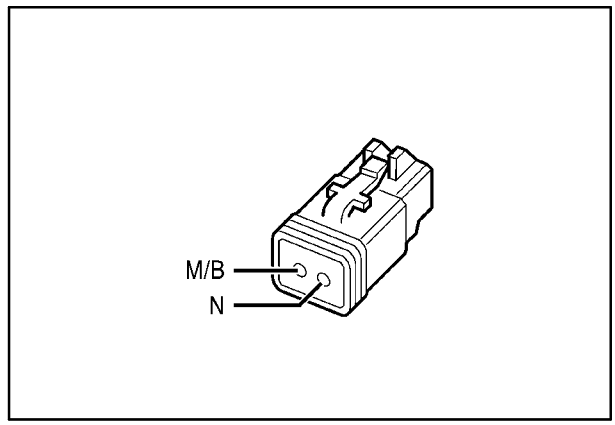
Activated by 12 volts at key start when reverse gear is selected.



100

With reverse selected 12v should be found at pin connector .

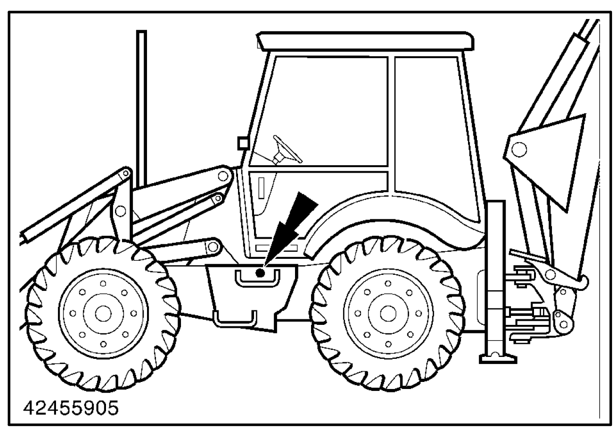
Resistance of the buzzer 162Ω



101

FUEL LEVEL SENDER R3

The signal from the fuel sender potentiometer determining the fuel level displayed on the instrument cluster gauge.

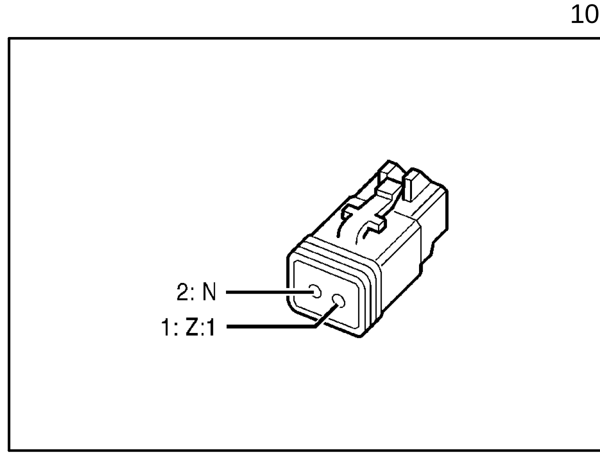


102

Test Procedure

Approximate Resistance:

Gauge Indication	Sensor Resistance
Full	9 Ω
Half	129 Ω
Empty	333 Ω



103

NOTES

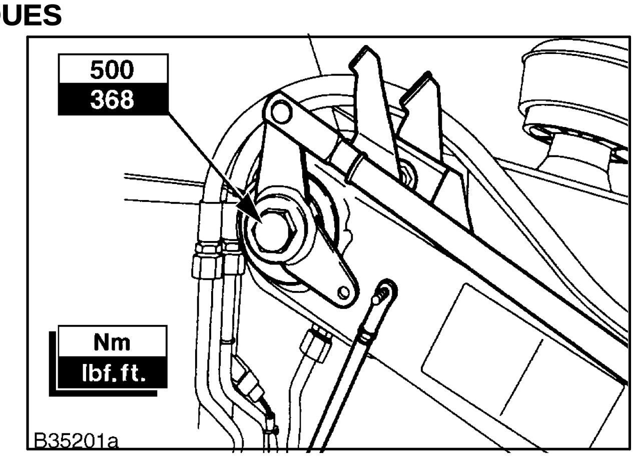
SECTION 82 – LOADER

Chapter 1 – Loader Frame, Controls and Buckets for 2 and 4 Wheel Drive Only

CONTENT

TORQUES

Loader arm Pivot retaining bolt
500 Nm (368 lbf.ft)



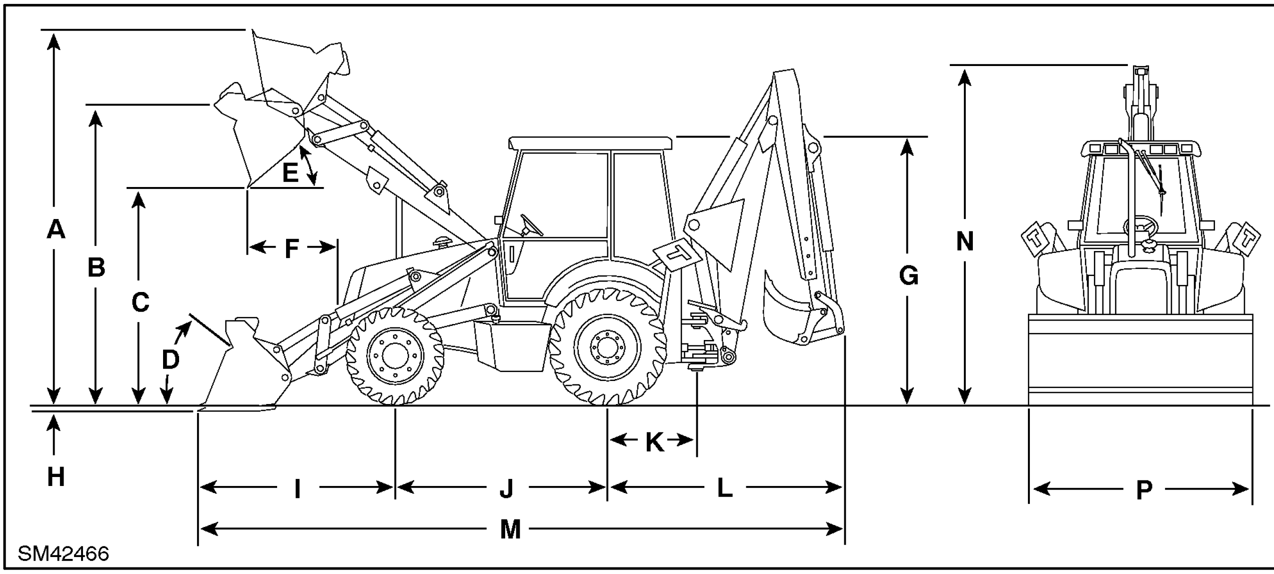
1

SPECIAL TOOLS

Loader Pivot Shaft Bolt Retainer 297189

SPECIFICATIONS

CENTRE PIVOT LOADER DIMENSIONS AND PERFORMANCE – MODELS 75.B, 95.B, 110.B, 115B

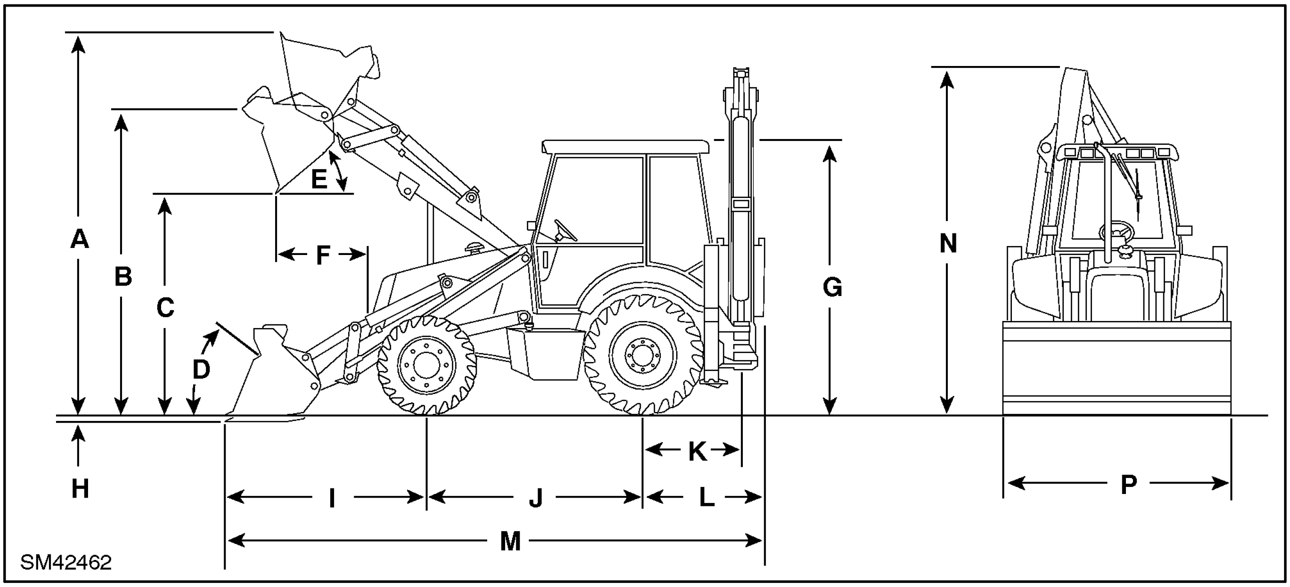


2

(PER SAE J 732 C) WITH TYRES **2WD FRONT = 11L–16SLF3 REAR = 17.5L–24 R4**
With Two or Four Wheel Drive and (1.0m^3 bucket) **4WD FRONT = 12–16.5 REAR = 17.5L.24 R4**

A. Overall Operating height	2WD 4284mm (13ft 9in) – 4WD 4298mm (14ft 0in)
Lift Capacity at Maximum Height	3598 kg (7916 lbs) – 4WD 3553 kg (7833 lbs)
Breakout Force	6329 kg (13924 lbs) – 4WD 6296 kg (13880 lbs)
B. Height to Hinge Pin Full Raise	2WD 3456mm (11ft 2in) – 4WD 3470mm (11ft 3in)
C. Dump Height	2WD 2716mm (8ft 8in) – 4WD 2732mm (8ft 9in)
D. Maximum Roll back at ground level	40°
E. Dump Angle	45°
F. Reach fully raised	2WD 781mm (2ft 5in) – 4WD 776mm (2ft 5in)
G. Height to Top Of Cab	2850mm (9ft 3in)
H. Digging Depth	2WD 127mm (4.9in) – 4WD 112mm (4.4in)
I. Centre line of axle to Bucket Lip at ground level	1987mm (6ft 5in)
J. Wheelbase	2WD 2175mm (7ft 1in) – 4WD 2175mm (7ft 1in)
K. Centre Line of rear axle to Centre line of swing post	1120mm (3ft 6in)
L. Centre Line of rear axle to rear of backhoe bucket	2933m (9ft 5in)
M. Overall Length with bucket at ground level	7100mm (23ft 1in)
N. Overall Height Lip of Bucket to top of Boom	3900mm (12ft 7in)
P.– Overall Width With Bucket	2250mm (7ft 4in)
P.– Overall Width Less Bucket	2170mm (7ft 2in)
Weight of machine Loader/Backhoe* example (4WD, 6 in 1 Bucket, Counterweights)	7700 kg (16940 lbs)

SIDESHIFT LOADER – DIMENSIONS AND PERFORMANCE – MODELS 90.B, 95.B, 110.B, 115.B / B95, 100.2, 110.2, 200.2



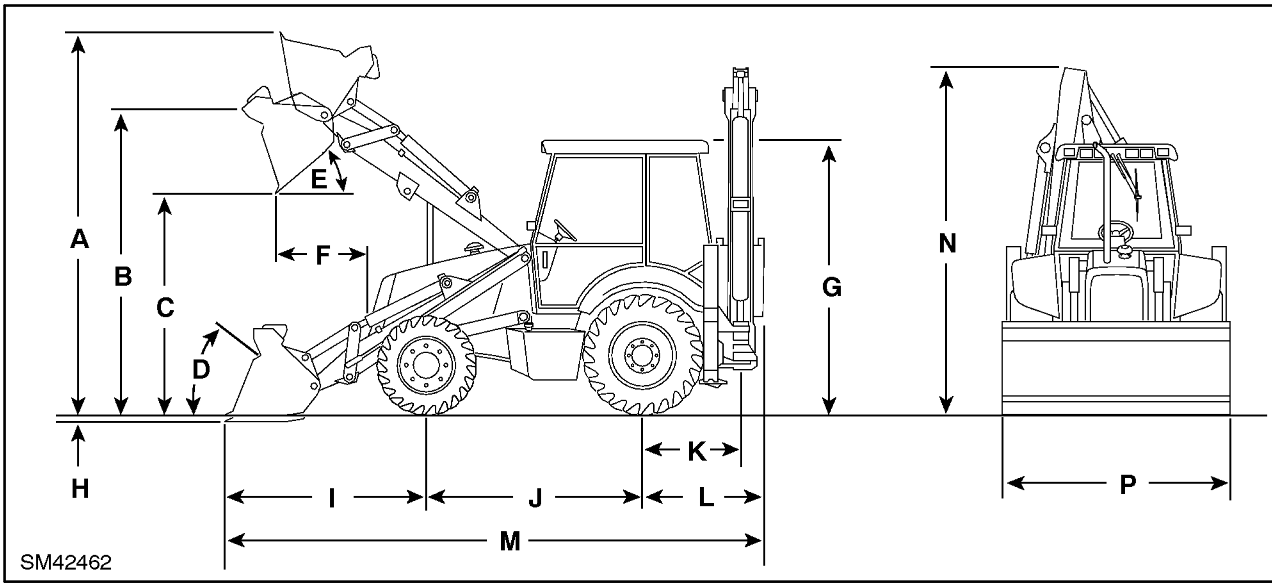
3

(PER SAE J 732 C) WITH TYRES
With Two or Four wheel drive and 1.0m^3 bucket.

2WD FRONT = 11L–16 F REAR = 18.4–26
4WD FRONT = 12.5/80–18 REAR = 18.4–26

A. Overall Operating height	2WD 4240mm (13ft 9in) – 4WD 4359mm (14ft 3in)
Lift Capacity at Maximum Height	2WD 3425 kg (7550 lbs) – 4WD 3553 kg (7833 lbs)
Breakout Force	2WD 6314 kg (13920 lbs) – 4WD 6296 kg (13880 lbs)
B. Height to Hinge Pin	2WD 3411mm (11ft 2in) – 4WD 3530mm (11ft 6in)
C. Dump Height	2WD 2649mm (8ft 7in) – 4WD 2785mm (9ft 1in)
D. Maximum Roll back at ground level	40°
E. Dump Angle	45°
F. Reach fully raised	2WD 830mm (2ft 7in) – 4WD 786mm (2ft 6in)
G. Height to Top Of Cab	2950mm (9ft 7in)
H. Digging Depth	2WD 181mm (7.1in) – 4WD 55mm (2.2in)
I. Centre line of axle to Bucket Lip, at ground level	2WD 2030mm (6.6in) – 4WD 1942mm (6ft 4in)
J. Wheelbase	2WD 2175mm (7ft 1in) – 4WD 2175mm (7ft 1in)
K. Rear axle to Centre of swing post	1325mm (4ft 3in)
L. Rear axle to edge of backhoe bucket	1630mm (5ft 3in)
M. Overall Length with bucket at ground level	2WD 5849mm (19ft 2in) – 4WD 5747mm (18.8in)
N. Lip of Bucket to top of Boom	4000mm (13ft 1in)
P. Width of Bucket	2250mm (7ft 4in)
Maximum Transport Width	2250mm (7ft 4in)
Weight of machine Loader/Backhoe* example (4WD, 4 in 1 bucket, counterweights)	7840 kg (17248 lbs)

SIDESHIFT LOADER – DIMENSIONS AND PERFORMANCE – MODELS 90.B, 95.B, 110.B, 115.B / B95, 100.2, 110.2, 200.2



4

(PER SAE J 732 C) WITH TYRES
With Two or Four wheel drive & 1.0m^3 bucket.

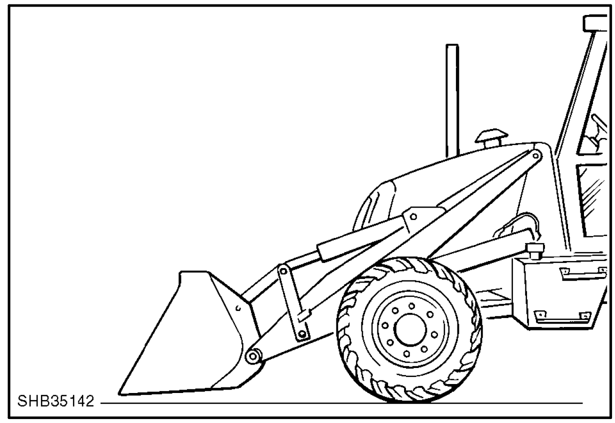
2WD FRONT = 11L–16 F3 REAR = 18.4–26 R4
4WD FRONT = 12.5/80–18 REAR = 18.4–26 R4

A. Overall Operating height	2WD 4240mm (13ft 9in) – 4WD 4359mm (14ft 3in)
Lift Capacity at Maximum Height	2WD 3425 kg (7550 lbs) – 4WD 3553 kg (7833 lbs)
Breakout Force	2WD 6314 kg (13920 lbs) – 4WD 6296 kg (13880 lbs)
B. Height to Hinge Pin	2WD 3411mm (11ft 2in) – 4WD 3530mm (11ft 6in)
C. Dump Height	2WD 2649mm (8ft 7in) – 4WD 2785mm (9ft 1in)
D. Maximum Roll back at ground level	40°
E. Dump Angle	45°
F. Reach fully raised	2WD 830mm (2ft 7in) – 4WD 786mm (2ft 6in)
G. Height to Top Of Cab	2950mm (9ft 7in)
H. Digging Depth	2WD 181mm (7.1in) – 4WD 55mm (2.2in)
I. Centre line of axle to Bucket Lip, at ground level	2WD 2030mm (6.6in) – 4WD 1942mm (6ft 4in)
J. Wheelbase	2WD 2175mm (7ft 1in) – 4WD 2175mm (7ft 1in)
K. Rear axle to Centre of swing post	1325mm (4ft 3in)
L. Rear axle to edge of backhoe bucket	1630mm (5ft 3in)
M. Overall Length with bucket at ground level	2WD 5849mm (19ft 2in) – 4WD 5747mm (18.8in)
N. Lip of Bucket to top of Boom	4000mm (13ft 1in)
P. Width of Bucket	2250mm (7ft 4in)
Maximum Transport Width	2250mm (7ft 4in)
Weight of machine Loader/Backhoe* example (4WD, 4 in 1 bucket, counterweights)	7840 kg (17248 lbs)

DESCRIPTION AND OPERATION

CONTROLS

The loader arms pivot on supports welded to the chassis and have a safe working load of 1000 Kgs (2204 lbs)



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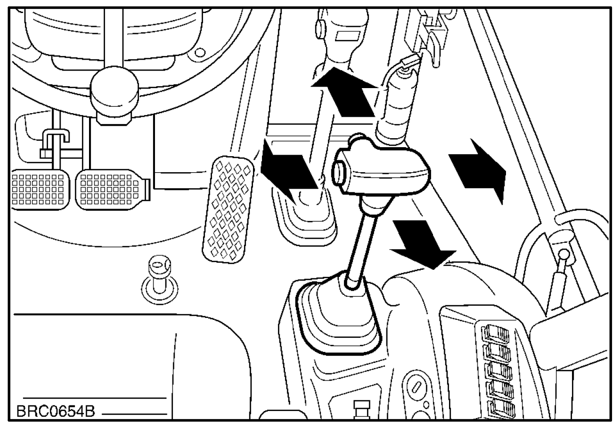
A single lever controls the lowering and raising of the lift arms, roll–back and dumping of the bucket and opening and closing of the multi–purpose bucket where fitted.

In addition to these movements a ‘float’ and “Return to dig” position is also available.

The “float” position enables the loader lift arms and bucket to follow the contour of the ground and is obtained by moving the loader control lever fully forward into the detent position. The lever will remain in the “float” position until it is moved manually towards neutral.



6

Loader Lever (Standard) Shift Pattern

NOTE: *Position of levers is with the operator seated looking forward, unless otherwise stated.*

Lever back (1) – loader arms lift

Lever forward (2) – loader arms lower

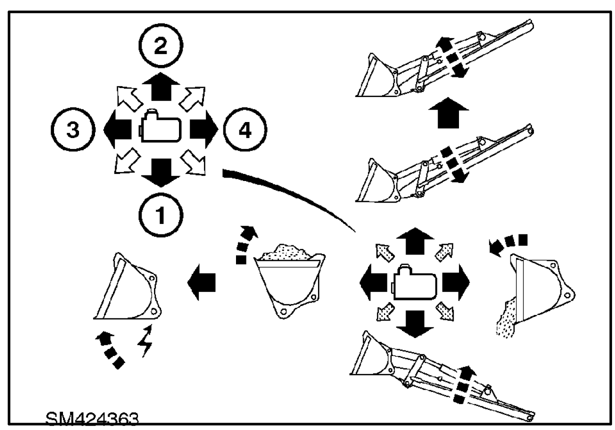
Lever fully forward (2) – loader arms “float”

Lever left (3) – loader bucket roll–back

Lever fully left (3) – loader bucket “return to dig”

Lever right (4) – loader bucket dump

NOTE: *Combinations of loader lift arm and bucket action can be obtained by moving the lever in a diagonal direction and/or rotating the knob to obtain movements simultaneously.*



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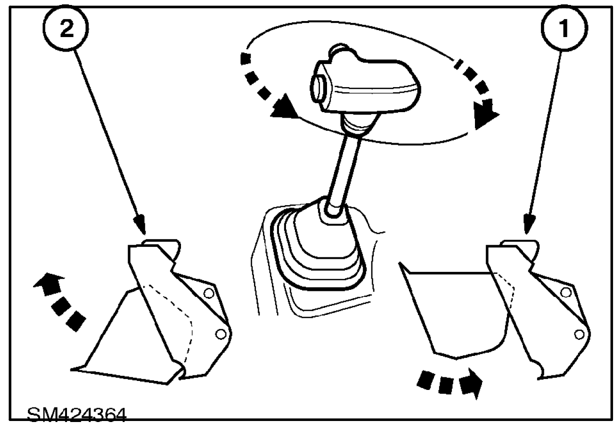
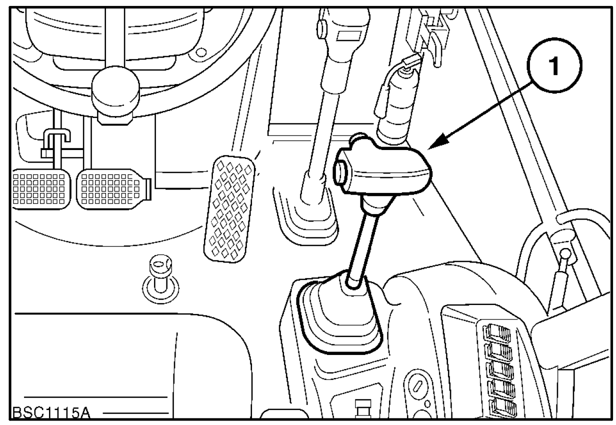
When a multi purpose bucket is fitted the loader lever can be twisted clockwise or counter clockwise to open and close the bucket clam.



8

OVERHAUL–LOADER CONTROLS

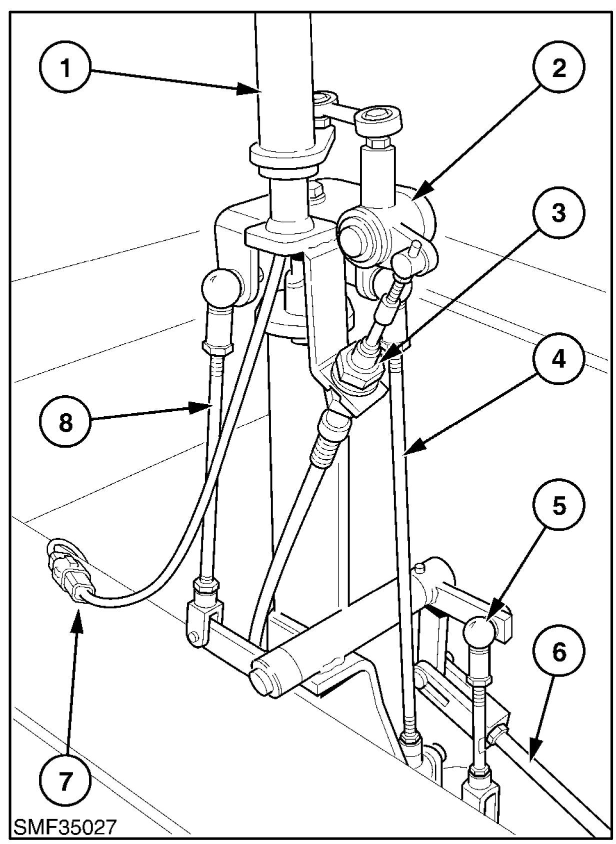
1. Remove covers at base of control lever.
2. Disassemble and examine linkage with reference to Figures 3 and 4.



9

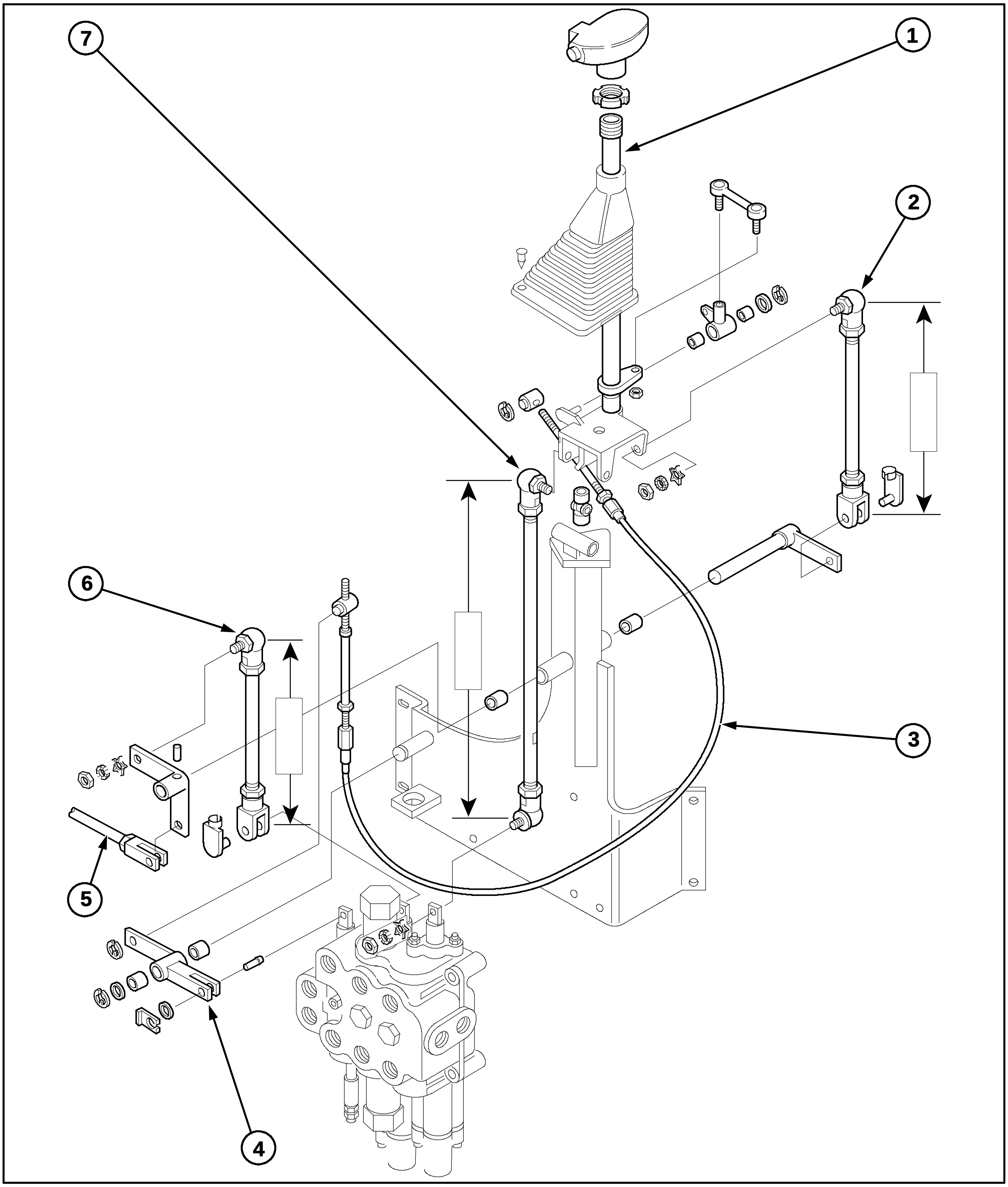
Loader Control Lever Linkage
(With Auxiliary Multi Purpose Bucket Option)

1. Control Lever
2. Multi Purpose Bucket Control Linkage
3. Auxiliary Bucket Control Cable
4. Bucket Control Link
5. Bucket Spool Link
6. Connection to Self Leveling Linkage
7. Transmission Dump Switch Connector
8. Loader Spool Link



10

3. Inspect linkage for wear and replace/adjust as necessary.
4. On re–assembly adjust auxiliary multi purpose bucket control cable to obtain full movement of the spool when the control lever is twisted clockwise or counter clockwise.
5. Adjust self levelling linkage as previously described.



11

Loader Control Linkage

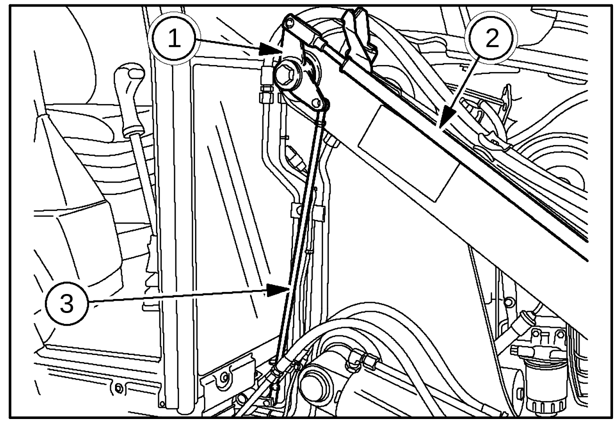
1. Loader Control Lever
2. Bucket Control Link
3. Multi Purpose Bucket Control Cable
4. Linkage to Multi Purpose Bucket Spool
5. Connection to Self Leveling Linkage
6. Bucket Spool Link
7. Loader Spool Link

SELF LEVELLING LINKAGE

A self levelling linkage mounted on the right hand loader arm and frame automatically controls the angle of the loader bucket during the raising cycle of the lift arms to maintain a constant bucket level. There is no self levelling during lowering.

Self levelling begins at the point where the tube (2) on the loader arm contacts the washer on the bell crank (1) and lifts the vertical linkage rod (3).

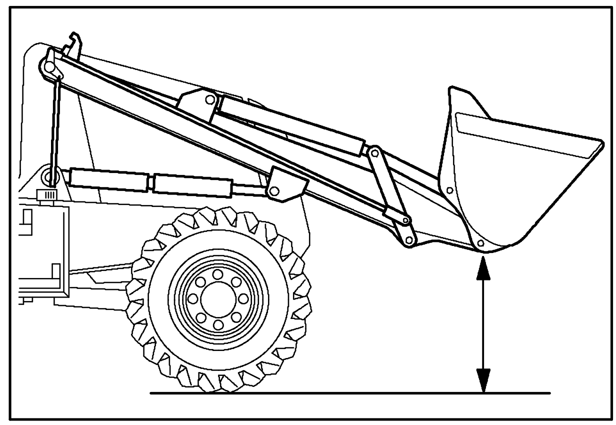
The linkage then moves the bucket control valve into the roll out position to level the bucket.



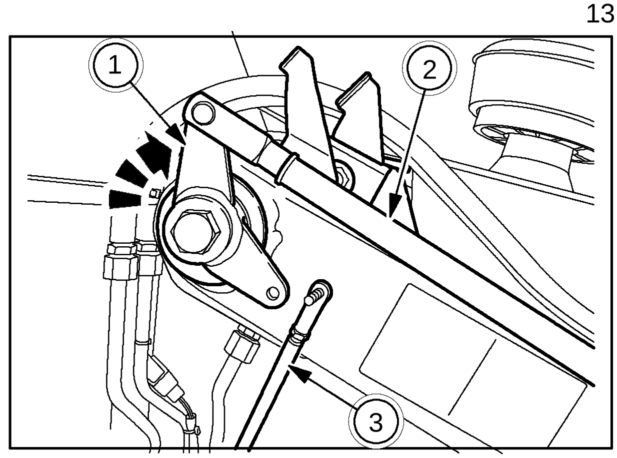
12

Self Levelling Linkage Adjustment

1. Lower the loader to the ground.
2. Disconnect vertical linkage (3) at upper bell crank (1).
3. Raise loader arms so that the bottom pin is 800 mm (31.5in) above the ground and fully roll back the bucket.


13

4. Rotate the bell crank (1) to touch the tube (2) on the loader arm.
5. Adjust the length of the vertical rod (3) so that when re-connected, the end of the loader arm tube remains in contact with bell crank.
6. Securely tighten locknuts on vertical rod.



14

RETURN TO DIG

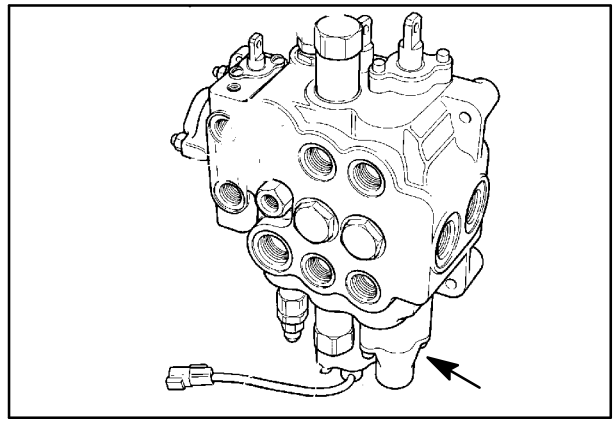
The electrically activated 'Return to Dig' feature enables the operator to automatically return the bucket to a level digging position after dumping with one simple movement of the loader control lever.

The return to dig system consists of an electro-magnet mounted on the end of the loader bucket control spool. a sensor (1) mounted on top of the loader arm, and a pointer (2) attached to the tube of the bucket self levelling linkage.

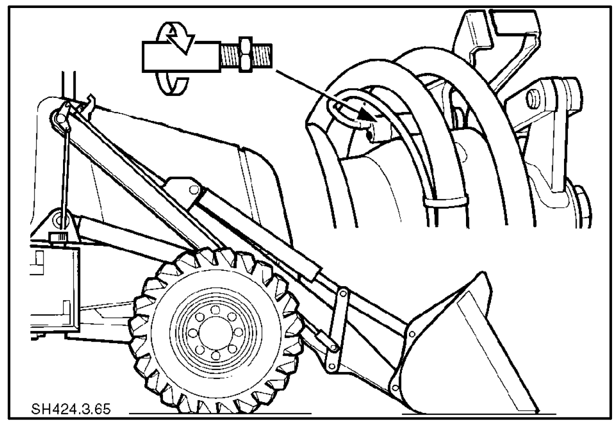
When the bucket is rolled forward to dump the pointer (2) no longer aligns with the face of the sensor(1) and causes the sensor to complete the return to dig electrical circuit and engergise the electromagnet.

The electro magnet remains energised until such time as the bucket is returned to the level digging position and the pointer re-aligns with the face of the sensor.

Consequently when the loader bucket control lever is moved either fully left to the return to dig position or diagonally left to simultaneously lower the loader arms using 'float' the bucket spool is held in the roll back position by the electromagnet. When the bucket reaches the level digging position the pointer aligns with the face of the sensor and de-energises the solenoid allowing the spool to automatically spring back to the neutral position.



15

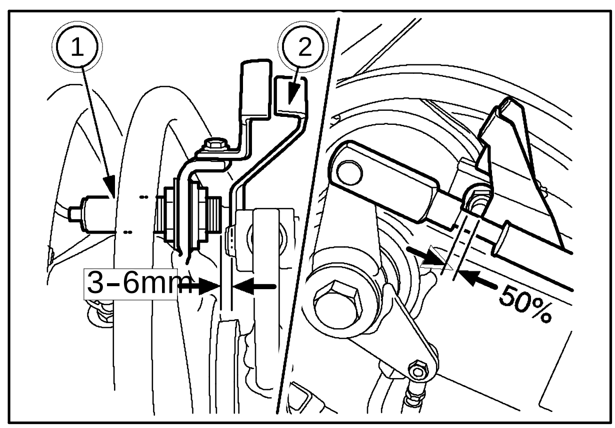


16

Return To Dig Sensor Adjustment

1. Place the bucket on the ground in the preferred digging position.
2. Adjust the position of the sensor so that when the bucket is in digging position and loader arms are lowered, 50% (half) of the sensor face is obscured by the self levelling linkage pointer.
3. Ensure the face of the sensor (1) is 3-6 mm from the pointer (2) on the self levelling linkage.

   As a visual aid for the operator, while seated in the cab, the pointer mounted on the loader arm can be seen to align with the pointer on the self levelling linkage, when the loader arms are lowered and the bucket is in the level digging position.



17

LOADER BUCKET REMOVAL AND INSTALLATION

1. Position the loader bucket on the ground fully rolled forward prior to removal. Remove the pivot pin securing bolts (1) and (2) and drive out the pivot pins.

WARNING

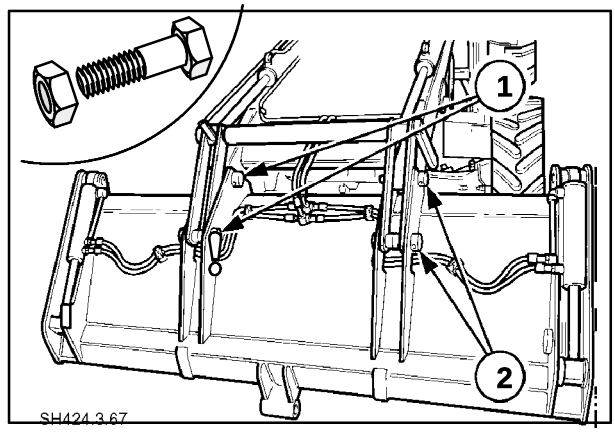
When it is necessary to remove pins from the loader that require a hammer and drift use only a brass hammer and brass drift and wear safety glasses.

2. If a multi purpose bucket is installed plug hydraulic hoses prior to removal.

WARNING

To avoid personal injury, shut off the engine, relieve all hydraulic pressure before any hydraulic connection is disconnected.

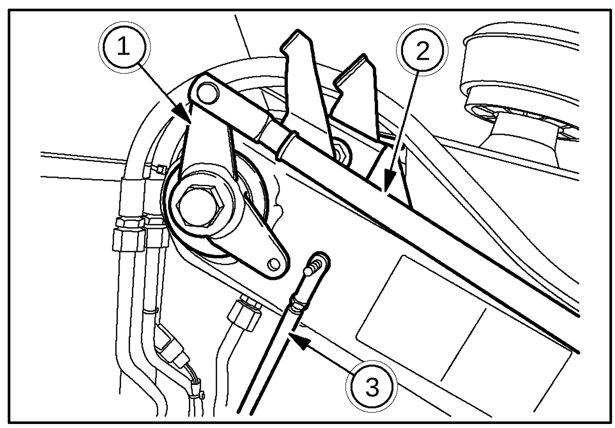
3. Inspect all bushings for dirt and foreign matter and clean before installing the pivot pins. Installation of a bucket follows the removal procedure in reverse.



18

LOADER ARM REMOVAL

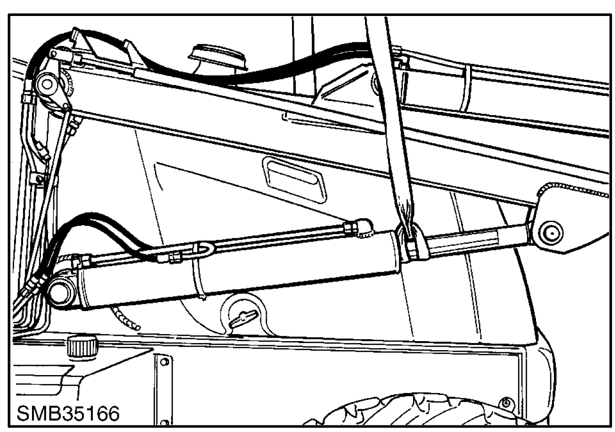
1. Remove loader bucket
2. Disconnect self levelling linkage rod (3) from bellcrank (1).
3. Strap linkage rod (2) to loader arm.



19

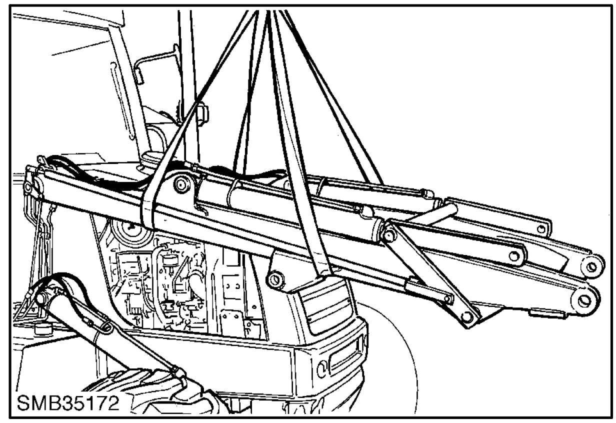
4. Disconnect loader lift cylinder rod end retaining pin.
5. Disconnect and cap hoses to bucket cylinder and multipurpose bucket pipework where fitted.

IMPORTANT: *Examine pipework to ensure that any clamps securing the hoses to the loader arms have also been released*



20

6. Support loader arms using a suitable sling.



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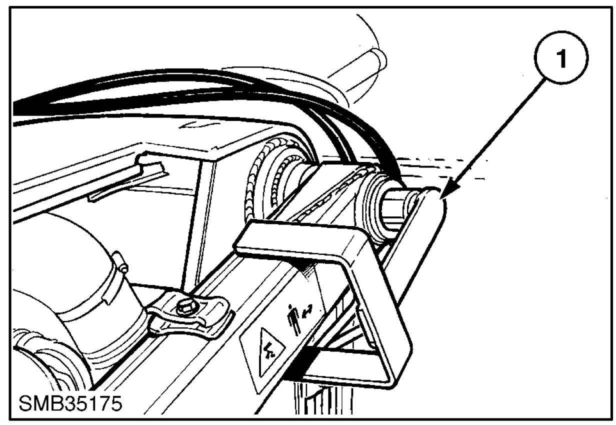
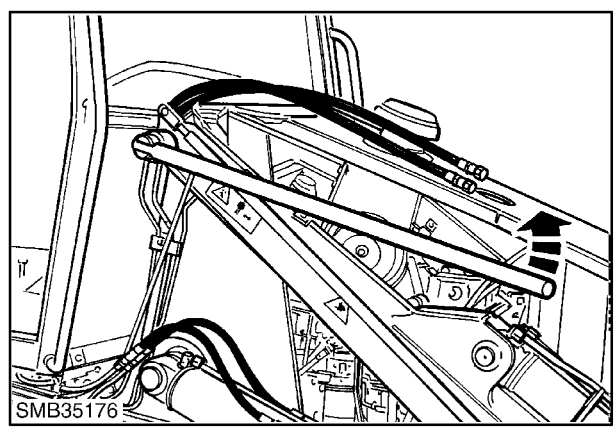
7. nstall loader pivot shaft bolt retainer V. L. Churchill Tool No 297189



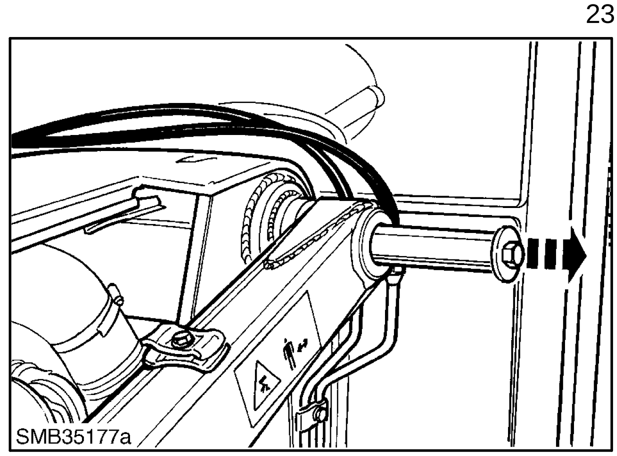
22

8. Using heavy duty socket remove pivot bolt.



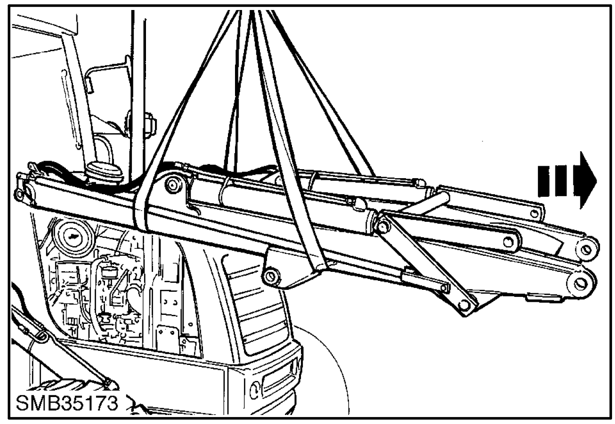
23

9. Ensure loader arms are properly supported and remove pivot bar.



24

10. Remove loader arms from machine.



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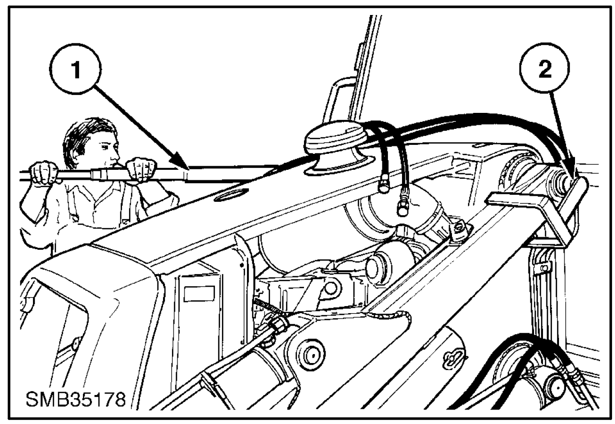
11. Installation folllows removal procedure in reverse. When installing the pivot rod retaining bolts tighten retaining retaining bolt to 500 Nm (368 lbf.ft)



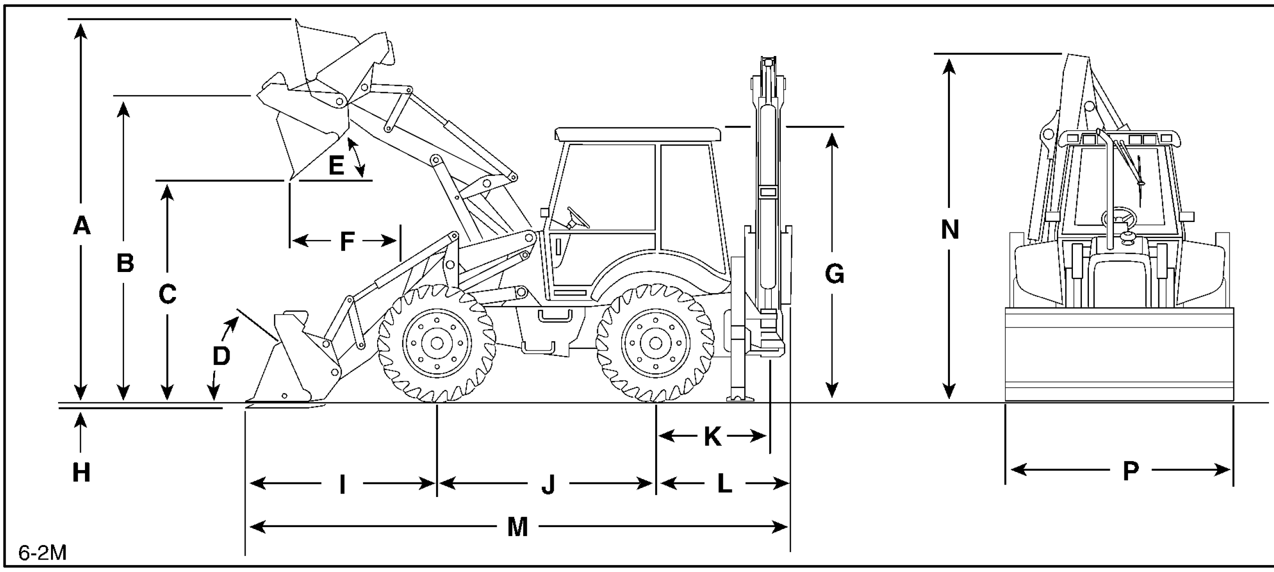
26

SECTION 82 – LOADER

Chapter 2 – Loader Frame, Controls and Buckets for 4 Wheel Steer Only

CONTENT

SPECIFICATIONS
SIDESHIFT LOADER - DIMENSIONS AND PERFORMANCE - MODELS 115.B, 200.2



1

(PER SAE J 732 C) **WITH TYRES FRONT AND REAR = 440/80 R28**

With Bucket m^3	**$1.15m^3$**	**$1.15m^3$ (with clam)**	**$1.15m^3$ (with clam and forks)**
A. Overall Operating Height	4347mm (14ft 1in)	4653mm (15ft 1in)	4653 (15ft 1in)
Lift Capacity at Maximum Height	3386 kg (7464 lbs)	3151 kg (6944 lbs)	3021 kg (6658 lbs)
Breakout Force	5518 kg (12161 lbs)	5518 kg (12161 lbs)	5518 kg (12161 lbs)
B. Height to Hinge Pin Full Raise	3491mm (11ft 3in)	3491mm (11ft 3in)	3491mm (11ft 3in)
C. Dump Height	2717mm (8.8 ft)	2717mm (8.8 ft)	2717mm (8.8 ft)
D. Maximum Roll back at ground level	45°	45°	45°
E. Dump Angle	45°	45°	45°
F. Reach fully raised	744mm (2ft 4in)	744mm (2ft 4in)	744mm (2ft 4in)
G. Height to Top Of Cab	2900mm (9ft 4in)	2900mm (9ft 4in)	2900mm (9ft 4in)
H. Peel Depth	113mm (4.4 in)	113mm (4.4 in)	113mm (4.4 in)
I. Centre line of axle to Bucket Lip	1975mm (6ft 4in)	1975mm (6ft 4in)	1975mm (6ft 4in)
I. Centre line of axle to Lift Fork Tip at ground level		-	1.375 m (4.5 ft)
J. Wheelbase	2200mm (7ft 2in)	2200mm (7ft 2in)	2200mm (7ft 2in)
K. Rear axle to Centre of swing post	1324mm (4ft 3in)	1324mm (4ft 3in)	1324mm (4ft 3in)
L. Rear axle to edge of backhoe bucket	1630mm (5ft 3in)	1630mm (5ft 3in)	1630mm (5ft 3in)
M. Overall Length	5783mm (18.8 ft)	5783mm (18.8 ft)	5783mm (18.8 ft)
N. Overall height to top of boom	3935mm (12ft 9in)	3935mm (12ft 9in)	3935mm (12ft 9in)
P. Overall Width With Bucket	2400 m (7ft 8in)	2400 m (7ft 8in)	2400 m (7ft 8in)

DESCRIPTION AND OPERATION

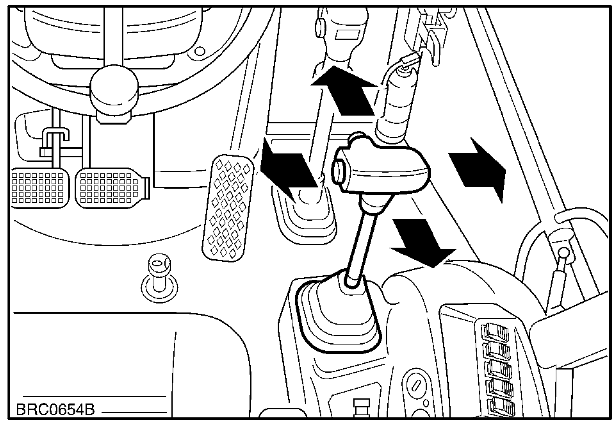
CONTROLS

The loader arms pivot on supports welded to the chassis and have a safe working load of 1000 kgs (2204 lbs).

A single lever controls the lowering and raising of the lift arms, roll–back and dumping of the bucket and opening and closing of the multi–purpose bucket where fitted.

In addition to these movements a ‘float’ and “Return to dig” position is also available.

The “float” position enables the loader lift arms and bucket to follow the contour of the ground and is obtained by moving the loader control lever fully forward into the detent position. The lever will remain in the “float” position until it is moved manually towards neutral.



2

Loader Lever (Standard) Shift Pattern

NOTE: *Position of levers is with the operator seated looking forward, unless otherwise stated.*

Lever back (1) – loader arms lift

Lever forward (2) – loader arms lower

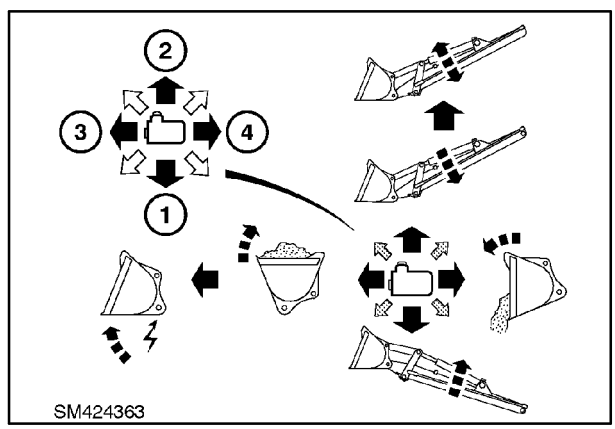
Lever fully forward (2) – loader arms “float”

Lever left (3) – loader bucket roll–back

Lever fully left (3) – loader bucket “return to dig”

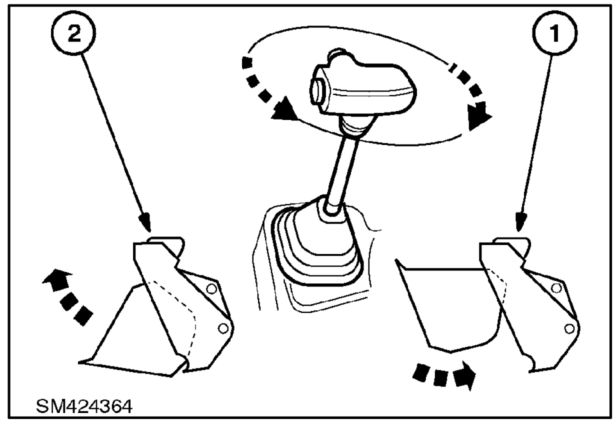
Lever right (4) – loader bucket dump

NOTE: *Combinations of loader lift arm and bucket action can be obtained by moving the lever in a diagonal direction and/or rotating the knob to obtain movements simultaneously.*



3

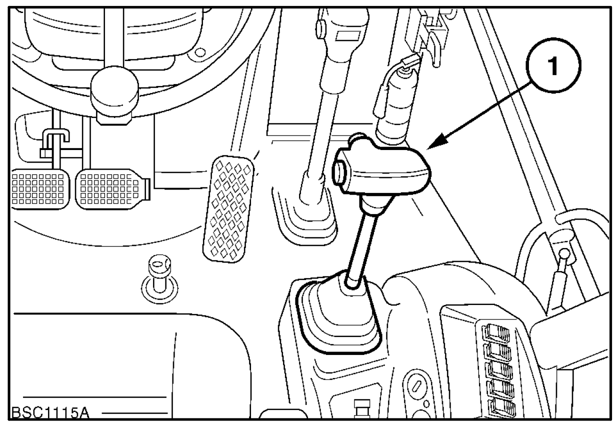
When a multi purpose bucket is fitted the loader lever can be twisted clockwise or counter clockwise to open and close the bucket clam.



4

OVERHAUL – LOADER CONTROLS

1. Remove covers at base of control lever (1).
2. Disassemble and examine linkage with reference to Figures 6 and 7.

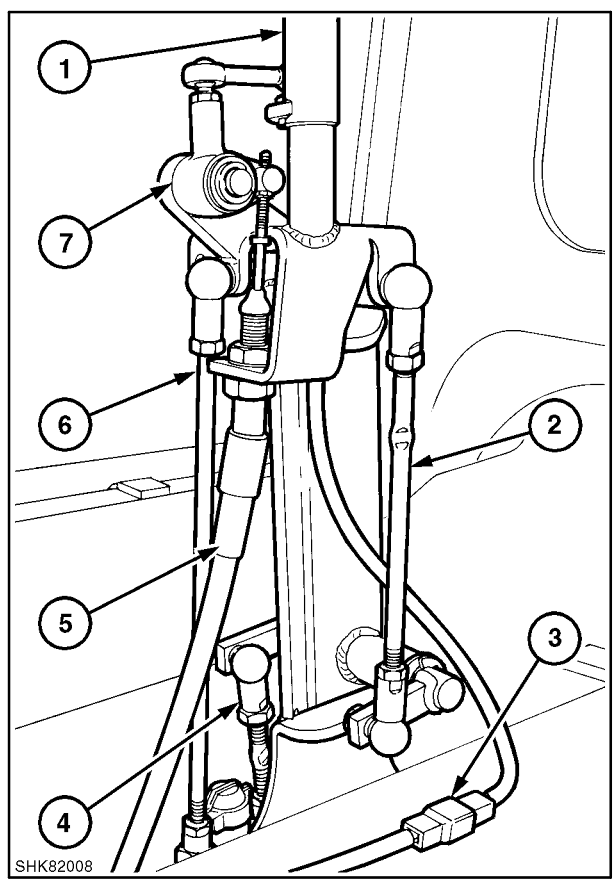


5

Loader Control Lever Linkage (with Auxiliary Multi Purpose Bucket Option)

1. Control Lever
2. Bucket Control Link
3. Transmission Dump Switch Connector
4. Bucket Spool Link
5. Multi Purpose Bucket Control Cable
6. Loader Spool Link
7. Multi Purpose Bucket Control Linkage

3. Inspect linkage for wear and replace/adjust as necessary.
4. On re–assembly adjust auxiliary multi purpose bucket control cable to obtain full movement of the spool when the control lever is twisted clockwise or counter clockwise.



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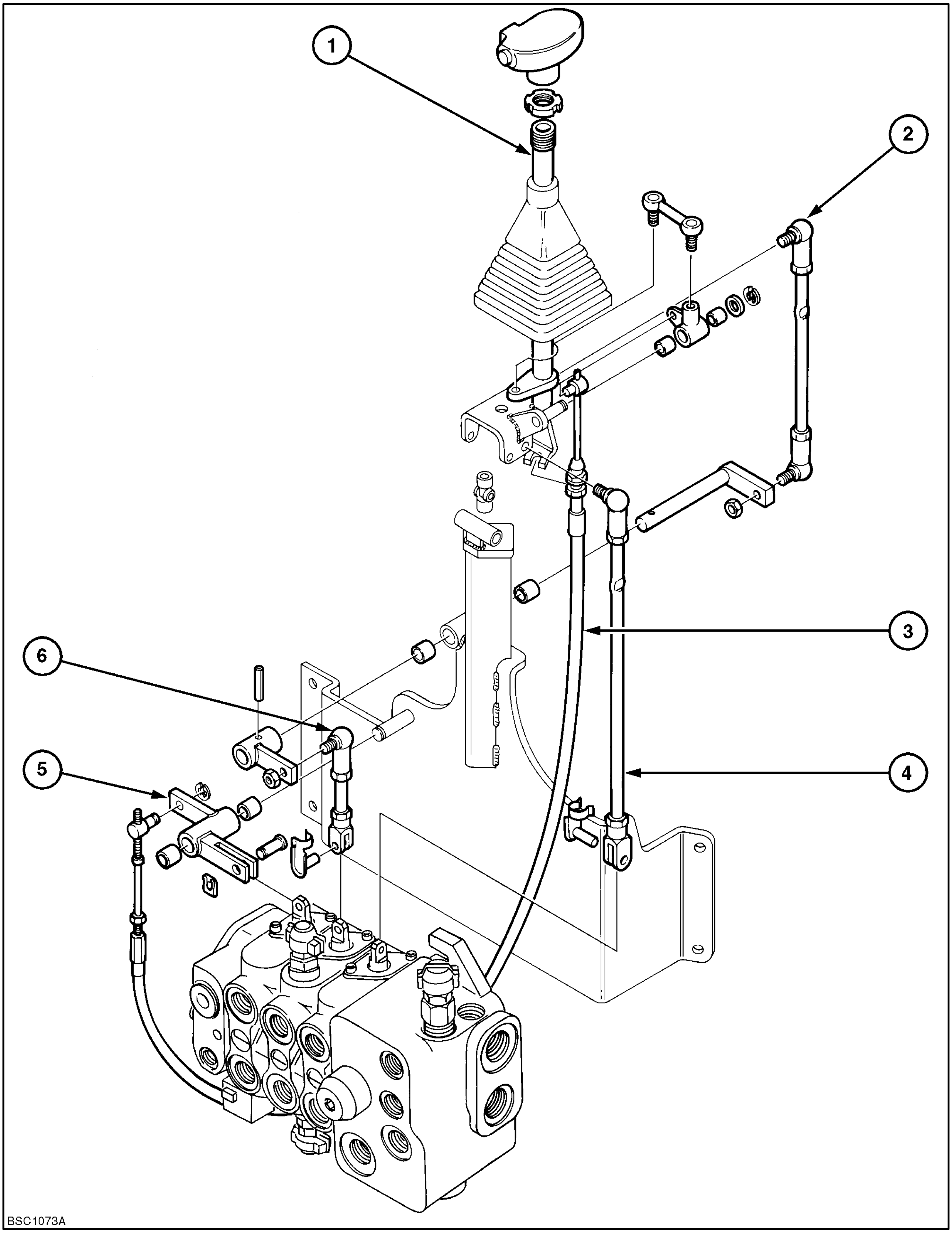


7

Loader Control Linkage

1. Loader Control Lever
2. Bucket Control Link
3. Multi Purpose Bucket Control Cable
4. Loader Spool Link
5. Linkage to Multi Purpose Bucket Spool
6. Bucket Spool Link

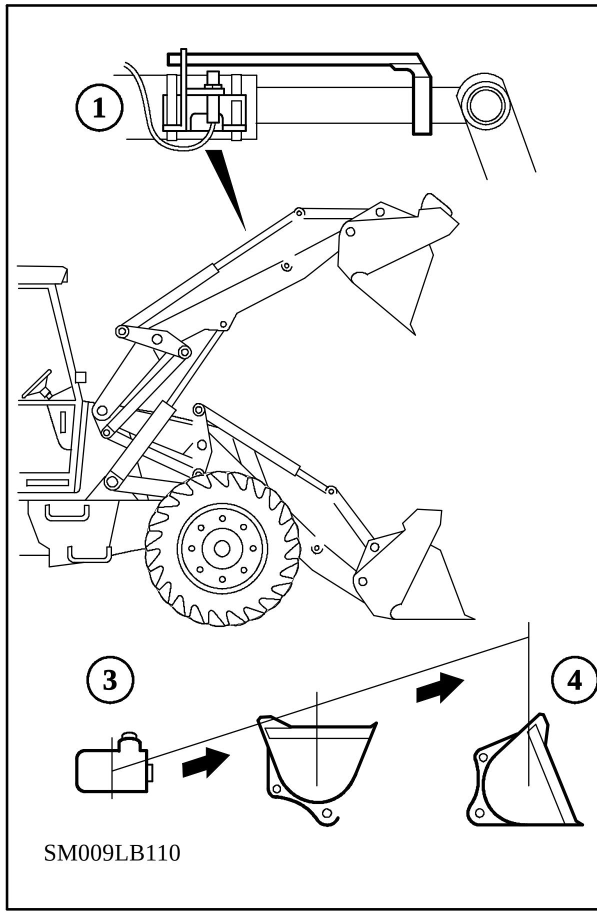
Return To Dig Sensor

Return to dig is an electrically activated feature which enables the operator to automatically return the bucket to a level digging position for a further work cycle with one simple movement of the loader control lever (3).

The return to dig system consists of an electromagnet mounted on the bucket spool, a sensor (1) mounted on top of the loader arm and attached to the cylinder.

Whenever the bucket is rolled forward to dump the return to dig electrical circuit is completed and the solenoid on the bucket spool is energised.

When the loader bucket control lever (3) is moved diagonally left to the return to dig position (4) the electromagnet will hold the bucket spool in the roll back position until the bucket is in the level digging position at which time the indicator on the rod of the bucket linkage will pass in front of the sensor which de-energises the electromagnet on the bucket spool enabling the spool to return to the neutral position.

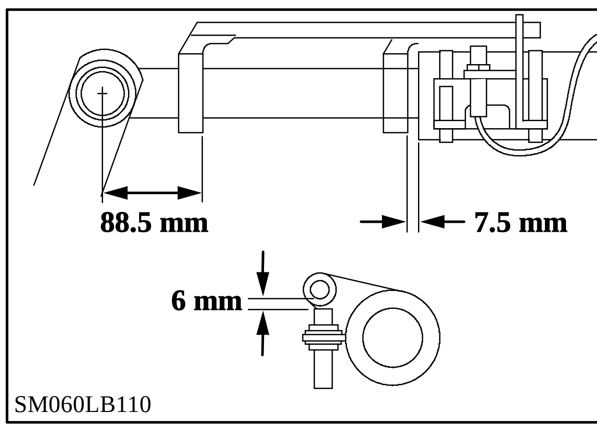


8

Adjustment of the return to dig sensor is as follows

1. Place the bucket on the ground in the preferred digging position.
2. Check the dimensions of 88.5 mm and 7.5 mm are maintained as shown.
3. Ensure the face of the sensor (1) is 6 mm from the rod (2).

As a visual aid for the operator, while seated in the cab, the pointer mounted on the loader arm can be seen to align with the pointer on the return to dig linkage, when the loader arms are lowered and the bucket is in the level digging position.



9

LOADER BUCKET REMOVAL AND INSTALLATION

1. Position the loader bucket on the ground fully rolled forward prior to removal. Remove the retaining rings (1) and locking pins (2) and drive out the pivot pins (3) at four locations (4).

WARNING

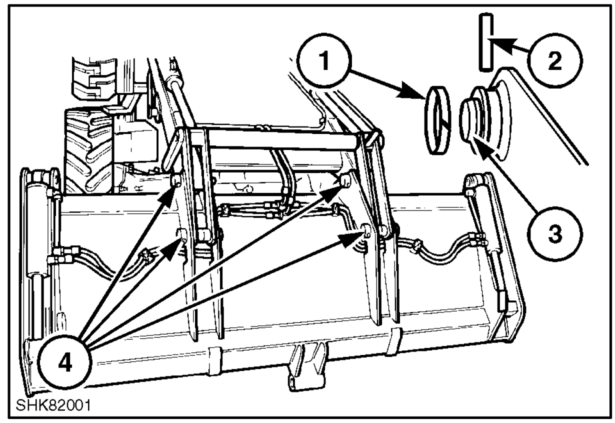
When it is necessary to remove pins from the loader that require a hammer and drift use only a brass hammer and brass drift and wear safety glasses.

2. If a multi purpose bucket is installed disconnect and plug hydraulic hoses prior to removal.

WARNING

To avoid personal injury, shut off the engine, relieve all hydraulic pressure before any hydraulic connection is disconnected.

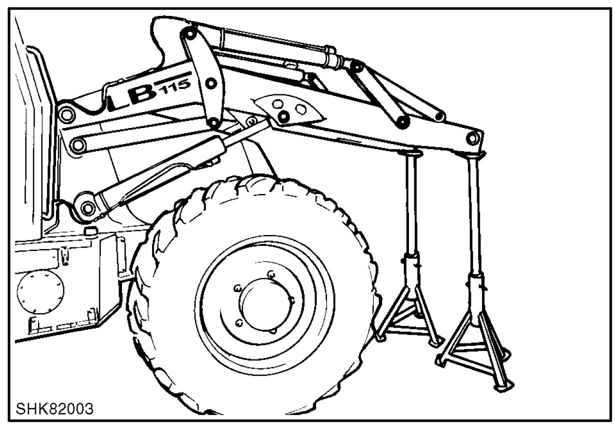
3. Inspect all bushings for dirt and foreign matter and clean before installing the pivot pins. Installation of a bucket follows the removal procedure in reverse.



10

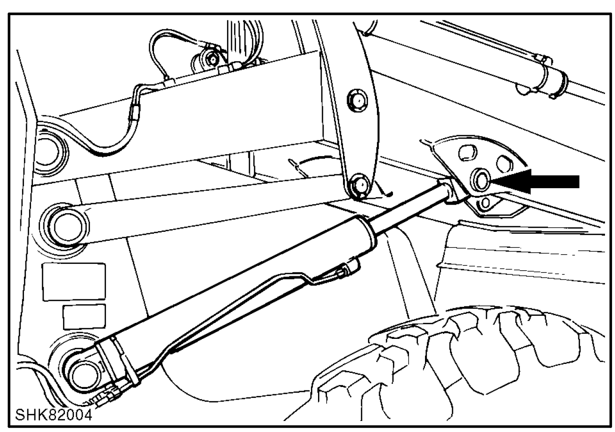
LOADER ARM REMOVAL

1. Remove loader bucket as above.
2. Fully retract bucket cylinders and raise arm until lift cylinder pivots can be seen above engine cover. Place a suitable stand under the end of the arm to take the weight while disconnecting the lift cylinder pivots.
3. Switch off the engine and relieve hydraulic pressure.



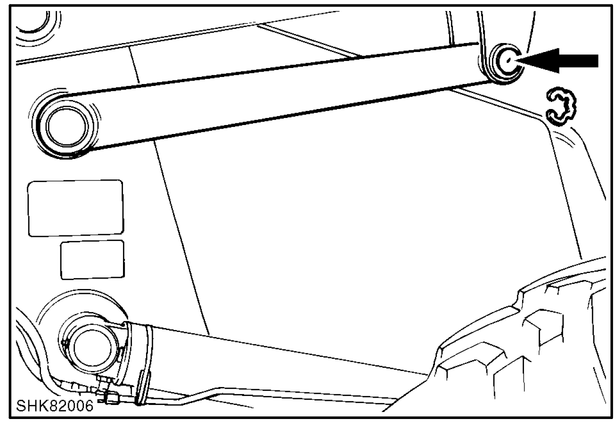
11

4. Remove the retaining rings and the locking pins and then drive out the pivot pins. Lower the lift cylinders carefully onto the chassis.



12

5. Release the retainers and drive out the pivot pins from the self levelling arms. Lower the arms onto the lift cylinders.



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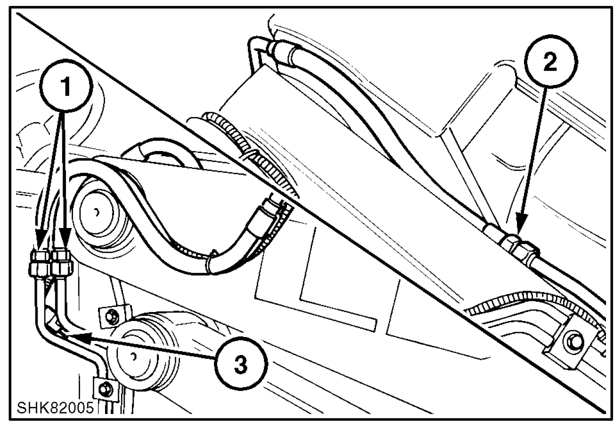
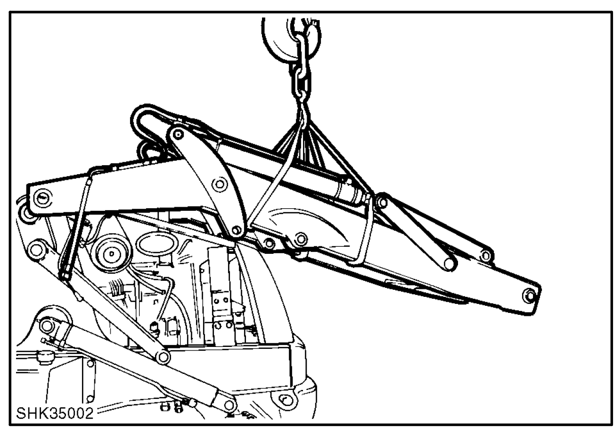
6. Disconnect and cap the lift cylinder hoses (1) at the top of the loader arm on each side of the machine and disconnect the return to dig sensor cable (3) on the right hand side. If the multi purpose bucket is fitted disconnect and cap hose (2) on each side of the loader arm



14

7. Support loader arm using a suitable sling.



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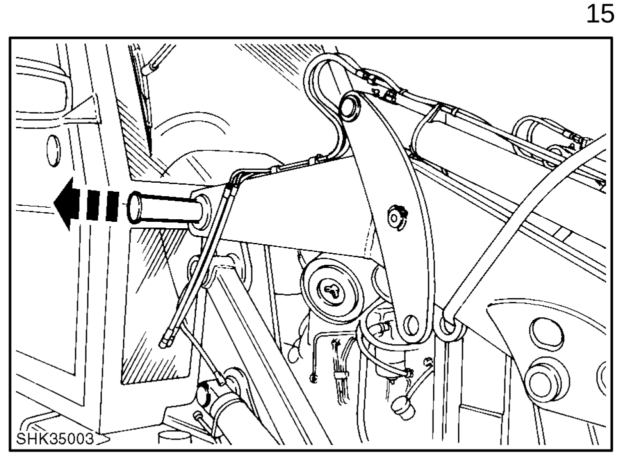
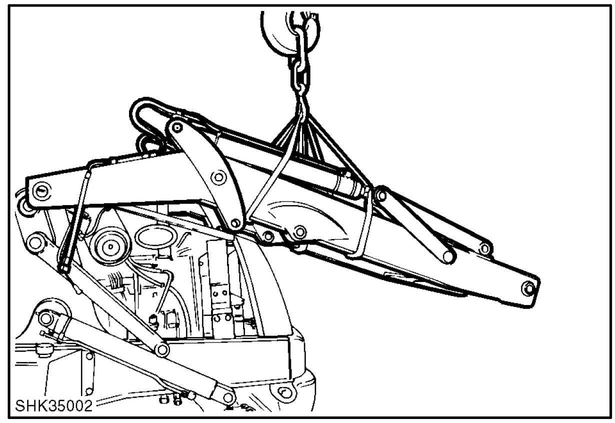
8. Remove the retaining ring and locking pin and then pull out the pivot pin.



16

9. Remove loader arm from machine.



17

10. Installation follows removal procedure in reverse.

NOTES

SECTION 84 – BACKHOE

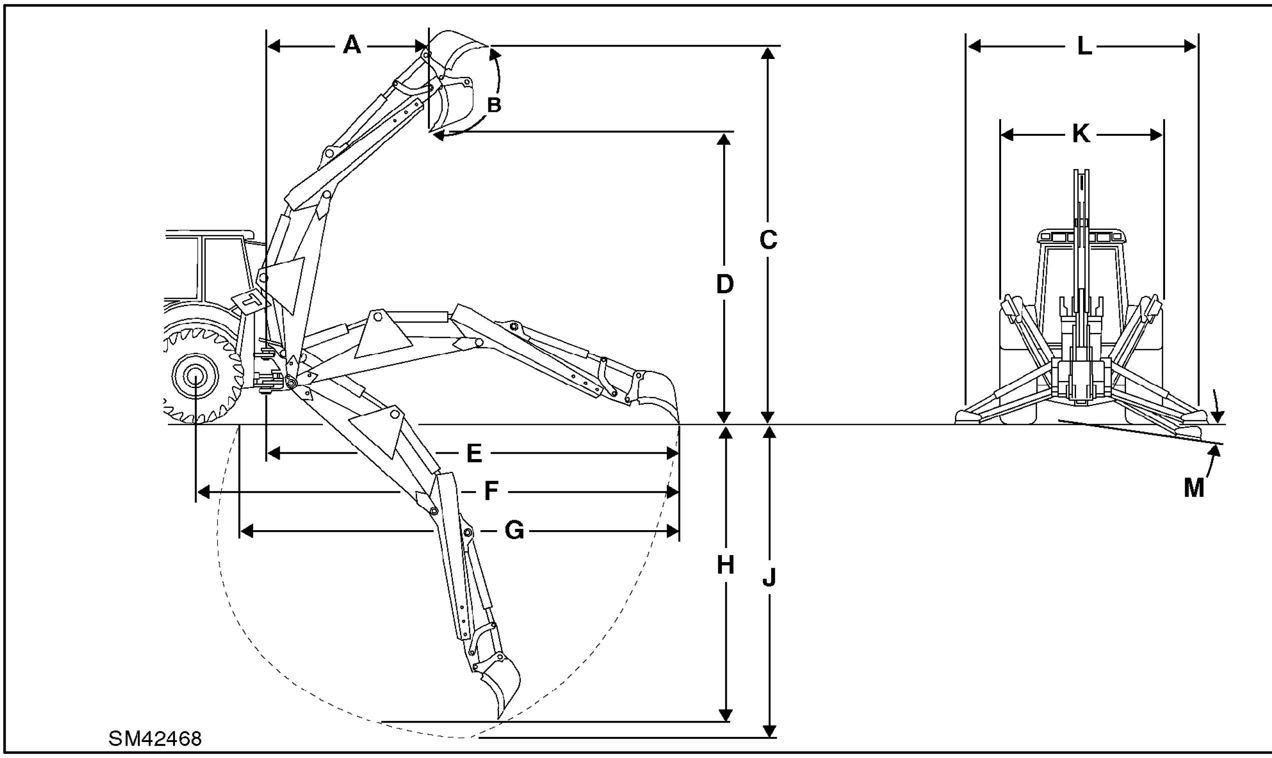
Chapter 1 – Backhoe, Boom and Dipperstick Assembly

CONTENT

SPECIFICATIONS

Grease	Ambra GR9 – NH710 A
Thread Sealant	Part No 82995773
Wear Pad Limits	Refer to Wear Pad Adjustment

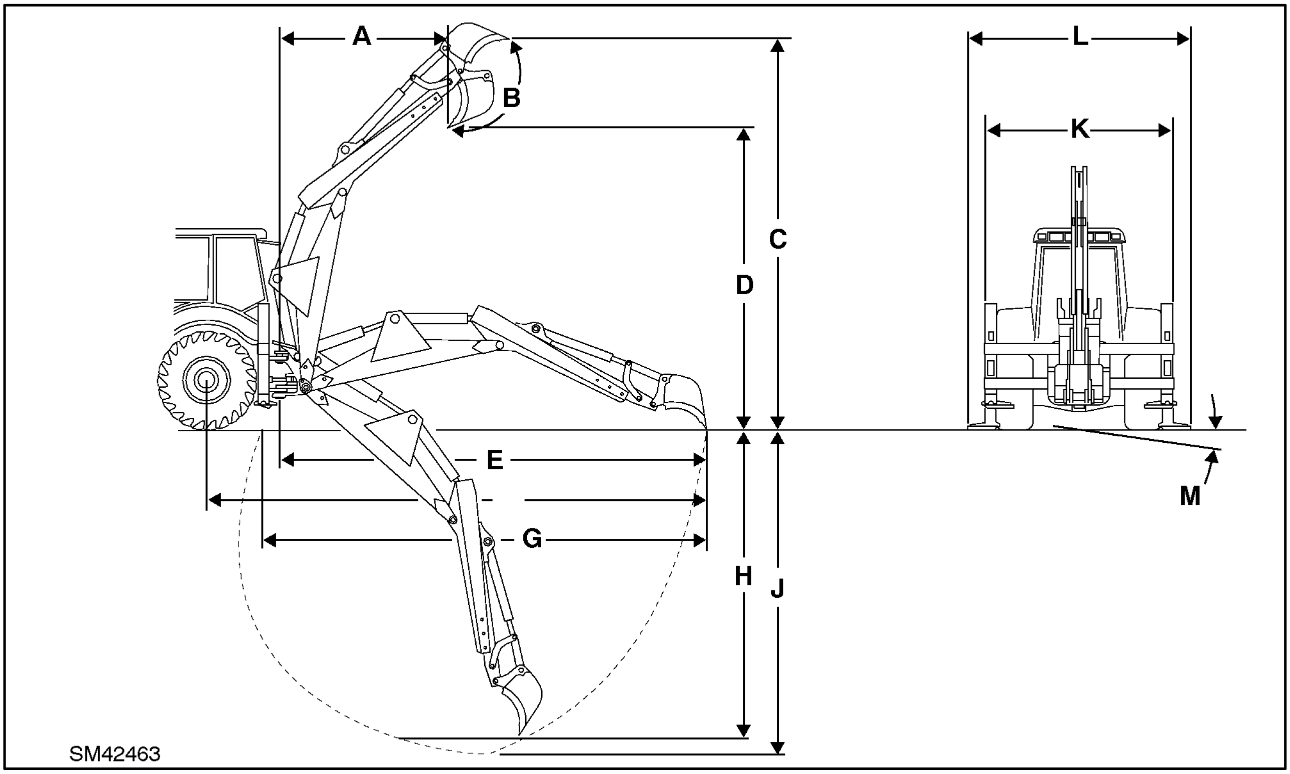
CENTRE PIVOT BACKHOE- DIMENSIONS AND PERFORMANCE MODEL 75.B, 95.B, 110.B, 115.B



1

(PER SAE J 732 C) WITH TYRES	4WD FRONT = 12–16.5	REAR = 17.5L–24 R4
	Standard Dipper	**H.E.D. (Extended)**
A. Loading Reach	1683mm (5ft.5in)	2657mm (8ft.6in)
B. Bucket Rotation	204°	204°
C. Operating Height, Fully Raised	5408mm (17ft.6in)	6136mm (19ft.9in)
D. Loading Height Maximum	3617mm (11ft.7in)	4347mm (14ft.1in)
E. Reach from Swing Post Pivot	5547mm (18ft.0in)	6657mm (22ft.6in)
F. Reach from Rear Axle Centre line	6666mm (22ft.7in)	7777mm (25ft.3in)
G. Maximum Length of Surface Excavation	6050mm (19ft.8in)	7190mm (23ft.6in)
H. Maximum Digging Depth		
To Achieve a 0.6m (2ft) Flat Bottom Trench	4324mm (14ft.0in)	5534mm (18ft 0in)
To Achieve an 2.4m (8ft) Flat Bottom Trench	3946mm (12ft.8in)	5246mm (17ft 0in)
J. Maximum Digging Depth	4356mm (14ft.2in)	5565mm (18ft.1in)
K. Stabilizer Spread – Transport	2230mm (7ft.3in)	2230mm (7ft.3in)
L. Stabilizer Spread – Working (pads reversed)	3200mm (10ft 5in)	3200mm (10ft 5in)
M. Stabiliser Pad Levelling Angle	14°	14°
– Swing Arc	180°	180°
– Maximum digging force (general purpose bucket) –		
crowd cylinder	4181 kg (9217 lbs)	2822 kg (6221 lbs)
bucket cylinder	5810 kg (12808 lbs)	5810 kg (12808 lbs)
– Lift capacity through dipper arc –	(SAE) 2480 kg (5466 lbs)	1475 kg (3251 lbs)
– Lift capacity, dipper 3.66m (12ft) above ground	(SAE) 2615 kg (5764 lbs)	1505 kg (3317 lbs)
– Lift capacity at 4.2m (14ft) above ground	(SAE)1365 kg (3008 lbs)	905 kg (1994 lbs)
– Extendible dipper extension length	–	1.05m (3ft.5in)

SIDESHIFT BACKHOE – DIMENSIONS AND PERFORMANCE MODELS 90.B, 95.B, 110.B, 115.B / B95, 100.2, 110.2, 200.2

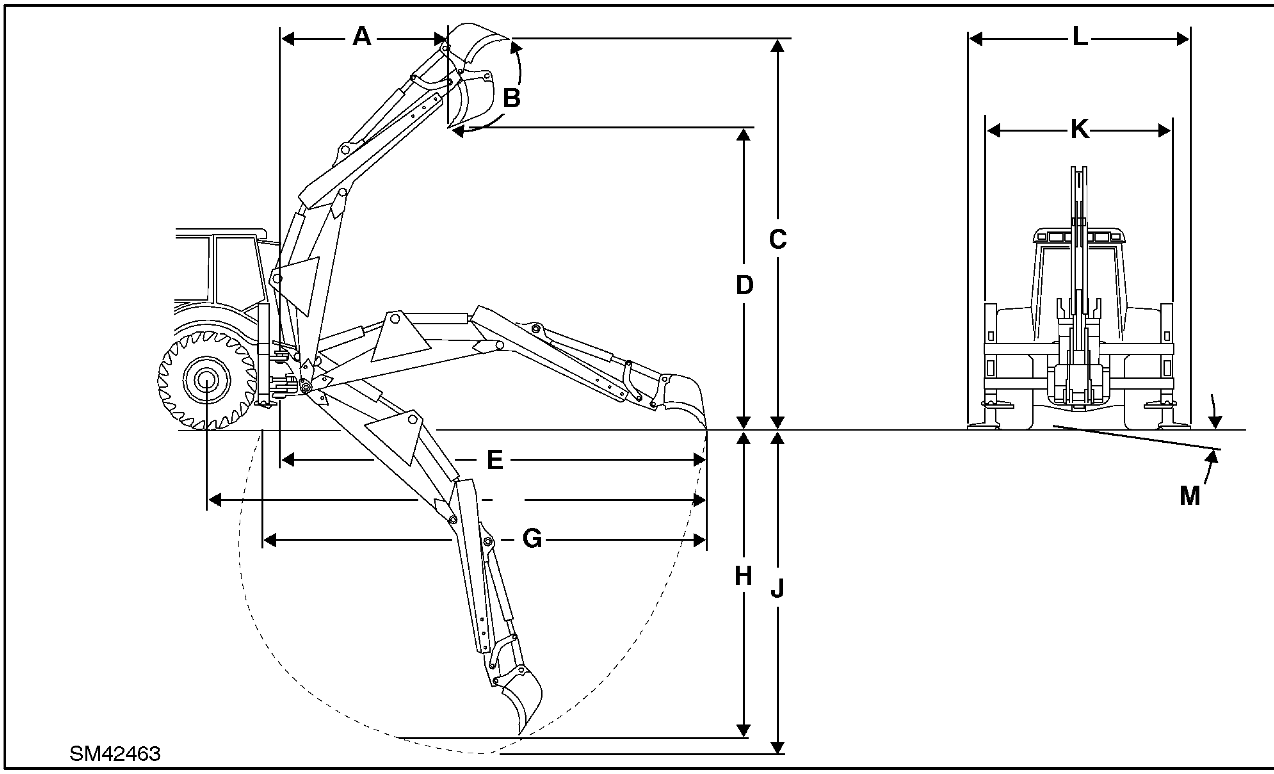


2

(PER SAE J 732 C) WITH TYRES **4WD FRONT = 12.5/80–18 REAR = 18.4–26**

	Standard Dipper	**H.E.D. (Extended)**
A. Loading Reach	1600mm (5ft 2in)	2573mm (8ft 4in)
B. Bucket Rotation	204°	204°
C. Operating Height, Fully Raised	5550mm (18ft 0in)	6290mm (20ft 7in)
D. Loading Height Maximum	3740mm (12ft.3in)	4550mm (14ft.9in)
E. Reach from swing post	5564mm (18ft.3in)	6675mm (21ft.9in)
E. Reach from rear axle centre line	6890mm (22ft 6in)	8000mm (26ft 3in)
G. Maximum Length of Surface Excavation	5950mm (19ft 5in)	7092mm (23ft 3in)
H. Maximum Digging Depth		
To Achieve a 0.6m (2ft). Flat Bottom Trench	4230mm (13ft 9in)	5450mm (17ft 9in)
To Achieve a 2.43m (8ft). Flat Bottom Trench	3850mm (12ft 6in)	5170mm (17ft 0in)
J. Maximum Digging Depth	4270mm (14ft 0in)	5485mm (18ft)
K. Stabilizer Spread – Transport	2280mm (7ft 5in)	2280mm (7ft 5in)
L. Stabilizer Spread – Working (pads reversed)	2790mm (9ft 2in)	2790mm (9ft 2in)
M. Stabiliser Pad Levelling Angle	14°	14°
– Swing Arc	180°	180°
– Maximum digging force (general purpose bucket) –		
crowd cylinder	4119 kg (9080 lbs)	2792 kg (6155 lbs)
bucket cylinder	5630 kg (12412 lbs)	5630 kg (12408 lbs)
– Lift capacity through dipper arc –	(SAE) 2105 kg (4640 lbs)	1515 kg (3345 lbs)
– Lift capacity, dipper 3.66m (12ft) above ground	(SAE) 2180 kg (4805 lbs)	1535 kg (3390 lbs)
– Lift capacity at 4.2m (14ft) above ground	(SAE) 1515 kg (3340 lbs)	975 kg (2150 lbs)
– Extendible dipper extension length	–	1.05m (3ft.4in)

SIDESHIFT BACKHOE – DIMENSIONS AND PERFORMANCE MODELS 90.B, 95.B, 110.B, 115.B / B95, 100.2, 11.2, 200.2

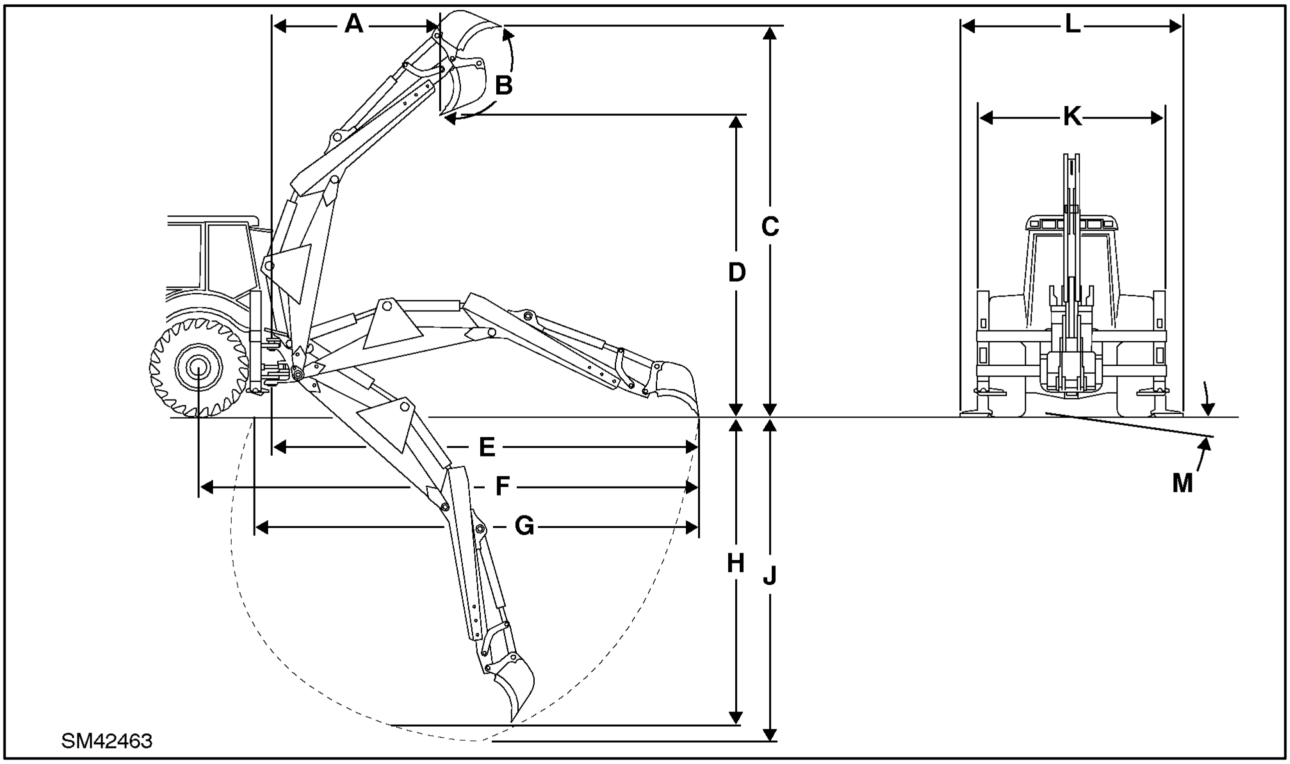


3

(PER SAE J 732 C) WITH TYRES **4WD FRONT = 12.5/80–18 REAR = 18.4–26**

	Standard Dipper	H.E.D. (Extended)
A. Loading Reach	1877mm (6ft 1in)	2820mm (9ft 2in)
B. Bucket Rotation	204°	204°
C. Operating Height, Fully Raised	5777mm (18ft 8in)	6467mm (21ft 0in)
D. Loading Height Maximum	3946mm (12ft.8in)	4664mm (15ft.1in)
E. Reach from swing post	5868mm (19ft.1in)	6953mm (22ft.6in)
E. Reach from rear axle centre line	7913mm (25ft 7in)	8278mm (26ft 9in)
G. Maximum Length of Surface Excavation	6300mm (20ft 5in)	7380mm (23ft 10in)
H. Maximum Digging Depth		
To Achieve a 0.6m (2ft). Flat Bottom Trench	4565mm (14ft 8in)	5744mm (18ft 6in)
To Achieve a 2.4m (8ft). Flat Bottom Trench	4224mm (13ft 7in)	5474mm (17ft 8in)
J. Maximum Digging Depth	4594mm (14ft 9in)	5778mm (18ft 8in)
K. Stabilizer Spread – Transport	2280mm (7ft 5in)	2280mm (7ft 5in)
L. Stabilizer Spread – Working (pads reversed)	2790mm (9ft 2in)	2790mm (9ft 2in)
M. Stabiliser Pad Levelling Angle	14°	14°
– Swing Arc	180°	180°
– Maximum digging force (general purpose bucket) –		
crowd cylinder	3621 kg (7983 lbs)	2592 kg (5714 lbs)
bucket cylinder	5630 kg (12412 lbs)	5630 kg (12408 lbs)
– Lift capacity through dipper arc –	(SAE) 1865 kg (4115 lbs)	1380 kg (3045 lbs)
– Lift capacity, dipper 3.66m (12ft) above ground	(SAE) 1925 kg (4250 lbs)	1400 kg (3085 lbs)
– Lift capacity at 4.2m (14ft) above ground	(SAE) 1560 kg (3445 lbs)	1030 kg (2275 lbs)
– Extendible dipper extension length	–	1.05m (3ft.4in)

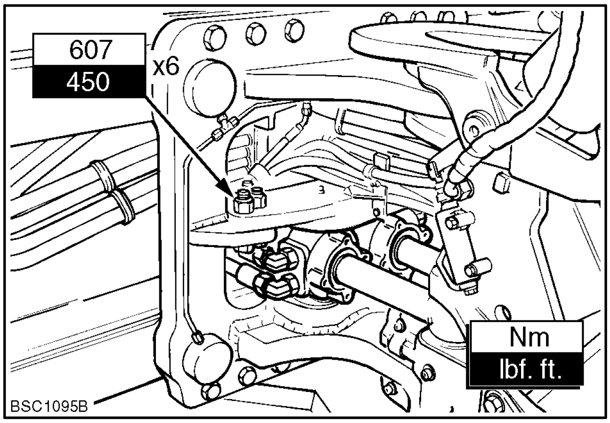
SIDESHIFT BACKHOE - DIMENSIONS AND PERFORMANCE MODELS 115.B, 200.2



(Per SAE J 49) WITH TYRES **FRONT AND REAR = 440/80R28**

Backhoe		**Standard Dipper**	**HED Extended**
A.	Loading Reach	1877mm (6ft .1in)	2818mm (9ft 2in)
B.	Bucket Rotation	204°	204°
C.	Operating Height, Fully Raised	5717mm (18ft 6in)	6374mm (20ft 7in)
D.	Loading Height Maximum	3905mm (12ft 7in)	4593mm (14ft 9in)
E.	Reach from Swing Post Pivot	5867mm (19ft 1in)	6952mm (22ft 6in)
F.	Reach from Rear Axle C/L	7193mm (23ft 4in)	8278mm (26ft 9in)
G.	Max Length Surface Excavation	6492mm (21ft 1in)	7500mm (25ft 0in)
H.	Maximum Digging Depth		
	To Achieve a 0.6m Flat Bottom Trench	4598mm (15ft 1in)	5771mm (18ft 9in)
	To Achieve a 2.4m Flat Bottom Trench	4255mm (14ft 0in)	5505mm (18ft 1in)
J.	Maximum Digging Depth	4302mm (14ft 1)	5527mm (18ft 1in)
K.	Stabilizer Spread - Transport	2280mm (7ft 5in)	2280mm (7ft 5in)
L.	Stabilizer Spread (pads reversed)	2790mm (9ft 2in)	2790mm (9ft 2in)
M.	Stabiliser Pad Levelling Angle	14°	14°
-	Swing Arc	180°	180°
-	Max digging force (general purpose bucket)		
	crowd cylinder (ICED)	3621 kg (7983 lbs)	2592 (5714 lbs)
	bucket cylinder (ICED)	5630 kg (12412 lbs)	5630 kg (12412 lbs)
-	Lift capacity through dipper arc -	2350 kg (5190 lbs)	1625 kg (3585 lbs)
-	Lift capacity, dipper 3.66m above ground	2425 kg (5945 lbs)	1625 kg (2409 lbs)
-	Lift capacity at 4.2m (14ft) above ground	1500 kg (3305 lbs)	995 kg (2195 lbs)
-	Extendible dipper extension length-		1.2m (3.9 ft)

TORQUES



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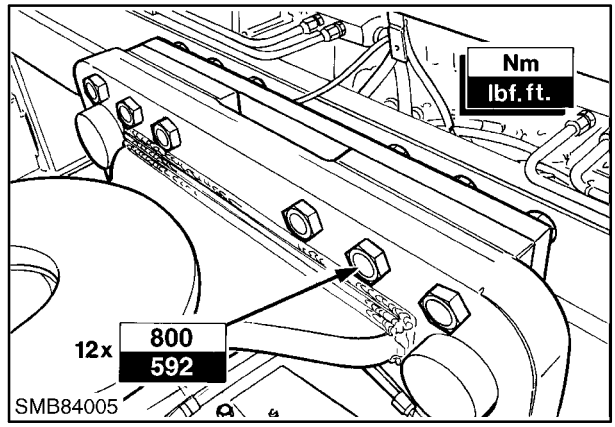

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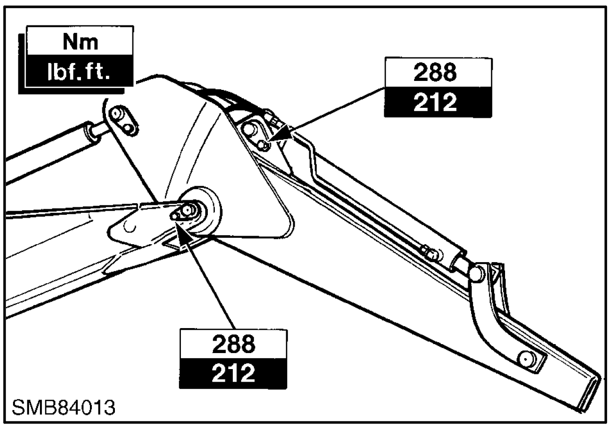

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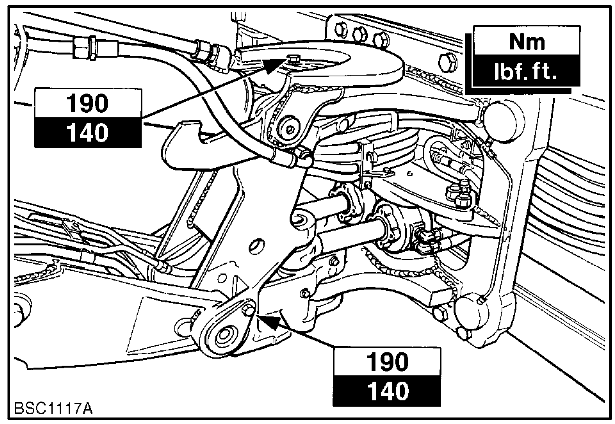


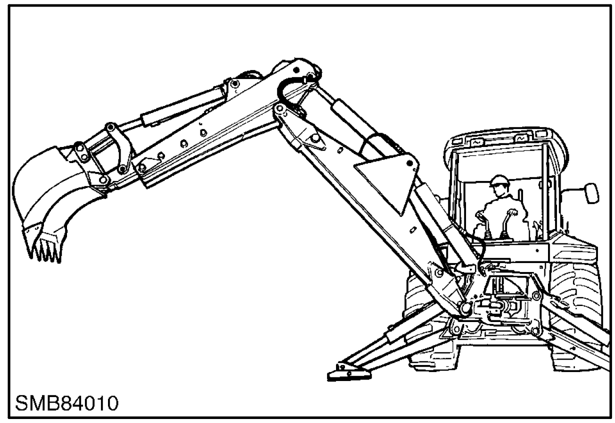
7

DESCRIPTION and OPERATION

Loader backhoes are available with a centre pivot or sideshift backhoe assembly.

On centre pivot machines the backhoe pivots on a fixed central point at the rear of the machine.

Independently operated stabilisers are attached to the base of the frame and pivot about an arc to raise or lower each side of the machine



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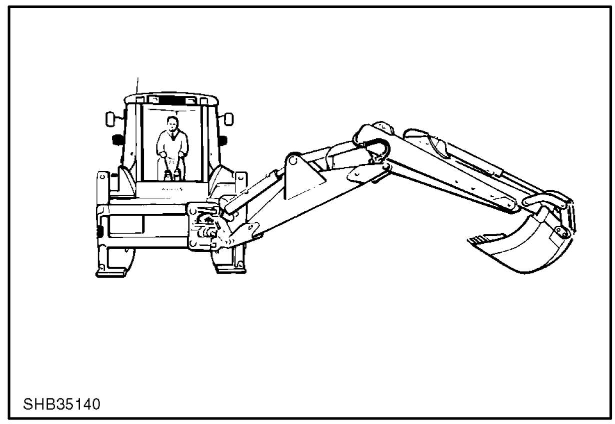
On sideshift machines the backhoe is attached to a carriage hydraulically clamped to a frame at the rear of the machine. This allows the operator to repositioning the carriage on the frame and adjust the pivot point of the backhoe to suit operating conditions.

The machine is raised using two vertical stabilisers attached to each side of the machine.



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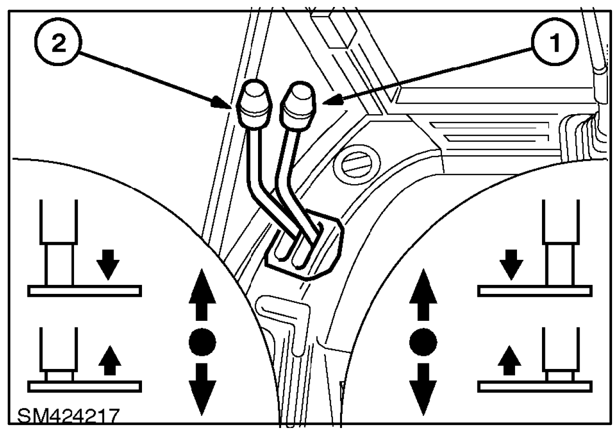
Each stabiliser is independently operated using levers (1) and (2).



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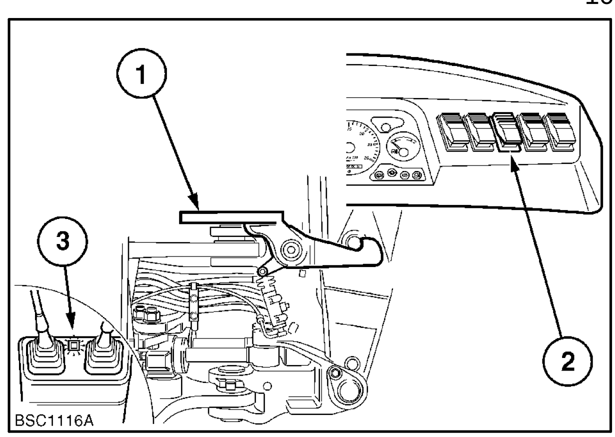
The backhoe is locked in position during transportation using a hydraulically operated boom lock(1). The lock is operated by a switch (3) which illuminates a warning light (2) whenever the lock is activated.

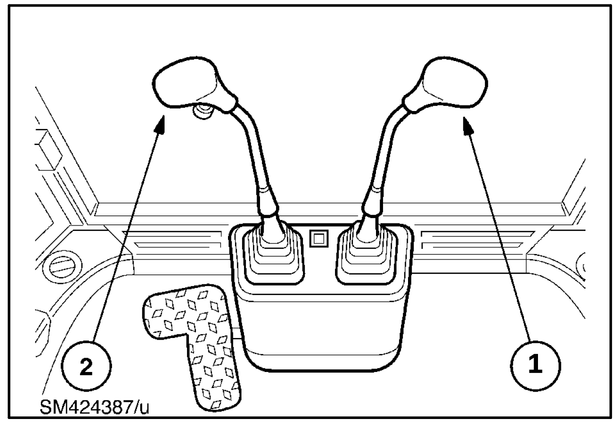


11

The backhoe digging elements are controlled using two main control levers.

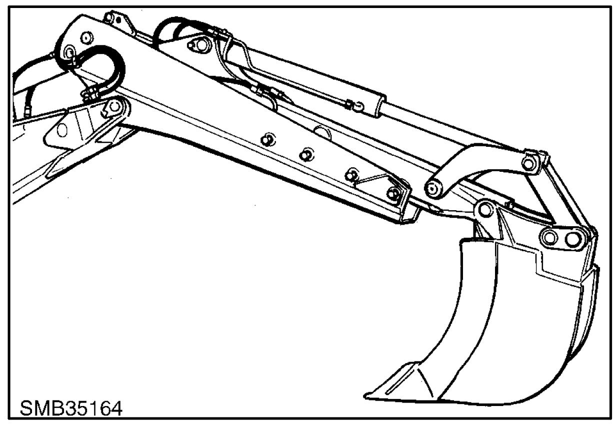
Three types of control pattern for 2 lever systems are available as shown on the following pages. A four lever dealer installed system is also available as a Dealer installed accessory.

Always familiarise yourself with the backhoe lever control pattern before operating the backhoe.



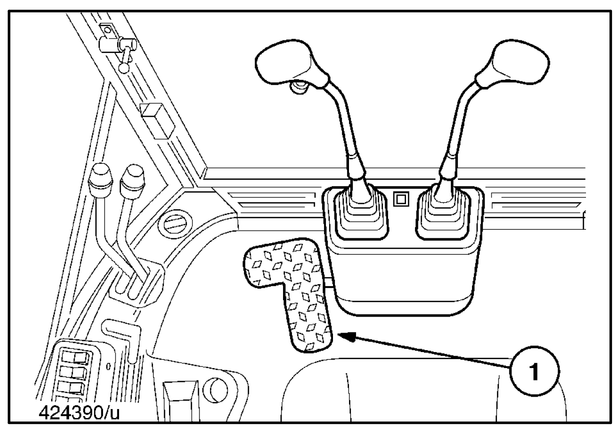
12

Machines may be fitted with an optional extendible dipperstick which can be operated simultaneously with other boom, dipperstick and bucket movements.



13

The extendible dipperstick is controlled using a foot operated pedal at the rear of the cab.

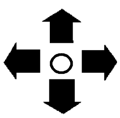


14

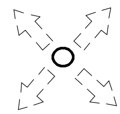
BACKHOE CONTROL LEVERS OVERVIEW (STANDARD PATTERN), FIGURE 15

IMPORTANT: *Ensure the Sideshift Carriage Clamp switch (3) is ON before operating the backhoe and the backhoe boom plate is disengaged either by lever or switch (4)*

RIGHT HAND – BACKHOE Operating Lever (1), is with the operator seated in the cab facing rearward.



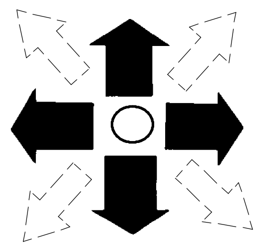
INDIVIDUAL OPERATION –
Straight line movement of the backhoe lever (1) operates dipstick and bucket.



DUAL OPERATION –
Diagonal movement of the backhoe lever (1) allows dual operation of dipstick and bucket.

DIPSTICK CROWDS OUT

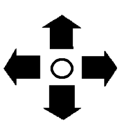
BUCKET CURLS IN



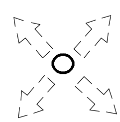
BUCKET CURLS OUT

DIPSTICK CROWDS IN

LEFT HAND – BACKHOE Operating Lever (2), is with the operator seated in the cab facing rearward.



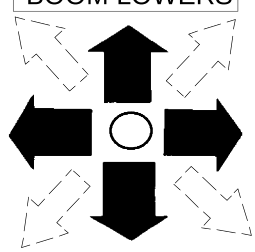
INDIVIDUAL OPERATION –
Straight line movement of the backhoe lever (2) operates boom and swing.



DUAL OPERATION –
Diagonal movement of the backhoe lever (2) allows dual operation of boom and swing.

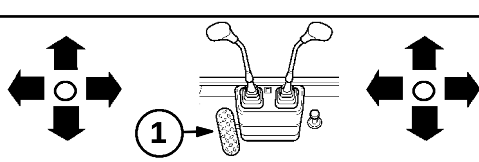
BOOM LOWERS

BOOM SWINGS LEFT

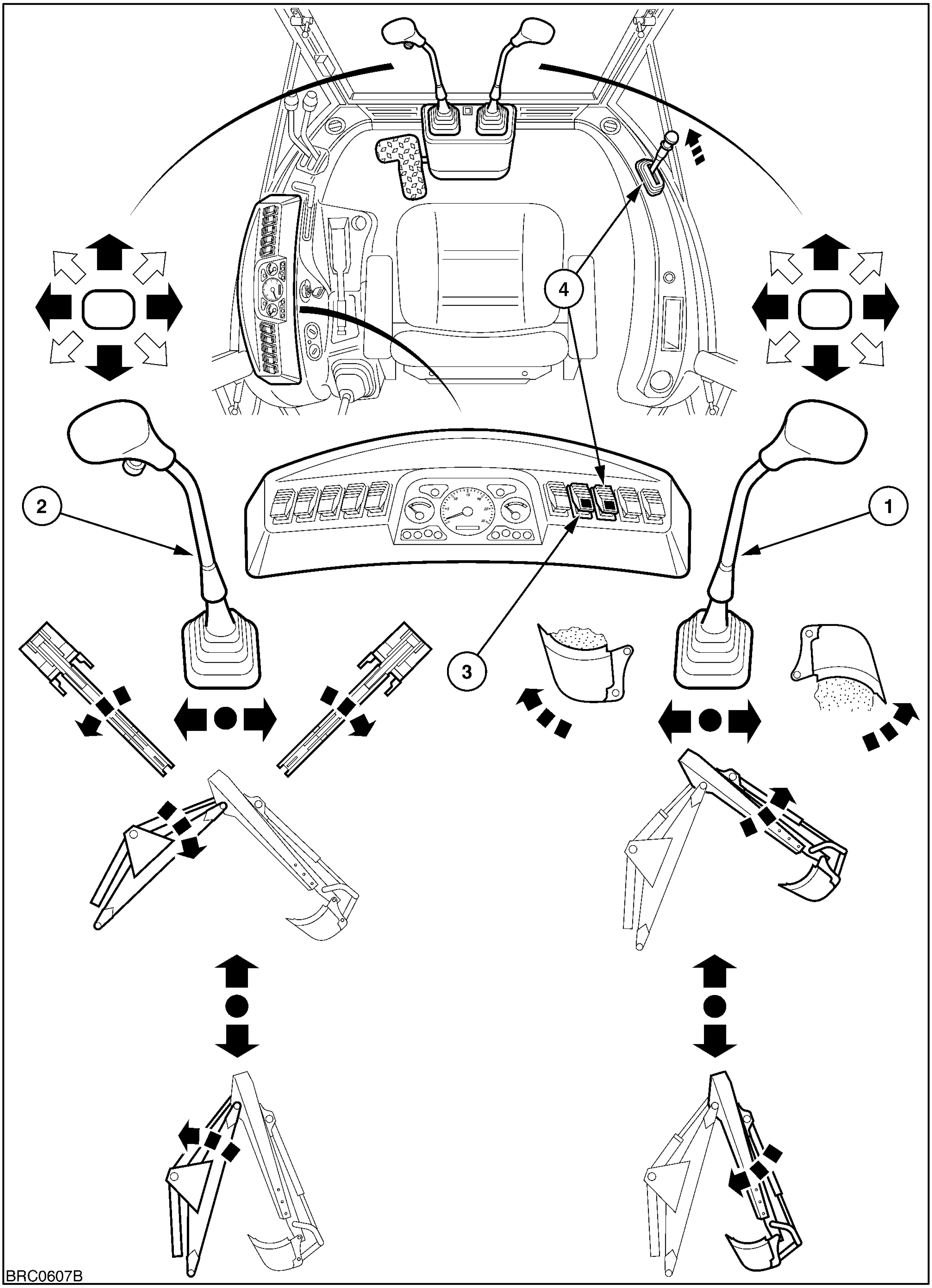


BOOM SWINGS RIGHT

BOOM LIFTS



FEATHERING CAPABILITY –
Operating both backhoe Levers and the H.E.D foot pedal (1) together (when fitted) allows multiple feathering operations.

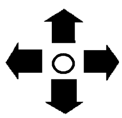


15

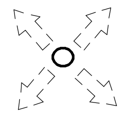
BACKHOE CONTROL LEVERS OVERVIEW (OPTIONAL ISO PATTERN), FIGURE 16

IMPORTANT: *Ensure the Sideshift Carriage Clamp switch (3) is ON before operating the backhoe and the backhoe boom plate is disengaged either by lever or switch (4)*

RIGHT HAND – BACKHOE Operating Lever (1), is with the operator seated in the cab facing rearward.



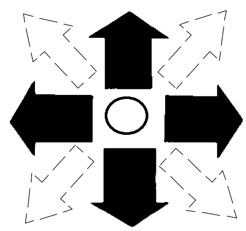
INDIVIDUAL OPERATION –
Straight line movement of the backhoe lever (1) operates boom and bucket.



DUAL OPERATION –
Diagonal movement of the backhoe lever (1) allows dual operation of boom and bucket.

BOOM LOWERS

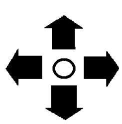
BUCKET CURLS IN



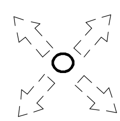
BUCKET CURLS OUT

BOOM LIFTS

LEFT HAND – BACKHOE Operating Lever (2), is with the operator seated in the cab facing rearward.



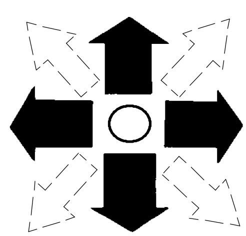
INDIVIDUAL OPERATION –
Straight line movement of the backhoe lever (2) operates dipstick and boom.



DUAL OPERATION –
Diagonal movement of the backhoe lever (2) allows dual operation of dipstick and boom.

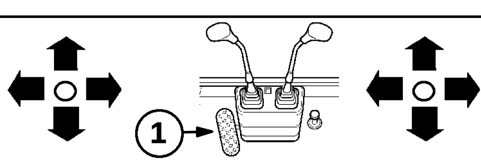
DIPSTICK CROWDS OUT

BOOM SWINGS LEFT

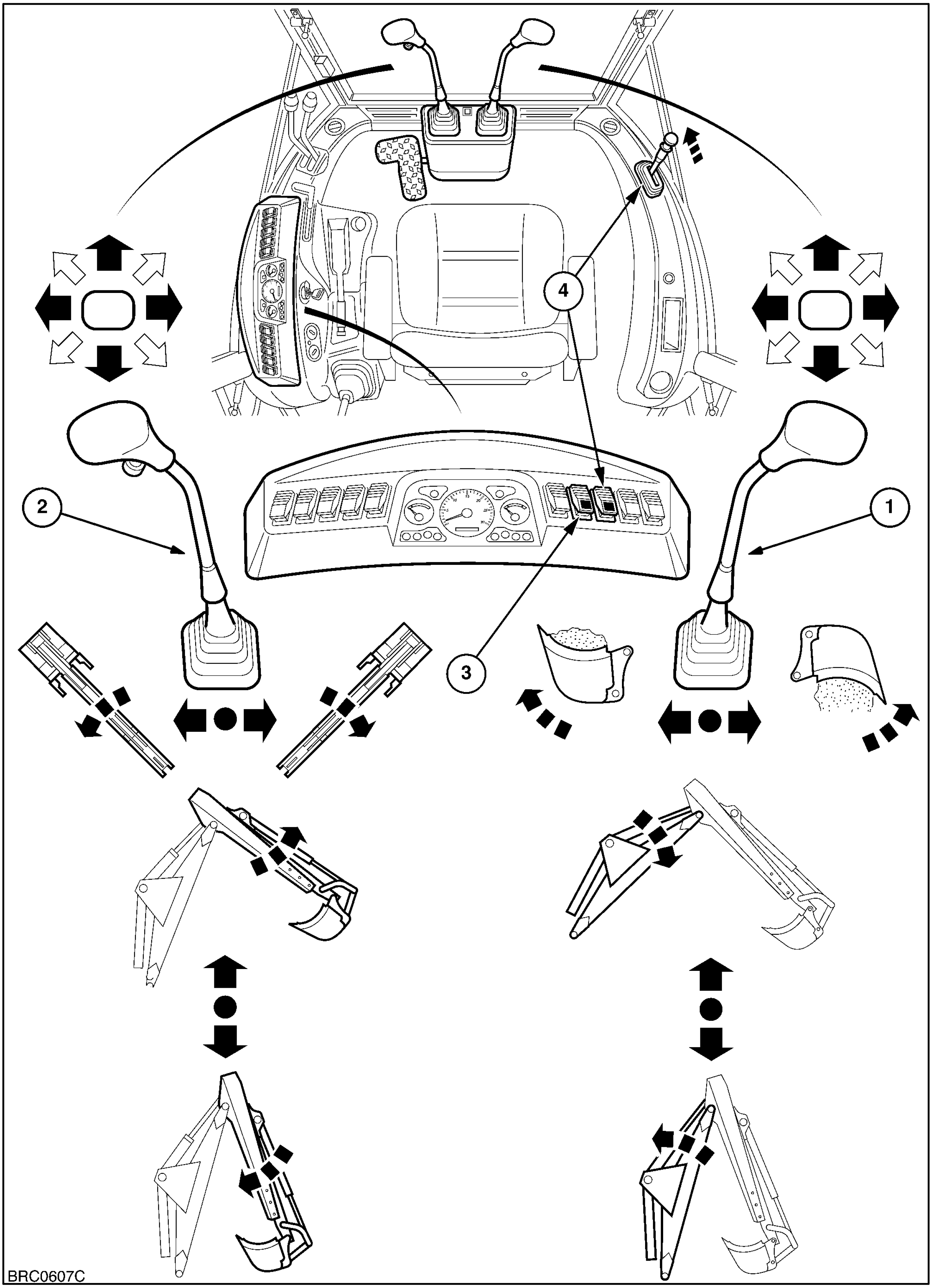


BOOM SWINGS RIGHT

DIPSTICK CROWDS IN



FEATHERING CAPABILITY –
Operating both backhoe Levers and the H.E.D foot pedal (1) together (when fitted) allows multiple feathering operations.



16

BACKHOE CONTROL LEVERS OVERVIEW (OPTIONAL PATTERN), FIGURE 17

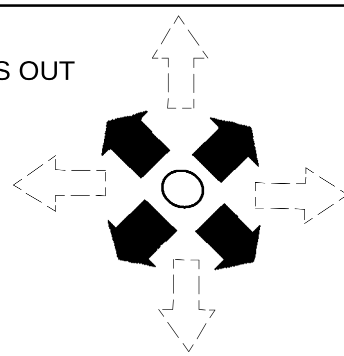
IMPORTANT: *Ensure the Sideshift Carriage Clamp switch (3) is ON before operating the backhoe and the backhoe boom plate is disengaged either by lever or switch (4)*

RIGHT HAND – BACKHOE Operating Lever (1), is with the operator seated in the cab facing rearward.

INDIVIDUAL OPERATION – Diagonal movement of the backhoe lever (1) operates dipstick and bucket.	DUAL OPERATION – Straight line movement of the backhoe lever (1) allows dual operation of dipstick and bucket.

DIPSTICK CROWDS OUT

BUCKET CURLS OUT



BUCKET CURLS IN

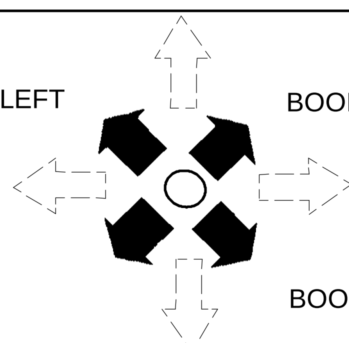
DIPSTICK CROWDS IN

LEFT HAND – BACKHOE Operating Lever (2), is with the operator seated in the cab facing rearward.

INDIVIDUAL OPERATION – Diagonal movement of the backhoe lever (2) operates boom and swing.	DUAL OPERATION – Straight line movement of the backhoe lever (2) allows dual operation of boom and swing.

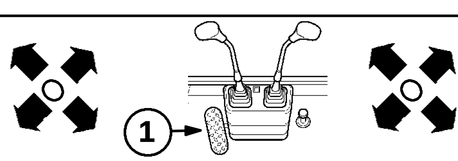
BOOM SWINGS LEFT

BOOM LOWERS

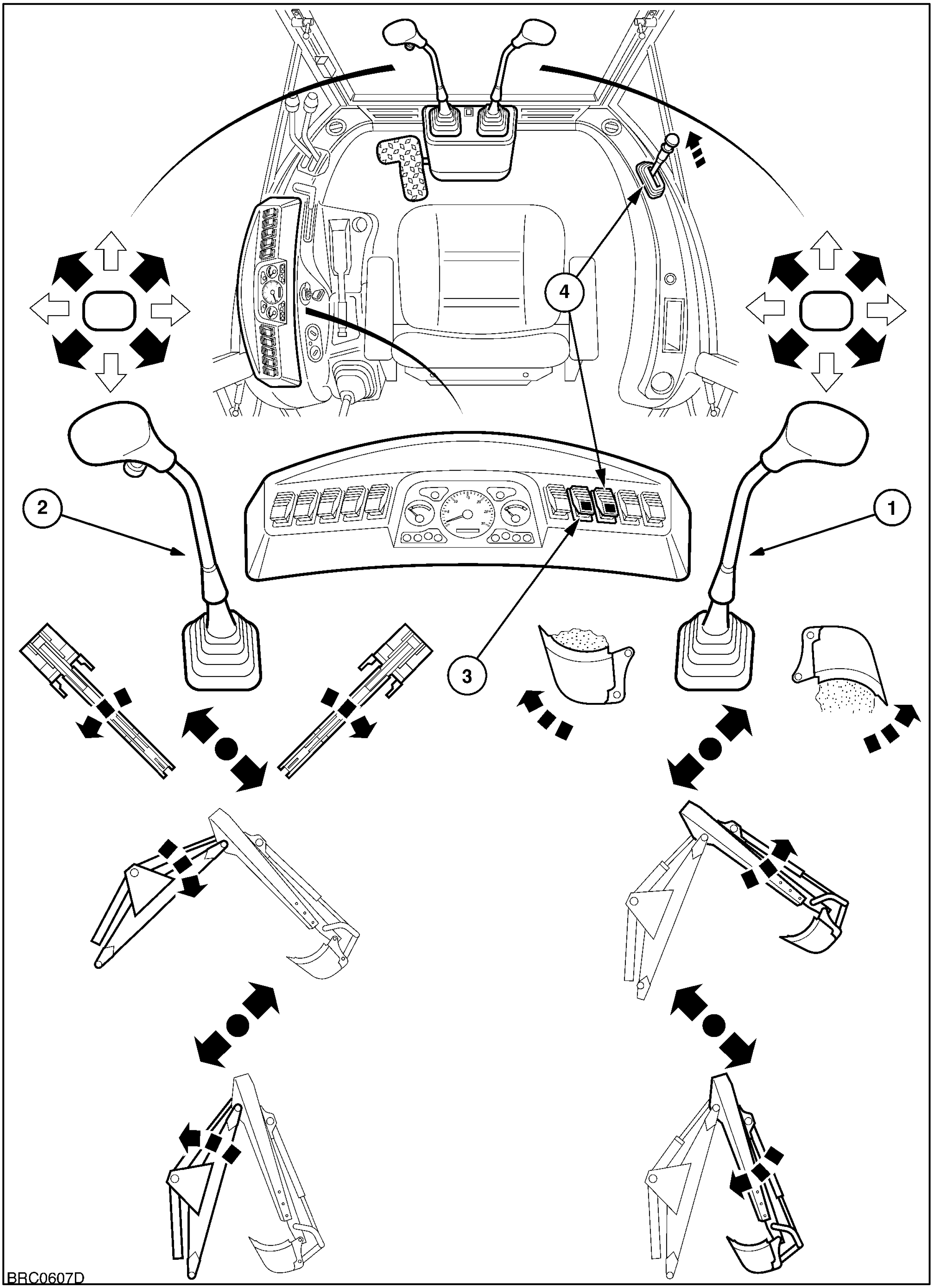


BOOM LIFTS

BOOM SWINGS RIGHT



FEATHERING CAPABILITY –
Operating both backhoe Levers and the H.E.D foot pedal (1) together (when fitted) allows multiple feathering operations.

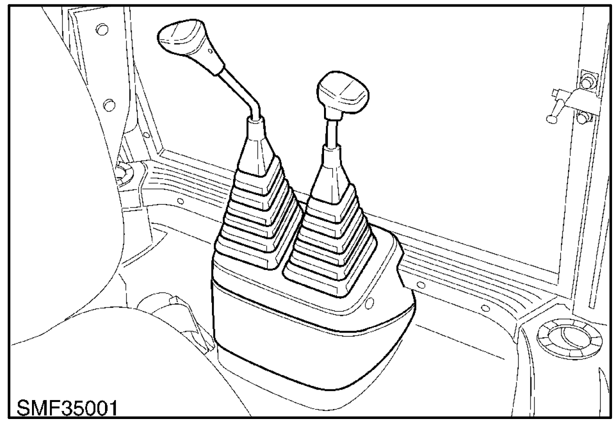


17

BACKHOE CONTROL LINKAGE-OVERHAUL

1. Remove control lever cover and Inspect and dis-assemble linkage with reference to Figures 19 to 21.
2. When overhauling linkage adjust each control rod to the correct length and check that levers automatically return to neutral position when released.

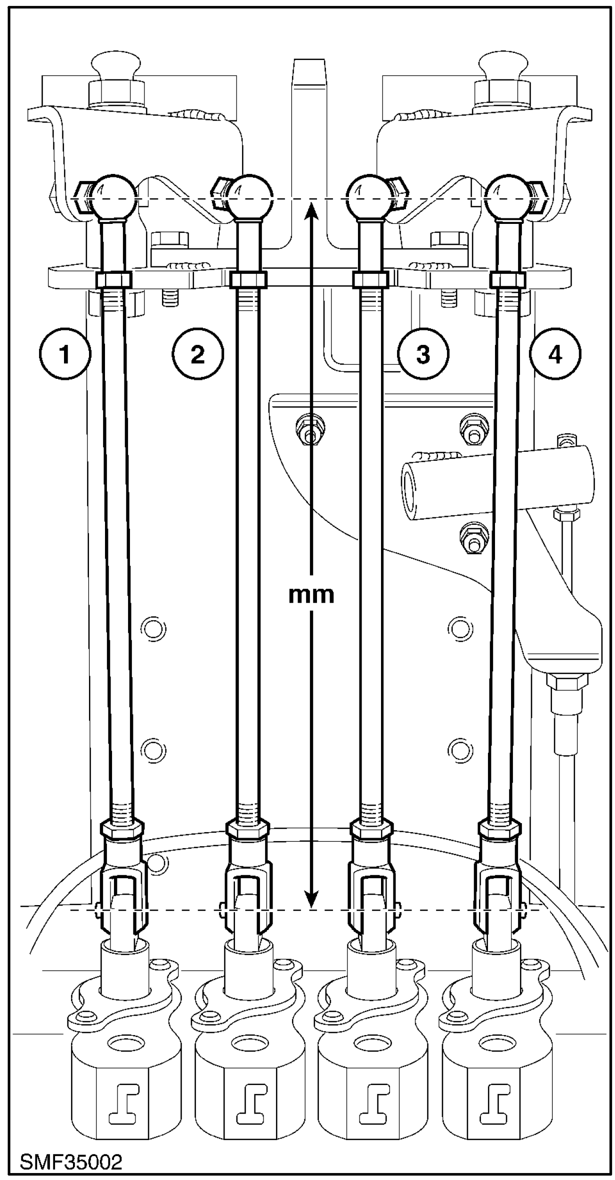
IMPORTANT: *If levers* ***Do Not*** *return to neutral re-examine installation of control rods.*



18

Standard 2 Lever Control Linkage

1.	Dipperstick Control Rod	Length 298mm
2.	Bucket Control Rod	Length 298mm
3.	Swing Control Rod	Length 298mm
4.	Boom Control Rod	Length 298mm

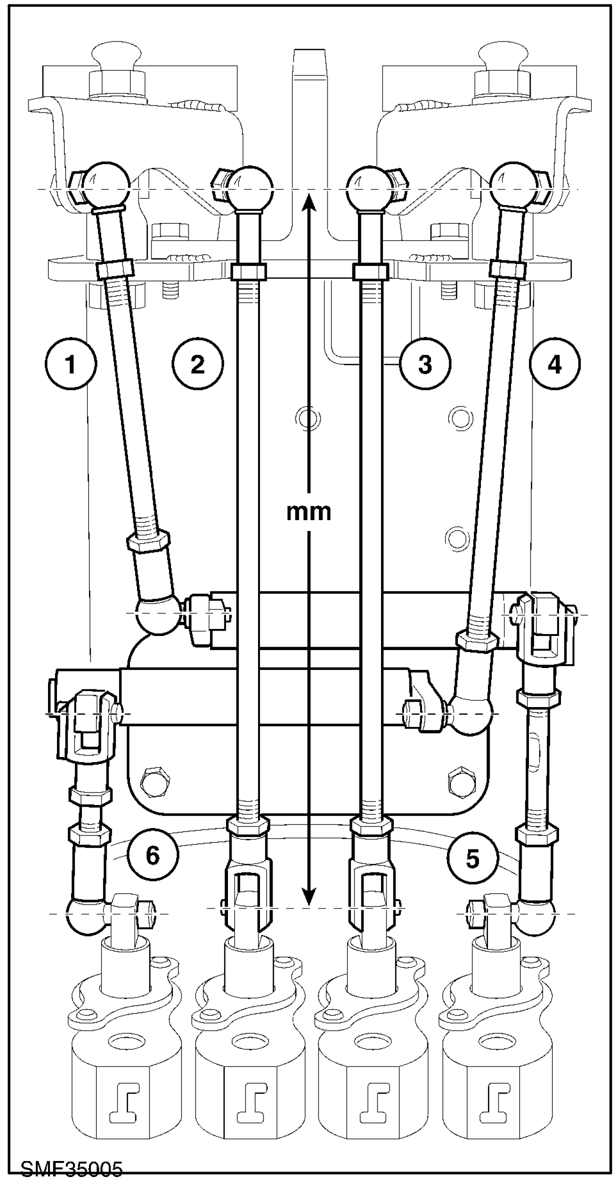


19

Backhoe Control Levers
Standard Pattern

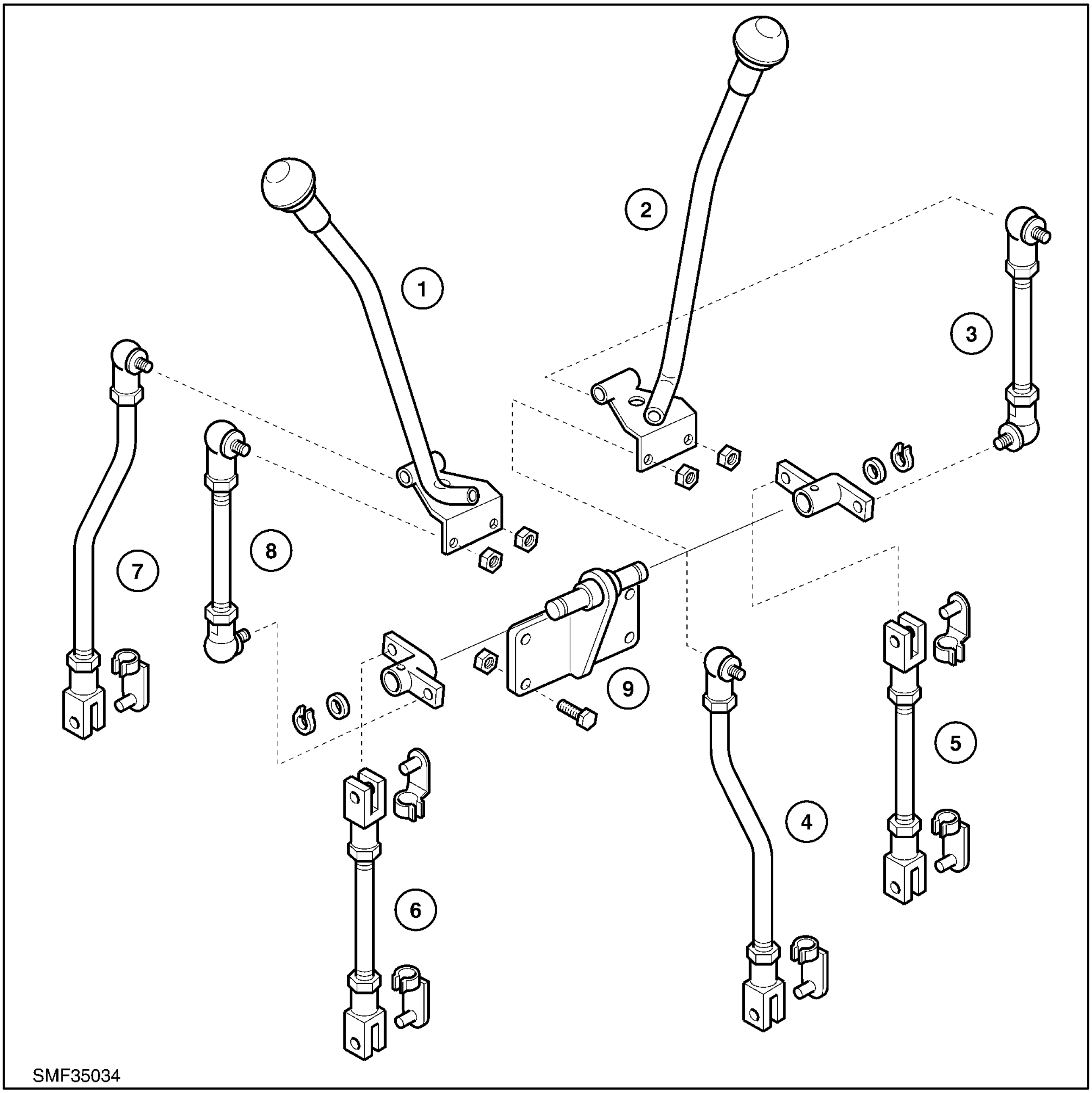
Optional ISO 2 Lever Control Linkage

1. Boom Control Rod – Length 179mm
2. Bucket Control Rod – Length 298mm
3. Swing Control Rod – Length 298mm
4. Dipperstick Control Rod – Length 214mm
5. Boom Control Rod – Length 120mm
6. Dipperstick Control Rod – Length 85mm



20

Backhoe Control Levers
Optional ISO Pattern



21

Backhoe Control Levers Optional Pattern

1. Control Lever
2. Control Lever
3. Swing Control Rod (175mm)
4. Boom Control Rod (297mm)
5. Swing Control Rod (127mm)
6. Bucket Control Rod (127mm)
7. Dipperstick Control Rod (297mm)
8. Bucket Control Rod (175mm)
9. Bracket and Bellcrank Assembly

Control rod lengths shown for this pattern are approximate and minor adjustment may be required after installation.

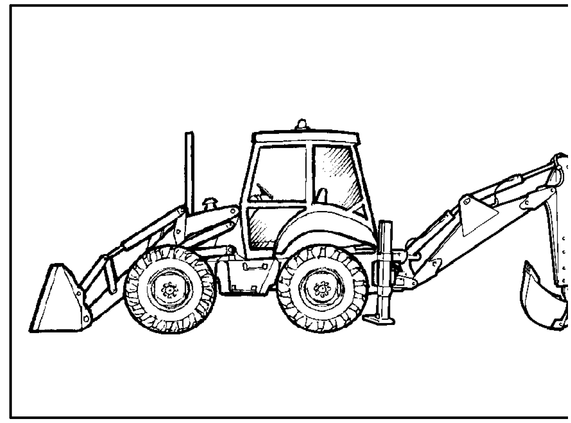
COMPONENT REMOVAL

Dipperstick and Boom-Complete Assembly

WARNING

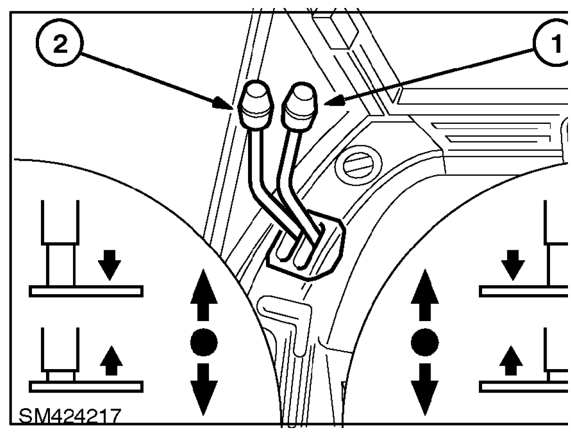
Always support the structural members so that they will be stable and safe to work around.

1. Park the machine on a level surface and position loader bucket on the ground

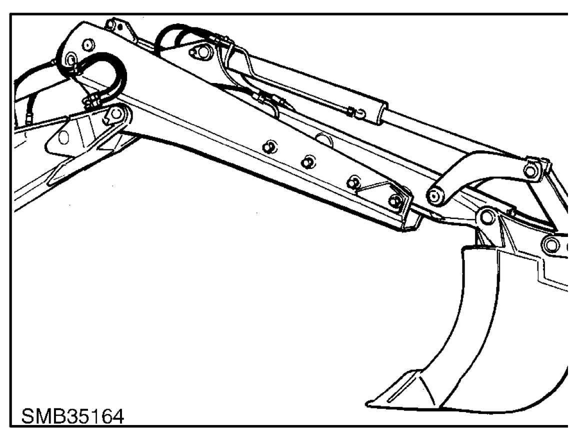


2. Lower stabilisers sufficiently to remove the weight from the rear wheels.

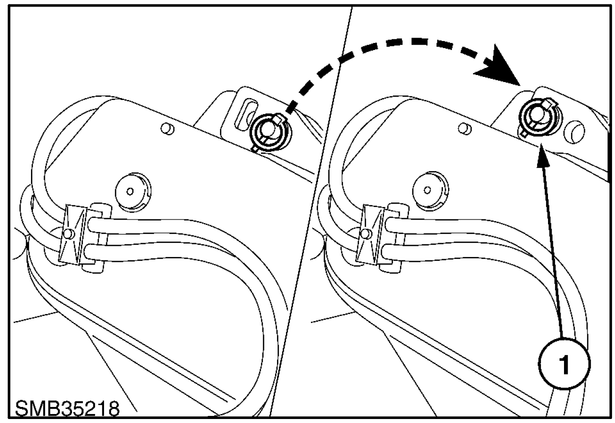
IMPORTANT: *The rear wheels must remain in contact with the ground.*



3. Fully retract extendible dipperstick, where fitted.

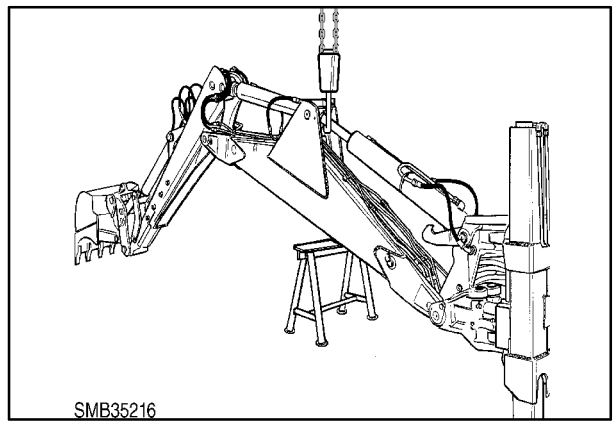


4. On machines fitted with extendible dipperstick install locking pin in transport hole (1).



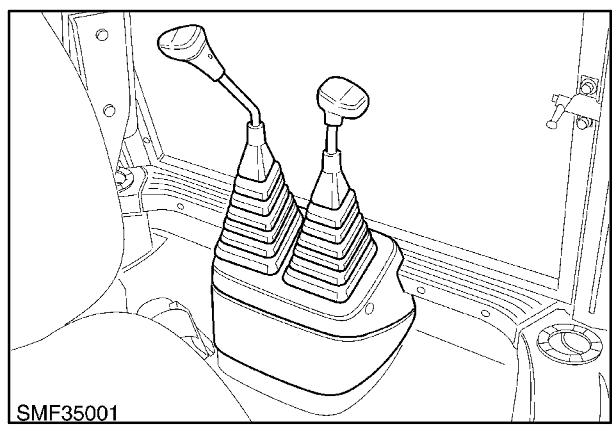
25

5. Fully retract dipperstick cylinder and lower boom until bucket is firmly resting on the ground.
6. Support the backhoe using suitable stand and hoist capable of carrying 1500 Kg.

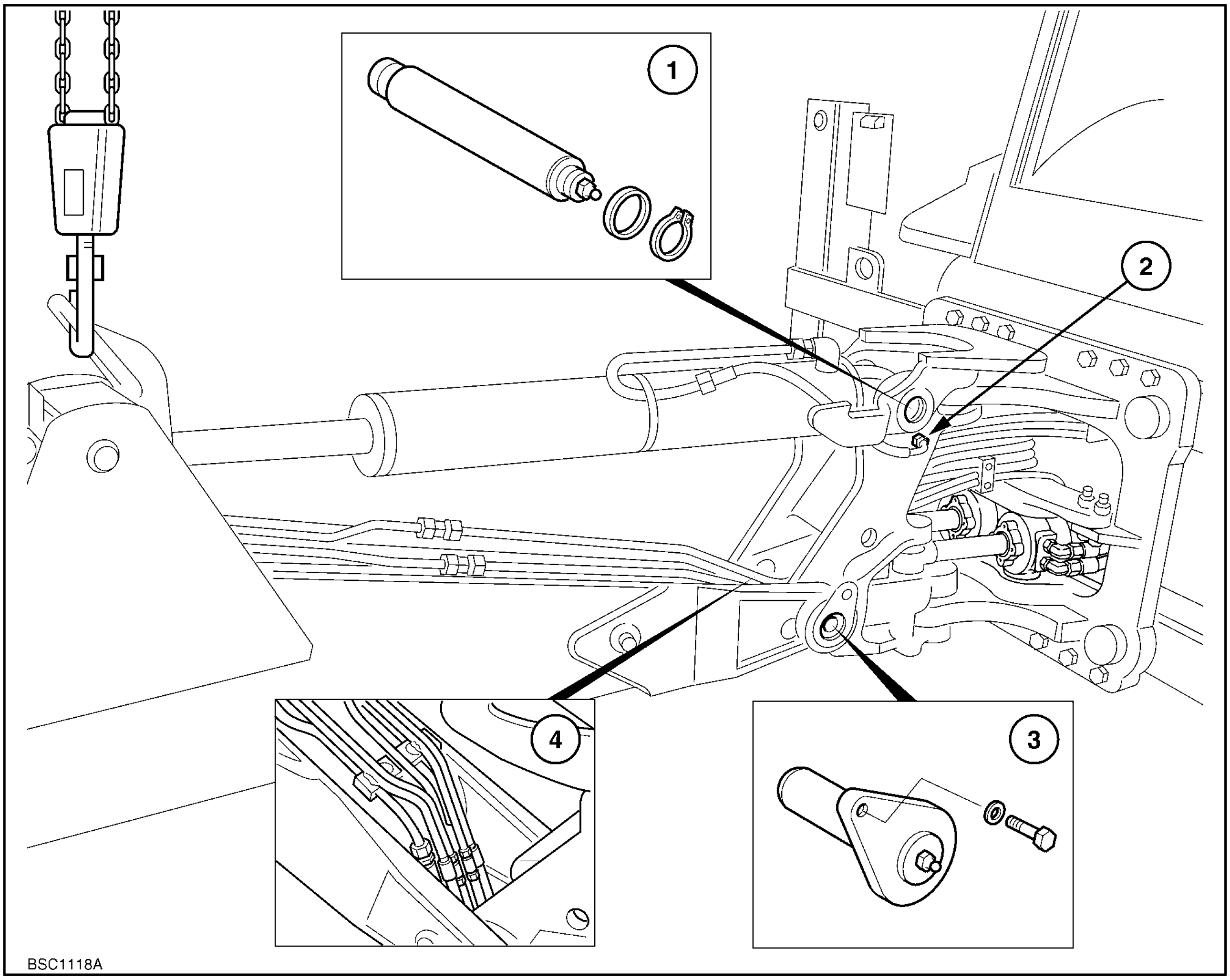


26

7. Turn off engine, then move backhoe control levers through all operating positions to relieve pressure in the system.
8. Re–check that backhoe elements are fully supported.



27



28

Backhoe Boom Removal

1. Boom Cylinder Pivot Pin
2. Boom Cylinder Hydraulic Connection
3. Boom Pivot Pin (2 off)
4. Boom Hydraulic Tube and Hose Connections

9. Disconnect boom cylinder hydraulic connection at swing post (4).
10. Remove boom cylinder retaining pin and carefully lower cylinder onto boom. Use suitable packing to ensure weight of cylinder does not damage hydraulic tubes and hoses.
11. Remove boom pivot pins and lower boom and dipperstick assembly to the ground.

IMPORTANT: *Ensure boom and dipper is* ***fully supported*** *and will not fall over and cause injury.*

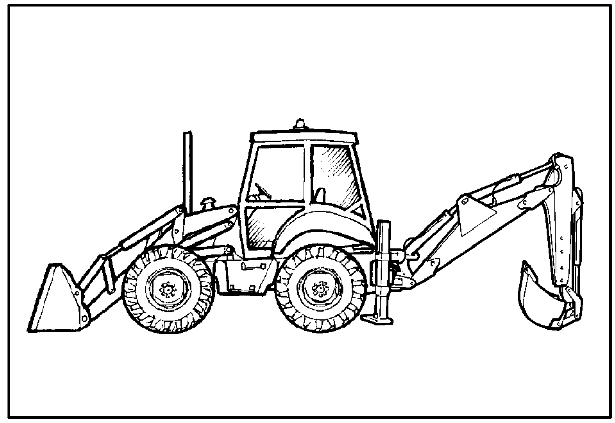
Installation

Installation follows removal procedure in reverse. During installation observe the following:–

- Tighten boom pivot pin retaining bolt (3) to torque of 190Nm (140 lbf.ft).
- Check all hoses for leaks.
- Check hydraulic reservoir oil level and add Ambra multi G 10W30 oil to specification NH410B or Hydrosystem bio–degradable oil to NH Specification NH646 H if applicable.
- Lubricate grease fittings.

Dipperstick Removal

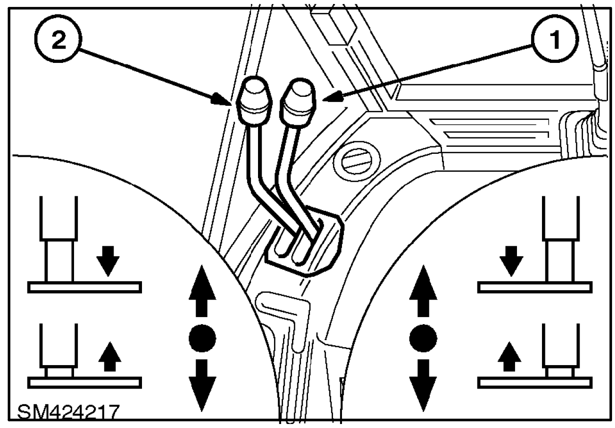
1. Park the machine on a level surface and position loader bucket on the ground.



29

2. Lower stabilisers sufficiently to remove the weight from the rear wheels.

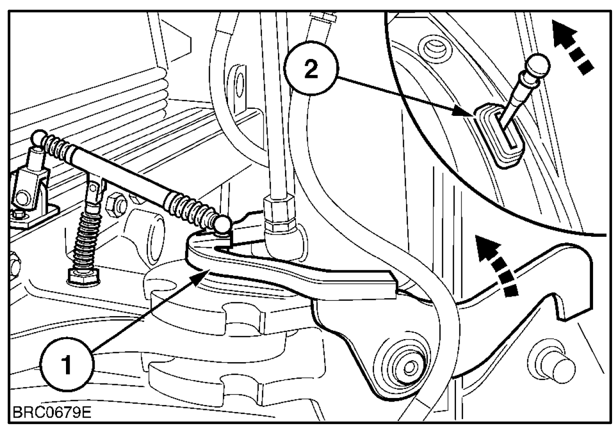
IMPORTANT: The rear wheels must remain in contact with the ground.



30

BOOM LOCK MECHANICAL (where fitted)

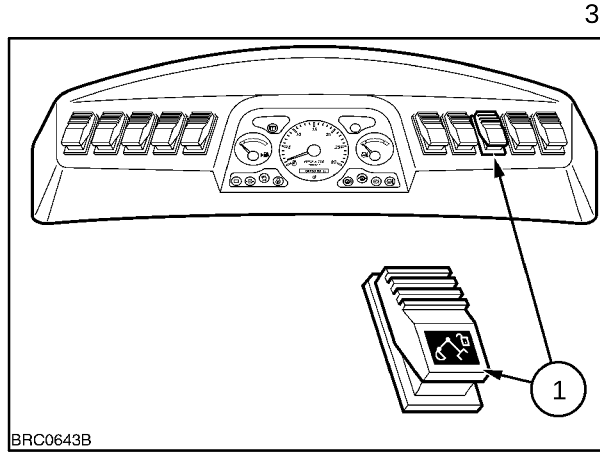
3. Disengage the boom lock



31

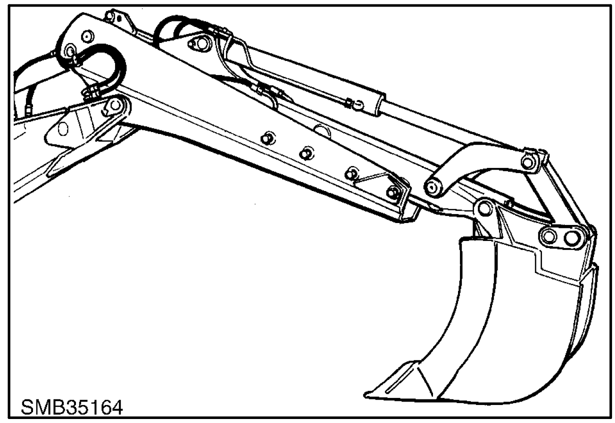
BACKHOE TRANSPORT BOOM LOCK ELECTRICALLY OPERATED (where fitted)

4. Disengage the boom lock



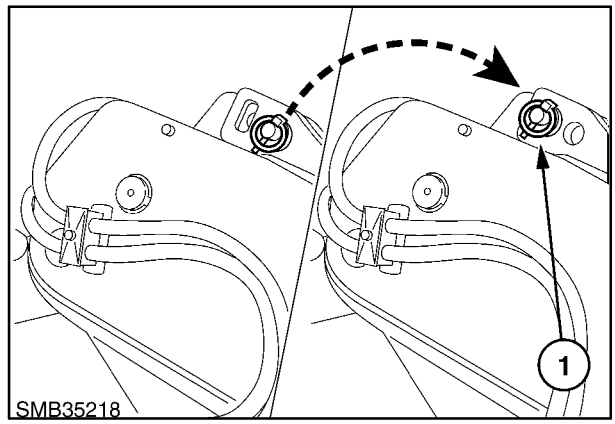
32

5. Remove bucket.



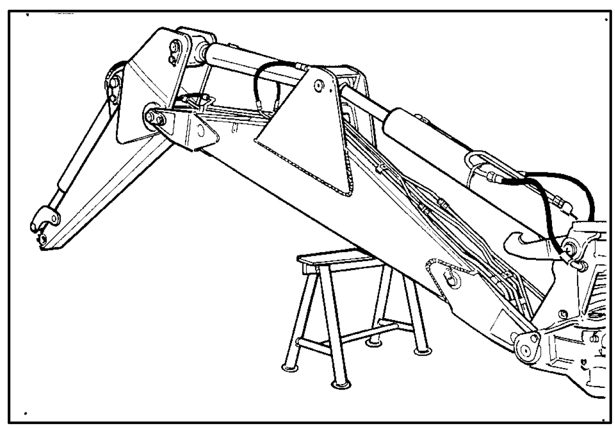
33

6. Fully retract extendible dipperstick where fitted and instal locking pin in transport hole (1).



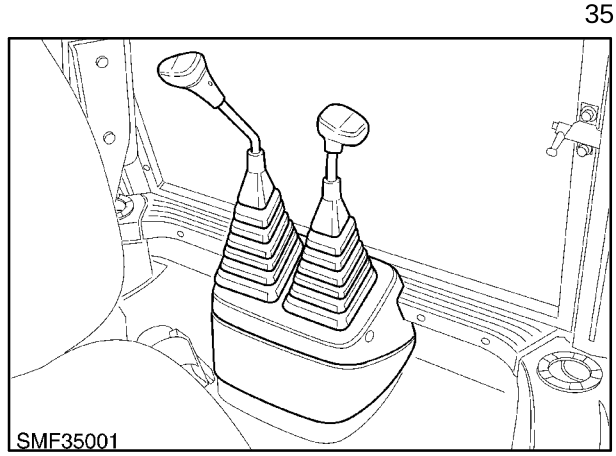
34

7. Lower the backhoe to the ground and support using a suitable stand.



35

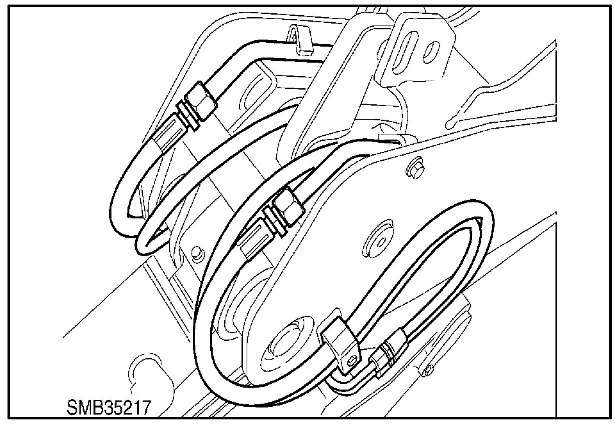
8. Turn off engine, then move backhoe control levers through all operating positions to relieve pressure in the system.



36

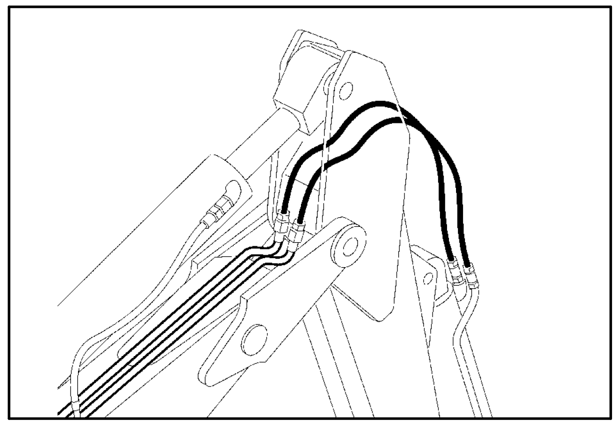
9. Disconnect hoses to dipperstick cylinders.

Extendible dipperstick hoses installation.



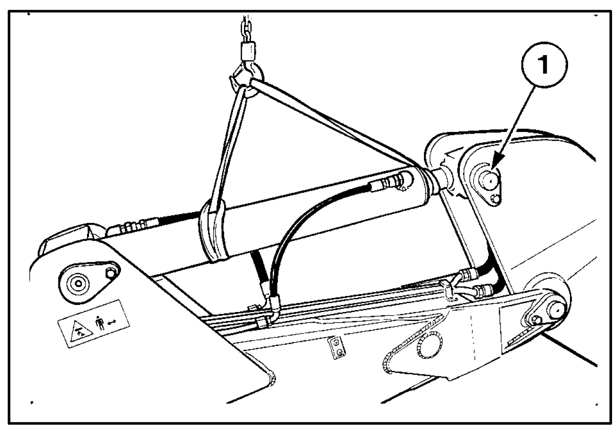
37

Standard dipperstick hose installation.



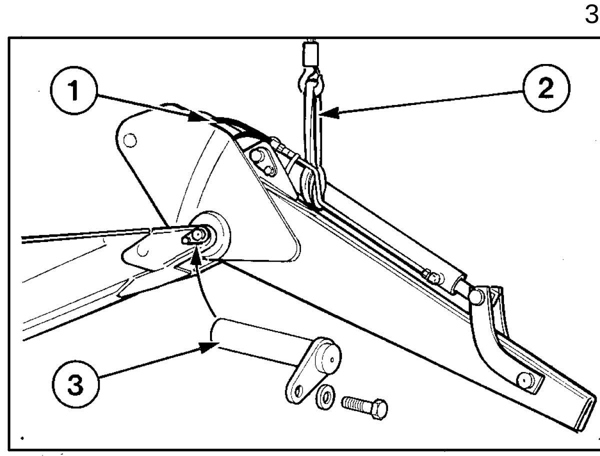
38

10. Support dipperstick cylinder and remove pivot pin (1). Lower cylinder onto boom. Use suitable packing to ensure weight of cylinder does not damage hydraulic tubes attached to dipperstick.



39

11. Support dipperstick using suitable hoist, remove pivot pin and carefully lower dipperstick to the ground.

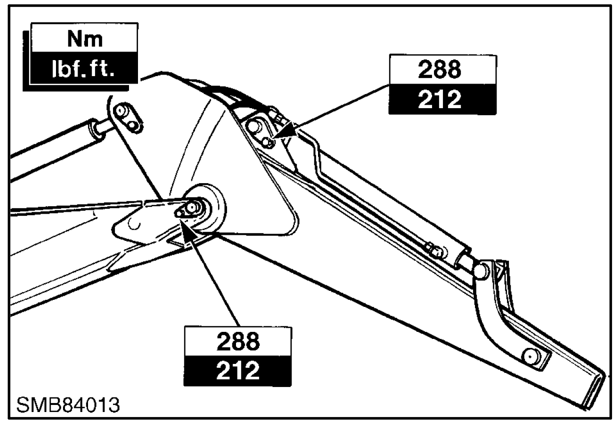


40

Installation

Installation follows removal procedure in reverse. During installation observe the following:–

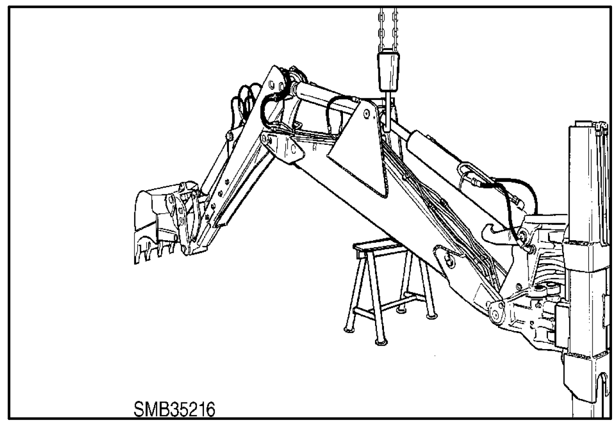
- Tighten pivot pin retaining bolts to torque of 288Nm (212 lbf.ft).
- Check all hoses for leaks.
- Check hydraulic reservoir oil level and add Ambra multi G 10W30 oil to specification NH410B or Hydrosystem bio–degradable oil to NH Specification NH646 H if applicable.
- Lubricate grease fittings.



41

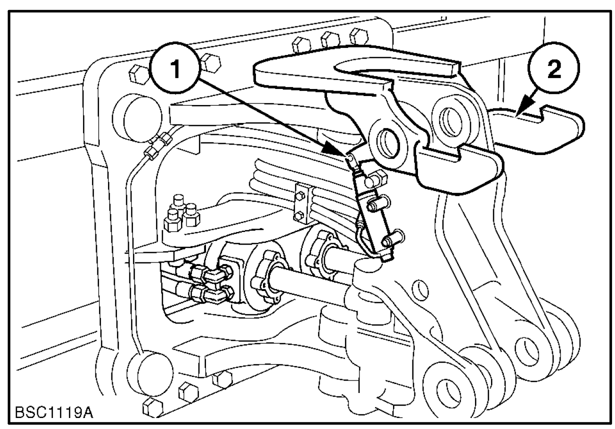
Swing Post Removal

1. Remove dipperstick and boom as described on Pages 13–15.



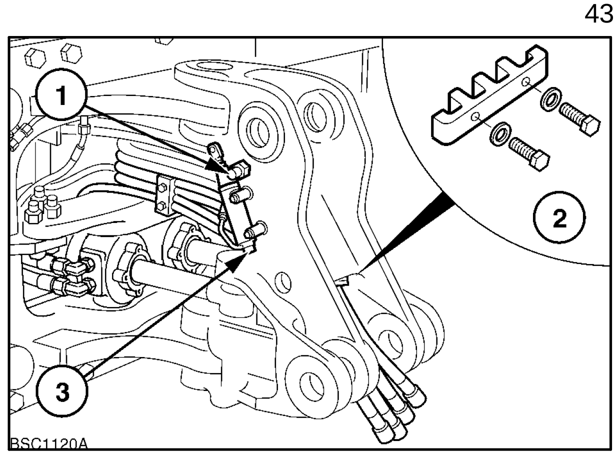
42

2. Disconnect control rod (1) and remove boom lock (2).



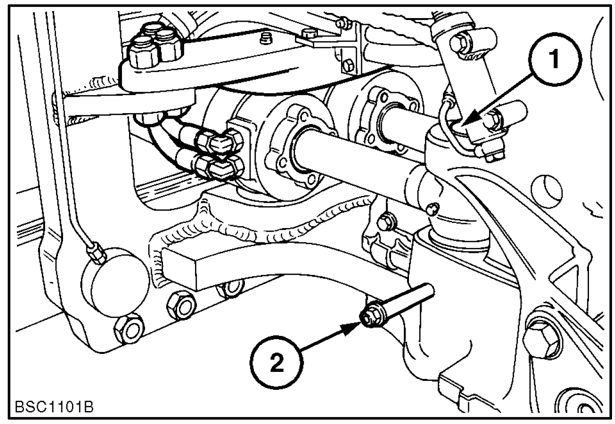
43

3. Disconnect hoses (1) from each side of swing post.
4. Remove swing post hose clamp (2).
5. Disconnect hose to boom lock valve (3) or mechanical lock linkage (where fitted)
6. Cap all hoses to prevent ingress of dirt.



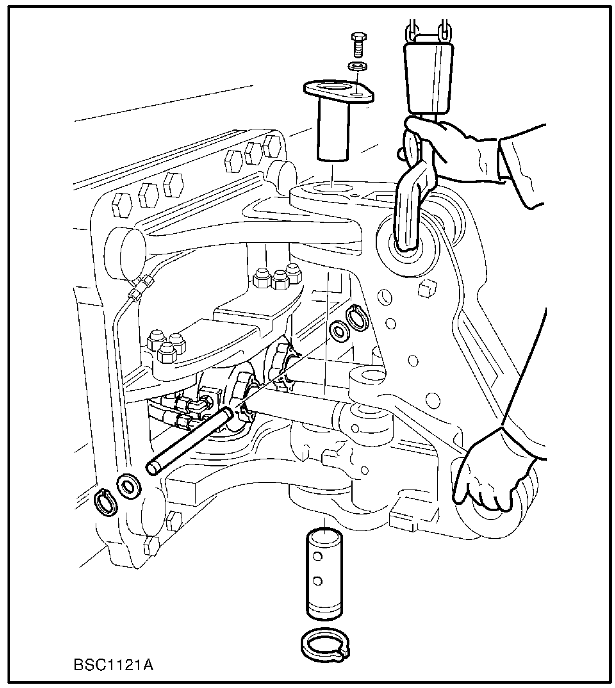
44

7. Remove locking pins (2) and drive out trunnion pins (1) from swing cylinders.



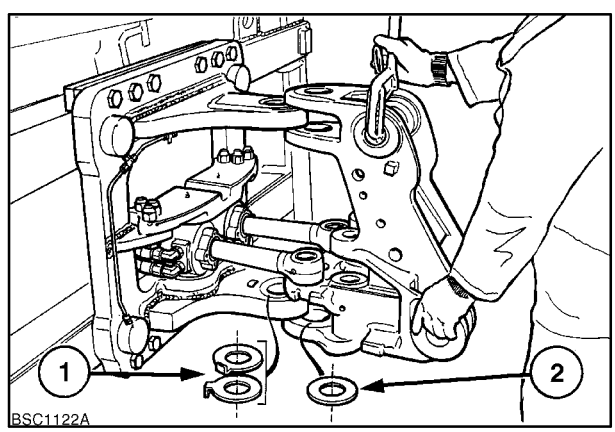
45

8. Support swing post with suitable hoist and remove pivot pins.



46

9. Remove swing post from frame and collect locking washers (1) and shim(s) (2) where fitted.



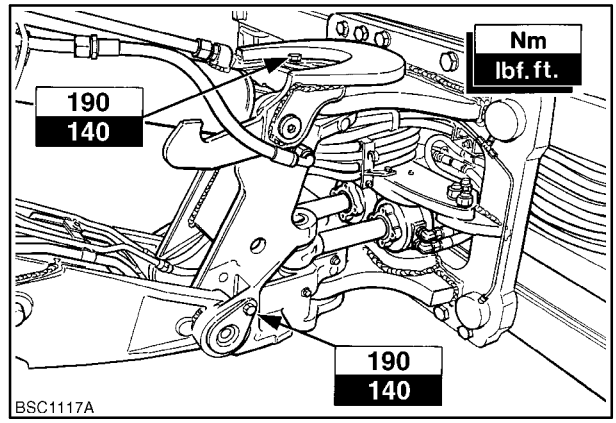
47

Inspection

Examine swing post and seals for wear or damage and replace as necessary.

Installation

Installation follows removal procedure in reverse. On installation tighten pivot pin retaining bolt to a torque of 190Nm (140 lbf.ft).

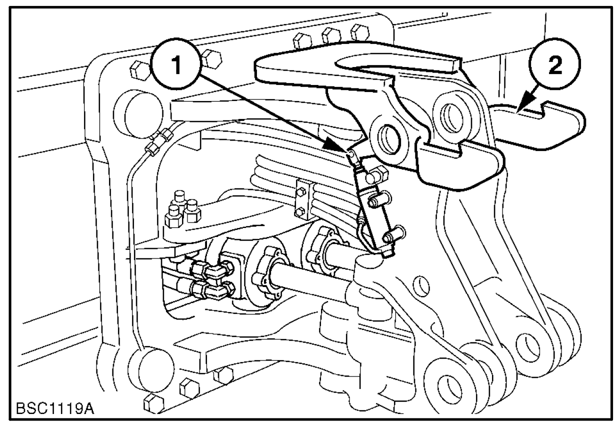


48

Carriage Removal

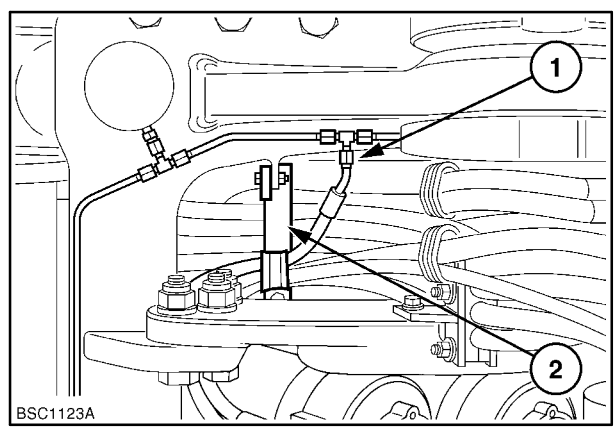
NOTE: *If carriage is being removed for overhaul of sideshift clamp cylinders refer to Section 35 Chapter 3 before proceeding.*

1. Remove dipperstick and boom as described on Page 15 of this Chapter and cap all hoses.
2. Disconnect control rod (1) and remove boom lock (2).



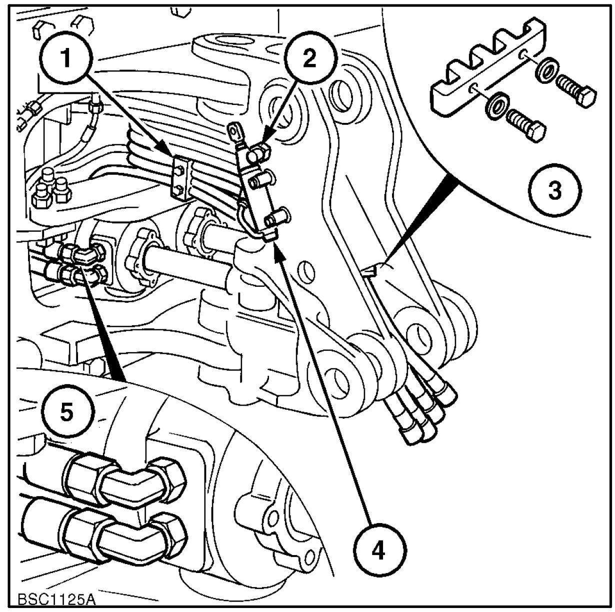
49

3. Disconnect carriage hose clamps (2).
4. Disconnect supply to clamp cylinders (1).



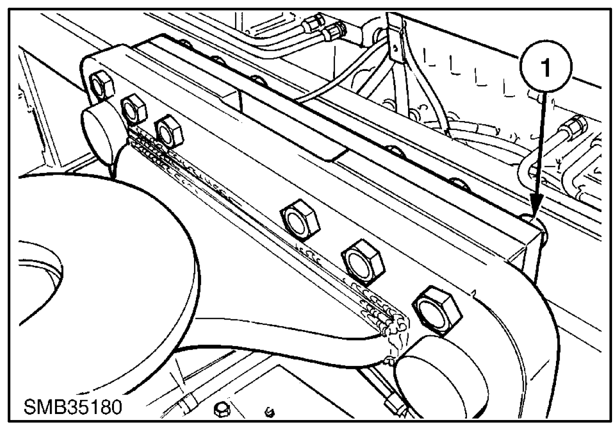
50

5. Remove hose clamps (1) and (3).
6. Disconnect hoses (2) from swing post (one each side of swing post).
7. Disconnect boom lock valve hose (4).
8. Disconnect the upper hose (5) from **each** swing cylinder.
9. Recheck that all hose clamps have been disconnected and that hoses will not catch on swing post or carriage during removal.



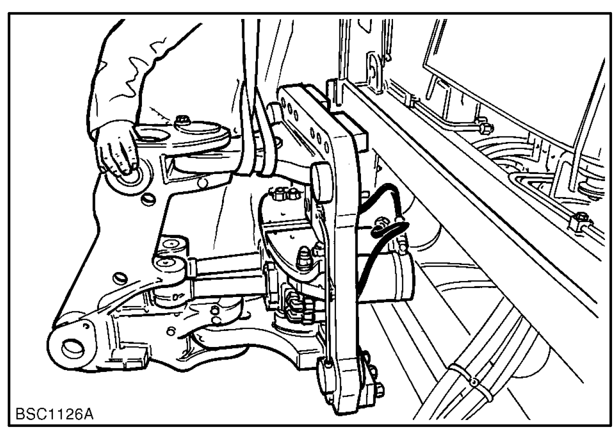
51

10. Attach suitable hoist to carriage as shown in Figure 52.
11. Remove the 6 clamp bolts (1) on the top of the carriage.



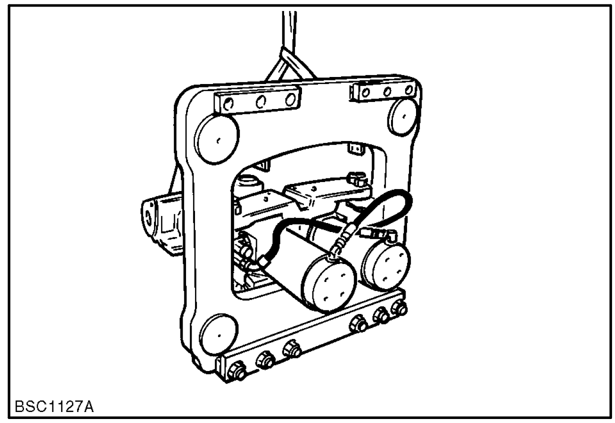
52

12. Carefully remove carriage.



53

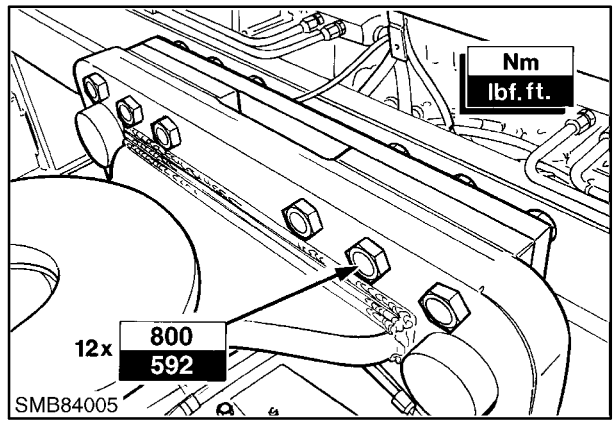
***NOTE:** It is not normally necessary to remove the lower clamp bar (1) to perform step 12. If difficulty is experienced remove the clamp bar.*



54

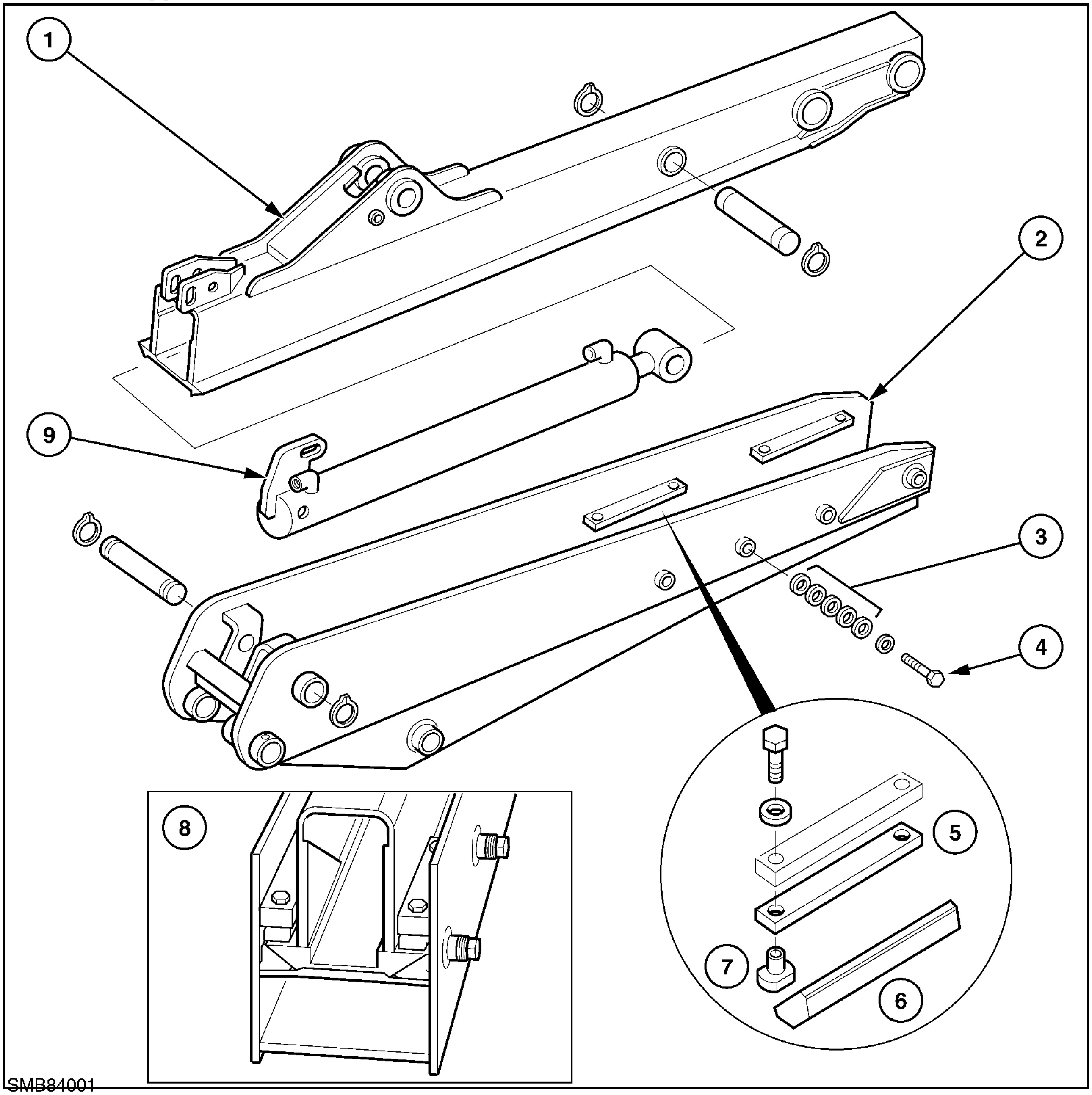
Installation

- Installation follows the disassembly procedure in reverse.
- Torque all carriage clamp bolts to a torque of 800 Nm (592 lbf ft).
- Check that all hoses are correctly routed and clamped.



55

Extendible Dipperstick Overhaul



56

Extendible Dipperstick

1. Inner Section
2. Outer Section
3. Shims
4. Adjusting Bolt
5. Upper Wear Pad
6. Lower Wear Pad
7. Threaded Insert
8. Wear Pad Installation
9. Cylinder Assembly

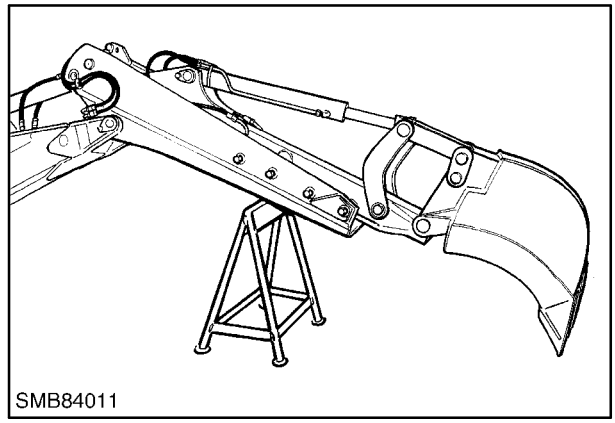
The extendible dipperstick comprises of two sliding sections. The inner and outer sections are supported and guided using four sets of adjustable nylon wear pads.

The wear pads should be inspected every 300 hours or whenever unacceptable vertical movement is observed between the inner and outer sections of the dipperstick.

When the wear pads have worn and can no longer be adjusted they should be replaced as complete sets.

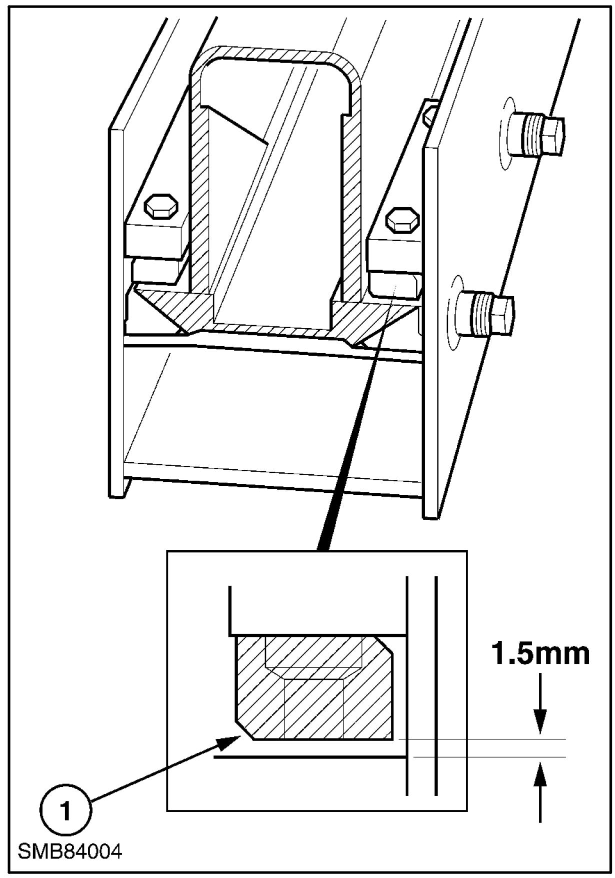
Inspection of Wear Pads

1. Park the machine on level ground and retract the extendible dipperstick.
2. Position the dipperstick on a suitable stand with the bucket raised from the ground.
3. Clean the area around the pads.



57

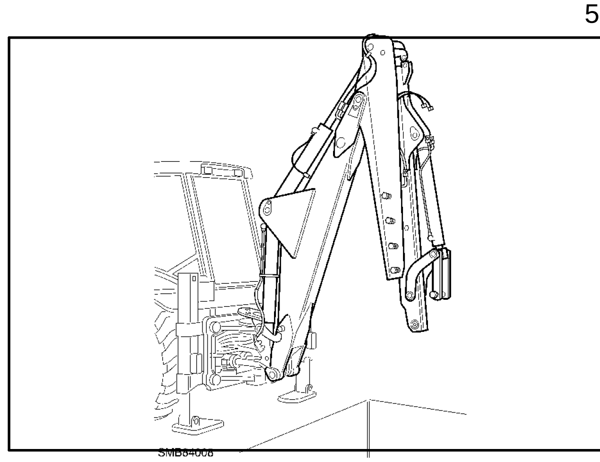
4. Inspect each upper wear pad and if the chamfered edge (1) on the corner of the pads is no longer visible the pads have worn beyond their limit and must be replaced.
5. If pads do not require replacement visually check if the gap between the inner section of the dipperstick and upper wear pad is greater than 1.5mm.
6. If the gap is greater than 1.5mm the wear pads must be adjusted as follows:–



58

Adjustment of Wear Pads

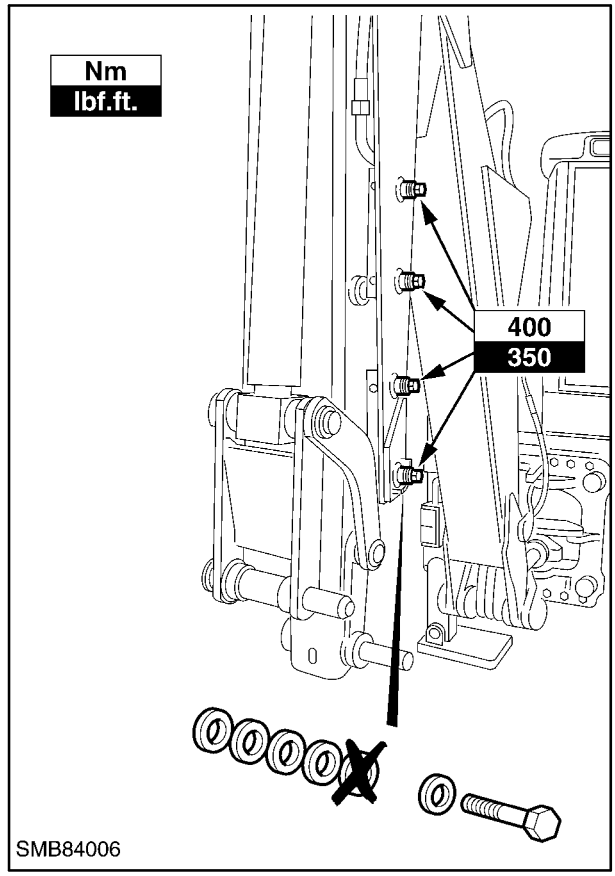
1. Position the dipperstick in the vertical position.



59

2. Count the number of shims behind the adjusting bolts on the left and right hand sides of the dipperstick to determine which side has the most shims.
3. Remove **one** shim from behind an adjusting bolt on the side of the dipperstick which contains the most shims.
4. Refit the bolt and tighten to a torque of 350–400Nm. **DO Not** over torque the bolt**.**
5. Repeat the procedure for the remaining three bolts on the same side of the dipperstick.
6. Recheck the gap as described in step 5.
7. If the gap remains greater than 1.5mm remove a shim from behind each of the adjusting bolts on the **opposite** side of the dipperstick.
8. After performing an adjustment apply a coat of Dry Moly–coat grease to the slide rails of the dipperstick.

NOTE: *When all shims have been removed the wear pads must be replaced.*



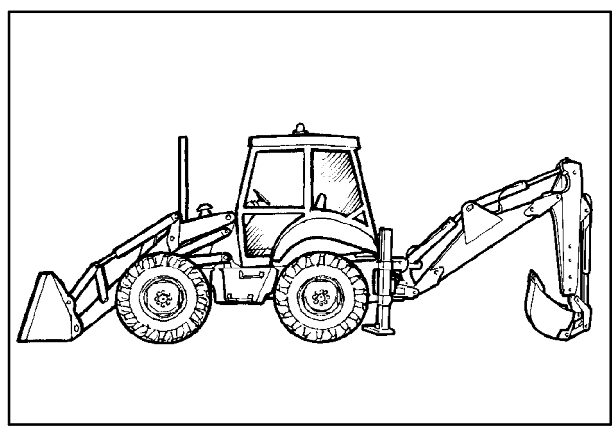
60

Replacement of Wear Pads

To replace the wear pads it is necessary to separate the inner and outer sections of the dipperstick using either of the following procedures which are dependant on workshop facilities.

Procedure 1

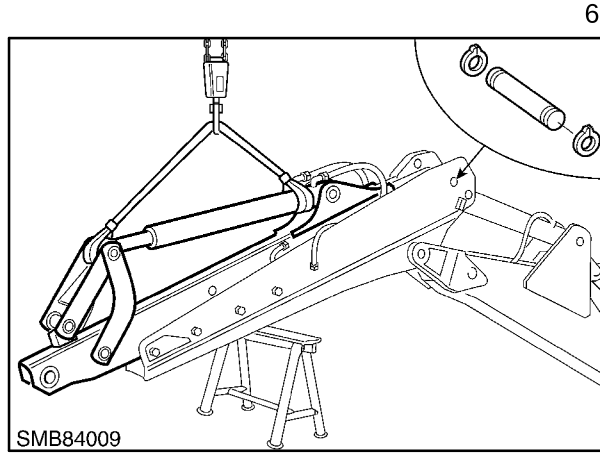
1. Park the machine on level ground and lower loader bucket.
2. Lower stabilisers sufficiently to remove the weight from the rear wheels.



61

IMPORTANT: *The rear wheels must remain in contact with the ground.*

3. Position dipperstick on a suitable stand.
4. Attach hoist to inner section of dipperstick.
5. Disconnect hose connections to bucket and extendible dipperstick cylinders.
6. Remove extendible dipperstick cylinder retaining pin and separate inner and outer sections of dipperstick.
7. Remove and replace wear pads as described on Page 27.

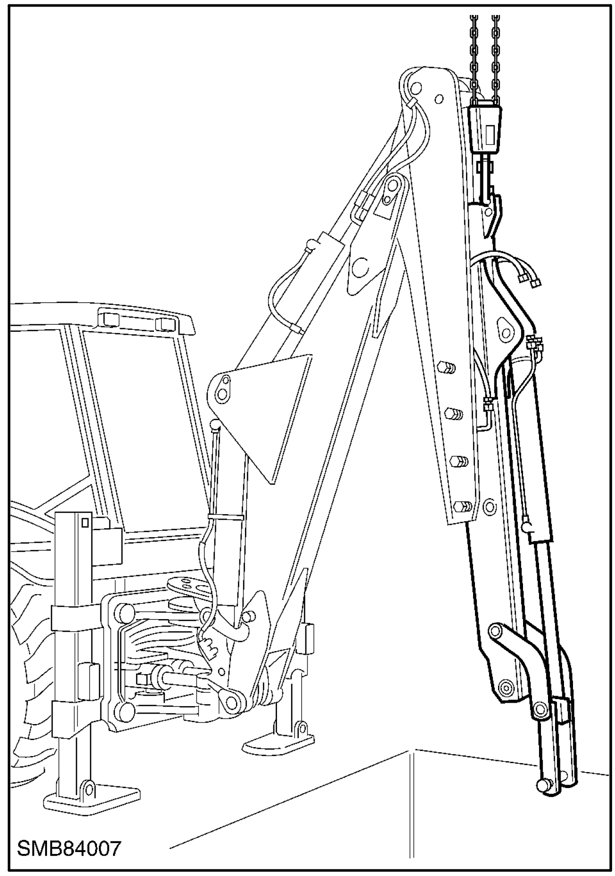


62

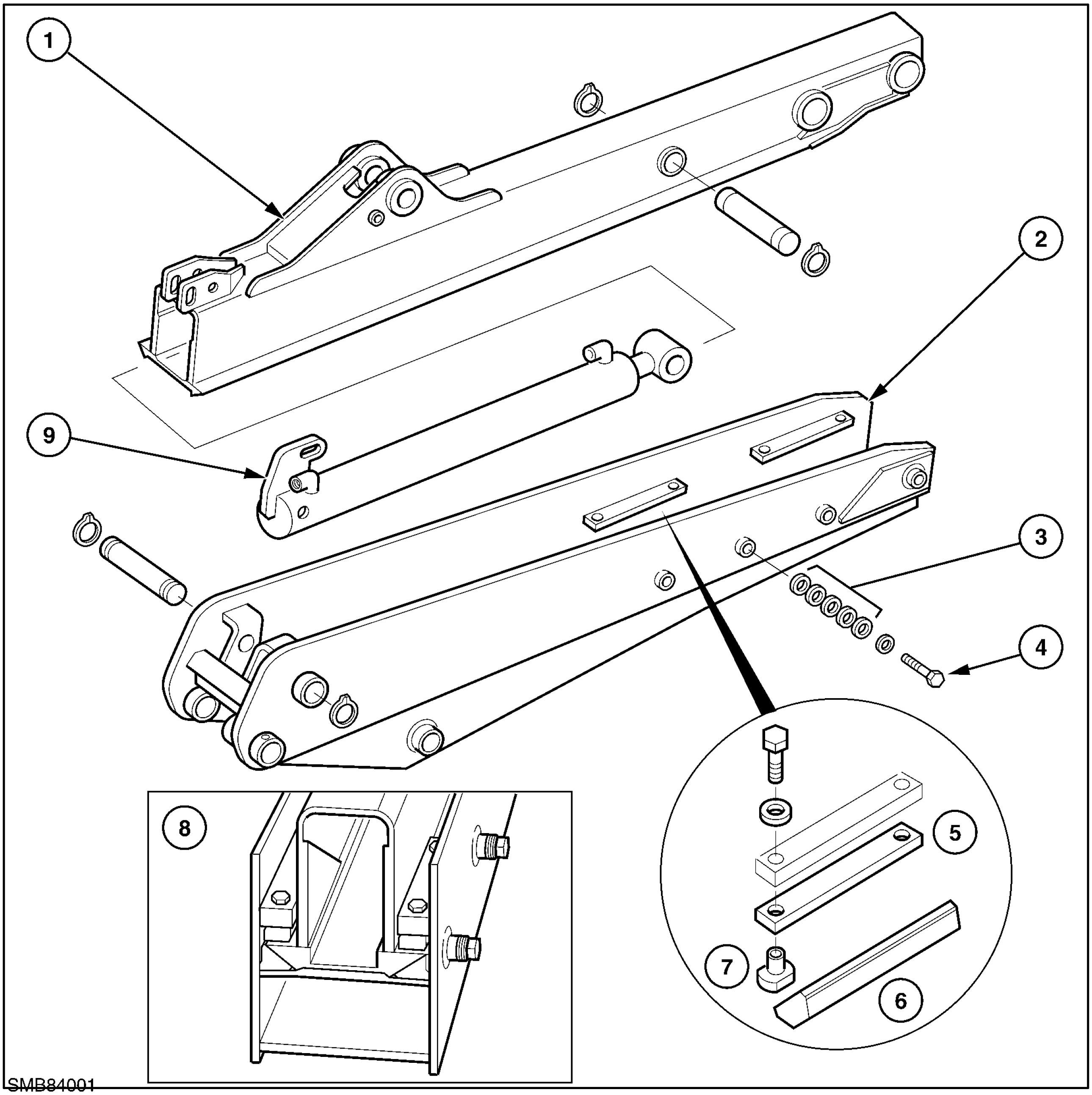
Procedure 2

This procedure requires the use of a loading bay or service pit.

1. Park the machine with backhoe positioned over loading bay or service pit.
2. Place the loader bucket on the ground and lower stabilisers sufficiently to remove the weight from the rear wheels.
3. Attach suitable hoist to top of inner section of dipperstick and position boom so that dipperstick is hanging vertically.
4. Disconnect hose connections at bucket and extendible dipperstick cylinders.
5. Remove extendible dipperstick cylinder retaining pin.
6. Slowly lower hoist allowing inner and outer sections of dipperstick to separate.
7. Remove and replace wear pads as described on Page 27.



63



64

Extendible Dipperstick

1. Inner Section
2. Outer Section
3. Shims
4. Adjusting Bolt
5. Upper Wear Pad
6. Lower Wear Pad
7. Threaded Insert
8. Wear Pad Installation
9. Cylinder Assembly

8. Remove and install new upper wear pads and apply thread sealant Part No 82995773 to the retaining bolts. Tighten to a torque of 29–31 Nm. **Do Not** over tighten or damage to the threaded inserts may occur.
9. Position new lower wear pads in the outer section of the dipperstick
10. Re–assemble inner and outer sections of dipperstick.
11. Place 5 shims beneath the heads of each adjusting bolt.
12. Adjust wear pads as described on Page 26.

NOTES